Calendopaedia
THE Encyclopaedia of Calendars

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Since the dawn of civilisation man has kept track of time by use of the sun, the moon, and the stars. Man noticed that time could be broken up into units of the day (the time taken for the earth to rotate once on its axis), the month (the time taken for the moon to orbit the earth) and the year (the time taken for the earth to orbit the sun).

This information was needed so as to know when to plant crops and when to hold religious ceremonies. The problems were that a month is not made up of an integral number of days, a year is not made of an integral number of months and neither is a year made up of an integral number of days. This caused man to use his ingenuity to overcome these problems and produce a calendar which enabled him to keep track of time.

The ways in which these problems were tackled down the centuries and across the world is the subject of this Web site. It is recommended that you start by looking at the Comparison of Calendars.

This page was produced by **Michael Astbury**. Thanks to all the reference sources which I have quoted (too many to list them all) and to all the friends who have contributed to these pages in so many ways.

If you have any comments, corrections or suggestions then please email me.

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Calendopaedia - Astronomical Calendar

Definition of a Year

The most common definition in the western world of the year is based on the revolution of the Earth around the Sun and is therefore called a `Solar Year'. However, there are several possibilities to define beginning and end of one revolution and thus also several kinds of solar years:

- A **tropical year** is the interval between two successive passages of the centre of the Sun through the mean vernal equinox and lasts 365.242199 days UT. The name refers to the changes of seasons (greek `tropai', the turning points) which are fixed in this kind of year. It is for this reason that the tropical year is of great importance in the construction of calendars. The length of the tropical year is a matter for debate and is discussed on this page.
- A **sidereal year** is the time required for the earth to complete an orbit of the sun relative to the stars. It lasts 365.256366 days UT.
- An **anomalistic year** is the interval between two successive passages of the Earth through the perihelion (the point closest to the Sun) of its orbit and it lasts 365.259636 days UT.

The years so defined differ in length because of the precession of Earth's rotation and the tumbling of the Earth orbit.

The Julian year (365.25 days UT) and the Gregorian year (365.2425 days UT) as defined in the calendars of the respective name are solar years as well.

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Calendopaedia - Aztec Calender

There were actually two Aztec Calendars and they were both based on the Mayan Calendars. One of them, called the Xiuhpohualli Calendar consisted of 365 days and was used for farming and normal daily life. The other, known as The Tonalpohualli, had 260 days and was used for worship and observing rituals. This calendar, the name means 'day count' in English, is the one described first.

The Tonalpohualli - the Aztec Sacred Calendar

Each day has both a number and a symbol and both are needed to define the date. The numbers run from 1 to 13 and there are 20 different symbols. Day one is defined by number 1 and symbol 1. Day two is defined by number 2 and symbol 2. This continues until day 13 which is defined by number 13 and symbol 13. Day 14 is defined by number 1 and symbol 14, day 15 by number 2 and symbol 15. Day 20 is defined by number 7 and symbol 20. Day 21 by number 8 and symbol 1. As 13 is not a factor of 20 the same pair do not re-occur for 260 days and then a new sacred year starts.

The Xiuhpohualli - The Aztec Seasonal Calendar

This calendar defines a year of 18 months, each of 20 days, and five extra days, 365 days in total. These extra days were considered unlucky and so very little was done on them. Each year had a name and number combination as did the days in the The Tonalpohualli but this time there were only 52 such combinations before repeating. This series was known as a 'bundle'.

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Calendopaedia - Miscellaneous Calenders

The Babylonian Calendar

The Babylonian Calendar is not particularly unsusual but is included because it was thought to be the main influence on the Egyptian, Hebrew and Islamic calendars.

The calendar was luni-solar. The year consisted of 12 months which each started at sunset when the new moon was first seen. This meant that each month was either 29 or 30 days long but their length would change from one year to the next. The new year started on the first new moon after the vernal equinox. After 19 years the cycles of the moon and the sun re-align and so an intercalary month was added at that time to bring the calendar back in line with the seasons. It would still be out by one day every 342 years (18 cycles) but it is not certain whether this correction was applied.

The Bahai Calendar

The date in the Bahai Calendar is quoted with the suffix 'BE' which stands for Bahai Era. The Bahai Era started on 21 March 1844 AD by the Gregorian Calendar. This is the date on which the Bab, the Bahai prophet, started his ministry.

The Bahai year starts on 21 March and contains 365 or 366 days just as the Gregorian Calendar. Leap years are handled in just the same way. The year consists of 19 months each of 19 days. Month 18 is followed by 4 or 5 intercalendary days which are given to feasting and present giving. The first day of each month is also a feast day. Days are considered to begin at sunset on the previous day.

The names of the months are - Splendor, Glory, Beauty, Grandeur, Light, Mercy, Words, Perfection, Names, Might, Will, Knowledge, Power, Speech, Questions, Honour, Sovereignty, Dominion and Loftiness. The intercalendary days falling between Dominion and Loftiness.

The Egyptian Calendar

The Egyptians had a lunar calendar at one time but very little is known about it. They later changed to a solar calendar which had a year that was made up of twelve months of thirty days each, and five days were added at the end. Since this meant an error of about 1/4 day per year, the starting date of the year slowly drifted forward with respect to the seasons until after 1460 years it had returned to where it started. However the Egyptians realised that the rising of the Nile, the crucial event in the Egyptian agricultural cycle, was predicted by the heliacal rising of Sirius, the brightest star in the heavens. (Heliacal rising is the time when Sirius comes out of the rays of the Sun after a period of invisibilty and is first visible on the eastern horizon at sunrise.) They then synchronised their calender with that event. The priests were given responsibility for adding the extra day when it was needed.

The French Revolutionary Calendar

The French Revolutionary Calendar, also known as the French Republican Calendar was introduced on 24th November 1793 and abolished on 1 January 1806. There were twelve months of 30 days duration followed by five or six extra days. The months were called Vendemiaire, Brumaire, Frimaire, Nivose, Pluviose, Ventose, Germinal, Floreal, Prairial, Messidor, Thermidor, Fructidor. Each month contained three weeks of ten days, the last day being the day of rest. This was the main source of discontent among the people who now had to work for nine days before having a break. The names of the days were Primidi, Duodi, Tridi, Quartidi, Quintidi, Sextidi, Septtidi, Octtidi, Nontidi, Decadi.

The additional days, five or six depending on whether it was a leap year, were known as :-

- Jour de la vertu - Virtue Day
- Jour du genie - Genius Day
- Jour du travail - Labour Day
- Jour de l'opinion - Reason Day
- Jour des recompenses - Rewards Day
- Jour de la revolution - Revolution Day

The last named was the extra day for leap years.

When the calendar was planned it was decided to make the autumn equinox the first day of the year. As the calendar was introduced on 24th November 1793 it was decided that the calendar would retrospectively start on 22 September 1792. This was the equinox and the day the French Republic was founded.

Leap years were intended to be as the Gregorian calendar with the addition of Herschel's rule that years divisible by 4000 should not be leap years. Leap years actually occurred in years 3, 7 and 11. Year 15 would have been a leap year but the calendar ended in year 14.

There was also an attempt to introduce a metric day which had ten hours. Each hour had 100 minutes and each minute 100 seconds. One reason the calendar failed has been mentioned (only one day off in every ten) but the traders did not like it as it made international trading difficult.

The Greek Orthodox Calendar

When the Orthodox church in Greece finally decided to switch to the Gregorian calendar in the 1920s, they tried to improve on the Gregorian leap year rules, replacing the "divisible by 400" rule with the following:

Every year which when divided by 900 leaves a remainder of 200 or 600 is a leap year.

This makes 1900, 2100, 2200, 2300, 2500, 2600, 2700, 2800 non-leap years, whereas 2000, 2400, and 2900 are leap years. This will not create a conflict with the rest of the world until the year 2800. This rule gives 218 leap years every 900 years, which gives an average year of 365 218/900 days = 365.24222 days, which is certainly more accurate than the official Gregorian number of 365.2425 days. However, this rule is NOT official in Greece.

The Indian Calendar

The Indian Civil Calendar was defined by the Calendar Reform Committee in 1957. Up to this time there were approximately 30 different calendars in use in India. The committee also laid down the rules for governing the religious calendar, but despite this there are still several different religious calendars in use in India.

Years are counted in the Saka Era which began with the vernal equinox in 79 AD (Gregorian). There are 12 months of 30 or 31 days and 365 or 366 days in the year. Leap years are determined in the same manner as the Gregorian Calendar. The year starts on 22 March (Gregorian) each non-leap year and 21 March in leap years. The names of the months are - Caitra, Vaisakha, Jyaistha, Asadha, Sravana, Bhadra, Asvina, Kartika, Agrahayana, Pausa, Magha and Phalguna.

The Indian Religious Calendar usually has 12 months but may have 13. This is because each month starts with the new moon. Each lunar month is given the name of the solar month in which it begins. When two new moons occur in the same solar month then the two lunar months both have the same name but with *adhika* placed before the name of the first month. Occasionally a solar month will occur with no new moon. When this happens the name of that solar month will not be used for a lunar month. This is known as a *ksaya* month. Any year which contains such a month will always also contain a *adika* month so that the total lunar months will never fall as low as 11. Such years occur between 19 and 141 years apart.

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Calendopaedia - The Chinese Calendar

The Chinese calendar is a lunisolar calendar based on calculations of the positions of the Sun and Moon. Months of 29 or 30 days begin on days of astronomical New Moons, with an intercalary month begin added every two or three years. Since the calendar is based on the true positions of the Sun and Moon, the accuracy of the calendar depends on the accuracy of the astronomical theories and calculations.

Although the Gregorian calendar is used in the Peoples' Republic of China for administrative purposes, the traditional Chinese calendar is used for setting traditional festivals and for timing agricultural activities in the countryside. The Chinese calendar is also used by Chinese communities around the world.

The exact rule for determining the leap months are complicated. Chinese New Year will normally be the New Moon closest to the "Beginning of Spring". (The Beginning of Spring is halfway between Winter Solstice and Spring Equinox and usually falls on February 4.) Chinese New Year is normally the second New Moon after Winter Solstice. This can fall anywhere between 21st January and 21st February. Western cultures date the years from the birth of Jesus Christ (For example, 1994 means 1,994 years after the birth of Christ), and thus approach the progression of years from a linear point of view. In traditional China, dating methods were cyclical, meaning that the years repeat according to a pattern. The repetition pattern for the calendar is 60 years. This is made up of two cycles, known as the **Stems** and the **Branches**.

There are ten stems which are jia, yi, bing, ding, wu, ji, geng, xin, ren and gui. These words do not have English equivalents. The branches number twelve and they are (followed by the corresponding animal) zi (rat), chou (ox), yin (tiger), mao (hare), chen (dragon), si (snake), wu (horse), wei (sheep), shen (monkey), you (fowl), jia (dog) and hai (pig).

The 60 year cycle starts with both the Stem and Branch cycles set to one. The next year both are incremented so now stand at two. This continues until year eleven when the Stem cycle returns to one. In year thirteen the Branch cycle restarts while the Stem increments to three. This sequence continues until both cycles are back at one together. This will be year one of the next 60 year cycle. The years are named after the animals of the Branch, so the names form a twelve year cycle.

The 60 year cycle is shown in the tables below, together with the Gregorian year numbers for the current cycle.

The 60 Year Cycle

No.	Name in Chinese	Name in English	Year AD
1	jia-zi	Rat	1984
2	yi-chou	Ox	1985
3	bing-yin	Tiger	1986
4	ding-mao	Hare	1987
5	wu-chen	Dragon	1988
6	ji-si	Snake	1989
7	geng-wu	Horse	1990

No.	Name in Chinese	Name in English	Year AD
21	jia-shen	Monkey	2004
22	yi-you	Fowl	2005
23	bing-xu	Dog	2006
24	ding-hai	Pig	2007
25	wu-zi	Rat	2008
26	ji-chou	Ox	2009
27	geng-yin	Tiger	2010
28	xin-mao	Hare	2011

No.	Name in Chinese	Name in English	Year AD
41	jia-chen	Dragon	2024
42	yi-si	Snake	2025
43	bing-wu	Horse	2026
44	ding-wei	Sheep	2027
45	wu-shen	Monkey	2028
46	ji-you	Fowl	2029
47	geng-xu	Dog	2030

8	xin-wei	Sheep	1991
9	ren-shen	Monkey	1992
10	gui-you	Fowl	1993
11	jia-xu	Dog	1994
12	yi-hai	Pig	1995
13	bing-zi	Rat	1996
14	ding-chou	Ox	1997
15	wu-yin	Tiger	1998
16	ji-mao	Hare	1999
17	geng-chen	Dragon	2000
18	xin-si	Snake	2001
19	ren-wu	Horse	2002
20	gui-wei	Sheep	2003

29	ren-chen	Dragon	2012
30	gui-si	Snake	2013
31	jia-wu	Horse	2014
32	yi-wei	Sheep	2015
33	bing-shen	Monkey	2016
34	ding-you	Fowl	2017
35	wu-xu	Dog	2018
36	ji-hai	Pig	2019
37	geng-zi	Rat	2020
38	xin-chou	Ox	2021
39	ren-yin	Tiger	2022
40	gui-mao	Hare	2023

48	xin-hai	Pig	2031
49	ren-zi	Rat	2032
50	gui-chou	Ox	2033
51	jia-yin	Tiger	2034
52	yi-mao	Hare	2035
53	bing-chen	Dragon	2036
54	ding-si	Snake	2037
55	wu-wu	Horse	2038
56	ji-wei	Sheep	2039
57	geng-shen	Monkey	2040
58	xin-you	Fowl	2041
59	ren-xu	Dog	2042
60	gui-hai	Pig	2043

The years are only counted within the cycles, there is no count of the number of the cycle. Historical dates are defined by the name of the emperor who was reigning at the time together with the sixty year cycle number. The current cycle began on 2nd February 1984 AD.

Since the length of the lunar cycle is approximately 29.53 days, each month has either 29 or 30 days. There are twelve months in a year except when an intercalary month is added for adjustment. Months do not have names, only numbers. The normal year consists of 353, 354 or 355 days depending on when the new moon occurs. Leap years have 383, 384 or 385 days. The rules for governing when a new year starts and when a leap year is needed are complicated. The calculations for this are performed by the staff of the Purple Mountain Observatory, Academia Sinica, Nanjing, China.

Thanks to Helmer Aslaksen for help and guidance on the Chinese calendar.

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Calendopaedia - The Christian Calendar

The Christian Calendar is different from the other calendars on this web site because it is not a means of dividing the year into weeks and months but rather a list of special days, festival days and days for remembering events in the life of Christ. These dates are then mapped onto the Gregorian calendar. Most churches around the world use the Gregorian calendar which is understandable as it was devised for the church under the instruction of Pope Gregory. The Orthodox Church, on the other hand, wanted to show its independence from the Roman Catholic Church and uses the Julian calendar.

Many of the days mentioned on this page are celebrated by either the Church Of England or the Roman Catholic Church or both. The free Protestant churches tend to celebrate only the more important dates. This page does not list saints days as there are many of these and they tend to be of interest to a limited number of people.

By using the information given on this page as a basis it should be possible to calculate when any of these days occur in any year. A large proportion of the days are calculated in relation to Easter, which is in turn based on the date of Passover. As Passover is a Jewish celebration its timing is dictated by the Hebrew lunar calendar. To make life easier for themselves, and remove their dependence on the Hebrew calendar, Protestants now calculate the timing of Easter by means of a formula. The result of this is that it does not always align with the Passover.

The rules to determine when Easter falls are -

1. Easter Day must be on a Sunday;
2. this Sunday must follow the 14th day of the paschal moon;
3. the paschal moon is that of which the 14th day (full moon) falls on or next follows the day of the vernal equinox;
4. the equinox is fixed in the calendar as 21 March. Easter can never occur before 22 March or later than 25 April.

Although Easter can fall at any time between these two dates it is rare for it to fall at either extreme. The last time Easter was on 22 March was AD 1818 and this will next happen in AD 2285. The latest date of 25 April last occured in AD 1943 and will next occur in AD 2038.

How to calculate the date for Easter Sunday

The calculation method described here will work for any year since 1752. Take the number of the year, add one, and then divide by 19. Forget the answer and just use the remainder. Look up the remainder in the following table. Easter is on the first Sunday after the date in the table. Let us take as an example, the year 2000. 2000 plus 1 is 2001. If you divide 2001 by 19, the answer is 105 with a remainder of 6. The date in the table for 6 is 18 April. Therefore, Easter Day falls on the following Sunday, which was 23 April 2000.

Remainder	*Date*	*Remainder*	*Date*	*Remainder*	*Date*
0	March 27	6	April 18	13	April 2
1	April 14	7	April 8	14	March 22
2	April 3	8	March 28	15	April 10
3	March 23	9	April 16	16	March 30
4	April 11	10	April 5	17	April 17
5	March 31	11	March 25	18	April 7
		12	April 13		

Alternatively you can consult the GENUKI Dates of Easter Sunday and Perpetual Calendar web site and just look it up.

Orthodox churches use the Julian calendar to calculate Easter Day and adjust the date so that it falls after the Jewish Passover. For them, Easter Season also lasts fifty days, ending on Pentecost.

The Christian Calendar

Day	Date	Explanation
Feast of the Circumcision	January 1	A festival in honour of the circumcision of Christ. Probably introduced to replace pagan New Year celebrations.
Epiphany	January 6	The day that the Wise Men visited Jesus at Bethlehem. This is also a Catholic holiday celebrating the baptism of Christ in the Jordan River by John the Baptist.
Christmas Day (Orthodox Church)	January 7	The Orthodox Church still use the Julian calendar.
Annunciation	March 25	The announcement by the angel Gabriel to the Virgin Mary of the incarnation of Christ.
Shrove Sunday	Sunday before Ash Wednesday	Also known as Quinquagesima.
Shrove Monday	Monday before Ash Wednesday	Also called Rose Monday.
Shrove Tuesday	Day before Ash Wednesday	From 'shrive', an ancient word meaning to seek forgiveness. Originally a day of repentance in preparation for the period of Lent. Later it became a time to feast and use up food stocks before the Lenten fast.
Ash Wednesday	46 days before Easter	The Day of Ashes. This is the first day of Lent, occurring forty days before Easter not counting Sundays. The ancient custom on this day is for the faithful to receive on the forehead the sign of a cross marked with blessed ashes. The palms from the previous Palm Sunday are burned and the ashes are blessed for the ceremony before the Mass.
First Sunday of Lent	Six weeks before Easter	Also known as Orthodoxy Sunday. Commemorates the restoration of the use of icons in the church (842 AD), and the triumph over all heresies.
Mothering Sunday (UK)	Three weeks before Easter	Also known as Laetare Sunday. Young people in domestic service were allowed the day off to visit their mothers.
Passion Sunday	Two weeks before Easter	Also known as Judica.
Palm Sunday	Sunday before Easter	Commemorates Christ's entry into Jerusalem. The start of Holy Week.

Maundy Thursday	Thursday before Easter	Commemorates Christ's Last Supper and His washing of the disciples' feet.
Good Friday	Friday before Easter	The anniversary of the crucifixion of Christ. Also known as Holy Friday.
Easter Sunday	See calculation at the top of this page.	Easter is the celebration of Christ's resurrection. The resurrection took place on Sunday, which was from then on the "Lord's Day".
Rogation Sunday	Sunday before Ascension Day	The Latin name is Vocem Juncunditatis. Rogation Days are the three days preceding Ascension Day.
Ascension Day	Ten days before Pentecost	Commemorates the Ascension of Christ.
Pentecost or Whitsunday	Seventh Sunday after Easter	A festival commemorating the descent of the Holy Ghost upon the apostles. Also known as Whitsunday, meaning "white Sunday", probably due to the white baptismal robes worn on that day.
Trinity Sunday	Sunday after Pentecost	A festival in honour of the Trinity.
Corpus Christi	Thursday after Trinity Sunday	A festival in honour of the Eucharist, or Lord's Supper. The name means "body of Christ".
Transfiguration	August 6	Commemoration of the biblical event when Christ is changed in appearance on the mountain. Observed by Roman Catholic and Anglican churches on August 6. Observed by Lutherans on the sixth Sunday after Epiphany.
Creation	October 23	According to Bishop James Ussher (1581-1656), God created the universe on October 23, 4004 BC. That would make the universe 6000 years old in 1997 AD. James Ussher was an Irish Archbishop whose chronology of Biblical history was, at one time, widely accepted throughout Christianity.
Advent Sunday	Sunday closest to St Andrew's Day (Nov 30)	Begins the Advent season and the beginning of the ecclesiastical year.
Immaculate Conception	December 8	Roman Catholics hold this in honour of the unique privilege by which Mary was conceived by her mother without the stain of original sin.
Christmas Day	December 25	Commemorates the birth of Jesus Christ.

Childermas	December 28	By orders of King Herod, the children of Bethlehem were massacred in an attempt to kill the baby Jesus.

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Calendopaedia - Modern Calendars

There are seven calendars in regular current use around the world. They are the Gregorian, the Chinese, the Hebrew, the Islamic, the Persian, the Ethiopian and the Balinese Pawukon. The Gregorian is used worldwide for business and legal reasons. The others are sometimes used for religious and sometimes social reasons.

The Chinese calendar is not used in China but is used in various countries of south east asia, usually with local variations. For example the calendar used in Japan is a variation of the Chinese one. It is also used socially by ethnic Chinese around the world.

The Hebrew calendar is used, of course, in Israel, as well as by Jews around the world for their religious observances.

The Islamic calendar is used by Moslems around the world for setting the dates of religious celebrations.

The Persian calendar is used in Iran and Afghanistan.

The Ethiopian calendar is used in Ethiopia.

The Balinese Pawukon calendar is used in Bali.

Many individuals and groups have designed other calendars with various advantages but they now stand very little chance of being adopted. There are several calendars which have been proposed and are more accurate than the Gregorian calendar, but it is unlikely that it will ever be displaced. The following calendars have not gained acceptance but are being proposed and pushed by different groups and are of interest.

The International Calendar

The International Calendar Association proposed a new calendar in 1931. The proposal is for a year made up of five quintals, each 73 days long. Each quintal consists of 12 weeks of six days plus one extra day. The last day of the week and the extra days are rest days. This makes the year 365 days long. Leap years are created by adding another day every fourth year unless the year number is a multiple of 128.

The Positivist Calendar

Auguste Comte's Positivist Calendar has 13 months of 28 days, an intercalary day at the end of each year, and another at the end of leap years. It is therefore a perennial calendar, the same every year. All the months on the Positivist Calendar have four, seven-day weeks beginning on Monday. So the days of the month always fall on the same weekday. For example, the 10th is always on Wednesday.

Comte named his 13 months after saints and heroes in human history, consecrating each day of the year to historical figures as well. Sunday's saints are distinguished by major festivals. Dozens of minor saints are substituted in leap years. Although the Positivist Calendar was first published in 1849, Comte began its reckoning of years from 1789. Comte's calendar was the model for the "International Fixed Calendar," promoted by Moses Cotsworth and George Eastman in the early 20th century.

The World Calendar

The object of the World Calendar is to create a calendar that is the same every year but with the minimum impact on the Gregorian calendar. This is done by dividing the year into quarters, each one having one month of 31 days and two of 30 days. Each quarter will also have exactly 13 weeks. This gives 364 days so an extra day is added at the end of the year which has a different name ('Year Day' has been proposed) so that each year, and indeed each quarter will always start on a Sunday. Leap years follow the Gregorian rule but are added between the second and third quarters and known as 'Leap Day' so as not to affect the pattern of starting the quarter on a Sunday.

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Calendopaedia - The Old English Calendar

Very little is known of the Old English calendar as used in Britain after the Roman occupation but before the coming of Christianity.

The Old English calendar had twelve months and the year started with the winter solstice. This festival was known as **Geola** from which we get the modern word Yule. The summer solstice was known as **Liþa** whose meaning is unclear.

The months were named as follows :-

Month Number	Month Name	Meaning
1	Æfterra Geola	After Yule
2	Solmonað	Sun Month
3	Hreþmonað	Named after the divinity Hrepe
4	Eastermonað	Named after the divinity Eostre The likely source of the name for Easter
5	Ðrimilcemonað	Cow milking month Cows were milked three times daily at this time of year
6	Ærra Liþa	Before Liþa
7	Æfterra Liþa	After Liþa
8	Weodmonað	Weed month This could be a reference to the growth of vegetation
9	Haligmonað	Holy month Probably a reference to harvest thanksgiving
10	Winterfylleð	Winter month The first full moon of winter
11	Blotmonað	Sacrifice month When animals who could not survive the winter would be slaughtered
12	Ærra Geola	Before Yule

The days of the week were named as follows :-

Modern name	Old English Name	Meaning
Sunday	Sunnandæg	The day of the Sun
Monday	Monandæg	The day of the Moon
Tuesday	Tiwesdæg	The day of Tiw The Norse God Tyr
Wednesday	Wodnesdæg	The day of Woden

		The Norse God Odinn
Thursday	Þunresdæg	The day of Thunor The Norse God Thor
Friday	Frigedæg	The day of Frige, or love
Saturday	Sæterndæg	The day of Saturn

The day was considered to start at sunset and run until the next sunset. This led the Anglo Saxons to refer to a length of time as 'so many nights' rather than 'so many days' which is why a period of two weeks is known as a fortnight in Britain to this day.

This calendar was later replaced by the Julian Calendar but I have been unable to obtain a date for this change-over.

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Calendopaedia - The Ethiopian Calendar

The Ethiopian calendar has a year of 365 days and leap years of 366 days. The Ethiopian year is divided into 12 months of thirty days each and one intercalary month of 5 days, or 6 days in a leap year.

The Ethiopian Calendar is similar to the Julian calendar in that it has a leap year every four years and does not miss one at the turn of the century. However it is not true to say that Ethiopia uses the Julian calendar. In fact their calendar owes more to the old Coptic Calendar.

The relationship between the Ethiopian and the Gregorian calendars varies when ever the Gregorian Calendar misses a leap year. The present situation (that is between 1900 and 2099 Gregorian) is that the year starts on 11th September (Gregorian) and from then until 31st December the year number is seven less than the Gregorian year number. From 1st January to 10th September the difference is eight. This means that the Ethiopians celebrated the dawning of the millennium (AD2000) at midnight on 10th September 2007 (Gregorian). The difference in year numbering is due to the Ethiopian Orthodox Church disagreeing with the Roman Catholic Church about when Christ was born. The Ethiopian Orthodox Church believe that Christ was born exactly 5,500 years after the creation of the world which they then equate to 7BC. Some experts believe that they are probably nearer the true date than the Gregorian calendar.

The month names and their relationship to Gregorian months is as follows :-

- Meskerem - September/October
- Tekemt - October/November
- Hedar - November/December
- Tahesas - December/January
- Tir - January/February
- Yekatit - February/March
- Megabet - March/April
- Meyazeya - April/May
- Genbot - May/June
- Senay - June/July
- Hamlay - July/August
- Nehasay - August/September
- Paguemain – September (intercalary month)

Time is also calculated differently in Ethiopia as hours are counted from dawn. Due to the closeness of the equator this is usually 6am in the European way of reckoning. Thus 9am is 3 o'clock, noon is 6 o'clock and the sun sets around 12 o'clock.

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Calendopaedia - The Gregorian Calendar

The Gregorian calendar is the one commonly used today. It was proposed by Aloysius Lilius, a physician from Naples, and adopted by Pope Gregory XIII in accordance with instructions from the Council of Trent (1545-1563) to correct for errors in the older Julian Calendar. It was decreed by Pope Gregory XIII in a papal bull in February 1582.

In the Gregorian calendar, the tropical year is approximated as 365 97/400 days = 365.2425 days. Thus it takes approximately 3300 years for the tropical year to shift one day with respect to the Gregorian calendar.

The approximation 365 97/400 is achieved by having 97 leap years every 400 years.

These are calculated as follows : Every year divisible by 4 is a leap year. However, every year divisible by 100 is not a leap year. However, every year divisible by 400 is a leap year after all.

So, 1700, 1800, 1900, 2100, and 2200 are not leap years. But 1600, 2000, and 2400 are leap years.

(Destruction of a myth: There are no double leap years, i.e. no years with 367 days. See, however, the note on Sweden lower down this page.)

The 4000-year rule.

It has been suggested (by the astronomer John Herschel (1792-1871) among others) that a better approximation to the length of the tropical year would be 365 969/4000 days = 365.24225 days. This would dictate 969 leap years every 4000 years, rather than the 970 leap years mandated by the Gregorian calendar. This could be achieved by dropping one leap year from the Gregorian calendar every 4000 years, which would make years divisible by 4000 non-leap years.

This rule has, however, not been officially adopted.

The change-over from the Julian to the Gregorian calendar.

The papal bull of February 1582 decreed that 10 days should be dropped from October 1582 so that 15 October should follow immediately after 4 October, and from then on the reformed calendar should be used.

This was observed in Italy, Poland, Portugal, and Spain. Other Catholic countries followed shortly after, but Protestant countries were reluctant to change, and the Greek orthodox countries didn't change until the start of this century.

The following list contains the dates for changes in a number of countries.

```
Albania:        December 1912

Austria: Different regions on different dates
                 5 Oct 1583 was followed by 16 Oct 1583
                14 Dec 1583 was followed by 25 Dec 1583

Belgium: Different authorities say
                14 Dec 1582 was followed by 25 Dec 1582
                21 Dec 1582 was followed by 1 Jan 1583

Bulgaria: Different authorities say
                Sometime in 1912
                Sometime in 1915
                18 Mar 1916 was followed by 1 Apr 1916

China: Different authorities say
                18 Dec 1911 was followed by 1 Jan 1912
```

```
                18 Dec 1928 was followed by 1 Jan 1929

Czechoslovakia (i.e. Bohemia and Moravia):
                 6 Jan 1584 was followed by 17 Jan 1584

Denmark (including Norway):
                18 Feb 1700 was followed by 1 Mar 1700

Egypt:          1875

Estonia:        January 1918

Finland: Then part of Sweden. (Note, however, that Finland later
                became part of Russia, which then still used the
                Julian calendar. The Gregorian calendar remained
                official in Finland, but some use of the Julian
                calendar was made.)

France:         9 Dec 1582 was followed by 20 Dec 1582

Germany: Different states on different dates:
                Catholic states on various dates in 1583-1585
                Prussia: 22 Aug 1610 was followed by 2 Sep 1610
                Protestant states: 18 Feb 1700 was followed by 1 Mar 1700

Great Britain and Dominions (including what is now the USA):
                2 Sep 1752 was followed by 14 Sep 1752

Greece:         9 Mar 1924 was followed by 23 Mar 1924

Hungary:        21 Oct 1587 was followed by 1 Nov 1587

Italy:          4 Oct 1582 was followed by 15 Oct 1582

Japan: Different authorities say:
                 19 Dec 1872 was followed by 1 Jan 1873
                 18 Dec 1918 was followed by 1 Jan 1919

Latvia:         During German occupation 1915 to 1918

Lithuania:      1915

Luxembourg:     14 Dec 1582 was followed by 25 Dec 1582

Netherlands:
        Brabant, Flanders, Holland, Artois, Hennegau:
                14 Dec 1582 was followed by 25 Dec 1582
        Geldern, Friesland, Zeuthen, Groningen, Overysel:
                30 Nov 1700 was followed by 12 Dec 1700

Norway: Then part of Denmark.

Poland:         4 Oct 1582 was followed by 15 Oct 1582

Portugal:       4 Oct 1582 was followed by 15 Oct 1582

Prussia :       22 Aug 1610 was followed by 2 Sept 1610

Romania:        31 Mar 1919 was followed by 14 Apr 1919

Russia:         31 Jan 1918 was followed by 14 Feb 1918

Spain:          4 Oct 1582 was followed by 15 Oct 1582

Sweden (including Finland):
                17 Feb 1753 was followed by 1 Mar 1753 (see note below)

Switzerland:
        Catholic cantons: 1583 or 1584
```

Zurich, Bern, Basel, Schafhausen, Neuchatel, Geneva:
31 Dec 1700 was followed by 12 Jan 1701
St Gallen: 1724

Transylvania : 14 Dec 1590 was followed by 25 Dec 1590

Turkey: 18 Dec 1926 was followed by 1 Jan 1927

Tyrol : 5 Oct 1583 was followed by 16 Oct 1583

USA: See Great Britain, of which it was then a colony.

Yugoslavia: 14 January 1919 was followed by 28 January 1919
but parts of the country had changed over earlier.

Sweden has a curious history. Sweden decided to make a gradual change from the Julian to the Gregorian calendar. By dropping every leap year from 1700 through 1740 the eleven superfluous days would be omitted and from 1 Mar 1740 they would be in sync with the Gregorian calendar. (But in the meantime they would be in sync with nobody!)

So 1700 (which should have been a leap year in the Julian calendar) was not a leap year in Sweden. However, by mistake 1704 and 1708 became leap years. This left Sweden out of synchronisation with both the Julian and the Gregorian world, so they decided to go ‘back’ to the Julian calendar. In order to do this, they inserted an extra day in 1712, making that year a double leap year! So in 1712, February had 30 days in Sweden.

Later, in 1753, Sweden changed to the Gregorian calendar by dropping 11 days like everyone else.

It should be noted that the Gregorian Calendar is useless for astronomy because it has a ten-day hiatus in it. For the purpose of calculating positions backward in time, astronomers use the Julian Date Calendar.

Thanks to Claus Tondering for most of this information.

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Calendopaedia - The Islamic Calendar

This calendar is based on the lunar cycle, with 12 lunar months making up a year. This means that the calendar regresses over a period of 33 years. That is it gets ahead of the Gregorian calendar by about 11 days each year until after 33 years it is one whole year ahead.

Each month should start with the first ***visible*** appearance of the new moon but this has its problems. Firstly it will be affected by factors such as how close the moon is to the sun as viewed by the observer, the relative brightness of sun and moon, weather conditions, and pollution. Secondly the day on which the new moon becomes visible depends on the position of the observer. Some Muslims prefer to use their own start to the month based on their own observation, while others will depend on an announcement by a person in authority. These factors mean that it cannot be predicted in advance. Because of this the first visible appearance of the new moon is used only for religious purposes. For civil purposes the calendar is based on calculated new moons. If there is poor visibility and the moon is not visible for several nights then a new month will always start no later than 30 days after the previous month started. Note that the month starts in the evening of the last day of the month, not at midnight.

The days of the week are not named but numbered. They are sometimes written as a word but this is just the number spelled out.

The names of the months are -

1. Muharram
2. Safar
3. Rabi' al-awwal (Rabi' I)
4. Rabi' al-thani (Rabi' II)
5. Jumada al-awwal (Jumada I)
6. Jumada al-thani (Jumada II)
7. Rajab
8. Sha'ban
9. Ramadan (the month of fasting)
10. Shawwal
11. Dhu al-Qi'dah
12. Dhu al-Hijjah

As these names are translated from the Arabic other spellings are possible.

Years are counted since the Hijra, that is, Mohammed's flight to Medina, which is assumed to have taken place on Friday 16th July 622 AD (Gregorian calendar). On that date AH 1 started (AH = Anno Hegirae = year of the Hijra, or 'going away'). For comparison the 1st January 2000 AD was 24th Ramadan 1420.

The Islamic calendar does vary from country to country. This is because of the lack of a standard definition of 'first visibility' and the fact that different countries are at different positions on the globe. Some of the variations are as follows -

Singapore - On the evening of the 29th day a new month will start if the moon is more than 2 degrees above the horizon. Otherwise the new month starts at the end of the 30th day.
Egypt - A new month will start if moonset is at least 5 minutes after sunset.
Saudi Arabia - Saudi Arabia doesn't rely on a visual sighting of the crescent moon to fix the start of a new month. Instead they base their calendar on calculations. Since 1999 (1420 AH) the rule has been as follows: On the 29th day of an Islamic month, the times when the sun and the moon set are compared. If the sun sets before the moon, the next day will be the first of a new month; but if the moon sets before the sun, the next day will be the last (30th) of the current month. The times for the setting of the sun and the moon are calculated for the co-ordinates of Mecca.

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Calendopaedia - The John Dee Calendar

Dr. John Dee (1527 – 1609) was a well known (in his time) scientist, mathematician, astronomer and astrologer. He was a member of the court of Queen Elizabeth I of England and had advised the Queen on various matters in the past. He was well read and collected books on a variety of subjects. His personal library was believed to be one of the largest in the country.

Introduction

The Julian calendar was in use around the world at this time but was known to be inaccurate. It had been adopted by the Roman Catholic Church at the Council of Nicaea in AD 325. In order to correct the problems with the Julian calendar Pope Gregory XIII proposed the adoption of the Gregorian calendar which was approved by the Council of Trent (1545-1563). This proposal was enforced by a papal bull, issued in 1582, that it should be adopted by all churches and all countries. However the church in England had separated from the church of Rome in 1534 during the reign of King Henry VIII. The Anglican bishops and the Queen refused to be ordered about by the Pope and wished to show their independence, so they were reluctant to implement the new calendar.

Sir Francis Walsingham proposed that John Dee be asked to look into the issue of improving the calendar without using the Gregorian calendar. He thoroughly investigated the problem and produced a report explaining his thoughts and his proposal of a new calendar. The report ran to 62 pages and was delivered on 26 February 1583. This report was entitled *"A playne Discourse and humble Advise for our Gratious Queen Elizabeth, her most Excellent Majestie to peruse and consider, as concerning the needful Reformation of the Vulgar Kalendar for the civile years and daies accompting, or verifyeng, according to the time truely spent."* which is often abbreviated to *"A playne Discourse"*. It is thought that the original document has been lost but there are at least two copies, hand-written in the same era, at the Bodleian Library in Oxford.

John Dee's Calendar

The calendar that Dr. Dee proposed was based on the days and months of the Gregorian calendar but the arrangement for leap years was different. The Gregorian calendar has a four hundred year cycle, that is 400 years must elapse before the leap years fall in exactly the same pattern. Dee's calendar has a cycle of only 33 years. During the 33 year cycle there are eight leap years. The leap years are every fourth year, that is years 4, 8, 12, 16, 20, 24, 28 and 32. This simple rule is actually more accurate than the Gregorian calendar, which has an average year length of 365.2425 whilst Dee's calendar has an average year length of 365.2424. The current year length between vernal equinoxes is 365.24238 days.

Dee's Proposed Transition

Pope Gregory's Papal Bull stated that ten days should be dropped to bring Easter back to the time it was at the Council of Nicaea (AD 325). Dee proposed that eleven days be dropped to bring the calendar back to the position it would have been in at the time of Christ. This does seem a more sensible suggestion. He also proposed that the days should not be dropped all in one go but two or three days at a time by shortening the months of May to September.

Attempts were made to convince other protestant countries to adopt Dee's calendar but none would commit to it. Traders complained that they would be out of step with Europe and the Anglican Bishops found it hard to agree on whether it was better than following Rome, or not. In the end no decision was made and Britain waited until 1752 and then adopted the Gregorian calendar. Because of the delay of almost 200 years it was necessary to drop 11 days just to align with the Gregorian calendar.

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Calendopaedia - The Julian Calendar

The Julian calendar was introduced by Julius Caesar in 45 BC. It was in common use until the 1500s, when countries started changing to the Gregorian Calendar. However, some countries (for example, Greece and Russia) used it into this century, and the Orthodox church in Russia still uses it, as do some other Orthodox churches.

This does not mean that years were counted the way we do now. They were counted from the start of the reign of the Emperor or Caesar and reset to one when the next Emperor took over. For more information on how the years are counted see the page counting years. Historians sometimes counted years *ab urbe condita*, that is since the founding of Rome.

The old Roman calendar was very complicated and required a group of men, known as the pontiffs, to decide when days should be added or removed to keep the calendar in track with the seasons. This made planning ahead difficult and the pontiffs were open to bribery in order to prolong the term of elected officials or hasten elections. In order to avoid these problems Julius Caesar abolished the use of the lunar year and the intercalary month, and regulated the civil year entirely by the sun. With the advice and assistance of Sosigenes, he fixed the mean length of the year at 365 1/4 days, and decreed that every fourth year should have 366 days, the other years having each 365. In order to restore the vernal equinox to the 25th of March, the place it occupied in the time of Numa, he ordered two extraordinary months to be inserted between November and December in the current year, the first to consist of thirty three, and the second of thirty-four days. The intercalary month of twenty-three days fell into the year of course, so that the ancient year of 355 days received an augmentation of ninety days; and the year on that occasion contained in all 445 days. This was called the last year of confusion. The first Julian year commenced with the 1st of January of the 46th before the birth of Christ, and the 708th from the foundation of the city.

In the distribution of the days through the several months, Caesar adopted a simpler and more commodious arrangement than that which has since prevailed. He had ordered that the first, third, fifth, seventh, ninth, and eleventh months, that is January, March, May, July, September and November, should each have thirty-one days, and the other months thirty, except February, which in common years should have only twenty-nine day, but every fourth year thirty days. This order was interrupted in 8 BC to gratify the vanity of Augustus, by giving the month bearing his name as many days as July, which had been re-named after the first Caesar during 44BC. A day was accordingly taken from February and given to August; and in order that three months of thirty-one days might not come together, September and November were reduced to thirty days, and thirty-one given to October and December.

The additional day which occurred every fourth year was given to February, being the shortest month, and was inserted in the calendar between the 24th and 25th day. February having then twenty-nine days, the 25th was the 6th of the calends of March, sexto calendas; the preceding, which was the additional or intercalary day, was called bis-sexto calendas,--hence the term bissextile, which is still employed to distinguish the year of 366 days. The English denomination of leap year would have been more appropriate if that year had differed from common years in defect, and contained only 364 days. In the modern calendar the intercalary day is still added to February, not, however, between the 24th and 25th, but as the 29th.

In the Julian calendar, the tropical year is approximated as 365 1/4 days = 365.25 days. This gives an error of 1 day in approximately 128 years.

The approximation 365 1/4 is achieved by having 1 leap year every 4 years (as explained above) and the rule for calculation is that every year divisible by 4 is a leap year.

However, this rule was not followed in the first years after the introduction of the Julian calendar in 45 BC. Due to a counting error, every 3rd year was a leap year in the first years of this calendar's existence. The leap years were:

```
45 BC, 42 BC, 39 BC, 36 BC, 33 BC, 30 BC,
27 BC, 24 BC, 21 BC, 18 BC, 15 BC, 12 BC, 9 BC,
AD 8, AD 12, and every 4th year from then on.
```

There were no leap years between 9 BC and AD 8. This period without leap years was decreed by emperor Augustus and earned him a place in the calendar, as the 8th month was named after him.

It is a curious fact that although the method of reckoning years after the (official) birth year of Christ was not introduced until the 6th century, by some stroke of luck the Julian leap years coincide with years of our Lord that are divisible by 4.

The seven day week was introduced by the Emperor Constantine I in the 4th century AD.

Problems with the Julian Calendar.

The Julian calendar introduces an error of 1 day every 128 years. So every 128 years the tropical year shifts one day backwards with respect to the calendar. Furthermore, the method for calculating the dates for Easter was inaccurate and needed to be refined.

In order to remedy this, two steps were necessary: 1) The Julian calendar had to be replaced by something more adequate. 2) The extra days that the Julian calendar had inserted had to be dropped.

The solution to problem 1) was the Gregorian Calendar.

The solution to problem 2) depended on the fact that it was felt that 21 March was the proper day for vernal equinox (because 21 March was the date for vernal equinox during the Council of Nicaea in AD 325). The Gregorian calendar was therefore calibrated to make that day vernal equinox. By 1582 vernal equinox had moved (1582-325)/128 days = approximately 10 days backwards. So 10 days had to be dropped.

What is a Julian date and a modified Julian date?

It's the number of days since noon 4713 BC January 1. What's so special about this date?

Joseph Justus Scaliger (1540--1609) was a noted Italian-French philologist and historian who was interested in chronology and reconciling the dates in historical documents. As many calendars were in use around the world this created the problem of which one to use. To solve this Scaliger invented his own era and reckoned dates by counting days. He started with 4713 BC January 1 because that was when solar cycle of 28 years (when the days of the week and the days of the month in the Julian calendar coincide again), the Metonic cycle of 19 years (because 19 solar years are roughly equal to 235 lunar months) and the Roman indiction of 15 years (decreed by the Emperor Constantine) all coincide. There was no recorded history as old as 4713 BC known in Scaliger's day, so it had the advantage of avoiding negative dates. Joseph Justus's father was Julius Caesar Scaliger, which might be why he called it the Julian Cycle. Astronomers adopted the Julian cycle to avoid having to remember "30 days hath September ...." and to avoid the 10/11 day hiatus in the Gregorian calendar.

For reference, Julian day 2450000 began at noon on 1995 October 9. Because Julian dates are so large, astronomers often make use of a "modified Julian date"; MJD = JD - 2400000.5. (Though, sometimes they're sloppy and subtract 2400000 instead.)

Thanks to Claus Tondering and William Hamblen for some of the above information.

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Calendopaedia - Lunar Calendars

The Lunar Year

Most calendars are based on the solar year. Solar years have the disadvantage of not being easily observable. Many years of observations are required to fix them with any significant degree of accuracy. On the other hand, the phases of the Moon -- and the first visibility after the new moon in particular -- are very easy and quick to observe. Therefore, the first calendars defined a lunar year, usually consisting of 12 synodic months. A synodic month is the interval from one new moon to the next and lasts 29.530588 days. This is equivalent to 29 days, 12 hours, 44 minutes and 2.9 seconds. Since for practical reasons a month should contain an integer number of days, most calendars alternated between months of 29 and 30 days, respectively. A year made out of six months of each type has 354 days and is thus too short by 0.3672 days as compared with a true lunar year. Therefore lunar calendars have to insert one leap day about every third year to keep in step with the moon phases. A pure lunar calendar is not synchronous with the seasons and after 16 years will put the winter in the summer and vice versa. Over a period of 32 years it will cycle through a complete year.

The Luni-Solar Year

A luni-solar year is the attempt to combine the phases of the moon and the seasons into one calendar. This is possible if leap months are inserted. Several schemes were used in history. The best known solution was found by the Greek Meton in the year 432 BC but apparently was known to other cultures before. The Metonic cycle encompasses a total of 235 months of which 125 are *full* (i.e. they have 30 days) and 110 are `hollow' (having 29 days). The months are combined into 12 normal years with 12 months each and 7 leap years with 13 months each. The cycle covers 6940 days whereas 225 synodic months sum up to 6939.688 days and 19 tropical years to 6939.602 days. The difference in motion between Sun and Moon amounts to only 0.0866 days so that eclipses repeat in the Metonic cycle with high accuracy.

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Calendopaedia - Mayan Calenders

There were two Mayan Calendars which later influenced the Aztec Calendars. One had 260 days and was a sacred calendar used for worship. The other one consisted of 365 days and was a seasonal calendar used for farming and normal daily life.

Another chronological measure used by the Mayans, but not the Aztecs, was the Long Count. This was a count of the number of days since they believed that the world had begun.

The Mayan Numbering System

Before looking at the calendars it will be helpful to understand a little of the Mayan numbering system. They used a vigesimal numbering system, that is one to the base of 20. They had the concept of zero long before it was understood in Europe. They only had two other symbols. Zero was represented by a shell, one by a dot and five by a bar. The symbols were placed together to make an icon, for example 13 (decimal) was represented by two bars with three dots over to make a single icon. A positional system, similar to ours, was used with an icon representing 0 - 19 in the right most position, then one representing (1x20) - (19x20) to the left of it.

As 20 x 20 = 400 which is more than the number of days in a solar year the numbering system was modified for the calender such that the second icon had a radix of 18 instead of 20. The remaining icons had a radix of 20.

The Tzolkin - The Mayan Sacred Calendar

The sacred year is made up of four quarters each of 65 days. Each quarter is then sub-divided into five groups of 13 days. Each day has both a number and a symbol and both are needed to define the date. The numbers run from 1 to 13 and there are 20 different symbols. Day one is defined by number 1 and symbol 1. Day two is defined by number 2 and symbol 2. This continues until day 13 which is defined by number 13 and symbol 13. Day 14 is defined by number 1 and symbol 14, day 15 by number 2 and symbol 15. Day 20 is defined by number 7 and symbol 20. Day 21 by number 8 and symbol 1. As 13 is not a factor of 20 the same pair do not re-occur for 260 days and then a new sacred year starts.

The Haab - The Mayan Seasonal Calendar

The year was made up of 18 months of 20 days each with five additional days to bring the total to 365. This calendar defines a year of 18 months, each of 20 days, and five extra days, 365 days in total. These extra days were considered unlucky and so very little was done on them. Each year had a name and number combination as did the days in the The Tzolkin but this time there were only 52 such combinations before repeating. This series was known as a 'bundle' or a 'Calendar Round'.

The Mayan Year Cycles

The two calendars of 260 days and 365 days run simultaneously and after a period of 52 years they will once more start on the same day. This is one of many cycles which the Mayans kept track of. They were great astronomers and recorded the sun-spot cycle (11.3 years) and various planetary cycles. The longest cycle they discovered was the orbit of our solar system around Pleiades, a cycle of 26,000 years.

The Maya Long Count

It was usual to quote dates by giving them in both calendars. This meant that each combination would only be unique for the period of a Calendar Round. To record dates for longer periods the Long Count was used. This is a count of the number of days since they believed that the world had begun. This has been calculated to be 12 August 3113 BC by the Gregorian Calendar.

The long count is normally written in two parts, the first being the count of days and the second being the current date according to both calendars.

The days are counted using the following system :-

```
 1 day    = 1 kin

20 kins   = 1 Uinal  (20 days)

18 Uinals = 1 Tun    (360 days)

20 Tuns   = 1 Katun  (7200 days)

20 Katuns = 1 Baktun (144,000 days)
```

The number is written as 5 groups of digits like this -
Baktuns . Katuns . Tuns . Uinals . kins

Most of the recorded dates which have been found begin with '9' which means between (9 x 144000) days and (10 x 144000) days since the start of the long count which would equate to 436 AD to 829 AD. It is thought that when the long count reaches 13.0.0.0.0 it is reset to 0.0.0.0.0 thus giving a period of 5125.37 years. This brings us to 22 Dec 2012 AD when either time ends or we start a new Maya Era. By combining the long count and the Tzolkiun and Haab dates it is possible to quote a date which will be unique for a period of 374,152 years, or 73 Maya Eras. So perhaps we will be safe after 2012 AD after all.

Examples of dates using the Maya Long Count

```
              Long Count      Calendar Round
Gregorian                     Txolkiun     Haab
===========   ==============  ===========  ======
14 Nov 1539 - 11.16. 0. 0. 0  13 Ahau       8 Xul
14 Aug 1995 - 12.19. 2. 7. 0   8 Ahau       8 Uo
14 Feb 1996 - 12.19. 2.16. 5  11 Chikehan  13 Pax
```

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Calendopaedia - The Nepalese Calendar

The country of Nepal use three calendars, the Gregorian, the old Nepalese calendar, also known as Nepal Sambat, and the calendar described on this page which is also known as 'Bikram Samwat'. It is this last calendar which is the official calendar of Nepal and is the subject of this page.

The calendar is named after King Bikramaditya, an Indian emperor and started in the year 56 BC after Vikramaditya won a battle against the Sakas. The year count is approximatly 56 Years, 8 Months and 15 Days ahead of the Gregorian calendar. That approximates to 56.7 years. The first day of 2000 AD Gregorian was 17 Paush 2056 BS Nepali.

The Nepalese calendar is a luni-solar calendar which means that the relationship to the Gregorian calendar will vary slightly from year to year. The calendar year starts on the 13th or 14th of April (Gregorian) and comprises of 12 months. The months are named as follows: Baishakh, Jetha, Asar, Saun, Bhadau, Asoj, Kartik, Mangsir,Push, Magh, Phagun and Chait. Each month can vary in length by one day the shortest five months being 29 or 30 days and the longest four months being 31 or 32 days. The remaining 3 months are 30 or 31 days long.

The lengths of the months are set by astrologers who also decide the leap years. Leap years are created during the process of setting the lengths of the months. That is no special leap days are added.

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Calendopaedia - The Persian Calendar

The Persian calendar is used to this day in Iran and Afghanistan. It was officially adopted by the Iranian parliament on 31 March 1925.

It is a solar calendar with 12 months and either 365 or 366 days. The new year starts when the Sun crosses the vernal (spring) equinox, as observed in Tehran. If this is before noon then that is New Year's Day, if after noon then the following day is New Year's Day. In theory this is judged by observation but in practice astronomical mathematicians predict the moment of coincidence each year. The year usually starts on 21st or 22nd of March (Gregorian), depending on the relationship with the Gregorian calendar at that time.

The months in each year are named as follows. Farvardin, Ordibehesht, Khordad, Tir, Mordad and Shahrivar each having 31 days; Mehr, Aban, Azar, Dey and Bahman each having 30 days and Esfand having 29 days or 30 in a leap year.

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Calendopaedia - The Roman Calendar

The Roman Calendar is believed to have been devised originally by Romulus (circa 750 BC), the founder of Rome. It was basically a lunar calendar and had ten months, six of 30 days and four of 31 days making a total of 304 days. The year started with the month of March and ended with the month of December. This was then followed by a gap before the next year started. The next year would start on a new moon to bring the calendar back into step with the lunar cycle. Many of the month names were based on the month number as follows :-

Month Number	Name	Meaning	Length (Days)
1	Martius	Mars - god of war	31
2	Aprilis	See below *	30
3	Maius	Goddess Maia	31
4	Iunius	Goddess Juno	30
5	Quintilis	Fifth month	31
6	Sextilis	Six month	30
7	September	Seventh month	30
8	October	Eighth month	31
9	November	Ninth month	30
10	December	Tenth month	30

* The origin of the name Aprilis is uncertain, however there are two possible explanations. It could be named after the goddess Venus whose name in Greek is Aphrodite. As several other months are named after deities this is quite a possibility. Alternately it could be named from the Latin *aperire* meaning 'to open'. This being a reference to the season when flowers begin to blossom or open.

In the reign of Numa Pompilius (circa 715 - circa 673 BC) two extra months were added. January (*Iannarils*) at the beginning of the year and February (*Februarias*) at the end. The total number of days in the year was now 354. One day was deducted from each month of 30 days (six) and added to the extra fifty to give two months of 28 days. As the year now had an even number of days, as did the two new months, an extra day was added to January to make the year length 355. This was done because even numbers were considered unlucky.

The calendar which we now consider to be the Roman Republican Calendar was introduced by Tarquinius Priscus (616 - 597 BC). It still had 355 days but the length of the months was changed as follows :- (using current names)

- 28 days - February
- 29 days - January, April, June, August, September, November, December
- 31 days - March, May, July, October

Again notice the lack of months with an even number of days. In the case of February the whole month was considered unlucky and one of the months had to have an even number to arrive at 365 as the total.

A later modification by Decemvirs changed the order of the months so that February followed January. The year was still 10 1/4 days short and so an intercalary period was introduced. This was known as *Intercalans* or *Mercedonius* and was inserted after 23rd of February in alternate years. Mercedonius was alternately 22 or 23 days in length. The remaining 5 days of February were dropped in intercalary years. This arrangement produced a four year period of 1465 days, an average of 366 1/4 days per year. This was one day too long so every 24 years further adjustment was made by dropping one of the Mercedonius months.

This was a very complicated system and still did not keep in synchronisation with the phases of the moon so the decisions as to when the intercalary month was added and how long it should be fell into the hands of a group of high priests known as the pontiffs. This power was abused for political ends and at the time of Julius Caesar the civil equinox was three months away from the astronomical equinox. This caused Caesar to order the production of a new calendar known as the Julian Calendar.

Days within the month were counted from designated division points within the month: Kalends, Nones, and Ides.

- The **Kalends** is the first day of the month. This was the day on which interest was paid on outstanding debts. The day gave the name *kalendarium* to an account book which in turn gave us the name **Calendar**.
- The **Ides** is the thirteenth day of the month, except in March, May, July, and October, when it is the fifteenth day.
- The **Nones** is always eight days before the Ides, that is the fifth or seventh day of the month.

Dates falling between these division points are designated by counting inclusively backward from the upcoming division point. This means that any day after the Ides is counted back from the Kalends of the next month. For example 30th March was known as III Kalends April.

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Calendopaedia - Abbreviations

Letters	Expansion	Additional information
AD	Anno Domini	Latin "The year of Our Lord". Counting from the incarnation of Christ.
AL	Anno Lucis	Latin "The year of light" Equivalent to AD + 4000.
AM	Anno Mundi	Latin "The year of the world". Counting from the year of creation in Jewish history. Creation is accepted as 7 Oct. 3761 BC.
AUC	Ab Urbe Conditв	Latin "Since the founding of the city (Rome)".
BC	Before Christ	Counts backwards from the incarnation of Christ.
BCE	Before Common Era	Equivalent to BC.
BP	Before Present	Counts backwards from the current year.
CE	Common Era	Equivalent to AD.
UT	Universal Time	The mean solar time at the meridian of Greenwich, UK.
UTC	Coordinated Universal Time	The universal standard of time based on atomic time

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Calendopaedia - Counting Years

How were years counted in the past?

The most common method of counting years was to count from the beginning of the rule of the King, Emperor or leader. This system is known as Regnal Years (see below). The Romans counted from the start of the reign of the Emperor or Caesar and reset to one when the next Emperor took over. Alternatively they counted from the founding of Rome. This was indicated by the letters AUC which stood for *ab urbe condita*.

To learn more about when the year actually started please see the New Year page.

Regnal Years

Regnal years are a method of counting years from the date that the monarch came to the throne. In mediaeval England regnal dates were normally used to date events and documents. They were still used for dating Acts of Parliament until 1963. To take an example King George the 1st was crowned on 1st August 1714. Days from 1st August 1714 to 31st July 1715 inclusive will be in his first regnal year - and so on. So 10th September 1718 was referred to as 10th September 5 George I. That is the 10th September which fell in the 5th year of the reign of George I.

How do we count years?

In about AD 523, the papal chancellor, Bonifacius, asked a monk by the name of Dionysius Exiguus to devise a way to implement the rules from the Nicean council (the so-called "Alexandrine Rules") for general use. Dionysius Exiguus (in English known as Denis the Little) was a monk from Scythia, he was a canon in the Roman curia, and his assignment was to prepare calculations of the dates of Easter. At that time it was customary to count years since the reign of emperor Diocletian; but in his calculations Dionysius chose to number the years since the birth of Christ, rather than honour the persecutor Diocletian. Dionysius (wrongly) fixed Jesus' birth with respect to Diocletian's reign in such a manner that it falls on 25 December 753 AUC (ab urbe condita, i.e. since the founding of Rome), thus making the current era start with AD 1 on 1 January 754 AUC. How Dionysius established the year of Christ's birth is not known, although a considerable number of theories exist. Although Dionysius proposed this system of counting it was not generally accepted.

When The Venerable Bede (673-735) wrote his history of the early centuries of Anglo-Saxon England he adopted the system of Dionysius and its use spread until it became a *de facto* standard.

Was Jesus born in the year 0?

No. There are two reasons for this:

- There is no year 0.
- Jesus was born before 4 BC.

The concept of a year "zero" is a modern myth (but a very popular one). Roman numerals do not have a figure designating zero, and treating zero as a number on an equal footing with other numbers was not common in the 6th century when our present year reckoning was established by Dionysius Exiguus (see above). Dionysius let the year AD 1 start one week after what he believed to be Jesus' birthday. He designated years before 1 AD as being Before Christ (BC). Therefore, AD 1 follows immediately after 1 BC with no intervening year zero. So a person who was born in 10 BC and died in AD 10, would have died at the age of 19, not 20. Furthermore, Dionysius' calculations were wrong. The Gospel of Matthew tells us that Jesus was born under the reign of king Herod the Great, and he died in 4 BC. The actual date of his birth is unknown but it was probably in the region of 7 - 4 BC. The month and day are also unknown.

Does the lack of year zero cause a problem?

Yes it does to astronomers who frequently use another way of numbering the years BC. Instead of 1 BC they use 0, instead of 2 BC they use -1, instead of 3 BC they use -2, etc.

What date did other calendars give when we started the year 2000?

Please note that I am not suggesting that this date is start of the new millennium, I know that that occurred on 1st January 2001.

Calendar	Date
Gregorian	1 January 2000
Babylonion	Year 2749
Buddhist	Year 2544
Chinese	Cycle 78, year 16 (Ji-Mao), month 11 (Wu-Yin), day 25 (Wu-Wu)
Egyptian	Year 6236
Ethiopian	23 Takhsas 1993
French	Décade II, Duodi de Nivôse de l'Année 208 de la Révolution
Greek	22 Kiyahk 1716
Hebrew	23 Teveth 5760
Islamic	24 Ramadan 1420
ISO	Day 6 of week 52 of year 1999
Julian	19 December 1999
Mayan	Long count = 12.19.6.15.0; tzolkin = 9 Ahau; haab = 8 Kankin
Persian	11 Dey 1378

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Calendopaedia - Months, Weeks, and Days

Months

The word month is derived from the Old English word for moon. A month was originally the time between two new moons. Today astronomers refer to this period of time as a lunar month. Its average length is 29 days, 12 hours, 44 minutes, and 2.8 seconds, or 29.530589 days. The moon travels around the Earth in 27 days, 7 hours, 43 minutes, and 11.5 seconds. This is the sidereal month. The length is different to the lunar month because the earth is moving along its orbit around the sun. Calendar months usually differ in length, and all except February are longer than 29 days in order to accommodate the solar year, which is almost 11 days longer than a lunar year.

The names for the months in the present Gregorian calendar are taken from the ancient Roman months of the Julian calendar. January is derived from Janus, a household god of beginnings. He was often depicted facing in two directions. February was the time of a feast of purification called Februa. March was named after Mars, the god of war. April is of uncertain origin. It may be named after the Greek goddess Aphrodite. May is probably derived from the goddess Maia. June was named after the goddess Juno. July and August were named, respectively, after Julius Caesar and his successor, Augustus. The last four months got their names from their original numerical placement in the year. Septem, for instance, is Latin for "seven." See the Roman Calendar for details.

Weeks

The origin of the seven-day week is not clear but it has no astronomical basis. It is likely that the luner cycle was the first recognised time unit greater than the day. This is because it is not too long to observe and it is easy to identify the cycle start with the first appearance of the new moon. The period thus measured is approximatley twenty nine and a half days (see above). This was probably devided into four (halved and halved again) to make a more useful measure. This would produce periods of seven and eight days, often three periods of seven and one of eight or nine waiting for the next new moon. It could have been regularised to seven days for consistancy or because The Israelites were told to do so by God. God said to Moses in Exodus Ch 20 'Six days you shall labour and do all your work, but the seventh day is a Sabbath to the LORD your God. On it you shall not do any work'.

The Emperor Constantine I introduced it to the Roman Empire in the 4th century AD. The days were named after the then known seven planets: Saturn, Jupiter, Mars, the sun (not distinguished from a planet at the time), Venus, Mercury, and the moon (also considered a planet). The names of days in Latin countries still point to these origins, as do Sunday, Monday, and Saturday in English. Tuesday, Wednesday, Thursday, and Friday, however, are named after the Scandinavian gods Tiw, Woden, Thor, and Frigga. See the English Calendar for more details.

I am aware of three exceptions to the seven day week. They are:-

- The French Revolutionary calendar using ten days.
- The Soviet Union has used both a 5-day and a 6-day week. In 1929-30 the USSR gradually introduced a 5-day week. Every worker had one day off every week, but there was no fixed day of rest. On 1 September 1931 this was replaced by a 6-day week with a fixed day of rest, falling on the 6th, 12th, 18th, 24th, and 30th day of each month (1 March was used instead of the 30th day of February, and the last day of months with 31 days was considered an extra working day outside the normal 6-day week cycle). A return to the normal 7-day week was decreed on 26 June 1940.
- The Mayan calendar used two different lengths of week, a numbered week of 13 days, in which the days were numbered from 1 to 13 and a week of 20 days, in which each day had a name.

Days

The Day, in chronology, is that period of time required for one rotation of an astronomical object, especially the earth, on its axis. The time for the stars to reappear in the same position as they were the previous day is known as a sidereal day. The time for the sun to reappear in the same position as it was on the previous day is known as a solar day. A solar day is about four minutes longer than a sidereal day. This is so because as the Earth orbits the sun, the sun appears to move slowly eastward against the fixed stars. Thus, for an observer on Earth, it takes slightly longer for the sun to return to its original position in the sky than it takes for the stars. The length of the earth's solar day, measured by reference to the sun's position, is averaged over a year, and the mean solar day thus obtained is used for all civil and many astronomical purposes. The civil day begins at midnight, local time. In common usage, day is the period of natural light between dawn and dusk. The period of daylight, nearly constant near the equator, varies with the latitude and the season, reaching a maximum of 24 hours in the polar zones in summer.

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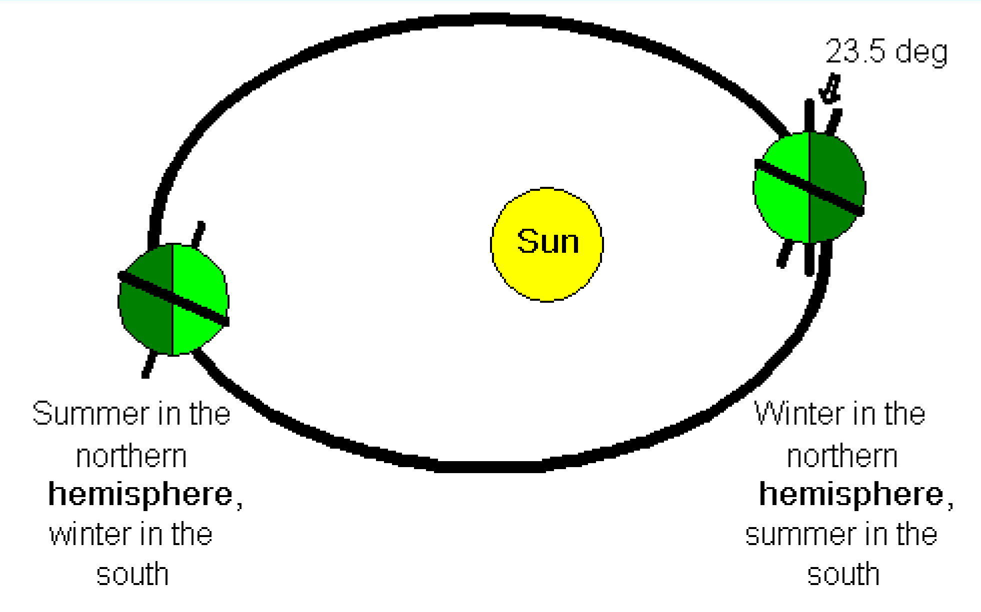
Calendopaedia - The Earth's Orbit.

This page explains how the Earth orbits the Sun and how this affects the seasons. This has always been the main driver behind designing the calendar. The goal being to have the Earth at the same point on its path on the same day in each year. The time taken to orbit the Sun once is known as a tropical year.

Kepler's First Law tells us that the orbits of all the planets are ellipses. An ellipse (a sqashed circle) has two focii and the sun is located at one focus of the ellipse. In the case of the Earth the ellipse is very close to being a circle. If the average radius of the Earth's orbit (93 million miles) is thought of as 100% then the shortest radius is 98% and the longest radius is 102%.

The point at which the Earth is nearest to the Sun is known as the **Perihelion** and the point at which it is furthest away is known as the **Aphelion**.

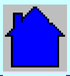


The image above (not drawn to scale) shows the Sun at the focus on the right. The left focus is not marked as there is nothing there. The aphelion is on the left side of the orbit and the perihelion is on the right.

The Earth leans on its axis at an angle of 23.5 degrees. When the Earth leans away from the Sun the northern hemisphere has winter. This is at the perihelion which means that the northern hemisphere is actually nearer the Sun when the weather is coldest. When the Earth is at its aphelion (left side of drawing) the northern hemisphere has summer and the Sun is higher in the sky.

The effect of Kepler's Second Law is that the Earth travels at different speeds at different parts of its orbit. At the perihelion it is going at its fastest and at the aphelion it is going at its slowest. This is not noticeable to us but it may be some comfort to those who live in the northern hemisphere that winter is slightly shorter than summer!

The time of perihelion slowly regresses (moves later) by 25 minutes each year, making a full cycle through the tropical year in approximately 21,000 years. The angle of tilt (or *obliquity*) of the earth also changes. This cycle takes 41,000 years and at 23.5 degrees the present figure is roughly mid-way between the two limits. These two cycles are known as the Malankovitch Cycles and may have some influence on the worlds climate in the long term.

Go to the  Home page

Explanations of the column headings in the comparison table

Start date

This is the date that the calender is reckoned as having started on. In some cases (French Revolution, and Islam) it did start on that date. In other cases the exact start date cannot be identified. In the case of the Gregorian the chosen start date was the date that Jesus Christ was believed to have been born. We now know that he must have been born in 4 BC or earlier. The day and month are not known. For the actual date that the Gregorian calender started in each country see the Gregorian page.

No. of days in a year

This is the average number of days in each year taken over the full cycle of leap days / months, even though the calender may not have been in operation long enough to complete the first cycle.

No. of months in a year

This is the number of periods of a length close to the lunar cycle into which the year is divided. The name 'month' may not be used by the calendar in question.

Correction for year length

This is a short explanation of the way in which the year length is corrected to match the tropical year. This is usually done by inserting an extra day into the calendar at regular intervals. Years when this happens are known as 'Leap Years'.

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Calendar Overview

This table gives an overview of each calendar and a quick comparison between them. For in depth information about any calendar just click on its name. For an explanation of the data given in any column just click 'Explain' at the top of that column.

This page was updated on Monday 8th January 2001 AD (Gregorian).

Calendar	Start date (in Gregorian) Explain	No. of days per year Explain	No. of months per year Explain	Correction applied Explain
Astronomical		365.24219 approx		
Aztec Sacred		260	20 of 13 days	
Aztec Solar		365	18 of 20 days + 5 days	
Babylonian		365.2467463	12 each of 29 or 30 days	Intercalary month added every 19 years
Bahai	21 Mar 1844 AD	365.2425	19 of 19 days and 4 or 5 feast days	If year is divisible by 4 then it is a leap year. If year is divisible by 100 then it is not a leap year. If year is divisible by 400 then it is a leap year.
Chinese	2637 BC	353 to 385	12 or 13 of 29 or 30 days	Intercalary month added according to complicated rules.
Egyptian		365	12 of 30 days + 5 days	No correction applied.
English		Unknown	12	
French Revolutionary	22 Sept 1792 AD	365.24225	12 of 30 days + 5 or 6 days	Years 3, 7 & 11 were leap years. Calender abolished in year 14.
Greek Orthodox		365.24222	12 in total.	If year is divisible by 4 then it is a leap year. If year is divisible by 100 then it is not a leap

			7 x 31, 4 x 30, 1 x 28 or 29	year. If year divided by 900 leaves a remainder of 200 or 600 then it is a leap year.
Gregorian	In theory - 1 Jan 1 AD. In practice.	365.2425	12 in total. 7 x 31, 4 x 30, 1 x 28 or 29	If year is divisible by 4 then it is a leap year. If year is divisible by 100 then it is not a leap year. If year is divisible by 400 then it is a leap year.
Hebrew	3761 BC	354 approx	12 or 13 each of 29 or 30 days.	If year divided by 19 leaves a remainder of 0, 3, 6, 8, 11, 14 or 17 then it is a leap year and has 13 months.
Hebrew Jubilee		364	12 of 30 days + 1 extra day in each quarter.	No correction applied.
Indian	22 Mar 79 AD	365.2425	12 in total 5 x 31 7 x 30	If year is divisible by 4 then it is a leap year. If year is divisible by 100 then it is not a leap year. If year is divisible by 400 then it is a leap year.
Islamic (Hijri)	16 July 622 AD	354.36	12 length variable.	The calender is based on the first sighting of the moon each month and therefore difficult to predict.
John Dee	Not adopted	365.2424	12 in total. 7 x 31, 4 x 30, 1 x 28 or 29	It is a leap year if the year number modulo 32 is not zero and is divisble by four with no remainder.
Julian	45 BC	365.25	12 in total. 7 x 31, 4 x 30, 1 x 28 or 29	If year is divisible by 4 then it is a leap year.
Lunar		354	12 in total. 6 x 29, 6 x 30	No correction applied.
Mayan Sacred	12 Aug 3113 BC	260	20 of 13 days	No correction applied
Mayan Solar	12 Aug 3113 BC	365	18 of 20 days	No correction applied

			+ 5 extra days	
Nepalese	56 BC	varies	12 of 29 to 32 days	Calculated by astrologers
Persian	22 Mar 622 AD	365.2422	12 in total 6 x 31, 5 x 30 1 x 29 or 30	One extra day inserted according to the time of the vernal equinox producing a cycle which lasts 33 years.
Roman	Approx 750 BC	Standard 355 Ave. 366.25	12 in total. 1 x 28, 7 x 29, 4 x 31	An additional month of either 28 or 29 days in alternate years.

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Calendopaedia - Figures

How long is a year? Is a lunar month 29 or 30 days? What is a second?

Here are the figures that I left out of other pages to stop it looking too complicated. For those of you who want to know the details - this is the place. To find out what the terms used here mean look for the relevant page on the Site Index page.

Unit	Duration
How long is a **year**?	A **tropical year** is 365.242199 days UT which is equal to 365 days, 5 hours, 48 minutes and 45 seconds. A **sidereal year** is 365.256366 days UT which is equal to 365 days, 6 hours, 9 minutes, and 9.5 seconds. An **anomalistic year** is 365.259636 days UT which is equal to 365 days, 6 hours, 13 minutes, and 33 seconds.
How far has the Gregorian calendar drifted since it was decreed in 1582?	2 hours, 59 minutes, 12 seconds.
When will the Gregorian calendar be one whole day out?	The year 4909 AD.
How many **lunar months** are there in a **year**?	12.368267
How long is a **lunar month**?	Its average length is 29 days, 12 hours, 44 minutes, and 2.9 seconds, or 29.530589 days.
How long is a **second**?	The second is the duration of 9 192 631 770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium 133 atom. *Well you wanted to know!*

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Calendopaedia - Kepler's Laws of Planetary Motion.

Kepler's First Law States

The orbits of the planets are ellipses, with the sun at one focus of the ellipse.
[This means that the distance that the earth is from the sun varies.]

Kepler's Second Law States

A line joining the planet to the sun sweeps out equal areas in equal times as the planets travel around the ellipse.
[This has the implication that the speed of the planet along the orbit varies as the distance from the sun varies.]

Kepler's Third Law States

The square of the period of a planet divided by the cube of the radius of the planet's orbit is a constant.
[This means that the greater the distance from the sun, the longer the orbital time.]

For a drawing see The Earth's Orbit.

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Calendopaedia - Links

This page contains links to other pages on the World Wide Web. Please choose from :

Calender sites

Astronomy sites

Timekeeping sites

Calender sites

CalendarZone.
This is the best site for links to calendars and other sites of related interest.

The World Calendar.
Here is an explanation of the proposed perennial calendar.

Today's Date and Time.
This site gives you the date according to every calendar there is and a few more beside!

GENUKI Perpetual Calendar
Look at the Gregorian calendar for any year between 1550 and 2049.

The Doomsday Rule.
The Doomsday algorithm gives you the day of the week for any date (and you can do it in your head).

Date Conversion.
The Roman Numeral & Date Conversion Page. Converts dates into latin.

Blank Calendar.
Printout blank calendars and year-round planners all completely free.

Astronomy sites

Astronomical Time Keeping.
A site which explains Sidereal Time, Solar Time, Universal Time (UT), Greenwich Time, Time zones, Atomic Time and much more.

Astronomical Sky Calendar.
Brian Casey's astronomical calculator which gives the Julian Date, Sun rise & set times, Moon rise & set times and percent illumination, etc. for each day in the given period.

U.S. Naval Observatory.
Sunrise/Sunset/Twilight and Moonrise/Moonset/Phase calculator.

Timekeeping sites

The Time Zone Page.
Find out the time in cities all over the world.

British Sundial Society.
Learn all you ever wanted to know about horizontal dials, vertical dials, equatorial dials, polar dials, analemmatic dials, reflected ceiling dials and portable dials.

Sundials on the Internet.
See sundials around the world. Even learn how to make your own.

Leap Second Alert!.
Find out when clock corrections are to be made.

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Calendopaedia - Time

Rotational time.

All methods for measuring the passage of time require counting the cycles of regularly occurring phenomena. The simplest and most universally used cycle is the rotation of the Earth. As the Earth turns, the stars and the sun appear to move in an arc across the sky, disappear under the horizon, reappear at the opposite horizon, and return to their original positions in the sky. A time system based on the apparent motion of the stars is called sidereal time. A sidereal day is the time it takes for a star to appear to make one complete circuit.

The period of the Earth's rotation with respect to the sun (from one high noon to the next) is called the solar day. A solar day is about four minutes longer than a sidereal day. This is so because as the Earth orbits the sun, the sun appears to move slowly eastward against the fixed stars. Thus, for an observer on Earth, it takes slightly longer for the sun to return to its original position in the sky than it takes for the stars.

Because the Earth moves faster in its orbit around the sun when it is close to the sun than when it is far away, the length of the apparent solar day is not constant throughout the year. To provide a more uniform time system, the mean solar day the annual average length of a solar day is used to establish mean solar time, to which we set our watches.

Standard time and time zones.

The local mean solar time at any location depends on where that place is on the globe: it advances by four minutes for each degree longitude to the east. To avoid confusion, most nations keep what is called standard time in established zones known as time zones. The world is divided into 24 time zones. The width of each is about 15 degrees longitude. By international agreement, the line of longitude running through Greenwich, England, was adopted as the prime, or zero, meridian. The time in this time zone is called Greenwich mean time (GMT).

The international date line is an imaginary zigzag line in the mid-Pacific Ocean that runs roughly along 180 degrees longitude. Travelers crossing it westward add a calendar day; travelers crossing it eastward lose a day.

An adjustment of regional standard time, called daylight saving time, was adopted by some countries to conserve fuel by reducing the need for artificial light in the evening hours. Clocks are advanced one hour in the spring and set back one hour in the autumn (fall).

Universal and ephemeris time.

In 1928 astronomers adopted the term Universal time (UT) for the mean solar time at the meridian of Greenwich, England. Later they defined several kinds of Universal time, the most accurate and uniform being UT2. Another time scale, ephemeris time (ET), is more uniform than UT2. It is based on the orbit of the Earth around the sun. This scale is not very practical, however, because accurate calculations require complex astronomical observations. In 1964 a new time scale, called coordinated Universal time (UTC), was internationally adopted and has now largely replaced Greenwich mean time as the universal standard of time. UTC is more uniform and more accurate than either the UT2 or ET systems because the UTC second is based on atomic time (see below), though the UTC year is still based on the time it takes the Earth to complete one orbit around the sun. Because the rate of the Earth's rotation is gradually slowing, it is necessary to add an extra second, called the leap second, to the length of the UTC year. This is usually done no more than once or twice a year.

Atomic time.

Today the length of the second as defined in the International System of Units is based on a specific number of transitions, or vibrations, in a particular kind of cesium atom. These transitions produce extremely regular waves of electromagnetic radiation that can be counted to produce a highly accurate time scale. Coordinated Universal time is based on this second, called the SI second.

The cesium-beam clock is the most accurate standard of atomic time currently in use, but scientists are working on using other kinds of atoms for atomic clocks. Such clocks based on hydrogen or beryllium atoms, for example could be thousands of times more accurate even than today's cesium clocks.

Many of the world's nations maintain very accurate cesium clocks. The time kept by these clocks is averaged together to produce what is called international atomic time (TAI). Time signals from the world's national-standards laboratories are broadcast around the globe by shortwave-radio broadcast stations or by artificial satellites. Highly accurate time signals are used for, among other things, tracking space vehicles and studying the motions of the Earth's crust.

Pulsar time.

In 1967 a new kind of star called a pulsar was discovered. These stars emit regular pulses of radiation many times per second. The regularity of these pulses has sparked interest in the possibility of a pulsar clock. Although the measurements involved are complex, it appears that some pulsars may be even more regular than atomic clocks.

Radiometric time.

Radioactive elements, such as uranium, decay spontaneously into other elements or isotopes. The time it takes for one half of the atoms in a sample of a particular radioactive element to decay is called the element's half-life. Each radioactive element has a different half-life, so in a sense these elements contain internal clocks that generate a kind of time known as radiometric time. Scientists use this principle to determine the approximate age of organic specimens by measuring the ratio within the specimen of a radioactive form of carbon to the stable form.

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Calendopaedia - The length of the Tropical Year.

What is in dispute?

The most common definition of the tropical year is the interval between two successive passages of the Sun through the vernal equinox and lasts 365.242199 days UT. Note that any start and end point could be used as long as the sun reappears in the same position one year later.

The trouble is that using different start points for this measurement results in different year lengths. I will now attempt to explain why.

The orbit of the earth around the sun was defined by Kepler's Laws which tell us that the speed of the earth varies as it follows its elliptical path around the sun. Even so one complete circuit should include the slow parts and the quick parts so one would expect the time taken to remain constant. But the earth is also precessing, like a gyroscope, on its own axis. Put more simply it is " wobbelling " which varies its position in the sky. This means that when it has completed a circuit of the sun it appears that it has overshot by a time equal to 24 to 26 minutes. The exact value being dependent on when the circuit started.

How much difference does it make?

In 2000 AD the following year lengths resulted from measurements starting and ending at the season stated :-

Start time	Year length in days
Vernal Equinox	365.2424
Summer Solstice	365.2416
Autumn Equinox	365.2421
Winter Solstice	365.2427
Average	365.242199

So what is happening is that most astronomers and calendar students are defining the Tropical Year as starting with the vernal equinox but using the average figure for their calculations.

Do you want more details?

You can learn more about this from Simon Cassidy's web pages on Error in statement of the Tropical Year.

Simon quotes two other sites. They are the Royal Greenwich Observatory pamphlet No. 48 and Leroy Doggett's chapter on Calendars in the Explanatory Supplement to the Astronomical Almanac.

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Calendopaedia - New Year's Day

Celebrating the end of one year and the start of a new one is an age-old religious, social, and cultural observance in all parts of the world. In Western nations the New Year festivities take place on December 31, but in other cultures they take place on different dates.

The earliest known record of a New Year festival dates from 2000 BC in Mesopotamia. In Babylonia the New Year began with the new moon closest to the spring equinox, usually mid-March. In Assyria it was near the autumnal equinox in September. For the Egyptians, Phoenicians, and Persians the day was celebrated on the autumnal equinox, which now falls on about September 23. For the Greeks it was the winter solstice, which now falls on about December 21 or 22. During the early Roman republic March 1 began a new year, but after 153 BC the date was January 1. This date was kept by the Julian calendar of 46 BC.

During the early Middle Ages March 25 (the feast of the Annunciation) was celebrated as New Year's Day. January 1 was restored as New Year's Day by the Gregorian calendar, which was adopted by the Roman Catholic church in 1582. Over the next 350 years other countries followed. Russia, in 1918, was the last major nation to adopt the practice. In countries that use the Julian calendar, New Year's Day is on January 14 of the Gregorian calendar.

The Jewish New Year, called Rosh Hashana, is sometimes called the "feast of the trumpets." It starts on the first day of the month of Tishri, which may begin any time from September 6 to October 5. The celebration lasts for 48 hours but ushers in a ten-day period of penitence. The Chinese New Year is celebrated wherever there are sizable Chinese communities. The official celebration lasts one month and begins in late January or early February. There are outdoor parades and fireworks to mark the occasion.

In Japan the New Year festivities take place on January 1 to 3. In some rural areas the time of celebration corresponds more closely to the Chinese New Year, and the dates vary between January 20 and February 19. The house entrance is hung with a rope made of rice straw to keep out evil spirits. Decorations of ferns, bitter orange, and lobster promise good fortune, prosperity, and long life. In South India the Tamil New Year is a religious celebration that takes place on the winter solstice. It is marked by pilgrimages to holy places and the boiling of new rice.

The American celebration of the New Year marks the end of the Christmas holiday period. Many people go to church on New Year's Eve, and many attend parties. Street celebrations in large cities are televised. New Year's Day itself is often a time for receiving guests at home.

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Michael Astbury

My Biography

I was born in Stretford, Manchester {Error 126 : Numeric overflow} years ago. I attended Gorse Park County Primary School which has since been demolished. During my last year there it was in the process of being converted into a girl's secondary school so I was surrounded by older girls! I failed my 11+ exam and went to Great Stone Secondary Modern School. This was a boys only school and has since been demolished (could it be something to do with me?). The site of my secondary school is now a PC World computer superstore which I consider a much better use of the land.

Leaving school I joined Post Office Telephones as a Trainee Technician (Apprentice) on a three year training scheme. I specialised in transmission systems and ended up in an FDM Terminal Station, but only for a few months before transferring to Radio Investigation. This work mainly involved locating and treating sources of interference to radio and television reception. Other duties included the inspection of amateur radio stations and the locating and prosecuting of pirate radio stations, both 'pop' and 'CB' type operators. CB was illegal in the UK at that time and the imported equipment used a band which had been allocated to other users.

Seeking a change of scene without getting stuck in a transmission repeater station I applied for a teaching post at the Post Office Technical Training College at Stone, Staffordshire. I went there to teach Radio Investigation staff but soon spread my experience to cover Basic Radio, microwave and television transmission courses. Whilst at the college I got to play with a computer for the first time - a Nascom 2. It had no language, not even an assembler, and was programmed by writing the machine code directly into the memory locations in hex.

On passing a promotion board I moved to London to work in the Satellite Systems division of British Telecom International. I disliked the commuting and after 15 months managed to get a transfer to Madley Satellite Earth Station where I was a contract supervisor. I led a team of Clerk of Works who oversaw the installation, testing and commissioning of the radio receive equipment from the SHF signal from the dish right through to the baseband signals being passed to the repeater station. We also looked after the television equipment and various odds and ends. It was here that I got a real taste for computers with an Apple II and CP/M machines.

After passing another promotion board I applied for a job at BT Research Labs at Martlesham Heath and joined the Fibre Local Access Group which worked on ways to use optical fibre to supply service to domestic customers. I worked for four years on management systems for access networks and for Concert (the BT-MCI (then BT-AT&T) joint global communications company). I changed to designing management systems for the BT International backhaul network and the Digital Terrestrial Television network. I then moved on to performance management and diagnostic systems for IP networks. Tools created by my team are used by BT engineers and the employees of Internet service providers.

I also represented BT at international standards meetings. These included The International Telecommunications Union, Internet Engineering Task Force and The DSL Forum.

Late 2007 I took early retirement and now work one day a week at Tools with a Mission.

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