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Year

A **year** is the orbital period of the Earth moving in its orbit around the Sun. Due to the Earth's axial tilt, the course of a year sees the passing of the seasons, marked by changes in weather, the hours of daylight, and, consequently, vegetation and soil fertility. In temperate and subpolar regions around the planet, four seasons are generally recognized: *spring*, *summer*, *autumn* and *winter*. In tropical and subtropical regions several geographical sectors do not present defined seasons; but in the seasonal tropics, the annual *wet* and *dry* seasons are recognized and tracked. The current year is 2018.

A calendar year is an approximation of the number of days of the Earth's orbital period as counted in a given calendar. The Gregorian, or modern, calendar, presents its calendar year to be either a common year of 365 days or a leap year of 366 days, as do the Julian calendars; *see* below. For the Gregorian calendar the average length of the calendar year (the mean year) across the complete leap cycle of 400 years is 365.2425 days. The ISO standard ISO 80000-3, Annex C, supports the symbol "a" (for Latin *annus*) to represent a year of either 365 or 366 days. In English, the abbreviations "y" and "yr" are commonly used.

In astronomy, the Julian year is a unit of time; it is defined as 365.25 days of exactly 86,400 seconds (SI base unit), totalling exactly 31,557,600 seconds in the Julian astronomical year.[1]

The word "year" is also used for periods loosely associated with, but not identical to, the calendar or astronomical year, such as the seasonal year, the fiscal year, the academic year, etc. Similarly, "year" can mean the orbital period of any planet: for example, a Martian year or a Venusian year are examples of the time a planet takes to transit one complete orbit. The term can also be used in reference to any long period or cycle, such as the *Great Year*.[2]

Contents

Etymology

English *year* (via West Saxon *ġēar* (jɛar), Anglian *ġēr*) continues Proto-Germanic **jæran* (**jē₁ran*). Cognates are German *Jahr*, Old High German *jār*, Old Norse *ár* and Gothic *jer*, from the Proto-Indo-European noun *Reconstruction:Proto-Indo-European/yeh₁-|*yeh₁r-om* "year, season". Cognates also descended from the same Proto-Indo-European noun (with variation in suffix ablaut) are Avestan *yārə* "year", Greek ὥρα (hō´ra) "year, season, period of time" (whence "hour"), Old Church Slavonic *jarŭ*, and Latin *hornus* "of this year".

Latin *annus* (a 2nd declension masculine noun; *annum* is the accusative singular; *annī* is genitive singular and nominative plural; *annō* the dative and ablative singular) is from a PIE noun **h₂et-no-*, which also yielded Gothic *aþn* "year" (only the dative plural *aþnam* is attested).

Both **yeh₁-ro-* and **h₂et-no-* are based on verbal roots expressing movement, **h₁ey-* and **h₂et-* respectively, both meaning "to go" generally (compare Vedic Sanskrit *éti* "goes", *atasi* "thou goest, wanderest"). Derived from Latin *annus* are a number of English words, such as annual, annuity, anniversary, etc.; *per annum* means "each year", *anno Domini* means "in the year of the Lord".

The Greek word for "year", ἔτος, is cognate with Latin *vetus* "old", from the PIE word **wetos-* "year", also preserved in this meaning in Sanskrit *vat-sa-ras* "year" and *vat-sa-* "yearling (calf)", the latter also reflected in Latin *vitulus* "bull calf", English *wether* "ram" (Old English *weðer*, Gothic *wiþrus* "lamb").

In some languages, it is common to count years by referencing to one season, as in "summers", or "winters", or "harvests". Examples include Chinese 年 "year", originally 秂, an ideographic compound of a person carrying a bundle of wheat denoting "harvest". Slavic besides *godŭ* "time period; year" uses *lěto* "summer; year".

Civil year

No astronomical year has an integer number of days or lunar months, so any calendar that follows an astronomical year must have a system of intercalation such as leap years. Financial and scientific calculations often use a 365-day calendar to simplify daily rates.

In international calendars

In the Julian calendar, the average (mean) length of a year is 365.25 days. In a non-leap year, there are 365 days, in a leap year there are 366 days. A leap year occurs every fourth year, or leap year, during which a leap day is intercalated into the month of February. The name "Leap Day" is applied to the added day.

The Gregorian calendar attempts to cause the northward equinox to fall on or shortly before March 21 and hence it follows the northward equinox year, or tropical year.[3] Because 97 out of 400 years are leap years, the mean length of the Gregorian calendar year is 365.242 5 days; this is within one ppm of the current length of the mean tropical year (365.242 19 days) and even closer to the current *March equinox year* of 365.242 374 days that it aims to match. It is estimated that by the year 4000 CE, the northward equinox will fall back by one day in the Gregorian calendar, not because of this difference, but due to the slowing of the Earth's rotation and the associated lengthening of the day.

The Revised Julian calendar, as used in some Eastern Orthodox Churches, currently does a better job than the Gregorian in synchronizing with the mean tropical year. As 218 out of every 900 years are leap years, the average (mean) length of this Julian year is 365.242 2222 days, which is closer to the length of the mean tropical year, 365.242 19 days, than is the Gregorian mean year, 365.242 5 days. In the year 2800 CE, the Gregorian and Revised Julian calendars will begin to differ by one calendar day.[4]

A calendar era assigns a cardinal number to each sequential year, using a reference point in the past as the beginning of the era. Worldwide, the most commonly used calendar era is referenced from the traditional—now believed incorrect—year of the birth of Jesus. Dates in this era are designated Anno Domini (Latin for *in the year of the Lord*), abbreviated AD, or the secular common era, abbreviated CE. The year before 1 AD, or 1 CE, is designated 1 Before Christ (BC), or 1 Before the Common Era (BCE), and the year before that is 2 BC/2 BCE, etc.; hence, there was no year 0 AD/0 CE.

When computations are done involving both years AD and years BC, it is common to use Astronomical year numbering, in which 1 BC is designated 0, 2 BC is designated −1, and so on.

Other eras are also used to enumerate the years in different cultural, religious or scientific contexts.

In the Persian calendar

The Persian calendar, in use in Afghanistan and Iran, has its year begin at the midnight closest to the instant of the northward equinox as determined by astronomical computation (for the time zone of Tehran), as opposed to using an algorithmic system of leap years.

Fiscal year

A fiscal year or financial year is a 12-month period used for calculating annual financial statements in businesses and other organizations. In many jurisdictions, regulations regarding accounting require such reports once per twelve months, but do not require that the twelve months constitute a calendar year.

For example, in Canada and India the fiscal year runs from April 1; in the United Kingdom it runs from April 1 for purposes of corporation tax and government financial statements, but from April 6 for purposes of personal taxation and payment of state benefits; in Australia it runs from July 1; while in the United States the fiscal year of the federal government runs from October 1.

Academic year

An academic year is the annual period during which a student attends an educational institution. The academic year may be divided into academic terms, such as semesters or quarters. The school year in many countries starts in August or September and ends in May, June or July. In Israel the academic year begins around October or November, aligned with the second month of the Hebrew Calendar.

Some schools in the UK and USA divide the academic year into *three* roughly equal-length terms (called *trimesters* or *quarters* in the USA), roughly coinciding with autumn, winter, and spring. At some, a shortened summer session, sometimes considered part of the regular academic year, is attended by students on a voluntary or elective basis. Other

schools break the year into *two* main semesters, a first (typically August through December) and a second semester (January through May). Each of these main semesters may be split in half by mid-term exams, and each of the halves is referred to as a *quarter* (or *term* in some countries). There may also be a voluntary summer session and/or a short January session.

Some other schools, including some in the United States, have *four* marking periods. Some schools in the United States, notably Boston Latin School, may divide the year into *five or more* marking periods. Some state in defense of this that there is perhaps a positive correlation between report frequency and academic achievement.

There are typically 180 days of teaching each year in schools in the USA, excluding weekends and breaks, while there are 190 days for pupils in state schools in Canada, New Zealand and the United Kingdom, and 200 for pupils in Australia.

In India the academic year normally starts from June 1 and ends on May 31. Though schools start closing from mid-March, the actual academic closure is on May 31 and in Nepal it starts from July 15.

Schools and universities in Australia typically have academic years that roughly align with the calendar year (i.e., starting in February or March and ending in October to December), as the southern hemisphere experiences summer from December to February.

In the International System of Quantities

In the International System of Quantities, the year (symbol, *a*) is defined as either 365 days or 366 days.

Astronomical years

Julian year

The Julian year, as used in astronomy and other sciences, is a time unit defined as exactly 365.25 days. This is the normal meaning of the unit "year" (symbol "a" from the Latin *annus*) used in various scientific contexts. The Julian century of 36 525 days and the Julian millennium of 365 250 days are used in astronomical calculations. Fundamentally, expressing a time interval in Julian years is a way to precisely specify how many days (not how many "real" years), for long time intervals where stating the number of days would be unwieldy and unintuitive. By convention, the Julian year is used in the computation of the distance covered by a light-year.

In the Unified Code for Units of Measure, the symbol, *a* (without subscript), always refers to the Julian year, a_j, of exactly 31 557 600 seconds.

$$365.25 \text{ days of } 86\,400 \text{ seconds} = 1 \text{ a} = 1 \text{ a}_\text{j} = 31.5576 \text{ Ms}$$

The SI multiplier prefixes may be applied to it to form *ka* (kiloannus), *Ma* (megaannus), etc.

Sidereal, tropical, and anomalistic years

Each of these three years can be loosely called an *astronomical year*.

The sidereal year is the time taken for the Earth to complete one revolution of its orbit, as measured against a fixed frame of reference (such as the fixed stars, Latin *sidera*, singular *sidus*). Its average duration is 365.256 363 004 days (365 d 6 h 9 min 9.76 s) (at the epoch J2000.0 = January 1, 2000, 12:00:00 TT).[5]

Today the mean tropical year is defined as the period of time for the mean ecliptic longitude of the Sun to increase by 360 degrees.[6] Since the Sun's ecliptic longitude is measured with respect to the equinox, the tropical year comprises a complete cycle of the seasons; because of the biological and socio-economic importance of the seasons, the tropical year is the basis of most calendars. The modern definition of mean tropical year differs from the actual time between passages of, e.g., the northward equinox for several reasons explained below. Because of the Earth's axial precession, this year is about 20 minutes shorter than the sidereal year. The mean tropical year is approximately 365 days, 5 hours, 48 minutes, 45 seconds, using the modern definition.[7] (= 365.242 19 days of 86400 SI seconds)

The anomalistic year is the time taken for the Earth to complete one revolution with respect to its apsides. The orbit of the Earth is elliptical; the extreme points, called apsides, are the perihelion, where the Earth is closest to the Sun (January 3 in 2011), and the aphelion, where the Earth is farthest from the Sun (July 4 in 2011). The anomalistic year is usually defined as the time between perihelion passages. Its average duration is 365.259 636 days (365 d 6 h 13 min 52.6 s) (at the epoch J2011.0).[8]

Draconic year

The draconic year, draconitic year, eclipse year, or ecliptic year is the time taken for the Sun (as seen from the Earth) to complete one revolution with respect to the same lunar node (a point where the Moon's orbit intersects the ecliptic). The year is associated with eclipses: these occur only when both the Sun and the Moon are near these nodes; so eclipses occur within about a month of every half eclipse year. Hence there are two eclipse seasons every eclipse year. The average duration of the eclipse year is

346.620 075 883 days (346 d 14 h 52 min 54 s) (at the epoch J2000.0).

This term is sometimes erroneously used for the draconic or nodal period of lunar precession, that is the period of a complete revolution of the Moon's ascending node around the ecliptic: 18.612 815 932 Julian years (6 798.331 019 days; at the epoch J2000.0).

Full moon cycle

The full moon cycle is the time for the Sun (as seen from the Earth) to complete one revolution with respect to the perigee of the Moon's orbit. This period is associated with the apparent size of the full moon, and also with the varying duration of the synodic month. The duration of one full moon cycle is:

411.784 430 29 days (411 days 18 hours 49 minutes 34 seconds) (at the epoch J2000.0).

Lunar year

The lunar year comprises twelve full cycles of the phases of the Moon, as seen from Earth. It has a duration of approximately 354.37 days. Muslims use this for celebrating their Eids and for marking the start of the fasting month of Ramadan. A Muslim calendar year is based on the lunar cycle.

Vague year

The vague year, from *annus vagus* or wandering year, is an integral approximation to the year equaling 365 days, which wanders in relation to more exact years. Typically the vague year is divided into 12 schematic months of 30 days each plus 5 epagomenal days. The vague year was used in the calendars of Ancient Egypt, Iran, Armenia and in Mesoamerica among the Aztecs and Maya.[9] It is still used by many Zoroastrian communities.

Heliacal year

A heliacal year is the interval between the heliacal risings of a star. It differs from the sidereal year for stars away from the ecliptic due mainly to the precession of the equinoxes.

Sothic year

The Sothic year is the interval between heliacal risings of the star Sirius. It is currently less than the sidereal year and its duration is very close to the Julian year of 365.25 days.

Gaussian year

The Gaussian year is the sidereal year for a planet of negligible mass (relative to the Sun) and unperturbed by other planets that is governed by the Gaussian gravitational constant. Such a planet would be slightly closer to the Sun than Earth's mean distance. Its length is:

365.256 8983 days (365 d 6 h 9 min 56 s).

Besselian year

The Besselian year is a tropical year that starts when the (fictitious) mean Sun reaches an ecliptic longitude of 280°. This is currently on or close to January 1. It is named after the 19th-century German astronomer and mathematician Friedrich Bessel. The following equation can be used to compute the current Besselian epoch (in years):[10]

$$B = 1900.0 + (\text{Julian date}_{TT} - 2\,415\,020.313\,52) / 365.242\,198\,781$$

The TT subscript indicates that for this formula, the Julian date should use the Terrestrial Time scale, or its predecessor, ephemeris time.

Variation in the length of the year and the day

The exact length of an astronomical year changes over time.

- The positions of the equinox and solstice points with respect to the apsides of Earth's orbit change: the equinoxes and solstices move westward relative to the stars because of precession, and the apsides move in the other direction because of the long-term effects of gravitational pull by the other planets. Since the speed of the Earth varies according to its position in its orbit as measured from its perihelion, Earth's speed when in a solstice or equinox point changes over time: if such a point moves toward perihelion, the interval between two passages decreases a little from year to year; if the point moves towards aphelion, that period increases a little from year to year. So a "tropical year" measured from one passage of the northward ("vernal") equinox to the next, differs from the one measured between passages of the southward ("autumnal") equinox. The average over the full orbit does not change because of this, so the length of the average tropical year does not change because of this second-order effect.
- Each planet's movement is perturbed by the gravity of every other planet. This leads to short-term fluctuations in its speed, and therefore its period from year to year. Moreover, it causes long-term changes in its orbit, and therefore also long-term changes in these periods.
- Tidal drag between the Earth and the Moon and Sun increases the length of the day and of the month (by transferring angular momentum from the rotation of the Earth to the revolution of the Moon); since the apparent mean solar day is the unit with which we measure the length of the year in civil life, the length of the year appears to decrease. The rotation rate of the Earth is also changed by factors such as post-glacial rebound and sea level rise.

Numerical value of year variation

Mean year lengths in this section are calculated for 2000, and differences in year lengths, compared to 2000, are given for past and future years. In the tables a day is 86,400 SI seconds long.[11][12][13][14]

Mean year lengths for 2000

Type of year	Days	Hours	Minutes	Seconds
Tropical	365	5	48	45
Sidereal	365	6	9	10
Anomalistic	365	6	13	53
Eclipse	346	14	52	55

Year length difference from 2000
(seconds; positive when length for tabulated year is greater than length in 2000)

Year	Tropical	Sidereal	Anomalistic	Eclipse
−4000	−8	−45	−15	−174
−2000	4	−19	−11	−116
0	7	−4	−5	−57
2000	0	0	0	0
4000	−14	−3	5	54
6000	−35	−12	10	104

Summary

Days	Year type
346.62	Draconic, also called eclipse.
354.37	Lunar.
365	Vague, and a common year in many solar calendars.
365.242 19	Tropical, also called solar, averaged and then rounded for epoch J2000.0.
365.2425	Gregorian, on average.
365.25	Julian.
365.256 36	Sidereal, for epoch J2000.0.
365.259 636	Anomalistic, averaged and then rounded for epoch J2011.0.
366	Leap in many solar calendars.

An average Gregorian year is 365.2425 days (52.1775 weeks, 8 765.82 hours, 525 949.2 minutes or 31 556 952 seconds). For this calendar, a common year is 365 days (8760 hours, 525 600 minutes or 31 536 000 seconds), and a leap year is 366 days (8784 hours, 527 040 minutes or 31 622 400 seconds). The 400-year cycle of the Gregorian calendar has 146 097 days and hence exactly 20 871 weeks.

"Greater" astronomical years

Equinoctial cycle

The Great Year, or equinoctial cycle, corresponds to a complete revolution of the equinoxes around the ecliptic. Its length is about 25,700 years, and cannot be determined precisely enough yet, as the precession speed depends on too many factors, causing not yet predictable variation.

Galactic year

The Galactic year is the time it takes Earth's solar system to revolve once around the galactic center. It comprises roughly 230 million Earth years.[15]

Seasonal year

A seasonal year is the time between successive recurrences of a seasonal event such as the flooding of a river, the migration of a species of bird, the flowering of a species of plant, the first frost, or the first scheduled game of a certain sport. All of these events can have wide variations of more than a month from year to year.

Symbols

In the International System of Quantities the symbol for the year as a unit of time is *a*, taken from the Latin word *annus*.[16]

In English, the abbreviations "y" or "yr" are more commonly used in non-scientific literature, but also specifically in geology and paleontology, where "kyr, myr, byr" (thousands, millions, and billions of years, respectively) and similar abbreviations are used to denote intervals of time remote from the present.[16][17][18]

Symbol

NIST SP811[19] and ISO 80000-3:2006[20] support the symbol *a* as the unit of time for a year. In English, the abbreviations *y* and *yr* are also used.[16][17][18]

The Unified Code for Units of Measure[21] disambiguates the varying symbologies of ISO 1000, ISO 2955 and ANSI X3.50[22] by using:

> a_t = 365.242 19 days for the mean tropical year;
> a_j = 365.25 days for the mean Julian year;
> a_g = 365.2425 days for the mean Gregorian year;

where:

> *a*, without a qualifier = 1 a_j;
> and, *ar* for *are*, is a unit of area.

The International Union of Pure and Applied Chemistry (IUPAC) and the International Union of Geological Sciences have jointly recommended defining the annus, with symbol *a*, as the length of the tropical year in the year 2000:

> *a* = 31 556 925.445 seconds (approximately 365.242 192 65 ephemeris days)

This differs from the above definition of 365.25 days by about 20 parts per million. The joint document says that definitions such as the Julian year "bear an inherent, pre-programmed obsolescence because of the variability of Earth's orbital movement", but then proposes using the length of the tropical year as of 2000 AD (specified down to the millisecond), which suffers from the same problem.[23][24] (The tropical year oscillates with time by more than a minute.)

The notation has proved controversial as it conflicts with an earlier convention among geoscientists to use *a* specifically for *years ago*, and *y* or *yr* for a one-year time period.[24]

SI prefix multipliers

For the following, there are alternative forms which elide the consecutive vowels, such as *kilannus*, *megannus*, etc. The exponents and exponential notations are typically used for calculating and in displaying calculations, and for conserving space, as in tables of data.

- ***ka*** (for kiloannus) — a unit of time equal to one thousand, or 10^3, years, or 1 E3 yr, also known as a millennium in anthropology and calendar uses. The prefix multiplier "ka" is typically used in geology, paleontology, and archaeology for the Holocene and Pleistocene periods, where a non−radiocarbon dating technique: e.g. ice core dating, dendrochronology, uranium-thorium dating, or varve analysis; is used as the primary dating method for age determination. If age is primarily determined by radiocarbon dating, then the age should be expressed in either radiocarbon or calendar (calibrated) years Before Present.
- ***Ma*** (for megaannus) — a unit of time equal to one million, or 10^6, years, or 1 E6 yr. The suffix "Ma" is commonly used in scientific disciplines such as geology, paleontology, and celestial mechanics to signify very long time periods into the past or future. For example, the dinosaur species *Tyrannosaurus rex* was abundant approximately 66 Ma (66 million years) ago. The duration term "ago" may not always be indicated: if the quantity of a duration is specified while not explicitly mentioning a duration term, one can assume that "ago" is implied; the alternative unit "mya" does include "ago" explicitly. It also written as "million years" (ago) in works for general public use. In astronomical applications, the year used is the Julian year of precisely 365.25 days. In geology and paleontology, the year is not so precise and varies depending on the author.
- ***Ga*** (for gigaannus) — a unit of time equal to 10^9 years, or 1 E9 yr, one billion years short scale (one thousand million years long scale). "Ga" is commonly used in scientific disciplines such as cosmology and geology to signify extremely long time periods in the past. For example, the formation of the Earth occurred approximately 4.54 Ga (4.54 billion years) ago.
- ***Ta*** (for teraannus) — a unit of time equal to 10^{12} years, or 1 E12 yr, one trillion years short scale (one billion years long scale). "Ta" is an extremely long unit of time, about 70 times as long as the age of the universe. It is the same order of magnitude as the expected life span of a small red dwarf.
- ***Pa*** (for petaannus) — a unit of time equal to 10^{15} years, or 1 E15 yr, one quadrillion short scale (one thousand billion long scale). The half-life of the nuclide cadmium-113 is about 8 Pa.[25] This symbol coincides with that for the pascal without a multiplier prefix, though both are infrequently used and context will normally be sufficient to distinguish time from pressure values.
- ***Ea*** (for exaannus) — a unit of time equal to 10^{18} years, or 1 E18 yr, one quintillion years short scale (one trillion years long scale). The half-life of tungsten-180 is 1.8 Ea.[26]

Abbreviations yr and ya

In astronomy, geology, and paleontology, the abbreviation *yr* for *years* and *ya* for *years ago* are sometimes used, combined with prefixes for thousand, million, or billion.[17][27] They are not SI units, using *y* to abbreviate the English "year", but following ambiguous international recommendations, use either the standard English first letters as prefixes (t, m, and b) or metric prefixes (k, M, and G) or variations on metric prefixes (k, m, g). These abbreviations include:

Non-SI abbreviation	SI-prefixed equivalent	Order of magnitude
kyr	ka	▪ Thousand years
Myr or *myr*	Ma	▪ Million years
byr	Ga	▪ Billion years (thousand million years)
kya or *tya*	ka ago	▪ Appearance of *Homo sapiens*, *circa* 200 kya ▪ Out-of-Africa migration, *circa* 60 kya ▪ Last Glacial Maximum, *circa* 20 kya ▪ Neolithic Revolution, *circa* 10 kya

Mya or *mya*	Ma ago	▪ Pliocene, 5.3 to 2.6 mya
		  ▪ The last geomagnetic reversal was 0.78 mya[28]
		  ▪ The (Eemian Stage) Ice Age started 0.13 mya
		▪ The Holocene started 0.01 mya

bya or *gya*	Ga ago	▪ oldest Eukaryotes, 2 bya ▪ age of the Earth, 4.5 bya ▪ Big Bang, 13.8 bya

Use of *mya* and *bya* is deprecated in modern geophysics, the recommended usage being *Ma* and *Ga* for dates Before Present, but "m.y." for the duration of epochs.[17][18] This *ad hoc* distinction between "absolute" time and time intervals is somewhat controversial amongst members of the Geological Society of America.[29]

Note that on graphs using *ya* units on the horizontal axis time flows from right to left, which may seem counter-intuitive. If the *ya* units are on the vertical axis, time flows from top to bottom which is probably easier to understand than conventional notation.

See also

- 2018: current year
- Astronomical year numbering
- Century
- Decade
- Millennium
- ISO 8601: standard for representation of dates and times
- List of calendars
- List of years
- Epoch (reference date)
- Orders of magnitude (time)
- Unit of time

References

Notes

1. International Astronomical Union "SI units (http://www.iau.org/science/publications/proceedings_rules/units/)" accessed February 18, 2010. (See Table 5 and section 5.15.) Reprinted from George A. Wilkins & IAU Commission 5, "The IAU Style Manual (1989)" (http://www.iau.org/static/publications/stylemanual1989.pdf) (PDF file) in *IAU Transactions* Vol. XXB

2. OED, s.v. "year", entry 2.b.: "*transf.* Applied to a very long period or cycle (in chronology or mythology, or vaguely in poetic use)."
3. Ziggelaar, A. (1983). "The Papal Bull of 1582 Promulgating a Reform of the Calendar" (http://articles.adsabs.harvard.edu/cgi-bin/nph-iarticle_query?journal=grc..&year=1983&volume=book&page_ind=209). In Coyne, Hoskin, Pedersen (eds), *Gregorian Reform of the Calendar: Proceedings of the Vatican Conference to Commemorate its 400th Anniversary*. Vatican City: Pontifical Academy of Sciences, Specolo Vaticano, p. 223
4. Shields, Miriam Nancy. (1924). "The New Calendar of the Eastern Churches (http://adsabs.harvard.edu/abs/1924PA.....32..407S), *Popular Astronomy*, Vol. 32, p.407. Courtesy NASA Astrophysics Data System.
5. International Earth Rotation and Reference System Service. (2010).IERS EOP PC Useful constants. (http://hpiers.obspm.fr/eop-pc/models/constants.html)
6. Richards, E. G. (2013). Calendars. In S. E. Urban & P. K. Seidelmann (Eds.), *Explanatory Supplement to the Astronomical Almanac* (3rd ed.). Mill Valley, CA: University Science Books. p. 586.
7. *Astronomical Almanac for the Year 2011* (http://asa.usno.navy.mil/SecM/Glossary.html#y). Washington and Taunton: U.S. Government Printing Office and the U.K. Hydrographic Office. 2009. p. M18 (Glossary).
8. *Astronomical Almanac for the Year 2011*. Washington and Taunton: US Government Printing Office and the UK Hydrographic Office. 2009. pp. A1, C2.
9. Calendar Description and Coordination (http://www.mayacalendar.com/descripcion.html) Maya World Studies Center
10. *Astronomical Almanac for the Year 2010*. Washington and Taunton: U.S. Government Printing Office and the U.K. Hydrographic Office. 2008. p. B3.
11. U.S. Naval Observatory Nautical Almanac Office and Her Majesty's Nautical Almanac Office (2010). *Astronomical Almanac for the year 2011*. Washington: U.S. Government Printing Office. pp. C2, L8.
12. Simon, J.L.; Bretagnon, P.; Chapront, J.; Chapront-Touzé, M.; Francou, G.; Laskar, J. (February 1994). "Numerical expressions for precession formulae and mean elements for the Moon and planets". *Astronomy and Astrophysics*. **282** (2): 663–683. Bibcode:1994A&A...282..663S (http://adsabs.harvard.edu/abs/1994A&A...282..663S).
13. Taff, Lawrence G. (1985). *Celestial Mechanics: A Computational Guide for the Practitioner*. New York: John Wiley & Sons. p. 103. ISBN 0-471-89316-1. Values in tables agree closely for 2000, and depart by as much as 44 seconds for the years furthest in the past or future; the expressions are simpler than those recommended in the *Astronomical Almanac for the Year 2011*.
14. Seidelmann, P. Kenneth (2013). *Explanatory Supplement to the Astronomical Almanac*. Sean E. Urban (ed.) (3 ed.). Univ Science Books. p. 587. ISBN 1-891389-85-8. Tabulates length of tropical year from −500 to 2000 at 500 year intervals using a formula by Laskar (1986); agrees closely with values in this section near 2000, departs by 6 seconds in −500.
15. "Science Bowl Questions, Astronomy, Set 2" (https://web.archive.org/web/20100307191635/http://www.orau.gov/sciencebowl/teams/files/astrset2.pdf) (PDF). *Science Bowl Practice Questions*. Oak Ridge Associated Universities. 2009. Archived from the original (http://www.orau.gov/SCIENCEBOWL/teams/files/astrset2.pdf) (PDF) on March 7, 2010. Retrieved December 9, 2009.
16. Russ Rowlett. "Units: A" (http://www.unc.edu/~rowlett/units/dictA.html). *How Many? A Dictionary of Units of Measurement*. University of North Carolina. Retrieved January 9, 2009.
17. "AGU Editorial Style Guide for Authors" (https://web.archive.org/web/20080714134306/http://www.agu.org/pubs/style_guide_intro.html). American Geophysical Union. September 21, 2007. Archived from the original (http://www.agu.org/pubs/style_guide_intro.html) on July 14, 2008. Retrieved January 9, 2009.
18. North American Commission on Stratigraphic Nomenclature (November 2005). "North American Stratigraphic Code" (http://ngmdb.usgs.gov/Info/NACSN/Code2/code2.html#Article13). *The American Association of Petroleum Geologists Bulletin* (Article 13 (c) ed.). **89** (11): 1547–1591. doi:10.1306/07050504129 (https://doi.org/10.1306%2F07050504129).
19. Ambler Thompson; Barry N. Taylor (2008). "Special Publication 811 – Guide for the Use of the International System of Units (SI)" (http://physics.nist.gov/Document/sp811.pdf) (PDF). National Institute of Standards and Technology (NIST). para 8.1.
20. "ISO 80000-3:2006, Quantities and units" (http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=31888). Geneva: International Organization for Standardization. 2006. Part 3: Space and time.

21. Gunther Schadow; Clement J. McDonald. "Unified Code for Units of Measure" (https://web.archive.org/web/20080520112256/http://aurora.rg.iupui.edu/UCUM/). Archived from the original (http://aurora.rg.iupui.edu/ucum) on May 20, 2008.
22. http://aurora.regenstrief.org/~ucum/ucum.html#para-31 Archived (https://web.archive.org/web/20100304195312/http://aurora.regenstrief.org/~ucum/ucum.html) March 4, 2010, at the Wayback Machine.
23. Norman E. Holden; Mauro L. Bonardi; Paul De Bièvre; Paul R. Renne & Igor M. Villa (2011). "IUPAC-IUGS common definition and convention on the use of the year as a derived unit of time (IUPAC Recommendations 2011)". *Pure and Applied Chemistry*. **83** (5): 1159–1162. doi:10.1351/PAC-REC-09-01-22 (https://doi.org/10.1351%2FPAC-REC-09-01-22).
24. Celeste Biever (April 27, 2011). "Push to define year sparks time war" (https://www.newscientist.com/article/dn20423-push-to-define-year-sparks-time-war.html). *New Scientist*. Retrieved April 28, 2011.
25. P. Belli; et al. (2007). "Investigation of β decay of ^{113}Cd". *Phys. Rev. C*. **76** (6): 064603. Bibcode:2007PhRvC..76f4603B (http://adsabs.harvard.edu/abs/2007PhRvC..76f4603B). doi:10.1103/PhysRevC.76.064603 (https://doi.org/10.1103%2FPhysRevC.76.064603).
26. F. A. Danevich; et al. (2003). "α activity of natural tungsten isotopes". *Phys. Rev. C*. **67**: 014310. arXiv:nucl-ex/0211013 (https://arxiv.org/abs/nucl-ex/0211013). Bibcode:2003PhRvC..67a4310D (http://adsabs.harvard.edu/abs/2003PhRvC..67a4310D). doi:10.1103/PhysRevC.67.014310 (https://doi.org/10.1103%2FPhysRevC.67.014310).
27. North American Commission on Stratigraphic Nomenclature. "North American Stratigraphic Code (Article 13 (c))" (http://ngmdb.usgs.gov/Info/NACSN/Code2/code2.html#Article13). "(c) Convention and abbreviations. – The age of a stratigraphic unit or the time of a geologic event, as commonly determined by numerical dating or by reference to a calibrated time-scale, may be expressed in years before the present. The unit of time is the modern year as presently recognized worldwide. Recommended (but not mandatory) abbreviations for such ages are SI (International System of Units) multipliers coupled with "a" for annus: ka, Ma, and Ga for kilo-annus (10^3 years), Mega-annus (10^6 years), and Giga-annus (10^9 years), respectively. Use of these terms after the age value follows the convention established in the field of C-14 dating. The "present" refers to AD 1950, and such qualifiers as "ago" or "before the present" are omitted after the value because measurement of the duration from the present to the past is implicit in the designation. In contrast, the duration of a remote interval of geologic time, as a number of years, should not be expressed by the same symbols. Abbreviations for numbers of years, without reference to the present, are informal (e.g., y or yr for years; my, m.y., or m.yr. for millions of years; and so forth, as preference dictates). For example, boundaries of the Late Cretaceous Epoch currently are calibrated at 63 Ma and 96 Ma, but the interval of time represented by this epoch is 33 m.y."
28. Bradford M. Clement (April 8, 2004). "Dependence of the duration of geomagnetic polarity reversals on site latitude". *Nature*. **428** (6983): 637–40. Bibcode:2004Natur.428..637C (http://adsabs.harvard.edu/abs/2004Natur.428..637C). doi:10.1038/nature02459 (https://doi.org/10.1038%2Fnature02459). PMID 15071591 (https://www.ncbi.nlm.nih.gov/pubmed/15071591).
29. "Time Units" (https://web.archive.org/web/20160616100504/http://www.geosociety.org/TimeUnits/). Geological Society of America. Archived from the original (http://www.geosociety.org/TimeUnits/) on June 16, 2016. Retrieved February 17, 2010.

Further reading

- Fraser, Julius Thomas (1987). *Time, the Familiar Stranger* (illustrated ed.). Amherst: University of Massachusetts Press. ISBN 0-87023-576-1. OCLC 15790499 (https://www.worldcat.org/oclc/15790499).
- Whitrow, Gerald James (2003). *What is Time?*. Oxford: Oxford University Press. ISBN 0-19-860781-4. OCLC 265440481 (https://www.worldcat.org/oclc/265440481).

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