

Standard 8				
Numbers and Operations - Fractions				
Benchmark 1	Develop understanding of fractions as numbers.	Extend understanding of fraction equivalence and ordering.	Use equivalent fractions as a strategy to add and subtract fractions.	Apply and extend previous understandings of multiplication and division to divide fractions by fractions.
	Understand a fraction $1/b$ as the quantity formed by 1 part when a whole is partitioned into $b$ equal parts; understand a fraction $a/b$ as the quantity formed by $a$ parts of size $1/b$ .	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.	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, $a/b + c/d = (ad + bc)/bd$ .)	Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions, e.g., by using visual fraction models and equations to represent the problem.
	Understand a fraction as a number on the number line; represent fractions on a number line diagram.	Compare two fractions with different numerators and different denominators, e.g., by creating common denominators or numerators, or by comparing to a benchmark fraction such as $1/2$ . Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with symbols $>$ , $=$ , or $<$ , and justify the conclusions, e.g., by using a visual fraction model.	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.	
	Explain equivalence of fractions in special cases, and compare fractions by reasoning about their size.			

Benchmark 2		Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers.	Apply and extend previous understandings of multiplication and division to multiply and divide fractions.	Apply and extend previous understandings of numbers to the system of rational numbers.
		Understand a fraction $a/b$ with $a > 1$ as a sum of fractions $1/b$ .	Interpret a fraction as division of the numerator by the denominator ( $a/b = a \div b$ ). Solve word problems involving division of whole numbers leading to answers in the form of fractions or mixed numbers, e.g., by using visual fraction models or equations to represent the problem.	Understand that positive and negative numbers are used together to describe quantities having opposite directions or values; use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation.
				Understand a rational number as a point on the number line. Extend number line diagrams and coordinate axes familiar from previous grades to represent points on the line and in the plane with negative number coordinates.
		Apply and extend previous understandings of multiplication to multiply a fraction by a whole number.	Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction.	Compute fluently with multi-digit numbers and find common factors and multiples.
			Interpret multiplication as scaling (resizing), by:	Fluently divide multi-digit numbers using the standard algorithm.
			Solve real world problems involving multiplication of fractions and mixed numbers, e.g., by using visual fraction models or equations to represent the problem.	Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation.

			Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions.1	Find the greatest common factor of two whole numbers less than or equal to 100 and the least common multiple of two whole numbers less than or equal to 12. Use the distributive property to express a sum of two whole numbers 1–100 with a common factor as a multiple of a sum of two whole numbers with no common factor.
Benchmark 3		Understand decimal notation for fractions, and compare decimal fractions.		
		Express a fraction with denominator 10 as an equivalent fraction with denominator 100, and use this technique to add two fractions with respective denominators 10 and 100.2 For example, express $\frac{3}{10}$ as $\frac{30}{100}$ , and add $\frac{3}{10} + \frac{4}{100} = \frac{34}{100}$ .		
		Use decimal notation for fractions with denominators 10 or 100. For example, rewrite 0.62 as $\frac{62}{100}$ ; describe a length as 0.62 meters; locate 0.62 on a number line diagram.		
		Compare two decimals to hundredths by reasoning about their size. Recognize that comparisons are valid only when the two decimals refer to the same whole. Record the results of comparisons with the symbols $>$ , $=$ , or $<$ , and justify the conclusions, e.g., by using a visual model.		

Benchmark 4				Understand ratio concepts and use ratio reasoning to solve problems.
				Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. For example, "The ratio of wings to beaks in the bird house at the zoo was 2:1, because for every 2 wings there was 1 beak." "For every vote candidate A received, candidate C received nearly three votes."
				Understand the concept of a unit rate $a/b$ associated with a ratio $a:b$ with $b \neq 0$ , and use rate language in the context of a ratio relationship. For example, "This recipe has a ratio of 3 cups of flour to 4 cups of sugar, so there is $\frac{3}{4}$ cup of flour for each cup of sugar." "We paid \$75 for 15 hamburgers, which is a rate of \$5 per hamburger." <sup>1</sup>
				Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.

				Make tables of equivalent ratios relating quantities with whole-number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios.
				Solve unit rate problems including those involving unit pricing and constant speed. For example, if it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed?
				Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means $30/100$ times the quantity); solve problems involving finding the whole, given a part and the percent.
				Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.