NOVA Classroom Activity: Cracking the Maya Code

http://www.pbs.org/wgbh/nova/teachers/activities/3506_mayacode.html

NOVA chronicles the 200-year worldwide quest by linguists, mathematicians, artists, architects, archeologists, and others to decipher the Maya hieroglyphs.

The program:

- describes where the Maya region is located.
- recounts the first documented discovery by an expedition from Spain, in 1785, of tablets with hieroglyphs.
- notes that the complexity of the hieroglyphs presented the greatest obstacle to deciphering the images.
- reports that Alfred Maudslay was the first to photograph the ruins in 1881.
- relates how the Maya language faded to obscurity after, in 1562, Bishop Deigo de Landa and other Spaniards destroyed—for religious reasons—all the Maya texts he could find.
- reports on how one of the first breakthroughs in deciphering the code came in 1810, when a scholar first determined that some of the glyphs stood for numbers.
- pieces together the puzzle of how numerous scientists and laypeople unraveled the mystery behind the hieroglyphs, including what sound each glyph represented.
- reports on present-day efforts to teach the original Maya language to children in the region.

Activity Summary

Students see how scientists began to unravel the meaning of Maya glyphs and then determine their own birth date using the Maya Long Count calendar system.

Learning Objectives

Students will be able to:

- explain some of the similarities and differences between the Maya and U.S. mathematical systems.
- calculate sums using Maya symbols.
- understand and use the Maya Long Count calendar system.

Materials:

Multimedia Resources

- The Forgotten Maya Temples QuickTime or Windows Media Video (9m 11s)

Additional Materials

- Calendar Count Worksheet Student Handout (PDF)
- calculator

Background
The Maya civilization began about 2600 BC and thrived for more than 2,000 years. It reached its height of glory at about the same time the Europeans were entering the Dark Ages (about AD 410). The Maya were renowned for their monumental architecture, exquisite art, and advances in mathematics and astronomy.

One of the most remarkable achievements of the Maya was their complex calendar system. The Maya developed three types of calendars, each serving a unique purpose:

- The Tzolkin: A 260-day cycle used primarily for religious and ceremonial events. It consists of twenty day-signs combined with numbers from one to thirteen.
- The Haab: A 360-day cycle for keeping track of seasons. The Haab calendar consists of eighteen months of twenty days each, and most closely resembles our solar year.
- The Long Count: The longest-lasting cycle, lasting about 5,125 years. It signifies the length of a Creation period. We are currently in the Fourth Creation, which began on August 13, 3114 BC and will end AD December 22, 2012.

When combined, the Tzolkin and Haab calendars could track 52 years of time before day combinations began to repeat. This combination of these two calendars was known as the Calendar Round.

Unlike U.S. mathematics, which works on a base 10 system, the Long Count works on a base 20 (vigesimal) system. In the base 10 system, a number in the first place is represented by numbers one to nine. The second place value is 10 times the number in that place $(10)^1$, the third place value is 100 times the number $(10)^2$, and so on. In a base 20 system, the first place value is represented by numbers one through nineteen, the second value is 20 times the number $(20)^1$, the third place value is 400 times the number $(20)^2$, and so on.

Many Maya structures feature engraved stone monuments, known as stelae, that reveal the date the monument was built (visit Decode Stela 3 to see Maya and English translations of an actual Maya stela).

Procedure:

1. Have students view and take notes on the nine-minute The Forgotten Maya Temples video clip. Tell students they will learn about where the Maya lived, what they were known for, and how scientists first started to decipher Maya glyphs. Follow the video with a discussion of the questions below:
    - Why is understanding original Maya writing important? *(Because it provides a picture of Maya history before the arrival of Europeans.)*

- Where is the Maya region located? *(In the region extending from southern Mexico through much of Central America.)*
- Why is it important to not rely solely on drawings in field research? *(While drawings can be helpful, the person creating them may introduce errors or omit important data when making them. False conclusions may be drawn based on the drawing. Photographs, [or when appropriate, field samples] provide actual representations of an object under study.)*
- Write the following Maya symbols on the board. Tell students that, like U.S. mathematics, Maya math uses a place value system. The only difference is that the place value is denoted vertically, rather than along a horizontal axis like in the U.S. system. Review the places values for each level and numerical values for each symbol (one dot = one; one bar = five). Walk through the Column A problem and answer with students and then have students calculate the solutions for the other columns. *(Column B = 26,981; Column C = 98,663)*

	Column A	**Answer**	**Column B**	**Column C**
8000s	•	8,000	• • •	• •
				▬▬ ▬▬
400s			• •	•
	▬	2,000	▬	▬
20s	• •	40	• • • •	• • •
			▬	▬ ▬
1s	• • • •	4	•	• • •
TOTAL		10,044		

2. Tell students they will now learn how to calculate their date of birth using one of the Maya calendar systems: the Long Count. The Maya Long Count system uses a base 20 number system. Review the difference between a base 10 system, which students are familiar with, and a base 20 system. Read the student handout to familiarize yourself with the calculations students will make.
3. Organize students in teams. Distribute copies of the Calendar Count Worksheet to each team.
4. Assist students in calculating their birth date according to Maya Long Count.
5. As an extension, have student calculate how many days until the Fourth Creation ends (December 22, 2012) and how many total days are in the Fourth Creation.

Assessment:

Days from the beginning of the Maya Fourth Creation to December 31, 1987:

12.18.14.11.16 =

12 baktuns x 144,000 days = 1,728,000
18 katuns x 7,200 days = 129,600
14 tuns x 360 days = 5,040
11 uinal x 20 days = 220
16 kin x 1 day = 16

Total = **1,862,876**

The number of days to each student's birth date will vary. Check to make sure students include the extra day for each leap year, and the day of their birth. Students will add the number of days from 1988 to their birth date to the number of days they converted in the first part of the activity. Students will then use the conversion chart to convert the number of total days back into Maya Long Count, dividing first by the largest equivalent (baktun at 144,000 days) successively down to the smallest equivalent (kin at 1 day).

The Fourth Creation will be completed on December 22, 2012, the Maya date of 12.19.19.17.19. Scholars disagree on the precise correlation of the Gregorian and Maya calendars. Their disagreements turn on differences of days, however, not decades. (A correlation is necessary to equate a Gregorian date with a Maya date; this means finding a particular date that is identified by both systems.) For this activity, the correlation for the most recent day of Maya Long Count 0.0.0.0.0 is 584,285 days on the Gregorian calendar, thus the first day of the Maya Long Count would be the 584,286th day on the Gregorian calendar. This correlation is incorporated into all Long Count calculations in this activity.

Standards:
The "Calendar Count" activity aligns with the following Principles and Standards for School Mathematics (**standards.nctm.org/document/index.htm**).

Grades 6-8
Number and Operations

Grades 9-12
Number and Operations

Classroom Activity Author

Written by Mary C. Turck. This classroom activity originally appeared in the companion Teacher's Guide for NOVA's "Lost King of the Maya" program.

Calendar Count Worksheet

If someone asks you when your birth date was, you probably answer them by giving a month, day, and year. But that's not the only way to record passing time. Different cultures have used different calendar systems to mark time. One such system used by the Maya culture is called the Maya Long Count. In this activity, you'll figure out your birth date in Maya Long Count.

Part I

Most people today measure time in days, months, years, decades, and centuries, based on what's known as the Gregorian calendar system. The ancient Maya measured time in kins, uinals, katuns, and baktuns based on the Maya Long Count system. The numbers add up to the number of days since the beginning of the Maya Fourth Creation (which is calculated as August 13, 3114 BCE, on the Gregorian calendar used today).

Procedure

1 Your first task is to convert a Maya Long Count date into days. In Maya Long Count, the date December 31, 1987 is recorded as 12.18.14.11.16

2 Use the "Maya Long Count Conversions" chart below to convert each Long Count place value in the date above to days and then add up all five values to calculate the total number of days. Write your answer below.

Days from the beginning of the Maya Fourth Creation to December 31, 1987 = _____

Maya Long Count Conversions

Maya Long Count dates are written as a series of numbers separated by periods.

12	18	14	11	16
baktun	**katun**	**tun**	**uinal**	**kin**

baktun = 144,000 days
katun = 7,200 days
tun = 360 days
uinal = 20 days
kin = 1 day

Part II

Procedure

1 Now, using the "Days in Each Month/Year" chart below, calculate how many days there are from January 1, 1988, to the day you were born. Note that leap years have an extra day in February.

Your Birth Date _____

Days from January 1, 1988, to your birth date = _____

Days in Each Month/Year

(Leap years are noted in **bold**.)

Days in Month	Days in Year
January = 31	**1988 = 366**
February = 28/29	1989 = 365
March = 31	1990= 365
April = 30	1991 = 365
May = 31	**1992 = 366**
June = 30	1993 = 365
July = 31	1994 = 365
August = 31	1995 = 365
September = 30	**1996 = 366**
October = 31	1997 = 365
November = 30	1998 = 365
December = 31	

Part III

Procedure

1 Add the number of days from the beginning of the Maya Fourth Creation to December 31, 1987, and the number of days from January 1, 1988, to your birth date. Write the total in below.

Days from the beginning of the Maya Fourth Creation to your birth date = _____

2 Now it's time to convert the number of days since the Maya Fourth Creation to your birth date back into Maya Long Count. Use the "Maya Long Count Conversions" chart to turn the number of days into Long Count. Write the conversions in below.

_____	_____	_____	_____	_____
baktun	**katun**	**tun**	**uinal**	**kin**

3 Congratulations! Now when somebody asks you when you were born, you can say "Do you want to know by the Gregorian calendar or Maya Long Count?"