

3.OA: OPERATIONS & ALGEBRAIC THINKING

Cluster Statement: D: Solve problems involving the four operations, and identify and explain patterns in arithmetic.

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.)

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| <p>Standard Text</p> <p>3.OA.D.8 Solve two-step word problems using the four operations. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.</p> | <p>Standard for Mathematical Practices</p> <p>SMP1: Students can make sense of problems and persevere in solving them by understanding single and multi-step word problems to distinguish relevant information and appropriate strategies, and apply them to find solutions.</p> <p>SMP3: Students can construct viable arguments and critique the reasoning of others by constructing mathematical arguments to justify the reasonableness of their answer using rounding, mental computation, or other estimation strategies, and compare their strategies with those of classmates. Students make connections among ideas and between concrete models and numerical notations.</p> | <p>Students who demonstrate understanding can:</p> <ul style="list-style-type: none"> Solve two-step word problems using addition, subtraction, and multiplication. Determine the first step in a two-step word problem. Students then are able to determine the second step in a two-step word problem. Utilize models, drawings, and equations to represent the equation. Represent problems using equations with a symbol for the unknown number. Develop their skills and assess the answer that it makes sense and correlates with visual equations |
| <p>Standard Text</p> <p>3.OA.D.9 Identify arithmetic patterns (including patterns in the addition table or multiplication table), and explain them using properties of operations. For example, observe that 4 times a number is always even, and explain why 4 times a number can be decomposed into two equal addends.</p> | <p>Standard for Mathematical Practices</p> <p>SMP5: Students can use appropriate tools strategically choosing a variety of representations to identify patterns.</p> <p>SMP7: Students can look for and make use of structure by extending mathematical patterns in a variety of situations, including tables and problems, and connect those patterns to the properties. These patterns help students to understand the structure of the four operations.</p> | <p>Depth of Knowledge: 2-3</p> <p>Bloom's Taxonomy: Apply, Analyze</p> <p>Students who demonstrate understanding can:</p> <ul style="list-style-type: none"> Identify patterns in addition and multiplication charts. Explain patterns when adjusting addends (any number that is added together in addition problem). Explain doubling a factor doubles the product. Explain a factor can be decomposed and the partial products can be put back together. Interpret patterns of multiplication on a hundreds board and/or multiplication table. |

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| | | <ul style="list-style-type: none"> Use visuals that represent their thinking when identifying arithmetic patterns. |
| <p>Previous Learning Connections</p> <p>Connect to addition and subtraction problems, skip counting and adding equal groups. Learners used addition and subtraction within 100 to solve word problems involving lengths that are given in the same units, e.g., by using drawings (such as drawings of rulers) and equations with a symbol for the unknown number to represent the problem. (2.MD.5) (2.OA.1) (2.NBT.5) (2.OA.3) (2.NBT.2)</p> | <p>Current Learning Connections</p> <p>Connect to the work throughout third grade with multiplication and division problems. (3.OA.3) (3.OA.6) (3.MD.8) (3.OA.3) (3.OA.7) (3.MD.7) (3.OA.5) (3.OA.4) (3.OA.8) (3.OA.9)</p> | <p>Future Learning Connections</p> <p>Connect to future work with solving multi-step word problems using the four operations and generating patterns which follow a given rule. (4.OA.3) (4.MD.2) (4.OA.5)</p> |
| <p>Clarification Statement:</p> <ul style="list-style-type: none"> This standard requires students to use their knowledge of the four operations to solve two-step word problems. They need to be able to determine the first and second step in a two-step word problem. They need to be able to represent a two-step word problem with models, pictures, and equations (two equations can be used in place of an equation with two operations). They also need to write an equation using a letter for the unknown. Students will determine if a solution to a two-step problem is reasonable using mental computation and estimation strategies including rounding. When adding and subtracting numbers, problems should include numbers within 1,000 When multiplying numbers, problems should include single-digit factors and products less than 100. This standard requires students to examine patterns of multiplication. The ability to recognize and explain patterns in mathematics leads students to developing the ability to make generalizations, a foundational concept in algebraic thinking. Some of the patterns students in third grade are expected to describe and explain are: <ul style="list-style-type: none"> Patterns in addition and multiplication charts Patterns when adjusting addends (56 + 98 is the same as 54 + 100) Doubling a factor doubles the product A factor can be decomposed and the partial products can be put back together Patterns in addition (even + even = odd, odd + odd = even, odd + even = odd, two addends less than 50 have a sum less than 100, a difference of numbers is unchanged when both numbers are adjusted by the same amount) Patterns in multiplication (even x even = even, odd x odd = odd, and odd x even = even) | | |
| <p>Common Misconceptions</p> <ul style="list-style-type: none"> Many students may think a patter occurs if it only happens twice. | | |

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 Solving problems involving the four operations, and identifying and explaining patterns in arithmetic because students will need to apply the prior knowledge of addition and subtraction in conjunction with the newer knowledge of multiplying and dividing when solving multi-step problems involving a combination of the four operations and identifying patterns.

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

- 2.OA.A.1 Use addition and subtraction within 100 to solve one- and two-step word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions: This standard provides a foundation for work with representing and solving problems involving addition and subtraction because using and understanding addition and subtraction to solve one & two steps problems is foundational to solving more complex problems involving any combination of the 4 operations. 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 solving problems involving the four operations, and identify and explain patterns in arithmetic benefit when learning experiences include ways to recruit interest such as providing contextualized examples to their lives because students will be more motivated to learn and solve problems if the problems are related to their lives or if the problems are real to the student for solving actual problems.

Build

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

- For example, learners engaging with solving problems involving the four operations, and identify and explain patterns in arithmetic benefit when learning experiences attend to students attention and affect to support sustained effort and concentration such as creating cooperative learning groups with clear goals, roles, and responsibilities because students can increase their effort and persistence with support of peers by fostering community and collaboration.

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 solving problems involving the four operations, and identify and explain patterns in arithmetic benefit when learning experiences attend to the linguistic and nonlinguistic representations of mathematics to ensure clarity can comprehensibility for all learners such as presenting key concepts in one form of symbolic representation (e.g., math equation) with an alternative form (e.g., an illustration, diagram, table, photograph, animation, physical or virtual manipulative) because students will have better understanding of the problem when there are visual supports to help scaffold and clarify key ideas.

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 solving problems involving the four operations, and identify and explain patterns in arithmetic benefit when learning experiences attend to the multiple ways students can express knowledge, ideas, and concepts such as providing multiple examples of ways to solve a problem (i.e. examples that demonstrate the same outcomes but use differing approaches, strategies, skills, etc.) because students have a variety of experiences and knowledge and sharing multiple ways gives all students a potential clear method to understand how to solve a problem in a way that makes sense to them at their current ability as well as extend and expand their comprehension of the problem.

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 solving problems involving the four operations, and identify and explain patterns in arithmetic 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 provide tasks with multiple entry points and optional pathways because students approach problems with varying sets of abilities and the multiple entry points and pathways will demonstrate a student's level of comprehension by showing if the student relies on and understands how to use manipulatives, patterns, drawings, and formulas to solve the problems. This clarifies what supports the student may need and at what level of comprehension (concrete, visual, or abstract).

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 representing and solving problems involving multiplication and division by revisiting student thinking through a short mini-lesson because understanding and representing multiplication and division appropriately to solve one & two steps problems is foundational to solving more complex problems dependent on a mix of the 4 operations.

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 on understanding properties of multiplication and the relationship between multiplication and division by offering opportunities to understand and explore different strategies because students may need to see, draw, and use manipulatives to better clarify their understanding of properties of multiplication (distributive, commutative, associative) with arrays, equal groups and number lines to concretely solidify their understanding of the properties.

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 Solving problems involving the four operations, and identify and explain patterns in arithmetic because students can be provided the opportunity of solving more complex questions, problems, and patterns without scaffolding assistance.

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?

Supporting Productive Struggle in Learning Mathematics: The standard for mathematical practice, makes sense of mathematics and persevere in solving them is the foundation for supporting productive struggle in the mathematics classroom. "Too frequently, historically marginalized students are overrepresented in classes that focus on memorizing and practicing procedures and rarely provide opportunities for students to think and figure things out for themselves. When students in these classes struggle, the teacher often tells them what to do without building their capacity for persistence." Teachers need to provide tasks that challenge students and maintain that challenge while encouraging them to persist. This encouragement or "warm-demander" requires a strong relationship with students and an understanding of the culture of the students. For example, when studying Solving problems involving the four operations, and identifying and explaining patterns in arithmetic, supporting productive struggle is critical because students need to be able to access (low entrance) to the problem so they feel they are capable of solving the problem using their repertoire of skills whether it is using manipulatives, drawing pictures, or jumping to formulas. They need to receive support at whatever level they begin to continue through and have expectations that they can solve the problem with their current skills whether or not it is the most efficient. Their thinking and processes need to be validated for correctness and shared as are more efficient methods of peers. Perseverance and comprehension should be celebrated.

Standards Aligned Instructionally Embedded Formative Assessment Resources:

Source: <http://tasks.illustrativemathematics.org/content-standards/3/OA/D/8/tasks/1301>

The Class Trip Task

Addresses standard 3. OA.D.8 - Solve two-step word problems using the four operations. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.

The purpose of this instructional task is for students to solve a two-step word problem and represent the unknown quantity with a variable.

Relevance to families and communities:

During a unit focused on Solving problems involving the four operations, and identifying and explaining patterns in arithmetic, 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, learning about the different examples of problem solving that occurs in the home and community can be a great connection to school. The problem solving can involve shopping, project costs, gardening resources, home repairs, building, and other home maintenance. Local jobs can also provide an opportunity to see the types of problem solving and pattern recognition that community workers are experiencing.

Cross-Curricular Connections:

Language Arts: Students can write down a step by step instruction guides on arithmetic patterns using the addition table or multiplication table and explain how to use them using the properties of operation. Students can publish their guides and keep them in a resource writing center.