

Math and the Maya: *Discussion Guide*

Overview

Maya civilization flourished during the Classic Period, from approximately A.D. 250 to 900. The Maya built dozens of cities, excelled in architecture and astronomy, and developed a complex culture centered on commerce, farming, and religious beliefs.

But of all their achievements, perhaps the most impressive is the invention of an advanced system of arithmetic—the most sophisticated mathematical system ever found in the Americas. With only three symbols, including an all-important zero, they were able to express any quantity.

Understanding how the Maya did math can help your students better grasp their own system of arithmetic. Explore important concepts in number theory with this discussion guide and its related activities.

Classroom Activities

For all of the following activities, show the segment “Math and Culture: The Ancient Maya” from *Discovering Math: Concepts in Number Theory*. (Access to *unitedstreaming* is required.)

1. Review the general principles of Maya arithmetic and how this system differs from the Hindu-Arabic numerals we use.
 - **Discussion:** Ask students: What number system do we use today? How does it work? In what ways does it differ from the Maya system of arithmetic? What are the three Maya symbols?
 - **What Year Is It?:** Have students write the year in Roman numerals and in the Maya system. For 2005, the answers are as follows:

Roman numerals

Maya system

MMV



- **Related Viewing:** Take a look at the use of numbers in other early cultures. Show the “Introduction to the Early History of Mathematics” segment from *Project Mathematics: Early History of Mathematics*. (Access to *unitedstreaming* is required.)
2. Explore the importance of zero—and the idea of place value—in a mathematical system.
- **Writing Activity:** In the video, students hear: “That the Maya had invented a symbol for zero is probably the most important aspect of their mathematical system.” Have students explain, in their own words, why having a symbol for zero is so crucial.
 - **Covering the Bases:** Unlike our base 10 numbering system, the Maya used a vigesimal system where each place is equal to a power of 20. In the program, students are shown that 9,999 in base 20 is equal to 75,789 in base 10. Have students calculate the base 10 equivalent of the following base 20 numbers.

Vigesimal / Base 20	Decimal / Base 10
1	1
11	21
77	147
111	421
444	1,684
1,111	8,421
2,005	16,005
4,321	33,241
11,111	168,421
12,345	177,285
111,111	3,368,421

- **Related Viewing:** Introduce place value to younger students by showing the “Bison (Place Value)” segment from *Math Investigations, Part One*. (Access to *unitedstreaming* is required.)

3. Try your hand at addition and subtraction using the Maya numerals.
 - **Discussion:** In the video students hear that when adding Maya numerals, it is only necessary to learn three rules. Ask students if they can name them. *(The first rule is that a dot represents one unit. The second rule is that five dots are equal to one bar. And the third rule is that four bars in any one place are equal to one dot in the next higher place.)*
 - **Maya Math Challenge:** Have each student create two math flashcards that use Maya numerals—one with an addition problem and one with a subtraction problem. You may want to limit students to creating problems that use no more than two place values. Then divide the class into two teams and use the flashcards to see which team can correctly solve the most problems.
 - **Related Viewing:** Take a more in-depth look at the commutative, associative, and distributive properties of addition and multiplication by viewing the three related segments in *The Power of Algebra: Basic Properties*. (Access to *unitedstreaming* is required.)

4. Investigate the Maya calendar and how they used their mathematical system to calculate the passage of time and study the night sky.
 - **Tracking Time:** One of the calendars the Maya created was the Haab, a 365-day solar calendar. This calendar had 18 months, each consisting of 20 days, plus a 5-day shortened month at the end, called Uayeb. The names of the months follow.
 1. Pop
 2. Uo
 3. Zip
 4. Zotz
 5. Tzec
 6. Xul
 7. Yaxkin
 8. Mol
 9. Chen
 10. Yax
 11. Zac
 12. Ceh
 13. Mac
 14. Kankin
 15. Muan
 16. Pax
 17. Kayab
 18. Cumku

If New Year's Day was the first day of Pop and New Year's Eve was the last day of Uayeb, have students determine what month their birthday would be on this Maya calendar. You may also ask them to determine the

Maya month for other significant dates such as national holidays or school events.

- **Related Viewing:** The Maya were able to predict the position of Venus in the sky with amazing accuracy. Discover why the appearance and disappearance of this planet were integral to Maya religion by viewing “The Maya and Astronomy” segment from *Earth Science: The Universe*. (Access to *unitedstreaming* is required.)
- **Web Exploration:** In the previous segment, students hear of the *Dresden Codex*. Have students visit the following Web site (<http://www.famsi.org/mayawriting/codices/dresden.html>), where they can learn more about pre-WWII copies of this Mayan book and download two different versions of the codex in PDF format.

Academic Standards

Mid-continent Research for Education and Learning (McREL)

McREL’s Content Knowledge: A Compendium of Standards and Benchmarks for K–12 Education addresses 14 content areas. To view the standards and benchmarks, visit <http://www.mcrel.org/compendium/browse.asp>.

This lesson plan addresses the following national standards:

- Mathematics
 - Uses a variety of strategies in the problem-solving process
 - Understands and applies basic and advanced properties of the concepts of numbers
 - Understands the general nature and uses of mathematics
- World History
 - Classical Traditions, Major Religions, and Giant Empires
 - Expanding Zones of Exchange and Encounter: Understands the rise of centers of civilization in Mesoamerica and Andean South America in the first millennium C.E.