



**Vic Michalak : Welcome to the first Science Circle presentation for 2011**

**Kitt Holgado :** < applause >

**Vic Michalak :** **On behalf of Nymf Hathaway and other members of the Science Circle Board and Science Circle I would like to welcome you here....**

In the audience are members who have been here since at least 2007 and other new members --- welcome all!

I will give the presentation in chat and I welcome questions....

If I am going too fast, let me know....

I understand that English is not the first language for many of you.

So we begin.....

**INTRODUCTION**

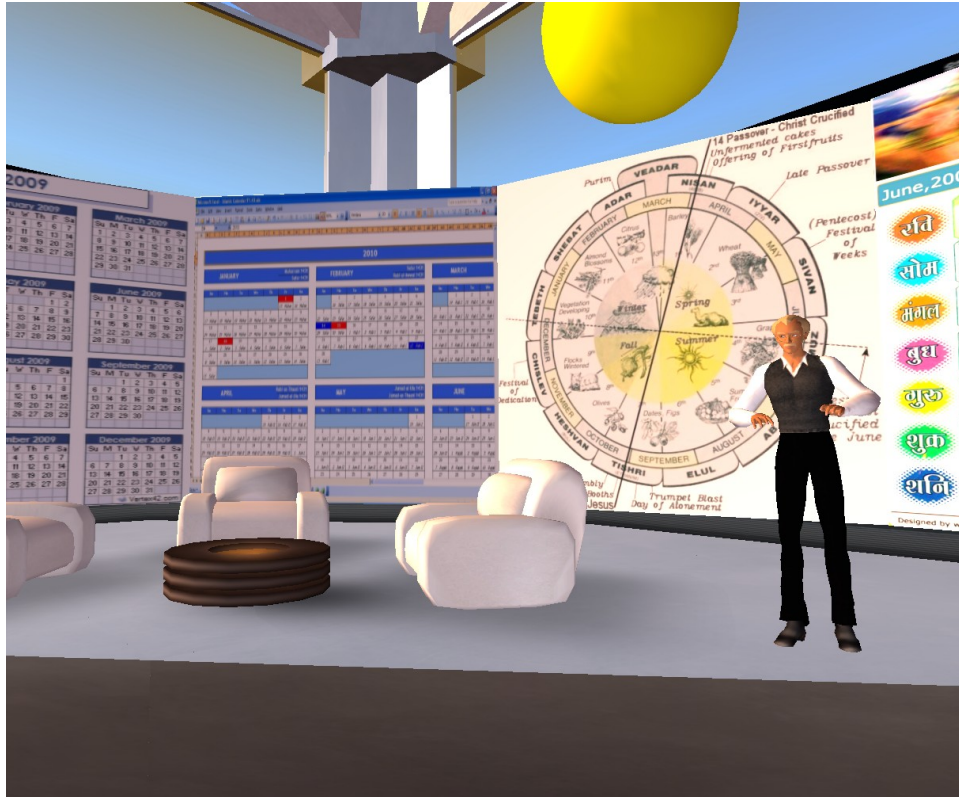
**Vic Michalak :** The world can be so unpredictable these days, and no less so in ancient days when most people grew their own food...

...and intimate knowledge of the cycles of the seasons could be a matter of life and death.

In a world with fewer lights and clearer air one had only to look up to be humbled by the life-giving sun and a multitude of stars at night...

...and to be in awe of the moon and other heavenly travelers that strode overhead with such seeming predictability.

**Vic Michalak :** Since the sun and moon and planets were outside the human realm it was easy to attribute their presence to the work of gods or goddesses...



**Ramana Sweetwater :** astrology developed...

**Vic Michalak :** ...particularly when their appearance or position foretold of weather and tidal changes and signaled the best times to plant or harvest or when migrating animals returned.

**Vic Michalak :** Yes, indeed... In the beginning there was astrology, not astronomy as we know it...

**Vic Michalak :** Keeping track of when the moon was full, how many times it rose over the course of seasons, and when certain planets appeared would become an important job...

...and calendar systems were developed to mark religious, civil, commercial, and administrative events...

...and often synchronized against the seemingly constant movement of the Earth, Moon, Sun and planets.

But the movement of these heavenly bodies is not as constant as you might think and the knowledge of calendars and when important events would occur was often a tightly guarded political or religious secret...

### CYCLES

Most calendar systems are a combination of two or more cycles based on physical events, notably the rotation of the Earth, the orbit of the Moon about the Earth, and the orbit of the Earth about the Sun.

One rotation of the Earth is called a day, a revolution of the Moon is a month, and a revolution of the Earth is a year.

This seems so obvious to us you may be saying to yourself, "yes, I know that, that is so simple..."

But defining a day, month, and year is not as simple as it seems and yet it is the basis of most calendar systems...

To see if you are awake, are there other objects in the sky on which calendar systems were or are based??



**Astronomer Somerset : yes the constellations**

**NullSubset Burner** : comets-asteroids.

**Vic Michalak** : Calendars?

**Ramana Sweetwater** : I was once told the universe would collapse if the rhythms of orbiting would have simple relations. The complexity of the relations makes the calendar complex?

**Patio Plasma** : Venus

**Vic Michalak** : Really? Very interesting....

**Vic Michalak** : Yes, Venus was one object.... the Mayan calendar has a civil part and a religious part and one is based on the Sun and one on Venus....

**Vic Michalak** : ...or maybe the Pleiades star cluster.

**Vic Michalak** : Any other important objects out there?

**NullSubset Burner** : prefix: short period comets.

**Vic Michalak** : Ah, okay..

**Vic Michalak** : First, let us ask, "What is a year?"

The Earth's orbit around the Sun is not a perfect circle but an ellipse, which means that both the distance to the Sun and the speed of the Earth's orbit around the Sun varies over the year.



**Ramana Sweetwater :** earth moves once around the sun

**Vic Michalak :** Yes, that is the classic definition of a "year."

But the actual meaning is a bit more complicated...

By coincidence, at 1900 GMT (11:00am SLT) on January 3, 2011, almost exactly one day ago, the Earth was at its closest approach the Sun this year (called perihelion).

At that time it was only 149,597,871 km. (92,955,807 mi.) away (or about 20 years travel if you went by jet!).

Still a long way away....

On July 4, 2011, will be at the farthest away from the Sun (152,096,155 km. or 94,507,988 mi.)

**Ramana Sweetwater :** Isn't this an important date in US calendar?

**Vic Michalak :** You will notice that this is far enough distance apart that the Sun is actually larger by 3% right now than in July.... at least it appears that way.



**Vic Michalak :** July 4? Yes, that is Independence Day for the U.S. from Britain...

**Ramana Sweetwater :** biggest distance from the sun :D

**Vic Michalak :** Although that is another story because the Declaration of Independence was announced on July 2.... history trivia...

**Vic Michalak :** Okay, so a year is the time it takes for the Earth to orbit the sun. Easy. We all know that.

Well, kind of... :)

If you mark the position of the Earth and Sun against the stars in the background, then the time it takes for the Earth to revolve back to where it started is 31,558,149 seconds - a "sidereal" year.

How many days is this? Well, it depends on how long a day is! 24 hours, right?

Well, not so fast...



**Ramana Sweetwater :** again not 100% ;)

**Vic Michalak :** If you mark a position against the stars and wait until the Earth rotates back to that position, this "sidereal" day is 86,164 seconds long or 23 hours 56 minutes 4 seconds.

???

Huh? Why not 24 hours exactly? Because the day we measure is relative to the Sun, not the stars, that is, measured from the time the Sun is overhead until it is overhead again.

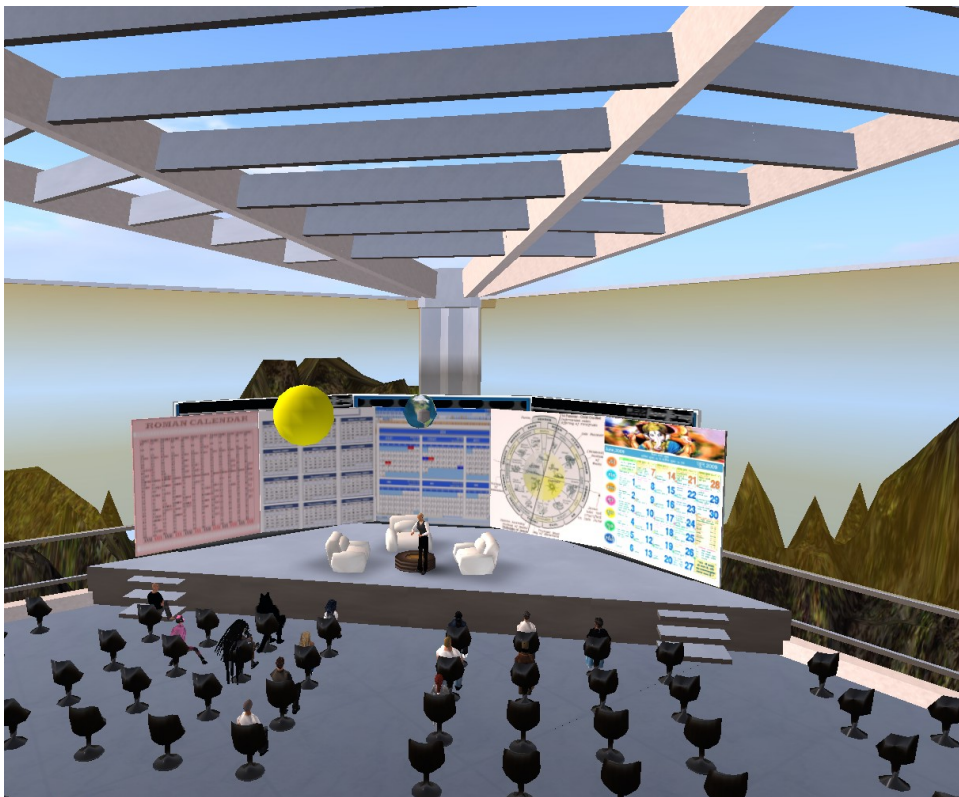
Since the Earth is orbiting around the sun at the time, the Sun is not in exactly the same place in the sky as it was when the day started, but about 1 degree farther ahead since it takes about 365 days to orbit the Sun.

This "solar" day is a bit longer than one rotation - 3m 56s to be exact - or 24 hours long.

So now, 31,558,149 seconds per sidereal year divided by 86,164 seconds per sidereal day is 366.256 days. But if you divide the year by 86,400 seconds per solar day, it is 365.256 days long.

Ouch.... and I thought this would be easy.... a day is a day, a year is a year....

But even the Earth, Moon, and Sun are not constant....



There are a couple of problems with this though... particularly when you are talking about long periods of time like you would measure with a calendar.

**Ramana Sweetwater** : wobbling bastards ;)

**Vic Michalak** : Bear with me... this can get a bit mind-boggling, so just relax and take it in...

Yes, wobbling too... in a minute... :)

**itsme Frederix** : 29

**Vic Michalak** : Good answer!

**Vic Michalak** : Or 41?

**Nymf Hathaway** : :))))

**Vic Michalak** : Because the Earth's orbit is an ellipse, the length of a day varies a bit as the Earth orbits the Sun so 86,400 seconds per solar day is actually an average over the year.

**Gilles Kuhn** : “relax and take it in” Vic please, it’s a pg sim ;-)

**Nymf Hathaway** : hehhehe





**Vic Michalak :** Also, the place in the sky where the Earth is closest to the Sun moves a bit - this is called precession. The Earth reached perihelion this year at 1900 GMT on January 3, 2011. In 2005 perihelion was on January 2 at 147,100,000 km. The change in perihelion comes back around to the same point in Earth's orbit every 100,000 years.

Acckkkk!

Have I lost anyone?

Like I said, just go with the flow...

Also, the Earth wobbles very slowly like a top, making one circle every 20,000 years. Right now its axis happens to be pointed towards the star Polaris, but this was not the case even when the pyramids were built. This makes the "tropical" year (the time from vernal equinox to vernal equinox, that is when the Sun crosses the equator) about 21 minutes shorter than the sidereal year.

[What does this have to do with calendars? Oh, only because they are based on this....]



**Ramana Sweetwater :** 25k--28k years precession of the earth?

**Vic Michalak** : The picture gets a bit more complicated when you throw in the effects of gravity from other planets, notably the Moon and Jupiter.  
**NullSubset Burner** : gravity and relativistic effects as well- just a aside:)  
**Vic Michalak** : Ramana, yes... depending on how it is measured...  
**Vic Michalak** : NullSubset.... absolutely.... that point is next!

**Vic Michalak** : They move around the Sun as well, pulling the Earth in different directions in different amounts over the year.

So our best measurements for the mean length of the year in 1986 was  $365.2421896698 \text{ days} - 0.00000615359 T - 7.29E-10 T^2 + 2.64E-10 T^3$  where  $T = (JD - 2451545.0)/36525$ , JD is the Julian day number, ^ denotes an exponent, \* is multiply, and E-10 is scientific notation meaning "10 to the minus 10", a very small factor.

ACCKKK!!

**quaezar Agnomen** : :))

**Vic Michalak** : If you really wanted to know, that is....

Whew!...

Oh, and the length of the day is increasing due to tidal effects by the Moon.

Just thought I would throw that in....

[By the way, for you newcomers, the presentations are not all technical...  
.... this one just is.... :)



**Ramana Sweetwater :** On the cold northern hemisphere we will enjoy longer days in a few thousand years ;)

**Vic Michalak :** Please feel free to comment or ask questions...

Ramana, exactly... that is one of the consequences...

The moon's distance is receding by 38.14 mm each year and the average length of the day (based on the observed changes in the Moon's orbit) is 2.3 ms per century, although the actual equation is  $T(\text{change}) = +31$  seconds/century squared.

That may not seem like much, but it means that 100 million years ago the length of the day was 38 minutes shorter than today.

Oh, no!!! That means not even the length of the day is constant!

**NullSubset Burner :** these measurements might seem trivial now but as we move out into the solar system they are going to become more important- Mars time?

**Gilles Kuhn :** now we know why the dinos got extinct...;-)

**Vic Michalak :** I vote for Mars time....

----- CALENDAR SYSTEMS ----- Finally...  
**NullSubset Burner** : agrees-XD

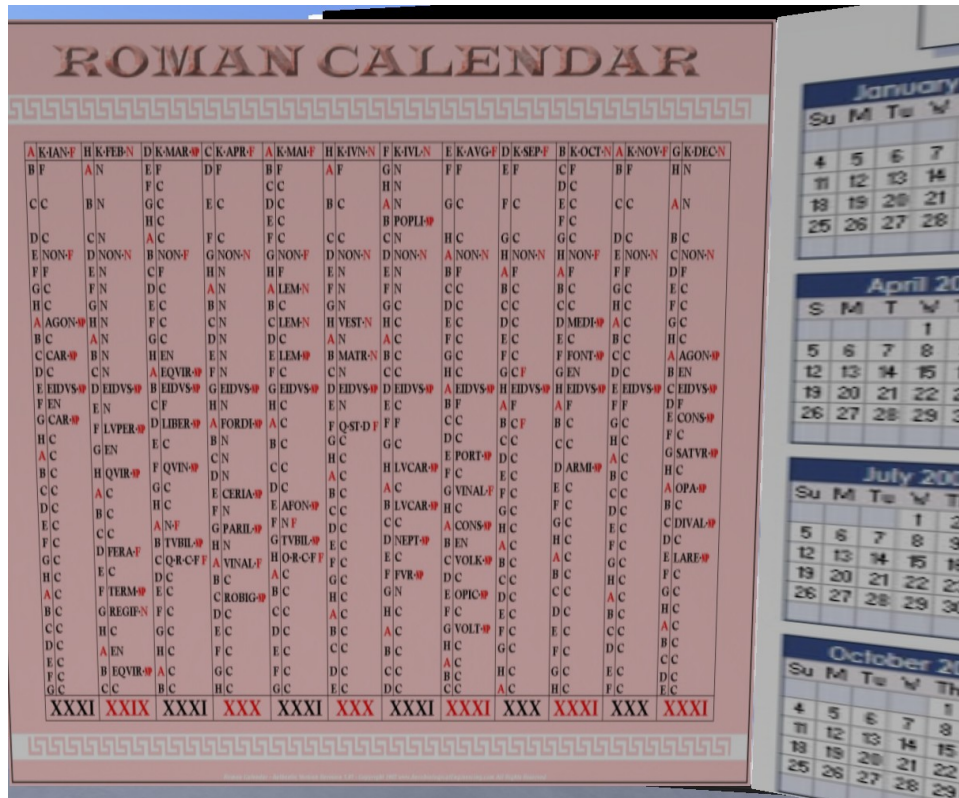
**Vic Michalak** : THE ROMAN (JULIAN) CALENDAR

Okay, so, with that introduction, let us move on to calendar systems... But you can see why determining the exact time or day, particularly any time in the future, is not an easy task.

As mentioned, early calendar systems were created for agricultural and religious and political purposes.

In Europe, the earliest Roman calendar had 8-day weeks and 10 months totaling 304 days (38 weeks of 8 days each). That is why the months of September, October, November, and December refer to months 7, 8, 9, and 10!

!!!!



**Ramana Sweetwater** : I also admire astronomers who are able to calculate backwards for a long time!

**Vic Michalak** : Did you ever think of that -- September, October, November, December - 7, 8, 9, 10?

**Ramana Sweetwater** : yep, learned that in latin ;)

**Nymf Hathaway** : -:\*:- (( Welcome )) -:\*:- Space :)

**Vic Michalak** : Ah, okay....

**Vic Michalak** : The rest of the year was largely ignored because it was unproductive agriculturally.

**Space Mode** : thanks a lot

**Vic Michalak** : I guess they had one big party then!

In the Roman calendar system, the Kalend (from where we get the word "calendar") was the first day of the month and the Ides was the middle of the month ("beware the Ides of March" - when Julius Caesar was assassinated).

You can see the Roman Calendar over to my far right (your left)...

Other days of the month were counted backwards like a countdown to the upcoming Ides for Kalends.

Speaking of Julius Caesar, one of his reforms was in the calendar system, applying the advice of his astrologer Sosigenes, the keeper of the calendar at that time.



The Roman Calendar system seems very strange for most of us today, but it was used for many centuries...

The first change was to realign the calendar to the solar year so that the year 708 AUC (Anno Urbe Condita - the year of the legendary founding of Rome) had 445 days (the longest year in history).

Hmmm... keep sitting when I touch the stage..

March 21 was also officially made the vernal equinox, the date that the Sun crosses the equator in the Spring.

**Nymf Hathaway** : we do not mind you sitting Vic ?

**Vic Michalak** : Any questions yet?

**Vic Michalak** : No, I prefer to stand....nervous energy...

**Vic Michalak** : Okay... now follow this one...

Then Caesar decreed that there would be 12 months of alternating 30 and 31 days for a total of 365 days: Januarius (31), Februarius (29), Martius (31), Aprilis (30), Maius (31), Junius (30), Quintilis (31), Sextilis (30), September (31), October (30), November (31) and December (30).

What do you see "wrong" here (it was right for that time)?

Anyone?

Is this the calendar in use today?

**quaezar Agnomen** : December?!

**Ramana Sweetwater** : no switching year?

**Vic Michalak** : Right, no leap year yet....

What about the months?

**itsme Frederix** : shifted 31

**quaezar Agnomen** : Dec has 31 days

**Vic Michalak** : Well, maybe December was Decemberus or something... :)

**NullSubset Burner** : latin-XD

**Vic Michalak** : Q! Good catch!

**Ramana Sweetwater** : Second half of the year months have different days to today

**Gilles Kuhn** : and julis and augustus were not honored as god still....

**quaezar Agnomen** : Feb...28 days

**Nymf Hathaway** : Sept is too long

**Vic Michalak** : Yes, indeed....

Lastly, a day would be added to Februarius every four years since the length of the year was calculated at 365.25 years (although Hipparchus in

Greece had actually come up with a closer figure of 365.242 days in century earlier).

We will look at when this changes in just a second....

So 709 AUC (45 BC or BCE in the Gregorian calendar) was declared the beginning of the new calendar.



**itsme Frederix** : I know August got 31 because Augustus wanted also 31 days like Julius

**Vic Michalak** : Yes...

The Roman Senate voted to rename Quintilis as Julius (our July) in Caesar's honor.

**Nymf Hathaway** : Typical, Its

**Vic Michalak** : [Later, when Augustus Caesar became Emperor, the Senate voted to rename Sextilis as Augustus (our August) and changed the number of days in the month to 31 - the same of Julius.

Politics were alive and well even back then!

**quaezar Agnomen** : :))

**Kitt Holgado** : Yep

**Vic Michalak** : But politics have consequences...

This act required reducing Februarius to 28 and renumbering September (30), October (31), November (30), and December (31), our current system) so that the year still had 365 days.

This is the calendar we know today.... kind of.... :)

Again, nothing is as simple as it seems...

### OTHER CALENDAR SYSTEMS

Now, before we go any further, let us step back and look at calendar systems in general...

Some calendars are based solely on the orbit of the Moon. The lunar phase cycle is not an even fraction of the year so the calendar drifts against the seasons but stays constant with regards to tides.

The earliest lunar calendar known may be depicted by marks on a bone that are 25,000 years old.

Why might calendars be important even back then??



**NullSubset Burner** : herd migrations

**Nymf Hathaway** : -:\*:- (( Welcome )) -:\*:- Astro :)



**Vic Michalak :** Very good! :)

**quaezar Agnomen :** To see when winter would come so they could prepare for it ... food etc

**Vic Michalak :** Food was ever on people's minds....

**Patio Plasma :** planting

**Vic Michalak :** Absolutely.... You have to remember that until the Industrial Revolution (and in many countries in the world today) that agriculture was the #1 occupation...

**Vic Michalak :** START TIMES AND DATES

When does the day begin??

Anyone?

**Ramana Sweetwater :** Midnight?

**quaezar Agnomen :** When the sun arises

**Patio Plasma :** :-) sunrise



**Vic Michalak :** Well, yes, for both of you....

...depending on where you live in the world and what calendar system you use.

In different calendar systems, a day may start at sunset, at midnight, or at sunrise.

The date of the beginning of the year also varies widely. January 1 is the current start date for the Gregorian calendar.

**Ramana Sweetwater** : I am glad there is at least consensus in science about it ;)

**Vic Michalak** : However, various other starting times have been March 1, March 25, August 23 or 24 (the birth of Augustus Caesar), September 1, December 25, and other dates that change yearly with lunar or luni-solar calendars.

**Vic Michalak** : Ramana.... yes, there were several attempts to reach a consensus so that people around the world could at least have a reference...

**Vic Michalak** : [Actually it is August 19, the death of Augustus Caesar - forgot to correct that one.]

**NullSubset Burner** : oo I didn't know that!

**Vic Michalak** : Not all calendars have start years. The Julian (Roman) calendar was based on the founding of Rome. The revised Julian and Gregorian calendars were based on a calculation (most assuredly incorrect) of the birth year of Jesus.

The Chinese calendar is merely cyclical and does not have a start year. The Islamic calendar is based on an historic event - the migration of the Prophet Muhhamed from Mecca to Medina.



**Nymf Hathaway :** I do not appreciate the fact we have a before Christ and after Christ.... hopefully people like Astro can come up with a more accurate date

**Vic Michalak :** The Japanese calendar dates from the beginning of the reign of each emperor - for example, Year 1 for Emperor Akihito corresponds to 1989 in the Gregorian calendar so the 2011 is Year 23.

[As an aside, the reason why Japan and other were not as concerned about the Y2K problem in 2000 was because the year 2000 is unique to the Gregorian calendar, not other calendar systems.]

Does anyone remember Y2K?

**quaezar Agnomen :** When did people actually start with counting the year they lived in .. is there a historical even know when they did..?

**itsme Frederix :** Y2K a lot of testing and no sleep but nothing happened

**Vic Michalak :** Q... I am not sure of the meaning of your question....

**quaezar Agnomen :** Yes I do Vic.. all system administrators where really busy with it.

**Vic Michalak :** During the reign of the emperor Diocletian, a monk named Dionysius Exiguus (Dennis the Humble), was calculating lunar phases based on the 19 year Metonic cycle.

He calculated that Anno Diocletian 248 was equivalent to Anno Domini 532, the "year of the lord" (the birth of Jesus), that is 532 AD.

It is not known how he calculated this, but it is known that this had to be in error because Herod the Great died in 4 BC (Before Christ) and the story of the birth of Jesus in the Christian Bible has him born before Herod died.

[Note: Because of the universal use of the Gregorian (revised Julian) calendar, AD is often referred to as CE (Common Era) and BC is BCE (Before the Common Era).]

Nymf, that might be part of your answer....

**quaezar Agnomen :** When did people start "counting" the year we lived in .. we know the Christians "reseted" that 2010 years ago .. but before that people also used a system for counting the years..

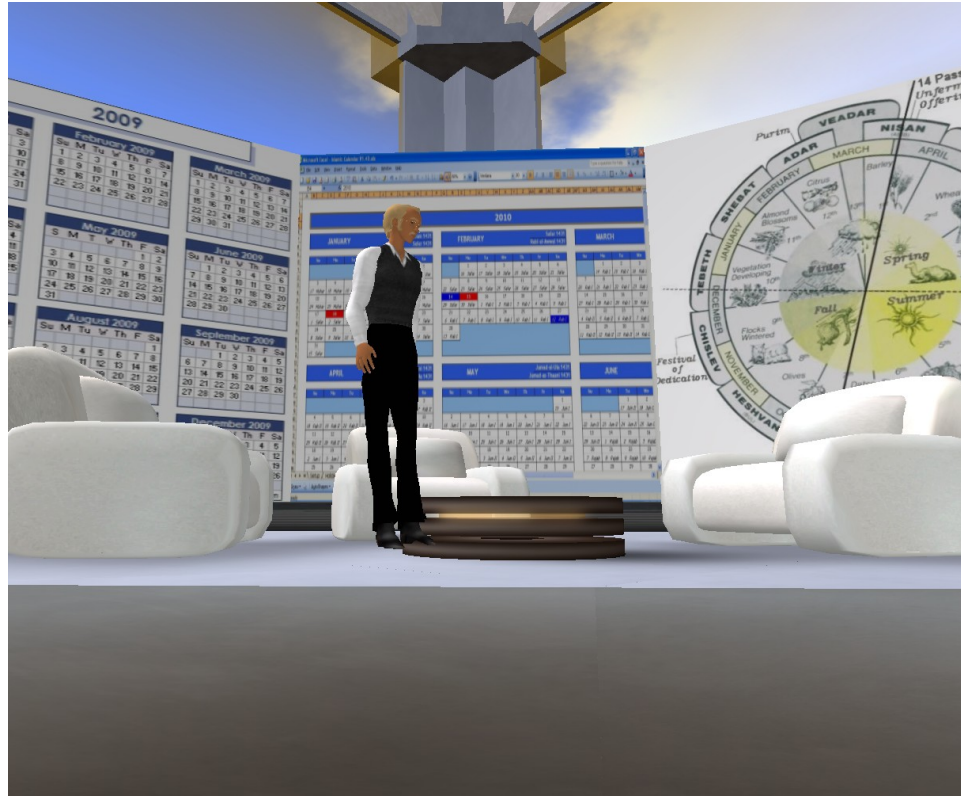
**Nymf Hathaway :** yes

**Vic Michalak :** Yes, Q.... Well, the Roman calendar was based on the founding year of Rome....

**quaezar Agnomen :** Indeed .. they reseted the date to an event to...

**Vic Michalak :** Many calendars were based on other important dates in their culture, or on the reigning ruler...

In the 700s , the English historian Bede began the practice of counting years backwards from A.D. 1 (1 CE) starting with 1 B.C. (1 BCE).



**Vic Michalak :** THE MIDDLE AGES IN WESTERN EUROPE

**Patio Plasma :** yes Vic the problem of the missing 0

**Nymf Hathaway :** You gotta love stubborn people

**Vic Michalak :** Yes, indeed....

**Astronomer Somerset :** many of the Christian celebration days were deliberately placed as a means of suppressing pagan festival celebrations

**NullSubset Burner :** judo-Christian mythos=Babylon Jews 6th century BCE.

**Vic Michalak :** Yes, well stubbornness is part of the adoption of the present calendar system.... more in a minute on that...

**quaezar Agnomen :** I believe the Maya's have a 26k year cycle ..am I correct?!

**Vic Michalak :** Astronomer... exactly... People were already celebrating so why not just make the days and objects Christian... like Christmas and holly and presents and trees for example...

**quaezar Agnomen :** quote; The beginnings of the Chinese calendar can be traced back to the 14th century B.C.E. Legend has it that the Emperor Huangdi invented the calendar in 2637 B.C.E.

**Vic Michalak :** Q, yes, the Mayans have long cycles....

**Vic Michalak** : Very interesting, Q...

**Vic Michalak** : The old Roman way of numbering the days (Kalends and Ides and counting backwards) persisted in Europe until after 1000 AD/CE when the days of the month were numbered starting with 1.

!!

I find that interesting....

The number of the year though was frequently numbered from the beginning of the reign of the ruler (as was customary in many parts of the world)...

**quaezar Agnomen** : It sure is!



**Vic Michalak** : GREGORIAN CALENDAR

[I sure hope we have time for other calendar systems! I believe we will...]

The Julian calendar system decreed by Julius Caesar was used for over 1500-1900 years by all Christians and continues to be used by the Eastern (Orthodox) Christians to determine religious events.

By the Middle Ages people noted that the true vernal equinox came earlier than March 21 and the best way to correct this drift was debated for the next 400 years.

Kind of like some Congresses or Parliaments today! :)

By the 1500s the vernal equinox was 10 days off of March 21 and New Moons used in determining Easter were 4 days off of the official table of lunar phases.

In 1572, Pope Gregory XIII convened a commission to consider calendar reform. It took 10 years to decide on a plan of action.

[No Facebook or email back then... things took time!]

Anyone know how they solved this??

itsme Frederix : we jumped forward

Gilles Kuhn : by burning Giordano Bruno? ;-)

quaezar Agnomen : ☺



Vic Michalak : Gilles... haha... no, that was just for entertainment (half time maybe)

**Vic Michalak :** To correct the calendar, Pope Gregory decreed that October 15, 1582 would follow October 4, 1582, so that the vernal equinox was now close to March 21.

Now that's power!

**Gilles Kuhn :** nothing like a good pyre to rejoice the hearts of the Christians people...

**Vic Michalak :** Julius Caesar leapt the calendar forward by 90 days and the Pope by 10...

However, do you think everyone agreed with what the Pope said?

**quaezar Agnomen :** Think not..

**itsme Frederix :** Well the pope had a heavier calendar (more years in it)

**Astronomer Somerset :** definitely not

**Vic Michalak :** [The Gregorian calendar is behind me, by the way...]  
Protestant countries rejected the new Gregorian calendar, but eventually adopted it over the centuries.

For example, the Netherlands adopted the new calendar in 1583, but it was not until 1752 that England (and the English colonies that would become the United States) adopted the new calendar.

Much later Russia adopted the calendar in 1918 (USSR in 1922), and Greece and Turkey in 1923 and 1926, respectively.

**quaezar Agnomen :** Nice historical facts

**Nymf Hathaway :** Neat





**Vic Michalak** : Interesting anyway... history is not dull if you see it as people like you and I trying to decide on things and making things work (or not)...

The Gregorian calendar is the same as the Julian calendar except that centuries divisible by 400 starting with 1600 BCE are leap years and other centuries are not.

**itsme Frederix** : not that bad, Russians had to rewrite history that time  
**quaezar Agnomen** : :)))

**Vic Michalak** : So, was 2000 a leap year??  
 Anyone?

**Edward Tarber** : no leap year, because it can be divided by 400

**itsme Frederix** : and not the millennium barrier!

**Vic Michalak** : Gotcha on that one... actually just the opposite, but you have the right idea...

**Astronomer Somerset** : did they not add a leap second in two thousand

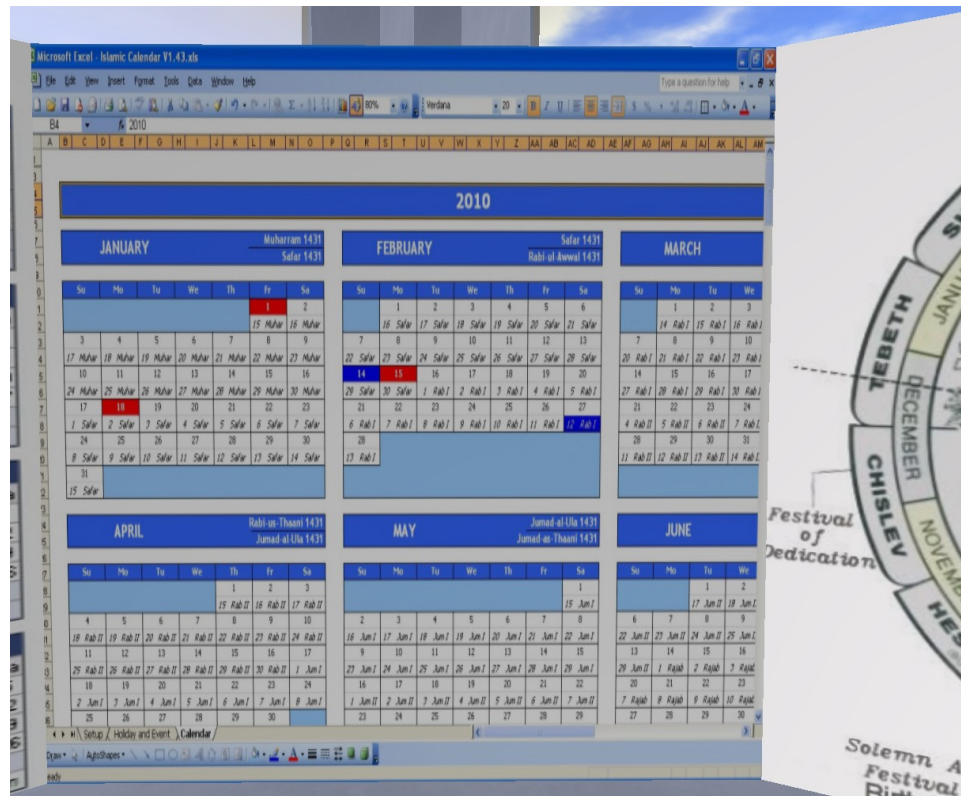
**Vic Michalak** : This means that 2000 was a leap year but 1900, 1800, and 1700 were not, even though they are divisible evenly by 4!

**Edward Tarber** : ahh .. yes

**Vic Michalak : Astronomer...** I will have to check... not sure when the last or next leap second is... but it is added at the end of December 31 if I am not mistaken.

By eliminating 3 days every 400 years, the average length of the year becomes 365.2425 days, which results in an error of one day extra every 2500 years.

Okay, this is again where it gets really deep, so just go along for the ride...



**Astronomer Somerset :** I seem to remember it being added then

**Vic Michalak :** This will be interesting for you mathematicians or religious studiers...

To calculate the day of Easter for any Gregorian year, the New Moon is considered Day 1 and the Full Moon is defined as Day 14.

Since in the Metonic cycle, 235 mean synodic months = 6939.688 days and 19 Gregorian years is 6939.6075 days, or 0.08 days apart, a longer cycle of 5,700,000 years or 2,081,882,250 days is used which equates to 70,499,183 months.

In 1940 J.-M. Oudin created a mathematical algorithm to calculate Easter day for any year. In this algorithm, all variables are integers and modular arithmetic is used (remainders in all divisions are dropped).

$C = \text{Year}/100$ ,  $N = \text{Year} - 19*(\text{Year}/19)$ , and  $K = (C - 17)/25$  Then  $I = C - C/4 - (C - K)/3 + 19*N + 15$   $I = I - 30*(I/30)$   $I = I - (I/28)*(1 - (I/28)*(29/(I + 1)))*((21 - N)/11)$  Then  $J = \text{Year} + \text{Year}/4 + I + 2 - C + C/4$   $J = J - 7*(J/7)$  And  $L = I - J$  So that Easter Month =  $3 + (L + 40)/44$  and Easter Day =  $L + 28 - 31*(\text{Month}/4)$ .

**quaezar Agnomen** : ouch

**Vic Michalak** : [Acckkkk again!!]

**quaezar Agnomen** : :))

**Vic Michalak** : Yes, lucky we have computers.... J.M.Odin had to work this out by hand...

For example, Easter is on April 24 in 2011... This is calculated by...

$C = 2011/100 = 20$

$N = 2011 - 19*(2011/19) = 2011 - 19*105 = 16$   $K = (20 - 17)/25 = 0$

Then  $I = 20 - 20/4 - (20 - 0)/3 + 19*16 + 15 = 15 - 7 + 304 + 15 = 327$   $I = 327 - 30*(327/30) = 327 - 300 = 27$   $I = 27 - (27/28)*(1 - (27/28)*(29/(27 + 1)))*((21 - 16)/11) = 27 - 0 = 27$  Then  $J = 2011 + 2011/4 + 27 + 2 - 20 + 20/4 = 2011 + 502 + 27 + 2 - 20 + 5 = 2527$   $J = 2527 - 7*(2527/7) = 2527 - 7*361 = 2527 - 2527 = 0$  And  $L = 27 - 0 = 27$  So that Easter Month =  $3 + (27 + 40)/44 = 4$  (April) and Easter Day =  $27 + 28 - 31*(4/4) = 27 + 28 - 31 = 24$

**quaezar Agnomen** : Gifted man

**Nymf Hathaway** : Pity JP skipped this one

**Vic Michalak** : Now you have the same power as religious authorities had (in keeping calendars secret for centuries, anyway)...

The Months of the Gregorian Calendar are:

1. January....31 days
2. February...28 or 29 in leap years
3. March.....31
4. April.....30
5. May.....31
6. June.....30
7. July.....31
8. August.....31
9. September..30
10. October....31
11. November...30

12. December...31

## ISLAMIC CALENDAR

Used by 1 billion+ persons around the world...

The Islamic (Hijiri) calendar system is lunar and is primarily used to determine holy days and festivals.

**Patio Plasma** : and some mechanical watches actually calculated the date of Easter!

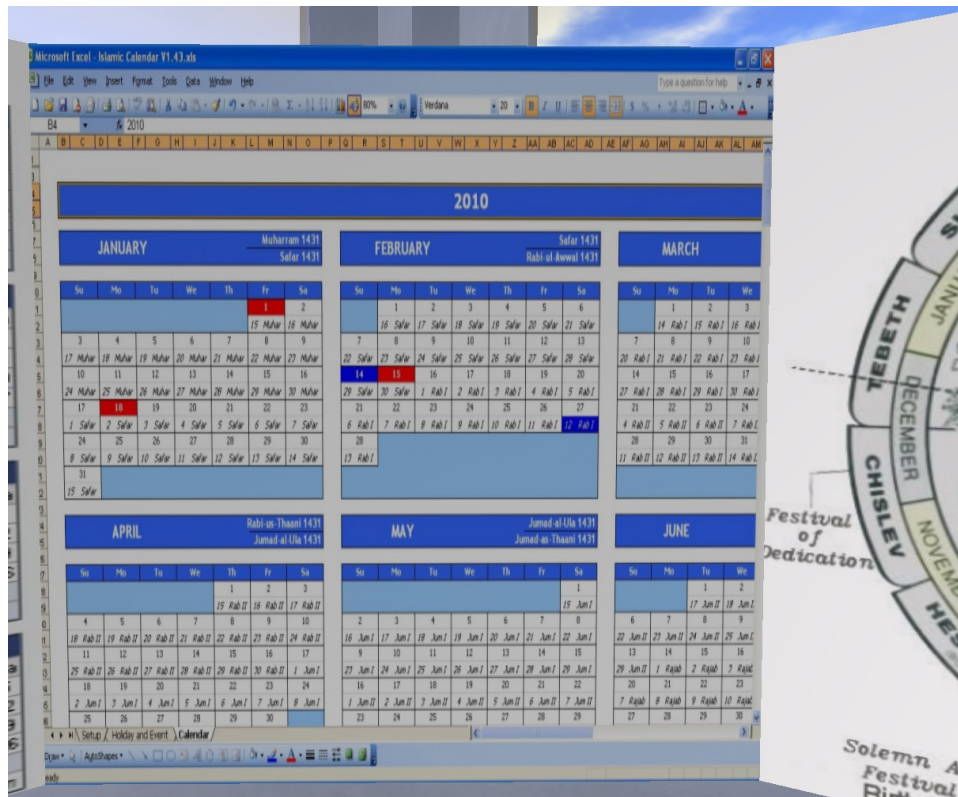
**Vic Michalak** : Really! I find that amazing...

The calendar is described in the Qur'an (Sura IX, verse 36-37). Before the time of the Prophet Muhammad the Arab world used a luni-solar calendar that added an extra (intercalary) month like the Hebrew calendar does today.

Caliph 'Umar I began the Hijira Era in A.H. 17. The initial New Moon occurred at 0444 UT on July 14, 622 CE.

[Calculated backwards... no accurate watches then!]

The Islamic calendar consists of 12 months that begin when the thin crescent of the new moon is observed. The exact date of observation depends on the geometry of the Sun, Moon, and horizon and other factors.



**NullSubset Burner** : attempts to shoe-horn those statements into a quadratic-lol:(P

**Vic Michalak** : [Just as an aside, when I was in the military we had exercises with Islamic countries and had to wait for the religious authorities to observe the moon so we could determine the day of exercises so we did not do military things on a religious holiday...]

Year 1 for the Islamic calendar is considered from the year that the Prophet Muhammad migrated from Mecca to Medina, an event known as the Hijira. Muharram 1 on 1 A.H. (Anno Higeræ) has been calculated to have been Thursday, July 15, 622 CE on the Julian calendar although some systems have it as Friday, July 16th.

Days begin and end at sunset. Weekdays are numbers beginning with Day 1 at sunset on Saturday. Day 6 is called Jum'a, a day for congregational prayers.

Months of the Islamic Calendar 1. Muharram.....30 2. Safar.....29 3. Rabi'a I.....30 4. Rabi'a II.....29 5. Jumada I.....30 6. Jumada II.....29 7. Rajab.....30 8. Sha'ban.....29 9. Ramadan.....30 10. Shawwal.....29 11. Dhu al-Q'adah..30 12. Dhu al-Hijjah..29 or 30 in a leap year

Years 2, 5, 7, 10, 13, 16, 18, 21, 24, 26, and 29 of the cycle are designated leap years in a 30 year cycle. The mean length of the month of the thirty-year tabular calendar is about 2.9 seconds less than the synodic period of the Moon.

**Vic Michalak** : Am I correct?

Does anyone here use the Islamic calendar?

#### HEBREW CALENDAR

**quaezar Agnomen** : I don't.. but I think very interesting

**Vic Michalak** : I think so too... but then that is why I am giving this presentation! :)

The Hebrew calendar system is the official calendar of Israel and is luni-solar, based on calculation rather than observation.

It is primarily used to determine the date for Passover and other Jewish religious festivals but may also be used for civil purposes (such as national holidays) and business purposes.

The earliest Hebrew calendar system was guarded as a secret by religious authorities who were influenced by the Babylonians during their exile in the 500s BCE.

Months were determined by observation of the New Moon such as with the Islamic calendar today. The calculated calendar is attributed to Hillel II, the Patriarch of the Sanhedrin between 385-320 CE.

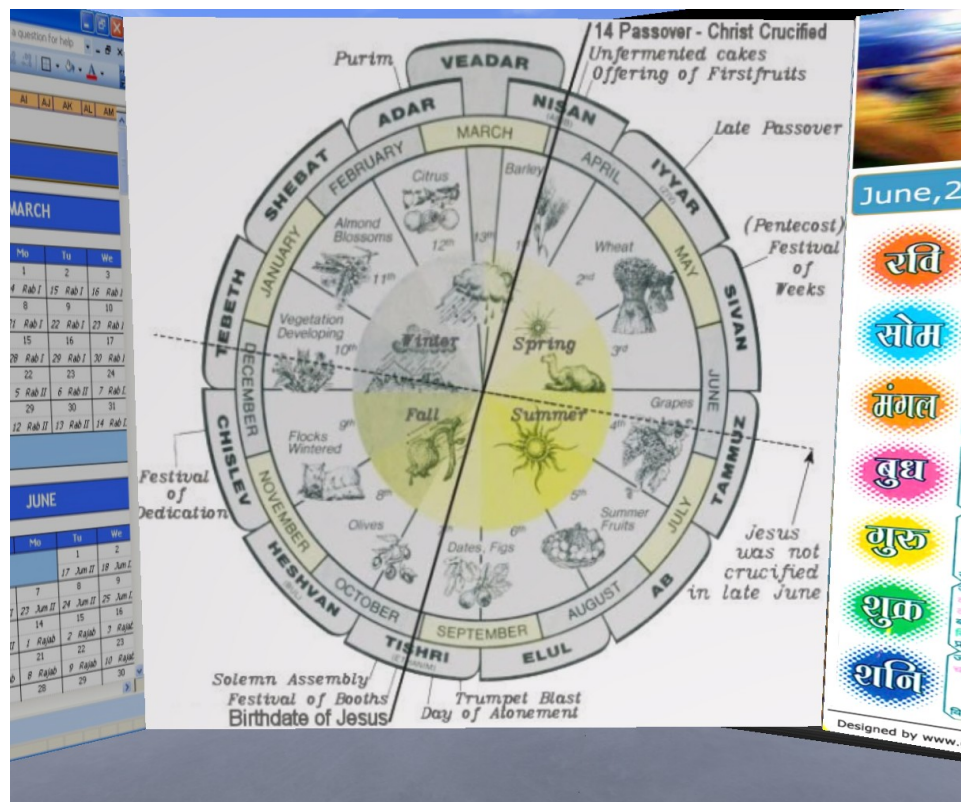
Years are counted from Era Mundi (Era of Creation) corresponding to 11:11:20 PM on Sunday, October 7, 3760 BCE on the Julian calendar.

The beginning of each month is determined by a table setting New Moons based on the mean value of the lunar cycle.

Days begin and end at sunset (6 PM). Days of the week are numbered and only the 7th day is named, called the Sabbath.

Hours are divided into 1080 halakim (1 helek = 3 1/3 seconds).

Calculations are made for Jerusalem, 2 hours 21 minutes east of Greenwich.



[Here is an interesting instance when seconds and hours are not used, but another division...]

Each year consists of either 12 or 13 months of 29 or 30 days. An extra (intercalary) month called Adar II is added to years 3, 6, 8, 11, 14, 17 and 19 in the 19 year cycle of 235 lunations. The month is calculated as 29 days, 12 hours and 793 halakim (29.530594 days).

Can anyone see the roots of both the Islamic and Hebrew calendars?

They have several similarities....

Months of the Hebrew Calendar 1. Tishri...30 2. Heshvan..29 in a Haser or Kesidrah year or 30 in a Shelemah year 3. Kislev...29 in a Haser year or 30 in a Shelemah or Kesidrah year 4. Tevet....29 5. Shevat...30 6. Adar.....30 (followed by month Adar II with 29 days in a leap year) 7. Nisan....30 8. Iyar.....29 9. Sivan....30 10. Tammuz...29 11. Av.....30 12. Elul.....29 A Haser year contains 353 days or 382 days in a leap year.

A Kesidrah year contains 354 days or 384 days in a leap year.

A Shelemah year contains 355 days or 385 days in a leap year.

Does anyone know why the year is either 353, 354, or 355 days long??

**Vic Michalak :** Another interesting rule: The year begins on Tishri 1 (first day of Rosh Hashanah). Depending on when the New Moon of Tishri falls, rules of Dehiyyot may postpone Tishri 1 by a day or two so that Hoshana Rabba (Tishri 21) is not on the Sabbath and Yom Kippur (Tishri 10) is not on the day before or after the Sabbath.

**Vic Michalak :** INDIAN AND HINDU CALENDARS

Does anyone use these calendars?

We have members from all over the world in Science Circle...

I was thinking that someone today used a calendar other than the Gregorian...

**Nymf Hathaway :** (in the future we might have participants from these countries though, Vic)

**itsme Frederix :** on the other hand western calendars seems to dominate

**Vic Michalak :** Or at least have more knowledge of their customs...:)

**Vic Michalak :** itsme, yes, I think that is because calendars are often associated with business (money)... and mass media has spread Western culture everywhere...

....which is good for me today because English is my first language. :)

**itsme Frederix :** that's called for some reason globalization

**Gilles Kuhn :** mass media and red jackets....

**Vic Michalak :** The Indian and Chinese calendar systems are luni-solar and used for religious purposes.

The Rig Veda dating from before 1300 BCE alludes to a lunisolar calendar with intercalary months.  
 When India became an independent country there were about 30 calendars in use by different groups of Hindus, Buddhists, and Jainists, plus Indian Muslims used the Islamic calendar and the government used the Gregorian calendar.  
**Patio Plasma** : and here we are using SL time  
**Nymf Hathaway** : Woops complicated :(



June, 2009		विक्रम संवत् 2066 आश्विन शुक्ल 12 से कार्तिक शुक्ल 13 तक		जून, 2009	
<b>रति</b>	<b>मुस्लिम पर्व :</b> 25 से 2 जुलाई तक ख्वाजा साहब का उर्स अजमेर शरीफ में	<b>ज्येष्ठ शुक्ल 15</b> स्वर्गाधीशो वरु रामायण- ६. पावरा न गुजरात कबीर जयंती देवरत्नमन पूर्णिमा सन्धादि, अनुत्था	<b>आषाढ कृष्ण 6</b> विदुषु लक्ष्मिनि	<b>आषाढ कृष्ण 13+14</b> उर्स, चतुर् अर्चन मासशिवरात्रि फादर्स डे सूर्य दक्षिणायन रोहिणी	<b>आषाढ शुक्ल 6+7</b> अर्ध श्रावणी विपरस रामजी सूर्य पूजा
<b>सोम</b>	<b>ज्येष्ठ शुक्ल 9</b> महेश जयंती - महोत्सव समाज महेश नवमी बाल सुरक्षा दिवस उत्तराषाढान्तुनी	<b>आषाढ कृष्ण 1</b> भुव इन्द्राधिकेन्द्र सिंह जयंती - श्रावण मूल रो	<b>आषाढ कृष्ण 7</b> कावलेरणी	<b>आषाढ कृष्ण 30</b> अश्विमेधव्रत अमावस्य सोमवती अमावस्य	<b>आषाढ शुक्ल 8</b> चतुर्भुजाष्टमी दुर्गाहिनी खरसी पूजा
<b>मंगल</b>	<b>ज्येष्ठ शुक्ल 10</b> शैलपुत्रक जन्मदिन प्रियतम गंगा सप्ताहर मद्रुक भैरव जयंती इन्द्र	<b>आषाढ कृष्ण 2</b> ज्येष्ठा	<b>आषाढ कृष्ण 8</b> शतभिषा	<b>आषाढ शुक्ल 1</b> मूल भास्करा प्रारंभ आषाढी संवत् 2066 प्रारंभ	<b>आषाढ शुक्ल 9</b> मूल भास्करा अस्त भडल्ले नवमी कर्तव्य नवमी
<b>बुध</b>	<b>ज्येष्ठ शुक्ल 11</b> निर्जला एकादशी - रावे भीमसेनी एकादशी रुक्मिणी विवाह नवमी एकादशी गाथावी जयंती, विवाह	<b>आषाढ कृष्ण 3</b> मूल	<b>आषाढ कृष्ण 9</b> पूर्वाभाद्रपद	<b>आषाढ शुक्ल 2</b> आषाढी स्वध्याना रामरघोत्सव चन्द्रदर्शन मनोहरपूजा प्रारंभ पुनर्वसु	<b>आषाढ शुक्ल 10</b> अश्विनी
<b>गुरु</b>	<b>ज्येष्ठ शुक्ल 12</b> चण्डिका द्वादशी त्रिविक्रम पूजा	<b>आषाढ कृष्ण 3</b> रावण चतुर्थी व्रत	<b>आषाढ कृष्ण 10</b> इन्द्राणी की पत्नी लक्ष्मीबाई शहीद दिवस... रावरीव रो	<b>आषाढ शुक्ल 3</b> ख्याजरादाव का शासना उर्स प्रारंभ - अजमेर शहीक मे	<b>आषाढ शुक्ल 10</b> अश्विनी
<b>शुक्र</b>	<b>ज्येष्ठ शुक्ल 13</b> कटकादिनी व्रत प्रारंभ - ३. पावरा, गुजरात बड़ा महादेव पूजा विश्व पर्यावरण दिना प्रदोष व्रत, स्वामी	<b>आषाढ कृष्ण 4</b> अश्विनी	<b>आषाढ कृष्ण 11</b> शोभिनी एकादशीव्रत - रावे	<b>आषाढ शुक्ल 4</b> बलभद्राचार्य वैकुण्ठव्रत मत्स्य निषेध विवाह	<b>आषाढ शुक्ल 11</b> अश्विनी
<b>शनि</b>	<b>ज्येष्ठ शुक्ल 14</b> चण्डिका चतुर्थी	<b>आषाढ कृष्ण 5</b> नाग चण्डनी - बंगाल में	<b>आषाढ कृष्ण 12</b> शनि प्रदोष व्रत	<b>आषाढ शुक्ल 5</b> अश्विनी स्वच्छ माही विश्व मातृपूज दिवस, मधा	<b>आषाढ शुक्ल 12</b> अश्विनी

**Vic Michalak** : Did I mention that an "intercalary" month is a month added to the calendar, like a day is added for a leap year?

Yes, very.... Like the languages in India....

Okay, trivia fans... what is the official language of India?

**itsme Frederix** : we have seen these in Islam/Jewish calendars

**Nymf Hathaway** : wouldn't know, Hindu?

**Vic Michalak** : [English...]

**Patio Plasma** : which is why there are so many call centers there

**Vic Michalak** : Too many other local languages.... had to pick something that most people know because of the English presence there...



**Ramana Sweetwater** : But Hindi has quite caught up

**NullSubset Burner** : another aside but - but the issue of time in relation to - VWs(Virtual Worlds)- is a interesting enough topic to fill a - whole presentation - I think.

**Vic Michalak** : Yes, Patio.... Plus a lot of fiber optics during the late 1990s! [Free advertising for my class on "Telecommunications"]

**Nymf Hathaway** : Pity really... English as a second language yes but a first? Pity

**Nymf Hathaway** : agrees with Null

**Kitt Holgado** : [Brits built the railway ...]

**Vic Michalak** : NullSubset.... yes, very interesting..... I know there has been a campaign for some time for Linden Lab to change to some more universal time...

....particularly when the times change twice a year in many places in the world!

The modern Indian calendar dates from the Saka Era with Saka 1 coinciding with the vernal equinox of 79 CE.

**Patio Plasma** : and SL time changes twice a year too at different dates than other parts of the world.

**SteveBurned Resident** : History is fine, But what about human's future? About space habitat calendars? Mars Colonies, Asteroid Space Habitats, Lunar Bases? Just keep to Earth calendar?

**Vic Michalak** : [I will conclude this by 1:00pm SLT, by the way.... an hour and a half is plenty long for any session.]

**Kitt Holgado** : Science Circle time ?

**Vic Michalak** : SteveBurned.... agree with you.

**Nymf Hathaway** : Perfect Vic

**itsme Frederix** : in a few years we can do it' with Chinese

**Ramana Sweetwater** : yes, Vic, that's a long time!

**Vic Michalak** : Science Circle time? Okay, you enterprising young minds out there -- sounds like a challenge to me!

**Vic Michalak** : Days begin and end at sunrise in the Indian calendar.

The revised National Calendar of India begins with Saka 1879 Caitra 1, which corresponds to March 22, 1957 CE with leap years coinciding with the Gregorian calendar.

Normal years have 365 days and leap years have 366. In a leap year, an intercalary day is added to the end of Caitra.

**Patio Plasma** : each science circle minute is 90seconds long so this lecture will be just 1 science circle hour long

**quaezar Agnomen** : ☺ Patio

**Nymf Hathaway** : You are quick Patio

**Vic Michalak** : Ah, but how long is a Second Life day?

**Patio Plasma** : 6 hours

**Vic Michalak** : Months of the Indian Civil Calendar 1. Caitra.....30 or 31 days in a leap year [Caitra 1 = March 22 or March 21 in a leap year] 2. Vaisakha....31 [Vaisakha 1 = April 21] 3. Jyaistha....31 [Jyaistha 1 = May 22] 4. Asadha.....31 [Asadha 1 = June 22] 5. Sravana.....31 [Sravana 1 = July 23] 6. Bhadra.....31 [Bhadra 1 = August 23] 7. Asvina.....30 [Asvina 1 = September 23] 8. Kartika.....30 [Kartika 1 = October 23] 9. Agrahayana..30 [Agrahayana 1 = November 22] 10. Pausa.....30 [Pausa 1 = December 22] 11. Magha.....30 [Magha 1 = January 21] 12. Phalguna....30 [Phalguna 1 = February 20]

**itsme Frederix** : because of the speed of Vic, we have relative a short time

**Vic Michalak** : Things speed up in virtual worlds...

**Vic Michalak** : The Hindu religious calendar is based on solar months. A solar month is defined as the interval required for the Sun's apparent longitude to increase by 30 degrees, the passage of the Sun into the next zodiacal sign (rasi).

**quaezar Agnomen** : Time is relative

**NullSubset Burner** : oo- bad physicists -bad--Times relative- and Vic's and good presenter :P

**Vic Michalak** : [This is still another way to tell time -- by the degrees of passage of the Sun!]

**quaezar Agnomen** : Sure he is NullSubset

**Vic Michalak** : [Thanks, NullSubset...] [and Q...]

**Vic Michalak** : Months of the Indian Religious Calendar 1. Vaisakha.....23 deg. 15 min. 30.9 days = Apr. 13 2. Jyestha.....53 deg. 15 min. 31.3 days = May 14 3. Asadha.....83 deg. 15 min. 31.5 days = Jun. 14 4. Sravana.....113 deg. 15 min. 31.4 days = Jul. 16 5. Bhadrapada..143 deg. 15 min. 31.0 days = Aug. 16 6. Asvina.....173 deg. 15 min. 30.5 days = Sep. 16 7. Kartika.....203 deg. 15 min. 30.0 days = Oct. 17 8. Margasirsa..233 deg. 15 min. 29.6 days = Nov. 16 9.

Pausa.....263 deg. 15 min. 29.4 days = Dec. 15 10. Magha.....293 deg. 15 min. 29.5 days = Jan. 14 11. Phalgura....323 deg. 15 min. 29.9 days = Feb. 12 12. Caitra.....353 deg. 15 min. 30.3 days = Mar. 14

Lunar months are divided into 30 tithis, or lunar days. Each tithi is defined by the time required for the longitude of the Moon to increase by 12 degrees over the longitude of the Sun so that a tithi varies from 20-27 hours.

I think I will wrap up in a minute to answer any questions or for others to comment....

**Kitt Holgado** : I'm 'all calendared out'!

### **Vic Michalak** : PERSIAN, ETHIOPIAN, THAI, AND BAHAI CALENDARS

The Persian calendar is used in Iran and parts of Afghanistan. The Ethiopian calendar is used in Ethiopia and Eritrea. The Thai solar calendar is used in Thailand and is based on the Buddhist calendar. The Bahai calendar is used by Bahai worldwide.

**Vic Michalak** : Kitt.... me too! :))

Heady stuff....

So, what is the significance of 2012 (particularly December 21)?

Just thought I would throw that in there....

**Ramana Sweetwater** : depends on the consens

**Nymf Hathaway** : I was looking forward to that question...what does science say?

**Kitt Holgado** : Buy your Xmas gifts early?

**Vic Michalak** : Science (and the Mayans, by the way), say there is no big deal.... no more so than any other turn of the calendar...

**quaezar Agnomen** : Science would say.. it is just a day..

**Vic Michalak** : No more than 2000.... (or 2001, depending on when you say the millennium started)....

Ho hum....

...but it makes for a good scare and movie and stuff....

**Nymf Hathaway** : yes

**Vic Michalak** : We are always looking for some kind of apocalypse...

**quaezar Agnomen** : It is the end of a 26K cycle according the Maya's

**Ramana Sweetwater** : Like "what's the significance of "Superman" ;) ?

**Vic Michalak** : Welll... hmm... I have 5 minutes... :)

**Nymf Hathaway** : hahhahaha Ramana

**Vic Michalak :** The Tzolkin is the religious calendar of the Maya that is still used for divinations and astrology in southern Mexico, Guatemala, Belize, and Honduras.

It is a calendar of 260 days composed of 20 day signs with 13 variations over four 65 day seasons.

**Nymf Hathaway :** Vic do not mind me saying this before you log out.... Thank you Vic... wonderful subject and presentation! I am happy to say I will make a PDF out of this and we will be able to read back, Wonderful Job!!!

**quaezar Agnomen :** I have no question Vic.. only I want to say it was a great and interesting presentation you gave ..thank you!

**Ramana Sweetwater :** me agrees 100%

**itsme Frederix :** I guess Vic nominates for the Greatest Show on SL

**Patio Plasma :** Yaaaaaaaaaaaaaaaaayyy!!! :D :D :D

**Gilles Kuhn :** I have to go rl was very nice thanks

**Nymf Hathaway :** Yes Its

**quaezar Agnomen :** Bye Gilles

**Ramana Sweetwater :** Bye Gilles!

**Vic Michalak :** Nymf... thank you... and, once again, thank you from all of us for your vision in founding and leading the Science Circles...

**Kitt Holgado :** Brilliant!!

**Patio Plasma :** Thanks Vic that was really informative and full of interesting information

**Nymf Hathaway :** With pleasure Vic

**Vic Michalak :** If anyone wants to know more, please contact me....

**NullSubset Burner :** very very informative my thanks Vic.

**itsme Frederix :** He did about 30 calendars with a span of thousand years in one SC hour

**Vic Michalak :** I will be happy to provide a Notecard with details...

**NullSubset Burner :** oo plz!

**itsme Frederix :** I loved it!

**Vic Michalak :** Thank you all for attending today....

**Nymf Hathaway :** Thank YOU Vic

**Patio Plasma :** and for those of you who want a quiz...here is one I give to my college students. Given this information come up with a leap year pattern for a Martian Calendar.

The solar day on Mars has been given a name, it is called a Sol.

There are approximately 668.6 Sols per Martian Year.

**Vic Michalak** : These sessions are nothing without an active audience!

**quaezar Agnomen** : We can offer the notes on our website.. you can download it there ..

**Edward Tarber** : thank you ... I will never see any calendar the same way from now on

**Vic Michalak** : Cool! Martian leap year....

**NullSubset Burner** : mars has a variable orbit--light core and such- so?

**Vic Michalak** : Thank you, Edward... that is the dream of every teacher....

...for participants to view the world a bit differently.

**Patio Plasma** : it's amazing how little people have actually thought of even how our simple (ha!) leap year system works

**Vic Michalak** : Yes, we take so much for granted and never think about it....

**Nymf Hathaway** : Very true Patio

**quaezar Agnomen** : Fully agree

**Nymf Hathaway** : Will send a notice when this presentation is online in PDF

**Patio Plasma** : and if you come up with the answer in less than 400 years you beat the implementation of the Gregorian calendar system

**itsme Frederix** : just tell (in the northern hemisphere) that in winter time sun is nearest! Most people won't believe it.

**Ramana Sweetwater** : How complex things actually are can also be noticed when trying to program things

**Kitt Holgado** : And, we managed all this without considering the effect of travelling near the speed of light!

**itsme Frederix** : well a quantum leap was introduced!

**Kitt Holgado** : yep!

**Vic Michalak** : Kitt... Yes, relativity does not figure into this much (except for the precession of the planets)....

**Vic Michalak** : That would REALLY complicate things!

**Kitt Holgado** : ok

**quaezar Agnomen** : I want to suggest a nice program where you can simulate astronomical events ... <http://www.shatters.net/celestia/>

**Patio Plasma** : Tune in last year to hear the exciting answer to the puzzle of faster than light travel LOL

**quaezar Agnomen** : it is free to download !

**Nymf Hathaway** : Thank you Q :)))

**Vic Michalak** : Except that Einstein had equations that would put everyone on a common reference... luckily... no specialized reference point... that whole idea of "relativity"

**quaezar Agnomen** : Here you can download hi-res textures ?

<http://www.celestiamotherlode.net/>

**Patio Plasma** : Celestia look great Q

**NullSubset Burner** : nice to see you all again- have a wonderful day all- XD

**Nymf Hathaway** : Thanks everyone for joining... wonderful FIRST for 2011

**quaezar Agnomen** : Yes.. one of my favorite programs

**Vic Michalak** : Okay, folks... Thanks again for coming.... You are free to stay and chat, but this ends the first presentation for 2011...

**Patio Plasma** : Thanks To science circle Nymf and Vic for this interesting program

**quaezar Agnomen** : Have a nice day Vic, Thank you!!!