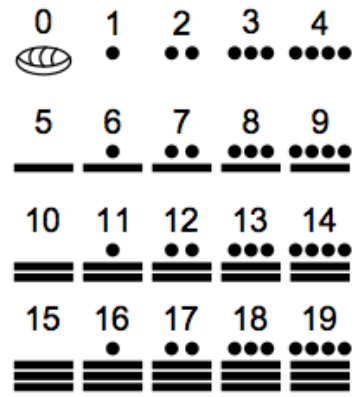


DSA
Alternate Base Systems
for Cross-Curricular Fun & Engineering Applications

OVERVIEW OF WHAT BASES ARE: MAYAN VIGESIMAL

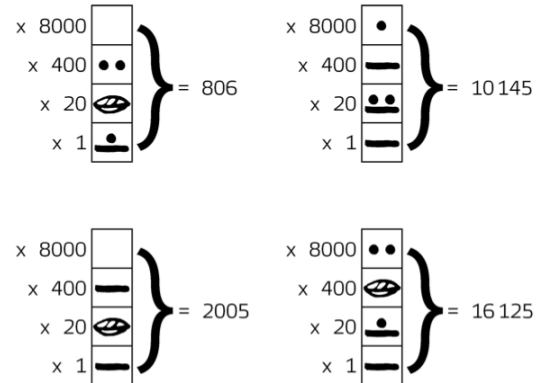
DESCRIPTION OF THE MAYAN VIGESIMAL BASE:

The Mayan Vigesimal Base was a base-20 number system which utilized dots and lines to construct numbers. The Maya also had a symbol for zero!



HISTORY OF MAYAN VIGESIMAL BASE:

The Mayan people of Central America and Mexico were using a base-20 system at least by the 3rd century BCE. The Maya had a complex and rich culture in which the calendar and numeric cycles carried great importance. Mayan cultural history was recorded in carved stone, other materials, and in books, as well as told to Spanish missionaries. One specific missionary, Diego de Landa was both responsible for imposing Spanish Inquisition-style torture & death of many Mayan people, and causing the near-total destruction of cultural artifacts & books/codices, as well as responsible for ensuring their preservation in the form of an ethnographic book he wrote about his time with the Maya Relación de las cosas de Yucatán. In late December 2012 the 13th Mayan 144,000 day B'ak'tun long count cycle finished and a new, 14th cycle began.



USE OF THE MAYAN VIGESIMAL BASE:

There are two different ways of writing Mayan numbers, either with numbers shown to the above left*, or with glyphs on the back of this page**. The Mayans had a pure base-20 system, but they also used two mixed or dual-base systems. Maya used 20x13 for their "Sacred Round" Tzolk'in 260-day calendar; and they used 20x18+5 for their Ha'ab 365-day solar calendar.

EXAMPLES:

Here is a number in base-10: 201.
What does it mean? It means:

two one-hundreds,
zero tens, and
one one.

What does this base-10 number, 201, equal in the Mayan base-20 system?

It is . What does it mean? It means
Two fives (10) of twenties:
And single one of one: ●

QUESTIONS:

1. Can you think of any reason why their zero looks so different from the other two symbols?
2. Notice that they had the larger numbers on top and the ones on the bottom. What is the benefit of that way of organizing place value?
3. Can you write the number 5203 in pure base-20 (400s)?
4. Can you write the number 5203 in dual-base 20 x 13 (260s)?

3.

4.

NOTE: Images on this page were Wikipedia Commons public domain images retrieved on 6/6/13

Top Numbers: <http://upload.wikimedia.org/wikipedia/commons/1/1b/Maya.svg> and <http://en.wikipedia.org/wiki/File:Maya.svg>

Middle Example: https://en.wikipedia.org/wiki/File:Examples_of_how_to_calculate_the_value_of_Mayan_numerals.gif

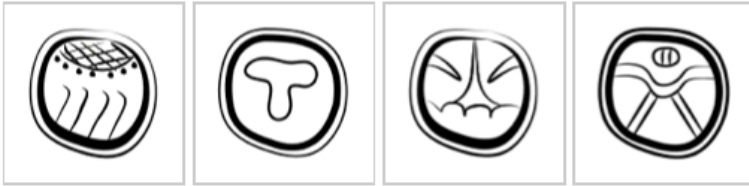
Glyphs: http://en.wikipedia.org/wiki/Maya_calendar and also the Smithsonian Institute's <http://maya.nmai.si.edu/resources>

Additional information: <http://maya.nmai.si.edu/calendar/calendar-system> and <http://maya.nmai.si.edu/calendar/maya-calendar-converter>

SELECTED MAYAN CALENDAR NOTATION

LEFT: "Tzolk'in named day glyphs, generic, in vector format"

RIGHT: The "Haab' system for the 18 months & the Wayeb (5 unlucky days)



IMIX Day-Sign Number 1; Trecena Number 1; Direction - East; Color - Red; Alligator/Crocodile

IK Day-Sign Number 2; Trecena Number 18; Direction - North; Color - White; Wind

AKBAL Day-Sign Number 3; Trecena Number 15; Direction - West; Color - Blue; Night/House

KAN Day-Sign Number 4; Trecena Number 12; Direction - South; Color - Yellow; Lizard/Seed



CHICCAN Day-Sign Number 5; Trecena Number 13; Direction - East; Color - Red; Serpent

CIMI Day-Sign Number 6; Trecena Number 6; Direction - North; Color - White; Death/Transformation

MANIK Day-Sign Number 7; Trecena Number 3; Direction - West; Color - Blue; Deer

LAMAT Day-Sign Number 8; Trecena Number 20; Direction - South; Color - Yellow; Rabbit



MULUC Day-Sign Number 9; Trecena Number 17; Direction - East; Color - Red; Water

OC Day-Sign Number 10; Trecena Number 14; Direction - North; Color - White; Dog

CHUEN Day-Sign Number 11; Trecena Number 11; Direction - West; Color - Blue; Monkey

EB Day-Sign Number 12; Trecena Number 8; Direction - South; Color - Yellow; Road/Grass

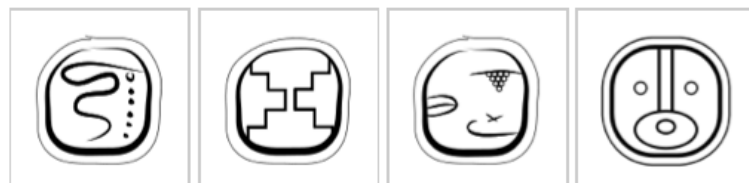


BEN Day-Sign Number 13; Trecena Number 5; Direction - East; Color - Red; Corn/Reed

IX Day-Sign Number 14; Trecena Number 2; Direction - North; Color - White; Jaguar

MEN Day-Sign Number 15; Trecena Number 19; Direction - West; Color - Blue; Eagle

CIB Day-Sign Number 16; Trecena Number 16; Direction - South; Color - Yellow; Owl/Vulture



CABAN Day-Sign Number 17; Trecena Number 13; Direction - East; Color - Red; Movement/Quake Earth/Incense

ETZNAB Day-Sign Number 18; Trecena Number 10; Direction - North; Color - White; Flint/Knife

CAUAC Day-Sign Number 19; Trecena Number 7; Direction - West; Color - Blue; Rain/Storm

AHAU Day-Sign Number 20; Trecena Number 4; Direction - South; Color - Yellow; Flower/Light Ancestors



Haab' Meaning of Glyph

- | | |
|----------------|-------------------|
| 1. Pop - | mat |
| 2. Wo' - | black conjunction |
| 3. Sip - | red conjunction |
| 4. Sotz'- | bat |
| 5. Sek - | death |
| 6. Xul - | dog |
| 7. Yaxk'in' - | new sun |
| 8. Mol - | water |
| 9. Ch'en - | black storm |
| 10. Yax - | green storm |
| 11. Sak' - | white storm |
| 12. Keh - | red storm |
| 13. Mak - | enclosed |
| 14. K'ank'in - | yellow sun |
| 15. Muwan' - | owl |
| 16. Pax - | planting time |
| 17. K'ayab - | turtle/song |
| 18. Kunk'u - | granary |
| 19. Wayeb - | five unlucky days |

- The Tzolk'in image on the left is from open-source Wikipedia Commons: http://commons.wikimedia.org/wiki/Maya_calendar retrieved 6/6/13.
- The Haab' image on the right is from public domain Smithsonian Institution Resources at <http://maya.nmai.si.edu/haab.htm> and the explanation is copied from Wikipedia: <http://en.wikipedia.org/wiki/Haab%27> both retrieved 6/6/13. NOTE: the turquoise-background squares represent "variants" of a single glyph.
- There is "The Mayan Calendar glyphs and how the calendar round works" found at <http://astrosociety.org/edu/publications/tm/79/79.html#1> which students and teachers might enjoy. It is found in Volume 79, Winter 2012 issue of "The Universe in the Classroom".