# Math Magic: Understanding Math Logic

Issue #3: The nature of multiplication and Division: language and symbols (6-8 grades)

## STUDENTS SHOULD KNOW THE LOGIC AND THE VOCABULARY OF MATH

It always amazes me how little many middle and high school students know about the nature of multiplication and division. One able high school student was confused on how to enter a division problem into a calculator. A simple explanation and trial and error of a simple problem fixed that: $4 \div 2 \neq 2 \div 4$.

## THE MANY WORDS, PHRASES, AND SYMBOLS FOR MULTIPLICATION

There are several ways of representing multiplication in language: "9 times 8", "9 groups of 8" =, "9 **of** 8", "the **product** of 9 and 8", and maybe a few others. In symbols: "9 x 8", "9 • 8" (not to be confused with "9.8", 9(8). Since multiplication is *commutative*[1], the order does not make a difference. 9(8) = 8(9), nine groups of 8 = 8 groups of 9, and so on.

Another important rule with multiplication is that it is repeated addition. Most people know it's easier to know that 9 x 8 = 72 than to add up all the eights.

8+8+8+8+8+8+8+8+8

But if you forget and do not have a calculator, or you do not know or remember the nine's rule mentioned in the last issue, you can simplify the problem by grouping the eights differently using the *associative*[2] principle, which means that numbers in multiplication and addition can be grouped or associated differently as:

9 x 8 = (8+8+8)+(8+8+8)+(8+8+8)
9 x 8 = (24) + (24) + (24) = 72

Addition can work for any multiplication problem, but many times it is much more difficult to do. Consider the problem:

29 x 18 = means 18 is added to itself 29 times but you can do it much easier by multiplying:

29
x 18 (Solve and show your work here)


## DIVISION IN LANGUAGE AND SYMBOLS

213
- 3 1 time
210
- 3 2 times
207
- 3 3 times
204

etc. until you reach zero or have a remainder less than 3.

Symbols:

$$6\overline{)48}^{*} \quad \frac{48 \div 6}{} = \frac{48}{6} = 48/6 =$$

Language:"48 divided by 6", "the quotient of 48 and 6"
"6 into 48" ,"how many 6's fit into 48"

Since division is not commutative like multiplication, the order is very important: 48 /6 ≠ 6/48.

*NOTE: that the *divisor* is mostly second or on the bottom except for the ones marked with an asterisk (*) above.

## JUST LIKE MULTIPLICATION IS REPEATED ADDITION, DIVISION IS REPEATED SUBTRACTION

So, if you think you hate doing long division, just use subtraction and count the number of times you subtract divisor (3) from the dividend (213) as on the left below until you have no 3's left.

Which do you think is easier: the subtraction method to see how many times 3 fits into 213 until you reach zero, or regular long division? _____ Solve by regular long division.

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[1] *mutare* comes from the Latin "to change": like a commuter, the distance from here to San Francisco is the same as the distance from San Francisco to here. Likewise 3x4=4x3. Other words from muto: mutilate, to disfigure; mutation, a change in a plant or animal's DNA, etc. A VOCABULARY LESSON.

[2] think of *social*, like people grouping or associating in different groups; in addition and multiplication the grouping () of mult. Is acceptable.