NEW MEXICO
Public Education Department

7.NS: THE NUMBER SYSTEM

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

Major Cluster (Students should spend the large majority of their time (65-85%) on the major work of the grade/course. Supporting work and, where appropriate, additional work should be connected to and engage students in the major work of the grade.)

Standard Text	**Standard for Mathematical Practices**	**Students who demonstrate understanding can:**
7.NS.A.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. • **7.NS.A.1.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.*** • **7.NS.A.1.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.** • **7.NS.A.1.C: Understand subtraction of rational numbers as adding the 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.**	SMP 4: Students can use tools strategically by choosing between number lines and other manipulatives to demonstrate the meaning of the operations. SMP 8: Students look for and express regularity in repeated reasoning by formulating rules for integer operations by creating and exploring several examples of models.	• Solve numerical addition and subtraction equations by using the properties of operations • Define and apply the commutative, associative, and additive identity properties to rational numbers • Formulate rules for integer operations • Expressively (orally and in writing) express understanding of “positive”, “negative”, “additive inverse”, and “zero” • Model combining positive and negative numbers and provide a rationale for their solutions • Apply mathematics to real-world examples of positive and negative numbers **Webb’s Depth of Knowledge:** 1-2 **Bloom’s Taxonomy:** Understand

• **7.NS.A.1.D: Apply properties of operations as strategies to add and subtract rational numbers.**		
Standard Text **7.NS.A.2: Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers.** • **7.NS.A.2.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.** • **7.NS.A.2.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/q) = (–p)/q = p/(– q)*. Interpret quotients of rational numbers by describing real world contexts.** • **7.NS.A.2.C: Apply properties of operations as strategies to multiply and divide rational numbers.** • **7.NS.A.2.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.**	**Standard for Mathematical Practices** SMP 5: Students use appropriate tools strategically by demonstrating their ability to select and use the most appropriate tool (paper/pencil, manipulatives, and calculators) while solving problems with rational numbers. SMP 6: Students attend to precision by using correct terminology and symbols and labeling units correctly. Students use precision in calculation by checking the reasonableness of their answers and adjusting accordingly.	**Students who demonstrate understanding can:** • Discover the rules for multiplying rational numbers Refer to the negative (-) sign correctly as "negative" or 'the opposite of" to make sense of real-world context. • Conclude that properties of the operations for multiplication are still applicable to rational numbers. • Use reasoning to determine that division by zero is undefined. • Discover that division as the inverse of multiplication still applies to rational numbers. • Generalize rules for division with signed numbers from examples. Use and articulate notations interchangeably p ÷(-q) is the same as p⁄-q. Interpret a rational quotient • Clarify their own understanding of the relationship between multiplications and division of rational numbers through writing. • Develop fluency through practice with multiplication and division of rational numbers. • Use properties of the operations to explain the solutions to real world problems. • Clarify and explain their understanding of properties of operations using mathematical discourse. • Use math vocabulary appropriately.

		• Use long division to convert rational numbers in fraction form to decimal form • Explain why and how they know a long division quotient will repeat. • Sort the decimal form of a rational numbers into two types: terminating or repeating.
		Webb's Depth of Knowledge: 1-2
		Bloom's Taxonomy: Understand, Apply
Standard Text **7.NS.A.3: Solve real-world and mathematical problems involving the four operations with rational numbers. (Computations with rational numbers extend the rules for manipulating fractions to complex fractions.)**	**Standard for Mathematical Practices** SMP 2: Students reason abstractly and quantitively by representing and solving real world situations using visuals, numbers, and symbols. They demonstrate abstract reasoning by translating numerical sentences into real world situations. SMP 3: Students construct viable arguments and critique the reasoning of others by discussing 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. SMP 4: Students model with mathematics by modeling their understanding of rational number operations using tools such as algebra tiles, counters, visuals, and number lines and connect these models to solve problems involving real-world situations.	**Students who demonstrate understanding can:** • Apply operations with rational numbers to problems that involve the order of operations • Solve mathematical problems that use the four operations with rational numbers • Compute with complex fractions
		Webb's Depth of Knowledge: 1-2
		Bloom's Taxonomy: Understand, Apply

Previous Learning Connections	Current Learning Connections	Future Learning Connections
• In grade 6, learners understand that positive and negative numbers are used together to describe quantities having opposite directions or values. In grade 6, learners solve problems involving fractions by fractions. In grade 6, learners use order of operations to solve problems.	• In grade 7, learners apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers. In grade 7, learners solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form. In grade 7, learners use variables to represent quantities in a real-world or mathematical problem and construct simple equations and inequalities to solve problems by reasoning about the quantities.	• In grade 8, learners understand that there are numbers that are not rational and approximate them by rational numbers. In grade 8, learners use square root and cube root symbols to represent solutions to equations of the form x6 2 = p and x 3 = p, where p is a positive rational number.

Clarification Statement:
Students learn to add and subtract rational numbers. As students begin this work visual representations are critical; they become less necessary as students become more fluent with these operations. In sixth grade, students found the distance of horizontal and vertical segments on the coordinate plane. In seventh grade, students build on this understanding to recognize subtraction is finding the distance between two numbers on a number line. This standard allows for adding and subtracting of negative fractions and decimals and interpreting solutions in given context. Students should learn to use the terms "rational numbers", "additive inverse", and "integers" with increasing precision.

Common Misconceptions
The major misconceptions in this cluster are around the conceptualization of integer operations and the properties of subtraction. Students may struggle with using the number line to understand positive and negative numbers as distances from zero. It is important to use models to allow students to visualize rational numbers. When moving into operations, subtraction can lead to misconceptions when students must recall that subtraction is not commutative. They also may find difficulties with conceptualization when expressing that subtraction is the same as adding the inverse.

Multi-Layered System of Supports (MLSS)/Suggested Instructional Strategies

Pre-Teach

Pre-teach (targeted): *What pre-teaching will prepare students to productively struggle with the mathematics for this cluster within your HQIM?*

- For example, some learners may benefit from targeted pre-teaching that rehearses prior learning when studying application and extension of previous understandings of operations with fractions to add, subtract, multiply, and divide with rational numbers because students learn best when concepts are connected and they can "see" the connection across and within grade levels. This allows a familiarity and comfort level to approach new or different tasks using what they already know.

Pre-teach (intensive): *What critical understandings will prepare students to access the mathematics for this cluster?*

- 6.NS.C.5 This standard provides a foundation for work with applying and extending previous understandings of operations with fractions to add, subtract, multiply, and

divide rational numbers because in Grade 6, the number line is extended to include negative numbers. Students initially encounter negative numbers in contexts where it is natural to describe both the magnitude of the quantity, e.g. vertical distance from sea level in meters, and the direction of the quantity (above or below sea level). If students have unfinished learning within this standard, based on assessment data, consider ways to provide intensive pre-teaching support prior to the start of the unit to ensure students are ready to access grade level instruction and assignments.

Core Instruction

Access:

Interest: *How will the learning for students provide multiple options for recruiting student interest?*

- For example, learners engaging with applying and extending previous understandings of addition and subtraction to add and subtract rational numbers of multiplication and division and of fractions to multiply and divide rational numbers, and representing addition and subtraction on a horizontal or vertical number line diagram benefit when learning experiences include ways to recruit interest such as utilizing classroom instructional routines to involve all students because these routines, done regularly, can benefit all students, though they are particularly supportive of English Language Learners or those struggling with the linguistic components of math. It allows for clearer understanding and application of concepts by spotlighting any misconceptions and reinforcing accurate computation. For example, using MLR-1(stronger and clearer each time), a discussion can be opened for students to talk about positive and negative numbers in real world situations and pre-assessment of prior knowledge can be determined. Then that prior knowledge can be corrected, clarified, or built upon.

Build:

Effort and Persistence: *How will the learning for students provide options for sustaining effort and persistence?*

- For example, learners engaging with applying and extending previous understandings of addition and subtraction to add and subtract rational numbers, of multiplication and division and of fractions to multiply and divide rational numbers, and representing addition and subtraction on a horizontal or vertical number line diagram benefit when learning experiences attend to students attention and affect to support sustained effort and concentration such as displaying the learning goals in multiple way because then students become active members of the learning process. They are invested in the process and outcome becomes relevant and applicable. It increases ownership and generates attainable benchmarks.

Language and Symbols: *How will the learning for students provide alternative representations to ensure accessibility, clarity and comprehensibility for all learners? (e.g., a graph illustrating the relationship between two variables may be informative to one learner and inaccessible or puzzling to another; picture or image may carry very different meanings for learners from differing cultural or familial backgrounds)*

- For example, learners engaging with applying and extending previous understandings of addition and subtraction to add and subtract rational numbers, of multiplication and division and of fractions to multiply and divide rational numbers, and representing addition and subtraction on a horizontal or vertical number line diagram benefit when learning experiences attend to the linguistic and nonlinguistic representations of mathematics to ensure clarity can comprehensibility for all learners such as allowing for flexibility and easy access to multiple representations of notation where appropriate (e.g., formulas, word problems, graphs) because this

opportunity accommodates for various learning styles and is leveled for each learners abilities to communicate. Students are encouraged to represent their thinking at their comfort level while seeing a variety of representations. Moves scholars from concrete to visual to abstract while acknowledging their understanding.

Expression and Communication: *How will the learning provide multiple modalities for students to easily express knowledge, ideas, and concepts in the learning environment?*

- For example, learners engaging with applying and extending previous understandings of addition and subtraction to add and subtract rational numbers, of multiplication and division and of fractions to multiply and divide rational numbers, and representing addition and subtraction on a horizontal or vertical number line diagram benefit when learning experiences attend to the multiple ways students can express knowledge, ideas, and concepts such as using physical manipulatives (e.g., blocks, 3D models, base-ten blocks) because directing and facilitating classroom activities and learning tasks which elicit evidence of learning, activating learners as instructional resources for one another, and activating learners as owners of their own learning. In all three cases, by actively engaging students in the doing of mathematics, manipulatives provide a foundation which encourages discussion and student ownership of their work.

Internalize:

Comprehension: *How will the learning for students' support transforming accessible information into usable knowledge, knowledge that is accessible for future learning and decision-making?*

- For example, learners engaging with applying and extending previous understandings of addition and subtraction to add and subtract rational numbers of multiplication and division and of fractions to multiply and divide rational numbers, and representing addition and subtraction on a horizontal or vertical number line diagram benefit when learning experiences attend to students by intentionally building connections to prior understandings and experiences; relating important information to the learning goals; providing a process for meaning making of new learning; and, applying learning to new contexts such as providing explicit, supported opportunities to generalize learning to new situations (e.g., different types of problems that can be solved with linear equations) because information becomes accessible and likely to be assimilated by learners when it is presented in a way that primes, activates, or provides any pre-requisite knowledge. Barriers and inequities exist when some learners lack the background knowledge that is critical to assimilating or using new information. However, there are also barriers for learners who have the necessary background knowledge but might not know it is relevant. Those barriers can be reduced when options are available that supply or activate relevant prior knowledge, or link to the prerequisite information elsewhere.

Re-teach

Re-teach (targeted): *What formative assessment data (e.g., tasks, exit tickets, observations) will help identify content needing to be revisiting during a unit?*

- Examine assessments for evidence of lingering misconceptions (see common misconceptions). If students exhibit one more of these misconceptions, consider addressing the misconception by re-engaging with content during a unit on applying and extending previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers by clarifying mathematical ideas and/or concepts through a short mini-lesson because it identifies and corrects

misconceptions, allows for quick formative checks for understanding to move learning forward.

Re-teach (intensive): *What assessment data will help identify content needing to be revisited for intensive interventions?*

- Examine assessments for evidence of students still developing the underlying ideas For example, some students may benefit from intensive extra time during and after a unit applying and extending previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers by confronting student misconceptions because it allows response to instruction as well as to response to intervention.

Extension

What type of extension will offer additional challenges to 'broaden' your student's knowledge of the mathematics developed within your HQIM?

- To extend students learning : For example, some learners may benefit from an extension such as in-depth, self-directed exploration of self-selected topics when studying application and extension of previous understandings of operations with fractions to add, subtract, multiply, and divide with rational numbers because extension and/or enrichments using rich mathematical tasks can be essential for engaging learners and creating dynamic classrooms. Rich modeling tasks are often the missing piece in problem-solving experiences in the classroom.

Culturally and Linguistically Responsive Instruction:

Validate/Affirm: How can you design your mathematics classroom to intentionally and purposefully legitimize the home culture and languages of students and reverse the negative stereotypes regarding the mathematical abilities of students of marginalized cultures and languages?
Build/Bridge: How can you create connections between the cultural and linguistic behaviors of your students' home culture and language the culture and language of school mathematics to support students in creating mathematical identities as capable mathematicians that can use mathematics within school and society?

Goal Setting: Setting challenging but attainable goals with students can communicate the belief and expectation that all students can engage with interesting and rigorous mathematical content and achieve in mathematics. Unfortunately, the reverse is also true, when students encounter low expectations through their interactions with adults and the media, they may see little reason to persist in mathematics, which can create a vicious cycle of low expectations and low achievement. For example, when studying application and extension of previous understandings of operations with fractions to add, subtract, multiply, and divide with rational numbers, goal setting is critical because it provides students opportunities to use mathematics to understand and investigate meaningful situations.

Standards Aligned Instructionally Embedded Formative Assessment Resources:

Source: https://tasks.illustrativemathematics.org/content-standards/7/NS/A/3/tasks/298
Sharing Prize Money
The three seventh grade classes at Sunview Middle School collected the most box tops for a school fundraiser, and so they won a $600 prize to share among them. Mr. Aceves' class collected 3,760 box tops, Mrs. Baca's class collected 2,301, and Mr. Canyon's class collected 1,855. How should they divide the money so that each class gets the same fraction of the prize money as the fraction of the box tops that they collected?

This type of assessment question requires students to be able to reason abstractly about fraction multiplication as it would not be realistic for them to solve it using a visual fraction model. Even though the numbers are too messy to draw out an exact picture, this task still provides opportunities for students to reason about their computations to see if they make sense. To introduce and scaffold, prompts such as, "Which class should get the

most prize money? Should Mr. Aceves' class get more or less than half of the money? Mr. Aceves' class collected about twice as many box tops as Mr. Canyon's class - does that mean that Mr. Aceves' class will get about twice as much prize money as Mr. Canyon's class?"
This task also represents an opportunity for students to engage in Standard for Mathematical Practice 5 Use appropriate tools strategically.

Relevance to families and communities:
During a unit focused on apply and extend previous understanding of operations with fractions, consider options for learning from your families and communities the cultural and linguistic ways this mathematics exists outside of school to create stronger home to school connections for students, for example, fractions are used for cooking, the amount of ingredients may need to increase or decrease based on the members of the family. Being able to convert fractions is essential.

Cross-Curricular Connections:[1]
Science and Technology: Science and math are intimately connected, particularly in fields such as chemistry, astronomy and physics. Students who can't master basic arithmetic skills will struggle to read scientific charts and graphs. More complex math, such as geometry, algebra and calculus, can help students solve chemistry problems, understand the movements of the planets and analyze scientific studies. Math is also important in practical sciences, such as engineering and computer science. Students may have to solve equations when writing computer programs and figuring out algorithms. Nursing majors may have great bedside manner. but they also need to know how to precisely calculate dosages to pass their courses.

Social Studies: Social studies classes, such as history, often require students to review charts and graphs that provide historical data or information on ethnic groups. In geography classes, students might need to understand how the elevation of an area affects its population or chart the extent to which different populations have different average life spans. Knowledge of basic mathematical terms and formulas makes statistical information accessible

Literature and Writing: Literature might seem like a far cry from math but mastering basic arithmetic can enable students to better understand poetry. The meter of poetry, the number of words to include in a line and the effect that certain rhythms have on the reader are all products of mathematical calculations. At a more mundane level, math can help students plan reading assignments in literature classes by discerning their average reading time and estimating how long it will take them to read a particular work. The linear, logical thinking used in mathematical problems can also help students write more clearly and logically.

Art/Music: Students interested in pursuing careers in theater, music, dance or art can benefit from basic

[1] *Thompson, Van. (2020, June 24). How Is Mathematics Used in Other Subjects?. sciencing.com. Retrieved from https://sciencing.com/how-is-mathematics-used-in-other-subjects-9861185.html*

	mathematical knowledge. Musical rhythm often follows complex mathematical series, and math can help students learn the basic rhythms of dances used in ballet and theater performances. Art thrives on geometry, and students who understand basic geometric formulas can craft impressive art pieces. Photographers use math to calculate shutter speed, focal length, lighting angles and exposure time.