Mathematics

DEPTH IN METERS

-10
-11
-12
-13
-14
-15
-16
-17
-18
-19
-20
-21
-22

USES 20.4 LITERS
OF OXYGEN PER MINUTE

MAXIMUM DEPTH:
-40 METERS

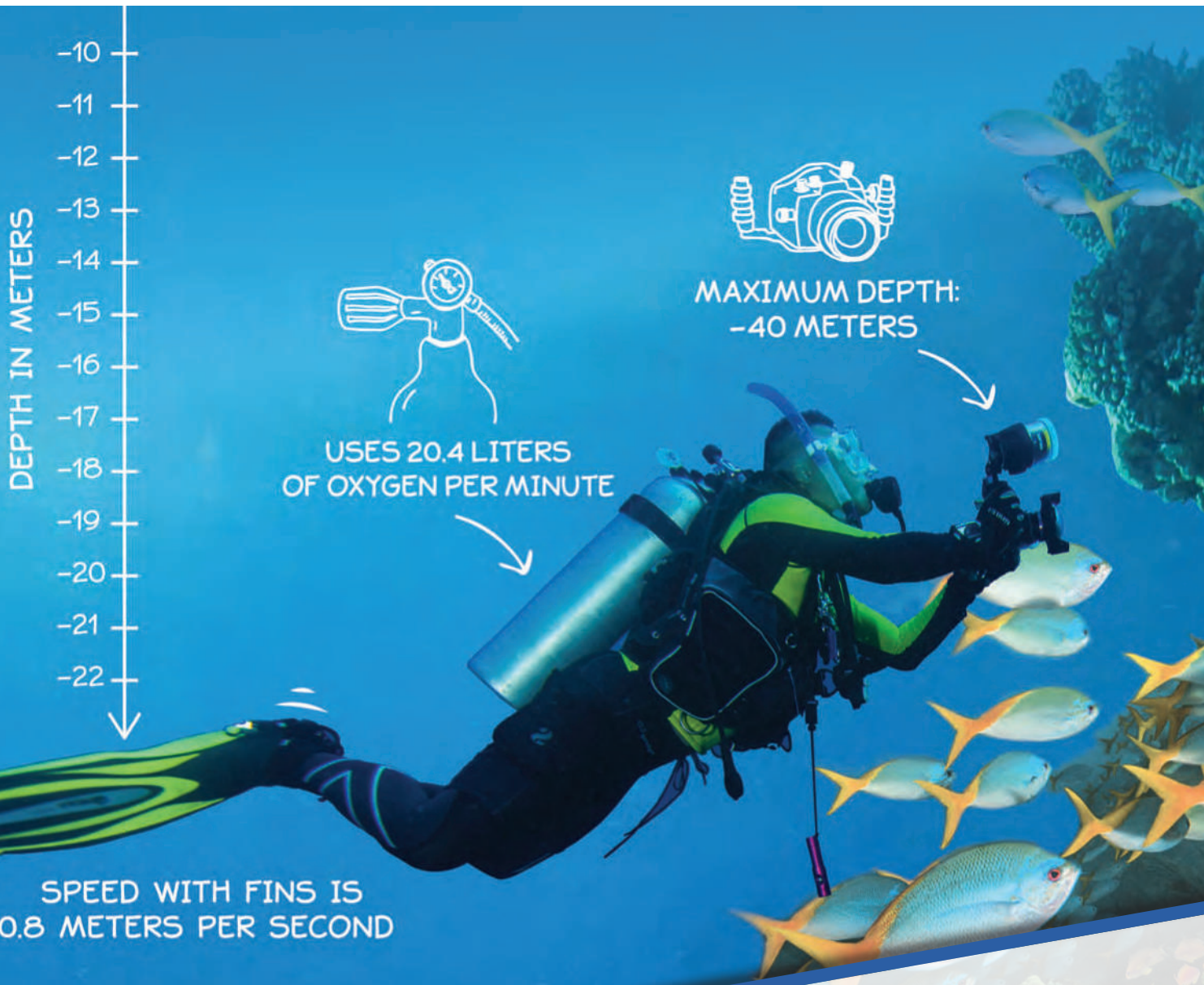SPEED WITH FINS IS
0.8 METERS PER SECOND

Sampler

Ready® Classroom
Mathematics
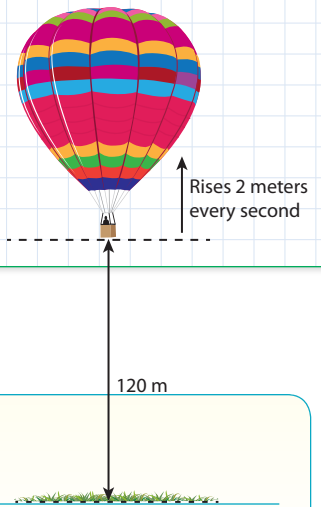
Grade 6 Student Worktext Sampler

In this sampler, you will see *Ready Classroom Mathematics* Student Worktext pages for the Beginning and End of Unit 2 and two complete lessons.

Contents

Rises 2 meters every second

120 m

UNIT 1

Expressions and Equations

Area, Algebraic Expressions, and Exponents

Item	Coins Needed
Dance move	175
Costume	850

UNIT 3

Ratio Reasoning

Ratio Concepts and Equivalent Ratios

1 s

5 ft   10 ft   15 ft   20 ft   25 ft
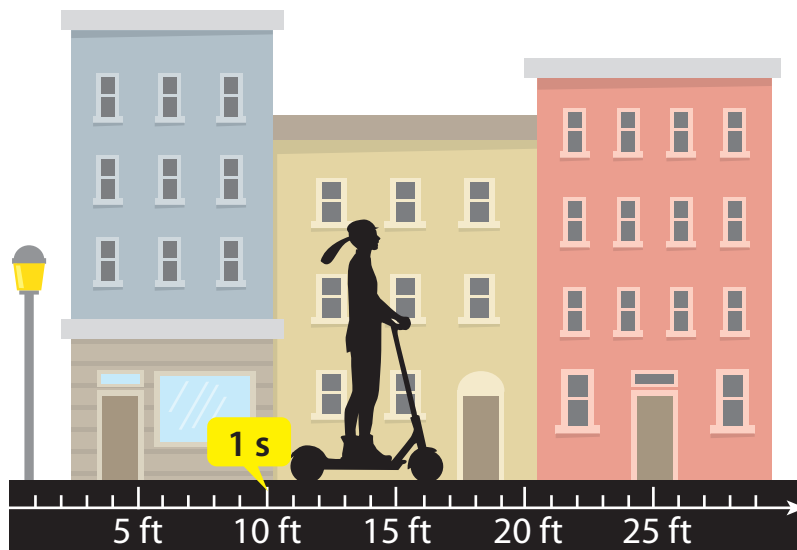
UNIT
4

Ratio Reasoning

Unit Rates and Percent

Contents (continued)

UNIT
6

Positive and Negative Numbers

Absolute Value, Inequalities, and the Coordinate Plane

More than 3/4 lb in every basket!

WEIGHT LIMIT
5T
20T
27T
28T

Contents (continued)

Beginning of Unit 2

Unit 2

Decimals and Fractions

Base-Ten Operations, Division with Fractions, and Volume

✓ **Self Check**	Before starting this unit, check off the skills you know below. As you complete each lesson, see how many more skills you can check off!		
I can . . .		**Before**	**After**
Add, subtract, and multiply multi-digit decimals using standard algorithms.		☐	☐
Divide multi-digit whole numbers and multi-digit decimals using standard algorithms.		☐	☐
Divide fractions.		☐	☐
Solve real-world problems that involve dividing fractions.		☐	☐
Find the volume of a right rectangular prism with fractional edge lengths.		☐	☐
Use math vocabulary and precise language to describe a strategy and how that strategy is used to solve a problem.		☐	☐

➤ **You have learned to use reasoning to add, subtract, multiply, and divide decimals and fractions. Without evaluating the expressions, place each expression in the correct category. Then write your own expression in each category.**

a. 98×0.01	**e.** $5.4 \div 0.5$	**i.** $0.6 + 0.54$
b. $5.8 \times \frac{1}{2}$	**f.** $5 \div \frac{1}{4}$	**j.** $\frac{1}{2} \times \frac{7}{8}$
c. 10×0.25	**g.** $0.75 - 0.5$	**k.** $2.2 - 1.18$
d. $\frac{1}{4} \div 2$	**h.** 9.9×1.35	**l.** $0.09 + 0.89$

Less than 1	Between 1 and 10	Greater than 10

Without performing any calculations, write $<$, $>$, or $=$ in each circle to make a true statement.

a. $152 \times 0.76 \bigcirc 152$

b. $28.4 \div 0.5 \bigcirc 28.4$

c. $68.3 \times 1.04 \bigcirc 68.3$

d. $0.8 + 0.07 \bigcirc 0$

Lesson 9

Understand Division with Fractions

Dear Family,

This week your student is exploring division with fractions.

You can think of the division expression $2 \div \frac{1}{4}$ as asking the question *How many parts of size $\frac{1}{4}$ are there in 2?* Using a bar model, you can divide each of 2 wholes into fourths and count to see that there are 8 parts of size $\frac{1}{4}$ in 2.

| $\frac{1}{4}$ | $\frac{1}{4}$ | $\frac{1}{4}$ | $\frac{1}{4}$ | $\frac{1}{4}$ | $\frac{1}{4}$ | $\frac{1}{4}$ | $\frac{1}{4}$ |

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

2
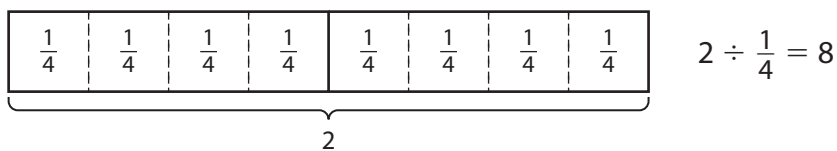
Your student will be learning to model division situations like the one below.

> How many pieces of yarn that are $\frac{2}{3}$ foot long can be cut from a piece of yarn that is $\frac{8}{3}$ feet long?

➤ **ONE WAY** to show how many $\frac{2}{3}$s are in $\frac{8}{3}$ is to use a bar model.

$$\frac{8}{3} \div \frac{2}{3} = 4$$
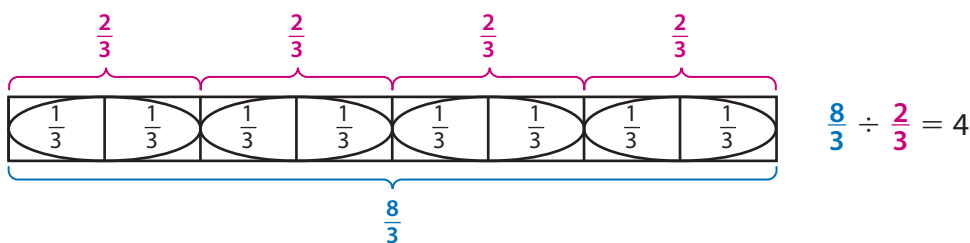
➤ **ANOTHER WAY** is to use a number line.
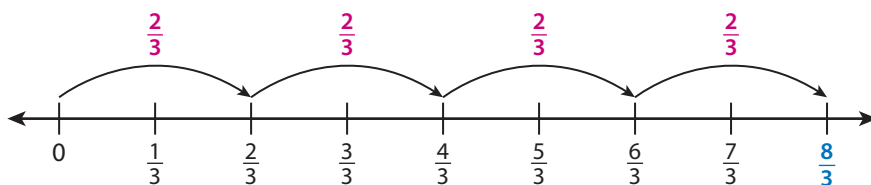
Both models show that a piece of yarn that is $\frac{8}{3}$ feet long can be cut into 4 pieces that are each $\frac{2}{3}$ foot long.

▶ Use the next page to start a conversation about dividing with fractions.

Activity Exploring Division with Fractions

➤ **Do this activity together to look for patterns in division with fractions.**

What patterns do you notice in each set?

SET 1

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

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

$2 \div \frac{1}{8} = 16$

SET 2

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

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

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

SET 3

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

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

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

? Do you notice any patterns between two of the sets?

Explore Division with Fractions

Model It

➤ **Complete the problems about dividing a whole number by a fraction.**

1 In carpentry class, students are making wooden stacking games. Brett cuts a board that is 3 feet long into pieces that are each $\frac{1}{4}$ foot long to make his game.

a. Complete the model to show $3 \div \frac{1}{4}$.

3
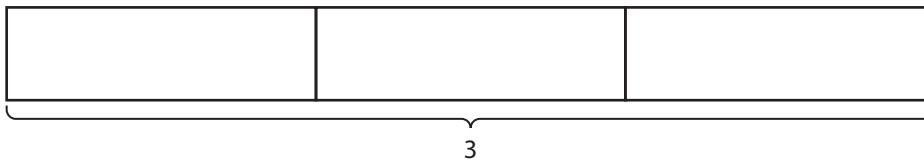
b. Brett cuts his board into _____ equal-size pieces.

2 Madison cuts a board that is 3 feet long into pieces that are each $\frac{3}{4}$ foot long for her stacking game.

a. Complete the model to show $3 \div \frac{3}{4}$.

3
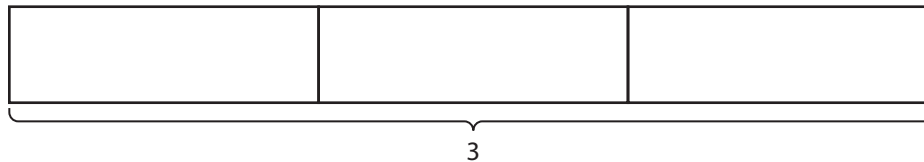
b. Madison cuts her board into _____ equal-size pieces.

Wooden stacking game

DISCUSS IT

Ask: Why are your two models the same in some ways and different in some ways?

Share: I noticed that when the divisor changes from $\frac{1}{4}$ to $\frac{3}{4}$ ...

◎ **Learning Target** SMP 2, SMP 3, SMP 7
Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions.

Model It

➤ **Complete the problems about dividing a fraction by a fraction.**

3 Lin starts with a board that is $\frac{3}{2}$ feet long. She cuts it into pieces that are each $\frac{1}{4}$ foot long for her stacking game.

a. Complete the model to show how many pieces Lin cuts her board into.

$\frac{3}{2}$

b. Write a division equation that represents your model and shows how many pieces Lin cuts her board into. What related multiplication equation does your model represent?

c. Lin cuts her board into _____ equal-size pieces.

> **DISCUSS IT**
>
> **Ask:** How does your model show the number of pieces Lin cuts her board into?
>
> **Share:** The whole model shows 3 halves, so I know that 1 half is shown by . . .

4 **Reflect** How are models for dividing with fractions similar to models for dividing with whole numbers? How are they different?

Prepare for Division with Fractions

1 Think about what you know about division. Fill in each box. Use words, numbers, and pictures. Show as many ideas as you can.

In My Own Words

My Illustrations

divisor

Examples

Non-Examples

2 Circle the equation that shows a divisor of 6.

$6 \div \frac{1}{2} = 12$ $12 \div 6 = 2$ $12 \div 2 = 6$

➤ **Complete problems 3–5.**

3 Lola cuts a string that is 4 feet long into pieces that are each $\frac{1}{6}$ foot long.

a. Complete the model to show $4 \div \frac{1}{6}$.

4
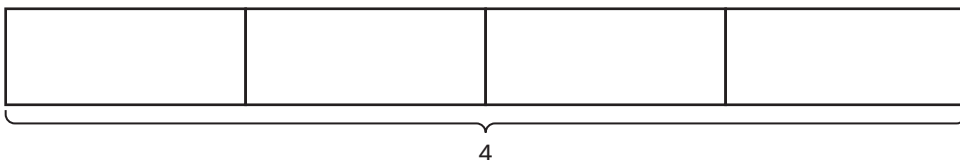
b. Lola cuts her string into _____ equal-size pieces.

4 Robert cuts a string that is 4 feet long into pieces that are each $\frac{2}{6}$ foot long.

a. Complete the model to show $4 \div \frac{2}{6}$.

4
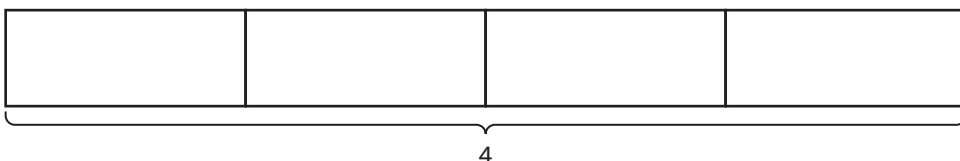
b. Robert cuts his string into _____ equal-size pieces.

5 Hiroko cuts a string that is 4 feet long into pieces that are each $\frac{4}{6}$ foot long.

a. Complete the model to show $4 \div \frac{4}{6}$.

4
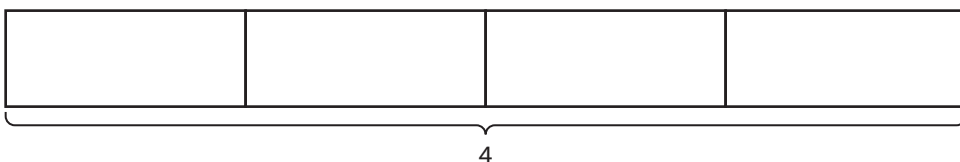
b. Hiroko cuts her string into _____ equal-size pieces.

Develop Understanding of Division with Fractions

Model It: Bar Models

➤ **Try these two problems about dividing a fraction by a fraction.**

1. Uma lives near a path that is $\frac{1}{2}$ mile long. She wants to know how many times she needs to run the path in order to run $\frac{6}{4}$ miles.

   a. Complete the model to show how many $\frac{1}{2}$s make $\frac{6}{4}$.

   $$\frac{1}{2}$$
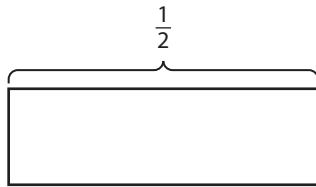
   b. How many $\frac{1}{2}$s make $\frac{6}{4}$?

   c. Use your model to write a division equation that represents this situation. What related multiplication equation represents your model?

   d. Uma needs to run the $\frac{1}{2}$-mile path _____ times to run $\frac{6}{4}$ miles.

2. **a.** Complete the model to show how many $\frac{3}{4}$s make $\frac{6}{4}$.

   $$\frac{3}{4}$$
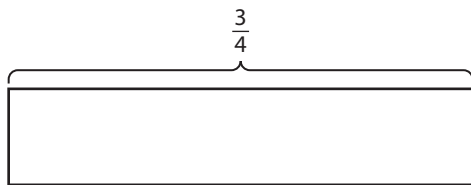
   b. Write a division equation and a related multiplication equation that represent your model.
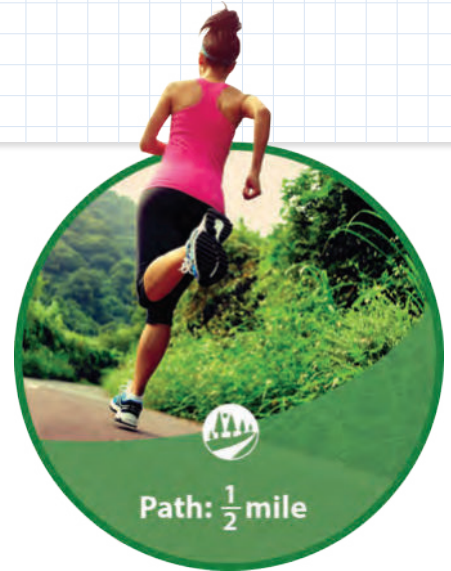
DISCUSS IT

Ask: How can you find a quotient by starting with a model that shows the divisor?

Share: Knowing how to multiply with fractions can help you divide with fractions because . . .

Model It: Number Lines

➤ **Try this problem about dividing with fractions.**

3   **a.**   Use the number line to show $\frac{4}{6} \div \frac{1}{6}$.

    0       $\frac{1}{6}$ 1
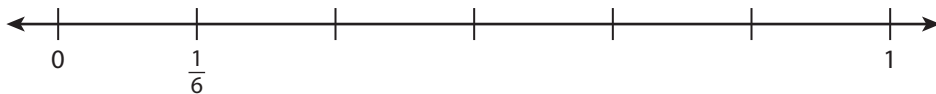
b.   What is the quotient $\frac{4}{6} \div \frac{1}{6}$?

> **DISCUSS IT**
>
> ***Ask:*** How would you change your number line to show dividing $\frac{4}{6}$ by $\frac{1}{3}$?
>
> ***Share:*** I think my number line shows dividing $\frac{4}{6}$ by $\frac{1}{6}$ because . . .

CONNECT IT

➤ **Complete the problems below.**

4   How can you show the quotient $\frac{4}{6} \div \frac{1}{6}$ with a bar model? How is using a bar model similar to showing the quotient with a number line? How is it different?

5   Draw a model to show $\frac{10}{8} \div \frac{1}{4}$. How many $\frac{1}{4}$s are in $\frac{10}{8}$?

Practice Division with Fractions

➤ **Study how the Example shows division of a fraction by a fraction. Then solve problems 1–4.**

Example

Mr. Díaz has $\frac{3}{4}$ yard of ribbon to make badges for the science fair. He uses $\frac{1}{8}$ yard of ribbon for each badge. How many badges can Mr. Díaz make?

Find the number of $\frac{1}{8}$s in $\frac{3}{4}$.
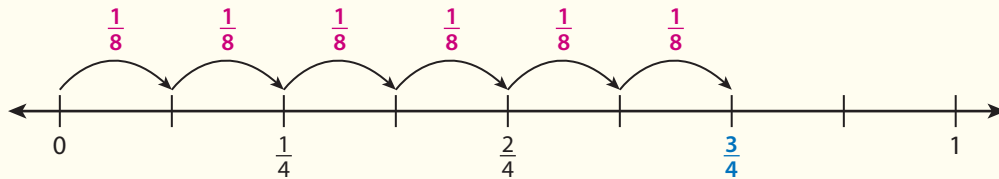
$$\frac{3}{4} \div \frac{1}{8} = 6$$

Mr. Díaz can make 6 badges.

1   **a.** How does the model in the Example show how much ribbon Mr. Díaz starts with?

b. How does the model show how much ribbon Mr. Díaz uses for each badge?

c. How many $\frac{1}{8}$s are in $\frac{3}{4}$?

2   Another day, Mr. Díaz makes badges using $\frac{3}{8}$ yard of ribbon for each badge. He starts with another $\frac{3}{4}$ yard of ribbon. Describe how you can change the model in the Example to show $\frac{3}{4} \div \frac{3}{8}$.

3 Rosa is filling tortillas. She puts $\frac{2}{3}$ cup of vegetables in each tortilla. She has 6 cups of vegetables.

a. Rosa says that to find how many tortillas she can fill, she can first find how many $\frac{1}{3}$ cups are in 6 cups. What else does Rosa need to do to find how many tortillas she can fill?

b. Do you expect the number of tortillas Rosa can fill to be *less than* or *greater than* 6? Explain.

c. Complete the model to show how many $\frac{2}{3}$s are in 6.
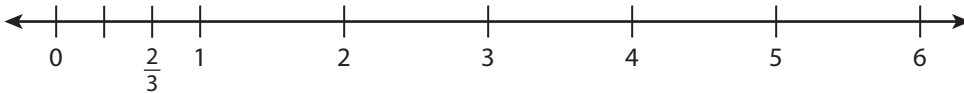
d. Complete the division equation to show how many tortillas Rosa can fill.

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

Rosa can fill _____ tortillas.

4 Michael has $\frac{12}{8}$ cups of orange juice in a jar. He pours the juice into glasses that each hold $\frac{3}{4}$ cup. How many glasses can he fill? Draw a model to show your work.

SOLUTION

Refine Ideas About Division with Fractions

Apply It ✏️ **Math Toolkit** fraction bars, fraction tiles, grid paper, number lines

➤ **Complete problems 1–5.**

1 **Interpret** Look at the model below. Write a division equation that the model can represent. Explain how to find the quotient using the model.

$$\frac{5}{6}$$
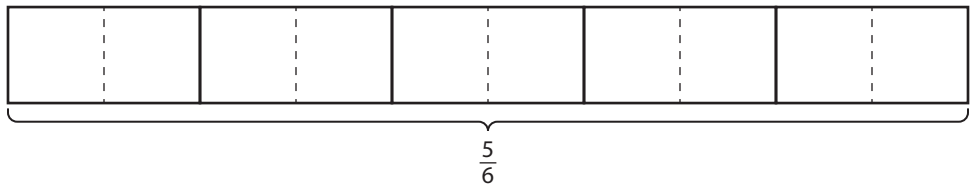
2 **Analyze** Nikia says that $\frac{3}{2} \div \frac{1}{4}$ equals $\frac{3}{8}$. Draw a model and use words to explain why Nikia's statement is not reasonable.

3 **Justify** Look at problem 2. Explain why the quotient is greater than the dividend when you divide by $\frac{1}{4}$.

4 Aiyana needs $\frac{3}{8}$ pound of sweet potatoes for each serving of sweet potato fries. She wants to know how many servings of sweet potato fries she can make with $1\frac{1}{2}$ pounds of sweet potatoes.

PART A Write a division expression and draw a model to represent the situation.

PART B Use your model to explain how to find the quotient and what the quotient means.

5 **Math Journal** What does it mean to divide with fractions? Use models and words to describe how to divide with fractions. Use $\frac{3}{4} \div \frac{3}{8}$ in your response.

✔ **End of Lesson Checklist**

☐ **INTERACTIVE GLOSSARY** Write a new entry for *reasonable*. Tell what you do when you determine whether a statement is *reasonable*.

Lesson 10

Divide Fractions

Dear Family,

This week your student is learning how to divide fractions.

When dividing fractions, it is helpful to think about the relationship between multiplication and division. Just as the equations **2 × 4 = 8** and **8 ÷ 4 = 2** tell you there are **two 4**s in **8**, the equations below tell you there is only **half** of $\frac{1}{4}$ in $\frac{1}{8}$.

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

Your student will be learning to solve problems like the one below.

A recipe calls for $1\frac{1}{2}$ cups of rice. You only have a $\frac{1}{3}$-cup measure. How many scoops of the $\frac{1}{3}$-cup measure should you use?

➤ **ONE WAY** to find how many $\frac{1}{3}$s are in $1\frac{1}{2}$ is to use the common denominator 6.

Split 1 whole into parts of size $\frac{1}{6}$. Now you can see that $1\frac{1}{2} = \frac{9}{6}$ and $\frac{1}{3} = \frac{2}{6}$.

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

$$1\frac{1}{2} = \frac{9}{6}$$

There are 4 full groups of $\frac{1}{3}$ plus $\frac{1}{2}$ of a group of $\frac{1}{3}$.
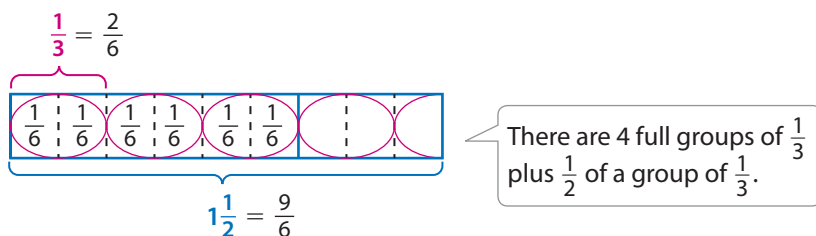
$$1\frac{1}{2} \div \frac{1}{3} = \frac{9}{6} \div \frac{2}{6} = 4\frac{1}{2}$$

➤ **ANOTHER WAY** is to use multiplication.

Multiply $1\frac{1}{2}$ by 3 to find how many $\frac{1}{3}$s are in $1\frac{1}{2}$ wholes.

$$1\frac{1}{2} \div \frac{1}{3} = 1\frac{1}{2} \times 3 \quad \longleftarrow \text{The numbers } \frac{1}{3} \text{ and 3 are called } \textbf{reciprocals}.$$

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

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

Using either method, you need $4\frac{1}{2}$ scoops of the $\frac{1}{3}$-cup measure to have $1\frac{1}{2}$ cups of rice.

Use the next page to start a conversation about fraction division.

Activity Thinking About Fraction Division Around You

➤ **Do this activity together to investigate division with fractions in the real world.**

Cities and towns often have rules for how land is used for housing. A town might require that a group of townhouses is built on at least $1\frac{1}{2}$ acres of land. The town might also require that each townhouse in the group has $\frac{1}{6}$ acre of land.

The division expression $1\frac{1}{2} \div \frac{1}{6}$ tells how many $\frac{1}{6}$-acre lots fit into $1\frac{1}{2}$ acres of land. Because $1\frac{1}{2} \div \frac{1}{6} = 9$, a builder knows that 9 townhouses can be built on $1\frac{1}{2}$ acres of land.

? What would the division expression be if the builder has $5\frac{2}{3}$ acres and each house needs $\frac{1}{4}$ acre?

Explore Dividing Fractions

Previously, you learned what it means to divide with fractions. In this lesson, you will learn more about dividing fractions.

➤ **Use what you know to try to solve the problem below.**

Ramona is making clay animals with her friends. She has $\frac{3}{4}$ lb of clay. She shares the clay equally among herself and 3 friends. How much clay does each person have?

TRY IT

Math Toolkit fraction bars, fractions circles, grid paper, number lines

DISCUSS IT

Ask: How does your model show that Ramona shares the clay equally among herself and 3 friends?

Share: My model shows . . .

◎ **Learning Target**   SMP 1, SMP 2, SMP 3, SMP 4, SMP 5, SMP 6, SMP 7
Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions.

CONNECT IT

1 **Look Back** How much clay does each person have when Ramona shares her clay? Explain how you know.

2 **Look Ahead** Dividing $\frac{3}{4}$ lb of clay equally among several people is a division situation that involves fractions. As when you divide with whole numbers, it can be helpful to estimate a quotient before you divide.

a. Estimate whether $\frac{3}{4} \div 6$ is *greater than* or *less than* the dividend, $\frac{3}{4}$. Use an example of dividing $\frac{3}{4}$ lb of clay into 6 equal portions to explain your thinking.

b. Estimate whether $2\frac{1}{2} \div \frac{1}{4}$ is *greater than* or *less than* the dividend, $2\frac{1}{2}$. Use an example of dividing $2\frac{1}{2}$ lb of clay into $\frac{1}{4}$-lb portions to explain your thinking.

c. Yolanda estimates that $3\frac{1}{4} \div \frac{1}{8}$ is about 24. Show how to use multiplication to check whether Yolanda's estimate is reasonable.

3 **Reflect** What division equation can you write to show that when $\frac{3}{4}$ lb of clay is divided equally among 6 people, each person gets $\frac{1}{8}$ lb of clay? How would you use multiplication to check that the quotient is correct?

Prepare for Dividing Fractions

1   Think about what you know about fractions. Fill in each box. Use words, numbers, and pictures. Show as many ideas as you can.

What Is It?	What I Know About It

fraction

Examples	Examples

2   A fraction of the model is shaded. What are the numerator and the denominator of the fraction? Explain how you know.
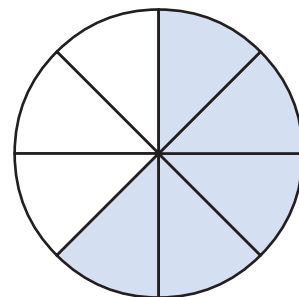
3 Patrick is using layers of colored sand in an art project. He divides $\frac{2}{3}$ lb of

blue sand into 3 equal parts in order to make 3 layers.

a. What is the weight of the sand in each layer of blue sand? Show your work.

SOLUTION

b. Check your answer to problem 3a. Show your work.

Develop Dividing Fractions

Juneteenth Festival

featuring $3\frac{1}{2}$ Hours of Performances

★ CELEBRATING FREEDOM ★

➤ **Read and try to solve the problem below.**

Imani is planning her city's Juneteenth festival. There will be $3\frac{1}{2}$ hours of performances on the main stage. Each performer's time slot lasts $\frac{3}{4}$ hour. How many time slots can Imani plan to have?
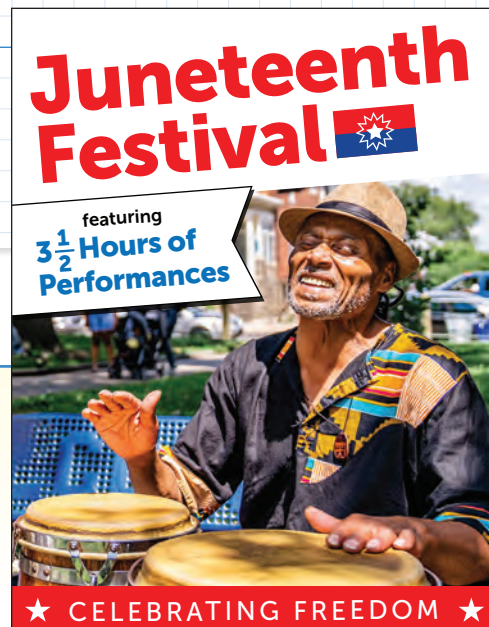
TRY IT

Math Toolkit fraction bars, fraction circles, grid paper, number lines

DISCUSS IT

Ask: How is your strategy similar to mine? How is it different?

Share: My strategy is similar to yours because . . . It is different because . . .

➤ **Explore different ways to divide fractions, including when the quotient is not a whole number.**

Imani is planning her city's Juneteenth festival. There will be $3\frac{1}{2}$ hours of performances on the main stage. Each performer's time slot lasts $\frac{3}{4}$ hour. How many time slots can Imani plan to have?

Dance performers at a Juneteenth festival

Model It

You can use the relationship between multiplication and division to represent a division situation with equations.

How many $\frac{3}{4}$-hour time slots are in $3\frac{1}{2}$ hours? $? \times \frac{3}{4} = 3\frac{1}{2}$

Use division to find the unknown factor. $3\frac{1}{2} \div \frac{3}{4} = ?$

Model It

You can use a bar model to divide fractions.

Show 3 wholes and $\frac{1}{2}$ of another whole. Split each whole into 2 halves. Then divide each half into 2 fourths and separate the fourths into groups of 3.
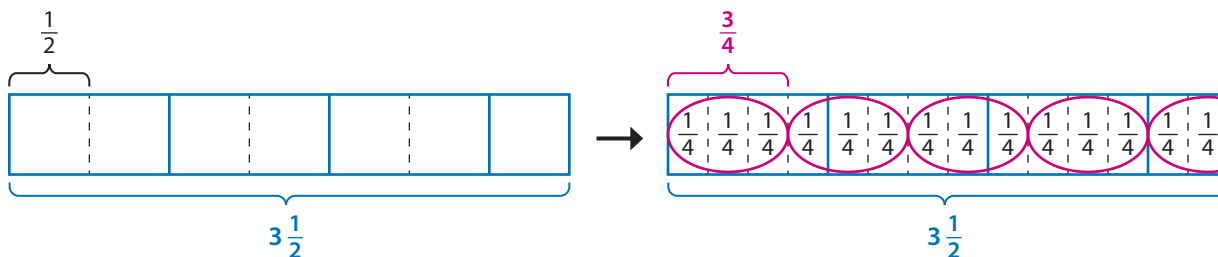
Analyze It

You can use a common denominator to divide fractions.

$$3\frac{1}{2} \div \frac{3}{4} = \frac{7}{2} \div \frac{3}{4}$$

$$= \frac{14}{4} \div \frac{3}{4}$$

Now you can think of dividing **14** fourths by **3** fourths, which is the same as **14 ÷ 3**.

➤ **Use the problem from the previous page to help you understand how to divide fractions when the quotient is not a whole number.**

1 Look at the second **Model It**. How many full $\frac{3}{4}$-hour time slots does Imani have for performances? How does the second bar model show this?

2 The second bar model shows one group that has only 2 parts of size $\frac{1}{4}$. Explain why this group is $\frac{2}{3}$ of a full time slot.

3 Look at **Analyze It** and the second **Model It**. How does the bar model show that you can use the quotient **14 ÷ 3** to find the quotient $\frac{14}{4} \div \frac{3}{4}$?

4 When you divide 14 by 3, the result is 4 with a remainder of 2. When you divide $\frac{14}{4}$ by $\frac{3}{4}$, the remainder is $\frac{2}{4}$. Where do you see this remainder in the bar model? What fraction of the divisor, $\frac{3}{4}$, does this remainder represent?

5 How many times does $\frac{3}{4}$ fit into $3\frac{1}{2}$? Use multiplication to check your answer.

6 **Reflect** Think about all the models and strategies you have discussed today. Describe how one of them helped you better understand how to divide fractions when the quotient is not a whole number.

Apply It

➤ **Use what you learned to solve these problems.**

7 Mr. Lincoln is making slime for his kindergarten class. He has 3 cups of glue. Each batch of slime uses $\frac{2}{3}$ cup of glue. How many batches of slime can Mr. Lincoln make? Show your work.

SOLUTION

8 Sofia has pitchers that each hold $1\frac{2}{5}$ L. She has $4\frac{1}{5}$ L of iced tea. Which division expression can you use to find the number of pitchers Sofia can fill with iced tea: $1\frac{2}{5} \div 4\frac{1}{5}$ or $4\frac{1}{5} \div 1\frac{2}{5}$? How many pitchers can Sofia fill? Show your work.

SOLUTION

9 What is $2\frac{3}{4} \div \frac{3}{8}$? Show your work.

SOLUTION

Practice Dividing Fractions

➤ **Study the Example showing how to divide fractions when the quotient is not a whole number. Then solve problems 1–5.**

Example

The jogging loop at Lake Park is $1\frac{1}{3}$ mi long. Brianna wants to jog $3\frac{1}{3}$ mi.

How many times should she jog around the loop?

You can use a number line to show dividing **$3\frac{1}{3}$ mi** into lengths of **$1\frac{1}{3}$ mi**.
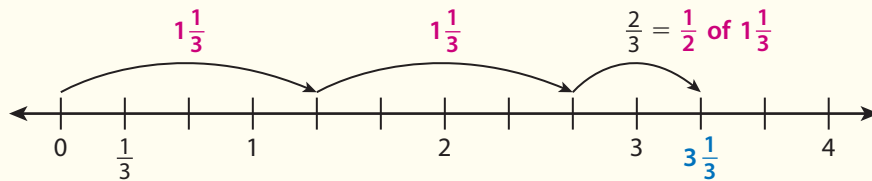
There are $2\frac{1}{2}$ lengths of $1\frac{1}{3}$ in $3\frac{1}{3}$. So, $3\frac{1}{3} \div 1\frac{1}{3} = 2\frac{1}{2}$.

Brianna should jog $2\frac{1}{2}$ times around the loop.

---

1 The number line model in the Example shows that $1\frac{1}{3}$ fits into $3\frac{1}{3}$ two times, with a remainder of $\frac{2}{3}$.

a. How is the remainder $\frac{2}{3}$ shown in the number line model?

b. How do you know that the remainder represents $\frac{1}{2}$ of the jogging loop?

2 Show that there is no remainder when you divide $2\frac{1}{2}$ by $\frac{5}{8}$.

Vocabulary

remainder
the amount left over when one number does not divide another number a whole number of times.

quotient
the result of division.

3 Andre is comparing the weights of his pets. His gerbil weighs $\frac{1}{4}$ lb. His kitten weighs $\frac{7}{8}$ lb. How many times the gerbil's weight is the kitten's weight? Show your work.

SOLUTION

4 An ant walks along a stick. The stick is $1\frac{1}{2}$ ft long. The ant travels $\frac{3}{10}$ ft every second. How long does it take the ant to to walk the whole length of the stick? Show your work.

SOLUTION

5 A serving of dried fruit is $\frac{1}{5}$ cup. A bag contains $\frac{9}{10}$ cup of dried fruit. Which division expression can you use to find the number of servings in the bag: $\frac{1}{5} \div \frac{9}{10}$ or $\frac{9}{10} \div \frac{1}{5}$? Explain your reasoning.

Develop Using Multiplication to Divide by a Fraction

➤ **Read and try to solve the problem below.**

Paulo and Aimee each have $\frac{3}{4}$ cup of feed left in their bags of chicken feed. Paulo uses $\frac{1}{2}$ cup of feed each time he gives his chickens a meal. Aimee uses $\frac{3}{2}$ cups of feed each time she gives her chickens a meal. How many meals can Paulo give his chickens? How many meals can Aimee give her chickens?

Feed for 1 meal
Paulo: $\frac{1}{2}$ cup | Aimee: $\frac{3}{2}$ cups

TRY IT

✎ **Math Toolkit** fraction bars, fraction circles, grid paper, number lines

DISCUSS IT

Ask: How does your model show the relationship between $\frac{3}{4}$ and $\frac{1}{2}$? Between $\frac{3}{4}$ and $\frac{3}{2}$?

Share: In my model, . . . represents . . .

➤ **Explore different ways to solve problems that involve dividing by a fraction.**

Paulo and Aimee each have $\frac{3}{4}$ cup of feed left in their bags of chicken feed. Paulo uses $\frac{1}{2}$ cup of feed each time he gives his chickens a meal. Aimee uses $\frac{3}{2}$ cups of feed each time she gives her chickens a meal. How many meals can Paulo give his chickens? How many meals can Aimee give her chickens?

Model It

You can use a diagram and words to help you represent a division situation.

Shade $\frac{3}{4}$ of a square to represent the amount of feed Paulo and Aimee have.

Paulo
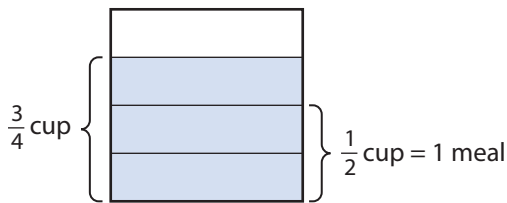
Aimee

How many $\frac{1}{2}$ cups are in $\frac{3}{4}$ cup of feed?

$$\frac{3}{4} \div \frac{1}{2} = ?$$
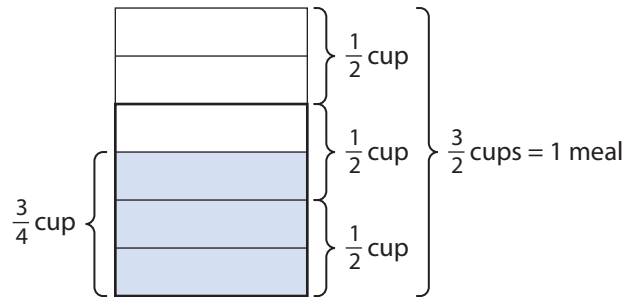
How many $\frac{3}{2}$ cups are in $\frac{3}{4}$ cup of feed?

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

Analyze It

You can use multiplication to divide by a fraction.

To find how many **$\frac{3}{2}$**s are in a number, you can use two multiplication steps.

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

First find how many $\frac{1}{2}$s are in the number. To do this, **multiply by 2**.

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

Then separate the **number of $\frac{1}{2}$s** into 3 equal parts. To divide by 3, **multiply by $\frac{1}{3}$**.

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

CONNECT IT

➤ **Use the problem from the previous page to help you understand how to use multiplication to divide by a fraction.**

1 How many meals can Paulo give his chickens? How many meals can Aimee give her chickens? Explain how you know.

2 Look at **Analyze It**. Why does multiplying by 2 tell you how many $\frac{1}{2}$s are in a number? Why does multiplying the number of $\frac{1}{2}$s by $\frac{1}{3}$ tell you how many $\frac{3}{2}$s are in the number?

3 The fraction $\frac{2}{3}$ is called the **reciprocal** of $\frac{3}{2}$. Explain why dividing by $\frac{3}{2}$ gives the same result as multiplying by its reciprocal, $\frac{2}{3}$.

4 Explain why dividing by any fraction gives the same result as multiplying by that fraction's reciprocal. Use the example $4 \div \frac{2}{5}$.

5 Complete the equations to show how to divide any fraction $\frac{a}{b}$ by any fraction $\frac{c}{d}$.

$$\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \boxed{} \times \frac{1}{\boxed{}} \quad \longrightarrow \quad \frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \frac{\boxed{}}{\boxed{}}$$

6 **Reflect** Think about all the models and strategies you have discussed today. Describe how one of them helped you better understand how solve problems that involve dividing by a fraction.

Apply It

➤ **Use what you learned to solve these problems.**

7 Find the quotient $\frac{2}{3} \div \frac{2}{5}$. Show your work.

SOLUTION

8 The parallelogram has an area of $1\frac{1}{8}$ yd². Use the formula $A = bh$ to find the length of the base, b. Show your work.

b

$\frac{3}{4}$ yd
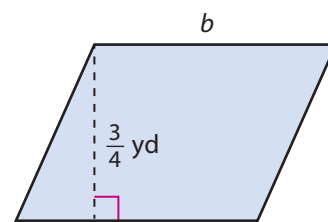
SOLUTION

9 It takes Francisco $\frac{5}{6}$ minute to upload a video to his blog. How much of one video can he upload in $\frac{1}{2}$ minute? Show your work.

SOLUTION

Practice Using Multiplication to Divide by a Fraction

➤ **Study the Example showing how to use multiplication to divide by a fraction. Then solve problems 1–4.**

Example

Tyrone has $1\frac{1}{2}$ quarts of honey. He is pouring the honey into jars that each hold $\frac{3}{8}$ quart. How many jars can Tyrone fill?

You can divide the total quarts of honey, $1\frac{1}{2}$, by the number of quarts each jar can hold, $\frac{3}{8}$.

$1\frac{1}{2} \div \frac{3}{8} = 1\frac{1}{2} \times \frac{8}{3}$ ← To divide by $\frac{3}{8}$, multiply by its reciprocal, $\frac{8}{3}$.

$\phantom{1\frac{1}{2} \div \frac{3}{8}} = \frac{3}{2} \times \frac{8}{3}$

$\phantom{1\frac{1}{2} \div \frac{3}{8}} = \frac{24}{6} = 4$

Tyrone can fill 4 jars of honey.

---

1 The Example shows finding the quotient $1\frac{1}{2} \div \frac{3}{8}$ by multiplying $1\frac{1}{2}$ by the reciprocal of $\frac{3}{8}$, or $\frac{8}{3}$. You can relate multiplying by the reciprocal to a bar model that represents the division equation $1\frac{1}{2} \div \frac{3}{8} = 4$.
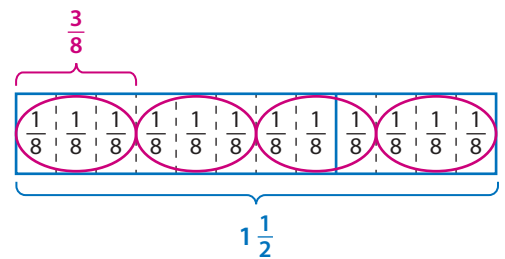
a. Explain why multiplying by $\frac{8}{3}$ gives the same result as first multiplying by 8 and then multiplying by $\frac{1}{3}$.

b. What is the value of the expression $\left(1\frac{1}{2} \times 8\right) \times \frac{1}{3}$? Explain how finding the value of the expression is related to the bar model.

Vocabulary

reciprocal

for any nonzero number a, the reciprocal is $\frac{1}{a}$. The reciprocal of any fraction $\frac{a}{b}$ is $\frac{b}{a}$.

2 A rectangular city park is $\frac{6}{8}$ mi long. The park has an area of $\frac{1}{4}$ mi². What is the width of the park? Show your work.

SOLUTION

3 Find the value of $6 \div 3\frac{3}{4}$. Show your work.

SOLUTION

4 During a community service day, 6 teams of students clean a beach by picking up trash. The beach is $1\frac{4}{5}$ mi long. Each team cleans the same length of beach. What is the length of beach that each team cleans? Show your work.

SOLUTION

Refine Dividing Fractions

➤ **Complete the Example below. Then solve problems 1–9.**

Example

Sarah uses this recipe to make trail mix. She puts the trail mix in small bags. Each bag holds $1\frac{1}{4}$ cups. How many bags does Sarah fill?

Look at how you could show your work using operations with fractions.

First, find the total amount of trail mix.

Trail Mix
$2\frac{1}{2}$ cups almonds
$\frac{3}{4}$ cup dried cherries
$2\frac{1}{4}$ cups walnuts
$\frac{3}{4}$ cup raisins

$$2\frac{1}{2} + \frac{3}{4} + 2\frac{1}{4} + \frac{3}{4} = 2\frac{1}{2} + 3 + \frac{3}{4}$$
$$= 5\frac{1}{2} + \frac{3}{4} = 6\frac{1}{4}$$

Then divide the total amount by the amount for 1 bag.

$$6\frac{1}{4} \div 1\frac{1}{4} = \frac{25}{4} \div \frac{5}{4} = 25 \div 5$$

SOLUTION _____

CONSIDER THIS . . .
The total amount of trail mix is the sum of the amounts of each ingredient.

PAIR/SHARE
What is another way you could find the value of $6\frac{1}{4} \div 1\frac{1}{4}$?

Apply It

1 Hiroaki buys $3\frac{1}{2}$ gal of paint. He uses $1\frac{1}{2}$ gal of paint. What fraction of the paint that Hiroaki buys does he use? Show your work.

CONSIDER THIS . . .
How could you use a multiplication equation with an unknown factor to represent the question?

PAIR/SHARE
How could you use estimation to help you check your answer?

SOLUTION _____

2 Tiana uses $1\frac{3}{5}$ oz of detergent for each full load of laundry. How many full loads of laundry can she do with 100 oz of detergent? Show your work.

SOLUTION _____

3 Which expression can be used to determine the number of $\frac{3}{4}$-cup servings in $\frac{1}{2}$ cup of pasta salad?

A $\frac{1}{2} \times \frac{3}{4}$

B $\frac{1}{2} \times \frac{4}{3}$

C $\frac{3}{4} \times \frac{2}{1}$

D $\frac{4}{3} \times \frac{2}{1}$

Lillie chose C as the correct answer. How might she have gotten that answer?

4 A new nature trail is $\frac{8}{10}$ mi long. A park ranger divides the trail into 4 equal sections. How long is each section of the trail? Show your work.

WOODS WALK TRAIL

SOLUTION _____

5 Estela has 10 ft³ of soil. She uses $3\frac{1}{2}$ ft³ in her garden. She uses the rest of the soil for tomato plants. She needs $\frac{3}{4}$ ft³ of the soil for each tomato plant. How many tomato plants can she plant? Show your work.

SOLUTION _____

6 Without dividing, tell whether each quotient is *less than 1, greater than 1,* or *equal to 1.*

	Less Than 1	Greater Than 1	Equal to 1
a. $\frac{2}{9} \div \frac{1}{27}$	○	○	○
b. $\frac{1}{2} \div \frac{3}{4}$	○	○	○
c. $\frac{4}{3} \div \frac{3}{5}$	○	○	○
d. $\frac{20}{8} \div 2\frac{1}{2}$	○	○	○

7 Querida spreads grass seed on her lawn. She needs $\frac{5}{6}$ lb of grass seed to cover her whole lawn. She has $\frac{1}{3}$ lb of grass seed. How much of her lawn can she cover?

Show your work.

SOLUTION

8 What is $4\frac{1}{7} \div 2\frac{1}{14}$?

A $\frac{1}{98}$ 　　　　　　　　　　　**B** $\frac{1}{2}$

C 2 　　　　　　　　　　　　　**D** 98

9 **Math Journal** Write a word problem that you can use the division expression $\frac{3}{4} \div \frac{3}{8}$ to solve. Then solve the problem.

✔ **End of Lesson Checklist**

☐ **INTERACTIVE GLOSSARY** Find the entry for *reciprocal*. Give examples of three numbers and their reciprocals.

☐ **SELF CHECK** Go back to the Unit 2 Opener and see what you can check off.

End of Unit 2

Volume and Operations with Decimals and Fractions

Study an Example Problem and Solution

➤ **Read this problem involving volume and decimal operations. Then look at one student's solution to this problem on the following pages.**

Growing Salt Crystals

In science club, Alberto looks at table salt under a microscope. Later, he mixes table salt with water to grow salt crystals. Read through Alberto's notes, and help him answer his question.

LAB NOTES

Table Salt Observations:

- The grains of salt are approximately cube-shaped.
- The edge lengths of the grains range from 0.2 mm to 0.4 mm.

Salt Crystal Observations:

salt crystal

- I grew 3 salt crystals. Each crystal is approximately a cube.
- The edge length of the smallest cube is 4.5 mm.
- The edge length of the middle cube is 5.7 mm.
- The edge length of the largest cube is 6.3 mm.

? **About how many grains of salt did it take to grow one of my salt crystals?**

Salt crystals magnified

One Student's Solution

First, I need to choose one of Alberto's three salt crystals.

I will choose the crystal with edge length 5.7 mm, since it is not the largest or the smallest.

> **NOTICE THAT . . .**
> Because the salt crystal is a cube, the length, width, and height are all 5.7 mm.

Next, I will draw a picture to help me think about the problem.

I can sketch a cube to represent the crystal and label its edge lengths.

5.7 mm

5.7 mm

5.7 mm
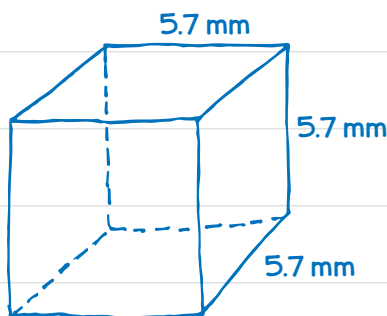
Then, I will imagine packing the crystal with grains of salt.

I know the edge lengths of the grains of table salt range from 0.2 mm to 0.4 mm. I can use 0.25 mm for the edge length of each grain of salt, since 0.25 mm is between 0.2 mm and 0.4 mm.

> **NOTICE THAT . . .**
> 0.25 is five hundredths greater than 0.2.

5.7 mm

5.7 mm

5.7 mm

0.25 mm

Problem-Solving Checklist

- [ ] Tell what is known.
- [ ] Tell what the problem is asking.
- [ ] Show all your work.
- [ ] Show that the solution works.
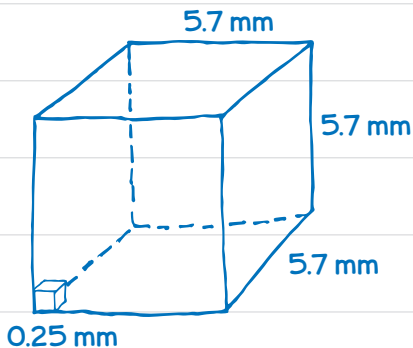
Now, I can calculate the number of grains of salt that fit along the length, width, and height of the crystal.

I need to figure out how many 0.25s are in 5.7. So, I need to divide 5.7 mm by 0.25 mm.

$$0.25\overline{)5.7} \longrightarrow \begin{array}{r} 22.8 \\ 25\overline{)570.0} \\ -\,50 \\ \hline 70 \\ -\,50 \\ \hline 20\,0 \\ -\,20\,0 \\ \hline 0 \end{array}$$

The number of grains will be a whole number, so I will round. About 23 grains of salt will fit along each edge of the salt crystal.

Finally, I will calculate the volume of a salt crystal in grains of salt.

I can use the formula for volume: $V = \ell wh$.

$$V = 23 \cdot 23 \cdot 23$$
$$= 12{,}167$$

Alberto's salt crystal is made from about 12,167 grains of salt.

There are approximately 4.5 to 4.9 billion tons of salt in the Great Salt Lake.

Try Another Approach

➤ **There are many ways to solve problems. Think about how you might solve the Growing Salt Crystals problem in a different way.**

Growing Salt Crystals

In science club, Alberto looks at table salt under a microscope. Later, he mixes table salt with water to grow salt crystals. Read through Alberto's notes, and help him answer his question.

LAB NOTES

Table Salt Observations:

- The grains of salt are approximately cube-shaped.
- The edge lengths of the grains range from 0.2 mm to 0.4 mm.

Salt Crystal Observations:

salt crystal

- I grew 3 salt crystals. Each crystal is a cube.
- The edge length of the smallest cube is 4.5 mm.
- The edge length of the middle cube is 5.7 mm.
- The edge length of the largest cube is 6.3 mm.

? **About how many grains of salt did it take to grow one of my salt crystals?**

Plan It

➤ **Answer these questions to help you start thinking about a plan.**

a. Which of the three salt crystals will you use? What edge length of a grain of salt will you use?

b. Is there another way you could use the idea of volume to calculate how many grains of salt make up one crystal?

Solve It

➤ **Find a different solution for the Growing Salt Crystals problem. Show all your work on a separate sheet of paper. You may want to use the Problem-Solving Tips to get started.**

PROBLEM-SOLVING TIPS

Math Toolkit grid paper, isometric dot paper, unit cubes

Key Terms

volume	dimensions	quotient
product	prism	formula

Models You may want to use . . .

• a picture or diagram to organize your work.

• a formula to calculate volume: $V = Bh$ or $V = \ell wh$.

• an area model or the standard algorithm to multiply or divide decimals.

Reflect

Use Mathematical Practices As you work through the problem, discuss these questions with a partner.

• **Persevere** What is your first step? What will you do next?

• **Be Precise** Would it make sense to round the result of your calculations to get your final answer? Why or why not?

Discuss Models and Strategies

➤ **Read the problem. Write a solution on a separate sheet of paper. Remember, there can be lots of ways to solve a problem.**

Aquatic Ecosystem

Alberto wants to set up an aquarium as a demonstration of freshwater ecosystems for the science club. Read the information he finds about aquarium ecosystems. Then suggest a tank, a number of guppies, and an amount of gravel for Alberto to use to set up his ecosystem.

Setting Up an Aquarium for Guppies

- Guppies are social fish. Keep at least 3 guppies in your aquarium.

- Each guppy will need $\frac{1}{4}$ cubic foot of water.

- Plants will help provide oxygen. To support the plants, the depth of the gravel should be between $\frac{1}{8}$ and $\frac{1}{4}$ of the height of the tank.

- There should be at least 2 inches $\left(\frac{1}{6}\text{ foot}\right)$ of space between the surface of the water and the top of the tank.

Tank Suggestions

These two tanks will provide enough room for a small colony of guppies:

Volume $= \frac{3}{2}\text{ft}^3$
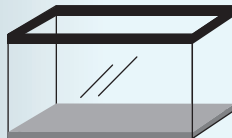
Base Area $= \frac{9}{8}\text{ft}^2$

Volume $= 1\frac{3}{4}\text{ft}^3$

Width $= \frac{7}{12}\text{ft}$

Length $= \frac{3}{2}\text{ft}$

FRANK'S FISHTANK EMPORIUM

Plan It and Solve It

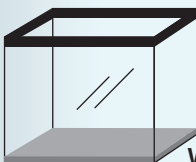➤ **Find a solution to the Aquatic Ecosystem problem.**

Write a detailed plan and support your answer. Be sure to include:

- the tank you suggest for Alberto.
- the amount of gravel (in cubic feet) needed for the tank.
- the amount of water (in cubic feet) to add to the tank.
- the number of guppies the tank can support.

PROBLEM-SOLVING TIPS

Math Toolkit grid paper, isometric dot paper, unit cubes

Key Terms

| volume | dimension | height |
| base | area | formula |

Questions

- Which tank do you suggest Alberto buy? How will you calculate the amount of gravel needed for the tank?
- What dimension(s) do you need to calculate for the tank before you can calculate the volume of water it will hold?

Reflect

Use Mathematical Practices As you work through the problem, discuss these questions with a partner.

- **Use Models** How can a sketch help you solve this problem?
- **Make an Argument** Does it make sense to suggest that Alberto put $4\frac{3}{4}$ guppies in the tank? Explain.

Guppies get their name from the British-born naturalist John Lechmere Guppy, who discovered them in Trinidad in 1866.

Persevere On Your Own

➤ **Read the problem. Write a solution on a separate sheet of paper.**

Making Slime

Alberto and Riley are choosing between two types of slime to make with the other members of the science club. Read an email from Riley about their plans, and help Alberto respond to Riley.

Delete   Archive   Reply   Reply All   Forward

To: Alberto
Subject: Planning our slime project!

Hi Alberto,

Here are my notes from when we tried making the two types of slime:

	Gooey Slime	**Firm Slime**
Mass of empty cup	0.007 kg	0.005 kg
Mass of water	0.36 kg	0.36 kg
Total mass after adding glue	0.492 kg	0.525 kg
Total mass after adding borax	0.5 kg	0.55 kg

Here is the glue and borax I saw at the store:

0.5 kg   1.84 kg

PLEASE LET ME KNOW:
• Which kind of slime do you want to make with the science club?
• How many boxes of borax and how many bottles of glue should we bring to the science club meeting? There are 24 members.
• How many batches of slime will the club be able to make?

Thanks!

Riley

Solve It

➤ **Find a solution to the Making Slime problem.**

- Choose one type of slime. Then calculate how much glue and borax is needed to make it.

- Determine how many bottles of glue and boxes of borax to bring to the science club meeting.

- Tell how many batches of slime the science club will be able to make with the materials.

Reflect

Use Mathematical Practices After you complete the problem, choose one of these questions to discuss with a partner.

- **Reason Mathematically** What operations did you use to find your solution? Explain why.

- **Critique Reasoning** Do you agree with the number of batches of slime your partner says the science club will be able to make? Explain.

In this unit you learned to . . .

Skill	Lesson(s)
Add, subtract, and multiply multi-digit decimals using standard algorithms.	7
Divide multi-digit whole numbers and multi-digit decimals using standard algorithms.	8
Divide fractions.	9, 10
Solve real-world problems that involve dividing fractions.	9, 10
Find the volume of a right rectangular prism with fractional edge lengths.	11
Use math vocabulary and precise language to describe a strategy and how that strategy is used to solve a problem.	7–11

Think about what you have learned.

➤ **Use words, numbers, and drawings.**

1 One topic I could use in my everyday life is _____ because . . .

2 I worked hardest to learn how to . . .

3 One thing I could do better is . . .

➤ **Review the unit vocabulary. Put a check mark by items you can use in speaking and writing. Look up the meaning of any terms you do not know.**

Math Vocabulary   **Academic Vocabulary**

☐ dividend   ☐ partial quotients   ☐ additional

☐ divisor   ☐ quotient   ☐ combine

☐ estimate (verb)   ☐ reciprocal   ☐ maximum

☐ fraction   ☐ remainder   ☐ reasonable

➤ **Use the unit vocabulary to answer the questions.**

1 Use the four division problems shown below to answer questions 1a–1f.

$$84 \div 7 = 12 \qquad \frac{144}{8} = 18 \qquad 25\overline{)160.0}^{\,6.4} \qquad \frac{3}{4} \div \frac{1}{8} = \frac{3}{4} \times \frac{8}{1} = 6$$

a. What part of the problem is 144?

b. What part of the problem is 160.0?

c. What part of the problem is 6.4?

d. What part of the problem is 6?

e. What is the relationship between $\frac{8}{1}$ and $\frac{1}{8}$?

f. Name the divisors in each division problem.

2 160 divided by 25 equals 6.4. Why does the quotient contain a whole-number part and a decimal part? Use at least two math or academic vocabulary terms in your answer. Underline each term you use.

3 Is 20 a reasonable answer for 170 ÷ 15? Use at least two math or academic vocabulary terms in your answer. Underline each term you use.

➤ **Use what you have learned to complete these problems.**

1 What is the value of the expression $f - 2gh$ when $f = 4.5$, $g = 0.21$, and $h = 1.8$? Show your work.

SOLUTION _____

2 Lupe drives from Dallas to Anchorage, a total trip of 3,894 miles. She drives 348 miles to Wichita. For the rest of the trip, she will drive 394 miles each day. How many days does Lupe drive from Wichita to Anchorage? Complete the steps that can be used to solve the problem. Write your answers in the blanks.

Miles left to travel: $3,894 -$ _____ $=$ _____

Number of days needed to travel: _____ $\div 394 =$ _____ days

3 Ms. Guzman orders 6,370 marbles. Each package contains 182 marbles. How many packages does Ms. Guzman order? Record your answer on the grid. Then fill in the bubbles.

4 Carson fills each bird feeder with $\frac{3}{4}$ pound of birdseed. He has 12 pounds of birdseed. Carson says that to find how many bird feeders he can fill, he first finds how many $\frac{1}{4}$ pounds are in 12 pounds. What else does Carson need to do to find how many bird feeders he can fill?

SOLUTION _____

_____

5 It takes 126 cubes that have edge lengths of $\frac{1}{3}$ ft to completely fill this plastic bin.

What is the area of the base of the bin? Show your work.

$2\frac{1}{3}$ ft

base
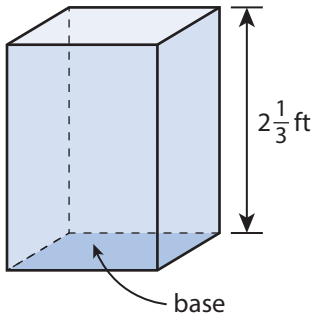
SOLUTION

6 What is $4\frac{2}{5} \div 1\frac{1}{10}$?

**A** $\frac{25}{121}$ **B** $\frac{1}{4}$

C 2   **D** 4

7 Bilal has 5 c of strawberries. He uses $2\frac{1}{6}$ c to make smoothies. He uses the rest of the strawberries to make fruit cups. He needs $\frac{2}{3}$ c of strawberries for each fruit cup. How many fruit cups can he make? Show your work.

SOLUTION

Performance Task

➤ **Answer the questions and show all your work on separate paper.**

Geraldine supplies number cubes to companies that make board games. Each number cube measures $\frac{3}{4}$ inch on each edge. For shipping, the number cubes can be packed into any of the boxes shown.

Box 1	Box 2	Box 3
4 in. 4 in. 4 in.	2 in. $3\frac{1}{2}$ in. 4 in.	$2\frac{1}{2}$ in. $6\frac{1}{4}$ in. $2\frac{1}{2}$ in.
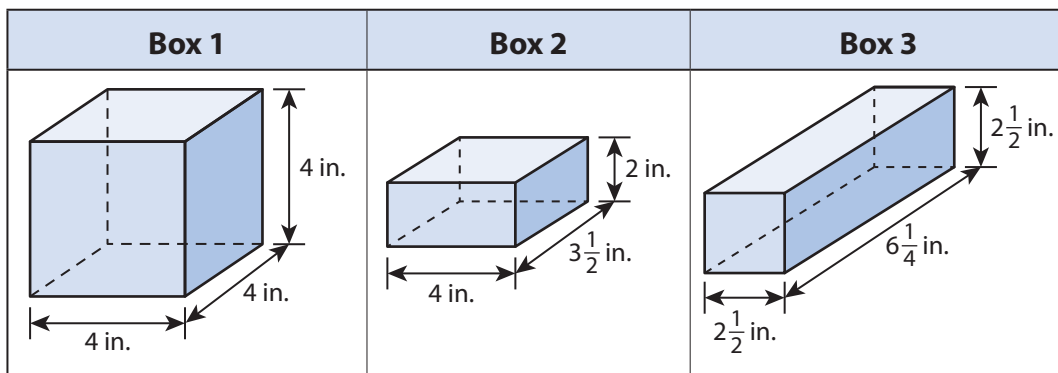
Geraldine receives an order for 780 number cubes. First, she needs to know the maximum number of cubes that can fit into each box. Then she needs a packing plan for the order. Remember: only whole cubes can be packed.

Design a packing plan for Geraldine. Your plan must meet the following requirements:

• The maximum number of cubes that can fit into each box is identified.

• The fewest number of boxes is used to pack the 780 number cubes.

• No box is packed with fewer than half the total number of cubes it can hold.

Reflect

Use Mathematical Practices After you complete the task, choose one of the following questions to answer.

• **Make Sense of the Problem** How are the dimensions of the number cubes related to the dimensions of the box?

• **Use Reasoning** How did you use the maximum capacity of each box to make your packing plan?

Sampler

Curriculum Associates