
A HISTORY OF TIME

by Lindsay Holiday (transcribed)

[Seconds, Minutes, Hours, Days and Weeks](#)

(click to watch video - <https://youtu.be/PRqccGG-AYo>)

Time. It marches on relentlessly outside of human control; but humanity has long found a variety of ways to mark our passage through the eons. Seconds, minutes, hours, days, weeks, months and years; but why do we count our collective journey through the ages in these integers? A day makes sense that's one rotation of the earth on its axis and can easily be marked by the rising and setting of the sun; and a year is one orbit of the earth around the sun traveling through the four seasons again and again. But why 60 seconds in a minute? 24 hours in a day? 7 days in a week and 12 months in a year?

Let's look back through history to learn the varied origins of these odd measurements of time...

Why are there 60 seconds in a minute and 60 minutes in an hour?

Modern humans are big fans of the decimal system, dividing everything by 10. It makes sense that early humans would have counted this way as we have ten fingers but this wasn't how the ancient Babylonians thought.

They counted with a sexagesimal system, dividing everything by 60 and rather than counting their fingers they counted their fingered joints. Twelve joints total on one hand times the five fingers on the other hand make it easy to count up to 60. This counting system was used to divide hours into minutes and minutes into seconds by the Babylonians and later the ancient Egyptians. The system became so pervasive in the ancient world that it was adopted throughout Europe then most of the world and it is still the time keeping system we use today.

As the world became more and more interconnected, it became more important for everyone in the world to be on the same page - or rather, the same second. So, in 1967, atomic time keeping was created which defined a second as 9,192,631,770 oscillations of a cesium-133

atom. This extremely precise measurement means that people on opposite sides of the earth can coordinate exactly what time it is for trading stocks, scheduling meetings or ringing in the new year.

Why are there 24 hours in a day?

The ancient Egyptians devised a system of dividing the day into 24 hours, or two sections of twelve (ten hours for the day plus one hour for dawn and one for twilight and twelve hours for the night), but the length of each hour was unfixed so daylight hours would be longer in the summer and shorter in the winter.

They measured the passage of the hours using sundials in the day. As the sun was at its highest and shadows were shortest at noon, this was considered the midpoint of the day and the opposite time midnight was when the day ended and began at night. The Egyptians used the movement of the constellations through the sky to track the passage of the hours. Charts of these stars can be found on the inside of ancient Egyptian tombs so the dead would be able to tell time.

Ancient Egyptians also used water clocks. A hole in a clay vessel would drip water at a consistent rate and fill up a basin below when the first basin was full one hour had passed and the basin would begin to overflow into another basin and below it. Twelve basins in all would be filled at a consistent rate until the day was half done. Water clocks were used in temples to allow priests to keep track of the hours for prayer. The ancient Chinese, Japanese and Europeans also used candle clocks, notches on a candle that would mark the hours as the candle burnt down. The Egyptian 24-hour system was adopted by Greek astronomer Hipparchus and then by the Romans where it spread throughout their vast empire.

The romans called the 12 hours before midday anti-meridian, or am; and the 12 hours after midday post-meridian, or pm. Utilizing a similar concept to the water clock, the hourglass was also used in medieval Europe. Mechanical clocks in 14th century Europe made it possible to keep accurate continuous count of the hours of the day. The Catholic church played a key role in keeping time. Accurate counting of the hours, which was crucial for making sure prayers were said at regular intervals throughout the day.

Often the local church was the only entity well off enough to afford a clock, so they communicated what hour it was to the rest of the community by ringing the church bells at the top of every hour. While each clock was now able to keep regular time, there was no

communication between clocks. So, one community would say it was 12:30 and the next would say it was 12:45. It wasn't until the 1800s when a universal system of time zones was first proposed.

This system divided the earth longitudinally into 24 parts. Each zone would be one hour different based on the time the sun was at midday in that zone. In 1929, Greenwich Meantime was officially adopted throughout most of the world. Beginning from the royal observatory in Greenwich London, one hour is added for each time zone to the East and one hour is subtracted for each time zone to the West. So, when it is noon in London, in New York City it is -5 (or 7 am) and in Hong Kong it is +8 (or 8 pm). That places the international date line on the opposite side of the Earth from London in the mid-Pacific Ocean. Each new day, and new year, begins here where there are fewer landmasses. After all it would be rather confusing if it was January 1st in London but still December 31st in Paris for another 23 hours.

Why are there seven days in a week?

We have the Babylonians yet again to thank for the seven-day week. They base their months on the 28 days they observed it took the moon to orbit the Earth. Unfortunately, 28 is not divisible by their favorite digit, 6, so they divided it into four seven-day weeks (six work days and the seventh holy day). The number seven is also significant as it corresponds with the seven observable heavenly bodies: the Sun, the Moon Mars, Mercury, Jupiter, Venus and Saturn. The Babylonians ordered the planets from fastest to slowest moving as they appear in the sky.

The Babylonians were so dominant and influential in ancient times that their seven-day week spread all around the world it was adopted by the Persian empire, the Hebrews and the Greeks and it took over the Egyptian system of using a 10-day week. The seven-day week has great significance in Hebrew culture as the book of genesis proclaims that God created the world in six days and rested on the seventh; therefore, the seventh day is the Sabbath - or the day of rest and religious observation.

Alexander the great brought the seven-day week to India where it was then introduced to China. The Ancient Romans and Etruscans, on the other hand, observed an 8-day week. Every 8 days a market would be held and farmers would enjoy a day of rest to travel to the city and sell their crops and goods as well as go to the local temple to make offerings and religious observances. Students were also given this day off school.

The eight days were named for the first eight letters of the alphabet but every town and city had a different market day so that itinerant traders could travel from one to another. It might be day C in one town and day F in the next so there was a lot of confusion. The Romans slowly began to adopt the Babylonian system instead. In 321 AD, Emperor Constantine decreed that the seven-day week would be standard throughout the empire and he made the seventh day a public holiday.

The Romans named the days of the week after the seven planets observable in the heavens; and each was associated with a god in the Roman pantheon. The Sun is personified by the god Sol, the moon by the goddess Luna. Mars is the god of war; the winged god, Mercury, is the messenger of the gods. Jupiter is the king of the gods and controls the sky and thunder; Venus is the goddess of love, desire and fertility and Saturn is a titan who represents wealth agriculture and time.

These astronomy-based day of the week names can still be heard in modern Romance languages. For example: in Spanish the days of the week are Lunes (for Luna/Moon), Martes (Mars), Miércoles (Mercury), Jueves (Jupiter), Viernes (Venus) and Sábado (Saturn). The exception is Sunday, which was later changed to the Christian day of religious observance and was renamed Domingo - Latin for the Lord's Day.

The seven-day week spread throughout Europe. In the 4th Century, when Germanic and Norse people adopted the system, they used some of the Roman planet names but replaced others with their own deities; and this, via Old English, is where we get the day of the week names we use in modern English. Sunday (Sun), Monday (Moon) and Saturday (Saturn) are still based on Roman planets. Tuesday is for Tiw, a little-known god who sacrificed his arm to the monstrous wolf Fenrir. Wednesday honors Odin, chief among the gods, who represents wisdom, healing and death. Thursday refers to Thor, Odin's son, who wields a hammer and creates thunder; and Friday honors Frigg, queen of the gods and Odin's wife who is associated with wisdom, love, marriage and motherhood.

Why do we get two days off at the weekend?

For many centuries people, who were mostly occupied by farming, allowed themselves a single day of rest and religious observance each week. They couldn't afford to take more time off as the fruits of their labor were a matter of their own life or death; but as labor was done mostly during daylight hours, and was tied to the seasons, this allowed for a decent amount of

down time throughout the day and year. For example: the Yule or, Christmas holiday, often meant several weeks of feasts and celebrations for farmers who had worked hard all spring summer and autumn but had little to do in the winter.

But all that changed with the Industrial Revolution. More and more people left the lands their ancestors had farmed for generations to seek out jobs in factories. There, the work days were long - often 12 hours or more. Factories churned out goods all year round; and holidays, including Christmas, were no excuse to halt the endless production. Many workers turned to drink to deal with this harsh new reality and, with only one day off a week, they often returned on Monday morning still drunk or hung over for another grueling shift.

In Northern Britain, the epicenter of 19th century manufacturing, factory owners saw a significant drop in productivity on Mondays. So, they began allowing their employees to leave work at 2 pm on Saturday afternoons to allow them to start drinking then and hopefully return to work on Monday sober and refreshed. This practice and its new name, the Weekend, was first used in the *Journal of Notes and Quarries* in 1879. So, you can thank hangovers for the extra day off at the end of the week.

The first five-day work week was observed in the United States in 1908 at a cotton mill in New England. This allowed the many Jewish employees to observe the Sabbath, which occurs from sundown on Friday to sundown on Saturday. In 1926, Henry Ford began shutting down his automotive factories for all of Saturday and Sunday. Ford was ahead of his time on many manufacturing practices and believed that happier, better rested staff would work much more efficiently.

In 1929, the Amalgamated Clothing Workers of America union was the first to demand and receive a five-day work week. Other unions and factories slowly followed suit but it wasn't until the 1938 Fair Labor Standards Act that the U.S. officially had a maximum 40-hour work week and a two-day weekend.

[Months and Years](#)

(click to watch video - https://youtu.be/_RJTfJlJuTw)

As we cycle through the different seasons that come each year – winter, spring, summer, and autumn - how were these months named and why are they such odd lengths? Thirty or 31 days plus 28 days for February? What is up with leap years and who decided that January was the right time for one year to end and another to begin?

Let's look back through history to learn the varied origins of these odd measurements of time...

Why are there 12 months in a year?

Many ancient cultures came up with the system of dividing the year based on the cycles of the Moon. The oldest known calendar in the world, a 10,000-year-old arrangement of 12 pits and an ark, was found in Aberdeenshire, Scotland. The ancient Sumerians counted 12 months in a year and started each month with the appearance of a new moon. Holy days occurred on the 1st, 7th and 15th of each month. The word "month" comes from the word "moon" but there is a big problem with using lunar cycles to divide up the year: the solar and lunar cycles don't line up. One lunar cycle is 29.5 days and 12 of them is 354 days; while it takes the earth 365.2422 days to orbit the sun.

The Sumerians added extra days at the end of the year to allow the two cycles to realign. According to legend, the founder of Rome - King Romulus - devised a 10-month calendar with each month counting 30 or 31 days. This used the cultural tradition of a month based on the moon but added a few extra days each month to keep in alignment with the sun. The year began in the spring with Martius - named after Mars, the god of crops and war. Martius signaled the beginning of the planting season and the time when young men would go off to battle to expand the empire.

Aprilis, derived from the Latin "aperire" meaning *to open*, as this is the time when trees and flowers blossom. Mayuse was named for Maya, the goddess of fertility, as the world springs to life and many new animals are born at this time of year. Maya was celebrated at festivals during this month. Junius was named for the goddess Juno, wife of Jupiter. She represents love marriage and childbirth; thus, June has long been considered the luckiest month to be married in.

At this point, Romulus must have gotten called to dinner by his wolf mother because the 5th through 10th months of the year are named a bit lazily after the roman numerals 5 through 10. Quintilis: 5, Sextilis: 6, September: 7, October: 8, November: 9 and December: 10. The remaining 60 odd days of the winter were floating free at the end of the year and not assigned to a month.

Romulus's successor, Numa Pompilius, revamped the calendar in several ways. As the Romans thought even numbers were unlucky, he made all the months which had been 30 days 29 days. He wanted the year to be exactly 12 lunar cycles, which are 29.5 days each, totaling

354. So, after adding up the 10 existing months, he had 57 days left over. He divided these into two new months of 29 and 28 days. Romans celebrated the god Janus around the time of the winter solstice, when days stopped growing shorter and colder and started growing longer and warmer. Janus has two faces, one looking into the past and the other into the future.

Numa Pompilius moved the celebration of the new year to the beginning of the new month, Januarius, which he named in honor of Janus. The second month, Februarius, means *to purify*; as rituals and festivals, often involving animal sacrifice, were held during this month to cleanse the land and community after winter and in preparation for new spring. And because this month was considered unlucky anyway, and was offered up to the gods, it didn't matter that it was an even number of days. Even though the months named 5 through 10 were now actually the 7th through 12th months of the year, the original names stuck.

But this calendar, at only 354 days, was still out of alignment with the sun so it got misaligned with the seasons by an additional 11.25 each year. To compensate, every other February would be cut short to 23 days and an additional leap month called Intercolaris was added in. The convoluted system became even more confusing as Roman politicians would often add extra leap months to extend their own terms or skip leap months to get opponents out of office faster; and when the empire was at war, which was often, the leap month was frequently forgotten for years. So, before long, Romans were shoveling snow in Junious and sunbathing in Januarius.

A few centuries later Julius Caesar came along and applied method to the madness. He borrowed from the Egyptian system of a 365-day calendar and added back the 30th day to the months that had lost it. He ignored the lunar cycles and made the 12 months stretch the entire solar year, eliminating the need for complicated leap months to be added in; and every fourth year he added an additional day in February to make up for the extra quarter day it takes to make the full orbit.

Julius Caesar also renamed Quintilis, the month of his own birth, after himself. Not to be outdone his successor, Augustus, named Sextilis after himself and added an extra day to make August as long as his predecessor's month; and thus we have the Julian calendar, pretty close to what we used today but there were still a few modifications to be made.

In the Middle Ages, the church followed the calendar religiously so they would know when to celebrate their various holidays, festivals and feast days. They used the 12-month Julian calendar but observed the new year on a variety of different dates, depending on local custom. Some areas began a new year on December 25th, Christmas. Others on March 25th, the

feast of the annunciation, on which the archangel Gabriel appeared to the Virgin Mary to tell her of Christ's impending birth. Still others followed the Roman tradition of January 1st but rather than saluting the pagan god, Janus, they Christianized the day as the feast of Christ's circumcision. This had a certain poetry per the significance of cutting.

The most important feast on the Christian calendar, Easter, was supposed to fall on the first full moon after the spring equinox in March; but the addition of the leap year in February every four years was pushing this date further and further forward. Because it takes the earth 365 days 5 hours 48 minutes and 46 seconds to travel around the sun, adding an additional day was rounding this up from 365.2422 to 365.25. May not seem like much but over the 1,500 years between Julius Caesar and the Renaissance, our orbit around the sun and the calendar had become misaligned by 10 days.

Pope Gregory XIII commissioned astronomer Aloysius Lilius to calculate what date it should really be and devise a new system to prevent further drift. The new Gregorian calendar was introduced in 1582 and Thursday, October 4th was followed by Friday, October 15th - skipping 10 days ahead. The leap day would also only occur 97 times, instead of 100, times every 400 years. It is omitted in years that are divisible by 100, except for years that are divisible by 400. So, the year 2000 was a leap year but the year 2100 will not be.

With the implementation of the Gregorian calendar, the Catholic world jumped ahead 10 days; but many other countries in Europe remained out of sync. Protestant England was 10 days behind their Catholic neighbors in France for two centuries so a person could travel back and forth in time simply by crossing the English Channel; but England finally gave in to papacy, and pressure from continental trade, and adopted the Gregorian calendar in 1752.

Russia stayed on the Julian calendar until their October Revolution in 1917 which, according to the Gregorian calendar, began in November. By this time, they had gotten even more out of sync and had to skip ahead a full 13 days.

Other calendars from around the world

While the Gregorian calendar is used throughout the world today, to keep us all on the same page when it comes to science diplomacy and business, there are several other calendar systems still used throughout the world for religion and culture.

The Chinese calendar follows both the sun and the moon and contains 12 months alternating between 29 and 30 days, which begin at each new moon. An extra month is added to keep the solar and lunar cycles in sync, according to a complex mathematical system. The Chinese New Year is usually celebrated on the second new moon following the Winter Solstice so it will fall on January 25th in 2021

The Chinese zodiac dedicates each year to a different animal in a 12-year cycle: Rat, Ox, Tiger, Rabbit, Dragon, Snake, Horse, Sheep, Monkey, Rooster, Dog and Pig. Certain animals are considered more auspicious than others and marriages, launching new businesses and other major life events are often planned around the zodiac calendar. The dragon is considered the luckiest and those years generally see a spike in the birth rate as many parents want to give their children a cosmic leg up. Conversely, the sheep is seen as less fortunate and January 2015 saw a surge in c-sections so that children could avoid being born in this unlucky year.

The Hebrew calendar is similarly lunisolar, with 12 lunar months and a 13th leap month added in as needed to keep up with the Sun. The new year, called Rosh Hashanah, is one of the most important Jewish holidays. It is celebrated on the first day of the month of Tishri, the beginning of the agricultural year, and generally falls in September. The Hebrew calendar marks the year from the creation of the world according to their tradition. So, the Rosh Hashanah of 2020 rang in the Hebrew year 5781. In Hebrew tradition the day begins and ends at sunset, rather than at midnight, so the Sabbath begins on Friday evening and ends on Saturday evening; and because of the importance of the Sabbath, the work week in Israel is Sunday through Thursday.

During the French Revolution, a new calendar and time keeping system (the French Republican Calendar) was adopted on September 22nd, 1792 - the day after the monarchy was abolished, which was considered day one of the republic era. The year was divided into 12 30-day months which were named for natural features of the seasons such as Frimaire, or frost, in the late Autumn; Floreal, or flower, in the Spring; and Thermidor, or heat, in the Summer. Each month was divided into three 10-day weeks, nine days for work and one for rest. Five or six complementary days were added at the end of each year to total 365. Each day it was divided into 10 hours, each hour into 100 minutes and each minute into 100 seconds. This was an attempt to remove religious and royalist influence over the people. It was hoped that if the populace couldn't remember which day was Sunday, then they wouldn't remember to go to church. The new system confused the people and failed to catch on so it was forgotten in 1805, after 12 years, and France went back to the Gregorian calendar and conventional timekeeping.

CALENDAR REFORM

THE 13-MONTH CALENDAR

By DWSmarter (transcribed)

Here's a brain buster: how many days are in a month? Twenty-eight? Twenty-nine? Thirty? Or thirty-one? Well, even the best answer is wrong almost half the time but what if I told you there was a way to be right all the time?

Riddle me this, Batman. If every month had exactly 28 days, then how many months would be in a year? Still 12, right? Huh.

[The Uniform Month Calendar](https://youtu.be/ZWpVQz-Ei30)

(click to watch video - <https://youtu.be/ZWpVQz-Ei30>)

The concept is simple: 13 28-day months. The extra month is placed between June and July and is named Sol for the Sun. One extra day goes between December and January; that's New Year's Day, or year day, and it doesn't count in the normal cycle of the week or months. Boom! That's a complete 365-day calendar but we still need a leap day to eliminate drift. So, leap days occur as normal every four years; only now, leap day shows up on the day after June, before Sol starts. And, just like year day, leap day doesn't count as a day of the week.

In this scenario, both leap day and year day will always fall on the weekend between Saturday and Sunday. They're practically free days of the year; and, with 13 28-day months, every month is identical. The first of the month always falls on a Sunday, the last day a Saturday. Monday will always be the 2nd, 9th, 16th or 23rd and - for the horror lovers out there - every month will have a Friday the 13th. It's so simple!

Well, geez Duncan, if this is so simple why hasn't anyone else started this before? That's the thing, they have. It's actually called the International Fixed Calendar, also known as the Cotsworth Plan, the Eastman Plan, the 13 Month Calendar or the Equal Month Calendar. The International Fixed Calendar was presented by Moses B Cotsworth way back in 1902 in his book, *The Rational Almanac*. Working as a railroad accountant, he found that monthly

accounting was greatly complicated by the fact that months do not divide evenly into weeks. So, he devised a scheme to fix that: 13 28-day months - the International Fixed Calendar.

There are so many reasons to adopt a fixed calendar but the two most compelling reasons I see are: one, to realign the new year with the Winter Solstice; and two, to create equal repeating months.

Let's explore these topics...

The Tropical New Year

We all know that the year is split into four seasons and goes into a yearly cycle of summer and winter. The reason for winters and summers is that Earth's spin is tilted 23 degrees away from the axis of its orbit around the Sun. This tilt generates the seasons. When the spin North Pole is directed maximally away from the Sun, it is winter in the Northern Hemisphere - because most of that hemisphere is in darkness for longer parts of the day. Half a year later, that spin north pole is directed maximally toward the Sun and its summer in the Northern Hemisphere - and the days are longer.

The moments of maximum tilt are the winter and summer solstices and they're the logical places to start and end a year. Since we already delineate seasons on these Solstice days, and the Midway spring and vernal equinox, it stands to reason that any calendar reform should reset the new year to the Winter Solstice. Unfortunately, the current Gregorian calendar ends ten days after the Winter Solstice and demands to be realigned to equal months.

This is intuitively beneficial for God knows how many reasons. All months would have the same number of days, 28. The same number of working days, except holidays, and the same number of Sunday's. Each weekday would always occur on the same four fixed dates of the month quarter years and half years would be of the same length. The date of Easter, being roughly based on the nearest spring equinox, could now be fixed. In fact, all the solstices and equinoxes will fall on the same day every year and they'll always be on a weekend.

And, if we deviate just a little from the Cotsworth plan, and put leap day on the Solstice; it would fall mid-month in Sol between Saturday and Sunday and it would be the longest day of the year so guess what? You'll always be able to go to the beach on the longest day of the year, if you can handle the crowds. Your specific calendars would no longer be necessary. One fixed monthly calendar would be sufficient. Just use erasable ink or print that month 13 times. And,

with 13 months, we can now add one more bikini clad woman to our swimsuit calendar. It's a win-win for the women and photographers; or just think, one more grumpy cat.

So why hasn't this caught on? Probably because a proper calendar reform, once awarded by astronomers and mathematicians in order to realign the calendar year with the tropical year, would require us to drop 10 days in whatever year we transfer to the new year. So, either we start the first fixed calendar year on January 11th, or we end the last Gregorian calendar year on December 21st - screwing with the holidays. Starting the first fixed year late seems to be the obvious best choice but we'd also want to schedule the adoption of the new calendar to be a year that the winter solstice falls on a Saturday, so we don't have to skip any days of the week.

But whatever happened to Cotsworth's plan? Well, in 1923, Cotsworth formed the International Fixed Calendar League to advocate the plan for use in businesses and governments. In 1927 the League of Nations formed a National Committee on Calendar Simplification which included George Eastman, of the Eastman Kodak Company, who ended up adopting the fixed calendar for his company from 1928 until 1989. In 1929, the committee recommended an international conference on the subject but the League of Nations never made a recommendation beyond outlining rules for future consideration. Future consideration? They were weak; and we also saw how their policy on appeasement led to the growth of Hitler and World War II. Then after World War II, when the United Nations was formed to replace the League of Nations, they never took up the mantle and it's never been heard of since.

What's the real reason calendar reform never took off? Weak. Political. Will. But I think that political will has returned, in America at least. Why? Because in 2018, California voters passed prop 7, allowing its state legislature to entertain the idea of permanent daylight-saving time. So, time reform is back on the table with daylight saving time getting some national attention. A full 100 years after its adoption, and after revisions in 1966 and as close as 2007, we have a unique opportunity to remind people of the innumerable benefits of the 13- month calendar. Thirteen months, 28 days each. One "year day" one extra leap day, neither of which count against the days of the week. It's brilliant! it's just so elegant! So, tell me: how many days are in a month?