UNIT 5

Operations with Fractions

Many newspapers and magazines sell advertising space. Why would a company pay for an advertisement?

Selling advertising space is a good way to raise funds. Students at Anishwabe School plan to sell advertising space in their yearbook.

How can fractions be used in advertising space?

What You'll Learn

- Add and subtract fractions using models, pictures, and symbols.
- Add and subtract mixed numbers.
- Solve problems involving the addition and subtraction of fractions and mixed numbers.

Why It's Important

- You use fractions when you read gauges, shop, measure, and work with percents and decimals, and in sports, recipes, and business.

Key Words

- fraction strips
- simplest form
- related denominators
- unrelated denominators
- common denominator
- unit fraction

5.1 Using Models to Add Fractions

Focus Use Pattern Blocks and fraction circles to add fractions.

Let the yellow hexagon represent 1:

Then the red trapezoid represents $\frac{1}{2}$:

the blue rhombus represents $\frac{1}{3}$:

and the green triangle represents $\frac{1}{6}$:

Explore

Use Pattern Blocks.

Bakana trains for cross-country one hour a day. Here is her schedule:
Run for $\frac{1}{3}$ of the time, walk for $\frac{1}{6}$ of the time,
then run for the rest of the time.
How long does Bakana run altogether?
What fraction of the hour is this?

- Use fractions to write an addition equation to show how Bakana spent her hour.
- Bakana never runs for the whole hour.
  Write another possible schedule for Bakana.
  Write an addition equation for the schedule.
- Trade schedules with another pair of classmates.
  Write an addition equation for your classmates' schedule.

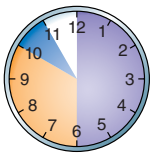
Reflect & Share

For the same schedule, compare equations with another pair of classmates.
Were the equations the same? How can you tell?
When are Pattern Blocks a good model for adding fractions?
When are Pattern Blocks not a good model?

Connect

There are many models that help us add fractions.

- We could use clocks to model halves, thirds, fourths, sixths, and twelfths.



$\frac{1}{2} + \frac{1}{3} + \frac{1}{12} = \frac{11}{12}$

Circle models are useful when the fractions are less than 1.

- The example below uses fraction circles to add fractions.

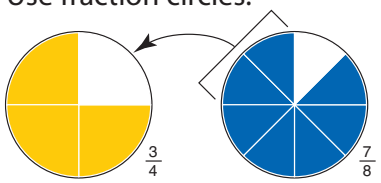
Example

Zack and Ronny each bought a small pizza.
Zack ate $\frac{3}{4}$ of his pizza and Ronny ate $\frac{7}{8}$ of his.
How much pizza did Zack and Ronny eat together?

A Solution

Add: $\frac{3}{4} + \frac{7}{8}$

Use fraction circles.



Use eighths to fill the circle for $\frac{3}{4}$.
Two-eighths fill the circle.

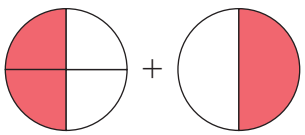
1 whole and 5 eighths equals $1\frac{5}{8}$.
So, $\frac{3}{4} + \frac{7}{8} = 1\frac{5}{8}$

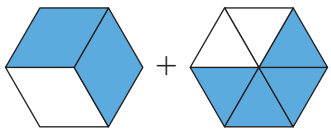
Together, Zack and Ronny ate $1\frac{5}{8}$ pizzas.

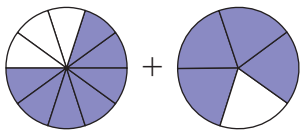
Practice

Use Pattern Blocks or fraction circles.

1. Model each picture. Then, find each sum.

a) 

b) 

c) 

2. Use a model to show each sum. Sketch the model.
Write an addition equation for each picture.

a) $\frac{7}{8} + \frac{1}{2}$ **b)** $\frac{3}{10} + \frac{2}{5}$ **c)** $\frac{2}{3} + \frac{1}{2}$ **d)** $\frac{2}{3} + \frac{5}{6}$

e) $\frac{3}{6} + \frac{1}{12}$ **f)** $\frac{1}{4} + \frac{2}{8}$ **g)** $\frac{1}{3} + \frac{1}{2}$ **h)** $\frac{1}{2} + \frac{4}{10}$

3. Simon spends $\frac{1}{6}$ h practising the whistle flute each day.
He also spends $\frac{1}{3}$ h practising the drums.
How much time does Simon spend each day practising these instruments?
Show how you found your solution.

4. **a)** Add.

i) $\frac{1}{5} + \frac{1}{5}$ **ii)** $\frac{2}{3} + \frac{1}{3}$ **iii)** $\frac{4}{10} + \frac{3}{10}$ **iv)** $\frac{1}{6} + \frac{3}{6}$

b) Look at your work in part a. How did you find your solutions?
How else could you add fractions with like denominators?

5. Is each sum greater than 1 or less than 1? How can you tell?

a) $\frac{1}{4} + \frac{2}{4}$ **b)** $\frac{2}{5} + \frac{7}{5}$ **c)** $\frac{3}{4} + \frac{1}{4}$ **d)** $\frac{1}{10} + \frac{3}{10}$

6. **Assessment Focus** Bella added 2 fractions. Their sum was $\frac{5}{6}$.
Which 2 fractions might Bella have added?
Find as many pairs of fractions as you can.
Show your work.

7. Asani's family had bannock with their dinner.
The bannock was cut into 8 equal pieces.
Asani ate 1 piece, her brother ate 2 pieces,
and her mother ate 3 pieces.

a) What fraction of the bannock did Asani eat?
Her brother? Her mother?

b) What fraction of the bannock was eaten?
What fraction was left?

Reflect

Which fractions can you add using Pattern Blocks? Fraction circles?
Give an example of fractions for which you cannot
use these models to add.

5.2 Using Other Models to Add Fractions

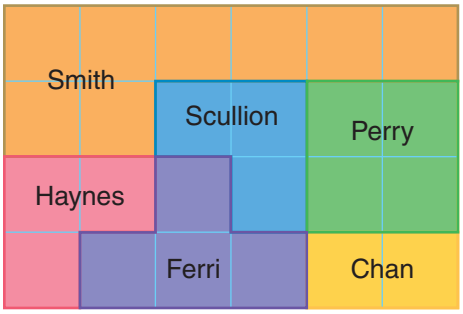
Focus Use fraction strips and number lines to add fractions.

We can use an area model to show fractions of one whole.

Explore

Your teacher will give you a copy of the map.
The map shows a section of land owned by 6 people.

- What fraction of land did each person own?
  What strategies did you use to find out?



Three people sold land to the other 3 people.

- Use the clues below to draw the new map.
- Write addition equations, such as $\frac{1}{2} + \frac{1}{4} = \frac{3}{4}$, to keep track of the land sales.

1. When all the sales were finished, four people owned all the land — Smith, Perry, Chan, and Haynes.
2. Smith now owns $\frac{1}{2}$ of the land.
3. Perry kept $\frac{1}{2}$ of her land, and sold the other half.
4. Chan bought land from two other people. He now owns $\frac{1}{4}$ of the land.
5. Haynes now owns the same amount of land as Perry started with.

Reflect & Share

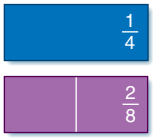
Did you find any equivalent fractions? How do you know they are equivalent?
Which clues helped you most to draw the new map? Explain how they helped.

Connect

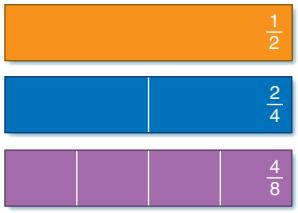
You can model fractions with strips of paper called **fraction strips**.

Here are more fraction strips and some equivalent fractions they show.

Recall that equivalent fractions show the same amount.



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



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

This strip represents 1 whole.

To add $\frac{1}{4} + \frac{1}{2}$, align the strips for $\frac{1}{4}$ and $\frac{1}{2}$.

Find a single strip that has the same length as the two strips.

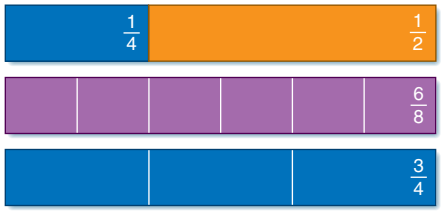
There are 2 single strips: $\frac{6}{8}$ and $\frac{3}{4}$

So, $\frac{1}{4} + \frac{1}{2} = \frac{6}{8}$

And, $\frac{1}{4} + \frac{1}{2} = \frac{3}{4}$

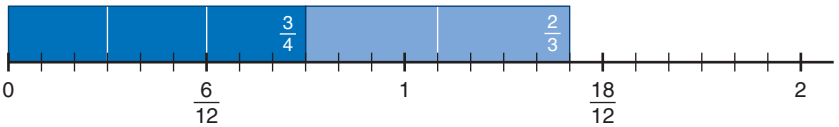
$\frac{3}{4}$ and $\frac{6}{8}$ are equivalent fractions.

The fraction $\frac{3}{4}$ is in simplest form.



A fraction is in **simplest form** when the numerator and denominator have no common factors other than 1.

When the sum is greater than 1, we could use fraction strips and a number line.



$\frac{3}{4} + \frac{2}{3} = \frac{17}{12}$

Example

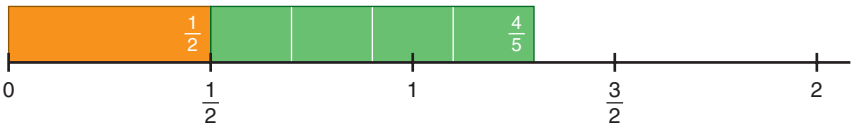
Add. $\frac{1}{2} + \frac{4}{5}$

A Solution

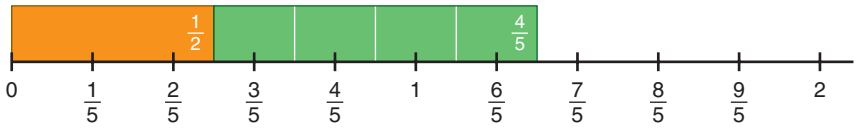
$\frac{1}{2} + \frac{4}{5}$

Place both strips end-to-end on the halves line.

The right end of the $\frac{4}{5}$-strip does not line up with a fraction on the halves line.

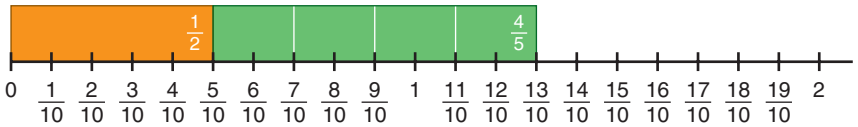


Place both strips on the fifths line.



The right end of the $\frac{4}{5}$-strip does not line up with a fraction on the fifths line.
Find a line on which to place both strips so the end of the $\frac{4}{5}$-strip lines up with a fraction.

Another Strategy
We could add these fractions using fraction circles.



The end of the $\frac{4}{5}$-strip lines up with a fraction on the tenths line.
The strips end at $\frac{13}{10}$. So, $\frac{1}{2} + \frac{4}{5} = \frac{13}{10}$

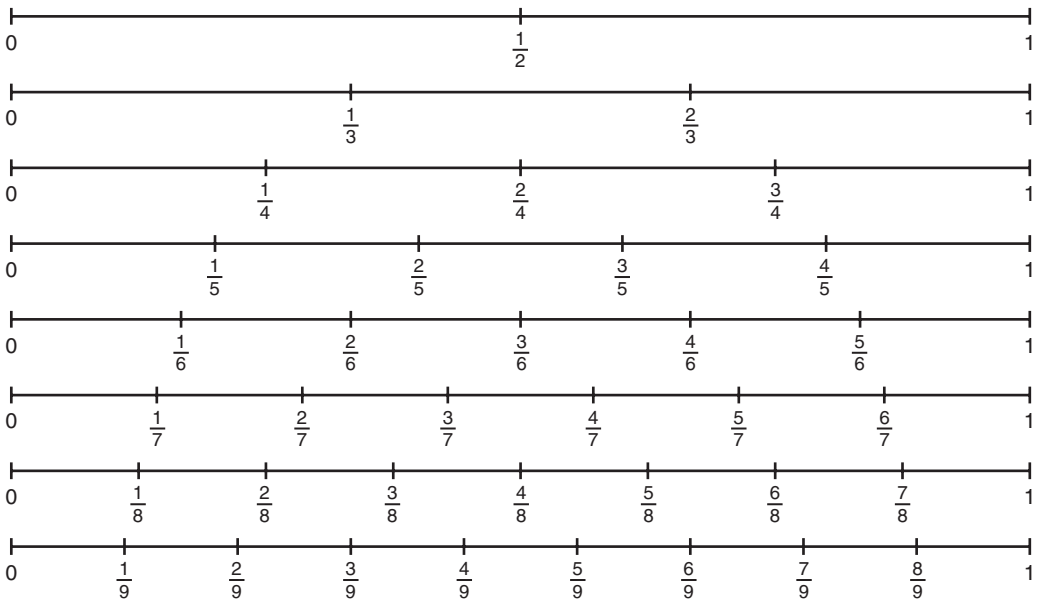
Practice

Use fraction strips and number lines.

1. Use the number lines below. List all fractions equivalent to:

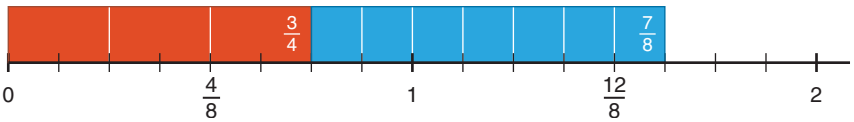
a) $\frac{1}{2}$ **b)** $\frac{1}{4}$ **c)** $\frac{2}{3}$

Use a ruler to align the fractions if it helps.



2. Write an addition equation for each picture.

a)



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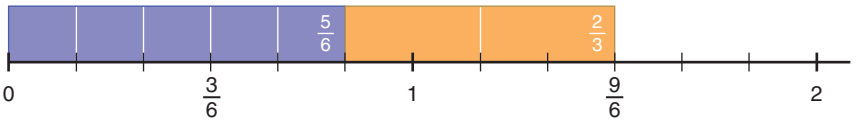

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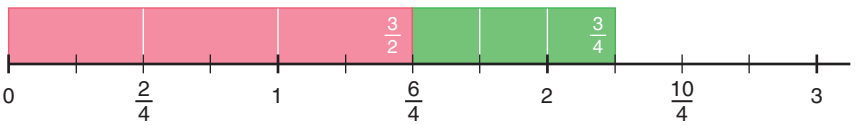


3. Use your answers to question 2.

a) Look at the denominators in each part, and the number line you used to get the answer. What patterns do you see?

b) The denominators in each part of question 2 are **related denominators**. Why do you think they have this name?

4. Add.

a) $\frac{1}{3} + \frac{5}{6}$ **b)** $\frac{7}{12} + \frac{1}{3}$ **c)** $\frac{3}{5} + \frac{1}{10}$ **d)** $\frac{1}{6} + \frac{1}{12}$

5. Add.

a) $\frac{1}{3} + \frac{1}{2}$ **b)** $\frac{3}{4} + \frac{5}{6}$ **c)** $\frac{3}{5} + \frac{1}{2}$ **d)** $\frac{2}{3} + \frac{1}{5}$

6. Look at your answers to question 5.

a) Look at the denominators in each part, and the number line you used to get the answer. What patterns do you see?

b) The denominators in each part of question 5 are called **unrelated denominators**. Why do you think they have this name?

c) When you add 2 fractions with unrelated denominators, how do you decide which number line to use?

7. Add.

a) $\frac{1}{3} + \frac{2}{7}$ **b)** $\frac{3}{4} + \frac{2}{9}$ **c)** $\frac{4}{5} + \frac{5}{8}$ **d)** $\frac{2}{5} + \frac{3}{7}$

8. Abey and Anoki are eating chocolate bars.

The bars are the same size.

Abey has $\frac{3}{4}$ left. Anoki has $\frac{5}{6}$ left.

How much chocolate is left altogether? Show your work.

9. **Assessment Focus** Use any of the digits 1, 2, 3, 4, 5, 6 only once. Copy and complete. Replace each ☐ with a digit.

$$\frac{\square}{\square} + \frac{\square}{\square}$$

a) Find as many sums as you can that are between 1 and 2.
b) Find the least sum that is greater than 1.
Show your work.

10. Find 2 fractions with a sum of $\frac{3}{2}$. Try to do this as many ways as you can. Record each way you find.

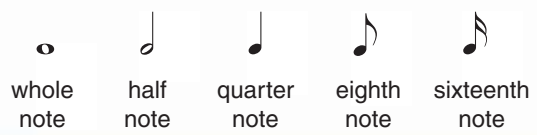
11. **Take It Further** A jug holds 2 cups of liquid. A recipe for punch is $\frac{1}{2}$ cup of orange juice, $\frac{1}{4}$ cup of raspberry juice, $\frac{3}{8}$ cup of grapefruit juice, and $\frac{5}{8}$ cup of lemonade. Is the jug big enough for the punch? Explain how you know.

12. **Take It Further** A pitcher of juice is half empty. After $\frac{1}{2}$ cup of juice is added, the pitcher is $\frac{3}{4}$ full. How much juice does the pitcher hold when it is full? Show your thinking.

Math Link

Music

Musical notes are named for fractions. The type of note shows a musician how long to play the note. In math, two halves make a whole — in music, two half notes make a whole note!



whole note | half note | quarter note | eighth note | sixteenth note

Reflect

What do you now know about adding fractions that you did not know at the beginning of the lesson?

5.3 Using Symbols to Add Fractions

Focus Use common denominators to add fractions.

In Lessons 5.1 and 5.2, you used models to add fractions.
You may not always have suitable models.

You need a strategy you can use to add fractions without using a model.

Explore

Copy these diagrams.

$\frac{\square}{\square} + \frac{\square}{\square} =$ greatest sum

$\frac{\square}{\square} + \frac{\square}{\square} =$ least sum

Use the digits 1, 2, 4, and 8 to make
the greatest sum and the least sum.
In each case, use each digit once.

Reflect & Share

Share your results with another pair of classmates.
Did you have the same answers?
If not, which is the greatest sum? The least sum?
What strategies did you use to add?

Connect

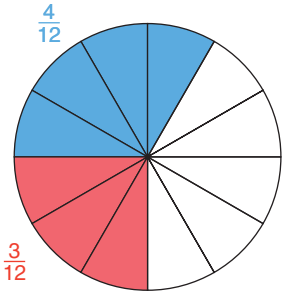
We can use equivalent fractions to add $\frac{1}{4} + \frac{1}{3}$.
Use equivalent fractions that have like denominators.
12 is a multiple of 3 and 4.
12 is a **common denominator**.

$\frac{1}{4} = \frac{3}{12}$ and $\frac{1}{3} = \frac{4}{12}$

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

$= \frac{7}{12}$

Both fractions are written with like denominators.



Look at the pattern in the equivalent fractions below.

$\frac{1}{4} \xrightarrow{\times 3} \frac{3}{12}$ $\quad$ $\frac{1}{3} \xrightarrow{\times 4} \frac{4}{12}$

So, to get an equivalent fraction, multiply the numerator and denominator by the same number.

We may also get equivalent fractions by dividing.

For example, $\frac{8}{10}$ can be written: $\frac{8 \div 2}{10 \div 2} = \frac{4}{5}$

$\frac{8}{10}$ and $\frac{4}{5}$ are equivalent fractions.

$\frac{4}{5}$ is in simplest form.

Example

Add: $\frac{4}{9} + \frac{5}{6}$

Estimate to check the sum is reasonable.

A Solution

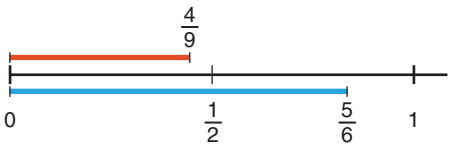
$\frac{4}{9} + \frac{5}{6}$

Estimate first.

$\frac{4}{9}$ is about $\frac{1}{2}$.

$\frac{5}{6}$ is close to 1.

So, $\frac{4}{9} + \frac{5}{6}$ is about $1\frac{1}{2}$.



Use equivalent fractions to write the fractions with a common denominator.

List the multiples of 9: 9, **18**, 27, *36*, 45, …

List the multiples of 6: 6, 12, **18**, 24, 30, *36*, 42, …

18 is a multiple of 9 and 6, so 18 is a common denominator.

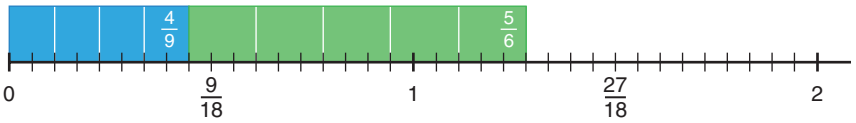
36 is also in both lists. So, 36 is another possible common denominator.

$\frac{4}{9} \xrightarrow{\times 2} \frac{8}{18}$ $\quad$ $\frac{5}{6} \xrightarrow{\times 3} \frac{15}{18}$

$\frac{4}{9} + \frac{5}{6} = \frac{8}{18} + \frac{15}{18}$ Add the numerators.

$= \frac{23}{18}$

We could have found this sum with fraction strips on a number line.



Since 23 > 18, this is an improper fraction.

To write the fraction as a mixed number:

$$\frac{23}{18} = \frac{18}{18} + \frac{5}{18}$$
$$= 1 + \frac{5}{18}$$
$$= 1\frac{5}{18} \quad \text{This is a mixed number.}$$

The estimate was $1\frac{1}{2}$, so the answer is reasonable.

Recall that an improper fraction is a fraction with the numerator greater than the denominator.

Practice

Write all sums in simplest form.

Write improper fractions as mixed numbers.

1. Find a common denominator for each pair of fractions.

a) $\frac{1}{2}$ and $\frac{5}{8}$ b) $\frac{1}{8}$ and $\frac{2}{3}$ c) $\frac{2}{3}$ and $\frac{1}{9}$ d) $\frac{3}{5}$ and $\frac{2}{3}$

2. Copy and complete. Replace each $\square$ with a digit to make each equation true.

a) $\frac{3}{12} = \frac{\square}{4}$ b) $\frac{3}{4} = \frac{6}{\square}$ c) $\frac{3}{6} = \frac{\square}{4}$ d) $\frac{6}{8} = \frac{15}{\square}$

3. Add. Sketch a number line to model each sum.

a) $\frac{4}{9} + \frac{1}{3}$ b) $\frac{1}{2} + \frac{1}{3}$ c) $\frac{3}{8} + \frac{3}{2}$ d) $\frac{3}{4} + \frac{1}{6}$

4. Estimate, then add.

a) $\frac{3}{5} + \frac{4}{8}$ b) $\frac{1}{6} + \frac{5}{8}$ c) $\frac{5}{6} + \frac{7}{9}$

d) $\frac{3}{4} + \frac{4}{7}$ e) $\frac{1}{3} + \frac{2}{5}$ f) $\frac{1}{5} + \frac{5}{6}$

5. One page of a magazine had 2 advertisements.
One was $\frac{1}{8}$ of the page, the other $\frac{1}{16}$.
What fraction of the page was covered?
Show your work.

6. Which sum is greater? Show your thinking.

$\frac{2}{3} + \frac{5}{6}$ or $\frac{3}{4} + \frac{4}{5}$

7. **Assessment Focus** Three people shared a pie.

Which statement is true? Can both statements be true?

Use pictures to show your thinking.

a) Edna ate $\frac{1}{10}$, Farrah ate $\frac{3}{5}$, and Ferris ate $\frac{1}{2}$.

b) Edna ate $\frac{3}{10}$, Farrah ate $\frac{1}{5}$, and Ferris ate $\frac{1}{2}$.

8. Damara and Baldwin had to shovel snow to clear their driveway.

Damara shovelled about $\frac{3}{10}$ of the driveway.

Baldwin shovelled about $\frac{2}{3}$ of the driveway.

What fraction of the driveway was cleared of snow?

9. Each fraction below is written as the sum of two unit fractions.

Which sums are correct? Why do you think so?

a) $\frac{7}{10} = \frac{1}{5} + \frac{1}{2}$ **b)** $\frac{5}{12} = \frac{1}{3} + \frac{1}{4}$ **c)** $\frac{5}{6} = \frac{1}{3} + \frac{1}{3}$

d) $\frac{7}{12} = \frac{1}{2} + \frac{1}{6}$ **e)** $\frac{11}{18} = \frac{1}{2} + \frac{1}{9}$ **f)** $\frac{2}{15} = \frac{1}{10} + \frac{1}{30}$

A fraction with numerator 1 is a unit fraction.

10. **Take It Further** Add.

a) $\frac{3}{8} + \frac{1}{2} + \frac{3}{4}$ **b)** $\frac{1}{4} + \frac{3}{2} + \frac{2}{5}$ **c)** $\frac{2}{3} + \frac{5}{6} + \frac{4}{9}$

Reflect

Suppose your friend has forgotten how to add two fractions with unlike denominators.

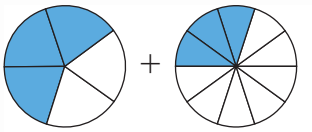
What would you do to help?

Mid-Unit Review

LESSON

Write all sums in simplest form. Write improper fractions as mixed numbers.

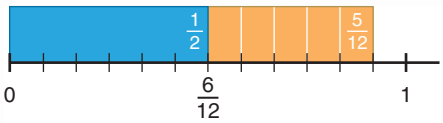
5.1 **1.** Use fraction circles. Model this picture, then find the sum.



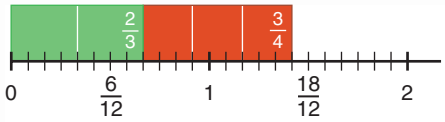
2. On Saturday, Howie hiked for $\frac{5}{12}$ h in the morning and $\frac{3}{6}$ h in the afternoon. What fraction of an hour did Howie spend hiking?

5.2 **3.** Write an addition equation for each picture.

a)



b)



4. Add. Sketch fraction strips and a number line to model each addition.

a) $\frac{2}{8} + \frac{3}{8}$ b) $\frac{2}{3} + \frac{1}{6}$

c) $\frac{3}{4} + \frac{2}{6}$ d) $\frac{1}{2} + \frac{2}{5}$

5. Find 3 different ways to add $\frac{2}{3} + \frac{5}{6}$. Draw pictures to help you explain each way.

5.3 **6.** Add. Estimate to check the sum is reasonable.

a) $\frac{4}{8} + \frac{5}{8}$ b) $\frac{1}{3} + \frac{3}{5}$

c) $\frac{1}{4} + \frac{1}{8}$ d) $\frac{5}{6} + \frac{7}{12}$

7. Takoda and Wesley are collecting shells on the beach in identical pails. Takoda estimates she has filled $\frac{7}{12}$ of her pail. Wesley estimates he has filled $\frac{4}{10}$ of his pail. Suppose the children combine their shells. Will one pail be full? Explain.

8. Each guest at Tai's birthday party brought one gift.
The circle graph shows the gifts Tai received.

a) What fraction of the gifts were:
   i) toys or books?
   ii) puzzles or toys?
   iii) games or puzzles?
   iv) books or games?

b) Which 2 types of gifts represent $\frac{1}{4}$ of all the gifts? Explain how you know.

5.4 Using Models to Subtract Fractions

Focus Use Pattern Blocks, fraction strips, and number lines to subtract fractions.

Explore

You will need congruent squares, grid paper, and coloured pencils.

Use these rules to create a rectangular design.
The design must be symmetrical.

- One-half of the squares must be red.
- One-third of the squares must be blue.
- The remaining squares must be green.

What fraction of the squares are green? How do you know?
How many squares did you use?
Explain why you used that number of squares.
Describe your design.
Record your design on grid paper.

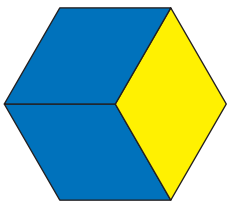
Reflect & Share

Compare your design with that of another pair of classmates.
If the designs are different, explain why your classmates' design obeys the rules.
How could you subtract fractions to find the fraction of the squares that are green?

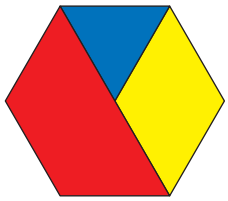
Connect

We can use models to subtract fractions.

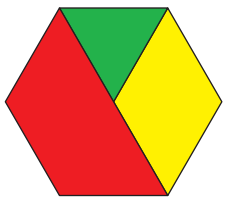
To subtract $\frac{2}{3} - \frac{1}{2}$, we can use Pattern Blocks.
The yellow hexagon represents 1. The blue rhombus represents $\frac{1}{3}$.
The red trapezoid represents $\frac{1}{2}$.
Place 2 blue rhombuses over the hexagon.



To subtract $\frac{1}{2}$, place a red trapezoid over the 2 blue rhombuses.



Find a Pattern Block equal to the difference.
The green triangle represents the difference.



The green triangle is $\frac{1}{6}$ of the hexagon.
So, $\frac{2}{3} - \frac{1}{2} = \frac{1}{6}$

We can also use fraction strips and number lines to subtract.
To subtract fractions with unlike denominators, we use equivalent fractions.

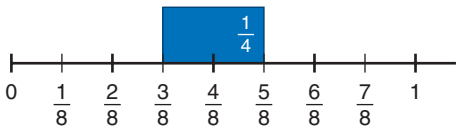
Example

Subtract: $\frac{5}{8} - \frac{1}{4}$

A Solution

$\frac{5}{8} - \frac{1}{4}$
Think addition.
What do we add to $\frac{1}{4}$ to get $\frac{5}{8}$?
Use a number line that shows equivalent fractions for eighths and fourths. That is, use the eighths number line.
Place the $\frac{1}{4}$-strip on the eighths number line with its right end at $\frac{5}{8}$.

Equivalent fractions:
$\frac{1}{4} = \frac{2}{8}$



The left end of the strip is at $\frac{3}{8}$.
So, $\frac{5}{8} - \frac{1}{4} = \frac{3}{8}$

Practice

Use models.

1. Find equivalent fractions with like denominators for each pair of fractions.

a) $\frac{1}{2}$ and $\frac{5}{8}$ **b)** $\frac{1}{4}$ and $\frac{1}{3}$ **c)** $\frac{2}{3}$ and $\frac{1}{6}$ **d)** $\frac{3}{5}$ and $\frac{1}{2}$

2. Is each difference less than $\frac{1}{2}$ or greater than $\frac{1}{2}$?
How can you tell?

a) $\frac{5}{6} - \frac{1}{2}$ **b)** $\frac{7}{8} - \frac{1}{8}$ **c)** $\frac{4}{6} - \frac{1}{3}$ **d)** $1 - \frac{5}{6}$

3. Subtract. Sketch pictures to show each difference.

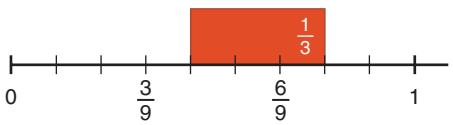
a) $\frac{3}{4} - \frac{2}{4}$ **b)** $\frac{4}{5} - \frac{1}{5}$ **c)** $\frac{2}{3} - \frac{1}{3}$ **d)** $\frac{5}{8} - \frac{3}{8}$

4. **a)** Write a rule you could use to subtract fractions with like denominators without using number lines or fraction strips.

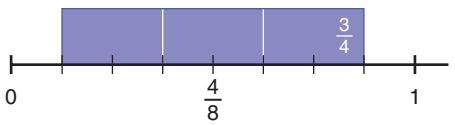
b) Write 3 subtraction questions with like denominators.
Use your rule to subtract the fractions.
Use fraction strips and number lines to check your answers.

5. Write a subtraction equation for each picture.

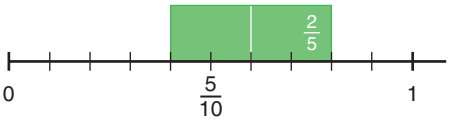
a)



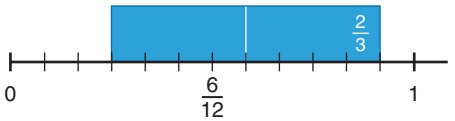
b)



c)



d)



6. Subtract. Sketch pictures to show each difference.

a) $\frac{3}{8} - \frac{1}{4}$ **b)** $\frac{7}{10} - \frac{1}{2}$ **c)** $\frac{7}{8} - \frac{1}{2}$ **d)** $\frac{5}{6} - \frac{1}{4}$

7. Sergio has the lead role in the school play.
He still has to memorize $\frac{1}{2}$ of his lines.
Suppose Sergio memorizes $\frac{1}{3}$ of his lines today.
What fraction of his lines will he have left to memorize?
Show your work.

8. Freida has $\frac{3}{4}$ of a bottle of ginger ale.
She needs $\frac{1}{2}$ of a bottle of ginger ale for her fruit punch.
How much will be left in the bottle after Freida makes the punch?

9. A cookie recipe calls for $\frac{3}{4}$ cup of chocolate chips.
Spencer has $\frac{2}{3}$ cup. Does he have enough?
If your answer is yes, explain why it is enough.
If your answer is no, how much more does Spencer need?

10. Copy and replace each ☐ with a digit, to make each equation true.
Try to do this more than one way.

a) $\frac{2}{3} - \frac{\square}{\square} = \frac{1}{3}$ **b)** $\frac{\square}{\square} - \frac{1}{5} = \frac{3}{5}$ **c)** $\frac{\square}{3} - \frac{2}{\square} = \frac{1}{6}$

11. **Assessment Focus** Kelly had $\frac{3}{4}$ of a tank of gas at the beginning of the week.
At the end of the week, Kelly had $\frac{1}{8}$ of a tank left.

a) Did Kelly use more or less than $\frac{1}{2}$ of a tank? Explain.

b) How much more or less than $\frac{1}{2}$ of a tank did Kelly use?

Show your work.

12. **a)** Which of these differences is greater than $\frac{1}{2}$?
Why do you think so?

i) $\frac{5}{6} - \frac{2}{3}$ **ii)** $\frac{5}{6} - \frac{1}{2}$ **iii)** $\frac{5}{6} - \frac{1}{6}$

b) Explain how you found your answers to part a.
Which other way can you find the fractions with a difference greater than $\frac{1}{2}$? Explain another strategy.

Reflect

When you subtract fractions with unlike denominators, how do you subtract?
Give 2 different examples.
Use diagrams to show your thinking.

5.5 Using Symbols to Subtract Fractions

Focus Use common denominators to subtract fractions.

Addition and subtraction are related operations.
You can use what you know about adding fractions to subtract them.

Explore

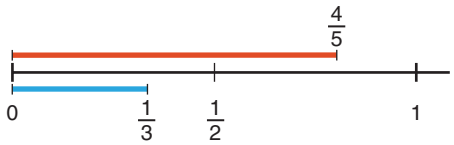
You will need fraction strips and number lines.
Find 2 fractions with a difference of $\frac{1}{2}$.
How many different pairs of fractions can you find?
Record each pair.

Reflect & Share

Discuss with your partner.
How are your strategies for subtracting fractions the same as your strategies for adding fractions? How are they different?
Work together to use common denominators to subtract two fractions.

Connect

To subtract $\frac{4}{5} - \frac{1}{3}$, estimate first.
$\frac{4}{5}$ is close to 1, and $\frac{1}{3}$ is about $\frac{1}{2}$.
So, $\frac{4}{5} - \frac{1}{3}$ is about $1 - \frac{1}{2} = \frac{1}{2}$.



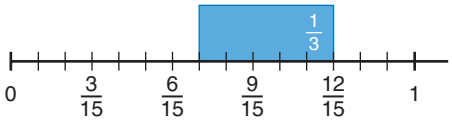
Use equivalent fractions to subtract.
Write $\frac{4}{5}$ and $\frac{1}{3}$ with a common denominator.
List the multiples of 5: 5, 10, **15**, 20, 25, …
List the multiples of 3: 3, 6, 9, 12, **15**, 18, …
15 is a multiple of 5 and 3, so 15 is a common denominator.

$\frac{4}{5} \overset{\times 3}{=} \frac{12}{15}$ and $\frac{1}{3} \overset{\times 5}{=} \frac{5}{15}$

$\frac{4}{5} - \frac{1}{3} = \frac{12}{15} - \frac{5}{15}$
$= \frac{7}{15}$

Think: 12 fifteenths minus 5 fifteenths is 7 fifteenths.

We could have used a fraction strip on a number line.



Example

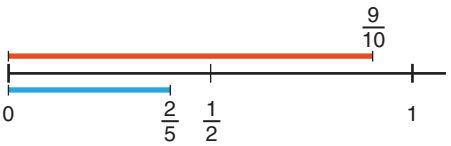
Subtract.

a) $\frac{9}{10} - \frac{2}{5}$ **b)** $\frac{5}{4} - \frac{1}{5}$

Estimate to check the answer is reasonable.

A Solution

a) $\frac{9}{10} - \frac{2}{5}$



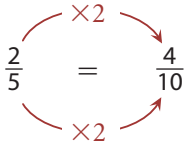
Estimate.

$\frac{9}{10}$ is about 1. $\frac{2}{5}$ is close to $\frac{1}{2}$.

So, $\frac{9}{10} - \frac{2}{5}$ is about $1 - \frac{1}{2} = \frac{1}{2}$.

Since 10 is a multiple of 5,

use 10 as a common denominator.



$\frac{9}{10} - \frac{2}{5} = \frac{9}{10} - \frac{4}{10}$

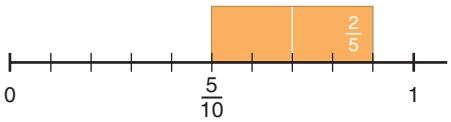
$= \frac{5}{10}$ This is not in simplest form.

$= \frac{5 \div 5}{10 \div 5}$ 5 is a factor of the numerator and denominator.

$= \frac{1}{2}$

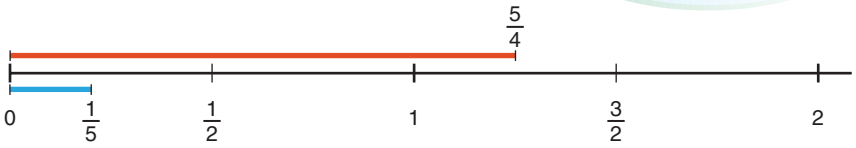
The estimate is $\frac{1}{2}$, so the difference is reasonable.

We could have used a fraction strip on a number line.



Another Strategy

b) $\frac{5}{4} - \frac{1}{5}$



Estimate.

$\frac{5}{4}$ is about 1. $\frac{1}{5}$ is close to 0.

So, $\frac{5}{4} - \frac{1}{5}$ is about $1 - 0 = 1$.

Find a common denominator.
List the multiples of 4: 4, 8, 12, 16, **20**, 24, …
List the multiples of 5: 5, 10, 15, **20**, 25, …
20 is a multiple of 4 and 5, so 20 is a common denominator.

$\frac{5}{4} \xrightarrow{\times 5} \frac{25}{20}$ $\qquad$ $\frac{1}{5} \xrightarrow{\times 4} \frac{4}{20}$

$$\frac{5}{4} - \frac{1}{5} = \frac{25}{20} - \frac{4}{20}$$
$$= \frac{21}{20}$$ This is an improper fraction.
$$\frac{21}{20} = \frac{20}{20} + \frac{1}{20}$$
$$= 1\frac{1}{20}$$

So, $\frac{5}{4} - \frac{1}{5} = 1\frac{1}{20}$
The estimate is 1, so the difference is reasonable.

Practice

Write all differences in simplest form.

1. Subtract.

a) $\frac{4}{5} - \frac{2}{5}$ $\qquad$ b) $\frac{2}{3} - \frac{1}{3}$ $\qquad$ c) $\frac{7}{9} - \frac{4}{9}$ $\qquad$ d) $\frac{5}{7} - \frac{3}{7}$

2. Estimate, then subtract.

a) $\frac{2}{3} - \frac{1}{6}$ $\qquad$ b) $\frac{5}{8} - \frac{1}{2}$ $\qquad$ c) $\frac{3}{2} - \frac{7}{10}$ $\qquad$ d) $\frac{11}{12} - \frac{5}{6}$

3. Subtract.

a) $\frac{3}{4} - \frac{2}{3}$ $\qquad$ b) $\frac{4}{5} - \frac{2}{3}$ $\qquad$ c) $\frac{7}{4} - \frac{4}{5}$ $\qquad$ d) $\frac{3}{5} - \frac{1}{2}$

4. Subtract.
Estimate to check the answer is reasonable.

a) $\frac{4}{6} - \frac{1}{2}$ $\qquad$ b) $\frac{5}{3} - \frac{3}{4}$ $\qquad$ c) $\frac{7}{5} - \frac{5}{6}$ $\qquad$ d) $\frac{5}{6} - \frac{3}{4}$

5. A recipe calls for $\frac{3}{4}$ cup of walnuts and $\frac{2}{3}$ cup of pecans.
Which type of nut is used more in the recipe?
How much more?

6. **Assessment Focus** On Saturday, Terri biked for $\frac{5}{6}$ h.
On Sunday, Terri increased the time she biked by $\frac{7}{12}$ h.
On Saturday, Bastien biked for $\frac{1}{2}$ h.
On Sunday, Bastien increased the time he biked by $\frac{3}{4}$ h.

a) Who biked longer on Sunday?
How can you tell?

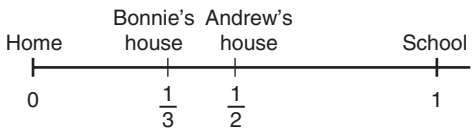
b) For how much longer did this person bike?

c) What did you need to know about fractions to answer these questions?

7. Write as many different subtraction questions as you can where the answer is $\frac{3}{4}$.
Show your work.

8. The difference of 2 fractions is $\frac{1}{2}$.
The lesser fraction is between 0 and $\frac{1}{4}$.
What do you know about the other fraction?

9. **Take It Further** Meagan walks from home to school at a constant speed.
It takes Meagan 3 min to walk the distance between Bonnie's house and Andrew's house.
How long does it take Meagan to get to school?



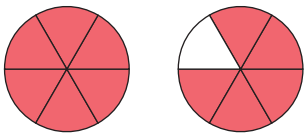
Reflect

Which fractions are easy to subtract?
Which are more difficult?
What makes them more difficult?
Give an example in each case.

5.6 Adding with Mixed Numbers

Focus Use models, pictures, and symbols to add with mixed numbers.

We have used fraction circles to model and add fractions.
We can also use fraction circles to model and add mixed numbers.
These fraction circles model $1\frac{5}{6}$.



1 whole $\frac{5}{6}$

Explore

Use any materials you want.
A recipe calls for $1\frac{1}{3}$ cups of all-purpose flour and $\frac{5}{6}$ cup of whole-wheat flour.
How much flour is needed altogether?
How can you find out?
Show your work.

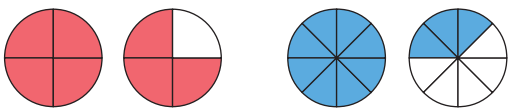
Reflect & Share

Describe your strategy.
Will your strategy work with all mixed numbers?
Test it with $2\frac{1}{3} + \frac{3}{4}$.
Use models or diagrams to justify your strategy.

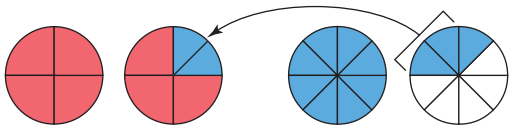
Connect

Use fraction circles to add: $1\frac{3}{4} + 1\frac{3}{8}$

Use fraction circles to model $1\frac{3}{4}$ and $1\frac{3}{8}$.



$1\frac{3}{4}$ $1\frac{3}{8}$



Use eighths to fill the fraction circle for $\frac{3}{4}$.

1 whole and 1 whole and 1 eighth equals 3 wholes and 1 eighth.
So, $1\frac{3}{4} + 1\frac{3}{8} = 3\frac{1}{8}$

To add with mixed numbers, we can:

- Add the fractions and add the whole numbers separately. Or:
- Write each mixed number as an improper fraction, then add.

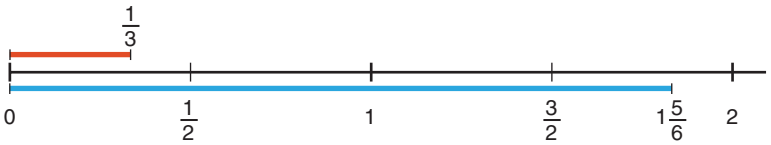
Example

Add: $\frac{1}{3} + 1\frac{5}{6}$

A Solution

$\frac{1}{3} + 1\frac{5}{6}$

Estimate:



$1\frac{5}{6}$ is close to 2.

So, $\frac{1}{3} + 1\frac{5}{6} > 2$, but less than $2\frac{1}{3}$

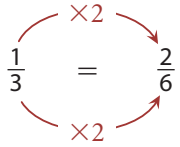
Add the fractions and
the whole number separately.

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

Add the fractions: $\frac{1}{3} + \frac{5}{6}$

Since 6 is a multiple of 3,

use 6 as a common denominator.



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

$= \frac{7}{6}$

Since 7 > 6, this is an improper fraction.

To write the improper fraction as a mixed number:

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

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

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

So, $\frac{1}{3} + \frac{5}{6} + 1 = 1\frac{1}{6} + 1$

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

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

This is close to the estimate of between 2 and $2\frac{1}{3}$, so the sum is reasonable.

Another Solution

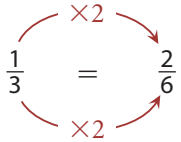
Write the mixed number as an improper fraction, then add.

$1\frac{5}{6} = 1 + \frac{5}{6}$

$= \frac{6}{6} + \frac{5}{6}$

$= \frac{11}{6}$

Since 6 is a multiple of 3, use 6 as a common denominator.



$\frac{1}{3} + 1\frac{5}{6} = \frac{2}{6} + \frac{11}{6}$

$= \frac{13}{6}$

To write the fraction as a mixed number:

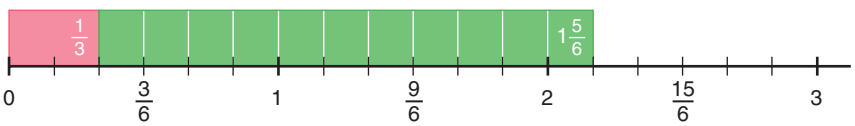
$\frac{13}{6} = \frac{12}{6} + \frac{1}{6}$

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

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

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

We can model this with a fraction strip on a number line.



Practice

Write all sums in simplest form.

1. Write each mixed number as an improper fraction in simplest form.

a) $1\frac{3}{6}$ **b)** $4\frac{2}{8}$ **c)** $1\frac{3}{4}$ **d)** $3\frac{3}{5}$

2. Write each improper fraction as a mixed number in simplest form.

a) $\frac{17}{5}$ **b)** $\frac{9}{4}$ **c)** $\frac{18}{4}$ **d)** $\frac{28}{6}$

3. Use Pattern Blocks to find each sum.

a) $1\frac{1}{6} + \frac{2}{6}$ **b)** $1\frac{2}{3} + \frac{2}{3}$ **c)** $1\frac{4}{6} + 2\frac{1}{2}$ **d)** $2\frac{1}{3} + 3\frac{5}{6}$

4. Find each sum.

a) $3\frac{2}{3} + 2\frac{1}{3}$ **b)** $1\frac{1}{8} + 3\frac{5}{8}$ **c)** $4\frac{2}{9} + 3\frac{5}{9}$ **d)** $2\frac{3}{5} + 5\frac{4}{5}$

5. Use fraction circles to find each sum.

a) $2\frac{5}{8} + \frac{3}{4}$ **b)** $2\frac{5}{12} + \frac{2}{3}$ **c)** $1\frac{3}{8} + 3\frac{3}{4}$ **d)** $2\frac{2}{5} + 1\frac{7}{10}$

6. We know $\frac{1}{2} + \frac{1}{5} = \frac{7}{10}$.
Use this result to find each sum.
Estimate to check the sum is reasonable.

a) $3\frac{1}{2} + \frac{1}{5}$ **b)** $\frac{1}{2} + 2\frac{1}{5}$ **c)** $3\frac{1}{2} + 2\frac{1}{5}$ **d)** $4\frac{1}{2} + 3\frac{1}{5}$

7. For each pair of numbers, find a common denominator. Then add.

a) $3\frac{1}{3} + \frac{1}{4}$ **b)** $\frac{1}{2} + 1\frac{9}{10}$ **c)** $\frac{3}{4} + 2\frac{3}{5}$ **d)** $\frac{3}{7} + 2\frac{1}{2}$
e) $4\frac{7}{8} + 1\frac{2}{3}$ **f)** $2\frac{3}{5} + 2\frac{2}{3}$ **g)** $5\frac{2}{5} + 1\frac{7}{8}$ **h)** $3\frac{5}{6} + 2\frac{1}{4}$

8. Two students, Galen and Mai, worked on a project.
Galen worked for $3\frac{2}{3}$ h.
Mai worked for $2\frac{4}{5}$ h.
What was the total time spent on the project?

9. **Assessment Focus** Joseph used $1\frac{3}{8}$ cans of paint to paint his room. Juntia used $2\frac{1}{4}$ cans to paint her room.

a) Estimate how many cans of paint were used in all.
b) Calculate how many cans of paint were used.
c) Draw a diagram to model your calculations in part b.

10. A recipe for punch calls for $2\frac{2}{3}$ cups of fruit concentrate and $6\frac{3}{4}$ cups of water.
How many cups of punch will the recipe make?
Show your work.

11. Use the fractions $1\frac{3}{5}$ and $2\frac{1}{10}$.

a) Add the fractions and the whole numbers separately.

b) Write each mixed number as an improper fraction.

c) Add the improper fractions.

d) Which method was easier: adding the mixed numbers or adding the improper fractions? Why do you think so? When would you use each method?

12. An auto mechanic completed 2 jobs before lunch.
The jobs took $2\frac{2}{3}$ h and $1\frac{3}{4}$ h.
How many hours did it take the mechanic to complete the 2 jobs?

13. **Take It Further** Replace the $\square$ with an improper fraction or mixed number to make this equation true.
$3\frac{3}{5} + \square = 5$
Find as many answers as you can.
Draw diagrams to represent your thinking.

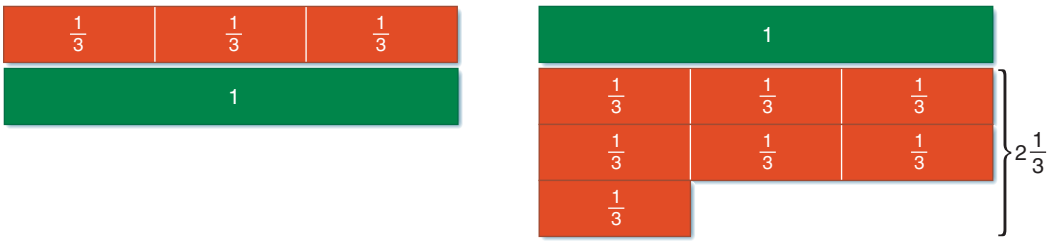
Reflect

How is adding a mixed number and a fraction like adding two fractions?
How is it different?
Use examples to explain.

5.7 Subtracting with Mixed Numbers

Focus Use models, pictures, and symbols to subtract with mixed numbers.

We can use Cuisenaire rods to model fractions and mixed numbers.
Suppose the dark green rod is 1 whole, then the red rod is $\frac{1}{3}$.
So, seven red rods is $\frac{7}{3}$, or $2\frac{1}{3}$.



Explore

Use any materials you want.
A bicycle shop closed for lunch for $1\frac{2}{3}$ h on Monday and for $\frac{3}{4}$ h on Tuesday.
How much longer was the shop closed for lunch on Monday than on Tuesday?
How can you find out? Show your work.

Reflect & Share

Describe your strategy.
Will your strategy work with all mixed numbers?
Test it with $2\frac{1}{4} - \frac{3}{8}$.
Use models or diagrams to justify your strategy.

Connect

Use Cuisenaire rods to subtract: $1\frac{1}{2} - \frac{3}{4}$

Use Cuisenaire rods to model $1\frac{1}{2}$ and $\frac{3}{4}$.

Let the brown rod represent 1 whole.

Then, the purple rod represents $\frac{1}{2}$ and the red rod represents $\frac{1}{4}$.

Model $1\frac{1}{2}$ with Cuisenaire rods.

Model $\frac{3}{4}$ with Cuisenaire rods.

Place the rods for $\frac{3}{4}$ above the rods for $1\frac{1}{2}$, so they align at the right.

Find a rod equal to the difference in their lengths.
The difference is equal to the dark green rod.

The dark green rod represents $\frac{3}{4}$ of the brown rod.
So, $1\frac{1}{2} - \frac{3}{4} = \frac{3}{4}$
To subtract with mixed numbers, we can:

- Subtract the fractions and subtract the whole numbers separately. Or:
- Write each mixed number as an improper fraction, then subtract.

Example

Subtract.
a) $3\frac{3}{4} - 1\frac{1}{5}$ **b)** $3\frac{1}{5} - \frac{3}{4}$
Estimate to check the answer is reasonable.

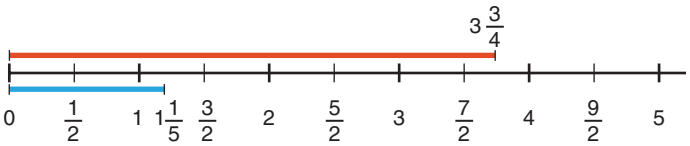
A Solution

a) $3\frac{3}{4} - 1\frac{1}{5}$

Estimate.

$3\frac{3}{4}$ is about 4. $1\frac{1}{5}$ is about 1.

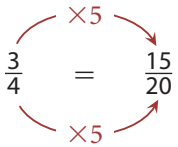
So, $3\frac{3}{4} - 1\frac{1}{5}$ is between 2 and 3.

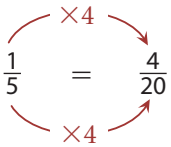


Subtract the fractions first: $\frac{3}{4} - \frac{1}{5}$

The denominators 4 and 5 have no common factors.

So, a common denominator is: $4 \times 5 = 20$.





$$\frac{3}{4} - \frac{1}{5} = \frac{15}{20} - \frac{4}{20}$$
$$= \frac{11}{20}$$

Subtract the whole numbers: $3 - 1 = 2$

Then, $3\frac{3}{4} - 1\frac{1}{5} = 2\frac{11}{20}$

This is close to the estimate of between 2 and 3,

so the answer is reasonable.

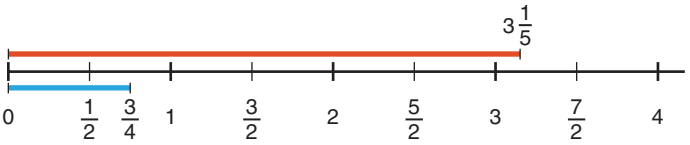
b) $3\frac{1}{5} - \frac{3}{4}$

Estimate.

$3\frac{1}{5}$ is about 3.

$\frac{3}{4}$ is close to 1.

So, $3\frac{1}{5} - \frac{3}{4}$ is about $3 - 1 = 2$.



We cannot subtract the fractions because $\frac{1}{5} < \frac{3}{4}$.

So, write $3\frac{1}{5}$ as an improper fraction.

$$3\frac{1}{5} = 3 + \frac{1}{5}$$
$$= \frac{15}{5} + \frac{1}{5}$$
$$= \frac{16}{5}$$

Another Strategy

We could use fraction circles to subtract.

The denominators have no common factors.

So, a common denominator is: $4 \times 5 = 20$

$\frac{16}{5} = \frac{64}{20}$ ($\times 4$ / $\times 4$)

$\frac{3}{4} = \frac{15}{20}$ ($\times 5$ / $\times 5$)

$$\frac{16}{5} - \frac{3}{4} = \frac{64}{20} - \frac{15}{20}$$
$$= \frac{49}{20}$$
$$= \frac{40}{20} + \frac{9}{20}$$
$$= 2 + \frac{9}{20}$$
$$= 2\frac{9}{20}$$

So, $3\frac{1}{5} - \frac{3}{4} = 2\frac{9}{20}$

This is close to the estimate of 2, so the answer is reasonable.

Before we subtract the fraction parts of two mixed numbers,
we must check the fractions to see which is greater.
When the second fraction is greater than the first fraction,
we cannot subtract directly.

Practice

Write all differences in simplest form.

1. Subtract.

a) $2\frac{3}{5} - 1\frac{2}{5}$ **b)** $3\frac{7}{8} - 1\frac{5}{8}$ **c)** $\frac{15}{4} - \frac{3}{4}$ **d)** $\frac{11}{6} - \frac{1}{6}$

2. Subtract. Use Cuisenaire rods.
Sketch diagrams to record your work.

a) $1\frac{2}{3} - \frac{2}{6}$ **b)** $3\frac{1}{2} - 1\frac{2}{4}$ **c)** $3\frac{3}{10} - 2\frac{4}{5}$ **d)** $2\frac{1}{4} - \frac{1}{2}$

3. We know that $\frac{2}{3} - \frac{1}{2} = \frac{1}{6}$.
Use this result to find each difference.
Estimate to check the answer is reasonable.

a) $2\frac{2}{3} - \frac{1}{2}$ **b)** $2\frac{2}{3} - 1\frac{1}{2}$ **c)** $4\frac{2}{3} - 2\frac{1}{2}$ **d)** $5\frac{2}{3} - 1\frac{1}{2}$

4. Estimate, then subtract.

a) $\frac{7}{2} - \frac{5}{4}$ **b)** $\frac{13}{6} - \frac{8}{12}$ **c)** $\frac{5}{4} - \frac{3}{5}$ **d)** $\frac{9}{5} - \frac{1}{2}$

5. **a)** Subtract.

i) $3 - \frac{4}{5}$ **ii)** $4 - \frac{3}{7}$ **iii)** $5 - \frac{5}{6}$ **iv)** $6 - \frac{4}{9}$

b) Which methods did you use in part a?
Explain your choice.

6. For the fractions in each pair of numbers, find a common denominator.
Then subtract.

a) $3\frac{3}{4} - 1\frac{1}{5}$ **b)** $4\frac{9}{10} - 3\frac{1}{2}$ **c)** $3\frac{3}{4} - 1\frac{1}{3}$ **d)** $4\frac{5}{7} - 2\frac{2}{3}$

7. For each pair of mixed numbers below:

a) Subtract the fractions and subtract the whole numbers separately.

b) Write the mixed numbers as improper fractions, then subtract.

c) Which method was easier? Why do you think so?

i) $3\frac{3}{5} - 1\frac{3}{10}$ **ii)** $3\frac{3}{10} - 1\frac{3}{5}$

8. A flask contains $2\frac{1}{2}$ cups of juice.
Ping drinks $\frac{3}{8}$ cup of juice, then Preston drinks $\frac{7}{10}$ cup of juice.
How much juice is in the flask now? Show your work.

9. The running time of a movie is $2\frac{1}{6}$ h.
In the theatre, Jason looks at his watch and sees that $1\frac{1}{4}$ h has passed.
How much longer will the movie run?

10. Subtract.
a) $3\frac{2}{3} - 2\frac{7}{8}$ **b)** $5\frac{1}{2} - 3\frac{7}{9}$ **c)** $4\frac{3}{5} - 1\frac{2}{3}$ **d)** $4\frac{2}{5} - 1\frac{7}{8}$

11. **Assessment Focus** The students in two Grade 7 classes made sandwiches for parents' night.
Mr. Crowe's class used $5\frac{1}{8}$ loaves of bread.
Mme. Boudreau's class used $3\frac{2}{3}$ loaves of bread.
a) Estimate how many more loaves Mr. Crowe's class used.
b) Calculate how many more loaves Mr. Crowe's class used.
c) Draw a diagram to model your calculations in part b.
d) The two classes purchased 10 loaves.
How many loaves were left?

12. **Take It Further** Replace the ☐ with an improper fraction or mixed number to make this equation true.
$4\frac{1}{8} - ☐ = 1\frac{1}{2}$
Find as many answers as you can.
Draw diagrams to represent your thinking.

Reflect

You have learned to use improper fractions to subtract mixed numbers.
When is this not the better method? Use an example to explain.

Advertising Sales Representative

Magazines and newspapers make money by selling advertising space.

The advertising sales representative contacts companies whose products might be of interest to readers. She offers to sell them various sizes of advertisement space at different rates.
When talking about ads smaller than a full page, the sales rep uses fractions to describe them. It's much simpler to talk about a $\frac{2}{3}$-page ad instead of a 0.666 667 page ad!

The sales rep tries to sell combinations of ads that can fill pages, with no space left over. A sales rep has sold two $\frac{1}{4}$-page ads and one $\frac{1}{6}$-page ad. She wants to know the possible combinations of ad sizes she can sell to fill the rest of the page.
What might they be?

Writing a Complete Solution

A question often says "Show your work."
What does this mean?

When you are asked to show your work, you should show your thinking by writing a complete solution.

Work with a partner.
Compare these solutions.

Solution 1

A cookie recipe calls for $\frac{3}{8}$ cup of brown sugar and $\frac{1}{3}$ cup of white sugar.
Which type of sugar is used more in the recipe?
How much more?

Solution

Which is greater, $\frac{3}{8}$ or $\frac{1}{3}$?

Write $\frac{3}{8}$ and $\frac{1}{3}$ with a common denominator.
List the multiples of 8: 8, 16, (24), 32, ...
List the multiples of 3: 3, 6, 9, 12, 15, 18, 21, (24), 27, ...

A common denominator is 24.

$\frac{3}{8} \overset{\times 3}{=} \frac{9}{24}$ $\quad \frac{1}{3} \overset{\times 8}{=} \frac{8}{24}$

$\frac{9}{24} > \frac{8}{24}$

So, $\frac{3}{8} > \frac{1}{3}$

Brown sugar is used more.

Subtract to find out how much more.

$\frac{9}{24} - \frac{8}{24} = \frac{1}{24}$

The recipe calls for $\frac{1}{24}$ cup more brown sugar.

Solution 2

$\frac{3}{8} = \frac{9}{24}$ $\quad \frac{1}{3} = \frac{8}{24}$

Answer: $\frac{9}{24}$, $\frac{1}{24}$

- Which solution is complete?
- Suppose this question is on a test. It is worth 4 marks.
  How many marks would you give each solution above?
  Justify your answers.

Make a list of things that should be included in a complete solution.

Reading and Writing in Math

Tips for writing a complete solution:

- Write down the question.
- Show all steps so that someone else can follow your thinking.
- Include graphs or pictures to help explain your thinking.
- Check that your calculations are accurate.
- Use math symbols correctly.
- Write a concluding sentence that answers the question.

Name: _____ Date: _____

1. Which fraction is greater? How do you know?

$\frac{3}{5}, \frac{2}{3}$

2. Add.

$\frac{3}{4} + \frac{1}{12}$

3. Subtract.

$4\frac{5}{6} - \frac{17}{18}$

4. Marty drank $\frac{4}{5}$ cup of orange juice.

Kobe drank $\frac{3}{4}$ cup of orange juice.

a) Who drank more orange juice?

b) How much more orange juice did he drink?

Unit Review

What Do I Need to Know?

Adding and Subtracting Fractions

- Use models, such as Pattern Blocks, fraction circles, fraction strips, and number lines.
- Like denominators: add or subtract the numerators.
  For example, $\frac{5}{6} + \frac{2}{6} = \frac{7}{6}$ $\frac{5}{6} - \frac{2}{6} = \frac{3}{6}$, or $\frac{1}{2}$
- Unlike denominators: Use a common denominator to write equivalent fractions, then add or subtract the numerators.
  For example:

$\frac{3}{4} + \frac{3}{5}$
$= \frac{15}{20} + \frac{12}{20}$
$= \frac{27}{20}$, or $1\frac{7}{20}$

$\frac{3}{4} - \frac{3}{5}$
$= \frac{15}{20} - \frac{12}{20}$
$= \frac{3}{20}$

Adding and Subtracting with Mixed Numbers

- Use models, such as fraction circles, Pattern Blocks, and Cuisenaire rods.
- Add or subtract the fractions and the whole numbers separately.
  For example:

$3\frac{5}{8} + 2\frac{1}{4}$
$= 3 + 2 + \frac{5}{8} + \frac{1}{4}$
$= 5 + \frac{5}{8} + \frac{2}{8}$
$= 5 + \frac{7}{8}$
$= 5\frac{7}{8}$

$3\frac{2}{3} - 1\frac{3}{5}$
$= 3 - 1 + \frac{2}{3} - \frac{3}{5}$
$= 2 + \frac{10}{15} - \frac{9}{15}$
$= 2 + \frac{1}{15}$
$= 2\frac{1}{15}$

Check that $\frac{2}{3} > \frac{3}{5}$.

- Write each mixed number as an improper fraction, then add or subtract.
  For example:

$1\frac{5}{6} + 1\frac{2}{5}$
$= \frac{11}{6} + \frac{7}{5}$
$= \frac{55}{30} + \frac{42}{30}$
$= \frac{97}{30}$, or $3\frac{7}{30}$

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

Since $\frac{1}{4} < \frac{1}{2}$, use improper fractions.

What Should I Be Able to Do?

LESSON

5.1 **1.** Add.
Use fraction circles.
Draw a picture to show each sum.

a) $\frac{8}{12} + \frac{5}{12}$ b) $\frac{3}{4} + \frac{2}{8}$

c) $\frac{1}{4} + \frac{2}{3}$ d) $\frac{1}{10} + \frac{3}{5}$

5.2 **2.** Add. Use fraction strips on number lines.
Draw a picture to show each sum.

a) $\frac{5}{9} + \frac{2}{3}$ b) $\frac{2}{3} + \frac{5}{6}$

c) $\frac{1}{6} + \frac{7}{12}$ d) $\frac{3}{8} + \frac{6}{8}$

3. Find 2 fractions that add to $\frac{5}{8}$.
Find as many pairs of fractions as you can.

5.3 **4.** Find a common denominator for each set of fractions.
Write equivalent fractions for each pair.

a) $\frac{3}{5}$ and $\frac{3}{4}$ b) $\frac{2}{5}$ and $\frac{3}{15}$

c) $\frac{4}{9}$ and $\frac{1}{2}$ d) $\frac{5}{8}$ and $\frac{1}{6}$

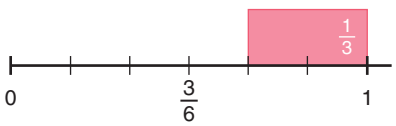
5. Add.

a) $\frac{1}{5} + \frac{3}{5}$ b) $\frac{1}{2} + \frac{3}{7}$

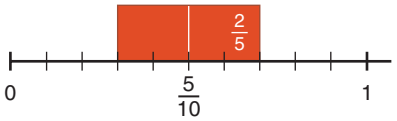
c) $\frac{2}{3} + \frac{3}{10}$ d) $\frac{3}{5} + \frac{1}{4}$

5.4 **6.** Write a subtraction equation for each picture.

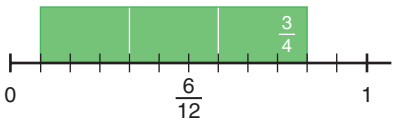
a)



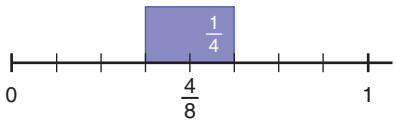
b)



c)



d)



7. Subtract. Draw a picture to show each difference.

a) $\frac{4}{5} - \frac{1}{5}$

b) $\frac{5}{6} - \frac{1}{3}$

c) $\frac{11}{12} - \frac{1}{2}$

8. Joyce and Javon each have the same MP3 player.
Joyce has used $\frac{7}{9}$ of her storage capacity.
Javon has used $\frac{5}{6}$ of his storage capacity.

a) Who has used more storage capacity?

b) How much more storage capacity has he or she used?

Show your work.

5.5 **9.** Subtract.

a) $\frac{9}{10} - \frac{2}{5}$ b) $\frac{7}{3} - \frac{5}{6}$

c) $\frac{8}{5} - \frac{1}{4}$ d) $\frac{9}{4} - \frac{2}{3}$

LESSON

10. Write a subtraction question that has each fraction below as the answer.
The two fractions that are subtracted should have unlike denominators.

a) $\frac{1}{2}$ **b)** $\frac{3}{4}$ **c)** $\frac{1}{10}$

d) $\frac{1}{6}$ **e)** $\frac{1}{4}$

11. Anton drank $\frac{3}{4}$ bottle of water.
Brad drank $\frac{7}{8}$ bottle of water.

a) Who drank more water?

b) How much more water did he drink?

12. The gas tank in Eddie's car is $\frac{5}{8}$ full. He uses $\frac{1}{4}$ tank of gas to run his errands. What fraction of a tank of gas is left?

5.6 **13.** Use fraction circles to find each sum.

a) $6\frac{1}{3} + \frac{1}{3}$ **b)** $1\frac{5}{12} + \frac{1}{6}$

c) $2\frac{3}{10} + 3\frac{1}{5}$ **d)** $5\frac{1}{4} + 1\frac{2}{5}$

14. Add.

a) $3\frac{5}{6} + \frac{4}{6}$ **b)** $4\frac{3}{8} + \frac{1}{4}$

c) $7\frac{3}{10} + 2\frac{4}{5}$ **d)** $2\frac{5}{9} + 5\frac{2}{3}$

15. Danielle mows lawns as a part-time job. On Monday, Danielle spent $1\frac{3}{4}$ h mowing lawns.
On Wednesday, she spent $1\frac{7}{8}$ h mowing lawns.
How much time did she spend mowing lawns over the 2 days?

5.7 **16.** Subtract. Draw a picture to show each difference.

a) $4\frac{1}{2} - \frac{3}{8}$ **b)** $3\frac{4}{9} - \frac{2}{3}$

c) $5\frac{5}{12} - 3\frac{5}{6}$ **d)** $4\frac{5}{8} - 2\frac{2}{3}$

17. Amelie wants to bake two kinds of muffins. One recipe calls for $1\frac{3}{4}$ cups of bananas.
The other recipe calls for $1\frac{7}{8}$ cups of cranberries.

a) Which recipe uses more fruit?

b) How much more fruit does the recipe in part a use?

18. Add or subtract as indicated.

a) $2\frac{2}{3} + 1\frac{1}{2}$ **b)** $3\frac{1}{3} - 1\frac{7}{10}$

c) $2\frac{1}{6} + 4\frac{7}{8}$ **d)** $3\frac{1}{2} - 2\frac{3}{4}$

19. On a trip from Edmonton to Saskatoon, Carly drove for $2\frac{1}{2}$ h, stopped for gas and lunch, then drove for $2\frac{2}{3}$ h.
The total trip took 6 h. How long did Carly stop for gas and lunch? Express your answer as a fraction of an hour.

Practice Test

1. Add or subtract.
Draw a picture to show each sum or difference.
Write each sum or difference in simplest form.

a) $\frac{7}{5} + \frac{3}{5}$ **b)** $\frac{13}{10} - \frac{2}{3}$ **c)** $\frac{11}{12} - \frac{8}{12}$ **d)** $\frac{4}{9} + \frac{7}{6}$

2. Find two fractions that have a sum of $\frac{3}{5}$.

a) The fractions have like denominators.

b) The fractions have unlike denominators.

3. Find two fractions that have a difference of $\frac{1}{4}$.

a) The fractions have like denominators.

b) The fractions have unlike denominators.

4. Add or subtract.

a) $6\frac{3}{8} + 2\frac{1}{5}$ **b)** $3\frac{1}{10} - 1\frac{4}{5}$

5. Lana does yard work.
The table shows the approximate time for each job.
For one Saturday, Lana has these jobs:
– mow 3 small lawns
– mow 1 large lawn
– mow lawn/tidy yard in 2 places
– plant annuals in 1 place
Lana needs travel time between jobs,
and a break for lunch.
Do you think she will be able to do all the jobs? Justify your answer.

Job	Time
Mow small lawn	$\frac{1}{2}$ h
Mow large lawn	$\frac{3}{4}$ h
Mow lawn/tidy yard	$1\frac{1}{2}$ h
Plant annuals	$2\frac{1}{2}$ h

6. Write each fraction as the sum of two different unit fractions.

a) $\frac{3}{4}$ **b)** $\frac{5}{8}$

7. A fraction is written on each side of two counters.
All the fractions are different.
The counters are flipped and the fractions are added.
Their possible sums are: $1, 1\frac{1}{4}, \frac{7}{12}, \frac{5}{6}$
Which fractions are written on the counters?
Explain how you found the fractions.

Unit Problem Publishing a Book

The students at Anishwabe School are preparing a special book for the school's 100th anniversary. They finance the book by selling advertising space to sponsors. The students sold the following space:

Full page	$\frac{1}{2}$ page	$\frac{1}{3}$ page	$\frac{1}{4}$ page	$\frac{1}{6}$ page	$\frac{1}{8}$ page
1	1	1	3	4	5

All the advertisements are to fit at the back of the book.
Sam asks: "How many pages do we need for the advertisements?"
Ruth asks: "Will the advertisements fill the pages?"
Jiba asks: "Is there more than one way to arrange these advertisements?"
Can you think of other questions students might ask?

1. Find the total advertising space needed.
2. Sketch the pages to find how the advertisements can be placed. Use grid paper if it helps.

3. Compare your group's sketch with those of other groups.
When you made your sketch, what decisions did you make about the shape of each advertisement?
Did other groups make the same decisions?
If your answer is no, explain how another group made its decisions.

4. What are the fewest pages needed to display the advertisements?
Will there be room for any other advertisements?
How can you tell?

5. What else might students need to consider as they prepare the layout for the book?

Check List

Your work should show:

- ✓ all calculations in detail
- ✓ diagrams of the layout for the advertisements
- ✓ a clear explanation of how you prepared the layout
- ✓ a clear explanation of which students received the prizes, and how much more the third student needed to sell

To encourage students to sell advertisements, the organizing committee offered prizes to the 2 students who sold the most space.

Sandra, Roy, and Edward are the top sellers.
This table shows the advertising space each of these students sold.

	Full page	$\frac{1}{2}$ page	$\frac{1}{3}$ page	$\frac{1}{4}$ page	$\frac{1}{6}$ page	$\frac{1}{8}$ page
Sandra		1			1	2
Roy	1				1	
Edward			1	1	1	1

6. Which two students sold the most space?
Show how you know.

7. How much more space would the third-place student have to sell to receive first prize?
Second prize? Show your work.

Reflect on Your Learning

Look back at the goals under *What You'll Learn*.
How well do you think you have met these goals?