

Mayan mathematics

By the time of the Spanish arrival to the Yucatan peninsula in Mexico, around 1520, the Mayans were a starkly diminished civilization. Their great cities were abandoned and the remnants of their population widely scattered. However, more than 1,000 years before, it had the makings of an advanced culture.

The Mayans* devised a counting system that was able to represent very large numbers by using only 3 symbols: a dot, a bar, and a symbol for zero, or completion, usually a shell. The chart to the right shows the first complete cycle of numbers. Like our numbering system, they used place values to expand this system to allow the expression of very large values. Their system has two significant differences from the system we use: 1) the place values are arranged vertically, and 2) they use a base 20, or vigesimal system. This means that, instead of the number in the second position having a value 10 times that of the numeral (as in 10, 100, 1,000), in the Mayan system, the number in the second place has a value 20 times the value of the numeral. The number in the third place has a value of $(20)^2$, or 400 times the value of the numeral. This principle is illustrated in the chart below.

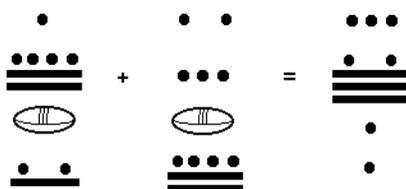
	•	• •	• • •	• • • •
0	1	2	3	4
				
5	6	7	8	9
				
10	11	12	13	14
				
15	16	17	18	19

$(20)^4$		=	3 x 160,000	=	480,000
$(20)^3$		=	10 x 8,000	=	80,000
$(20)^2$		=	6 x 400	=	2,400
$(20)^1$		=	13 x 20	=	260
$(20)^0$		=	17 x 1	=	17
					562,677

Sometimes this number will be expressed in the shorthand 3.10.6.13.17 in writings on the Mayan numeration system, especially when discussing dates that are recorded in monuments. Using this system for expressing numbers has two advantages: 1) large numbers can be easily expressed, so long time periods can be recorded; and 2) simple arithmetic can be easily accomplished, even without the need for literacy among the population. In the marketplace, sticks and pebbles, small bones and cacao beans, or other items readily

at hand could be used to express the numbers in the same way that they are expressed on the monuments or in the books of the upper classes. Simple addition can be performed by simply combining 2 or more sets of symbols (within their same set). This is shown below.





For more complicated arithmetic, you must simply remember that you borrow or carry only when you reach 20, not 10, as shown to the left.

It is important to note that this number system was in use in Mesoamerica while the people of Europe were still struggling with the Roman numeral system. That system suffered from serious defects: there was no zero (0) in the system,

and, as opposed to the Mayan system, the numbers were entirely symbolic, without direct connection to the number of items represented.

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