Math and Mayans: Then and Now

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BEFORE YOU READ:

1. What is "base 10"? What do you think "base 20" means?

2. What is the difference between a digit and a number? What is equinox and solstice?

3. Share what you know about other "number systems" besides the one we use.

In the 1980s, I lived in the Mayan world of Chiapas. I traveled to the southeast corner of Mexico to complete my social service after graduating from medical school. The government sent me to be the one staff person at the clinic for one year. The Tzeltal Mayan community accepted me as a foreign healer. They named me "Caxlan Pox ta Wanej." After seeing patients all day, I spent my nights observing starry skies in the Lacandon Jungle. I imagined how the Mayan priests did the same to uncover the secrets of the universe.

The Mayan cosmology is focused on the connection between the natural and spiritual worlds —and mathematics helps explain how the pieces fit together. The Mayans recognized the sun as their father and the earth as their mother. Tracking the movements of the sun, moon, and planets across the sky, the ancient Mayans mastered precise astronomical calculations. Mayan astronomers used their knowledge to predict eclipses and the passage of comets. Predicting these events gave Mayan rulers seemingly magical powers that linger today when sunlight pours into temple windows aligned with the equinox or solstice sun. This advanced astronomy and engineering relied on an equally advanced system of mathematics.

During the equinox, the sun aligns perfectly with the doorways of this Mayan temple in Mexico.

Like the Hindu-Arabic system, the Mayan number system is positional. That means the position of the digit gives you information about its value. The number system we use is linear. You can tell the value of a digit based on which column it is in. And you read the columns from left to right. For example, the number 8,421 would have

Math and the Universe

In the 16th century AD, Nicolaus Copernicus used math to prove that the earth revolves around the sun. He wasn't the first to discover this, however. An Indian philosopher named Yajnavalkya wrote about *heliocentrism* in the 9th century BC. In the 1st century BC, a Greek astronomer named Aristarchus made similar claims. The Mayans understood the relationship between the planets and the sun as early as 870 AD.

Sources: <www.astronomytrek.com/who-discovered-the-earth-moves-around-the-sun>

Position Matters!

In a *positional* number system, the placement of the digit tells you its value. For example, in the number 532.6, you know that the 5 is worth 5 hundred because it is in the hundreds column. How much are the 3, 2, and 6 worth?

the digit 8 in the "thousands" column, a 4 in the "hundreds" column, a 2 in the "tens" column, and a 1 in the "ones" column.

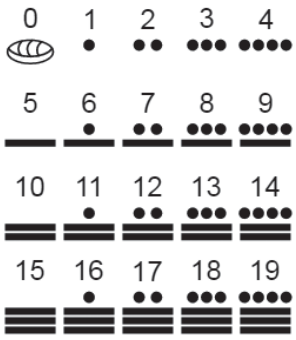
Base 10 multiple	1000s (100x10)	100s (10x10)	10s (1x10)	1s
Digit	8	4	2	1
Total value	8,000	400	20	1

The Mayan system is also positional, but instead of reading it horizontally from left to right, you read the numbers vertically from top to bottom. And here is another big difference: Instead of using base 10, the Mayans used base 20. This is called a vigesimal system. In a base 10 *horizontal* system, each *column* is ten times bigger than the one on the right. In a base 20 *vertical* system, each *row* is 20 times bigger than the one below. In the Mayan number system, a dot (•) = 1.

Base 20 (vigesimal) multiple	Digit	Total value
8,000s (400x20)	•	8,000
400s (20x20)	•	400
20s (1x20)	•	20
1s	•	1

The Mayans would write 8,421 as four dots stacked on top of each other.

The Mayans were among the earliest civilizations to develop the concept of "zero." Mayan numbers are formed by a combination of three symbols: a zero (shell shaped), a one (dot), and a 5 (bar). (See the chart on the right.)



Calculations (addition and subtraction) were also advanced. There is archeological evidence of Mayans doing sums up to the hundreds of millions. Some dates were so complex it took several lines to represent them.

Between 250-900 AD, without telescopes or similar devices, the Mayans calculated the duration of the year to be 365.2420 days. This is more accurate than the calendar we use, which has a total of 365.2425 days. While the brutal history of the Spanish conquest is clear, it is also clear that the Mayan people continue to survive, often in remote Mexican communities. I was sent to provide these communities with access to modern medicine. But during my year in the jungle, I realized they have just as much to teach us as we have to teach them.

Source: *The Mathematical Traveler: Exploring the Grand History of Numbers*, Calvin C. Clawson, p. 90. (Available on Google books.)

AFTER YOU READ:

1. Try explaining in your own words what "base 10" and "base 20" mean. Try writing more numbers using the Mayan number system.

2. What is most surprising about this article?

3. Pick something from this article to research further. For example, find out more about the Lacondon Jungle, the Tzeltal Mayan community, the Mayan number system, or anything else that interests you. Create a presentation based on your research and share it with your class.

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