



San Diego Museum of Man
Lesson Plan
Maya Math: Addition and Subtraction
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Teacher Lesson Plan

OBJECTIVES	Students will learn how the ancient Maya counted, and will practice addition and subtraction using Maya number glyphs.
MATERIALS	Provided by Classroom Teacher: Pens or pencils Included in this Lesson Plan (make one copy per student): Mathematics Maya Style! The Long Count—Maya Math in Action Maya Math—Addition and Subtraction Exercises
DIRECTIONS	<p>Use the Mathematics Maya Style! handout to explain how Maya numbers are drawn and counted. Some points to emphasize include:</p> <ul style="list-style-type: none">• The Maya used a dot to represent 1, a bar for 5, and a shell-symbol for 0.• The Maya system of place notation is based on units of twenty, compared to ours which is based on units of ten, and places are written vertically, instead of horizontally. <p>Pass out The Long Count—Maya Math in Action handouts to each student. Read and discuss as a class.</p> <p>Pass out Maya Math—Addition and Subtraction Exercises handouts to each student. Have students complete the exercises.</p>
FURTHER STUDY	Students can practice their understanding of Maya numbers and base-twenty place notation by converting higher numbers from our decimal (base-ten) counting system to Maya vigesimal (base-twenty) numbers. As they become more advanced, students should look for ways to add and subtract in Maya numbers without converting to decimal numbers.
So WHAT?	<p>The Maya used zero and a system of place notation at a time when Europeans were struggling with the limitations of Roman numerals.</p> <p>Studying the Maya system of place notation reinforces basic mathematical concepts like place and value, and hones skills in addition, subtraction, and multiplication.</p>
EDUCATION STANDARDS	<p>This lesson plan can be used to fulfill state and national education standards in Social Science (World History) and Mathematics.</p> <p>This lesson plan fulfills California State Education Content Standards in History—Social Science for grade 7 (7.7.5), and Mathematics (Number Sense, Mathematical Reasoning) for grades 2 and up.</p>




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Mathematics Maya Style!

Among their numerous achievements, the Maya invented an advanced numbering system that included ZERO.


Maya numbers are written using three symbols. These symbols are a shell symbol for ZERO, a dot for ONE, and a bar for FIVE. Examples of how to write numbers from zero to 19 are given below. These twenty numbers (0 through 19) can be written with bars and dots positioned vertically, as shown on the following page, or horizontally, as shown here.

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

Only numbers from zero to 19 can be written in this way. To write numbers higher than 19, a system of PLACE NOTATION, based on units of TWENTY, is used.

Numbers are written in vertical columns, where each row has the value of a power of 20 (1, 20, 400, 800, etc.). At most, twenty units (0 through 19) can go into each row. The number of units are MULTIPLIED by the value of the row, and the results are summed for the entire column.

The following are examples of how to write different numbers using this system.

400's						• •	400x2= <u>800</u>
20's	•	20x1= <u>20</u>	• •	20x2= <u>40</u>	— —	20x10= <u>200</u>	+
1's		+ 1x0= <u>0</u> =20	• • •	+ 1x3= <u>3</u> =43	• • •	+ 1x3= <u>3</u> =203	+
						• — —	+ 20x0= <u>0</u> + 1x11= <u>11</u> =811

Now, complete the following exercises to test your understanding of Maya math.

Write your age in Maya number symbols.

Take this number and double it (try to use only Maya numbers to do this).



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The Long Count—Maya Math in Action

The Maya used their counting system to keep track of time using a sophisticated calendar called the Long Count. This calendar was used to count time going back thousands of years to the day the world was created, which, according to the beliefs of the ancient Maya, happened over 5,000 years ago.

Units of Time

Calendars are useful for keeping track of time because they are organized into units. The basic unit in our calendar is the day. Days are grouped into months, months into years, years into decades, decades into centuries, and centuries into millennia.

In the Maya Long Count Calendar, there are five basic units of time: Kin, Winal, Tun, Katun, and Baktun. But since the Maya numbering system is different from ours, so too are the basic units of the Maya calendar.

1 Kin	= 1 day	
1 Winal	= 20 Kin	(20 days)
1 Tun	= 18 Winal	(360 days, ~ 1 year)
1 Katun	= 20 Tun	(7,200 days, ~ 20 years)
1 Baktun	= 20 Katun	(144,000 days, ~400 years)

For example, how long ago did the following Long Count date occur:

13 Baktun, 0 Katun, 0 Tun, 0 Winal, 0 Kin



↔ $13 \text{ Baktun} = 13 \times 20 \text{ Katun} = 13 \times 144,000 \text{ days} = 1,872,000 \text{ days}$



↔ $0 \text{ Katun}^* = 0 \times 20 \text{ Tun} = 0 \times 7,200 \text{ days} = 0$



↔ $0 \text{ Tun} = 0 \times 18 \text{ Winal} = 0 \times 360 \text{ days} = 0$



↔ $0 \text{ Winal} = 0 \times 20 \text{ Kin} = 0 \times 20 \text{ days} = 0 \text{ days}$



↔ $0 \text{ Kin} = 0 \times 1 \text{ Kin} = 0 \times 1 \text{ day} = 0 \text{ days}$

$1,872,000 + 0 + 0 + 0 + 0 = 1,872,000 \text{ days ago} \cong 5,128 \text{ years ago}$

*Note: A shell symbol is not needed for a simple value of zero



The ancient Maya wrote Long Count dates on the sides of giant carved statues called stelae.

The 20-foot high monument shown above is called Stela D and was carved to commemorate a special event that occurred on February 19, A.D. 766 in the city of Quirigua,



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Answer Sheet

Use the Maya numbers on the **Mathematics—Maya Style!** handout to verify that students have correctly written their age in Maya number glyphs. When students double their age, use the chart below to verify Maya numbers from twenty-one to forty.

•	•	•	•	•	•	•	•	•	•
•	• •	• • •	• • • •	_____	•	• •	• • •	• • • •	_____
21	22	23	24	25	26	27	28	29	30
•	•	•	•	•	•	•	•	•	• •
•	• •	• • •	• • • •	_____	•	• •	• • •	• • • •	
31	32	33	34	35	36	37	38	39	40

Addition and Subtraction

- $\begin{array}{c} \cdot \\ \hline \cdot \cdot \cdot \cdot \end{array} + \begin{array}{c} \cdot \\ \hline \cdot \cdot \end{array} = \begin{array}{c} \cdot \\ \hline \hline \hline \end{array}$
- $\begin{array}{c} \cdot \cdot \\ \hline \hline \hline \end{array} - \begin{array}{c} \cdot \cdot \cdot \cdot \end{array} = \begin{array}{c} \cdot \cdot \cdot \\ \hline \hline \hline \end{array}$
- $\begin{array}{c} \hline \hline \hline \end{array} + \begin{array}{c} \hline \hline \hline \end{array} = \begin{array}{c} \cdot \\ \hline \hline \hline \end{array}$
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Number Block Activity

				$\begin{array}{c} \cdot \cdot \cdot \\ \hline \hline \hline \end{array}$
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