NEW MEXICO
Public Education Department

4.OA: OPERATIONS & ALGEBRAIC THINKING

Cluster Statement: C: Generate and analyze patterns.

Additional 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:**
4.OA.C.5 Generate a number or shape pattern that follows a given rule. Identify apparent features of the pattern that were not explicit in the rule itself. *For example, given the rule "Add 3" and the starting number 1, generate terms in the resulting sequence and observe that the terms appear to alternate between odd and even numbers. Explain informally why the numbers will continue to alternate in this way.*	SMP 8: Students look for and express regularity in repeated reasoning by using rules to generate or extend a number or shape pattern.	• Describe rules in number and shape patterns. • Identify features of a pattern when given a rule. • Make observations about a resulting sequence given a rule, such as noticing that the terms alternate between even and odd numbers. • Model and solve multi-step word problems using equations.
		Depth Of Knowledge: 2-3
		Bloom's Taxonomy: Evaluate, Create

Previous Learning Connections	**Current Learning Connections**	**Future Learning Connections**
• Connect to arithmetic patterns and properties of operations (3.OA.D.9)	• Connect to solving problems using a letter to stand in for an unknown quantity (4.OA.A2) • Connect patterns to multiples and the multiplication table.	• Connect to future learning of generating two numerical patterns given two rules (5.OA.B3)

Clarification Statement:
4.OA.C5: **Patterns** involving numbers or symbols either repeat or grow. Students need multiple opportunities creating and extending number and shape patterns. **Numerical patterns** allow students to reinforce facts and develop fluency with operations. Students investigate different patterns to find rules, identify features in the patterns, and justify the reason for those features. After students have identified rules and features from patterns, they need to generate a numerical or shape pattern from a given **rule**.

Common Misconceptions
- Students may not think a number is a multiple of itself.
- Students may think that numbers with a greater value have more factors than numbers with a lesser value.

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 generating and analyzing patterns because students will be building on arithmetic that was built in previous grades. This standard in 4th grade will build on working with patterns, which began in previous grades.

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

- 3.OA.D.9: This standard provides a foundation for work with generating and analyzing patterns because students are reasoning about operations and begin identifying patterns in addition and multiplication. 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 generating and analyzing patterns 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 visual information such as concrete manipulatives and models or other mathematical tools such as tables because this allows students to gain concrete understanding of different patterns and visually see what is happening between patterns. As students become more efficient with concrete models, they can move towards tables to organize and make connections through numbers.

Build

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

- For example, learners engaging with generating and analyzing patterns benefit when learning experiences attend to students attention and affect to support sustained effort and concentration such as providing alternatives in the mathematics representations and scaffolds because students can rise to high expectations using flexible tools and supports.

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 generating and analyzing patterns 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 students will be able to construct meaning from visuals, symbols, and numbers using different representations.

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 generating and analyzing patterns 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 students will be able to express their learning in flexible ways and communicate their thoughts and ideas through using these physical manipulatives. For example, student can see different patterns by seeing them laid out with counters.

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 generating and analyzing patterns 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 using activities that include a means by which learners get feedback and have access to alternative scaffolds (e.g., charts, templates, feedback displays) that support understanding progress in a manner that is understandable and timely because students might look at patterns and become frustrated, however when given feedback and encouragement students can progress and develop independent understanding. For example, questions and comments will be based on group or individual work and progressing them through understanding.

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 generating and analyzing patterns by revisiting student thinking through a short mini-lesson because students can usually identify patterns, but may not know how to put them into a rule or statement. Reviewing student thinking will help students identify patterns and put them into mathematical representation or tables.

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 generating and analyzing patterns by addressing conceptual understanding because students will be able to see patterns better with conceptual understanding (examples: manipulatives or concrete models). Looking at a list of numbers is an abstract skill that struggling students need to work towards. The teacher will need to support conceptual work and move students to more abstract work (example: manipulatives to data table).

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 open ended tasks linking multiple disciplines when studying generating and analyzing patterns because data is accessible in many different subjects. Students can explore data in social studies, science, or independent investigations. In this way, students learn more about practical or real-world applications.

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 generating and analyzing patterns the use of mathematical representations within the classroom is critical because students need to understand patterns, create tables that accurately represent the mathematics, and answer questions based on the data. These representations are seen in many different areas of academics, but in everyday life and can be related to home cultures.

Standards Aligned Instructionally Embedded Formative Assessment Resources:

Source: http://tasks.illustrativemathematics.org/content-standards/4/OA/C/5/tasks/487

Standard: 4.OA.C.5

Task: Double Plus One

Double Plus One

a.

The table below shows a list of numbers. For every number listed in the table, multiply it by 2 and add 1. Record the result on the right.

number	double the number plus one
0	
1	
2	
3	
4	
5	
10	
23	
57	
100	
309	

b. What do you notice about the numbers you entered into the table?

c.

Sherri noticed that all the numbers she entered are odd.

i.

Does an even number multiplied by 2 result in an even or odd number? Why do you think this is?

ii.

Does an odd number multiplied by 2 result in an even or odd number? Why do you think this is?

iii.

Does an even number plus 1 result in an even or odd number? Why do you think this is?

iv.

Does an odd number plus 1 result in an even or odd number? Why do you think this is?

v.

Explain why the numbers you entered in the table are all odd.

This type of assessment question requires students to find, extend, and describe patterns. Students will use SMP 4, SMP 5, and SMP 7. These math practices use manipulatives or visual models for determining patterns within problems. Students are also asked to determine patterns (which can be found in multiple areas in this task). This task might be used within instruction of this standard. Students can work with groups to determine and discuss different patterns seen. This task can also be broken down into multiple days or parts as students work through it. Differentiation can be built in also for this task (for example, having students finish one part before moving to the next).

Relevance to families and communities:	**Cross-Curricular Connections:**
During a unit focused on generating and analyzing patterns, 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 can be expanded to	Art: Patterns are prevalent in artistic compositions. Have students generate a rule to create a mosaic pattern. For example: Given the rule “add three” and the starting point “one” create a mosaic or other artistic composition using two different colors that follows the pattern. Increase the complexity of the pattern to result in a more complex

home. Students can ask questions or gather data that pertains to their home unit or culture.	color scheme. This could also be used with notes in music.