NVACS: Operations and Algebraic Thinking

Addition, Subtraction, Multiplication, and Division

Overview For 5th Graders

5. OA

Write and interpret numerical expression.

Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols. Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them. The terms students should learn to use with increasing precision with this standard are parentheses, brackets, braces, numerical expressions.

Analyze patterns and relationships.

Generate two numerical patterns using two given rules. Identify apparent relationships between corresponding terms. Form ordered pairs on a coordinate plane. The terms students should learn to use are numerical patterns, rules, ordered pairs, coordinate plane

Algebra is sometimes referred to as generalized arithmetic. Arithmetic and algebraic thinking are closely connected in the Nevada Academic Content Standards. Algebraic reasoning includes three major components: study of structures in the number system (See Base Ten Numbers and Operations Overview, 5. NBT), study of patterns, relations, and functions, and process of mathematical modeling, including the meaningful use of symbols.

Connection of Operations Algebraic Thinking to Numbers and Base Ten System

In grades 3-5, students apply the properties of addition and multiplication as they learn their basic facts and computational strategies. As the students learn them they are also expected to apply them to solving problems. Properties of Operations can be built into students' explorations with true/false statements and open number sentences.

4567 + 346 = 346 + 4567 (Is this true for any two numbers?)

217 + □= 195 + 22

I have more patches on my quilt than my friend.
He has eight rows of four and I have five rows of seven.

NVACS: Operations and Algebraic Thinking

Addition, Subtraction, Multiplication, and Division

Overview For 5th Graders

If the numbers are large like in the example below the student can use relation thinking to figure out which symbol goes in the box. (= ,<, >)

$$5467 + 270 \square 275 + 5{,}300$$

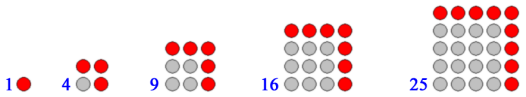
If the numbers are like the ones in the example below the students could use both relational thinking and base ten understanding to agree or disagree with the following equation.

$$6000 \div 1000 = 600 \div 100$$

Patterns Functional Thinking

Patterns are found in all areas of mathematics. Learners to look for patterns and how to describe, translate, and extend them is part of algebraic thinking. One of the eight mathematical practices actually begins with the phrase "look for" implying that students who are mathematically proficient pay attention to patterns and relate it to the mathematics.

Generate a number or shape pattern that follows a given rule. Identify apparent features of the pattern that were not explicit.

Number Pattern	1, 4,9,16,25
Shape Pattern	
Rule	Each number in the pattern can be described by multiplying the number of the pattern sequence by itself. For the 5th shape in the pattern you multiply 5 by 5 and the answer is 25. n x n = 25. n= the number in the sequence.
Features	The numbers in this pattern can be used to build arrays that are squares. The dimensions in the pattern match the number of the pattern in the sequence. The 3rd shape in the pattern has 3 as the dimension.

NVACS: Operations and Algebraic Thinking

Addition, Subtraction, Multiplication, and Division

Overview For 5th Graders

Symbols

Provide an efficient way in mathematics to convey information without using words. Then people talk about the language of mathematics, they are often referring to the symbols and shorthand notation that we use to do mathematics. The important thing for the students to understand is that the symbols are describing mathematics and has a real life application. That is why the ***representations** are critical in the development of algebraic reasoning. 5th graders are expected to apply the symbols below in addition to +, –, x, ÷, =, >, <, 10^4 (Powers of 10)

Parentheses: ( ) Brackets: [ ] Braces: { }

Order of operations concept begins in 3rd grade and continues on in 4th and 5th. Students evaluate expressions in 5th grade with **no** variables.

Expressions are a series of numbers or variables and operators with no equals sign.

(9+7)

Equations are expressions with equal signs and an answer...
or can be thought of as two or more expressions with an equals sign.

(9 + 7 = 16) or (9+ 7 = 8 + 8)

Example:

$$2\{5[12 + 5(500 - 100) + 399]\}$$

The first step would be to subtract 500-100 = 400. Then multiply 40 by 5 = 2,000.

Inside the bracket, there is now $[12 + 2{,}000 + 399]$. That equals 2,411.

Next multiple by the 5 outside the bracket. 2,411 x 5 = 12,055

Next multiply by the 2 outside of the braces. 12, 055 x 2 = 24,110

NVACS: Operations and Algebraic Thinking

Addition, Subtraction, Multiplication, and Division

Overview For 5th Graders

***Representations**

Algebra can be represented graphically, symbolically, pictorially, or verbally.

Graphs: Bar Graphs, Line Graphs, Line Plots, Circle Graphs

Symbolically: Use symbols including equations, formulas, and rules

Pictorially: two and three dimensional drawings and balance scales

Verbally: If I have *n* boxes of juice with 6 bottles in them each. How many bottles will I have if I have 2 boxes, 5 boxes, 100 boxes?

Students should have opportunities to connect different representations to understand the relationships.

The Meaning of Variables

In Elementary and Middle School, variables are primarily used to represent specific unknown values in equations, sets of numbers in inequalities, property and pattern generalizers, formulas and varying quantities of functions.

Inequalities: *n* is less than 10

Property and Pattern Generalizers: $a + b = b + c$ (Commutative Property)

Formulas: H x W x B = V (Height times Width times Base to find Volume)

The Meaning of the Equal Sign, Equality

Two mathematical expressions can have the same value. This idea is at the heart of number sense that the idea that two mathematical expressions can have the same value. We want them to understand that they can use what they know about composition of numbers to help them solve computation. This concept of equality lays for foundation of Algebra in later grades.

For Example:

9 x 4 = 2 x 3 x 6

NVACS: Operations and Algebraic Thinking

Addition, Subtraction, Multiplication, and Division

Overview For 5th Graders

This concept can be modeled by thinking of a balance scale because it gives a visual model to students because most students understand that if you remove something from one side of the scale it is no longer balanced. They have to then figure out what changes have to happen to the other side to balance.

Students should also evaluate equations to determine if they are true of false.

For Example: Is this a true or False Number Sentence? 346 + 30 = 290 + 56