

## Math Teaching for Learning:

### Addition and Subtraction of Fractions across the K-12 Mathematics Curriculum

Within the [Fractions Learning Pathways](#), six cells specify the foundational actions that support student understanding of addition and subtraction of fractions. This support document is intended to provide a K-12 perspective on the role of adding and subtracting fractions in students' learning.

*Studies have shown "if children are given the time to develop their own reasoning for at least three years without being taught standard algorithms for operations with fractions and ratios, then a dramatic increase in their reasoning abilities occurred, including their proportional thinking" (Brown & Quinn, 2006, p. 39, citing Lamon, 1999).*

### Connecting Addition and Subtraction to Counting by Unit Fractions and Composing/Decomposing Fractions

Intuitive understanding of addition and subtraction of fractions is developed by students' initial experiences with fraction representation. For example, in the following rectangle, a student may identify that  $\frac{2}{5}$  of the total area is shaded. At the same time, they will recognize that  $\frac{3}{5}$  of the total area is unshaded and therefore,  $\frac{2}{5} + \frac{3}{5} = 1$  whole.



### Addition and Subtraction with Like Denominators

**What does this look like in the Ontario Mathematics Curriculum (Specific Expectations)?**

**Students will:**

*Grade 2: regroup fractional parts into wholes, using concrete materials.*

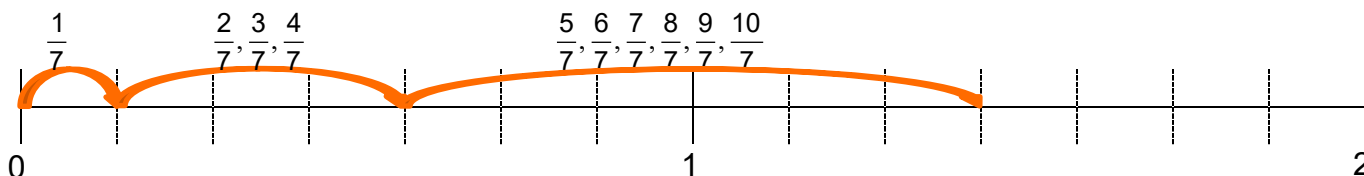
*Grade 5: represent, compare, and order fractional amounts with like denominators, including proper and improper fraction and mixed numbers, using a variety of tools and using standard fractional notation.*

*Grade 7: use a variety of mental strategies to solve problems involving the addition and subtraction of fractions and decimals.*

*Grade 12: recognize and describe an event as a set of outcomes and as a subset of a sample space, determine the complement of an event, determine whether two or more events are mutually exclusive or non-mutually exclusive. (MDM 4U)*

As with all addition and subtraction, the fractions being added or subtracted require being expressed in a common unit.

When students combine fractions with like denominators, understanding of the numerator as the count and the denominator as the fractional unit is reinforced. Through exploration, students are able to consider flexible strategies for addition of fractions, including combining fractions to make wholes. For example, consider  $\frac{1}{7} + \frac{2}{7} + \frac{3}{7} + \frac{6}{7}$ . Combining  $\frac{1}{7} + \frac{2}{7} + \frac{3}{7}$  to make a whole and then adding  $\frac{6}{7}$  for a final answer of  $1\frac{3}{7}$ . Alternatively, students could use a counting on strategy, demonstrated here on the number line.



**What does this look like in the Ontario Mathematics Curriculum (Specific Expectations)?**

**Students will:**

Grade 2: determine, through investigation using concrete materials, the relationship between the number of fractional parts of a whole and the size of the fractional parts.

Grade 4: compare and order fractions by considering the size and the number of fractional parts.

Grade 7: add and subtract fractions with simple like and unlike denominators, using a variety of tools

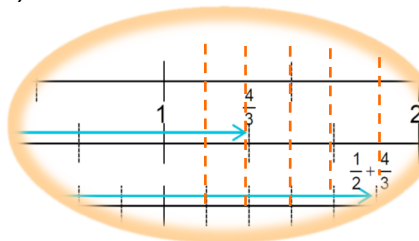
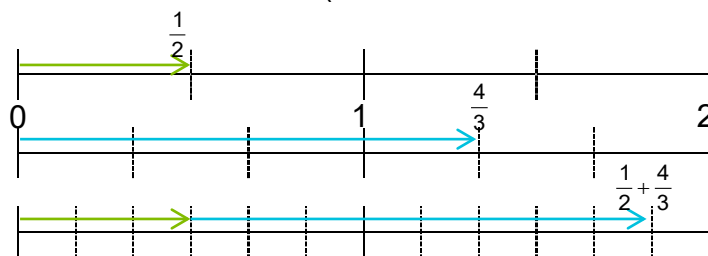
Grade 12: measure, using a variety of tools, the lengths of common objects and the capacities of common containers, using the metric system and the imperial system (MEL 4E; also MFM 2P, MBF 3C, MAP 4C and MEL 4E)

**Addition and Subtraction with Unlike Denominators**

Students with a strong fraction number sense can compose wholes with unlike denominators as well using equivalent fractions. For example, when determining the result of  $\frac{18}{24} + \frac{5}{10} - \frac{3}{12}$ , if students

recognize that  $\frac{18}{24} + \frac{5}{10} - \frac{3}{12} = \frac{3}{4} + \frac{1}{2} - \frac{1}{4}$ , they may have an easier time reasoning that  $\frac{3}{4} - \frac{1}{4} + \frac{1}{2} = 1$ .

In order to calculate the sum of fractions with unlike units, such as  $\frac{1}{2} + \frac{4}{3}$ , they must express each fraction in a common unit (with a common denominator).



When using stacked number lines, the partitions of both units can be mapped to the third line to show the common unit.

**What does this look like in the Ontario Mathematics Curriculum (Specific Expectations)?**

**Students will:**

Grade 1: divide whole objects into parts and identify and describe, through investigation, equal sized parts of the whole, using fractional names (e.g., halves, fourths)

Grade 7: add and subtract fractions with simple like and unlike denominators, using a variety of tools

Grade 12: measure, using a variety of tools, the lengths of common objects and the capacities of common containers, using the metric system and the imperial system (MEL 4E; also MFM 2P, MBF 3C, MAP 4C and MEL 4E)

**Addition and Subtraction of Fractions in Contexts**

Students use their knowledge of addition and subtraction of fractions in contexts across the strands and grades. Students add and subtract fractions when they determine complementary probabilities or combine measures such as Imperial linear, time or rotational quantities. All secondary students add and subtract fractions as they manipulate algebraic equations.

**What does this look like in the Ontario Mathematics Curriculum (Specific Expectations)?**

**Students will:**

Grade 4: predict the frequency of an outcome in a simple probability experiment.

Grade 8: evaluate algebraic expressions with up to three terms, by substituting fractions, decimals, and integers for the variables.

Grade 12: solve linear and quadratic equations, with and without graphing technology, for the domain of real values from 0 to  $2\pi$ , and solve related problems. (MHF 4U)

**For further information, visit [fractionsteaching.ca](http://fractionsteaching.ca)**

- *Fractions Learning Pathways* (adding and subtracting fractions tasks and supporting documents)
- *Foundations to Learning and Teaching Fractions: Addition and Subtraction*