

ELEMENTARY: NUMBER (OPERATIONS)

SUMMARY

The intention of this unit was to have students explore the CONCEPT of operations, BEFORE teaching the how of them. I wanted students to understand when and why we add, subtract, multiply, and divide, not just how to do it. Mathematical concepts such as constancy, communication, patterns, and predictability, are all explored. The NCTM describes number sense as “an awareness and understanding of what numbers are”, and notes that “number sense typically results as a by-product of learning rather than through direct instruction. Number sense can be developed by providing rich mathematical tasks that allow students to make connections.”

According to the NCTM the main goals of mathematics education are to prepare students to:

1. Communicate and reason mathematically
2. Use mathematics confidently, accurately, and efficiently to solve problems
3. Appreciate and value mathematics
4. Make connections between mathematical knowledge and skills and their applications
5. Commit themselves to lifelong learning
6. Become mathematically literate citizens, using mathematics to contribute to society and to think critically about the world

The K-12 Mathematics curriculum is designed to support and promote the understanding that mathematics is:

1. A way of learning about our world
2. Part of our daily lives
3. Both quantitative and geometric in nature, with both aspects being equally important in the development of mathematical literacy.

In addition, mathematics and its study encourages the development of:

1. Creative thinking
2. Logical thinking
3. Problem-solving skills
4. Data analysis skills
5. Co-operative interaction.

****If this is our curriculum, there is NO WAY to teach this through rote drill and text books! By definition, creative thinking, co-operative interaction, valuing and appreciating mathematics, and using math to contribute to society have to go beyond turn to page 24 and do the odd numbers!***

***** The unit would need to be adjusted up or down somewhat depending on the grade you are teaching. This is intended to provide a model that teachers can use to “see what it looks like” and adapt to their own circumstance.***

ESSENTIAL UNDERSTANDINGS

1. Numbers communicate! They can represent quantity, position, location, and relationships
2. Operations help us determine quantity
3. Addition and multiplication result in larger amounts
4. Subtraction and division result in smaller amounts
5. Being a mathematician involves taking apart and combining numbers in many different ways
6. We use operations everyday, for important reasons, and for fun!

ESSENTIAL QUESTIONS

- A. What do numbers tell us?
- B. When and why do we take apart and put together numbers?
- C. What are the most efficient ways for finding sums, differences, products, and quotients?
- D. How do the four operations relate to one another?
- E. What kinds of questions can be answered by addition, subtraction, multiplication, and division?

ASSESSMENT RUBRIC

Limited	Basic	Good	Excellent
Identifies numbers concretely, pictorially, and symbolically	Recognizes that numbers communicate quantity, location, position, and relationships	Explains how computation determines quantity (e.g. when we add we are counting how many “all together”), location (e.g. how far away), position (e.g. ranking) and relationships (e.g. greater/less than)	Analyzes the different uses of operations for determining quantity, position, location, and relationships and relates to cardinal, ordinal, and nominal numbers
Recognizes symbols for operations	Describes operations as “making more” or “taking away/apart	Justifies the logic of an answer given the operation (e.g. answer should be larger if adding, multiplying)	Evaluates estimations based on logic related to an operation
Solves problems given the necessary operation	Selects appropriate operation for a given problem	Flexibly selects operations, and methods of using operations (e.g. counting on, doubles, etc.) to solve problems	Connects operations to real life problems across subjects
Identifies ways in which operations are used in their everyday lives	Describes common uses of operations in daily life (e.g. money)	Compares and contrasts the ways in which operations are used in their everyday lives, and in others	Evaluates the importance of relative uses of operations (e.g. buying candy versus resolving social issues), articulates the power and scope communicated by numbers

SAMPLE STATIONS & CENTRES (COOPERATIVE WORK)

Verbal Linguistic	Logical Math	Visual Spatial	Body-Kinesthetic	Musical-Rhythmic
<p>Write a problem for a given operation related to daily life</p> <p>Or</p> <p>Write instructions for another student on how to solve a problem</p>	<p>Categorize problems by operations required, importance, etc.</p> <p>Or</p> <p>Create a math game that uses one or more operations</p>	<p>Pictorially represent the operations used in their lives</p> <p>Or</p> <p>Represent the steps taken for a given problem pictorially</p>	<p>Create/Make a new manipulative that can be used to solve a given problem</p> <p>Or</p> <p>Demonstrate operations using your body (e.g. clapping, snapping, etc.)</p>	<p>Use musical instruments to demonstrate operations (e.g. adding might increase beat, or number of instruments)</p> <p>Or</p> <p>Create a dance to demonstrate an operation</p>
Naturalist	Interpersonal	Intrapersonal	Existential	
<p>Illustrate an operation that occurs naturally (e.g. population densities of an animal)</p> <p>Or</p> <p>Apply operations to an environmental issue to determine possible solutions</p>	<p>Explore the factors contributing to a social issue, and their magnitude – What causes them to multiply? Or reduce?</p> <p>Or</p> <p>With a partner, use a venn diagram to compare how you use operations in your daily life</p>	<p>Demonstrate one important reason why YOU need to know operations</p> <p>Or</p> <p>How do you feel about math? What connections can you make between math and your personal interests (e.g. video gamed)</p>	<p>Think about the social implications of words like adding, taking away, multiplying, and dividing. How is mathematical language a part of our lives? When is it positive/negative? (e.g. words like divisive, less than, etc.)</p> <p>Or</p> <p>In younger grades, have students sort words into positive and negative related to how they feel about themselves as mathematicians, and math in the world</p>	

EXAMPLES OF SOME INTRODUCTORY ACTIVITIES

Essentially, introductory activities are intended to be sure students can all achieve column one in the rubric, and begin to move them to column two.

1. Have students work with a partner.
 - a. Give each student a pile of a small manipulative (buttons, unifix cubes...). Have students physically push together their piles, while chanting math language like (more, add, multiply, grow, greater), and then pull the piles apart chanting words like less, subtract, divide, reduce, and so forth. This need only take a few minutes, but the physical embodiment of making more, and then taking away/dividing is critical to conceptual understanding for many learners. Rhythmically chanting this (e.g. “push lets add, pull let’s subtract” to a drumbeat) for just a couple of minutes a day at the beginning of the unit, no matter what the grade, will yield surprising “aha” moments, often for students you thought understood because they can compute, but didn’t. Use grade level language as appropriate (In older grades using language like push let’s make double digits / large sets, pull let’s reduce).
 - b. Continue the above activity by now making students more intentional about what they’re doing and teaching strategies. You can give students the same amount if you want to teach things like “double your number” or “divide evenly”. Alternatively, you can give students different numbers (and larger or smaller amounts, depending on grade level), and have them add them, then try to divide them, or subtract one, or whatever strategy you want to teach. Again, pairing the language you want students to know, with the physical embodiment, is powerful and supports students ability to later visualize mental math.
 - c. Note, this can also be used to discuss whole and part, integers and fractions, ones/tens/hundreds, and more. It can also at the early grades be used for simple counting and number association (e.g. count 2, 4, 6 etc and have students physically make the numbers as you chant)
2. Have students work in small groups.
 - a. Ask students to select a name for their group, and get their group into a line. Introduce the words cardinal, ordinal, and nominal. Randomly point at students and ask them to identify themselves by one of the criteria. E.g. if a student is second in line, if you call out cardinal he should say “I am number 2 or there are four of us”, if you call out ordinal she should say “I am second in line”, and if you say nominal, he or she could say “I am Dragon 2 (if their group is called Dragons).”
 - b. Ask students to demonstrate/act out a computation. For instance, if you write 3×4 on the board, students will need to join up with two other groups and show three groups of four by first standing apart, and then moving together.