Explore Adding Fractions

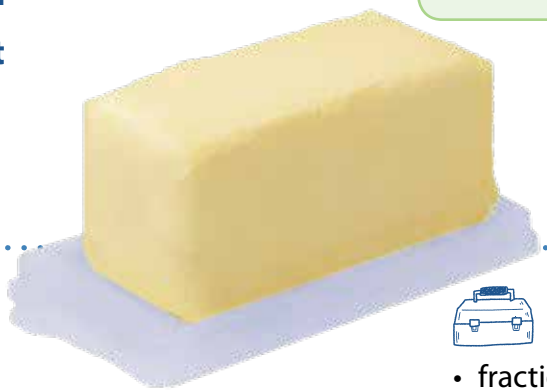
Learning Target

- Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators.

SMP 1, 2, 3, 4, 5, 6, 7

You know how to add fractions with like denominators. Now you will learn how to add fractions with unlike denominators. Use what you know to try to solve the problem below.

Emiliano needs $\frac{1}{2}$ stick of butter to make corn bread. He also needs $\frac{1}{4}$ stick of butter to make apple muffins. What fraction of a stick of butter does he need in all?



TRY IT

Math Toolkit

- fraction tiles
- fraction circles
- fraction bars
- fraction models
- grid paper
- number lines

DISCUSS IT

Ask your partner: Why did you choose that strategy?

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

CONNECT IT

1 LOOK BACK

Explain how you found how much butter Emiliano needs.

2 LOOK AHEAD

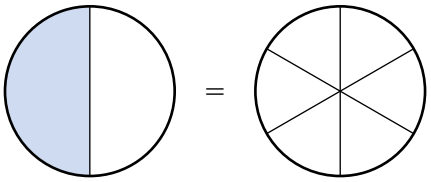
Before adding fractions, the fractions must have the same-size parts of a whole. You can use what you know about multiples and equivalent fractions to find a common denominator for fractions that have unlike denominators.

a. Use the fractions $\frac{1}{2}$ and $\frac{1}{3}$. Write the next four multiples of each denominator. Then circle the multiple that 2 and 3 have in common.

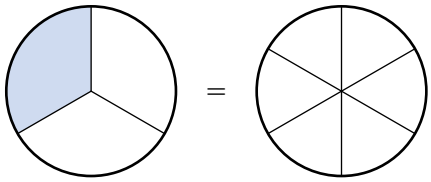
Multiples of 2: 2, ..., ..., ..., ...

Multiples of 3: 3, ..., ..., ..., ...

b. Complete the models and equations to show equivalent fractions for $\frac{1}{2}$ and $\frac{1}{3}$ using the common multiple as the common denominator.



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



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

c. Use the equivalent fractions to add. $\frac{1}{2} + \frac{1}{3} = \frac{\square}{6} + \frac{\square}{6} = \frac{\square}{6}$

3 REFLECT

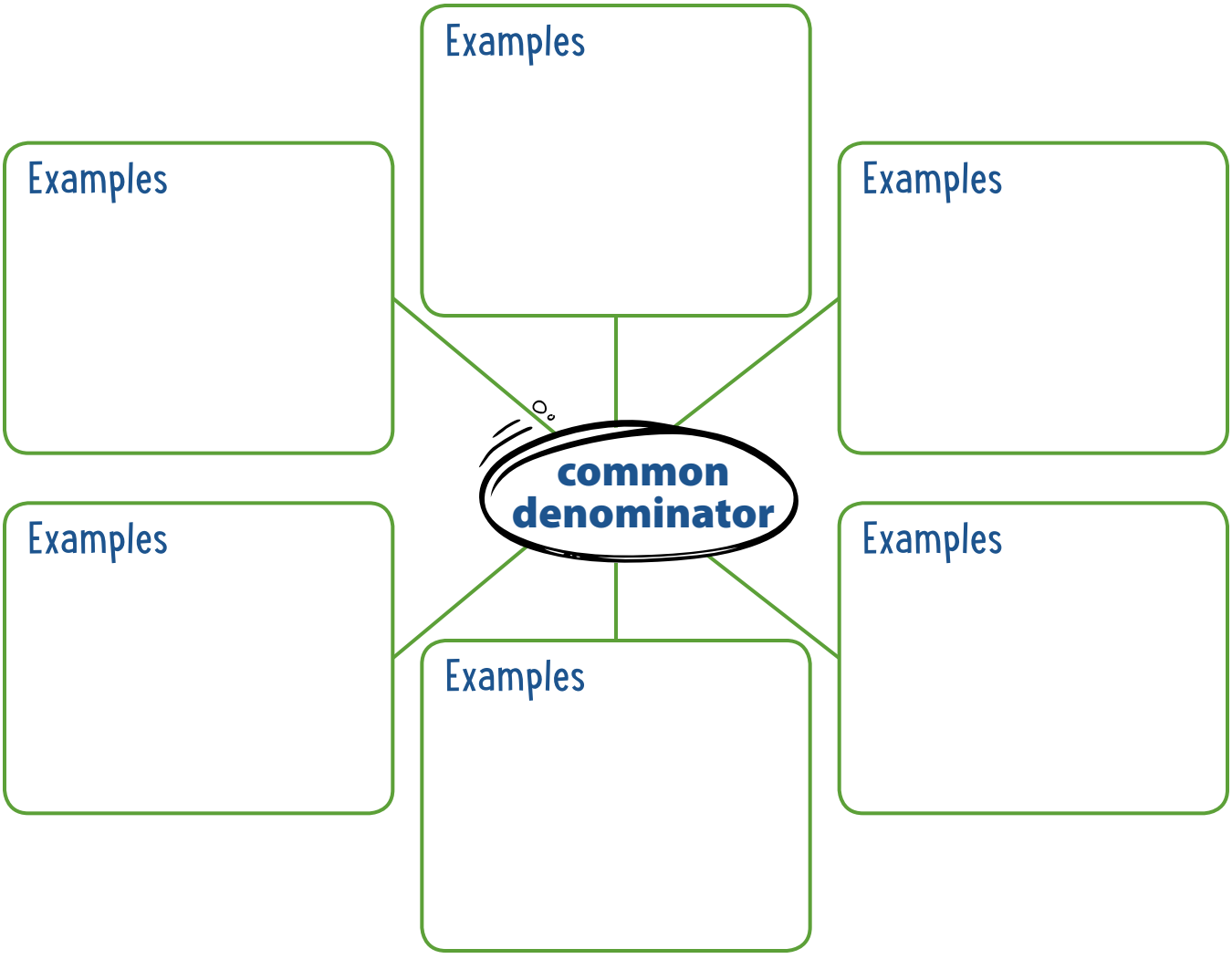
What equivalent fractions could you write to add $\frac{1}{2}$ and $\frac{2}{3}$? Explain.

.....

.....

Prepare for Adding Fractions

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



2 How can you find a common denominator for $\frac{1}{3}$ and $\frac{1}{5}$?

3 Solve the problem. Show your work.

Naeem needs $\frac{1}{4}$ cup of milk to make a carrot cake. He also needs $\frac{1}{8}$ cup of milk to make the icing for the cake. What fraction of a cup of milk does Naeem need in all?

Solution

4 Check your answer. Show your work.

Develop Adding Fractions with Unlike Denominators

Read and try to solve the problem below.

Maggie paddles her kayak $\frac{1}{2}$ mile to an island. Then she paddles $\frac{4}{5}$ mile to a beach. How far does Maggie paddle her kayak in all?

TRY IT

Math Toolkit

- fraction tiles
- fraction circles
- fractions bars
- fraction models
- grid paper
- number lines

DISCUSS IT

Ask your partner: Do you agree with me? Why or why not?

Tell your partner: I disagree with this part because . . .

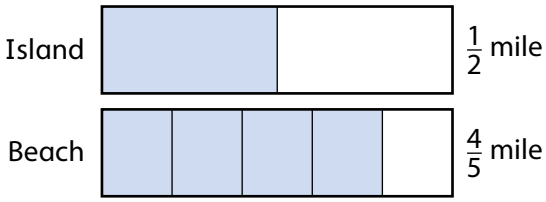
Explore different ways to understand adding fractions with unlike denominators.

Maggie paddles her kayak $\frac{1}{2}$ mile to an island. Then she paddles $\frac{4}{5}$ mile to a beach. How far does Maggie paddle her kayak in all?

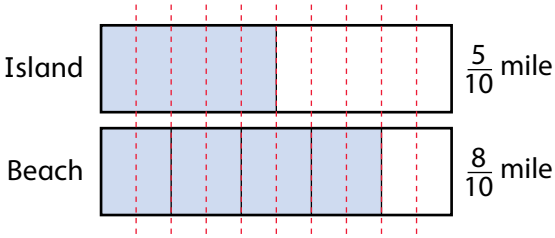
PICTURE IT

You can picture the fractions in the problem using fraction bars.

The fraction bars are divided into halves and fifths.



Both fraction bars need to be divided into same-size parts.



Now you can add equivalent fractions.

MODEL IT

You can model the problem with an equation.

Replace the fractions $\frac{1}{2}$ and $\frac{4}{5}$ with equivalent fractions with a common denominator.

$$\frac{1}{2} = \frac{1 \times 5}{2 \times 5} = \frac{5}{10} \text{ and}$$
$$\frac{4}{5} = \frac{4 \times 2}{5 \times 2} = \frac{8}{10}$$

So, $\frac{1}{2} + \frac{4}{5} = \frac{5}{10} + \frac{8}{10}$.

CONNECT IT

Now you will use the problem from the previous page to help you understand how to add any two fractions with unlike denominators.

1. Explain why both fraction bars in **Picture It** are divided into 10 equal pieces.

2. Write the total distance Maggie paddles as a fraction. _____ miles

   Write the total distance Maggie paddles as a mixed number. _____ miles

3. Look at the denominators in **Model It**. What do you notice about the relationship between the original denominators, 2 and 5, and the common denominator, 10?

4. Is 10 the only common denominator for 2 and 5? Justify your answer.

5. Explain how to add two fractions with unlike denominators.

6 REFLECT

Look back at your **Try It**, strategies by classmates, and **Picture It** and **Model It**. Which models or strategies do you like best for adding fractions with unlike denominators? Explain.

APPLY IT

Use what you just learned to solve these problems.

7 Hank practices $\frac{5}{8}$ of the words on his spelling list on Monday. He practices another $\frac{1}{4}$ of his list on Tuesday. What fraction of his spelling list has Hank practiced so far? Show your work.

Solution

8 What is the sum of $\frac{7}{6}$ and $\frac{5}{8}$? Show your work.

Solution

9 What is the value of the expression $\frac{2}{3} + \frac{5}{12}$?

Ⓐ $\frac{7}{36}$

Ⓑ $\frac{7}{15}$

Ⓒ $\frac{13}{12}$

Ⓓ $\frac{38}{36}$

Practice Adding Fractions with Unlike Denominators

Study the Example showing one way to add fractions with unlike denominators. Then solve problems 1–4.

EXAMPLE

What is $\frac{3}{4} + \frac{1}{6}$?

To add fractions, the size of the parts must be the same. Write each addend as an equivalent fraction with a common denominator.

Identify 12 as a common multiple of the denominators 4 and 6. Divide the models into 12 equal parts.

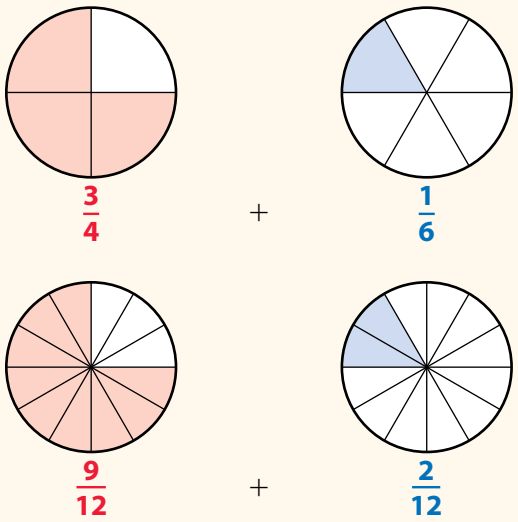
Write the equivalent fractions.

$\frac{3}{4} = \frac{9}{12}$ and $\frac{1}{6} = \frac{2}{12}$

Find the sum.

$\frac{3}{4} + \frac{1}{6} = \frac{9}{12} + \frac{2}{12}$

$= \frac{11}{12}$



1 The Example uses 12 as the common multiple of 4 and 6.

a. Name a different common multiple of 4 and 6.

b. If you used the common multiple from part a as the common denominator, how would the models in the Example be different? How would they be the same?

c. Use the common multiple from part a as the common denominator to write equivalent fractions for $\frac{3}{4}$ and $\frac{1}{6}$.

$\frac{3}{4} =$ ..... $\frac{1}{6} =$ .....

2 Find a common denominator for each pair of fractions. Then use multiplication to write each fraction as an equivalent fraction with the common denominator.

a. $\frac{1}{8}$ and $\frac{1}{2}$ common denominator .....

$\frac{1 \times \square}{8 \times \square} = \frac{\square}{\square}$ $\frac{1 \times \square}{2 \times \square} = \frac{\square}{\square}$

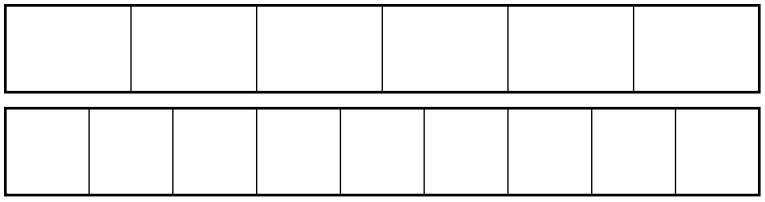
b. $\frac{1}{8}$ and $\frac{9}{5}$ common denominator .....

$\frac{1 \times \square}{8 \times \square} = \frac{\square}{\square}$ $\frac{9 \times \square}{5 \times \square} = \frac{\square}{\square}$

c. $\frac{1}{8}$ and $\frac{11}{6}$ common denominator .....

$\frac{1 \times \square}{8 \times \square} = \frac{\square}{\square}$ $\frac{11 \times \square}{6 \times \square} = \frac{\square}{\square}$

3 Show how to find the sum of $\frac{5}{6}$ and $\frac{1}{9}$ using the fraction bars below.



Write an equation for the sum.

4 Glenn swims $\frac{2}{3}$ mile on Monday, $\frac{3}{4}$ mile on Wednesday, and $\frac{5}{6}$ mile on Friday. What is the total distance Glenn swims on those three days? Show your work.

Solution .....

Develop Adding with Mixed Numbers

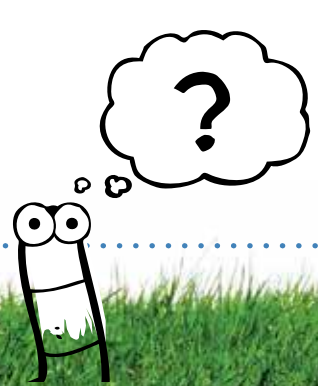
Read and try to solve the problem below.

Jenna spent $1\frac{2}{3}$ hours mowing the back yard. After taking a break, she spent $\frac{3}{4}$ hour mowing the front yard. How many hours did she spend mowing the whole yard?

TRY IT

Math Toolkit

- fraction tiles
- fraction circles
- fractions bars
- fraction models
- grid paper
- number lines



DISCUSS IT

Ask your partner: Can you explain that again?

Tell your partner: I do not understand how . . .

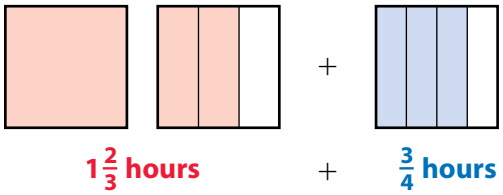
Explore different ways to understand adding with mixed numbers.

Jenna spent $1\frac{2}{3}$ hours mowing the back yard. After taking a break, she spent $\frac{3}{4}$ hour mowing the front yard. How many hours did she spend mowing the whole yard?

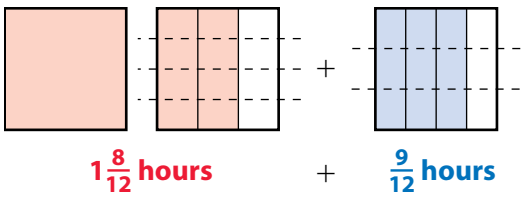
PICTURE IT

You can picture the fractions in the problem using models.

The shaded parts represent time spent on the back yard, $1\frac{2}{3}$ hours, and the front yard, $\frac{3}{4}$ hour.



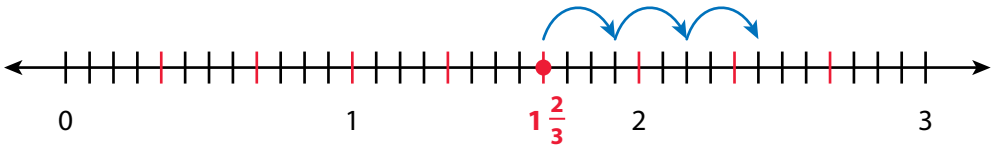
The sections need to be divided into same-size parts to add. Use dashed lines to divide the fraction models into 12 equal parts.



MODEL IT

You can use a number line to add fractions.

The number line is divided first into thirds and then into twelfths, with a point at $1\frac{2}{3}$.



$\frac{1}{4} = \frac{3}{12}$, so $\frac{3}{4} = \frac{3}{12} + \frac{3}{12} + \frac{3}{12}$.

$\frac{3}{12} + \frac{3}{12} + \frac{3}{12} = \frac{9}{12}$

Start at $1\frac{2}{3}$ and jump right a total of $\frac{9}{12}$.

CONNECT IT

Now you will use the problem from the previous page to help you understand how to add with mixed numbers.

1. Look at the models on the previous page. What is a common denominator of $1\frac{2}{3}$ and $\frac{3}{4}$? .....

2. You can find this common denominator without a model. Write a multiplication equation that shows how the denominators 3 and 4 are related to 12.

   .....

3. Use this common denominator to find equivalent fractions for $1\frac{2}{3}$ and $\frac{3}{4}$.

   $1\frac{2}{3} + \frac{3}{4} = 1\frac{\square}{12} + \frac{\square}{12}$

   Then write the sum as a mixed number.

   $= 1\frac{\square}{12}$

4. The fractional part of the mixed number in problem 3 is more than 1. How could you rewrite the mixed number so that its fractional part is less than 1?

   How many hours did Jenna spend mowing the whole yard? .....

5. Explain how to add with mixed numbers.

6 REFLECT

Look back at your **Try It**, strategies by classmates, and **Picture It** and **Model It**. Which models or strategies do you like best for adding with mixed numbers? Explain.

.....

.....

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APPLY IT

Use what you just learned to solve these problems.

7 What is the sum $1\frac{1}{6} + 2\frac{3}{8}$? Show your work.

Solution

8 Cameron has $4\frac{3}{4}$ pounds of raspberries, $2\frac{1}{8}$ pounds of blueberries, and $\frac{1}{2}$ pound of blackberries to make a fruit salad. How many pounds of fruit does Cameron have in all? Show your work.

Solution

9 What is the value of the expression $5\frac{3}{5} + 4\frac{1}{15}$? Show your work.

Solution

Practice Adding with Mixed Numbers

Study the Example showing how to add with mixed numbers. Then solve problems 1–4.

EXAMPLE

What is $1\frac{2}{3} + 1\frac{1}{2}$?

To add mixed numbers, the fractional parts must be the same size.

Replace the given fractions with equivalent fractions that have the denominator 6.

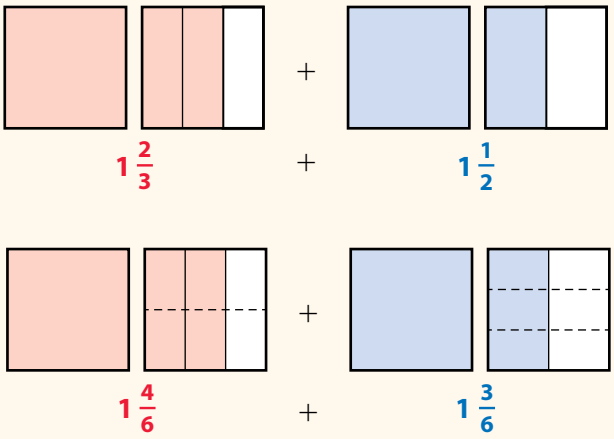
Find the sum. $1\frac{2}{3} + 1\frac{1}{2} = 1\frac{4}{6} + 1\frac{3}{6}$

$= 2\frac{7}{6}$

Rewrite the mixed number so that the fractional part is less than 1.

$2\frac{7}{6} = 2 + \frac{7}{6} = 2 + 1\frac{1}{6}$

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



1 Draw a model to show how you can use equivalent fractions to find the sum $2\frac{1}{6} + 3\frac{1}{4}$. Show your work.

Solution

2 One way to find a common denominator is by multiplying the denominators of the two fractions together and using the product as the common denominator.

Use this method to find a common denominator for each pair of fractions. Write the equivalent fractions.

a. $1\frac{3}{5} = 1\frac{\square}{20}$ $1\frac{3}{4} = 1\frac{\square}{20}$

b. $2\frac{1}{2} =$ ..... $\frac{4}{5} =$ .....

c. $\frac{3}{8} =$ ..... $\frac{1}{6} =$ .....

3 Show how to add $2\frac{1}{2} + \frac{4}{5}$ using the number line below.

Write an equation to represent the problem.

4 Maya is packing her backpack for a hike. In one pocket, she puts in a $\frac{1}{2}$-pound bag of trail mix, a water bottle weighing $2\frac{1}{8}$ pounds, and a flashlight weighing $\frac{1}{4}$ pound. How much weight do these three items add to her backpack? Show your work.

Solution .....

Refine Adding Fractions

Complete the Example below. Then solve problems 1–8.

EXAMPLE

What is $\frac{11}{8} + \frac{5}{6}$?

Look at how you could show your work using equations.

24 is a multiple of 8 and 6.

$$\frac{11 \times 3}{8 \times 3} = \frac{33}{24} \text{ and } \frac{5 \times 4}{6 \times 4} = \frac{20}{24}$$

$$\frac{33}{24} + \frac{20}{24} = \frac{53}{24}$$

$$\frac{53}{24} = \frac{24}{24} + \frac{24}{24} + \frac{5}{24} = 1 + 1 + \frac{5}{24} = 2\frac{5}{24}$$

Solution

The student found a common denominator before adding.

PAIR/SHARE

How would the solution method be different if you first wrote $\frac{11}{8}$ as $1\frac{3}{8}$?

APPLY IT

1 What is $\frac{3}{5} + \frac{13}{15}$? Show your work.

How can you use an estimate to check if your answer is reasonable?

Solution

PAIR/SHARE

Explain why you chose the type of model you did to solve this problem.

2 Michael rides his bike $2\frac{2}{3}$ miles on Saturday. He rides another $1\frac{5}{6}$ miles on Sunday. How many miles did Michael ride his bike on both days combined? Show your work.

How are the denominators 3 and 6 related?

PAIR/SHARE
How did you decide what common denominator to use to solve this problem?

Solution

3 Sasha needs $\frac{3}{4}$ cup of flour to make a batch of muffins and $1\frac{2}{3}$ cups of flour to make a loaf of bread. How many cups of flour does Sasha need to make both a batch of muffins and a loaf of bread?

Ⓐ $\frac{17}{12}$

Ⓑ $\frac{8}{7}$

Ⓒ $1\frac{5}{7}$

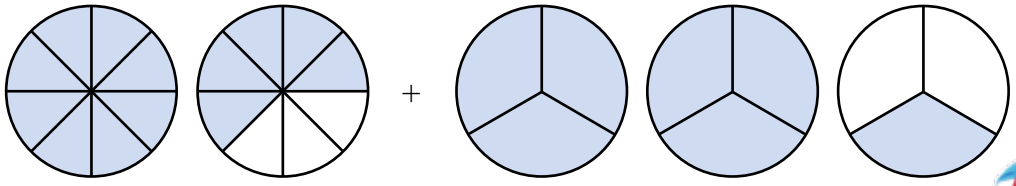
Ⓓ $2\frac{5}{12}$

Nicola chose Ⓐ as the correct answer. How did she get that answer?

How can you replace the given fractions with equivalent fractions that have like denominators?

PAIR/SHARE
What should be the denominator of the sum?

4 The model below represents the expression $1\frac{5}{8} + 2\frac{1}{3}$.



Which of the following could NOT be represented by the model?

Ⓐ $1 + 2 + \frac{6}{10}$

Ⓑ $1\frac{15}{24} + 2\frac{8}{24}$

Ⓒ $1 + 2 + \frac{23}{24}$

Ⓓ $\frac{39}{24} + \frac{56}{24}$

5 Sam has $5\frac{1}{2}$ yards of rope. He needs an additional $3\frac{5}{6}$ yards for a project. What is the total length of rope Sam needs for his project? Show your work.

Solution

6 Which two fractions below can be added using the denominator 18?

$\frac{1}{4}$	$\frac{5}{6}$	$\frac{7}{12}$	$\frac{1}{8}$	$\frac{4}{9}$

Solution

7 Lucy is making a smoothie by following the recipe below.

Recipe

Sunshine Smoothie

$1\frac{1}{3}$ cups banana

$\frac{1}{2}$ cup yogurt

1 cup strawberries

$\frac{3}{4}$ cup orange juice

Place ingredients in blender.

Blend until smooth.

Explain whether the recipe will make enough for Lucy and 3 friends to each have at least 1 cup of smoothie. If it does not make enough, explain how to change the recipe to make enough.

8 MATH JOURNAL

Lin says that $\frac{5}{7} + \frac{3}{2}$ is $\frac{31}{14}$. Carlos says the sum is $\frac{8}{9}$. Who is right? Explain your answer.

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

Explore Subtracting Fractions

Learning Target

- Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators.

SMP 1, 2, 3, 4, 5, 6, 7

In the previous lesson, you learned about adding fractions. Now you will learn about subtracting fractions. Use what you know to try to solve the problem below.

Paul has a $\frac{3}{4}$-inch long bolt. He buys a bolt that is $\frac{1}{8}$ inch longer and a bolt that is $\frac{1}{8}$ inch shorter than the $\frac{3}{4}$-inch bolt. What are the lengths of the two bolts he buys?

TRY IT

Math Toolkit

- fraction tiles
- fraction circles
- fraction bars
- fraction models
- grid paper
- number lines

DISCUSS IT

Ask your partner: Can you explain that again?

Tell your partner: I started by . . .

CONNECT IT

1 LOOK BACK

Explain how to find the lengths of the two bolts Paul buys.

2 LOOK AHEAD

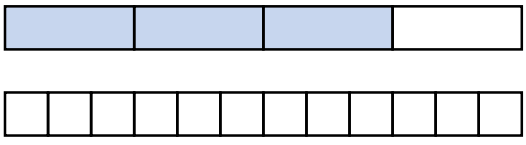
Just like with adding fractions, you must find a common denominator to subtract fractions with unlike denominators, such as $\frac{3}{4} - \frac{1}{3}$.

a. Write the first four multiples of each denominator. Then circle the common multiple to find a common denominator.

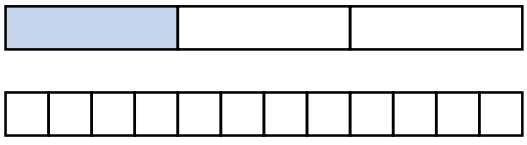
Multiples of 4: ....., ..., ..., ...

Multiples of 3: ....., ..., ..., ...

b. Complete the models and equations to show the equivalent fractions for $\frac{3}{4}$ and $\frac{1}{3}$ using the common multiple as the common denominator.



$\frac{3}{4} = \frac{\square}{12}$



$\frac{1}{3} = \frac{\square}{12}$

c. Use the equivalent fractions to subtract.

$\frac{3}{4} - \frac{1}{3} = \frac{\square}{12} - \frac{\square}{12} = \frac{\square}{12}$

3 REFLECT

How is subtracting fractions like adding fractions?

.....

.....

.....

Prepare for Subtracting 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.

In My Own Words	My Illustrations
equivalent fractions	
Examples	Non-Examples

2 Jackie says that the fraction $\frac{7}{8}$ is equivalent to $\frac{3}{4}$. Is she right? Explain.

3 Solve the problem. Show your work.

Solange has a nut that is $\frac{5}{8}$ inch wide. She buys a nut that is $\frac{1}{4}$ inch wider and a nut that is $\frac{1}{4}$ inch narrower than the $\frac{5}{8}$-inch nut. What are the widths of the two nuts she buys?

Solution

4 Check your answer. Show your work.

Develop Subtracting Fractions with Unlike Denominators

Read and try to solve the problem below.

Gavin has $\frac{2}{3}$ pint of water left in his water bottle.

He drinks $\frac{1}{2}$ pint. How much water is left in the bottle now?

TRY IT

Math Toolkit

- fraction tiles
- fraction circles
- fraction bars
- fraction models
- grid paper
- number lines

DISCUSS IT

Ask your partner: How did you get started?

Tell your partner: I am not sure how to find the answer because . . .

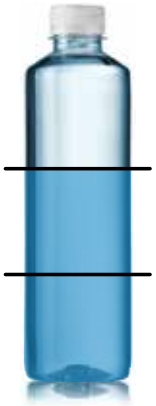
Explore different ways to understand subtracting fractions with unlike denominators.

Gavin has $\frac{2}{3}$ pint of water left in his water bottle. He drinks $\frac{1}{2}$ pint. How much water is left in the bottle now?

PICTURE IT

You can use a picture to model subtracting fractions.

The water bottle is marked to show that it has $\frac{2}{3}$ pint of water in it. Gavin drinks $\frac{1}{2}$ pint of water.

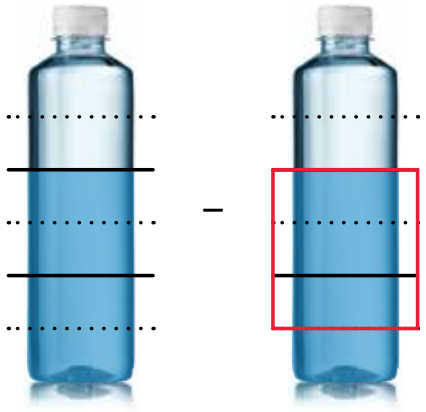


Use equivalent fractions to find a common denominator.

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

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

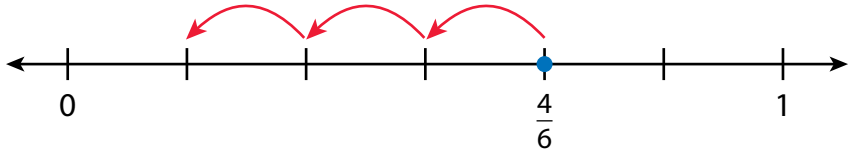
Now the water bottle is marked to show sixths. You can subtract $\frac{3}{6}$ from $\frac{4}{6}$.



MODEL IT

You can use a number line to model subtracting fractions.

The number line below is divided into sixths, the common denominator.



Start at $\frac{4}{6}$ and jump left $\frac{3}{6}$. ($\frac{3}{6}$ is three $\frac{1}{6}$ units on the number line.)

CONNECT IT

Now you will use the problem from the previous page to help you understand how to use equivalent fractions to subtract.

1 Look at **Picture It** and **Model It** from the previous page. Why is $\frac{2}{3}$ rewritten as $\frac{4}{6}$? Why is $\frac{1}{2}$ rewritten as $\frac{3}{6}$?

2 Why are sixths chosen as a common denominator?

3 Use sixths as a common denominator. Write an equation to show the difference of $\frac{2}{3}$ and $\frac{1}{2}$.

4 How much water is left in the bottle?

5 Could you have subtracted with a different common denominator? Provide an example.

6 Explain how to subtract two fractions with unlike denominators.

7 REFLECT

Look back at your **Try It**, strategies by classmates, and **Picture It** and **Model It**. Which models or strategies do you like best for subtracting fractions with unlike denominators? Explain.

APPLY IT

Use what you just learned to solve these problems.

8 What is $\frac{7}{8} - \frac{1}{6}$? Show your work.

Solution

9 Emily's shelf is $\frac{3}{4}$ foot wide. Her clock is $\frac{2}{3}$ foot wide.
How much wider is her shelf than her clock? Show your work.

Solution

10 What is the value of the expression $\frac{9}{10} - \frac{3}{5}$? Show your work.

Solution

Practice Subtracting Fractions with Unlike Denominators

Study the Example showing one way to subtract fractions with unlike denominators. Then solve problems 1–5.

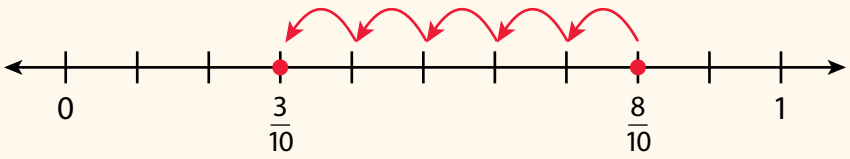
EXAMPLE

Felicia lives $\frac{4}{5}$ mile from school and $\frac{3}{10}$ mile from the soccer field. How much closer does she live to the soccer field than to school?

You can show $\frac{4}{5} - \frac{3}{10}$ using a number line. Use a common multiple to find the common denominator.

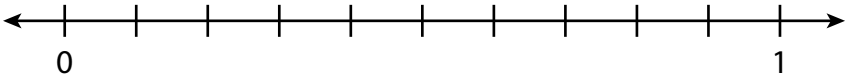
Rewrite the fractions as needed. $\frac{4}{5} = \frac{8}{10}$

Show the difference between the distance from school, $\frac{8}{10}$ mile, and the distance from the soccer field, $\frac{3}{10}$ mile, on a number line.



Felicia lives $\frac{5}{10}$, or $\frac{1}{2}$, mile closer to the soccer field than to school.

1 How could you count back on a number line to find the difference between $\frac{4}{5}$ and $\frac{5}{10}$? Show your work.



The difference is _____.

2 Eric added up on a number line to find $\frac{4}{5} - \frac{5}{10}$. Use equivalent fractions and an addition equation to show how Eric found the difference.

3 What is the difference between $\frac{5}{6}$ and $\frac{1}{4}$? Show your work.

$\frac{5}{6} - \frac{1}{4} =$ .....

4 Show how you can use the visual model to subtract $\frac{3}{4} - \frac{5}{8}$.

$\frac{3}{4} - \frac{5}{8} =$ .....

5 James sleeps $\frac{3}{8}$ of each day. He spends $\frac{1}{3}$ of each day at work. What fraction of his day is he not sleeping or working? Show your work.

Solution .....

Develop Subtracting with Mixed Numbers

Read and try to solve the problem below.

On Saturday, Chloe spent $3\frac{1}{4}$ hours at the park with her family. Then she spent $1\frac{2}{3}$ hours riding her bike. How much longer did Chloe spend at the park than riding her bike? Give your answer as a number of hours.

TRY IT

Math Toolkit

- fraction tiles
- fraction circles
- fraction bars
- fraction models
- grid paper
- number lines

DISCUSS IT

Ask your partner: Why did you choose that strategy?

Tell your partner: A model I used was . . . It helped me . . .

Explore different ways to understand subtracting with mixed numbers.

On Saturday, Chloe spent $3\frac{1}{4}$ hours at the park with her family. Then she spent $1\frac{2}{3}$ hours riding her bike. How much longer did Chloe spend at the park than riding her bike? Give your answer as a number of hours.

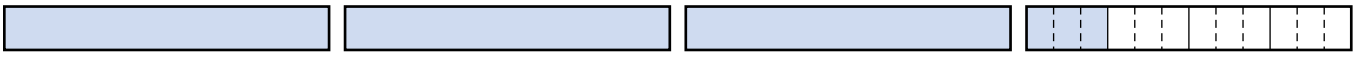
PICTURE IT

You can use fraction bars to picture subtracting with mixed numbers.

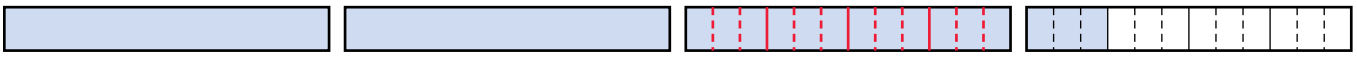
Chloe spent $3\frac{1}{4}$ hours at the park. To subtract $1\frac{2}{3}$ hours, find a common denominator.

Hours spent at the park: $3\frac{1}{4} = 3\frac{3}{12}$ Hours spent riding her bike: $1\frac{2}{3} = 1\frac{8}{12}$

Model $3\frac{3}{12}$.



You need **more twelfths** to subtract $1\frac{8}{12}$.



$3\frac{3}{12} = 2\frac{15}{12}$

MODEL IT

You can use equations to subtract mixed numbers.

You can regroup one whole and break apart the mixed numbers to find $3\frac{3}{12} - 1\frac{8}{12}$.

3 wholes and $\frac{3}{12}$ is the same as 2 wholes and $\frac{15}{12}$.

$2 - 1 = 1$ and $\frac{15}{12} - \frac{8}{12} = \frac{7}{12}$

CONNECT IT

Now you will use the problem from the previous page to help you understand how to subtract mixed numbers with regrouping.

1. Look at the first set of fraction bars in **Picture It**. Why is the last bar split into 12 pieces instead of 4 pieces?

2. Now look at the second set of fraction bars in **Picture It**. Explain why $3\frac{3}{12}$ is now shown as $2\frac{15}{12}$.

3. Look at **Model It**. How does the regrouping of $3\frac{3}{12}$ as $2\frac{15}{12}$ help you find how much longer Chloe spent at the park than riding her bike?

4. How much longer did Chloe spend at the park than riding her bike? _____ hour(s)

5. Show how you can use addition to check your answer.

6. Do you always need to regroup when you subtract mixed numbers with unlike denominators? Explain.

7 REFLECT

Look back at your **Try It**, strategies by classmates, and **Picture It** and **Model It**. Which models or strategies do you like best for subtracting mixed numbers? Explain.

APPLY IT

Use what you just learned to solve these problems.

8 What is $7\frac{3}{5} - \frac{9}{10}$? Show your work.

Solution

9 What is the difference between $2\frac{5}{8}$ and $1\frac{1}{4}$? Show your work.

Solution

10 Charlie is practicing the long jump. His first jump is a distance of $16\frac{5}{6}$ feet. His second jump is a distance of $18\frac{2}{3}$ feet. How much longer is Charlie's second jump?

Ⓐ $1\frac{1}{6}$ feet

Ⓑ $1\frac{5}{6}$ feet

Ⓒ $2\frac{1}{6}$ feet

Ⓓ $2\frac{5}{6}$ feet

Practice Subtracting with Mixed Numbers

Study the Example showing how to subtract mixed numbers. Then solve problems 1–5.

EXAMPLE

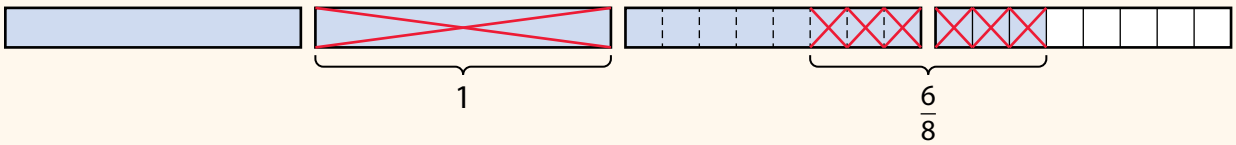
What is the difference between $3\frac{3}{8}$ and $1\frac{3}{4}$?

You can show $3\frac{3}{8} - 1\frac{3}{4}$ using fraction bars.

Rewrite the mixed numbers using common denominators. $3\frac{3}{8} - 1\frac{6}{8}$

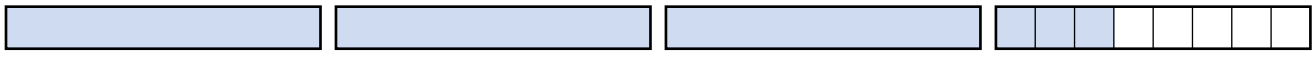
Model $3\frac{3}{8}$. Divide the last fraction bar into eighths.

Divide one more fraction bars into eighths so there are enough eighths to subtract.



Find the difference: $2\frac{11}{8} - 1\frac{6}{8} = 1\frac{5}{8}$.

1 Now use the fraction bars to find $3\frac{3}{8} - 1\frac{1}{4}$. Show your work.

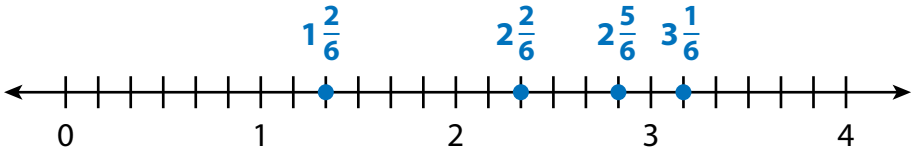


$3\frac{3}{8} - 1\frac{1}{4} =$ .....

2 What is $6\frac{5}{6} - 4\frac{1}{3}$? Show your work.

Solution .....

3 Sometimes it is helpful to rewrite mixed numbers in a form that includes a fraction greater than 1. Use the number line to write the missing numbers.



a. $1\frac{2}{6} = \frac{\square}{6}$

b. $2\frac{5}{6} = 1\frac{\square}{6}$

c. $2\frac{2}{6} = 1\frac{\square}{\square}$

d. $3\frac{1}{6} = \square\frac{\square}{\square}$

4 What is $3\frac{1}{3} - 1\frac{1}{2}$? Show your work.

Solution

5 Emil's backpack weighs $6\frac{3}{8}$ pounds. He removes a book that weighs $\frac{3}{4}$ pound. Then he removes a book that weighs $\frac{1}{2}$ pound. How much does Emil's backpack weigh now? Show your work.

Solution

Refine Subtracting Fractions

Study the Example below. Then solve problems 1–8.

EXAMPLE

The first chapter of Henry's book is $5\frac{2}{3}$ pages long. The second chapter is $8\frac{2}{5}$ pages long. How much longer is the second chapter than the first chapter?

Look at how you could show your work using equations.

$$5\frac{2}{3} = 5 + \left(\frac{2 \times 5}{3 \times 5}\right) = 5\frac{10}{15}$$

$$8\frac{2}{5} = 8 + \left(\frac{2 \times 3}{5 \times 3}\right) = 8\frac{6}{15} = \left(7 + \frac{15}{15}\right) + \frac{6}{15} = 7\frac{21}{15}$$

$$\begin{array}{r} 7\frac{21}{15} \\ -\,5\frac{10}{15} \\ \hline 2\frac{11}{15} \end{array}$$

Solution

After finding a common denominator, the student used a vertical format to subtract.

PAIR/SHARE

Explain why $8\frac{6}{15}$ is regrouped as $7\frac{21}{15}$.

APPLY IT

1 What is $5\frac{4}{5} - 1\frac{9}{10}$? Show your work.

Should you regroup $5\frac{4}{5}$ before you subtract?

PAIR/SHARE

Explain how your model shows regrouping.

Solution

2 What number do you add to $\frac{3}{4}$ to get $\frac{5}{6}$? Show your work.

What common multiple of 6 and 4 can you use as a common denominator?

PAIR/SHARE
Explain why you chose the model you did to solve this problem.

Solution

3 Cara's bathroom floor has an area of $3\frac{2}{3}$ square yards. She lays down a rug that has an area of $1\frac{1}{4}$ square yards. What area of her floor is NOT covered by the rug?

What equivalent mixed number could you subtract?

Ⓐ 2 square yard

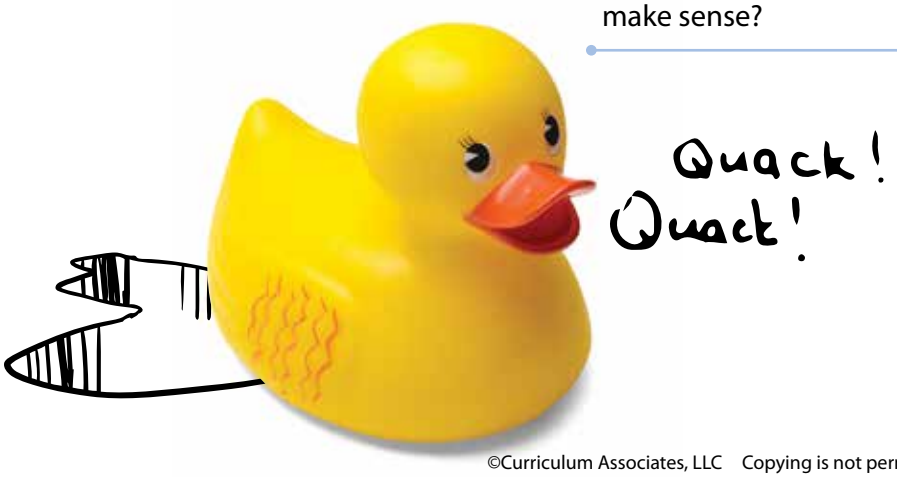
Ⓑ $2\frac{1}{12}$ square yards

Ⓒ $2\frac{5}{12}$ square yards

Ⓓ $2\frac{3}{7}$ square yards

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

PAIR/SHARE
Does a denominator of 7 make sense?



4 What is the value of the expression $\frac{3}{5} - \frac{1}{3}$?

Ⓐ $\frac{2}{2}$

Ⓑ $\frac{4}{15}$

Ⓒ $\frac{2}{5}$

Ⓓ $\frac{6}{15}$

5 Mackenzie's footprint is $\frac{7}{12}$ foot long. Her dad's footprint is $1\frac{1}{6}$ feet long. Can the equation be used to find how much longer Mackenzie's dad's footprint is than Mackenzie's?

	Yes	No
$1\frac{2}{12} - \frac{7}{12} = ?$	Ⓐ	Ⓑ
$\frac{7}{12} + 1\frac{1}{6} = ?$	Ⓒ	Ⓓ
$1\frac{1}{6} - \frac{2}{3} = ?$	Ⓔ	Ⓕ
$\frac{14}{12} - \frac{7}{12} = ?$	Ⓖ	Ⓗ

6 The sum of $4\frac{1}{2}$ and what number is $12\frac{5}{7}$? Show your work.

Solution

7 Carter has an older sister and a younger brother.

Part A Carter's sister is $17\frac{1}{3}$ years old. Carter is $2\frac{1}{2}$ years younger than his sister. What is Carter's age in years? Show your work.

Solution

Part B Carter's brother is $5\frac{3}{4}$ years younger than their sister. How much older is Carter than his brother? Show your work.

Solution

8 MATH JOURNAL

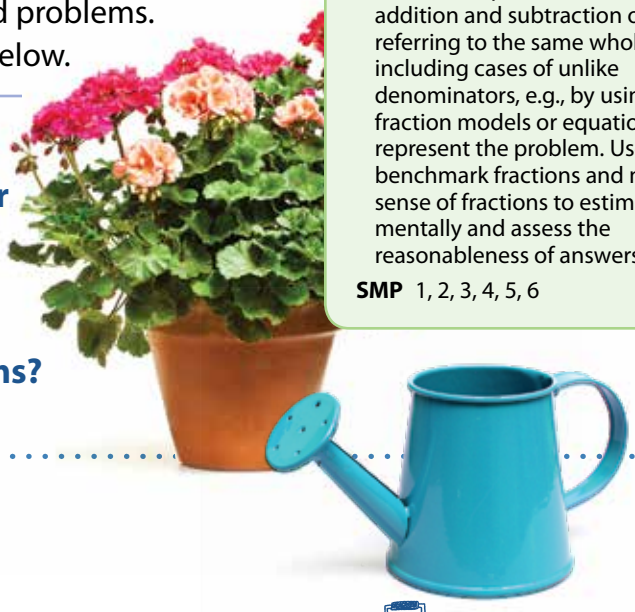
Find the difference between $1\frac{2}{5}$ and $\frac{9}{10}$. Explain how you solved the problem.

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

Explore Adding and Subtracting in Word Problems

Now that you can add and subtract fractions with different denominators, you can use this skill to solve word problems. Use what you know to try to solve the problem below.

Aleena has a 1-gallon watering can that is full of water. She uses $\frac{3}{8}$ gallon to water her roses and $\frac{1}{3}$ gallon to water her geraniums. How much water did Aleena use to water both the roses and geraniums?



Learning Target

- Solve word problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators, e.g., by using visual fraction models or equations to represent the problem. Use benchmark fractions and number sense of fractions to estimate mentally and assess the reasonableness of answers.

SMP 1, 2, 3, 4, 5, 6

TRY IT

Math Toolkit

- fraction tiles
- fraction circles
- fraction bars
- fraction models
- grid paper
- number lines

DISCUSS IT

Ask your partner: How did you get started?

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

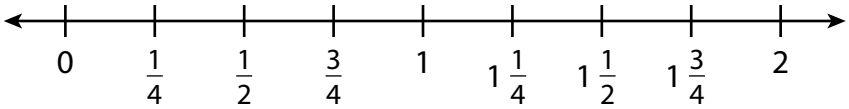
CONNECT IT

1 LOOK BACK

Explain how you found how much water Aleena used to water both the roses and the geraniums.

2 LOOK AHEAD

A benchmark fraction is a common fraction that you can easily compare to other fractions. The number line below shows the location of some benchmark fractions between 0 and 2. You can use these fractions to estimate sums and differences.



a. Between which two benchmark fractions is $\frac{3}{8}$? How do you know?

b. Between which two benchmark fractions is $\frac{1}{3}$? How do you know?

c. Use your answers from parts a and b above to find a low estimate for the sum $\frac{3}{8} + \frac{1}{3}$ and a high estimate for the sum $\frac{3}{8} + \frac{1}{3}$. Explain your reasoning.

3 REFLECT

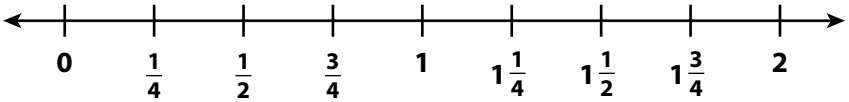
The actual sum of any two fractions will be somewhere between a low estimate and a high estimate for the sum. How does the actual sum you found in problem 1 compare to your low estimate and high estimate for the sum?

Prepare for Adding and Subtracting in Word Problems

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

In My Own Words	My Illustrations
benchmark fraction	
Examples	Non-Examples

2 Between which two benchmark fractions is $\frac{5}{8}$? How do you know?



3 Solve the problem. Show your work.

Hai has a 1-gallon jug of water. He drinks $\frac{1}{8}$ gallon of water before lunch and $\frac{2}{3}$ gallon of water after lunch. How much water did Hai drink all day?

Solution

4 Check your answer. Show your work.

Develop Estimating in Word Problems with Fractions

Read and try to solve the problem below.

Frankie purchases a $3\frac{1}{2}$-pound bag of chicken. He uses $1\frac{1}{3}$ pounds of chicken for fajitas. How many pounds of chicken does Frankie have left? Estimate and solve. Tell if your answer is reasonable.

TRY IT

Math Toolkit

- fraction tiles
- fraction circles
- fraction bars
- fraction models
- grid paper
- number lines

DISCUSS IT

Ask your partner: Do you agree with me? Why or why not?

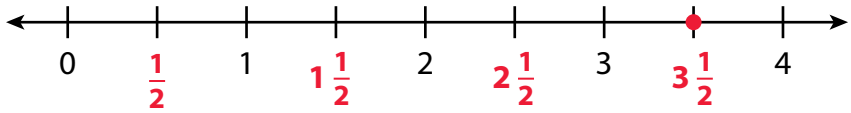
Tell your partner: I disagree with this part because . . .

Explore different ways to understand estimating with fractions.

Frankie purchases a $3\frac{1}{2}$-pound bag of chicken. He uses $1\frac{1}{3}$ pounds of chicken for fajitas. How many pounds of chicken does Frankie have left? Estimate and solve. Tell if your answer is reasonable.

MODEL IT

You can use a number line to find benchmark fractions to estimate.



$3\frac{1}{2}$ is already a benchmark fraction you can use to estimate.

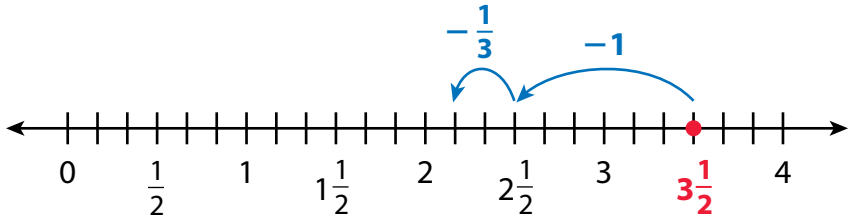
You can find a benchmark fraction close to $1\frac{1}{3}$ to help you estimate the difference.

MODEL IT

You can model the problem with a number line.

Since $2 \times 3 = 6$, the fractions in the problem, $3\frac{1}{2}$ and $1\frac{1}{3}$, can be rewritten using a common denominator of 6. $3\frac{1}{2} = 3\frac{3}{6}$, and $1\frac{1}{3} = 1\frac{2}{6}$.

The number line below is divided into sixths. It shows starting with a total of $3\frac{1}{2}$ pounds and then making two jumps to the left for the $1\frac{1}{3}$ pounds of chicken used.



You can rewrite $3\frac{1}{2} - 1\frac{1}{3}$ as $3\frac{3}{6} - 1\frac{2}{6}$.

CONNECT IT

Now you will use the problem from the previous page to help you understand how to use estimation with adding and subtracting fractions.

1 Look at the first **Model It**. Identify the closest half on each side of $1\frac{1}{3}$.

$1\frac{1}{3}$ is greater than _____ and less than _____.

Why are halves a good choice for benchmark fractions for $1\frac{1}{3}$?

2 Use one of the benchmark fractions for $1\frac{1}{3}$ that you found in problem 1 to estimate how many pounds of chicken Frankie has left. Write a subtraction equation to show your estimated difference.

3 Use the common denominator found in the second **Model It** to find the actual difference. How many pounds of chicken does Frankie have left?

4 Is the actual difference greater than or less than your estimate in problem 2? Why?

5 Explain how you can check if a fraction sum or difference is reasonable.

6 REFLECT

Look back at your **Try It**, strategies by classmates, and **Model Its**. Which models or strategies do you like best for estimating with fractions? Explain.

APPLY IT

Use what you just learned to solve these problems.

7 Tim's bean sprout grew $3\frac{3}{8}$ inches. Teegan's bean sprout grew $2\frac{3}{4}$ inches. How many more inches did Tim's bean sprout grow than Teegan's?

Estimate to tell if your solution is reasonable. Show your work.

Tim's bean sprout grew _____ more than Teegan's bean sprout.

8 Samantha likes to run at least 5 miles each day. She plans a new course: from home to the park is $1\frac{1}{3}$ miles, from the park to the library is $2\frac{2}{5}$ miles, and from the park to home is $\frac{2}{3}$ mile. Will Samantha run at least 5 miles on this new course?

Use only estimation to decide. Then explain if you are confident in your estimate or if you need to find an actual sum. Show your work.

Samantha _____ run at least 5 miles.

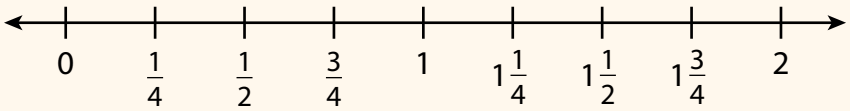
Practice Estimating in Word Problems with Fractions

Study the Example showing how to estimate a sum using benchmark fractions. Then solve problems 1–5.

EXAMPLE

David grew $1\frac{3}{4}$ inches last year and $1\frac{5}{8}$ inches this year. Estimate how much he grew in the two years.

You can estimate $1\frac{3}{4} + 1\frac{5}{8}$ using benchmark fractions. The number line below shows common fractions used as benchmark fractions to estimate sums and differences.



$1\frac{3}{4}$ is one of the benchmark fractions. $1\frac{5}{8}$ is a little greater than $1\frac{1}{2}$. Estimate using $1\frac{1}{2}$.

$1\frac{3}{4} + 1\frac{1}{2} = 1\frac{3}{4} + 1\frac{2}{4} = 2\frac{5}{4}$, or $3\frac{1}{4}$.

The sum is a little greater than $3\frac{1}{4}$, so David grew a little more than $3\frac{1}{4}$ inches.

1 Look at the Example. Shade the fraction bars below to show that $1\frac{5}{8}$ is a little greater than $1\frac{1}{2}$.

$1\frac{5}{8}$ ☐ ☐

$1\frac{1}{2}$ ☐ ☐

2 Find the actual sum $1\frac{3}{4} + 1\frac{5}{8}$ to determine how much David grew in two years. Use the estimate to explain how you know your answer is reasonable. Show your work.

Solution

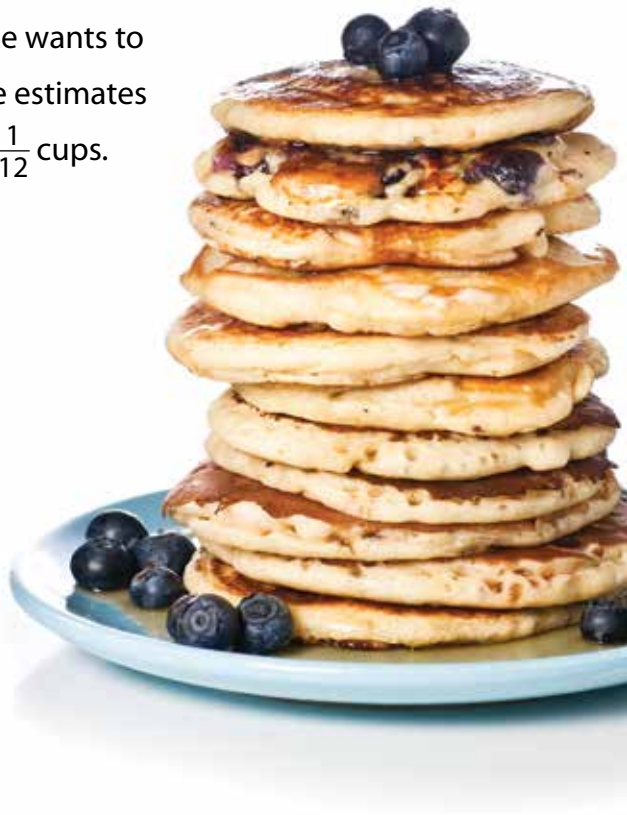
Irene makes $4\frac{2}{3}$ cups of pancake batter. She splits the batter into 2 bowls. She mixes blueberries into $2\frac{1}{4}$ cups of batter and walnuts into the rest of the batter.

3 Estimate how much of the batter has walnuts in it. Explain your estimate.

4 Find the actual amount of batter that has walnuts in it.
Explain how you know your answer is reasonable. Show your work.

Solution

5 Irene makes a second batch of $3\frac{1}{4}$ cups of pancake batter. She wants to know how much more batter she made in the first batch. She estimates that the difference between the sizes of the two batches is $2\frac{1}{12}$ cups. Explain why this estimate is *not* reasonable.



Develop Using Estimation with Decimals

Read and try to solve the problem below.

Scott is conducting a science experiment. He has 3.74 liters of Liquid A and 3.65 liters of Liquid B. He pours both liquids into a container.

How much liquid is in the container? Estimate and solve. Tell if your answer is reasonable.

TRY IT

Math Toolkit

- base-ten blocks
- base-ten grid paper
- decimal grids
- number lines
- thousandths decimal place-value charts

DISCUSS IT

Ask your partner: Can you explain that again?

Tell your partner: I agree with you about . . . because . . .

Explore different ways to understand estimating with decimals.

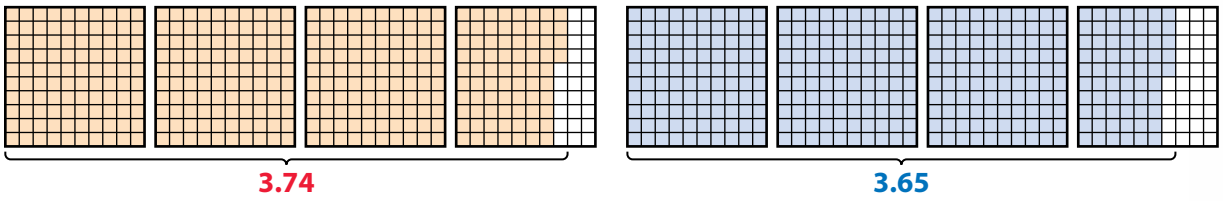
Scott is conducting a science experiment. He has 3.74 liters of Liquid A and 3.65 liters of Liquid B. He pours both liquids into a container.

How much liquid is in the container? Estimate and solve. Tell if your answer is reasonable.

PICTURE IT

You can picture an estimate of the problem using decimal grids.

Both 3.74 liters and 3.65 liters are about 4 liters.



An estimate of the sum is 4 + 4.

The actual sum can be found by finding 3.74 + 3.65.

MODEL IT

You can use a number line to help estimate.

3.74 and 3.65 are both between 3.5 and 4.

An estimate of the sum is 3.5 + 3.5.

The actual sum can be found by finding 3.74 + 3.65.

CONNECT IT

Now you will use the problem from the previous page to help you understand how to estimate with decimals.

1. Look at **Picture It**. Why is 4 a good number to use for each addend in an estimated sum?

2. Is the actual sum of the measures of Liquids A and B in **Picture It** less than or greater than the estimated sum? Why?

3. Look at **Model It**. Why is 3.5 a good number to use for each addend in an estimated sum?

4. Is the actual sum of the measures of Liquids A and B in **Model It** less than or greater than the estimated sum? Why?

5. Explain how you can check if a decimal sum or difference is reasonable.

6 REFLECT

Look back at your **Try It**, strategies by classmates, and **Picture It** and **Model It**. Which models or strategies do you like best for estimating with decimals? Explain.

APPLY IT

Use what you just learned to solve these problems.

7 Sean has 12.6 meters of garden netting. He needs 15.85 meters to enclose his garden. How many more meters of netting does Sean need to buy? Estimate to tell if your solution is reasonable. Show your work.

Sean needs _____ meters more of garden netting.

8 Erika wants at least 6 kilograms of apples for a recipe. She picks a 2.56-kilogram bag of red apples, a 1.18-kilogram bag of green apples, and a 2.79-kilogram bag of yellow apples. Does Erika need to pick more apples?

Use estimation only to decide. Then explain if you are confident in your estimate or if you need to find an actual sum. Show your work.

Erika _____ to pick more apples.

9 Vinh is having lunch at a café. He has $15 in his pocket and has already ordered a sandwich for $8.57 and a drink for $2.34. Vinh also wants to buy a side salad for $5.25. Does he have enough money? Estimate or find an exact answer to solve. Show your work.

Vinh _____ enough money.

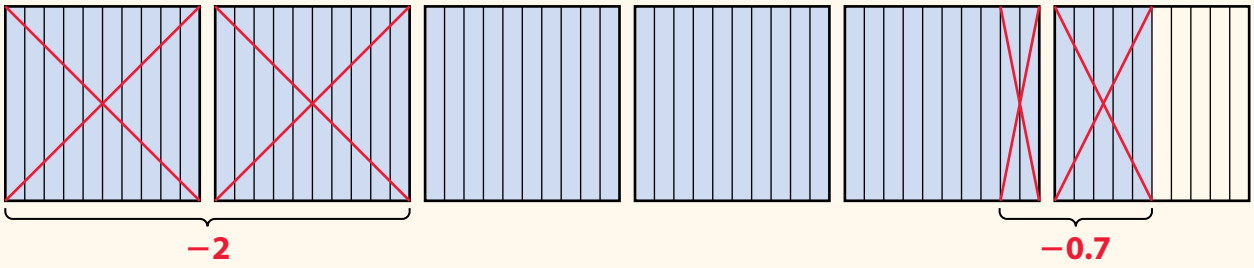
Practice Using Estimation with Decimals

Study the Example showing how to estimate a difference using decimal grids. Then solve problems 1–4.

EXAMPLE

Kamala has 2.73 liters of lemonade. She wants to have about 5.5 liters for her party. About how much more lemonade does Kamala need?

One way to estimate is to round to the nearest tenth.
5.5 is given to the nearest tenth. **2.73** is about **2.7**.



Kamala needs about 2.8 liters more of lemonade.

1 Look at the Example. Does this situation require an exact answer, or is the estimate enough? Explain.

2 Suppose Kamala wants to have exactly 5.5 liters of lemonade for her party. How much more lemonade does she need? Show your work.

Kamala needs ..... liters more of lemonade.

3 Ryan and Sarah are looking at cell phone plans. They could share a group plan that costs $119.95 per month, or they could each pay for an individual plan that costs $62.77 per month.

a. Estimate which choice would cost less for Ryan and Sarah. Explain why.

b. How much money could they save per month by paying for the choice that costs less instead of the choice that costs more? Show your work.

Ryan and Sarah can save _____ by choosing a(n) _____ plan.

4 Chris wants to make at least 4.5 pounds, but no more than 5 pounds, of berry salad. He finds a carton of raspberries that weighs 1.83 pounds, a carton of blueberries that weighs 1.5 pounds, a carton of blackberries that weighs 1.72 pounds, and a carton of strawberries that weighs 1.29 pounds. If Chris wants to use three different types of berries, what is one combination of cartons he could buy? Explain. Show your work.

Solution

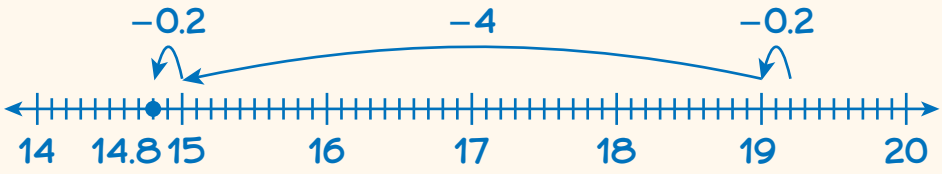
Refine Adding and Subtracting in Word Problems

Complete the Example below. Then solve problems 1–7.

EXAMPLE

Steven buys a movie ticket for $14.75 and then buys some snacks for the movie. He spends a total of $19.23. About how much did Steven spend on snacks?

Look at how you could show your work using a number line.



Solution

The student rounded to the nearest tenth to estimate the answer.

PAIR/SHARE
How do you know if the amount spent on snacks will be more or less than $4?

APPLY IT

1 Parker mixes $3\frac{1}{2}$ ounces of blue paint with $1\frac{2}{5}$ ounces of yellow paint to make green paint for the leaves of a tree. How many ounces of green paint did Parker make?

Estimate and then compute. Explain how you know your result is reasonable. Show your work.

Will there be a little more than $4\frac{1}{2}$ ounces or a little less than $4\frac{1}{2}$ ounces of green paint?

Solution

PAIR/SHARE
Was your estimate more than or less than the actual answer? By how much?

2 Jaime's football has a mass of 0.435 kilograms. His football helmet has a mass of 2.57 kilograms. Estimate how much more the mass of the helmet is than the mass of the football. Explain your estimate. Show your work.

I could think about rounding to the nearest half or whole kilogram, instead of to the nearest tenth or hundredth.

PAIR/SHARE
How does the exact difference compare to your estimate?

Solution

3 Which is a reasonable estimate for the difference $5\frac{1}{2} - 3\frac{5}{9}$?

Ⓐ between $\frac{1}{2}$ and 1

Ⓑ between 1 and $1\frac{1}{2}$

Ⓒ between $1\frac{1}{2}$ and 2

Ⓓ between 2 and $2\frac{1}{2}$

How can you use benchmark fractions to estimate the difference?

Elise chose Ⓓ as the correct answer. How did she get that answer?

PAIR/SHARE
Does Elise's answer make sense?

4 William compares monthly rainfall amounts for the summer months using the table below.

Month	Monthly Rainfall
June	$3\frac{3}{16}$ inches
July	$3\frac{3}{4}$ inches
August	$3\frac{1}{2}$ inches

Which estimate is closest to the actual difference between the rainfall amounts for June and July?

Ⓐ $\frac{1}{4}$ inch

Ⓑ $\frac{1}{2}$ inch

Ⓒ 1 inch

Ⓓ $1\frac{1}{2}$ inches

5 Carter is at the school store. He wants to buy a pack of notebooks that costs $4.79, a calculator that costs $33.54, and a tablet case that costs $12.67. About how much money does Carter plan to spend at the school store? Will the actual cost be more or less than your estimate? Explain. Show your work.

Solution

6 A certain liquid boils at 175.62°F. The liquid is currently at 68.8°F. Jimmy says that the temperature needs to rise by about 125°F to boil.

Part A Without finding the actual difference, explain why Jimmy's estimate is or is not reasonable.

Part B Find the actual amount the temperature must rise for the liquid to boil. Show your work.

Solution

7 MATH JOURNAL

Ramona has $4\frac{1}{5}$ gallons of red paint. She knows she needs at least $12\frac{3}{4}$ gallons to paint her whole house. Use benchmark fractions to explain about how much more paint Ramona needs.

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