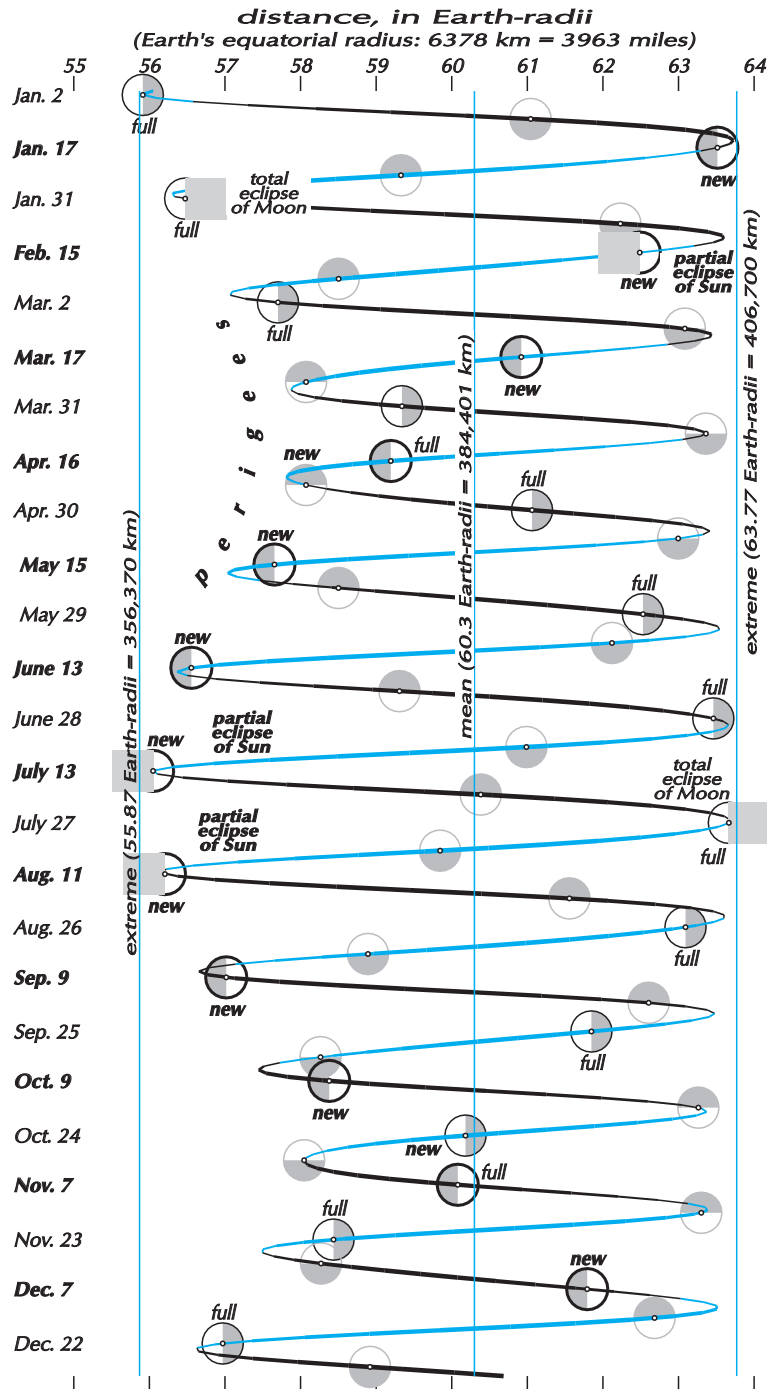


Graph of the Moon's varying distance. The curve is black when the Moon is north of the ecliptic, blue when south; and thicker when farther north or south. The Moon is drawn, to scale, at the moments of its cardinal phases—New (dark side toward us), First Quarter (sunlit side to west), Full (sunlit side toward us), Last Quarter (sunlit side to east).

For the mean distance, *Allen's Astrophysical Quantities* (1999) gives $384,401 \pm 1$ km (60.27 Earth-radii). Jean Meeus in *Mathematical Astronomy Morsels* (1997) gives 10 values, ranging from 381,546 to 385,001 km (59.82 to 60.36 ER), depending on what we mean by "mean distance"!



Traditional names for the Full Moons of the year

Almanacs give names such as these and many others, said to come down from old England or Native America:

- Moon After Yule, or Old Moon
- Wolf Moon, Snow Moon, Hunger Moon
- Lenten Moon, Sap Moon, Crow Moon, Worm Moon
- Egg Moon, Grass Moon, Easter Moon, Paschal Moon
- Milk Moon, Planting Moon
- Flower Moon, Rose Moon, Strawberry Moon
- Hay Moon, Thunder Moon
- Grain Moon, Green Corn Moon
- Fruit Moon
- Harvest Moon
- Hunter’s Moon, Frosty Moon, Beaver Moon
- Moon Before Yule, Long Night Moon

Phases more (or less) than one a month

Our calendar year of 365.2425 days has irregular months of 28, 29, 30, or 31 days (averaging 30.4369 so as to fit into the solar year). But the true cycle of the Moon (synodic month) averages 29.53 days, varying from about 29.2 to 29.9. A “year” of 12 lunar months is about 354.36 days.

(After a Metonic Cycle of 19 years (6940 days, 228 solar months, 235 lunar months) the dates of the phases repeat almost exactly, to within 2 hours.)

So the dates of the four main phases (New, First Quarter, Full, and Last or Third Quarter) get about a day earlier each month. There are in a year not 48 but an average of $365.2425/29.53 \times 4 = 49.5$ phases. In a 49-phase year, the first in January occurs 13 times—twice in one of the months, usually on its first and last days—and is also the last in the year. In a 50-phase year, the first

Blue Moon, extra-in-season sense

The word *season* is used with several different meanings; here, it applies to the divisions of the year made by the equinoxes and solstices (as opposed to “quarter,” meaning a group of three months). Thus one of the seasons runs from the December solstice to the next year’s March equinox.

Since Full Moons can be either 12 or 13 in a year, there comes (in 7 out of every 19 years) a quarter-year season with 4 Full Moons instead of 3. When this happened, a 13th name was needed, and could not be of the same seasonal kind like “Snow Moon” since it could be in any season. What old calendar makers did was to call the 3rd of the 4 “Blue.” The first known mention of this practice was in the *Maine Farmers’ Almanac* in 1937, which used it till 1957.

It remarked that the early monks “who had charge of the calendar” found this such a nuisance for calculation and the arrangement of festivals that this was why 13

These are not necessarily the Moons of Jan., Feb., etc., but may be the Moons of the four seasons, divided by the equinoxes and solstices of around the 21st of March, June, Sep., and Dec. Thus Old Moon may fall in the last third of December or in the first two-thirds of January.

“Yule” is the Christmas season. “Lent” stretches from Ash Wednesday, Feb. 10, to Easter, Mar. 27. “Long Night Moon” is doubly appropriate: the midwinter night is long and its Full Moon is above the horizon a long time.

two phases occur 13 times—each of them twice in a month, not the same one—and they are the year’s last two.

Each phase occurs on average each 29.53 days, or 12.3685 times per year; so months containing two of a certain phase occur on average every 2.72 years, or 2 years plus 7, 8, 9, or 10 months.

February, with only 28 or 29 days, is the only month shorter than the shortest time (29.2 days) in which a phase can repeat. So it is never a 5-phase month, and may contain only 3. This happens if the year’s first phase occurs twice in January; it then misses February and falls twice in March (another 31-day month); the year’s second phase repeats in some other month, and the year is 50-phase.

became the unlucky number. Yet it doesn’t really arise from the number 13.

In this sense, no Full Moon in 2018 is Blue. The December Moon narrowly misses.

Full	Jan 2	
	Jan 31	29.460
	Mar 2	29.475
equinox	Mar 20	<u>18.642</u>
	Mar 31	10.848
	Apr 30	29.515
	May 29	29.557
solstice	Jun 21	<u>22.826</u>
	Jun 28	6.781
	Jul 27	29.644
	Aug 26	29.650
equinox	Sep 23	<u>27.581</u>
	Sep 25	2.041
	Oct 24	29.578
	Nov 23	29.537
solstice	Dec 21	<u>28.698</u>
	Dec 22	0.809

At right, the time in days from the previous event.

Blue Moon, extra-in-month sense

The meaning now popular is easier to grasp: a second Full Moon in a calendar month. This has been traced to a March 1946 article in *Sky & Telescope* by J. Hugh Pruett, who misinterpreted the older rule:

“ . . . this gives 11 months with one full moon each and one with two. This second in a month, so I interpret it, was called blue moon.”

Blue Moon, literal sense

Why “blue”? The Moon does rarely appear so. It often, not necessarily Full, but usually when near the horizon, appears strange in shape or color, but usually in the yellow or red direction; even more so when eclipsed. It has been described as blue under conditions much rarer and sometimes not understood: when dust filled the upper

Blue Moon, vague sense

Phrases such as “once in a blue moon” don’t really refer to the Moon, merely to rare occasions, or long spans of time. This simplest sense is probably the oldest: the *Oxford English Dictionary* now gives earliest quotations from 1821 (“haven’t seen you this blue moon”) and 1833

In this sense, 1999 and 2018 are years of the type in which Blue Moons happen in both January and March—because February has no Full Moon. Some years of the much commoner one-Blue-Moon type are 2001 (2 Full in Nov.), 2004 (July), 2007 (June), 2009 (Dec.), 2012 (Aug.), 2015 (July), 2020 (Oct.).

atmosphere after Canadian forest fires in 1950, and after the eruptions of El Chichón in Mexico (1982) and Pinatubo in the Philippines (1991). After the 1883 eruption of Krakatao, between Java and Sumatra, the Moon appeared bluish for two years, even green from Sweden in 1884.

(“once in a blue moon such a thing may be allowed”), and (according to Stuart Clark in the *Guardian*, 2015 Aug. 1) the *Morris Dictionary of Word and Phrase Origins* claims a use in 1528.