

9.2

Adding Fractions with Models

You will need

- fraction strips
- number lines

GOAL

Add fractions that are less than 1 using fraction strips and number lines.

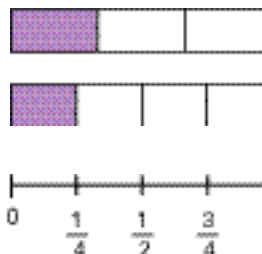
Learn about the Math

Sandra is reading a mystery novel. Last weekend, she read $\frac{1}{3}$ of the book. Yesterday, she read $\frac{1}{4}$ more of the book.

? What fraction of the book has Sandra read?

You can use fraction strips or number lines to make models of fractions. A fraction strip shows rectangles that are the same size. The whole length of each fraction strip should be the same, no matter what fraction the strip represents.

The $\frac{1}{3}$ strip and the $\frac{1}{4}$ strip show different denominators.



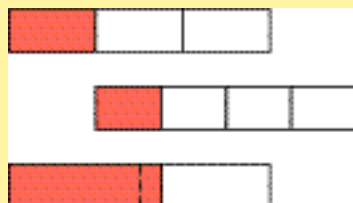
A number line is like a thin fraction strip.

Example 1: Estimating using fraction strips

Use fraction strips to estimate $\frac{1}{3} + \frac{1}{4}$.

Sandra's Solution

I divided each fraction strip into the number of parts shown in the denominator. Then I coloured the number of parts shown in the numerator.



I made a $\frac{1}{3}$ strip.

I made a $\frac{1}{4}$ strip and put it at the end of the $\frac{1}{3}$ strip.

I made a $\frac{1}{2}$ strip to compare with $\frac{1}{4} + \frac{1}{3}$. It looks like the sum is a bit more than $\frac{1}{2}$.



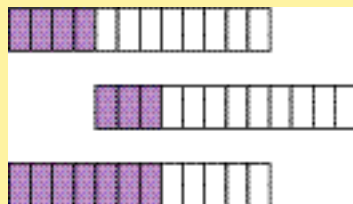
Example 2: Adding using fraction strips

Use fraction strips to add $\frac{1}{3} + \frac{1}{4}$.

Ravi's Solution

If my fraction strips had the same number of parts, I could count the parts in the sum.

Both the $\frac{1}{3}$ strip and the $\frac{1}{4}$ strip can be made into twelfths. 12 is a **common denominator** for $\frac{1}{3}$ and $\frac{1}{4}$ because 12 is a common multiple of 3 and 4.



The $\frac{1}{3}$ strip becomes $\frac{4}{12}$ because $\frac{1}{3} = \frac{1 \times 4}{3 \times 4}$, which is $\frac{4}{12}$.

The $\frac{1}{4}$ strip becomes $\frac{3}{12}$ because $\frac{1}{4} = \frac{1 \times 3}{4 \times 3}$, which is $\frac{3}{12}$.

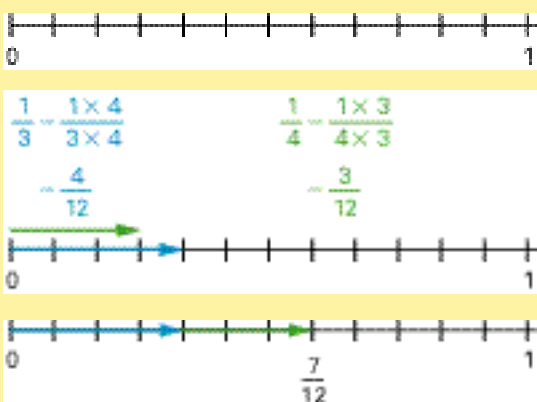
I added $\frac{4}{12} + \frac{3}{12}$ to get $\frac{7}{12}$.



Example 3: Adding using a number line

Use a number line to add $\frac{1}{3} + \frac{1}{4}$.

Chang's Solution



I know that 12 is a common multiple of 3 and 4, so 12 is a common denominator for $\frac{1}{3}$ and $\frac{1}{4}$. I used a number line marked in twelfths.

I renamed $\frac{1}{3}$ and $\frac{1}{4}$ in twelfths.

I drew arrows to show $\frac{4}{12}$ and $\frac{3}{12}$.

I put the arrows together to show $\frac{4}{12} + \frac{3}{12} = \frac{7}{12}$.



Reflecting

1. In Example 1, how did Sandra know that the answer was a bit more than $\frac{1}{2}$?
2. In Example 3, how could Chang use a number line to estimate that the answer must be more than $\frac{1}{4}$ but less than $\frac{1}{2}$?
3. Explain how using a common denominator helped Ravi and Chang add fractions using models.

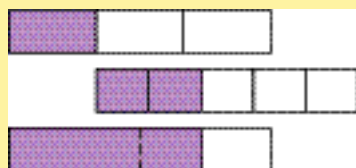
Work with the Math

Example 4: Estimating and adding using models

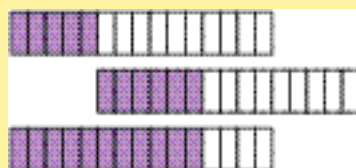
Estimate and then add $\frac{1}{3} + \frac{2}{5}$.

Solution A

Estimate. $\frac{1}{3} + \frac{2}{5}$ looks like about $\frac{3}{4}$.



To add, first find the common denominator.



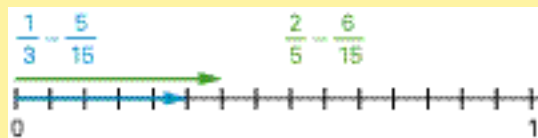
$$\frac{1}{3} = \frac{5}{15}$$

$$\frac{2}{5} = \frac{6}{15}$$

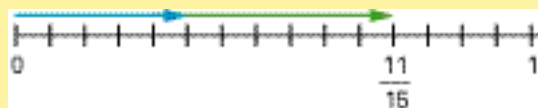
$$\frac{5}{15} + \frac{6}{15} = \frac{11}{15}$$

Solution B

Use a number line marked in fifteenths, since 15 is a common denominator for $\frac{1}{3}$ and $\frac{2}{5}$.



Put the arrows together to model addition.



$$\begin{aligned}\frac{1}{3} + \frac{2}{5} &= \frac{5}{15} + \frac{6}{15} \\ &= \frac{11}{15}\end{aligned}$$

A Checking

4. a) How do you know that the sum of $\frac{3}{4}$ and $\frac{1}{6}$ is less than 1?
b) Use fraction strips to add $\frac{3}{4} + \frac{1}{6}$. Show your work.
5. Use a number line to add $\frac{2}{5} + \frac{7}{10}$. Show your work.
6. a) Describe how you would use fraction strips or a number line to estimate the sum for $\frac{1}{5} + \frac{1}{4}$.
b) Describe how you would use fraction strips or a number line to add $\frac{1}{5} + \frac{1}{4}$.

B Practising

7. Use fraction strips to estimate and then add. Show your work.

a) $\frac{2}{3} + \frac{1}{3}$	d) $\frac{2}{3} + \frac{1}{2}$
b) $\frac{1}{4} + \frac{1}{2}$	e) $\frac{2}{3} + \frac{3}{5}$
c) $\frac{1}{8} + \frac{1}{4}$	f) $\frac{5}{6} + \frac{3}{4}$
8. Use a number line to add. Show your work.

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

Use fraction strips or a number line to model each addition in questions 9 to 18.

9. Determine each sum.

a) $\frac{1}{8} + \frac{3}{4}$ b) $\frac{4}{5} + \frac{1}{2}$

10. The recipe for a cheese sauce requires $\frac{1}{3}$ c. of flour at the beginning and another $\frac{1}{8}$ c. of flour later. How much flour is required?

11. In a Grade 7 class, $\frac{1}{5}$ of the students have two pets and $\frac{1}{20}$ have three pets.

- Estimate the fraction of the class that has either two or three pets.
- Calculate the fraction of the class that has either two or three pets.
- How many students do you think are in the class? Why?

12. a) Rewrite $\frac{1}{5}$ and $\frac{1}{20}$, from question 11, as percents. Add the percents.

b) How does your answer for part (a) relate to your answer for question 11, part (b)?

13. In the fall of 2003, the population of Ontario was about 39% of the population of Canada. The population of the western provinces was about $\frac{3}{10}$ of the population of Canada.

- What fraction of Canadians live in Ontario and the western provinces?
- What percent of Canadians live in Ontario and the western provinces?

14. Jane watched one television program for $\frac{1}{4}$ of an hour and then changed channels to watch another program for 20 min. Write an equation to describe the fraction of an hour that Jane watched television.



15. What denominators make this equation true? Write four possible answers.

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

E Extending

16. Yan has three measuring cups filled with sugar.



- Can Yan empty all three measuring cups into a 1 c. measuring cup? Explain.
- How much sugar does he have in total?

17. a) Add each pair of fractions. Describe the model you used, and look for a pattern in the sums.

i) $\frac{1}{3} + \frac{1}{4}$ iii) $\frac{1}{5} + \frac{1}{6}$
 ii) $\frac{1}{4} + \frac{1}{5}$ iv) $\frac{1}{6} + \frac{1}{7}$

b) Describe a rule for adding fractions in the form $\frac{1}{\square} + \frac{1}{\square}$. Justify your rule.

18. a) Copy and complete the table. Describe a pattern in the sums.

$\frac{1}{2} + \frac{1}{4} =$	$\frac{3}{4}$
$\frac{1}{3} + \frac{1}{6} =$	$\frac{3}{\square}$
$\frac{1}{4} + \frac{1}{8} =$	$\frac{3}{\square}$
$\square + \square =$	$\frac{3}{10}$

b) Use the pattern to predict the answer to $\frac{1}{20} + \frac{1}{40}$.