



CALENDAR IN THE SKY

calendarinthesky.org

Time: 45 minutes

Grade Level: 3rd-5th

What You'll Need

- 16 black beans per pair
- 12 toothpicks per pair
- 3 shells per pair
- 1 pen per pair
- 1 Maya Math worksheet per pair
- Paper towel or tissue for erasing sheets
- Maya numbers and place values chart

Maya Math

About this Activity

This simple exercise demonstrates how Maya numbers are written and how higher place values of numbers are calculated. This activity can also be used in informal education settings with people ages 9 through adult.

Introduction

The Maya were one of the first cultures to use the number zero and as a result numerical place values can be written making calculations of very large numbers possible. The Mesoamerican Long Count calendar developed in south-central Mexico and Central America required the use of zero as a place-holder within its vigesimal (base-20) positional numeral system. Many different glyphs were used as a zero symbol for these Long Count dates, the earliest of which (on Stela 2 at Chiapa de Corzo, Chiapas) has a date of 36 BC.¹

Vocabulary

- place value
- decimal (base-ten)
- vigesimal (base-twenty)

Student prerequisites

- knowledge and understanding of place-value structure
- ability to do basic operations

Common Core Math Standards

- represent and solve problems using multiplication and division
- understand properties of multiplication and the relationship between multiplication and division
- solve problems involving the four operations
- use place value understanding and properties of operations to perform multi-digit arithmetic

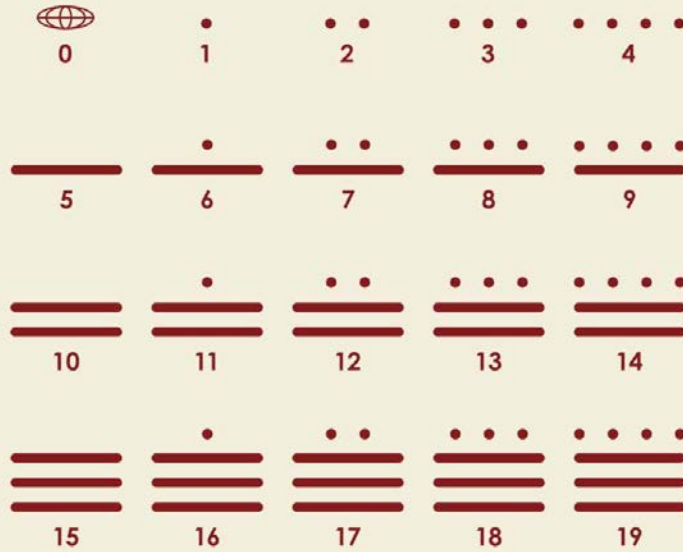
Objective

- To recognize and represent Maya numbers with small objects
- To calculate numbers of higher value
- To write Arabic numbers as Maya numbers

Teacher Preparation

1. Prepare each worksheet for re-use by placing a packaging tape strip along the right hand column. "Duck" brand packaging tape works well with ink pens, dry erase makers and Sharpies. Experiment to find the best tape/pen combination that wipes off easily.

Maya Numbers



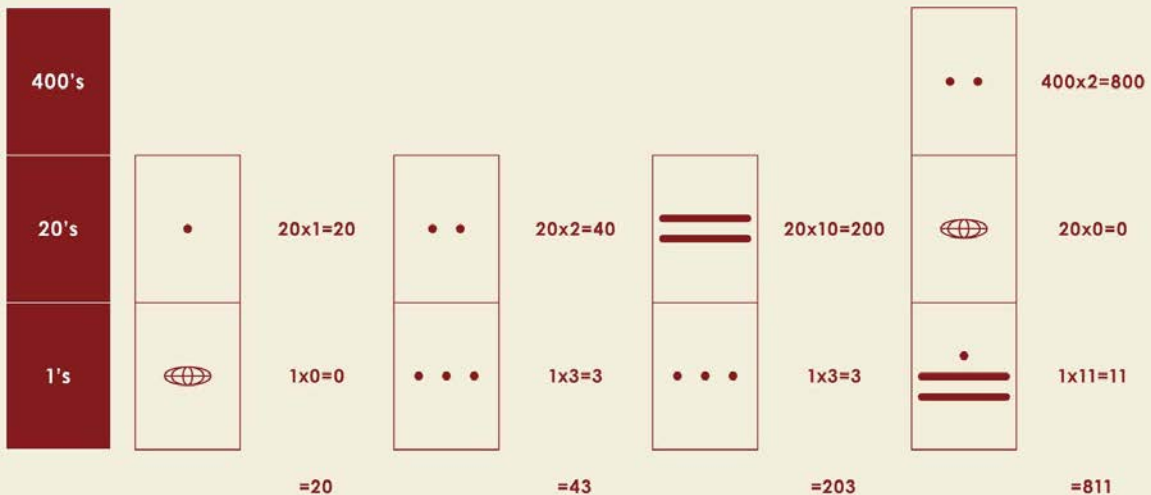
Maya number place values increase by a factor of 20 from bottom to top

8000
400
20
↑ 1

Arabic number place values increase by a factor of 10 to the left

←
1
10
100
1000

Maya Arithmetic



Maya Math

Use the black beans, toothpicks and shells to fill in Maya numbers at each place value. Multiply across then add down to determine the result.

| | | |
|--------------|--|----------------|
| 8000s | | |
| 400s | | |
| 20s | | |
| 1s | | + _____ |
| | | |

Fill in the proper Maya numbers above to solve for these numbers. 13, 52, 584, 2922, 7200, 144,000

2. Assemble the materials for each pair of students.
3. Display the Maya numbers chart for all to see.

Process




1. Referring to the Maya numbers chart, review how Maya numbers from 0-19 are written. A dot represents a value of one; a bar represents a value of five. A shell represents completion of a place value, or zero.
2. Review and demonstrate how Maya place values of 20 work. Numbers 0-19 are written in the 1s place. Numbers above 19 are written above in higher place values. Each place value is a multiple of 20. By multiplying the first place value (the 1s) by 20, the second place value of 20 results and is written above the 1s place. By multiplying the second place value (the 20s) by 20, the third place value of 400 results and is written above the 20s place. This system continues infinitely. Compare this system with the Arabic numbers system in which place values increase by a factor of 10 from right to left rather than a factor of 20 from bottom to top.
3. Demonstrate how to use the small objects to represent Maya numbers with the black beans representing the dots, the toothpicks representing the bars and the shells representing zero.
4. Have students work in pairs to complete the worksheet. They can work in turns randomly inserting Maya numbers using the small objects in the box next to each place value. Then they multiply the place value by the number and write the result in the box on the right hand side. When each place value is complete, they will add all the numbers in the right column to determine the result. See chart for examples. Wipe with tissue to erase and repeat.
5. To convert Arabic numbers to Maya numbers, use the highest place value that will divide into the number without going over. Fill in that amount in the box next to the place value as a Maya number with the beans, toothpicks and shells. Continue to divide the place values into the remainder until the remainder is a number between 0 and 19. Put the amount of the remainder in the 1s place. Now you've written an Arabic number the Maya way!

Assessment

Have students fill in the worksheet to write the current year in Maya numbers. See below for example.

Maya Math

Use the black beans, toothpicks and shells to fill in Maya numbers at each place value. Multiply across then add down to determine the result.

| | | |
|-------|---|--|
| 8000s | | |
| 400s |  | 2000 |
| 20s |  | 0 |
| 1s |  | 13 |
| | + | <hr style="border: 0.5px solid black;"/> 2013 |

Fill in the proper Maya numbers above to solve for these numbers. 13, 52, 584, 2922, 7200, 144,000

Example of completed worksheet. for 2013.