NVACS: Operations and Algebraic Thinking

In First Grade, students must:

1.OA.1 -	Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.
1.OA.2 -	Solve word problems that call for addition of three whole numbers whose sum is less than or equal to 20, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.
1.OA.3 -	Apply properties of operations as strategies to add and subtract. Examples: If 8 + 3 = 11 is known, then 3 + 8 = 11 is also known. (Commutative property of addition.) To add 2 + 6 + 4, the second two numbers can be added to make a ten, so 2 + 6 + 4 = 2 + 10 = 12. (Associative property of addition.) (Students need not use formal terms for these properties.)
1.OA.4 -	Understand subtraction as an unknown-addend problem.
1.OA.5 -	Relate counting to addition and subtraction (e.g., by counting on 2 to add 2).
1.OA.6 -	Add and subtract within 20, demonstrating fluency for addition and subtraction within 10. Use strategies such as counting on; making ten (e.g., 8 + 6 = 8 + 2 + 4 = 10 + 4 = 14); decomposing a number leading to a ten (e.g., 13 – 4 = 13 – 3 – 1 = 10 – 1 = 9); using the relationship between addition and subtraction (e.g., knowing that 8 + 4 = 12, one knows 12 – 8 = 4); and creating equivalent but easier or known sums (e.g., adding 6 + 7 by creating the known equivalent 6 + 6 + 1 = 12 + 1 = 13).
1.OA.7 -	Understand the meaning of the equal sign, and determine if equations involving addition and subtraction are true or false.
1.OA.8 -	Determine the unknown whole number in an addition or subtraction equation relating three whole numbers.

Students will develop strategies for adding and subtracting whole numbers based on their prior work with small numbers. They use a variety of models, including discrete objects and length-based models (e.g., cubes connected to form lengths), to model add-to, take-from, put-together, take-apart, and compare situations to develop meaning for the operations of addition and subtraction, and to develop strategies to solve arithmetic problems with these operations.

Students in first grade will understand connections between counting and addition and subtraction (e.g., adding two is the same as counting on two).

Elementary students often believe that there are hundreds of isolated addition and subtraction facts to be mastered. However, when students understand the commutative and associative properties, they are able to use relationships between and among numbers to solve problems. They use properties of addition to add and subtract whole numbers and to create and use increasingly sophisticated strategies based on these properties. Students in first grade do not use the formal terms “commutative” and “associative.” Instead, they use the understandings of the commutative and associative property to solve addition and subtraction problems to 20.

Word problems Students act out, retell, model using materials or drawing pictures to represent what is going on in the story.

Students in first grade should be working on the following addition and subtraction situations:

	add to	**take from**
result unknown	Rose had four pencils. Mario gave her three more. How many does she have now? 4 + 3 = ?	Six kids were in the pool. Two got out. How many kids are in the pool now? 6 – 2 = ?
change unknown	Rose had four pencils. Mario gave her three more. How many does she have now? 4 + 3 = ?	Six kids were in the pool. Some got out. Now there are four kids in the pool. How many got out? 6 - ? = 4
start unknown	Rose had some pencils. Mario gave her three more and now she has seven. How many pencils did Rose start with? ? + 3 = 7.	Some kids were in the pool. Two got out. Now there are four kids in the pool. How many were in the pool before? ? – 2 = 6

	put together/take apart
total unknown	Four black puppies and two white puppies were in the basket. How many puppies were in the basket? 4 + 2 = 6.
addend unknown	Seven pencils were in the jar. Three were sharpened. The rest weren't. How many were not sharpened? 3 + ? = 7, 7 – 3 = ?
both addends unknown	There were six fish in the tank. Some were yellow and some were orange. How many of each could there be? 6 = 0 + 6, 6 = 1 + 5, 6 = 2 + 4, 6 = 3 + 3, 6 = 4 + 2, 6 = 5 + 1, 6 = 6 + 0

	Compare	
	How many more? version	**How many less? version**
difference unknown	Bob made five baskets. Maria made eight baskets. How many more baskets did Maria make than Bob? 5 + ? = 8	Bob made five baskets. Maria made eight baskets. How many fewer baskets did Bob make than Maria? 8 – 5 = ?
bigger unknown	Alex has four more apples than Jacob. Jacob has two apples. How many apples does Alex have? 2 + 4 = ?	Jacob has four fewer apples than Alex. Jacob has two apples. How many apples does Alex have? 4 + 2 = ?
smaller unknown	Alex has two more apples than Jacob. Alex has six apples. How many apples does Jacob have? 6 – 2 = ?	Jacob has two fewer apples than Alex. Alex has six apples. How many apples does Jacob have? ? + 2 = 6

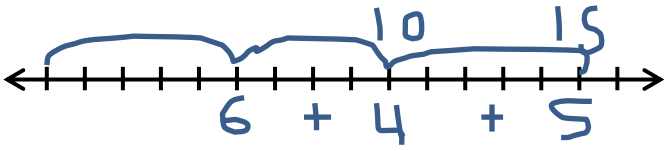
Word problems with three addends:

Students act out, retell, model using materials or drawing pictures to represent what is going on in the word problem.

Students can use a variety of models to solve a given word problem, such as, ***"There were 5 girls, 6 boys, and 4 grownups at my birthday party. How many people were at my party?"***

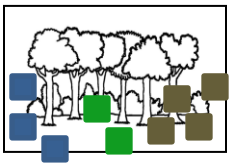
Students can use number lines, ten frames, written equations, etc. to model and solve the problem.

For example:



Students should also have opportunities to create their own stories by acting out, using materials or drawing pictures and writing equations.

For example: Using story boards, the student makes up word problems that involve three addends.



"My dad saw 3 bears, 2 deer, and 4 elk in the forest. He saw 9 animals."

3 + 2 + 4 = 9

Students must develop an understanding of the properties of addition and subtraction.

Students need many experiences, using a variety of materials to develop an understanding of the properties of addition that will help them develop strategies to solve addition and subtraction problems.

Commutative property of addition:

When students understand that 4 + 3 = 7 and that 3 + 4 = 7, they can use this property to solve problems more efficiently and accurately.

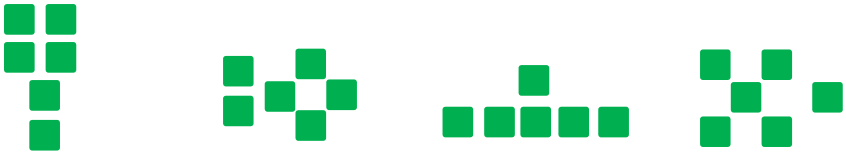
Associative property of addition:

Students also need to understand that they can add multiple numbers in any order. (3 + 4) + 6 = 3 + (4 + 6). Knowing that they can look for combinations that can be used to solve the problems, helps students to do so more efficiently and accurately.

Types of tasks that help develop understanding of the properties of addition and subtraction:

Arrangements: Students use a variety of objects to make arrangements and describe that arrangement by its parts. Students develop an understanding that numbers can be broken up in many different ways.

For example: Using color tiles, the student makes as many different arrangements of a given number as they can and describe the parts.



I see 4 and 2.

4 + 2 = 6

I see 2 and 4.

2 + 4 = 6

I see 1 and 5.

1 + 5 = 6

I see 1 and 5.

5 + 1 = 6

Students record their equations and look for combinations that are commutative.

Name _____

4 + 2 = 6	2 + 4 = 6
1 + 5 = 6	5 + 1 = 6

Combinations: Students use a variety of materials to find combinations of a number.

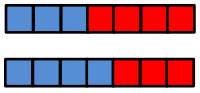
For example: Using two sided counters, students toss the counters and record how many landed on red and how many landed on yellow.

Students record their results and look for combinations that are commutative.

Name _____

red	yellow	equations
4	2	4 + 2 = 6
2	4	2 + 4 = 6

For example: Students use two colors of cubes to make as many different combinations of 7 as possible.



3 + 4 = 7

4 + 3 = 7

When the students find all of the ways, they can look for the pairs that are commutative.

How Many Ways?

Students find several solutions when presented with a "How Many Ways" problem.

For example: I have a basket of 6 pieces of fruit. Some are apples and some are bananas. How many of each could there be.

Students problem solve to find multiple solutions.

Name		
apples	bananas	equations
1	5	1 + 5 = 6
5	1	5 + 1 = 6

After the students work to find as many solutions as they can by themselves or with a partner, bring the class together and chart all the different ways the class found.

Ask the students if there is a way we could organize the ways so that we know we have all of the ways.

Ask the students to find combinations that are commutative.

Missing Parts

Students begin to work with problems where one of the parts is missing but they know the whole. This can be through story problems or tasks.

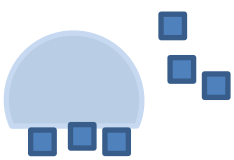
For example: Students act out, retell, model using materials or drawing pictures to represent what is going on in the story.

- Call 3 students up to the front of the room and say that you wish there were 5 students.
- Say 6 students went to the restroom. 4 were girls. How many were boys?

Students who are not acting out the problem should be modeling it with materials or drawings.

For example: Students complete tasks where the must tell the part that is missing.

Count out a given quantity of counters. Use a cup or a bowl to cover the counters. Reach under the bowl and take out some. How many are left under the bowl?



I started with 6. I pulled out 3. Now there are 3 under the bowl.

6 – ? = 3

Symbolic Problems: Students should also work on symbolic problems that they have practiced using models and connecting symbols, such as the tasks above.

Students can be given number strings to practice using the associative property to add. These should be written both horizontally and vertically.

3 + 2 + 7 — We want students not to automatically add in order, but to look for combinations that can be used to solve the problem most efficiently. In this problem, a student may see that 3 + 7 = 10 and 10 + 2 = 12.

$$\begin{array}{r} 3 \\ 6 \\ +\ 6 \\ \hline \end{array}$$

In this problem, a student may see that 6 + 6 = 12 and 12 + 3 = 15.

Equal sign Students must first understand the meaning of the equal sign in order to determine whether an equation is true or false.

This understanding is developed as students solve joining and separating situations in a variety of ways with a variety mathematical tools, such as those above, rather than symbols alone.

Once the concepts of joining, separating, and "the same amount/quantity as" are developed concretely, students in first grade are ready to connect these experiences to the corresponding symbols (+, -, =).

The students learn that the equal sign does not mean "the answer comes next", but that the equal sign indicates that the left side 'has the same value as' the right side of the equation.

Students should see equations written so that the equation is written on the left or right side of the equal sign. When modeling this, match the symbols to the language used in the situation.

For example: If a student says, "I know there are 10 because I saw 5 and 5," record, 10 = 5 + 5.

If a student says, "I saw 5 and 5 and that makes 10," record, 5 + 5 = 10.