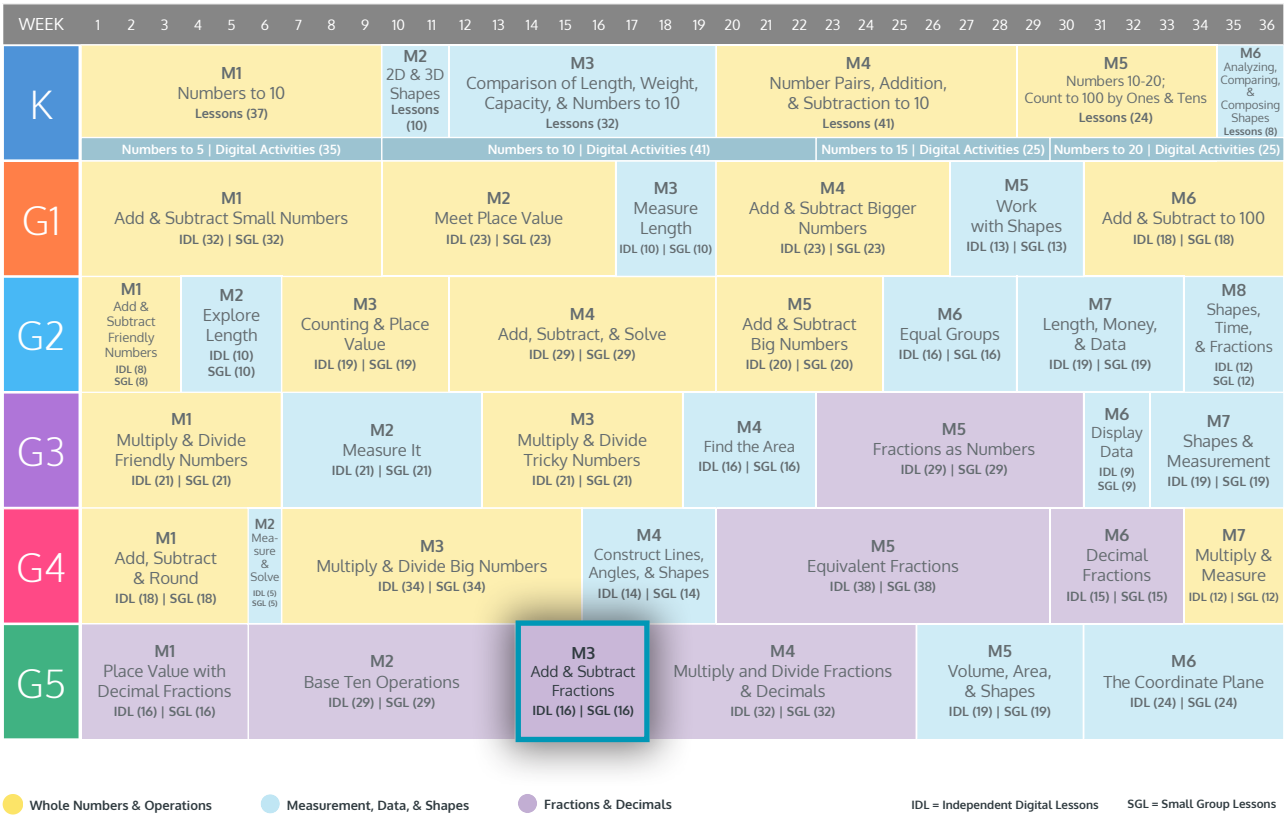
MISSION OVERVIEW

Grade 5, Mission 3
Add and Subtract Fractions

In this Mission, students will develop flexibility with addition and subtraction of fractions so they can mentally or numerically solve, reason, and estimate their calculations. The Mission begins with concrete and pictorial work (using area models and number lines) and moves to numeric work with word problems by the end.

CURRICULUM MAP



Overview of Topics and Lesson Objectives

Each mission is broken down into topics. A topic is a group of lessons that teach the same concept. For each topic, Zearn offers Whole Group Fluencies, Whole Group Word Problems, Small Group Lessons, and Independent Digital Lessons. There is a balance of Independent Digital Lessons and Small Group Lessons in each topic of a mission to ensure every student learns with a mix of modalities, feedback, and support while engaging in grade-level content. Throughout each mission, students work on grade-level content with embedded remediation to fill gaps in prior knowledge.

	Objective	INDEPENDENT DIGITAL LESSON	SMALL GROUP LESSON
Topic A	**Equivalent Fractions** **4.NF.1, 4.NF.3c, 4.NF.3d**		
Lesson 1	Make equivalent fractions with the number line, the area model, and numbers.	✓	✓
Lesson 2	Make equivalent fractions with sums of fractions with like denominators.	✓	✓
Topic B	**Making Like Units Pictorially** **5.NF.1, 5.NF.2**		
Lesson 3	Add fractions with unlike units using the strategy of creating equivalent fractions.	✓	✓
Lesson 4	Add fractions with sums between 1 and 2.	✓	✓
Lesson 5	Subtract fractions with unlike units using the strategy of creating equivalent fractions.	✓	✓
Lesson 6	Subtract fractions from numbers between 1 and 2.	✓	✓
Lesson 7	Solve two-step word problems.	✓	✓
	Mid-Mission Assessment: Topics A-B		
Topic C	**Making Like Units Numerically** **5.NF.1, 5.NF.2**		
Lesson 8	Add fractions to and subtract fractions from whole numbers using equivalence and the number line as strategies.	✓	✓
Lesson 9	Add fractions making like units numerically.	✓	✓
Lesson 10	Add fractions with sums greater than 2.	✓	✓

	Objective	INDEPENDENT DIGITAL LESSON	SMALL GROUP LESSON
Lesson 11	Subtract fractions making like units numerically.	✓	✓
Lesson 12	Subtract fractions greater than or equal to 1.	✓	✓
Topic D	**Further Applications** **5.NF.1, 5.NF.2**		
Lesson 13	Use fraction benchmark numbers to assess reasonableness of addition and subtraction equations.	✓	✓
Lesson 14	Strategize to solve multi-term problems.	✓	✓
Lesson 15	Solve multi-step word problems; assess reasonableness of solutions using benchmark numbers.	✓	✓
Lesson 16	Explore part-to-whole relationships.	✓	✓
	End-of-Mission Assessment: Topics C-D		

Foundational Missions

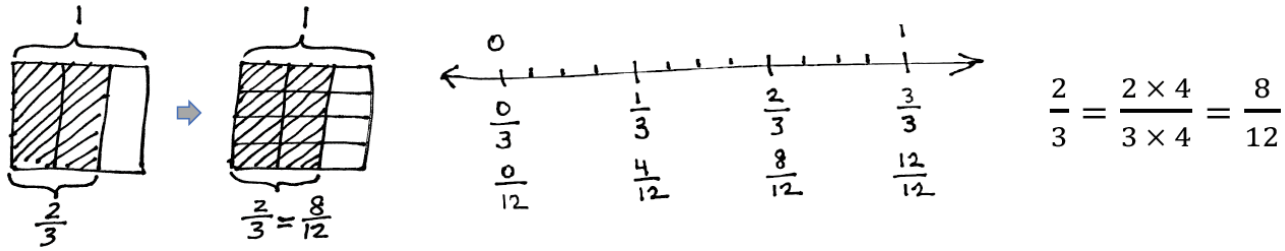
For each mission, Zearn Math highlights the foundational missions, the earlier content where concepts are introduced and developed. Teachers can access foundational missions directly from the mission page of their Teacher Account to address any gaps in prior knowledge. Zearn recommends that teachers assign foundational missions during Flex Day or during additional non-core instruction time. It is important to use a foundational mission to support a struggling student, rather than an unaligned mission, because the content students learn in each foundational mission supports their Core Day learning.

Foundational Missions for G5M3: G3M5 Fractions as Numbers, G4M5 Equivalent Fractions

Mission Overview

In Mission 3, students' understanding of addition and subtraction of fractions extends from earlier work with fraction equivalence and decimals. This mission marks a significant shift away from the elementary grades' centrality of base ten units to the study and use of the full set of fractional units from Grade 5 forward, especially as applied to algebra.

In **Topic A**, students revisit the foundational Grade 4 standards addressing equivalence. When equivalent, fractions represent the same amount of area of a rectangle and the same point on the number line. These equivalencies can also be represented symbolically.



$$\frac{2}{3} = \frac{2 \times 4}{3 \times 4} = \frac{8}{12}$$

Furthermore, equivalence is evidenced when adding fractions with the same denominator. The sum may be decomposed into parts (or recomposed into an equal sum). An example is shown as follows:

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

$$\frac{7}{8} = \frac{3}{8} + \frac{3}{8} + \frac{1}{8}$$

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

$$\frac{8}{5} = \frac{5}{5} + \frac{3}{5} = 1\frac{3}{5}$$

$$\frac{7}{3} = \frac{6}{3} + \frac{1}{3} = 2 \times \frac{3}{3} + \frac{1}{3} = 2 + \frac{1}{3} = 2\frac{1}{3}$$

This also carries forward work with decimal place value from Missions 1 and 2, confirming that like units can be composed and decomposed.

5 tenths + 7 tenths = 12 tenths = 1 and 2 tenths

5 eighths + 7 eighths = 12 eighths = 1 and 4 eighths

In **Topic B**, students move forward to see that fraction addition and subtraction are analogous to whole number addition and subtraction. Students add and subtract fractions with unlike denominators (**5.NF.1**) by replacing different fractional units with an equivalent fraction or like unit.

1 fourth + 2 thirds = 3 twelfths + 8 twelfths = 11 twelfths

$$\frac{1}{4} + \frac{2}{3} = \frac{3}{12} + \frac{8}{12} = \frac{11}{12}$$

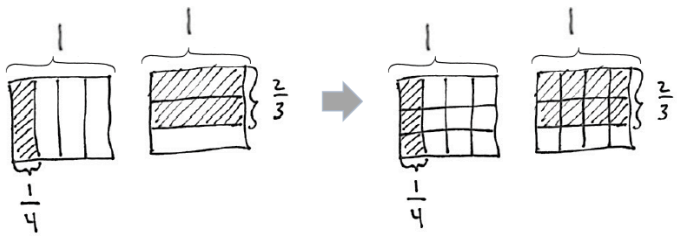
This is not a new concept, but certainly a new level of complexity. Students have added equivalent or like units since kindergarten, adding frogs to frogs, ones to ones, tens to tens, etc.

1 boy + 2 girls = 1 child + 2 children = 3 children

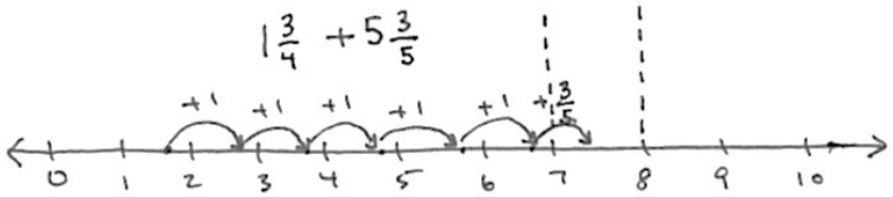
1 liter – 375 mL = 1,000 mL – 375 mL = 625 mL

Throughout the mission, a concrete to pictorial to abstract approach is used to convey this simple concept. Topic A uses paper strips and number line diagrams to clearly show equivalence. After a brief concrete experience with folding paper, Topic B primarily uses the rectangular fractional model because it is useful for creating smaller like units by means of partitioning (e.g., thirds and fourths are changed to twelfths to create equivalent fractions as in the diagram below). In **Topic C**, students move away from the pictorial altogether as they are empowered to write equations clarified by the model.

$$\frac{1}{4}+\frac{2}{3}=\left(\frac{1\times 3}{4\times 3}\right)+\left(\frac{2\times 4}{3\times 4}\right)=\frac{3}{12}+\frac{8}{12}=\frac{11}{12}$$



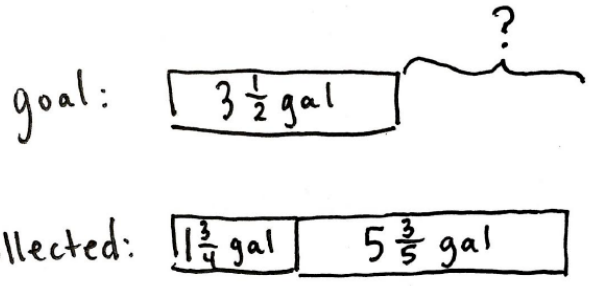
Topic C also uses the number line when adding and subtracting fractions greater than or equal to 1 so that students begin to see and manipulate fractions in relation to larger whole numbers and to each other. The number line allows students to pictorially represent larger whole numbers. For example, "Between which two whole numbers does the sum of 1 ¾ and 5 ⅗ lie?"



$\_\_\_\_ < 1\frac{3}{4} + 5\frac{3}{5} < \_\_\_\_$

This leads to an understanding of and skill with solving more complex problems, which are often embedded within multi-step word problems:

Cristina and Matt's goal is to collect a total of 3 ½ gallons of sap from the maple trees. Cristina collected 1 ¾ gallons. Matt collected 5 ⅗ gallons. By how much did they beat their goal?



$$1\frac{3}{4}+5\frac{3}{5}-3\frac{1}{2}=3+\left(\frac{3\times 5}{4\times 5}\right)+\left(\frac{3\times 4}{5\times 4}\right)-\left(\frac{1\times 10}{2\times 10}\right)$$

$$=3+\frac{15}{20}+\frac{12}{20}-\frac{10}{20}=3\frac{17}{20}$$

Cristina and Matt beat their goal by $3\frac{17}{20}$ gallons.

Word problems are a part of every lesson. Students are encouraged to draw tape diagrams, which encourage them to recognize part-whole relationships with fractions that they have seen with whole numbers since Grade 1.

In **Topic D**, students strategize to solve multi-term problems and more intensely assess the reasonableness of their solutions to equations and word problems with fractional units (**5.NF.2**).

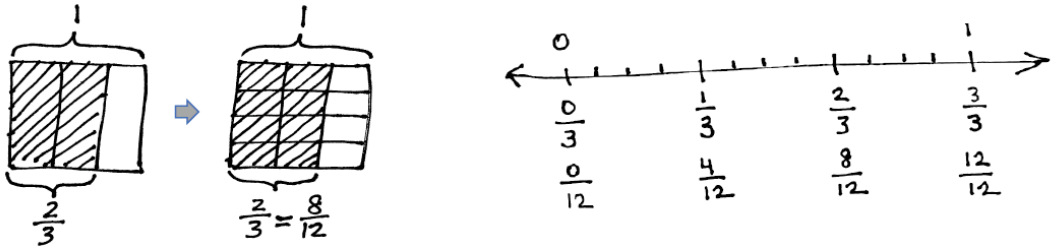
"I know my answer makes sense because the total amount of sap they collected is about 7 and a half gallons. Then, when we subtract 3 gallons, that is about 4 and a half. Then, 1 half less than that is about 4. 3 17/20 is just a little less than 4."

The Mid-Mission Assessment follows Topic B. The End-of-Mission Assessment follows Topic D.

Topic A: Equivalent Fractions

LESSONS 1-2

In Topic A, students revisit the foundational Grade 4 standards addressing equivalence. When equivalent, fractions can be represented by the same amount of area of a rectangle as well as the same point on a number line. Students subdivide areas and divide number line lengths to model this equivalence. On the number line below, there are 3 × 4 parts of equal length. Both the area model and number line show that 2 thirds is equivalent to 8 twelfths.



This equivalence can also be represented symbolically as follows:

$$\frac{2}{3} = \frac{2 \times 4}{3 \times 4} = \frac{8}{12}$$

Furthermore, equivalence is evidenced when adding fractions with the same denominator. The sum may be decomposed into parts (or recomposed into an equal sum). An example is shown as follows:

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

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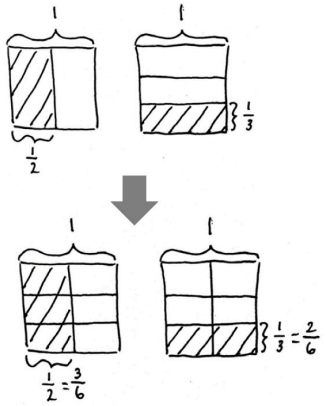
In Lesson 1, students analyze how and when units must change, particularly when making an equivalent fraction by decomposing larger units into smaller units. This hones their ability to look for and make use of structure (**MP.7**). They study the area model to make generalizations and then apply those generalizations to work with the number line as they see the same process occurring there within the lengths.

Topic B: Making Like Units Pictorially

LESSONS 3-7

In Topic B, students use the familiar rectangular fraction model to add and subtract fractions with unlike denominators.

Students make like units for all addends or both minuend and subtrahend. First, they draw a wide rectangle and partition it with vertical lines as they would a tape diagram, representing the first fraction with a bracket and shading. They then partition a second congruent rectangle with horizontal lines to show the second fraction. Next, they partition both rectangles with matching lines to create like units.



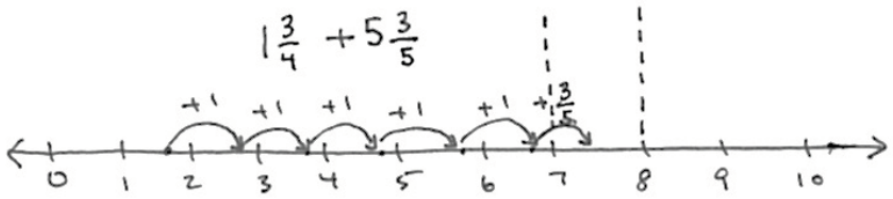
$$\frac{1}{2} + \frac{1}{3}$$
$$= \frac{3}{6} + \frac{2}{6}$$
$$= \frac{5}{6}$$

This strategy pictorially proves 3 sixths are equal to 1 half and 2 sixths are equal to 1 third. Students practice making these models extensively until they internalize the process of making like units. Students use the same systematic drawing for addition as they do for subtraction. In this manner, students are prepared to generalize with understanding to multiply the numerator and denominator by the same number. The topic closes with a lesson devoted to solving two-step word problems involving addition and subtraction of fractions.

Topic C: Making Like Units Numerically

LESSONS 8-12

In Topic C, students use the number line when adding and subtracting fractions greater than or equal to 1. The number line helps students see that fractions are analogous to whole numbers. The number line makes it clear that numbers on the left are smaller than numbers on the right, which leads to an understanding of integers in Grade 6. Using this tool, students recognize and manipulate fractions in relation to larger whole numbers and to each other. For example, "Between which two whole numbers does the sum of 1 ⅔ and 5 ¾ lie?"



$$\_\_\_\_ < 1\frac{3}{4} + 5\frac{3}{5} < \_\_\_\_$$

This leads to an understanding of and skill with solving more complex problems often embedded within multi-step word problems:

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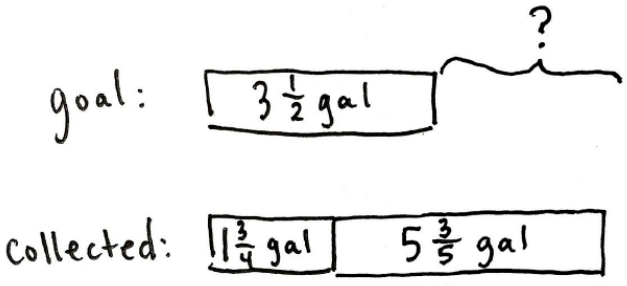


$$1\frac{3}{4}+5\frac{3}{5}-3\frac{1}{2}=3+\left(\frac{3\times5}{4\times5}\right)+\left(\frac{3\times4}{5\times4}\right)-\left(\frac{1\times10}{2\times10}\right)$$

$$=3+\frac{15}{20}+\frac{12}{20}-\frac{10}{20}=3\frac{17}{20}$$

Cristina and Matt beat their goal by $3\frac{17}{20}$ gallons.

Word problems are a part of every lesson. Students are encouraged to utilize tape diagrams, which facilitate analysis of the same part–whole relationships they have worked with since Grade 1.

Topic D: Further Applications

LESSONS 13-16

Topic D opens with students estimating the value of expressions involving sums and differences with fractions. "Will your sum be less than or greater than one half? One? How do you know?" Though these conversations have been embedded within many debrief questions up to this point, by setting aside an instructional day to dig deeply into logical arguments, students see that it is very easy to forget to make sense of numbers when calculating. This is really the theme of this topic—reasoning while using fractions.

In Lesson 14, students look for number relationships before calculating, for example, to use the associative property or part-whole understanding. Looking for relationships allows them to see shortcuts and connections that are so often bypassed in the rush to get the answer.

In Lesson 15, students solve multi-step word problems and actively assess the reasonableness of their answers. In Lesson 16, they explore part-whole relationships while solving a challenging problem: "One half of Nell's money is equal to 2 thirds of Jennifer's." This lesson challenges the underlying assumption of all fraction arithmetic—that when adding and subtracting, fractions are always defined in relationship to the same whole amount. The beauty of this exploration is to see students grasp that ½ of one thing can be equivalent to ⅔ of another!

Terminology

New or Recently Introduced Terms

- **Benchmark fraction**
  E.g., ½ is a benchmark fraction when comparing ⅓ and ⅗
- **Like denominators**
  E.g., ⅛ and ⅝
- **Unlike denominators**
  E.g., ⅛ and ⅐

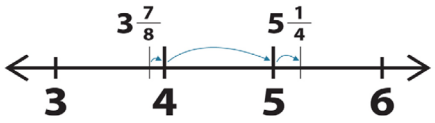
Familiar Terms and Symbols[1]

- **Between**
  E.g., ½ is between ⅓ and ⅗
- **Denominator**
  Denotes the fractional unit: fifths in 3 fifths, which is abbreviated as the 5 in ⅗
- **Equivalent fraction**
  E.g., ⅗ = ⅙₀
- **Fraction**
  E.g., 3 fifths or ⅗
- **Fraction greater than or equal to 1**
  E.g., ⅞, 3 ½, an abbreviation for 3 + ½
- **Fraction written in the largest possible unit**
  E.g., ⅜ = $^{(1 \times 3)}/_{(2 \times 3)}$ = ½ or 1 three out of 2 threes = ½
- **Fractional unit**
  E.g., the fifth unit in 3 fifths denoted by the denominator 5 in ⅗
- **Hundredth**
  ⅟₁₀₀ or 0.01
- **Kilometer, meter, centimeter, liter, milliliter, kilogram, gram, mile, yard, foot, inch, gallon, quart, pint, cup, pound, ounce, hour, minute, second**
- ***More than halfway* and *less than halfway***
- **Number sentence**
  E.g., Three plus seven equals ten. Usually written as 3 + 7 = 10.
- **Numerator**
  Denotes the count of fractional units: 3 in 3 fifths or 3 in ⅗
- ***One tenth of***
  E.g., ⅟₁₀ × 250
- **Tenth**
  ⅟₁₀ or 0.1
- **Whole unit**
  E.g., any unit that is partitioned into smaller, equally sized fractional units
- **<, >, =**

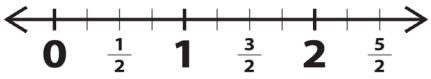
1 These are terms and symbols students have seen previously.

Suggested Tools and Representations

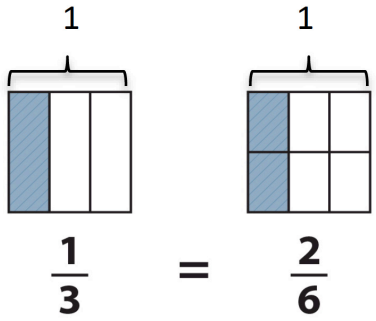
- **Fraction strips**
- **Number line**
  A variety of templates
- **Paper strips**
  For modeling equivalence
- **Rectangular fraction model**
- **Tape diagrams**



Example of an "empty" number line



Example of a number line



Example of a rectangular fraction model

Focus Grade Level Standards

Use equivalent fractions as a strategy to add and subtract fractions.[2]

5.NF.1
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. *For example,* $2/3 + 5/4 = 8/12 + 15/12 = 23/12$. *(In general,* $a/b + c/d = (ad + bc)/\cdot$.)

5.NF.2
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. *For example, recognize an incorrect result* $2/5 + 1/2 = 3/7$, *by observing that* $3/7 < 1/2$.

Foundational Standards

4.NF.1
Explain why a fraction a/b is equivalent to a fraction $(n \times a)/(n \times b)$ by using visual fraction models, with attention to how the number and size of the parts differ even though the two fractions themselves are the same size. Use this principle to recognize and generate equivalent fractions.

4.NF.3
Understand a fraction a/b with $a > 1$ as a sum of fractions $1/b$.

a. Understand addition and subtraction of fractions as joining and separating parts referring to the same whole.
b. Decompose a fraction into a sum of fractions with the same denominator in more than one way, recording each decomposition by an equation. Justify decompositions, e.g., by using a visual fraction model. *Examples:* $3/8 = 1/8 + 1/8 + 1/8$; $3/8 = 1/8 + 2/8$; $2\ 1/8 = 1 + 1 + 1/8 = 8/8 + 8/8 + 1/8$.
c. Add and subtract mixed numbers with like denominators, e.g., by replacing each mixed number with an equivalent fraction, and/or by using properties of operations and the relationship between addition and subtraction.
d. Solve word problems involving addition and subtraction of fractions referring to the same whole and having like denominators, e.g., by using visual fraction models and equations to represent the problem.

2 Examples in this mission also include tenths and hundredths in fraction and decimal form.

Focus Standards for Mathematical Practice

MP.1

Make sense of problems and persevere in solving them. Students make sense of problems when they use number lines, tape diagrams, and fraction models to conceptualize and solve fraction addition and subtraction problems. Students also check their work and monitor their progress, assessing their approach and its validity within the given context and altering their method when necessary.

MP.3

Construct viable arguments and critique the reasoning of others. As students add and subtract with fractions and mixed numbers, they make choices and reason about which like unit to choose and draw conclusions about what makes some problems simpler than others. Students analyze multiple solution strategies for given problems and draw conclusions about which method is most efficient in each case. Students also critique the reasoning of others and construct viable arguments during this analysis. They also use their understanding of fractions to assess the reasonableness of sums and differences and use these assumptions to justify their conclusions to others.

MP.5

Use appropriate tools strategically. Students use mental computation and estimation strategies to assess the reasonableness of their answers. They decide which pictorial model to draw and label and reason about its size relative to the context of the problem. Students decide on the appropriateness of using special strategies when adding and subtracting mixed numbers.

MP.7

Look for and make use of structure. Students discern patterns and structures as they draw fraction models and reason about the number of units represented, the size or length of those units, and the name of the fraction that each model represents. They identify patterns in sums and differences when the same fraction is added to or taken from a variety of numbers and use this understanding to generate predictions about the sums and differences.

MP.8

Look for and express regularity in repeated reasoning. Students express regularity in repeated reasoning when they look for and use whole number general methods to add and subtract fractions. Adding and subtracting fractions requires finding like units just as it does with whole numbers, such as when adding centimeters and meters.