NEW MEXICO
Public Education Department

5.OA.A: OPERATIONS & ALGEBRAIC THINKING

Cluster Statement: Write and interpret numerical expressions

Additional Cluster This standard represents additional work for this grade. As a reminder, 65-85% of instructional time over the course of the year should be focused on the major work of the grade.

Standard Text	**Standards for Mathematical Practice**	**Students who Demonstrate Understanding Can:**
5.OA.A.1: Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.	**SMP 6:** Students can attend to precision to describe their work with grouping symbols and order of operations.	• Understand the use of parentheses, expressions inside parentheses/brackets must be completed first when solving the equation. • Apply rules and solve problems for orders of operations (not to include exponents). • Solve problems and equations that employ parentheses.
		Depth of Knowledge: 1
		Bloom's Taxonomy: Remember, Understand and Apply
Standard Text	**Standards for Mathematical Practice**	**Students who Demonstrate Understanding Can:**
5.OA.A.2: Write simple expressions that record calculations with numbers and interpret numerical expressions without evaluating them. *For example, express the calculation "add 8 and 7, then multiply by 2" as 2 × (8 + 7). Recognize that 3 × (18932 + 921) is three times as large as 18932 + 921, without having to calculate the indicated sum or product.*	SMP 7: Students can look for and make use of structure by exploring order of operations and apply the rules in a variety of situations, they look for patterns and the structure of expressions.	• Explain where to use parentheses to write numerical expressions to represent real world problems. • Interpret real world problems and write it as a numerical expression.
		Webb's Depth of Knowledge: 1, 2
		Bloom's Taxonomy: Apply

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Previous Learning Connections	Current Learning Connections	Future Learning Connections
• Connect to fluently adding and subtracting within 1,000 (3.NBT.2) • Connect to recalling from memory products of two 1-digit numbers. (4.OA.1. B)	• Connect to using knowledge of parentheses as a building block for order of operations.	• Connect to performing arithmetic operations following the order of operations with and without parentheses, including those involving whole number exponents. (6.EE.2. D) • Connect to applying the properties of operations to generate equivalent expressions with an emphasis on the distributive property. (6.EE.3) • Connect to writing, reading, and evaluating expressions in which letters stand for numbers. (6.EE.A.2) • Connect to applying the properties of operations to generate equivalent expressions. (6.EE.A.3) • Connect to identifying when two expressions are equivalent (i.e., when the two expressions name the same number regardless of which value is substituted into them). For example, the expressions y + y + y and 3y are equivalent because they name the same number regardless of which number y stands for. (6.EE.A.4) • Connect to finding 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. For example, express 36 + 8 as 4 (9 + 2). (6.NS.B.4)

Clarification Statement:
5.OA.A.1: In fourth grade, students used comparison of multiplication and division problems; thinking about solutions in terms of reasonableness by using estimation in order to determine if the solutions were reasonable.

Listening to others and gathering a variety of strategies to solve problems. Used appropriate mathematical vocabulary and accurate units of measure begin solving more sophisticated problems.
The order of operations is introduced in third grade and is continued in fourth. This standard calls for students to evaluate expressions with parentheses ( ), brackets [ ] and braces { }. In upper levels of mathematics, evaluate means to substitute for a variable and simplify the expression. However, at this level students are only to simplify the expressions because there are no variables.
In fifth grade, students work with exponents only dealing with powers of ten (5.NBT.2). Students are expected to evaluate an expression that has a power of ten in it.
5.OA.A.2: In fourth grade, students used quantitative reasoning to solve single and multi-step problems that included all four operations using models, pictures, words, and numbers. Students continues to develop problem solving strategies by using various representations and models and selecting appropriate tools. They started writing equations to represent the mathematics of the situation.
This standard refers to expressions. Expressions are a series of numbers and symbols (+, -, x, ÷) without an equal's sign. Equations result when two expressions are set equal to each other (2 + 3 = 4 + 1).
This standard calls for students to verbally describe the relationship between expressions without calculating them. This standard calls for students to apply their reasoning of the four operations as well as place value while describing the relationship between numbers. The standard does not include the use of variables, only numbers and signs for operations.

Common Misconceptions

- Students may be confused about the order of operations, thinking that all multiplications are calculated before division and additions before subtractions. Instead of solving first multiplications and/or division in order from left to right and continue with addition and/or subtraction in order from left to right.
- Students may misapply generalizations as they attempt to make sense of rules/patterns. A strategy that can be used is posing the question as a debate, "Is it always true?" students' groups are assigned to a group to prove or disprove that a given rule will or will not always apply.
- Students may believe the order in which a problem with mixed operations is written is the exact order to solve the problem. The use of mnemonic phrase “Please Excuse My Dear Aunt Sally” to remember the order of operations (Parentheses, Exponents, Multiplication, Division, Addition, and Subtraction) can mislead students to always perform multiplication before division and addition before subtraction. This is incorrect thinking. Multiplication and division are always performed first in the order that they appear in the problem –unless there are grouping symbols. To help correct students’ thinking, they need to understand that addition and subtraction are inverse operations and multiplication and division are inverse operations, as in they have the same “impact”. At this level, students need opportunities to explore the “impact” of the various operations on numbers and solve equations starting with the operation of greatest “impact”.
- Students may not understand the equal sign, for example when given 8+4=___+5, students may understand it as a 'balance'.
- Students often do not use the correct terminology for the operations. Frequently students say “times” for multiplication. This is NOT the action for multiplication. Students need to say and think “groups of” (or “of” when using fractions and decimals) when explaining multiplication. For addition, students can explain that it is “joining”, “combining”, “putting together”, or other appropriate words for addition. The same for the rest of the operational symbols.
- Students may not realize that math symbols are just short cuts for using words but that ALL symbols represent words in mathematics.

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

Pre-Teach

Pre-teach (targeted): *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 introduces new representations (e.g., grouping symbols) when studying writing and interpreting numerical expressions because the concept of order of operations will be new to students.

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

- 4.OA.A.3: This standard provides a foundation for work with writing and interpreting numerical expressions because students have previous experience writing expressions. In addition, students worked informally with order of operations in grades 3 and 4 as they solved multi-step problems through modeling and writing equations. 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

Perception: *How will the learning for students provide multiple formats to reduce barriers to learning, such as providing the same information through different modalities (e.g., through vision, hearing, or touch) and providing information in a format that will allow for adjustability by the user?*

- For example, learners engaging with writing and interpreting numerical expressions benefit when learning experiences ensure information is accessible to learners with sensory and perceptual disabilities, but also easier to access and comprehend for many others such as offering alternatives for auditory information. *For example, express the calculation "add 8 and 7, then multiply by 2" as (8 + 7) X 2. Recognize that 3 × (18932 + 921) is three times as large as 18932 + 921, without having to calculate the indicated sum or product*. For students who are impaired provide text equivalents in the form of captions or automated speech-to-text (voice recognition) for spoken language; visual diagrams, charts, notations of music or sound; written transcripts for videos or auditory clips; American Sign Language (ASL) for spoken English; visual analogues to represent emphasis and prosody (e.g., emoticons, symbols, or images); visual or tactile (e.g., vibrations) equivalents for sound effects or alerts because this will allow students to be able to hear the words and see them written down.

Build

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

- For example, learners engaging with writing and interpreting numerical expressions benefit when learning experiences attend to students attention and affect to support sustained effort and concentration such as providing feedback that models how to incorporate evaluation, including identifying patterns of errors and wrong answers, into positive strategies for future success because this is a hard concept for 5th grade students to understand and the feedback will help this see patterns of errors and understand why their answer will not work correctly.

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 writing and interpreting numerical expressions benefit when learning experiences attend to the linguistic and nonlinguistic representations of mathematics to

ensure clarity can comprehensibility for all learners such as pre-teaching vocabulary and symbols, especially in ways that promote connection to the learners' experience and prior knowledge providing graphic symbols with alternative text descriptions because students need to understand the vocabulary words that go with the math symbols to be able to write out and interpret the numerical expressions.

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 writing and interpreting numerical expressions benefit when learning experiences attend to the multiple ways students can express knowledge, ideas, and concepts such as solving problems using a variety of strategies because students need to be able to understand that the way they interpret the numerical expression could lead to an incorrect answer.

Internalize

Self-Regulation: *How will the design of the learning strategically support students to effectively cope and engage with the environment?*

- For example, learners engaging with writing and interpreting numerical expressions benefit when learning experiences set personal goals that increase ownership of learning goals and support healthy responses and interactions (e.g., learning from mistakes), such as elevating the frequency of self-reflection and self-reinforcements because students will be able to express themselves through self-reflection and this will allow them to go back over their thinking and double check their work.

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?*

- For example, students may benefit from re-engaging with content during a unit on writing and interpreting numerical expressions by revisiting student thinking through a short mini-lesson because student misconceptions in thinking may lead to errors in calculation. Encourage students to explain and clarify their reasoning in solving equations.

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

- For example, some students may benefit from intensive extra time during and after a unit writing and interpreting numerical expressions by confronting student misconceptions because the order in which to calculate and knowing when to use parenthesis can be confusing to a number of students.

Extension

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

- For example, some learners may benefit from an extension such as the opportunity to understand concepts more quickly and explore them in greater depth than other students when studying writing and interpreting numerical expressions because some students will be able to write and solve more complicated equations. Offer opportunities to play games in which they must write equations to make a target number and explain their reasoning.

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?

Using and Connecting Mathematical Representations: The standard for mathematical practice, use appropriate tools strategically, provides a strong foundation to validate and bridge for students. Mathematical representations are mathematical tools. The linguistic and cultural experiences of students provide different and varied types of representations for solving mathematical problems. By explicitly encouraging students to use multiple mathematical representations students can draw on their "mathematical, social, and cultural competence". By valuing these representations and discussing them we can connect student representations to the representations of school mathematics and build a bridge for students to position them as competent and capable mathematicians. For example, when studying writing and interpreting numerical expressions the use of mathematical representations within the classroom is critical because this cluster focuses on writing and evaluating mathematical expressions. Students are asked to solve multi-step problems using mathematical representations in the form of expressions that may include grouping symbols. In addition, students are expected to apply the rules of order of operations to evaluate, write, and interpret numerical expressions.

Standards Aligned Instructionally Embedded Formative Assessment Resources:
Source: Cognia

Each day Mia spends 20 minutes jogging and 35 minutes cycling.

A. How many minutes does Mia spend jogging and cycling in 4 days? Write an expression to show or explain how you know.

The expression 7[(35 + 20) + (10 X 2)] can be used to determine the total number of minutes that Mia spends exercising in a week, including warm-up and cool-down times.

B. Evaluate the expression 7[(35 + 20) + (10 X 2)]. Show or explain how you found your answer.

Answer Key

Constructed-Response Rubric	
Score	**Description**
4	4 points
3	3 points
2	2 points
1	1 point
0	The response is incorrect or irrelevant to the skill or concept being measured.
Blank	No Response.

Scoring Notes

Part a: 2 points for correct answer, **220** (minutes), with sufficient work or explanation shown involving the expression, 4(20 + 35) or equivalent

OR

1 point for correct answer with insufficient or no explanation or work shown

or

for correct strategy with incorrect or no answer

Part b: 2 points for correct answer, **525**, with sufficient work or explanation to indicate correct strategy

OR

1 point for correct answer with insufficient or no explanation or work shown

or

for correct strategy with incorrect or no answer

Sample Response

a. 220 minutes; 4(20 + 35) = 4 × 55 = 220 minutes in 4 days

b. 525; 7[(35 + 20) + (10 × 2)] = 7(55 + 20) = 7 × 75 = 525

Relevance to families and communities:

During a unit focused on writing and interpreting numerical expressions, 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, students can write or verbally state mathematical expressions that represent real-life situations such as, "My brother is 2. I am five times older than my brother. My sister is 4 years older than me. How old is my sister?" [(2x5)+4=14].

Cross-Curricular Connections:

Science: Students can create numerical expressions from data displayed in a table or graph