

Connections to Previous Learning:

In Grade 6, students develop an understanding of rational numbers by using vertical and horizontal number lines and by applying their previous knowledge of whole numbers and integers to rational number systems.

Students have a great deal of background in operations from K-6 that will lead to achievement of the expectations in this unit. In the primary grades, students build understanding of whole number addition and subtraction. In the intermediate grades, students build understanding of multiplication and division with whole numbers and addition, subtraction, multiplication, and division with fractions and decimals. 6th grade students learn to comprehend division of fractions by fractions, and work to build an understanding of the value of integers. All of these concepts are crucial for students to be successful in this unit on operations with rational numbers. In the past, students have used number line models with whole numbers, fractions, and decimals. 6th graders have represented integers on vertical and horizontal number line diagrams, but this is their first experience in adding and subtracting positive and negative rational numbers.

Focus of this Unit:

Students will be able to add, subtract, multiply, and divide rational numbers fluently as well as solve real-world and mathematical problems. In this unit, students will represent their calculations using number line models, equations or expressions, and real world applications.

Connections to Subsequent Learning:

Students will apply their understanding of rational numbers to linear functions.

Desired Outcomes

Standard(s):

Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.

- **7.NS.1** Apply and extend previous understandings of addition and subtraction to add and subtract rational numbers; represent addition and subtraction on a horizontal or vertical number line diagram.
 - a) Describe situations in which opposite quantities combine to make 0. *For example, a hydrogen atom has 0 charge because its two constituents are oppositely charged.*
 - b) Understand $p + q$ as the number located a distance $|q|$ from p , in the positive or negative direction depending on whether q is positive or negative. Show that a number and its opposite have a sum of 0 (are additive inverses). Interpret sums of rational numbers by describing real-world contexts.
 - c) Understand subtraction of rational numbers as adding additive inverse, $p - q = p + (-q)$. Show that the distance between two rational numbers on the number line is the absolute value of their difference, and apply this principle in real-world contexts.
 - d) Apply properties of operations as strategies to add and subtract rational numbers.
- **7.NS.2** Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers.
 - a) Understand that multiplication is extended from fractions to rational numbers by requiring that operations continue to satisfy the properties of operations, particularly the distributive property, leading to products such as $(-1)(-1) = 1$ and the rules for multiplying signed numbers, interpret products of rational numbers by describing real-world contexts.
 - b) Understand that integers can be divided, provided that the divisor is not zero, and every quotient of integers (with non-zero divisor) is a rational number. If p and q are integers, then $-(p/1) = (-p)/q = p/(-q)$. Interpret quotients of rational numbers by describing real-world contexts.
 - c) Apply properties of operations as strategies to multiply and divide rational numbers.
 - d) Convert a rational number to a decimal using long division; know that the decimal form of a rational number terminates in 0s or eventually repeats.
- **7.NS.3** Solve real-world and mathematical problems involving the four operations with rational numbers.

Supporting Standard:

- **7.EE.2** Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related. *For example, $a + 0.05a = 1.05a$ means that "increase by 5% is the same as multiply by 1.05."*

Transfer:

Students will apply concepts and procedures for representing, interpreting, and solving real-world and mathematical problems involving operations with rational numbers.

Ex: $2/3$ of the students at our school have cell phones. $1/4$ of those students have smartphones. What fraction of the students with phones have smartphones?

Ex: Sarah has \$135 left in her checking account after writing checks for \$25, \$32.50 and \$18.40. What was her balance before she wrote the checks?

Understandings: *Students will understand that ...*

- Rational numbers use the same properties as whole numbers.
- Rational numbers can be used to represent and solve real-life problems.
- Rational numbers can be represented with visuals (including distance models), language, and real-life contexts.
- A number line model can be used to represent the unique placement of any number in relation to other numbers.
- There are precise terms and sequences to describe operations with rational numbers.

Essential Questions:

- How are rational numbers used and applied in real-life and mathematical situations?
- What is the relationship between properties of operations and types of numbers?

Mathematical Practices: (Practices to be explicitly emphasized are indicated with an *.)

- *1. Make sense of problems and persevere in solving them.** Students explain and demonstrate rational number operations by using symbols, visuals, words, and real life contexts. Students demonstrate perseverance while using a variety of strategies (number lines, manipulatives, drawings, etc.).
- *2. Reason abstractly and quantitatively.** Students demonstrate quantitative reasoning by representing and solving real-world situations using visuals, numbers, and symbols. They demonstrate abstract reasoning by translating numerical sentences into real world situations.
- 3. Construct viable arguments and critique the reasoning of others.** Students will discuss rules for operations with rational numbers using appropriate terminology and tools/visuals. Students apply properties to support their arguments and constructively critique the reasoning of others while supporting their own position.
- 4. Model with mathematics.** Students model understanding of rational number operations using tools such as algebra tiles, counters, visuals, and number lines. Students use these models to solve problems involving real-world situations.
- 5. Use appropriate tools strategically.** Students demonstrate their ability to select and use the most appropriate tool (paper/pencil, manipulatives, and calculators) while solving problems with rational numbers.
- 6. Attend to precision.** Students demonstrate precision by using correct terminology, correct symbols, and correct unit labeling. Students use precision in calculation by checking the reasonableness of their answers and making adjustments accordingly.
- 7. Look for and make use of structure.** Students look for structure in positive and negative rational numbers when they place them appropriately on the number line. They then use this structure in calculation, taking into consideration the position of numbers on the number line. Lastly, students recognize the problem solving structures of word problems and use this awareness to aid in solving said problems.
- 8. Look for and express regularity in repeated reasoning.** Students will use manipulatives to explore the patterns of operations with rational numbers. Students will then use these patterns to develop algorithms. Using said algorithms, they can solve problems with a variety of problem solving structures.

<p>Prerequisite Skills/Concepts:</p> <p><i>Students should already be able to:</i></p> <ul style="list-style-type: none"> Develop a conceptual understanding of positive and negative numbers. (6.NS.5-6) 	<p>Advanced Skills/Concepts:</p> <p><i>Some students may be ready to:</i></p> <ul style="list-style-type: none"> Know that there are numbers that are not rational, and approximate them by rational numbers. (8.NS.1-2) Interpret and apply positive and negative slopes of lines and positive and negative coefficients in equations; develop understanding of square roots and irrational numbers. Understand relationships between positive and negative coefficients or values for variables; use positive and negative integers to communicate directions in two dimensions. Evaluate algebraic expressions involving positive and negative coefficients or values for variables; interpret isometrics in the plane given in symbolic form. Graph equations on coordinate grids; locate square roots on the number line. Use the properties and order of operations to write equivalent expressions and solve equations.
<p>Knowledge: <i>Students will know...</i></p> <p>All standards in this unit go beyond the knowledge level.</p>	<p>Skills: <i>Students will be able to ...</i></p> <ul style="list-style-type: none"> Add and subtract rational numbers. (7.NS.1) Represent addition and subtraction on a horizontal or vertical number line diagram. (7.NS.1) Use words, visuals, and symbols to describe situations in which opposite quantities combine to make 0. (7.NS.1) Represent addition of quantities with symbols, visuals, and words by showing positive or negative direction from one quantity to the other. (7.NS.1) Show that a number and its opposite have a sum of 0 using visuals, symbols, words, and real-world contexts. (7.NS.1) Use the term “additive inverse” to describe 2 numbers whose sum is zero. (7.NS.1) Use commutative, distributive, associative, identity, and inverse properties to add and subtract rational numbers. (7.NS.1) Use the term “absolute value” to describe the distance from zero on number line diagram and with symbols. (7.NS.1) Multiply and divide rational numbers. (7.NS.2) Use the distributive property to multiply positive and negative rational numbers using symbols, visuals, words, and real-life contexts. (7.NS.2)

- Interpret products of rational numbers by describing real-world contexts. (7.NS.2)
- Identify situations when integers can and cannot be divided. (7.NS.2)
- Use words and real-world contexts to explain why the quotient of two integers is a rational number. (7.NS.2)
- Identify and apply properties used when multiplying and dividing rational numbers. (7.NS.2)
- Convert a rational number to a decimal using long division. (7.NS.2)
- Identify terminating or repeating decimal representations of rational numbers. (7.NS.2)
- Solve real-world and mathematical problems involving the four operations with rational numbers. (7.NS.3)

WIDA Standard: (English Language Learners)

English language learners communicate information, ideas, and concepts necessary for academic success in the content area of Mathematics.

English language learners benefit from:

- The use of manipulatives for developing understanding of operations with positive and negative numbers.
- Attention to mathematical vocabulary when solving real-world and mathematical problems involving positive and negative numbers.

Academic Vocabulary:**Critical Terms:**

Commutative Property
Distributive Property
Integers
Negative Numbers
Opposites
Positive Numbers
Income/Profit

Supplemental Terms:

Absolute Value
Additive Inverse
Associative Property
Expanding
Factoring
Quadrant I, II, III, IV
Order of Operations
Rational Numbers
Area
Coordinate Grid
Decimals
Expressions
Fact Family
Fractions
Mathematical Sentence
Number Line
Number Sentence
Operations
Ordered Pair
Variable

Assessment			
Pre-Assessments	Formative Assessments	Summative Assessments	Self-Assessments
<ul style="list-style-type: none"> Integers and Absolute Value 	<ul style="list-style-type: none"> Contexts and Representations for Adding and Subtracting Integers Contexts and Representations for Multiplying and Dividing Integers Salute Integer Game 	<ul style="list-style-type: none"> Contexts and Representations for Adding and Subtracting Rational Numbers Contexts and Representations for Multiplying and Dividing Rational Numbers NASA Task Rational Number Task 	<ul style="list-style-type: none"> Pre-Assessment
Sample Lesson Sequence			
<ol style="list-style-type: none"> Absolute Value Revisited 7.NS.1 Adding and Subtracting Integers 7.NS.1 & 7.NS.3 Adding and Subtracting Rational Numbers 7.NS.1 & 7.NS.3 Multiplying and Dividing Integers 7.NS.2abc & 7.NS.3 (Model Lesson) Multiplying and Dividing Rational Numbers 7.NS.2 & 7.NS.3 			