Tutorial 2: *Working with Operators and Expressions*

Order of Operations

When an expression contains more than one operation, you can get different answers depending on the order in which you solve the expression. Mathematicians have agreed on a certain order for evaluating expressions, so we all arrive at the same answers. We often use grouping symbols, like parentheses, to help us organize complicated expressions into simpler ones. Here's the order we use:

1. First, do all operations that lie inside parentheses.
2. Next, do any work with exponents or roots.
3. Working from left to right, do all multiplication and division.
4. Finally, working from left to right, do all addition and subtraction.

PEMDAS:

Parenthesis, Exponents, (Multiplication/Division), then (Add/Subtract)
( ) ^ * / + -

There is a phrase that helps students remember the order:
Please Excuse (My Dear) (Aunt Sally).

Example 1 – Parenthesis
In *Example 1*, without any parentheses, the problem is solved by working from left to right and performing all the addition and subtraction. When parentheses are used, you first perform the operations inside the parentheses, and you'll get a different answer!

WITHOUT PARENTHESIS	WITH PARENTHESIS
8 - 7 + 3 = 1 + 3 = 4	8 - (7 + 3) = 8 - 10 = -2

Example 2 – Order of Operations

In *Example 2* the problem is correctly solved by following the order of operations.

ORDER OF OPERATIONS	EXPLANATION
2^2 x 20/4 - 7 x 3 + 55 =	Original Problem
4 x 20/4 - 7 x 3 + 55 =	Calculate the exponent
4 x 5 - 21 + 55 = Note that "4 x 20/4" can be worked out in one of two ways. Both methods give the same result of 20. (4 x 20) / 4 or 4 x (20/ 4)	Working from left to right, do all multiplications and divisions. When there are several of these operations in the same term, the order within the term doesn't matter
20 - 21 + 55 =	Calculate remaining multiplication
20 - 21 + 55 =	Add and subtract from left to right
54	The correct answer!