

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 $2 \times 4 = 8$ and $8 \div 4 = 2$ tell you there are **two 4s** in **8**, the equations below tell you there is only **half** of $\frac{1}{4}$ in $\frac{1}{8}$.

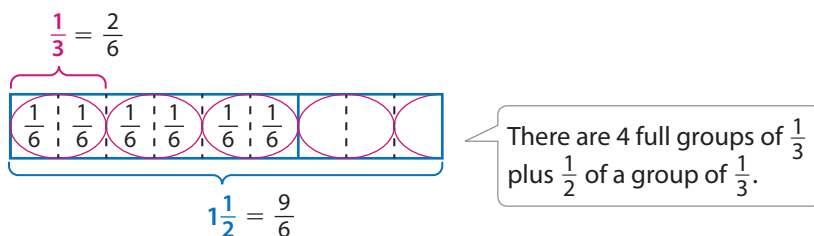
$$\frac{1}{2} \times \frac{1}{4} = \frac{1}{8} \quad \frac{1}{8} \div \frac{1}{4} = \frac{1}{2}$$

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



$$1\frac{1}{2} \div \frac{1}{3} = \frac{9}{6} \div \frac{2}{6} = 4\frac{1}{2}$$

- **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.

$$\begin{aligned} 1\frac{1}{2} \div \frac{1}{3} &= 1\frac{1}{2} \times 3 \quad \leftarrow \text{The numbers } \frac{1}{3} \text{ and } 3 \text{ are called } \mathbf{reciprocals}. \\ &= \frac{3}{2} \times 3 \\ &= \frac{9}{2}, \text{ or } 4\frac{1}{2} \end{aligned}$$

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.

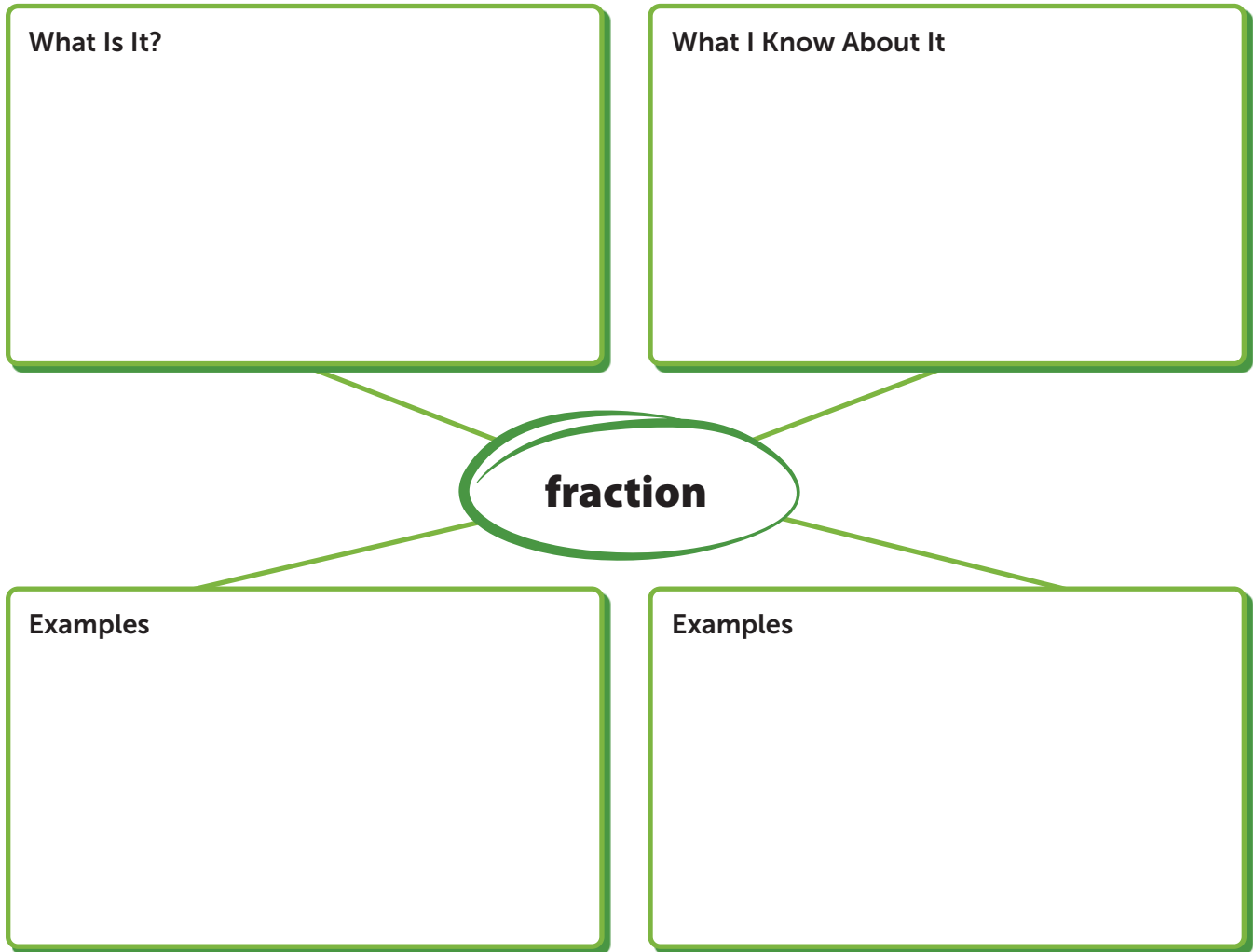
 - b.** Estimate whether $2\frac{1}{2} \div \frac{1}{4}$ is *greater than* or *less than* the dividend, $2\frac{1}{2}$. Use an example of dividing $2\frac{1}{2}$ lb of clay into $\frac{1}{4}$ -lb portions to explain your thinking.

 - 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.

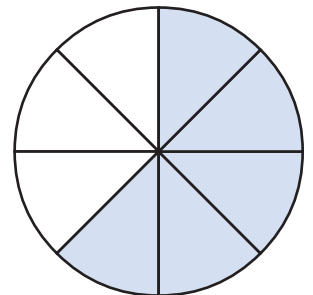
- 3 Reflect** What division equation can you write to show that when $\frac{3}{4}$ lb of clay is divided equally among 6 people, each person gets $\frac{1}{8}$ lb of clay? How would you use multiplication to check that the quotient is correct?

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.



- 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

► 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.



Dance performers at a Juneteenth festival

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?

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?

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

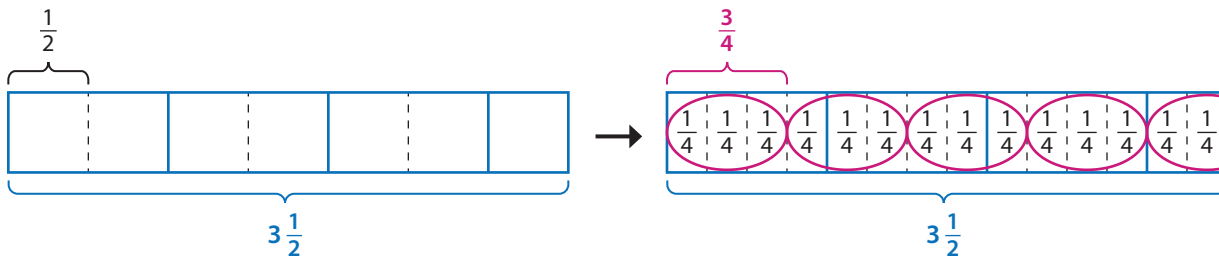
Use division to find the unknown factor.

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

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.

$$\begin{aligned} 3\frac{1}{2} \div \frac{3}{4} &= \frac{7}{2} \div \frac{3}{4} \\ &= \frac{14}{4} \div \frac{3}{4} \end{aligned}$$

Now you can think of dividing 14 fourths by 3 fourths, which is the same as $14 \div 3$.

CONNECT IT

► 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 $14 \div 3$ 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

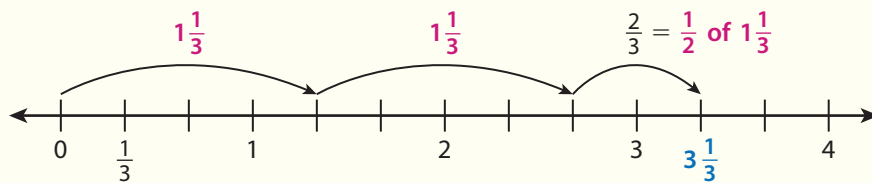
- Study the Example showing how to divide fractions when the quotient is not a whole number. Then solve problems 1–5.

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 walk the whole length of the stick? Show your work.



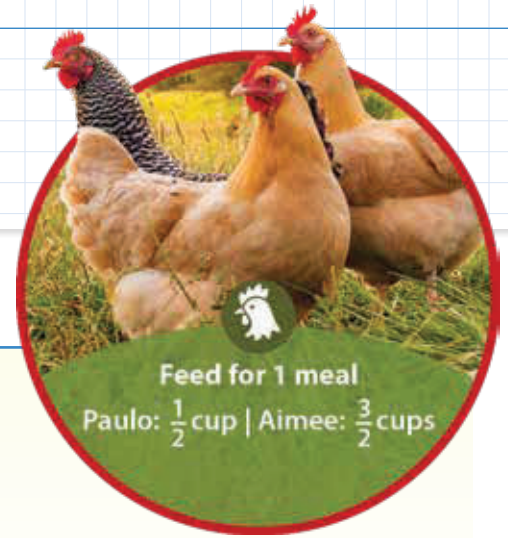
SOLUTION _____

- 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?



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.

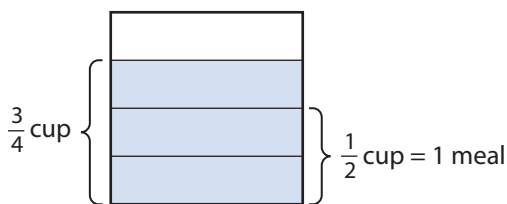
Paulo and Aimee each have $\frac{3}{4}$ cup of feed left in their bags of chicken feed. Paulo uses $\frac{1}{2}$ cup of feed each time he gives his chickens a meal. Aimee uses $\frac{3}{2}$ cups of feed each time she gives her chickens a meal. How many meals can Paulo give his chickens? How many meals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

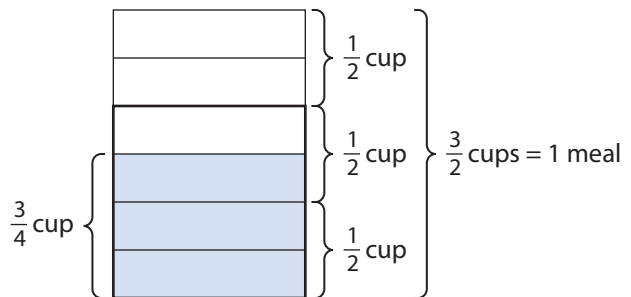
Paulo



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

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

Aimee



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.

First find how many $\frac{1}{2}$ s are in the number.

To do this, **multiply by 2**.

Then separate the **number of $\frac{1}{2}$ s** into 3 equal parts.

To divide by 3, **multiply by $\frac{1}{3}$** .

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

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

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



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 $\frac{c}{d}$.
$$\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \square \times \frac{1}{\square} \rightarrow \frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \frac{\square}{\square}$$
- 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.

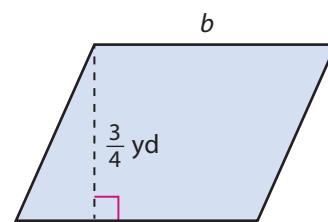
Apply It

► 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.



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

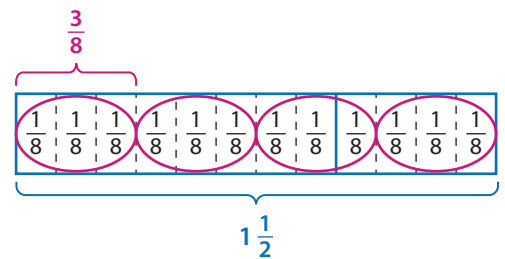
Tyrone has $1\frac{1}{2}$ quarts of honey. He is pouring the honey into jars that each hold $\frac{3}{8}$ quart. How many jars can Tyrone fill?

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

$$\begin{aligned}
 1\frac{1}{2} \div \frac{3}{8} &= 1\frac{1}{2} \times \frac{8}{3} \quad \leftarrow \text{To divide by } \frac{3}{8}, \text{ multiply by its reciprocal, } \frac{8}{3}. \\
 &= \frac{3}{2} \times \frac{8}{3} \\
 &= \frac{24}{6} = 4
 \end{aligned}$$

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 $(1\frac{1}{2} \times 8) \times \frac{1}{3}$? 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.

$$\begin{aligned} 2\frac{1}{2} + \frac{3}{4} + 2\frac{1}{4} + \frac{3}{4} &= 2\frac{1}{2} + 3 + \frac{3}{4} \\ &= 5\frac{1}{2} + \frac{3}{4} = 6\frac{1}{4} \end{aligned}$$

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 _____

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

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

- 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.

SOLUTION _____

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?

- 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.

CONSIDER THIS ...

What would a remainder represent in this division situation?

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?

PAIR/SHARE

How do you know that your answer is reasonable?

CONSIDER THIS ...

How can you rewrite a division expression as a multiplication expression?

PAIR/SHARE

Is there *more than* one full serving of pasta salad or *less than* one full serving? How do you know?

- 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.

SOLUTION _____

- 5 Estela has 10 ft^3 of soil. She uses $3\frac{1}{2} \text{ ft}^3$ in her garden. She uses the rest of the soil for tomato plants. She needs $\frac{3}{4} \text{ ft}^3$ 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. $\frac{2}{9} \div \frac{1}{27}$	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b. $\frac{1}{2} \div \frac{3}{4}$	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
c. $\frac{4}{3} \div \frac{3}{5}$	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
d. $\frac{20}{8} \div 2\frac{1}{2}$	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



- 7 Sierra 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.