

Mexican Roots

Lesson #4: MAYAN MATH

TIME

50 minutes

MATERIALS FROM THE TRUNK:

Object - poster *Math of Mexico*

Worksheets

#2 An Introduction to Mayan Math, and

#3 Using Mayan Numbers

TEACHER PREPARATION:

- Review the historical background information and be prepared to share with the class.
- Make copies of worksheets #2 and #3 for each student. Copy the answer sheet for yourself. Answer sheets are located on the back of the worksheets. It may be necessary to review worksheet #2 ahead of time and complete a couple of math problems on worksheet #3 to understand the Mayan mathematical system.

OBJECTIVES

Students will be able to:

- 1) recognize the presence of differing mathematical systems
- 2) demonstrate an understanding of the Mayan numerical system through transcribing Arabic and Mayan numbers and using Mayan numbers in mathematical problems

HISTORICAL SIGNIFICANCE

The Mayan culture is one of the oldest and best known of the Mesoamerica cultures. The Maya are recognized for their system of writing and their accomplishments in mathematics, astronomy, and architecture. They developed the concept of zero around 300 B.C. This put the Maya one thousand years ahead of the Europeans in the use of the zero. Without a zero, all of higher mathematics is impossible. Another measure of Mayan mathematical ability is their calendar, which was more accurate than the one we use today.

By the time the Maya reached their classical period in 300 A.D., they had dozens of varieties of corn. Corn was probably the most important ingredient in the civilizations of Mesoamerica and Peru. Experiments in farming by the old Mayan methods have shown that a Mayan farmer could probably grow enough corn to feed his family by working as little as forty-eight days of the year. The rest of the time could be spent building roads and temples and growing surplus food for priests, scientists, scholars, and craftsmen.

We know little about Mayan writing since all but three of the hundreds of Mayan books found by the Spaniards were burned as works of the devil. More and more of the writing is being deciphered, however. We do know that their system was able to express ideas as

abstract as a calculation of the eclipses of the planet Venus.

In the graphic arts too the Maya were very accomplished. The few painted murals that have survived in the jungle contain figures that are about three hundred years ahead of western Europe in their naturalism.

Set against this impressive list of intellectual accomplishments is the Maya's relative lack of technological development. They sometimes put wheels on their children's toys, but they never developed a practical use of the wheel as far as we know. Metals were used almost exclusively as ornaments.


The political organization is one of the most perplexing aspects of the Mayan culture. During their classical period, from 300 to 900 A.D., there was no central political organization. Still, the far-flung centers were in constant touch, and no wars or political upheavals interrupted their scientific and artistic development. Religion seems to have been the stabilizing force. The importance of agriculture gave the Maya a sense of mystical union with the soil, and their religion seems to have been a highly complex outgrowth of that union. Religion motivated the Maya to build the elaborate cities which amazed Cortes when he first saw them in the sixteenth century.

Bibliography

Acuna, Rudy. *A Mexican American Chronicle*. New York: American Book Co., 1967.

Casagrande, Louis B. and Sylvia A. Johnson. *Focus on Mexico: Modern Life in an Ancient Land*. Minneapolis: Lerner Publications Co., 1986.

The following information can be found on the poster *Math of Mexico*, included in this trunk

Astronomy, calendar, agriculture stimulated the growth of mathematics in the ancient Mayan world. The Mayans developed a place value system of numbers based upon 20. The dot ● represents 1; the bar — represents 5. The eye symbol  represents zero. All whole numbers can be written as a combination of these three symbols. Numbers are written vertically from bottom to top. Place value increases in multiples of 20. Instead of ones, tens, hundreds, thousands, etc., the Mayan system uses ones, twenties, four hundreds, eight thousands, etc.

The number 20 is shown with a dot over a zero symbol.
Reading from the bottom up, there are no ones and one twenty.



The number 48 is read from bottom to top as 8 ones and 2 twenties.



400 requires a third place value. It is read as no ones, no twenties, and one four hundred.



VOCABULARY

- **Maya** = One of several Indian nations living in Central America at the time of the Spanish explorers' arrival.

ACTIVITY

- 1) Discuss with the class the advanced state of the Mayan and other native cultures at the time of the European's arrival.

Developments in agriculture, architecture, mathematics, and writing were equal to the developments in Europe at the same time.

- 2) Introduce the class to the Mayan system of numbers. Using the poster *Math of Mexico* and copies of worksheet #2, An Introduction to Mayan Math, explain how the numerical system used by the Maya is organized.

Mayan numbers are based upon 20. The dot represents 1, the bar represents 5, and the eye symbol represents 0. All whole numbers can be written as a combination of these three symbols. Numbers are written vertically from bottom to top. Instead of ones, tens, hundreds, thousands, etc., the Mayan system used ones, twenties, four hundreds, eight thousands, etc.

While this system is not identical to Roman numerals, the concept is similar in that it is not the method students use on a daily basis.

On worksheet #2, An Introduction to Mayan Math, it is shown that at 20 and 400 a new level of symbols is added. (Numbers 1-19 are on the bottom level, 20-399 are on the second level from the bottom, 400-7999 are on the third level from the bottom, etc.)

Ask the class why new levels are added at 20 and 400.

The Mayan system is based on 20. This means that 20 begins a new level and 400, which is actually 20×20 , begins another new level.

What will be the first number in the next level after 400? The next after that?

8,000 (which is 400×20) is the first after 400. 160,000 (which is $8,000 \times 20$) is the next after eight thousand.

Have the students complete this worksheet. An answer sheet is located on the back of the worksheet original.

- 3) Hand out worksheet #3, Using Mayan Numbers, and have the class identify Mayan numbers, translate Mayan numbers into Arabic and vice-versa, and use the Mayan numbers in math calculations. The answer sheet for this worksheet is located on the back of the worksheet original.

Note for teacher: It is easier to change Arabic into Mayan beginning with the largest row.

STEP ONE: For example, for 503 begin by dividing it by 400. This is one dot in the third, or four hundreds, row ($1 \times 400 = 400$).

STEP TWO: Next take the remaining 103 and divide it by 20. This will be a bar in the second, or twenties, row ($5 \times 20 = 100$).

STEP THREE: Next take the remaining 3 and translate it into three dots in the first, or ones, row ($3 \times 1 = 3$).

This gives you $400 + 100 + 3 = 503$.



EXTENDED ACTIVITIES

- 1) Have the students write their own math problems, exchange them with classmates, and then solve each others problems.
- 2) See the complementary lessons in this manual: "Mexicans: Old Roots, Young People" and "The Aztec Calendar."
- 3) Explore the world of Mexican Indians through their stories. Books to use may include *The Fifth and Final Sun: An Ancient Aztec Myth of the Sun's Origin* by C. Shana Greger, *How Music Came to the World: An Ancient Mexican Myth* by Hal Ober, *The Legend of Food Mountain* by Harriet Rohmer, and *The Hungry Woman: Myths and Legends of the Aztecs* by John Bierhorst.