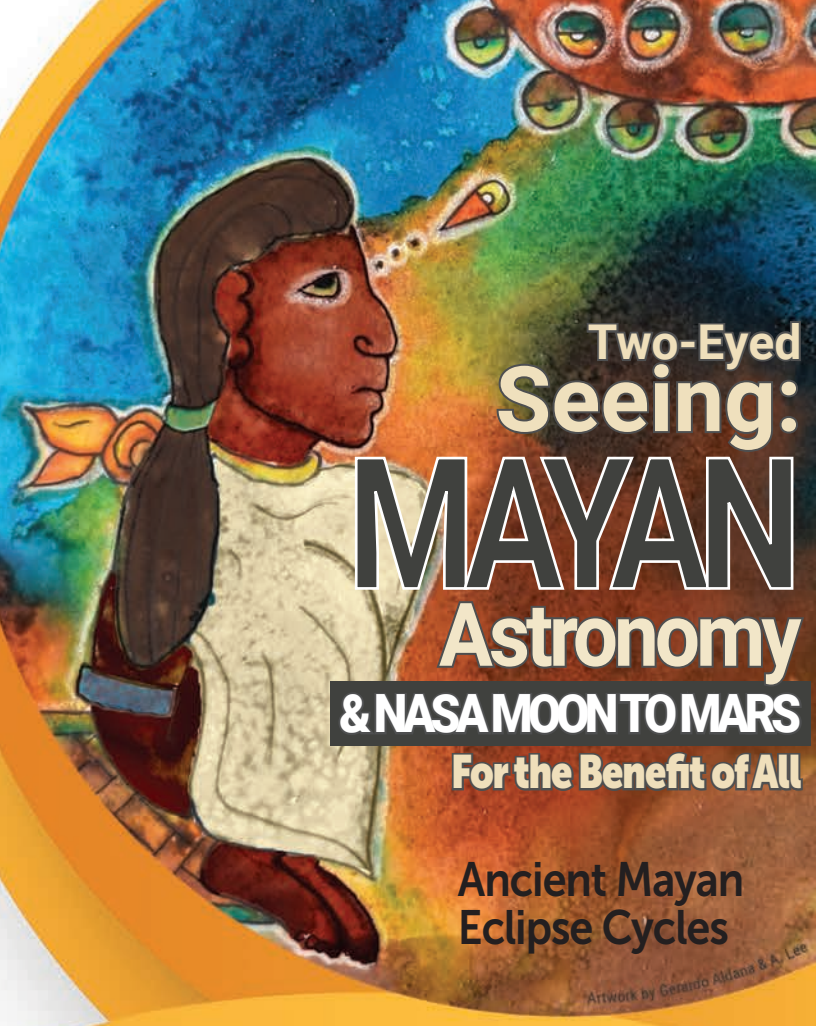


"Two-eyed Seeing" is learning to see from one eye with the strengths of Indigenous knowledges and ways of knowing, and from the other eye with the strengths of Western knowledges and ways of knowing, and to use both these eyes for the benefit of all."
-Bartlett, Marshall and Marshall 2012

VIRTUAL **LIVE SHOW**

2020 **Thursday**
December 17
6:30 pm PST

Presented by: Gerardo Aldana, Andrea Carrillo, Annette S. Lee, Andrea Medina, and Graciela Rodriguez.

In coordination with Adelante Charter School in Santa Barbara, California.

NATIVE SKY WATCHERS

Supporting organizations are Native Skywatchers, NASA, and the Chicano Studies Institute at UC Santa Barbara.

Land Acknowledgment

This booklet was created in the region and with the communities of the California Central Coast region around Santa Barbara. As we work and play here, we recognize this as the ancestral land and waters of Chumash communities. At the same time, we recognize that the land itself is being actively cultivated by the indigenous hands of Mixtec migrants from Oaxaca in southern Mexico, alongside Chicanx and Latinx communities that have been here for decades. The indigeneity of this land is complex and evolving, but we are all indebted to the Chumash communities who stewarded these lands for thousands of years.

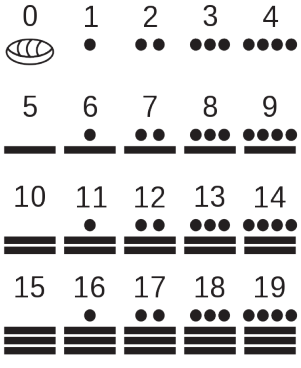
The *Native Skywatchers* team offering Mayan Astronomy from Santa Barbara, California, respectfully acknowledges that the land under our feet is the homeland of the Chumash people. One of the many inventions of the Chumash, the tomol (the plank canoe) was used to navigate from the Central Coast of California to the Channel Islands. Their extraordinary baskets, tools and bead-making would be part of a larger, sophisticated trade system. Their very name, Chumash, means bead money people. In the spirit of exchange and learning from various cultures across time and space, we honor the many diverse Indigenous peoples that live and connect to this land on which we gather (Andrea Medina and Gerardo Aldana, with content from the Samala-English Dictionary, Santa Ynez Band of Chumash Indians 2007).

Pictographs, Chumash Painted Cave State Historic Park, wikipedia

Mesoamerican Time

Mesoamerica is a region of central and southern Mexico as well as northern Central America that includes communities speaking scores of different languages, such as Nahuatl, Mixtec, Zapotec and numerous forms of Mayan. The regions these communities occupied varied from the rainforest lowlands of the Gulf, Pacific and Caribbean coasts to the pine forest highlands of Guatemala and the Basin of Mexico. One thing that they all had in common – one cultural feature that they shared, was a calendric device known as the *tonalpohualli* (Nahuatl) or the *chol q'iij* (K'iche'). This is often referred to more descriptively as the 260 Day Count. To understand the 260 Day Count, with start with its two parts: Mayan numbers and the Day Signs.

Mayan Numbers



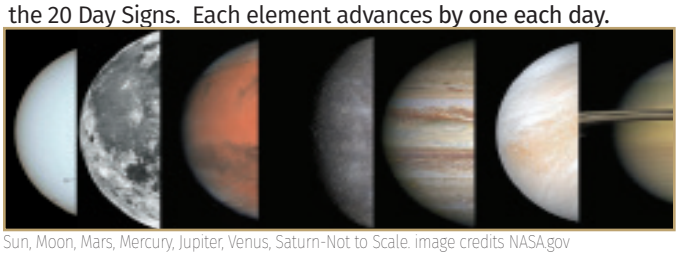
Maya numerals, wikipedia, by Bryan Derksen

Most representations in popular culture as well as in the academic literature give the sense that time was mechanical. Often times we think of time as mechanical gears, as purely cyclical, or sometimes when we're more adventurous we can think of it as a spiral. When we see the operation of the 260 Day Count, we find that such representations do seem to make sense.

Mayan Day Signs

Now that we have the numbers, we can combine them with the Day Signs. We can think of these something like days of the week: Monday, Tuesday... The parallel to the origin of these terms is even stronger. Sunday and Monday are –days connected to the Sun and Moon as symbols. Tuesday is connected to Mars, Wednesday to Mercury, Thursday to Jupiter, Friday to Venus and Saturday to Saturn. Similarly, each of the Day Signs is represented by a *cartouche* – the visual parallel to the suffix –day. The central image is what varies, similar to the prefixes Mon-, Tues-, Wednes-, etc. Of course, the other main difference is that there are 20 Day Signs and only 7 days of the week, but the comparison is still useful.

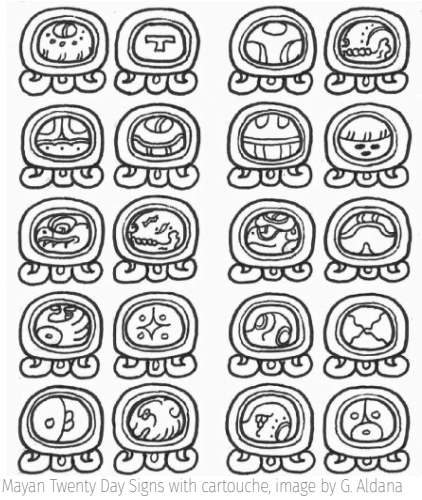
In operation, the 260 Day Count combines the 13 numbers with the 20 Day Signs. Each element advances by one each day.



Sun, Moon, Mars, Mercury, Jupiter, Venus, Saturn-Not to Scale. image credits NASA.gov

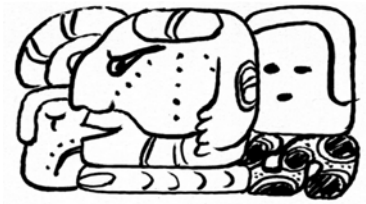
Starting from the date 1 Imix, then, the next day would be 2 Ik'. This is followed by 3 Ak'bal, 4 K'an, 5 Kimi...

We can easily perform computations, for example, adding 5 days to the date 8 Ok. Each element advances each day, so we have 8 + 5 = 13 for the new number and Ok plus 5 days gets us to the Day Sign Men. So 5 days after 8 Ok is 13 Men.



Mayan Twenty Day Signs with cartouche, image by G. Aldana

Mayan Hieroglyphs

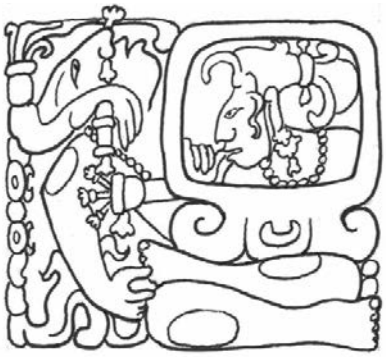


PITZILEEN -
"I AM A BALL PLAYER"

Each of the syllables can be stretched or squished, and many can be rotated to fit the available space. The most important thing is to maintain the proper reading order, and to leave as little open space as possible within the glyph block.

Drawings by G. Aldana

Time as 'Communities Interacting'



'Full figure' heiroglyph from Quirigua (Guatemale). image credit G. Aldana

It is easy to see time as a very mechanical construct, but representations from Mayan scribes themselves are much more organic. In the "full figure" hieroglyph from Quiriguá (Guatemala), the image (left) represents a date in the 260 Day Count. The larger figure, looking up, represents the number '8' as a wealthy Maize deity. The smaller figure is inside of a Day Sign cartouche, representing the Day Kaban. Together, they make up the date 8 Kaban, which does occur as an element of a recurring cycle of 260 days, but also demonstrates much more personality. So while it is easier to perform computations thinking of the Mayan calendar as very mechanical, it does go against a broader indigenous perspective, which appears to consider time as the result of communities interacting.

Mayan Manuscript - Dresden Codex

The Indigenous Yucatec Mayan manuscript known as the Dresden Codex, shows how the 260 Day Count guides ceremonial activities, which involve deities. In the image (lower-right), we find a list of Day Signs below a numerical coefficient. The number was originally '3', but the first dot has been eroded, so it looks like a '2.' The list depicts a sequence of Day Signs, *Ix, Kimi, Etz'nab, Ok* and *Ik'*. If we recognize the 3 as part of a sequence of dates, we find they are separated by 52 days (3 *Ix* + 52 days = 3 *Kimi*; 3 *Kimi* + 52 days = 3 *Etz'nab*; etc.), which is basically what the rest of the almanac tells us. Specifically, the scribe depicted *Chaak* in each section below a paragraph of text. That text gives us a time interval of 13 days and a coefficient of 3. Since there are 4 columns, 4 x 13 = 52, so each row advances one place down the sequence of Day Signs. Moreover, the text tells us that at each time interval station, *Chaak*, the rain deity, is 'stood up,' as part of ceremonial activity. Here then, the 260 Day Count guides community ceremonial interactions with their environment.

Dresden Codex, Close up. *Etz'nab* (white circle). http://www.famsi.org/mayawriting/codices/pdf/dresden_fors_schele_all.pdf

Popul Vuh & The Keepers of Time

Another departure from a strict mechanical interpretation of time appears in the *Popol Vuh*. This Creation narrative written by K'iche' Mayan scribes in the 16th century, describes how the Hero Twins passed through a challenging childhood and overcame many obstacles during their lives, but eventually they went on to become the Sun and the Moon.

Plate. The Maize God (Hun Nal Ye) , http://research.mayavase.com/kerrmaya_hires.php?vase=1892, photo by Justin Kerr

They didn't give up their personalities in this transformation, but they did now acquire the responsibilities of keeping time for the Earth and its inhabitants. What appears to be a Classic period version of the K'iche' story is depicted on a plate probably from a workshop at/near X. In the scene, the Maize deity is (re-)born out of a turtle carapace, brought forth by *Jun Ajaw* and *Yax B'ahlam Ajaw* as cognates of the Hero Twins. In the *Popol Vuh*, it was after this event that they transformed into the Sun and the Moon.

The Classic Period Lunar Series

The image below is from a hieroglyphic inscription at Copán (Honduras). The table to its right gives a coded translation of the text. Overall, it provides the date of a historical event, which is typical for Classic period inscriptions. The Initial Series Introductory Glyph is a standard symbol that leads off hieroglyphic inscriptions and only very rarely shows up in the middle of an inscription. The central element varies with the months of the year. The next five elements are all the components of the Long Count, which is simply a register of the number of days elapsed from a mythological 'zero' date. The number is in five registers because each corresponds to a coefficient attached to a period of time.

Initial Series Introductory Glyph	
9 pih	15 winikhaab
10 haab	0 winik
0 k'in	3 Ajaw
Glyphs G & F	Glyph D
Glyph C	Glyph X
Glyph B	Glyph A
3 Mol	tanlam

Illustration and table by G. Aldana

Hieroglyphs at Copan, Honduras

Copan Temple 11, photo by G. Aldana

Using the table above, we can see that the date in the Copan inscription corresponds to 9 pih, 15 winikhaab, 10 haab, 0 winik and 0 k'in, which is often written by modern scholars as the Long Count Date 9.15.10.0.0. It would correspond to the day X days after the 'zero' date. Since we also know that that 'zero date' corresponded to the 260 Day Count date of 4 Ajaw, we can also see that X days after 4 Ajaw, we arrive at this date, which corresponds to 3 Ajaw.

Following the Long Count and 260 Day Count portions of the inscription, we encounter the "Lunar Series" portion, here referred to as Glyphs A through D.

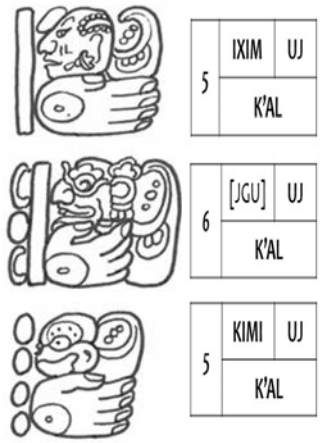
Period Name	Also known as	Relative to Sub-period	Equivalent in days
pih	baktun	20 winikhaab	144,000 days
winikhaab	katun	20 haab	7,200 days
haab	tun	18 winik	360 days
winik	winal	20 k'in	20 days
k'in	k'in	1 k'in	1 day

Glyph A gives the symbol ("logograph") representing the number 20, accompanied by a skull, which itself has the value of 10. Overall, then, Glyph A here gives us the number 30 and tells us the number of days in this lunar period. Classic period scribes alternated 29 and 30 day periods to approximate the lunar synodic period of 29.53 days as we'll see below. Glyphs B and X work together with Glyph A to provide the sentence: [Glyph X] is the name of the 30 days. This tells us that scribes gave a name to each lunar month. Glyph D gives us the number of days that have elapsed within the Glyph X moon. In the glyph block, the number '9' is affixed to the verb 'to arrive.' The sentence tells us that '9 days ago, the Moon arrived,' i.e. the date is nine days after New Moon.

Glyph C nests the Glyph X lunar month within a much larger cycle. Three different "lunar patrons" govern collections of lunar months. As shown in the image above, the three patrons are Ixim Uj (the Maize Moon), the Jaguar God of the Underworld Moon, and Kimi Uj (the Death Moon). Each governs a sequence of 5 or 6 lunar months. A sequence of moons, therefore, would be 1 Ixim Uj, 2 Ixim Uj, 3 Ixim Uj... 6 Ixim Uj, 1 JGU Uj, 2 JGU Uj... 6 JGU Uj, 1 Kimi Uj, 2 Kimi Uj... 6 Kimi Uj. And in this sequence, each moon would be of 29 or 30 days.

The Lunar Series was used in hieroglyphic inscriptions throughout the Classic period and at virtually all Mayan cities that erected such monuments. In the vast majority of cases, the Moon Age (Glyph D) was recorded consistently and so is understood to have recorded actual observations.

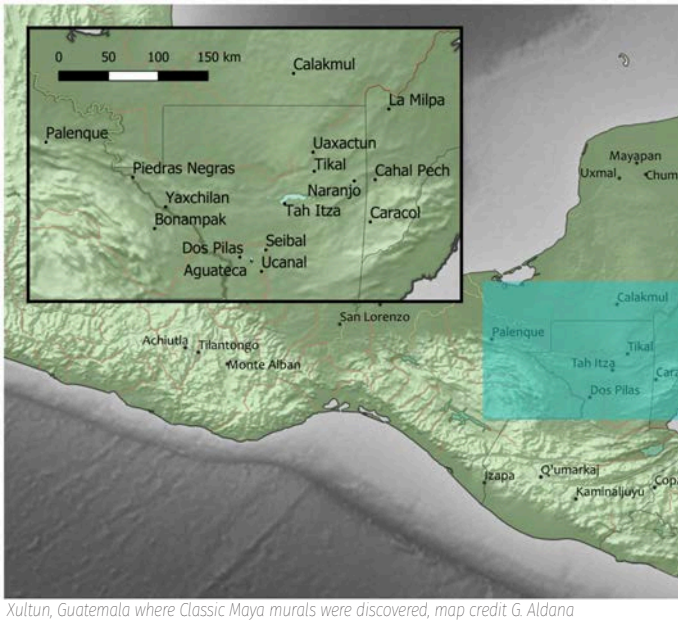
Three Different Lunar Patrons



Ixim Uj (the Maize Moon), the Jaguar God of the Underworld Moon, and Kimi Uj (the Death Moon), by G. Aldana

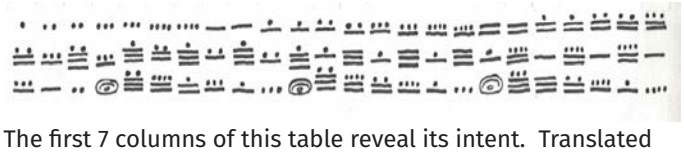
Glyph C, however, was unconnected to physical phenomena and so was arbitrarily assigned. For most of the Classic period, scribes at different city-states followed independent sequences through the lunar patrons. There was one time period, though, during the Late Classic, in which all Lunar Series records follow precisely the same progression – all were synchronized. It appears that in this case, political alliance impacted even astronomical practice, during a time that may have been a parallel to the Pax Romana (Teeple; Aldana). Unfortunately, it appears to have lasted less than 50 years, before alliances crumbled and discord reigned in the progressions of Glyph C from city to city.

Buried City at Xultun, Guatemala



Xultun, Guatemala where Classic Maya murals were discovered, map credit G. Aldana

Xultun was a small city located in between such Classic period political powerhouses as Tikal, Calakmul, Naranjo and La Milpa. It is on a wall at Xultun, within the ruins of a relatively small house structure, that we find the table of numbers below.



The first 7 columns of this table reveal its intent. Translated into Arabic numbers in Mayan positional form, we have:

		1	1	2	2	3
8	17	8	17	8	17	8
17	14	11	8	5	2	0

Xultun Scribes

In turn, these can be transformed into the following sequence:

177	354	531	708	885	1062	1240

And now this sequence can be recognized as multiples of a common factor:

1 x 177	2 x 177	3 x 177	4 x 177	5 x 177	6 x 177	7 x 177

There is a problem, though, and that is that actually, the final column actually doesn't work. The number in Mayan represents 1240, but 7 x 177 = 1239. So the Xultun scribes here were including an interval of (7 x 177) +1. If we look a little more closely, we can see what is happening.

To get 177, we simply follow the Classic period practice of combining 3 moons of 29 days each with 3 moons of 30 days each. This gives us a 6-moon period of 177 days. But this only gets us a synodic period of 29.5 days for the Moon, which gradually slips away from observation. To get closer to the observational period of 29.5306 days, we need to add more 30 day moons than 29 day moons. This it what the scribes did at Xultun. In that table, they brought together 6 groups of 3 moons at 29 days and 3 moons at 30 days + 1 group with 2 moons at 29 days and 4 moons at 30 days. This now yields 42 moons at 1240 days, which in turn produces a 29.52381 lunar synodic period. While closer to the modern number of 29.5306, it now overshoots the average.

The Xultun scribes handled the difference by strategically adding 30 day moons such that overall the period covers 4784 days (= 13.5.4) for 162 moons. The result is a lunar synodic period of 29.5309 days, which is off by only 3/10,000ths of a day, meaning it is accurate to 25 seconds over 13 years. The recent excavation of Xultun by modern archaeologists leading to the recovery of the mural of astronomical tables was aided in part by modern satellite technology.

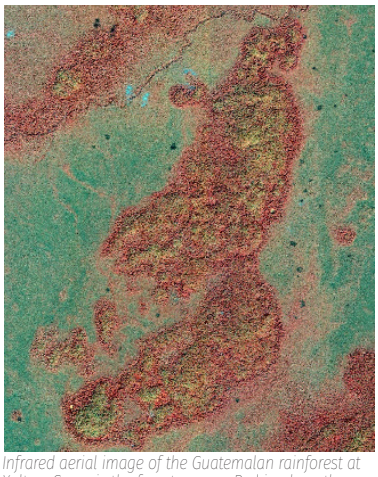
Xultun Murals

In 2003 archaeologist William (Bill) Saturno traveled through rural Yucatan looking find a site that he was told should be not far from the well known site of Uaxactun. He didn't get to the monument he was looking for. In fact, the conditions of the "road" and his navigation led him to spend the night camping in the rainforest, and seeking shelter from the heat late the next day while his companions searched for water. He was lucky to find an overhang in the side of a mound, the remains of a looter's trench. He tells the story of how he looked up and realized that he was sitting

SMural fragment in San Bartolo, Guatemala, rediscovered 2003, wikipedia

He had encountered the site now known as San Bartolo, and he collaborated with artist Heather Hurst to reveal the earliest mural in the Mayan region. The find has been one of the biggest stories in Mayan archaeology of the 21st century, but it also led to another important development.

Saturno wanted to find high resolution maps of the rural regions of Yucatan to work on locating the sites he was trying to identify on the ground. In doing so, he found a way to team up with NASA scientist Tom Sever, who had been interested in remote sensing using satellite technology. Together, they found that the sites they knew about could be identified on satellite images of the region taken using infrared photography. Even though visible spectrum photographs simply showed a sea of blotchy green trees, infrared images revealed differences that corresponded to architectural constructions. They eventually found that the trees that grew on top of archaeological mounds were themselves changed by soil of the mounds. Because Mayan architecture was constructed with limestone blocks, that limestone left a chemical signature that would be picked up by the tree roots and detected by infrared imagery. Infrared satellites thus revealed Mayan architecture beneath the floral canopy, which Saturno was able to verify by traveling back through the region.



Infrared aerial image of the Guatemalan rainforest at Xultun. Green is the forest canopy. Red is where the buried Mayan city left a chemical signature beneath the floral canopy! NASA.gov

One of the sites he went back to was the Classic Maya city of Xultun, which revealed another set of murals, and these with information that bring us back to Mayan lunar astronomy.

NASA Astronaut - José Hernández

José Moreno Hernández is a former NASA astronaut and American engineer. Hernández was assigned to the crew of Space Shuttle mission STS-128. He also served as chief of the Materials and Processes branch of Johnson Space Center. Hernández is from La Piedad, Michoacán, Mexico, with indigenous Purépecha roots. In an August 25, 2009, conversation with President Felipe Calderón of Mexico, Hernández stated that as a child, he lived half the year in La Piedad and half in the United States. As a child, Hernández worked alongside his family and other farmworkers throughout the fields of California, harvesting crops and moving from one town to another. He attended many schools and didn't learn to speak English until he was 12. His first memory of space is about adjusting the television in order to watch the Apollo 17 mission in 1972.

Astronaut Jose M. Hernandez, mission specialist, NASA.gov

Mayan Eclipse Table

Finally, this all brings us back to the Dresden Codex and pages 51-58

Dresden Codex, eclipse tables, pages 51-58, Dresden Library, SLUB

two columns of text	hieroglyphic text				
	2422	2599	2776	2953	3130
Eclipse Image	2 Muluk 3 Ok 4 Chuwen	10 Kimi 11 Manik 12 Lamat	5 Ak'bal 6 K'an 7 Chikchan	13 Ajaw 1 Imix 2 Ik'	8 Kaban 9 Kawak 10 Etz'nab
	177	177	177	177	177

	two columns of text	hieroglyphic text		
3278		3455	3632	3809
13 Chikchan 1 Kimi 2 Manik	Eclipse Image	8 Ik' 9 Ak'bal 10 K'an	3 Kawak 4 Ajaw 5 Imix	11 Kib 12 Kaban 13 Etz'nab
148		177	177	177

hieroglyphic text							
8829	9007	9184	9361	9538	9715	9892	10040
13 Kib 1 Kaban 2 Etz'nab	9 Ix 10 Men 11 Kib	4 Chuwen 5 Eb 6 Ben	12 Lamat 13 Muluk 1 Ok	7 Chikchan 8 Kim 9 Manik	2 Ik' 3 Ak'bal 4 K'an	10 Kawak 11 Ajaw 12 Imix	2 Manik 3 Lamat 4 Muluk
177	177	177	177	177	177	177	148

two columns of text	hieroglyphic text			
	10217	10395	10572	10749
Eclipse Image	10 K'an 11 Chikchan 12 Kimi	6 Ik' 7 Ak'bal 8 K'an	1 Kawak 2 Ajaw 3 Imix	9 Kib 10 Kaban 11 Etz'nab
	177	177	177	177

A Yucatec Mayan scribe assembled dates, intervals, images and hieroglyphic text to capture cycles of the moon. It is straightforward to recognize that the bottom row of numbers on Pages 51 through 58 represented individual time intervals, mostly of 177 days, or 6 moons. Above these intervals is a sequence of 3 dates in the 260 Day Count, and above these is a running tally of the smaller time intervals.

The vast majority of the individual time intervals recorded were of 177 days; the other most common interval was of 148. Specifically, 177 days is equivalent to 3 x 30 + 3 x 29 and 148 is 3 x 30 + 2 x 29. In the Eclipse Pages of the Dresden Codex, long strings of 6-month groupings (time intervals of 177 days) are followed by a single 5-month grouping (of 148 days). These are precisely the base intervals useful for tracking eclipse events (Aveni 2001:173-184).

A problem we confront here, however, is that modern scholars have not been able to find a sequence of historical eclipses that would match the record given. So either there were mistakes in the original record, or we still haven't figured out the method they were using.

NASA Moon to Mars

NASA Publishes Artemis Plan to Land First Woman, Next Man on Moon in 2024! Following a series of critical contract awards and hardware milestones, NASA has shared an update on its Artemis program, including the latest Phase 1 plans to land the first woman and the next man on the surface of the Moon in 2024. In the 18 months since NASA accepted a bold challenge to accelerate its exploration plans by more than four years and establish sustainable exploration by the end of the decade, the agency has continued to gain momentum toward sending humans to the Moon again for the first time since the last Apollo lunar mission in 1972.

Artemis Plan, Photo credit NASA.gov

Our Educators Recommend:

Educator Ms. Andrea Carrillo. First grade teacher at Adelante Charter School in Santa Barbara, California recommends the NASA activity-*Make a Moon Phases Calendar and Calculator.* Most people are familiar with Moon trackers and calendars online but did you know NASA has a resource that allows you to make your own Moon Phase Calendar Calculator at home? This is a fun DIY project for you and your family to complete during distance learning! This is also a great learning opportunity for students because you will have to color in the Moon Phases Wheel based on what type of Moon is listed - you will be Moon phase experts in no time. This project will increase your learning about Moon phases and ability to track the Moon throughout the year. Have you ever wondered what the Moon will look like on your birthday? Complete your very own Moon Phase Calendar to find out! (Available in Spanish and English.)

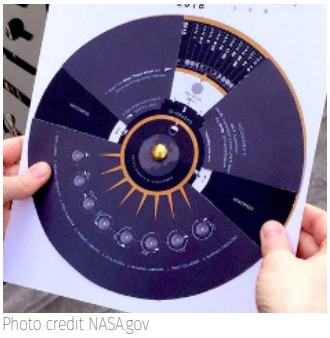
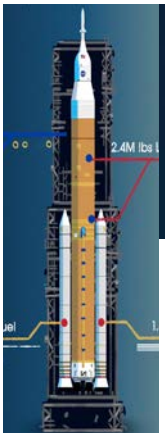


Photo credit NASA.gov

Photo credit NASA.gov

Educator Ms. Graciela Rodriguez, First grade teacher at Adelante Charter School in Santa Barbara, California recommends the NASA activity "Moon Pod Essay Contest & NASA Moon to Mars". The challenge to students is to imagine a one-week expedition to the Moon's South Pole...What should you bring? Who gets to be on your team? What skills should they have? What tech do you need? Write an essay and tell NASA about your idea! Grades K-4; 5-8; 9-12

How We are Going to the Moon



Artemis Plan, Photo credit NASA.gov

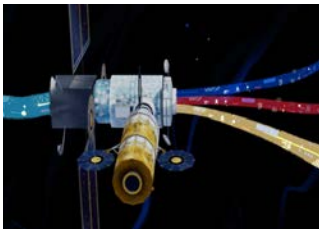

Artemis Plan, Photo credit NASA.

Orion, The Space Rocket. So, what will an Artemis mission look like? Everything is designed and tested with our most important element in mind: the astronauts. This is their deep space, human-rated spacecraft called **Orion,** built in 3 parts: the crew module, where up to 4 astronauts will live and work throughout the flight; the service module, with life support systems for the crew and its own engine and fuel reserves; and a launch-abort system, with engines capable of pulling the crew module to safety during launch, should anything go wrong. To accomplish the task of launching our crew and heavy payloads, NASA is building the Space Launch System, comprising of a cargo hold, an Exploration Upper Stage, a massive core stage and 2 extended solid rocket boosters. Altogether, this is the world's most powerful rocket.


Artemis Plan, Photo credit NASA.gov

Gateway, The Lunar Space Station. Approaching the Moon, we see the fundamental differences between Artemis and Apollo. Instead of requiring Orion to serve as an expendable lunar command module or carry a constrained lunar lander, the Artemis missions will take advantage of a different approach: pre-staging. Everything needed for lunar missions will be positioned in advance by commercial and international partners...this includes rovers, science experiments and human-rated systems on the surface. But it also includes a dedicated lunar station in orbit around the Moon, called **Gateway.**

Designed with open standards, the Gateway can be expanded as new missions and partnerships develop, allowing multiple human missions on the Moon at the same time, and enabling ongoing science to be conducted even between human missions. The Gateway is also capable of adjusting its orbit to allow access to every part of the Moon...But the real key in this approach is placing Gateway in a unique halo orbit to perfect the maneuvers needed for Mars missions...Gateway is the ideal hub between Earth and all that lies beyond. Once back aboard the Orion spacecraft and undocked from Gateway, the crew fire their engines to break out of the halo orbit and once again to sling the spacecraft around the Moon, placing it on a multi-day trajectory back towards Earth. Entering Earth's atmosphere at 25,000 miles per hour, the friction of air slows Orion considerably, while also subjecting it to temperatures of 5,000 degrees. With the Orion now at just 300 miles per hour, a series of parachutes uniquely tested and produced for this moment deploy, decelerating the craft to just 20 miles per hour for splashdown. With each successful mission, Artemis ushers in the next wave of men and women to explore our Moon. And proves that together, we're ready to go beyond.


Artemis Plan, Photo credit NASA.gov

Indigenous Contributions to Science

History at the K-12 level has generally followed 'great man' narratives as a pedagogical tool to draw students into complex historical events through individuals who have directly impacted them. Histories of science have relied even more heavily on these tropes, as readily called to mind by Galileo Galilei, Isaac Newton and Albert Einstein. In virtually all cases for U.S. K-12 curricula, these approaches center the agency of European or European-diaspora men. In 2014, however, for the first time, the majority of America's public schools were non-white. In 2040 the U.S. will be a 'majority minority.'

The Maya had a repository of knowledge that included a vigesimal numerical system, astronomical observations and calendrics, medicinal practices, architecture, art and systems of hieroglyphic writing -among many other "disciplines"- prior to contact with the European peoples. This knowledge has resisted the various attacks and forceful removals of the Maya people from their own land, the people that protect, adapt and maintain it through time. Today's Maya communities in Mexico, Guatemala, Belize, Honduras, El Salvador –as well as urban cities and other pueblos throughout the globe continue contributing to science. This project creates Indigenous astronomy content by Indigenous people for our communities and everyone.

Indigenous Engineering

Photo credits: The Corn God being dressed by ladies, then paddled in a canoe. lower register; The maize god in the watery realm with fish. Photograph by Justin Kerr, http://research.mayavase.com/kerrmaya_hires.php?vase=3033

With all the rivers, lakes and canoes in the Maya region, canoe transportation was an essential part of the trading systems. Canoes are often depicted in Mayan art, such as ceramic plates, vases and murals. The image above shows the Maize god being paddles in a canoe. (- Andrea Medina)

Plant Medicine & Healing

If you study Maya Codices as well as historical records from the XVI and XVII centuries, you will find over 300 medicinal plants used by the Maya! For example: Xanab mukuy (Euphorbia hirta) that cures stomach aches, fever, dissolves blood clots and heals the skin...Chacah (Bursera simaruba) is good for so many ailments and you must know it is the powerful antidote you need if you get burned or poisoned with ch'echen (Metopium brownei) – remember, all medicine can be poison if not used properly! The entire jungle is filled with medicine that supports the wellbeing of the people that care for it and protect it. Medicine women and men have their own specialties: bone doctors, herb doctors, midwives, snake-bite doctors and more! (- Andrea Medina)

Mario, a herb doctor, photo by A. Medina

Food Sovereignty

Mesoamerican cultures have a diet rich in calories and protein. There is archaeological evidence that by the Preclassic period, the Maya area had settlements that cultivated corn, beans, squash, chiles and amaranth. Studies have shown that beans have satisfactory amounts of vegetable protein, fiber and carbs that, along with corn, allow for a healthy and complete diet (192mg/g protein).

Indigenous agricultural design, Milpa crop, photo by A. Medina

In order for our bodies to absorb the nutrients corn provides, it must go through a process called nixtamalización (in Spanish) where corn is soaked in a mixture of water and lime, which adds protein and calcium, and makes it digestible for us! This knowledge not only nurtured people's bodies but it also helped maintain them in good health. Milpas, fields of corn, beans and squash planted together, are systems of agriculture that Maya communities have kept from centuries ago to today.

However, traditional agriculture is at risk of being lost due to increased use of GMOs, herbicides, pesticides, polluted water, lack of water (mainly due to concessions given to various industries) and corruption of local governments. We must learn about the struggles today's Mayan communities are facing and stand with them, protect the land, the native seeds and the practices that provide an opportunity for a healthy life on this planet. (- Andrea Medina)

Indigenous Housing

The morphology of the Maya house has resisted centuries of change as well as climate conditions including hurricane seasons, droughts, and – in recent years – cold seasons (known as La Heladez). These houses are a refuge from the hot and humid weather of the peninsula, offering a cool and well-ventilated space. On the other hand, the palm roof gives the Maya house a smoke exit, making it possible to use a stove for cooking and to keep warm when it gets cold. (- Andrea Medina)

Indigenous architecture, Maya house, photo by Andrea Medina

The peninsular Maya have used a great variety of plant species in the construction of their homes. The roofing may be made out of Guano palm ("Kuum" in Maya) or out of grass on the coast (since it's more resistant to the salty ocean breeze) or even a mix of both at the same time. Many trees used as posts ("Okom" in Maya) are hardwoods that are resistant and come from old trees. The rest of the wood used in the construction comes from abandoned Milpas, in some cases. There can be up to 100 different species of trees used in the construction of the Maya house. This is an example of ancestral Maya knowledge with regards to sustainable ecosystem management. By using small amounts of different types of wood, they can continue using the resources found in nature without causing deforestation.

The construction of the Maya house is ecological and not only involves botanic knowledge, but understanding of forestry as well. Bland and flexible woods, palms, and grass are used for the arcs. Vines are used to tie the structure of the house together without the need of a single nail, screw, or gram of cement. As if this wasn't enough, the soil and rock of the region (both in their natural states and mixed to make lime) are utilized for masonry. The housing spaces are traced so that homes are strategically oriented according to the sun's path so that they can have a vegetable patch. In some cases, two or three houses are built one behind the other depending on the size of the family. (by Andrea Medina and Felipe Trabanino)

"Two-eyed Seeing" *is learning to see from one eye with the strengths of Indigenous knowledges and ways of knowing, and from the other eye with the strengths of Western knowledges and ways of knowing, and to use both these eyes for the benefit of all."*

-Bartlett, Marshall and Marshall 2012

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Aldana, Gerardo, Annette S. Lee, Andrea Medina . *"Two-Eyed Seeing: Mayan Astronomy & NASA Moon to Mars"*, Dec. 2020, https://nativeskywatchers.com/two-eyed-nasa-maya.html

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We respectfully acknowledge that in the Santa Barbara region, we live on the ancestral lands of Chumash communities.

Native Skywatchers is located on the traditional and treaty land of the Dakota people,who along with the Ojibwe are the Indigenous peoples of this land, Mnisóta Makhóčhe or Minnesota.