Mayan Math

Created by Kate Beck
Spring 2016

The Task

Study the Mayan counting system. Complete the following tasks:

- Determine the number that the Mayan counting system is based on.
- Make a place value chart for the Mayan system.
- Choose a number that fits each category below in base 10 and record the equivalent number in the Mayan system.
  * A number between 40 and 100.
  * A number between 100 and 500.
  * A number between 500 and 1,000.
  * A number between 1,000 and 10,000.
  * A number greater than 10,000.

Big Ideas

- Place value in a positional number system.

Standards of Learning for Grades 3-4-5

3.1a Read and write 6-digit numerals and identify the place value and value of each digit.

4.1a Identify orally and in writing the place value for each digit in a whole number expressed through millions.

Standards of Learning for Grades 6-7-8

6.5 Investigate and describe concepts of positive exponents.

7.1a Investigate and describe the concept of negative exponents for powers of 10.

7.1b Determine scientific notation for numbers greater than zero.

Process Goals

- Problem Solving and Reasoning – Students will apply an understanding of base 10 place value to make sense of the Mayan number system (base 5 within base 20).
- Connections and Representations – Students will recognize and use mathematical connections to extend and generalize patterns in a positional number system. They will use a variety of representations as they explore base 20 and communicate their thinking.
- Communication – Students will justify their findings and present their results to the class with precise mathematical language.

Related Task – Out of this World

Your mission is to make sense of the Woop/Zoobie/Glim number system and present it to the mathematicians on Earth. You must help them understand this new way of counting. Peace in our solar system depends on it!

Related Task – A Splash of Color

Create a colorful design for your iPhone screen. Use the chart to help you choose your colors and be sure to include at least 8 different colors. Label each component of your design with the RGB value as well as the hexadecimal #RRGGBB value. Finally, color your design!

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Lesson Plan

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Materials

- Copies of the task for each pair/group
- Copies of the Mayan Number System sheet for each pair/group
- Graph paper
- Blank paper
- Calculators
- 1 large sheet of paper for each pair/group on which to create the place value chart.
- 5 large pieces of chart paper labeled with each heading from the task (e.g. A number between 40 and 100) that are hung in different places around the classroom.
- Markers
- Sea shells or a similar manipulative that can be used to represent the shell in the Mayan system
- Orange Cuisenaire rods or other "sticks" that can be used to represent 5 in the Mayan system
- Round chips (colored chips or two-sided counters that can be used to represent the dots in the Mayan system)

Facilitating Task

- Divide the class into pairs or groups of 3 students. Give each group a copy of the task.
- Read the task together and answer clarifying questions.
- Make materials available to the groups.
- Each group will explore the Mayan system and create their place value charts on a large sheet of paper.
- Students may wish to use the manipulatives to create their numbers on their place value charts before recording them.
- Each group will record five numbers that fit the categories on separate sheets of paper and attach these sheets to the appropriate chart.
- Allow 10-15 minutes at the end of the lesson for discussion. Discuss the place value charts and the numbers that the students created.
- As the groups present, draw connections between the Mayan counting system and our base 10 decimal system (see prompts/questions below).
- An extension to this task is to have each student create his or her own "ancient" world (i.e. in a base other than 10 or 20). They can explore that world by creating numbers.

Misconceptions

- Students may think the Mayans only used zero in the "ones" place. They may create numbers in which they just leave a blank place rather than inserting a shell.
- Students may be confused by the base 5 within a base 20 system. So, they may say that it's based on five, which is not incorrect but is not

Suggested Prompts or Questions

- What patterns do you notice within the Mayan system?
- How did you figure out what number the system was based on?
- How is the Mayan system similar to our base 10 system?
- How is it different?

completely correct. • Students may be confused by the vertical positional system, as they are used to the horizontal positional system that we use.	• What did you find trickiest about the Mayan system? • Has anything become clearer about base ten after working in the Mayan system?

Mayan Math

Name_____
Date_____

The ancient Mayan civilization existed from around 2,000 B.C. until around 900 A.D. in modern-day Mexico and Central America. The Mayans used a sophisticated counting system to create their calendar and make astronomical observations. They even developed the concept of zero which they represented using a shell:

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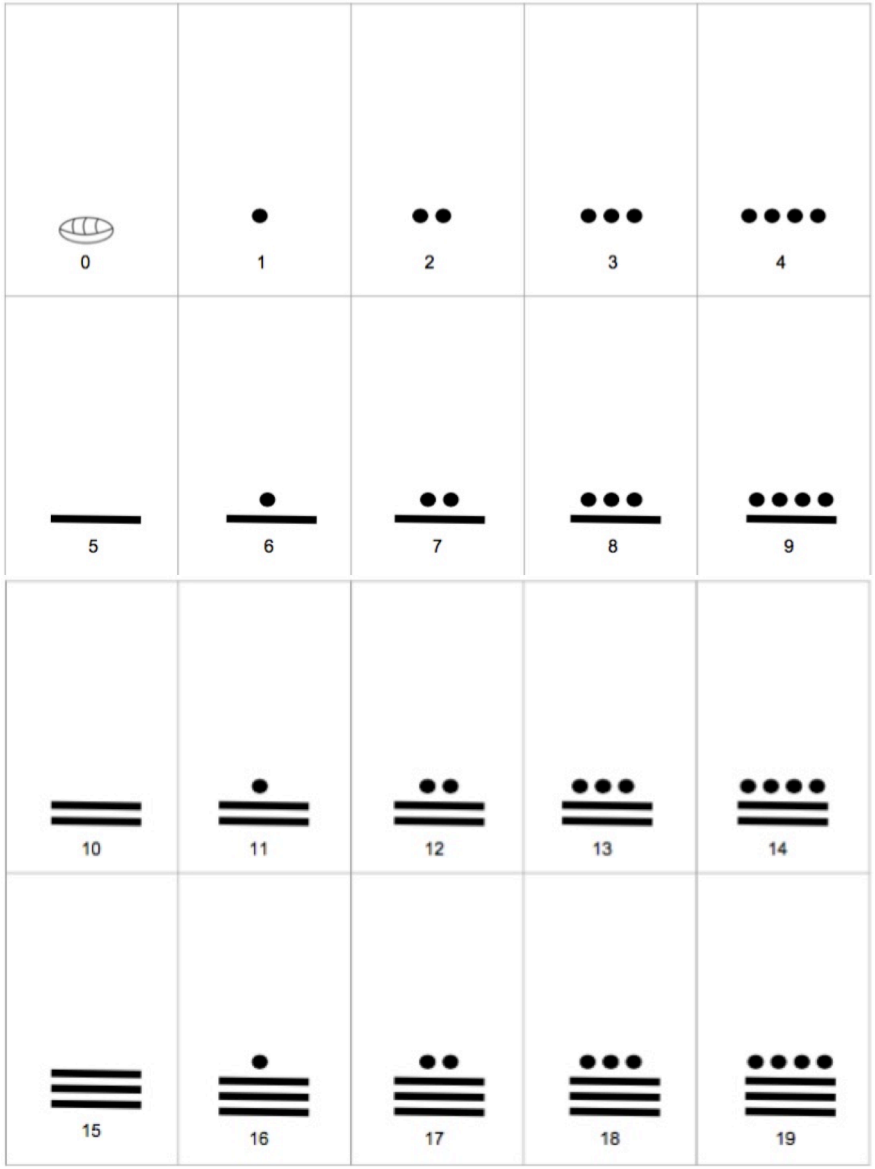
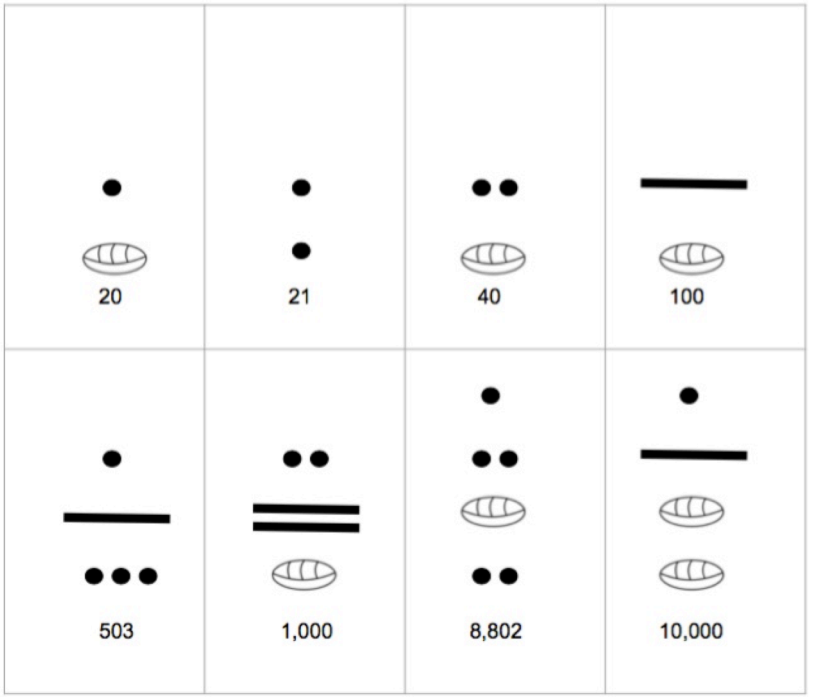
Mayan Counting System

0-19:



Some larger numbers:



Mayan Math Solution Strategies

- The Mayan number system is a base 5 within a base 20 system. Students might identify only one of these elements as they are making sense of the system.

- Place value chart:

eight thousands place 20^3	
four hundreds place 20^2	
twenties place 20^1	
ones place 20^0	

Examples of Mayan numbers that fit each category:

- A number between 40 and 100

60

twenties place 20^1	●●●
ones place 20^0	

(3x20) + (0x1)= 60

- A number between 100 and 500:

465

eight thousands place 20^3	
four hundreds place 20^2	●
twenties place 20^1	●●●
ones place 20^0	—

(1x400) + (3x20) + (5x1) = 465

- A number between 500 and 1,000

644

four hundreds place 20^2	
twenties place 20^1	
ones place 20^0	

(1x400) + (12x20) + (4x1) = 644

- A number between 1,000 and 10,000

9,100

eight thousands place 20^3	
four hundreds place 20^2	
twenties place 20^1	
ones place 20^0	

(1x8,000) + (2x400) + (15x20) + (0x1) = 9,100

- A number greater than 10,000

20,007

eight thousands place 20^3	
four hundreds place 20^2	
twenties place 20^1	
ones place 20^0	

(2x8,000) + (10x400) + (0x20) + (7x1) = 20,007