The Globe's Sky

# ASTRONOMICAL CALENDAR 2026

# ASTRONOMICAL CALENDAR
# 2026
## Guy Ottewell

**Universal Workshop**
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**Durham, North Carolina, and London, England**

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The *Astronomical Calendar* was published as a printed book for the years 1974 to 2016. It started because Professor Bill Brantley, chairman of the physics department at Furman University, Greenville, South Carolina, got me to show the stars to his students. For many years it was under the auspices of the university and the Astronomical League, then Sky & Telescope, then Celestial Products, for which I owe gratitude to Ed Merritt and to Larry and Sherrie Bohlayer.

It was continued by web pages for 2017 to 2021. Then I was able to revive it as an electronic book for 2022, and in both electronic and printed forms for 2023 onward. These became, and remain, possible only because of the help of Daniel Cummings, an innovator in science education (starinastar.com).

I am heartily grateful to John Goss, past President of the Astronomical League, and to Bruce Andrews, for proofreading (any surviving errors will be due to subsequent changes by me); to Alastair McBeath for expert advice on meteors; to Alan Hale for expert advice on comets; and to Tilly, for driving me to get this complex book ready in time.

**A tip on how to use the electronic version of this book**

It has facing pages, of letter size (8.5 by 11 inches), like a paper book. The larger the screen you can view it on, the better. And it will be best with a facing-pages view.

This can be done because it is a PDF document and will open in Adobe Reader. In the “view” menu, click “page display,” then “two page view” or, even better, “two page scrolling,” which lets you move up and down with the “hand” tool and the mouse wheel. In the same dropdown, make sure that “show cover page in two page view” is enabled.

When reading that for a certain date there is, e.g., a meteor shower, you can refer to the section on meteors (remembering that the list of contents is on page 3).

Explore www.universalworkshop.com for these and more:

**The Astronomical Companion**, universal explanation!

**To Know the Stars**, for children and other beginners

**Albedo to Zodiac**, glossary of astronomical terms

**Map of the Starry Sky**, huge detailed poster

**Zodiac Wavy Chart for 2026** (and other years), poster-size, the Sun, Moon, and planets throughout the year

**Venus**: the planet and the goddess

**Uranus, Neptune, Pluto**

**The Thousand-Yard Model** of the solar system, a walk

**The Under-Standing of Eclipses**

**Berenice’s Hair**, historical novel—what was the real story of how her hair became a constellation?

—and free web pages on everything from global heating to imaginary islands!

**Simple calendar**

Darker color means less moonlight in the following night.
Julian dates are at 0h UT on day 1 of the months.

| Julian Date at 0 UT between months | 2026 Sun | Mon | Tue | Wed | Thu | Fri | Sat |
|---|---|---|---|---|---|---|---|
| 2461041.5 | | | | | 1 | 2 | 3 |
| January | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| 2461072.5 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| February | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 2461100.5 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| March | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 2461131.5 | 29 | 30 | 31 | 1 | 2 | 3 | 4 |
| April | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 2461161.5 | 26 | 27 | 28 | 29 | 30 | 1 | 2 |
| May | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 2461192.5 | 31 | 1 | 2 | 3 | 4 | 5 | 6 |
| June | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| | 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| 2461222.5 | 28 | 29 | 30 | 1 | 2 | 3 | 4 |
| July | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 2461253.5 | 26 | 27 | 28 | 29 | 30 | 31 | 1 |
| August | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| 2461284.5 | 30 | 31 | 1 | 2 | 3 | 4 | 5 |
| September | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 2461314.5 | 27 | 28 | 29 | 30 | 1 | 2 | 3 |
| October | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| 2461345.5 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| November | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 2461375.5 | 29 | 30 | 1 | 2 | 3 | 4 | 5 |
| December | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 2461406.5 | 27 | 28 | 29 | 30 | 31 | 1 | |

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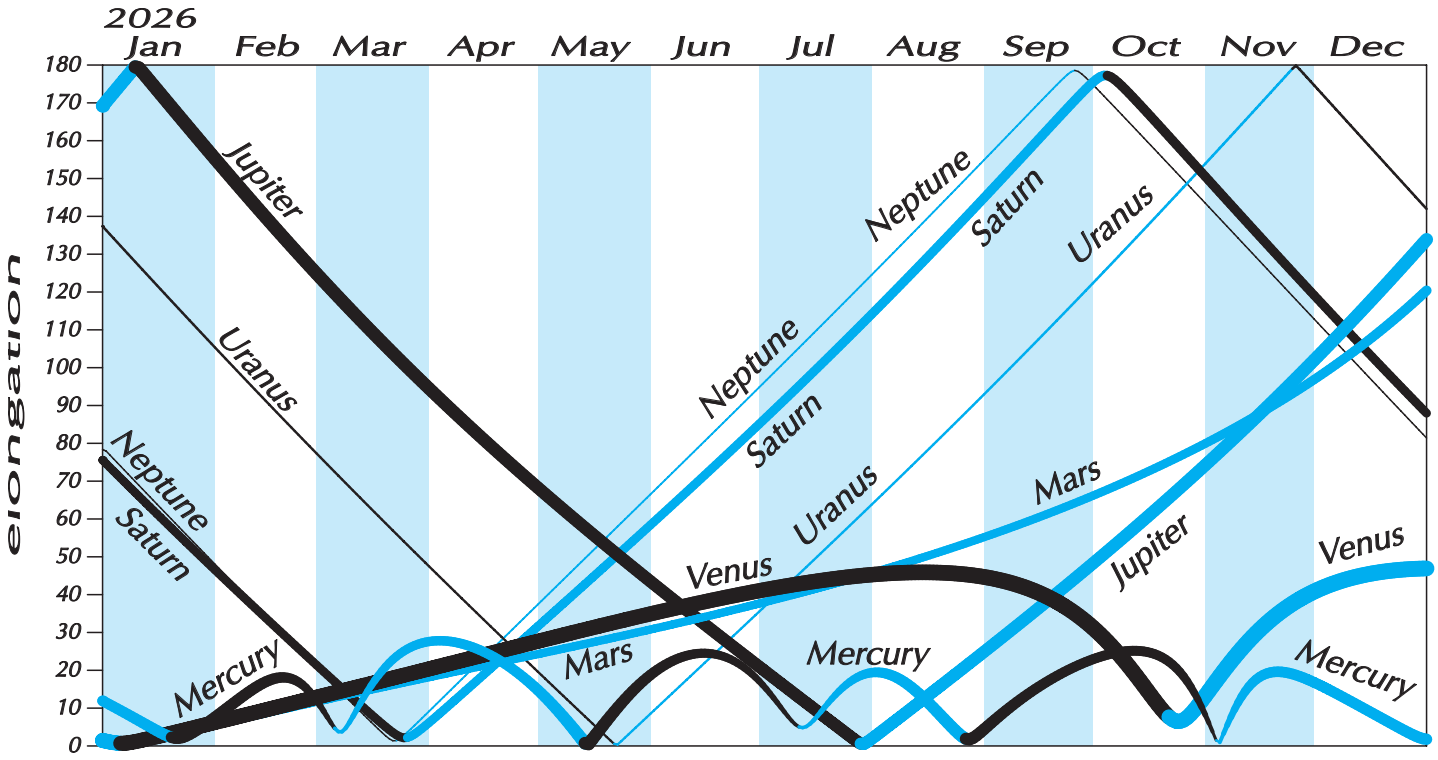
**This graph summarizes the observability of the planets. The vertical dimension is elongation (angular distance from the Sun). The curve for a planet is blue when it is in the morning sky, black when in the evening sky. The thickness of the curve is proportional to the planet's magnitude (brightness). Not taken into account is the planet's declination (angular distance north or south of the equator). A planet reaches the top of the graph when it is at opposition.**



*Cover picture:* ***The Globe's Sky***

From our balcony we look far down on the Globe: a building, a theatre in the round, open to the sky. It was, as we realized when we came to live here, the inevitable theme for the final Astronomical Calendar cover picture.

The Globe we look down on, close beside the Thames, is a replica of the 1599 Globe, which itself was made of timber stolen from an earlier theatre, called The Theatre, which was in the Shoreditch district of central London.

In Elizabethan times, there were "playing companies" with names like Lord Hunsdon's Men, Lord Strange's Men, Leicester's Men, Pembroke's Men. The Lord Chamberlain's Men had as patron the queen's courtier in charge of entertainment.

They performed at first in The Theatre. James Burbage had had it built, in 1576. When the lease on the land expired, the landlord, Giles Allen, claimed he also owned the building. While he was away for Christmas dinner in 1598, Burbage's sons and the carpenter Peter Street and other members and supporters of the Lord Chamberlain's Men dismantled it and carted all the beams to Street's riverside warehouse, from which they were ferried across for rebuilding on a site in Southwark, one block back from the river.

The company consisted of six business "sharers," two of whom, the Burbage brothers, owned double shares. Most but not all were actors; other actors were hired, and there were boy apprentices, needed for the female roles. The star actors were Richard Burbage (the great tragic roles, Hamlet, Othello, Lear, Macbeth) and William Kempe (Bottom, Falstaff, and other clowns to please the groundlings). Plays by Ben Jonson and others were performed. One sharer, William Shakespeare from Warwickshire, not only acted but wrote. His plays proved so profitable that the company kept him churning them out. Pressure to hurry-hurry-we-need-it-tomorrow could have been what forced his quill pen to pour out, with no time for editing down to normality, his streams of dazzlingly incautious language.

The theatre burned down in 1613. It was rebuilt in 1614, but closed in 1642 when the Puritan Parliament banned playhouses for their "lascivious mirth and levity."

It was reconstructed in 1997, on a more conspicuous site 250 yards to the northwest beside the Thames.

The endeavor was headed by the American actor and director Sam Wanamaker. The reconstruction was to be as faithful as possible to the 1599 design. What exactly that design was had been a long topic of research; evidence was from old documents and from traces of the foundations, which, when they could be located, were mostly under other buildings and could not be excavated.

It's a remarkable design — architected by whom? Perhaps the Lord Chamberlain's Men asked their carpenter, Peter Street, for a circular building, and the twenty-sided polygon was the approximation they got.

The "yard" at ground level was rush-strewn and "groundlings" paid a penny to stand there. Above were galleries with seating for those paying more, and total capacity was three thousand. (Modern safety regulations allow half as many.)

The stage projected into the yard, at shoulder level among the groundlings. Actors might enter through doors from the "tiring house" (dressing room), or run up the steps on three sides, or even emerge by a trap door from the "cellarage." The roof over the stage was a place for musicians, or for upper scenes such as Juliet's balcony appearance. The outer walls were half-timbered in the Tudor black-and-white style, and the roof over the top gallery was thatched.

The replica is called Shakespeare's Globe, to distinguish it from its predecessor (Burbage's Globe?). The street between us and it is called New Globe Walk.

Globe, sphere, dome, theatre: overlapping words.

Globe and sphere derive, through Latin globus and Greek sphaira, from roots in the proto-Indo-European language with the meaning of a clod, a lump of earth. Dome came, through Latin and Greek words for a home or house or the cupola on it, from a proto-language root meaning house. From a stem meaning "see, watch, contemplate" Greek got theatron and theoria (but not theme or theos).

Globe and sphere both came to be applied to a lump that is round, a ball; hence to the planet; hence to a model of it. Sphere went on to mean any volume of that shape, whether filled or empty; or a model of it; or a shell of that volume, such as the atmosphere, troposphere, hydrosphere; or the surface of it, as in "celestial sphere.

Both acquired figurative meanings, but contrastingly. Globe, from its association with the planet, carries a sense of wholeness; sphere, from association with layers, connotes partialness. You can make a global change, you can't make a spherical one. The anthroposphere is sliced into components such as the cybersphere, blogosphere, and (forsooth) manosphere.

Universality, as much as shape, suggested Globe as the name. Drama puts all humanity on display. "All the world's a stage" says Jacques in As You Like It. And Macbeth: "Life's but a walking shadow, a poor player That struts and frets his hour upon the stage."

Dome: it's the upper section of a sphere. From our balcony we look down to the Globe, and across the river to the dome of St. Paul's cathedral. From nearby, there are sightlines to that great dome past the Globe, or past the astonishing steel arches of the Millennium Bridge or the Blackfriars Railwayh Bridge. Domes are composed of arches.

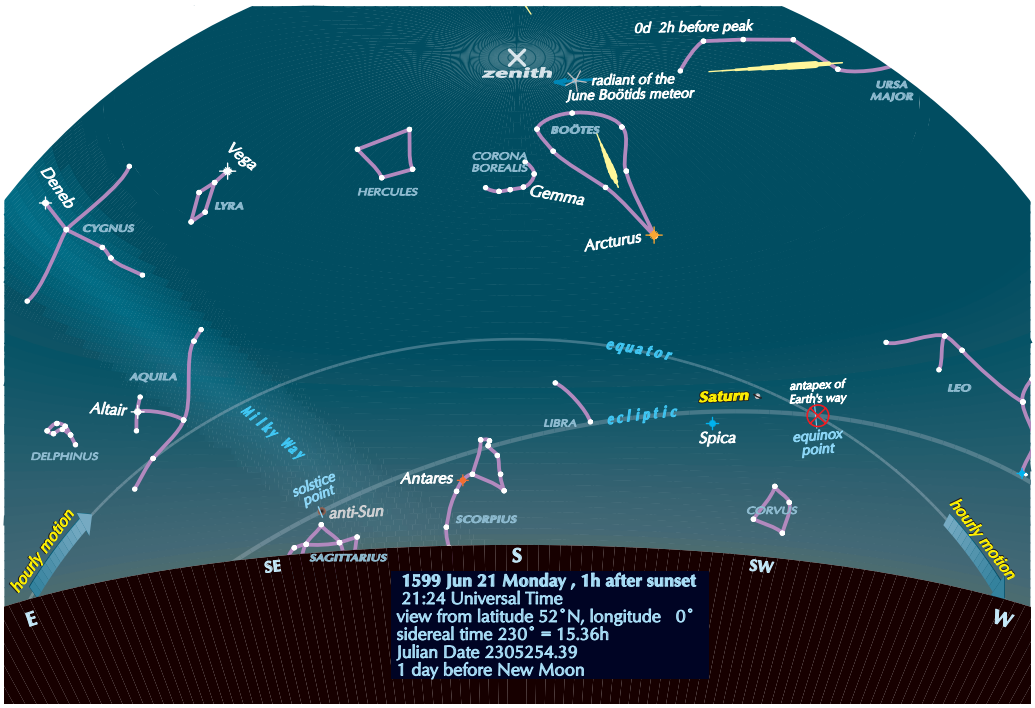
Theatres: the early Greek ones were cut into hillsides, with a semicircular slope of seating focused on the stage. Later came the amphitheatre, a closed circle or oval, like a stadium. And later, the roofed or indoor theatre.

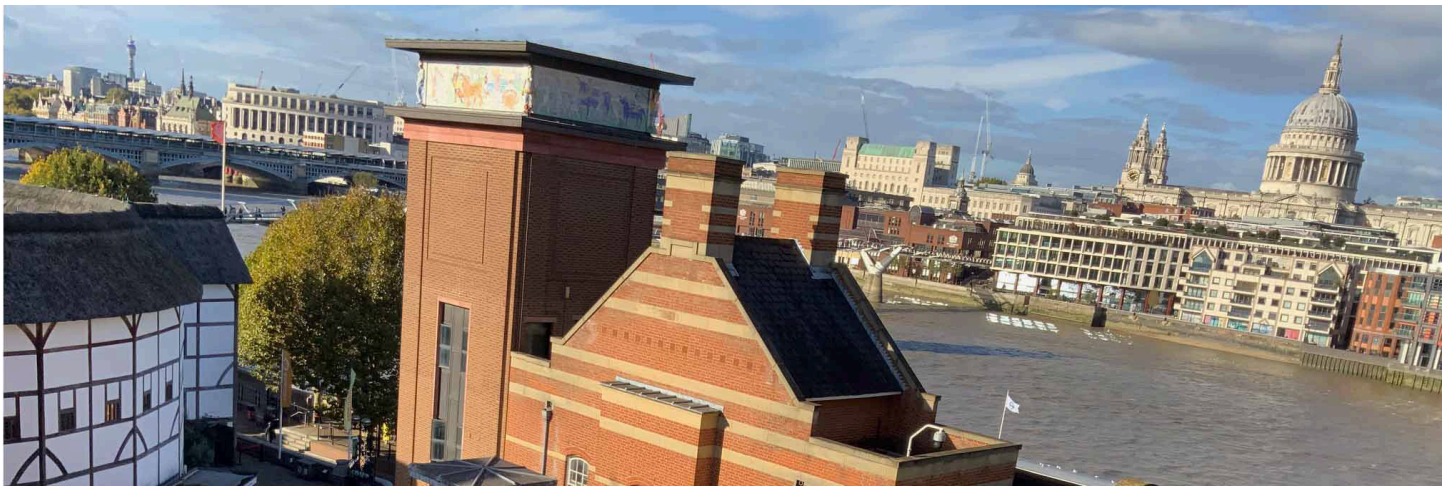
The circumpolar sky is dome-shaped: it's the section of the celestial sphere that is above the Arctic circle. The sky above your horizon at any time is a hemisphere, half of the universe. I refer to the sky map for each month in this book as a Sky Dome. It cannot be a real dome, being on flat paper; the intention is to help your imagination overcome that.

A planetarium is a theatre surmounted by a dome onto which stars are projected. An observatory has a rotating dome with a telescope slit.

The Globe, then, is amphitheatre and planetarium and observatory — poetically. The groundlings, at least, can through that wide skylight watch the stars go by. Shakespeare would have seized on these metaphors.

We need a night performance in our Globe, and I thought of



A Midsummer Night's Dream, but we need a night scene, so, the witches around their cauldron, cooking up deceptive promises for Macbeth. Make it midsummer night in 1599.

The entrance to the building is from the Thames path, on the north. The stage faces northeast into the audience. As you come in and raise your eyes, you are looking up at the north polar sky.

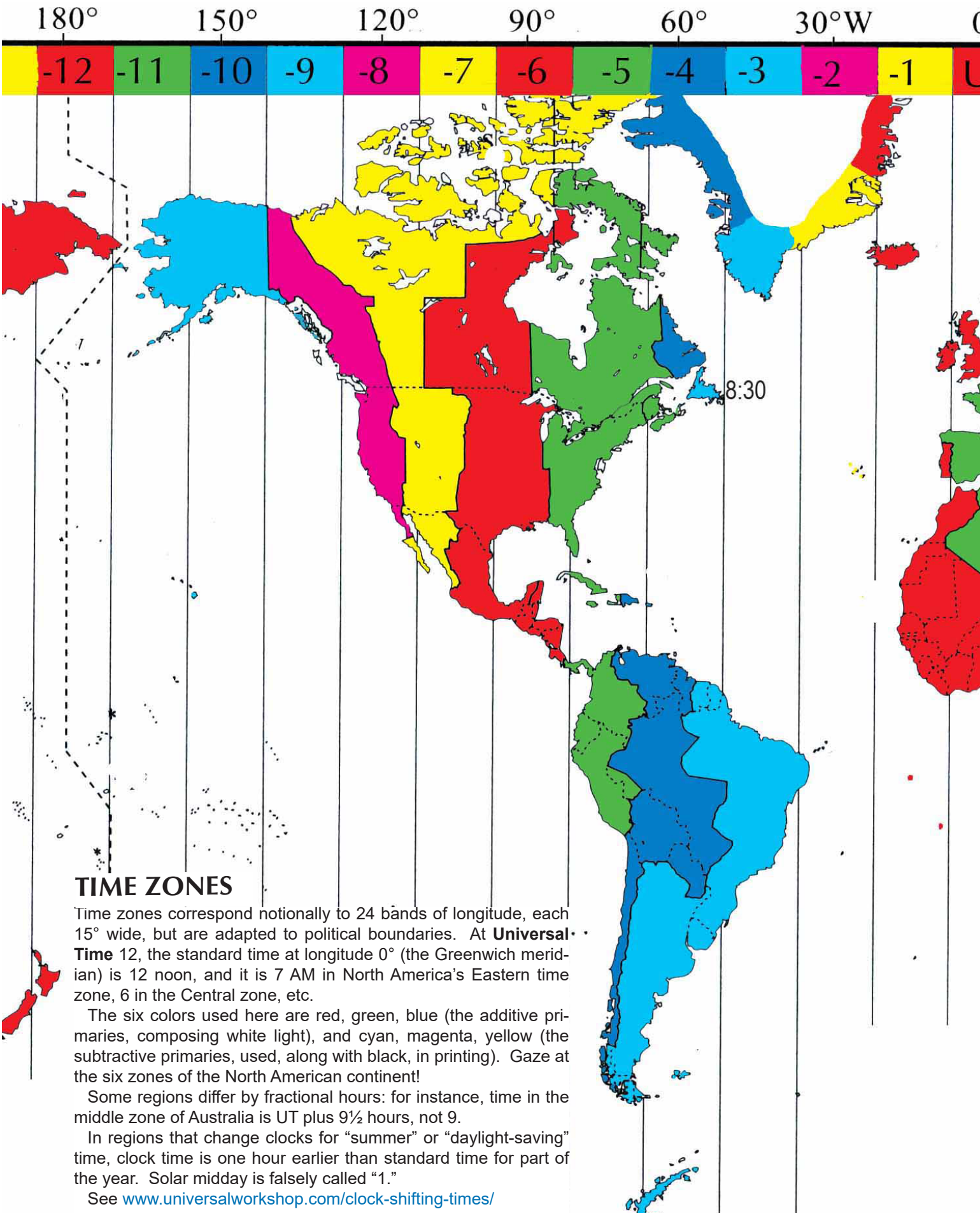
To make a drawing of complexly related structures filling a visual field that stretches from the ground underfoot to overhead and beyond — a feat of subconscious spherical trigonometry — I would need to to see it, from the viewpoint. We got no permission for special entrance. Performances in the Globe are expensive, except that you can still get standing room, not for a penny but for a few pounds. Macbeth was not on the calendar; we had to settle for Troilus and Cressida — regarded as a minor play consisting of overheated speeches by puzzling characters. So the line to get in would not be long. Cressida was a medieval conflation of Chryseis and Briseis, the heroine of my Troy Town Tale, and Troilus combined the two names of the city, Troia and Ilion. We stood near where we came in and could slip out after enduring some minutes of what Macbeth would have called "sound and fury signifying nothing."

You come in not at midnight but in the early evening. You don't see, from inside the amphitheatre, the planets and bright stars that are down on the ecliptic, but you see golden Arcturus and the jewelled Northern Crown and other Arctic constellations. And, with luck, a meteor of the June Boötids, a minor annual shower that coincides with the summer solstice. It produces usually one or two meteors an hour but occasionally a storm of hundreds.

"In the cauldron boil and bake Eye of newt and toe of frog, Wool of bat and tongue of dog, Adder's fork and blind-worm's sting, Lizard's leg and owlet's wing For a charm of powerful trouble Like a hell-broth boil and bubble."

Thus chant the Weird Sisters around their fire, which serves to provide ruddy uplighting for our scene. Could a spark have landed in the thatch and ignited the disaster of 1613?

With or without the Globe, time brings Shakespeare to mind. "The ills that flesh is heir to," "Tomorrow and tomorrow and tomorrow Creeps in this petty pace from day to day," "I sigh the lack of many a thing I sought..."




## TIME ZONES

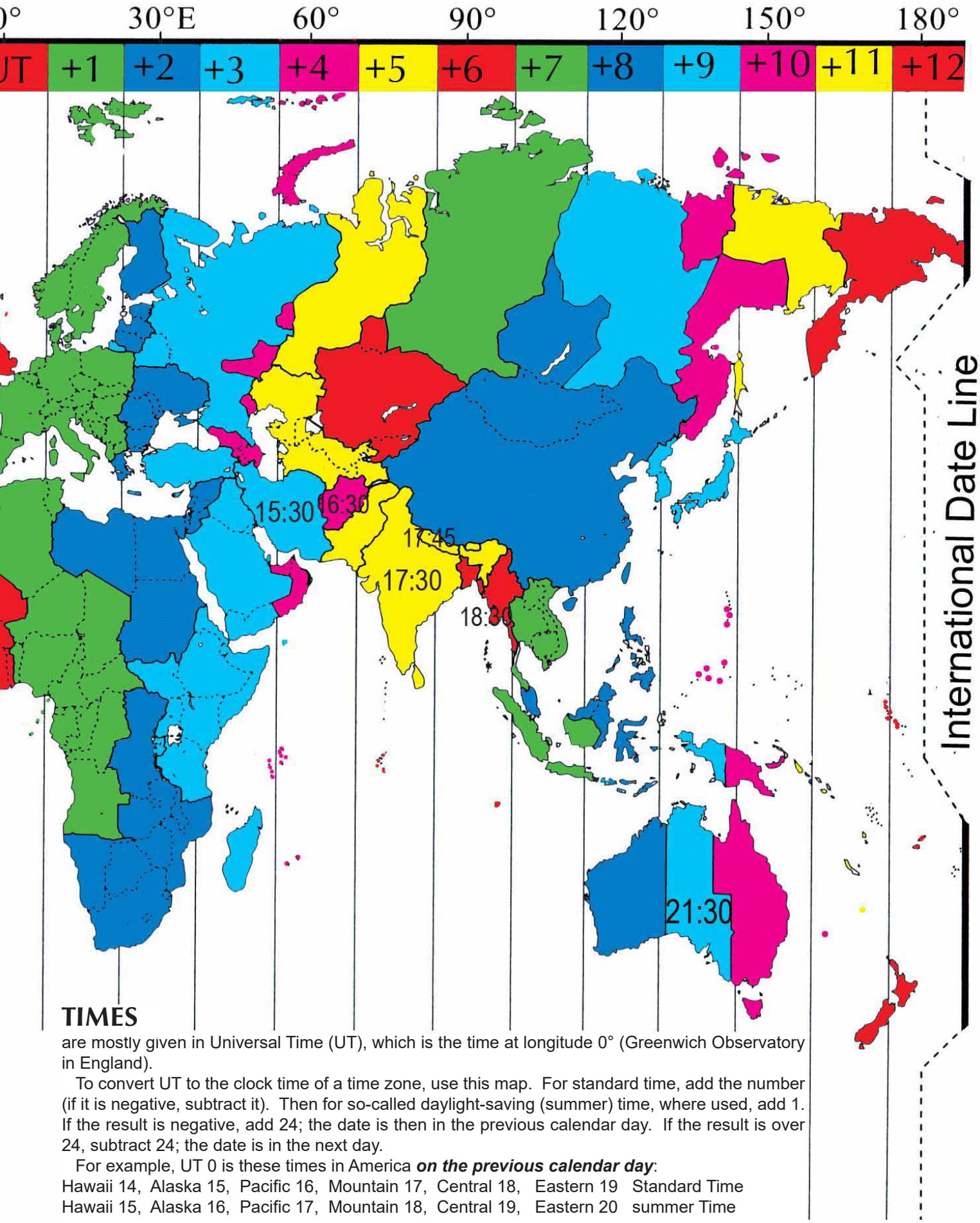
Time zones correspond notionally to 24 bands of longitude, each 15° wide, but are adapted to political boundaries. At **Universal Time** 12, the standard time at longitude 0° (the Greenwich meridian) is 12 noon, and it is 7 AM in North America's Eastern time zone, 6 in the Central zone, etc.

The six colors used here are red, green, blue (the additive primaries, composing white light), and cyan, magenta, yellow (the subtractive primaries, used, along with black, in printing). Gaze at the six zones of the North American continent!

Some regions differ by fractional hours: for instance, time in the middle zone of Australia is UT plus 9½ hours, not 9.

In regions that change clocks for "summer" or "daylight-saving" time, clock time is one hour earlier than standard time for part of the year. Solar midday is falsely called "1."

See www.universalworkshop.com/clock-shifting-times/




## TIMES

are mostly given in Universal Time (UT), which is the time at longitude 0° (Greenwich Observatory in England).

To convert UT to the clock time of a time zone, use this map. For standard time, add the number (if it is negative, subtract it). Then for so-called daylight-saving (summer) time, where used, add 1. If the result is negative, add 24; the date is then in the previous calendar day. If the result is over 24, subtract 24; the date is in the next day.

For example, UT 0 is these times in America ***on the previous calendar day***:

Hawaii 14, Alaska 15, Pacific 16, Mountain 17, Central 18, Eastern 19 Standard Time
Hawaii 15, Alaska 16, Pacific 17, Mountain 18, Central 19, Eastern 20 summer Time

# EXPLANATION OF THE MAIN FEATURES

The map for each month shows what is above the horizon at a convenient evening time, for latitude 40° north.

You can see the relation between map and sky by lying on your back with your feet pointing south, and hold the map over your face. The central point of the map is the overhead point or zenith. East is at the right of an Earth map, which is a view down, but at the left of a sky map, which is a view up. When instead of facing south you face east, turn the map so that the eastern horizon is at the bottom.

**"Rising" and "setting" arrows** show how far everything in the sky moves in one hour, rotating around the north celestial pole (near which is the Pole Star). If you look successively at the January, February, etc. maps, you will see that they form a "movie" of this rotation. The sky rotates westward (1) from hour to hour through any one night, and (2) from month to month, if viewed at the same time each month.

**The approximate evening time** of the maps (around 9-10 PM) are in local Sun time, disregarding summer clock-change rules.

**Stars** are shown down to magnitude 5.5, which is about the naked-eye limit in average conditions.

**Constellations.** Lines from star to star suggest the traditional pictures of the constellations. There are 88 official constellations, but in these maps we show only the more conspicuous ones. Not all the stars along the lines are bright enough to be marked. Such form-lines are usually straight, but ours curve for better expressivity. The aim is to make the constellations perceivable in the real sky (so it's no use drawing lines to stars too dim to see, or ingenious lines to non-adjacent stars to make stick figures). There is nothing official about these form-lines; you can imagine your own.

Stars are a **fixed background.** As they look on a January evening this year, so they will look next year, or indeed next century, except for small changes by *precession*, and even smaller changes by proper motion (their motion in space). In front of them is a **moving foreground**, consisting of everything inside our solar system, and inside our atmosphere, such as meteors.

**Planets** are shown at the 16th of the month, with symbols sized for brightness like the stars. Planets, when not too near the Sun, are visible to the naked eye, except Neptune; Uranus is just visible in good conditions.

These maps are of the mid-evening sky; there are other groupings of planets in the sky after midnight and in the twilight sky near sunset or sunrise. Mercury cannot appear except close to sunset or sunrise.

The **Moon** is shown (exaggerated 8 times in size) at 0h Universal Time on the days when it is at first quarter and full phases. This is 7 PM of the previous day by Eastern Standard Time, 6 PM by Central Time, etc. It is shown in its geocentric position, that is, without parallax; as seen from northern latitudes, it is slightly farther south.

**Meteor showers** listed in our calendar and described in the Meteors section are indicated by bursts of lines pointing out from their **radiant** (generally in the constellations from which the showers get their names). But some are not shown, because their radiants are not in view at map time.

The **ecliptic** is drawn as a thick curve. It marks the plane in which the Earth revolves around the Sun. The Sun appears to move along it, at a little less than 1° a day (there are 360 degrees in the circle and 365.2425 days in the year). The planets and Moon follow it approximately, sloping across it at the ascending and descending nodes of their orbits.

The **celestial equator** curves from the east point to the west point of each map. At declination 0, it is the only line of declination shown. Ticks along it are at the 24 hours of right ascension.

Four main **lines of right ascension** are shown, at 0h, 6h, 12h, and 18h. Ticks along them are at intervals of 10° of declination.

The two points where equator and ecliptic cross are the **equinox** points, where the Sun crosses the equator in March and September. And the two points where equator and ecliptic are farthest apart are the **solstice** points, where the Sun is farthest north and south of the equator in June and December.

The March or **vernal equinox point** is the origin or zero point for measuring angles around the whole sky. (It is sometimes called the "First Point of Aries" because in ancient times it was at the western edge of that constellation. Since then it has moved most of the way through Pisces, because of the effect called precession.)

The **Milky Way** (which cannot really be seen all the way down to the horizon) is drawn as six approximate levels of brightness, from star clouds down to dark lanes and dark nebulae.

The horizon, ecliptic, celestial equator, lines of right ascension, and equator of the Milky Way are all **great circles**: they appear straight as we look out at them, but they represent planes and wrap all around us.

Map positions in the sky change slightly from year to year because of precession (see our short glossary). These maps are for the present standard **epoch** of 2000.

**The difference for other latitudes on Earth.** The maps show what is seen from 40° north (such as Denver, Philadelphia, Madrid, Ankara, Beijing). There is little difference for most of the U.S., Europe, the northern Middle East, central Asia, and Japan. If you travel north, stars at the south edge of the map disappear; at the north edge others spend more time above the horizon. If you stand on either pole of the Earth, stars neither rise nor set: those on the celestial equator travel around the horizon. See the small dome maps for other latitudes.

Your **longitude** makes little difference, except for the position of the Moon, which moves westward by about its own width every hour.

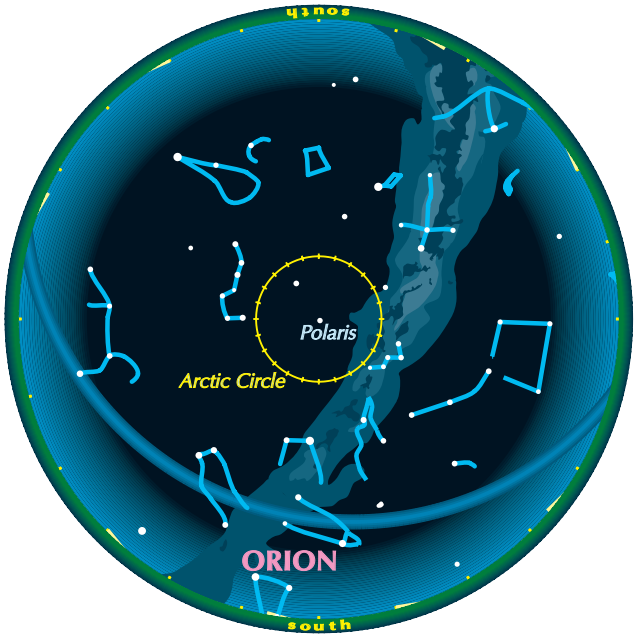
The **projection** used for the sky domes is **stereographic**, in which shapes remain constant but sizes are exaggerated toward the horizon.

For vastly richer detail of stars, galaxies, interesting points: see our poster *Map of the Starry Sky*.

**How the sky changes for other latitudes**

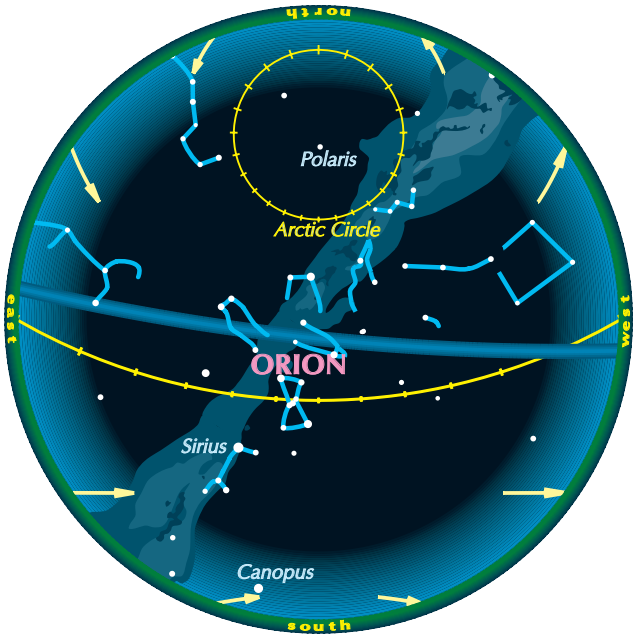
These smaller versions of the January evening sky dome show how different stars come into view at the northern and southern horizons.

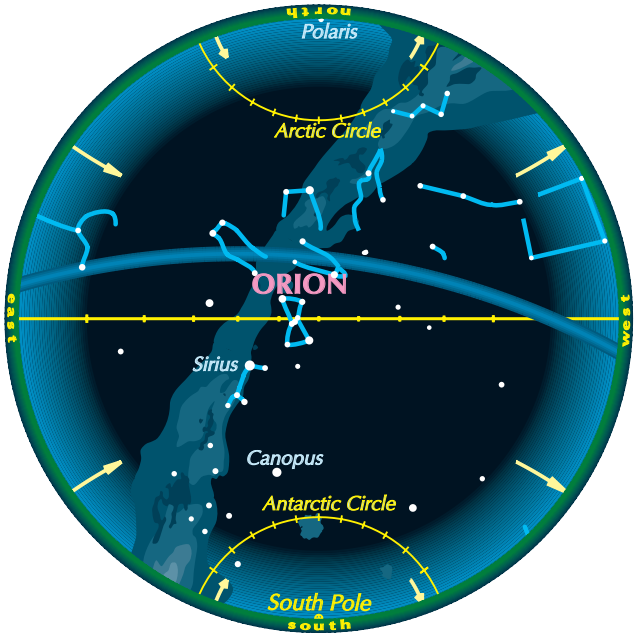
The yellow circles represent points that pass overhead for the Arctic and Antarctic circles; the yellow line is the celestial equator.



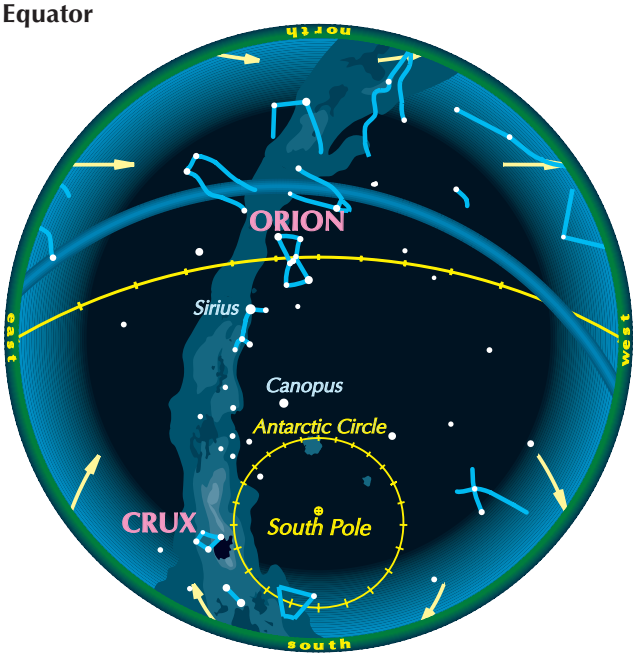

**North pole**

**Latitude 30° north**

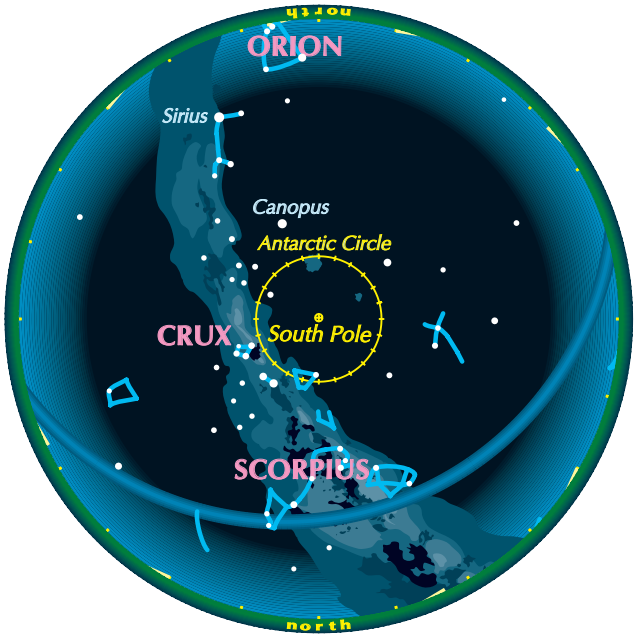



**Equator**




**Latitude 30° south**




**South pole**

### Timetables of events

The left column gives Julian dates (number of days from 4713 BC Jan. 1 noon), useful for finding time spans between events by subtraction. The first 3 digits of the Julian date (246) are omitted, to save space.

Hours and minutes, where given, are in Universal Time. (Sometimes the hour appears as "24" or the minute as "60," because the instant is shortly before the end of the day or hour.) 59 minutes and 31 seconds, rounded to the nearest minute, is 60 minutes.

Occasions such as "Moon 1.25° NNE of Venus" are **appulses**: closest apparent approaches. They are slightly different from conjunctions, when one passes north of the other as measured in right ascension or in ecliptic longitude. A quasi-conjunction is an appulse without a conjunction, and typically happens when a planet is near its stationary moment.

Occasions when three bodies are within a circle of small size are "**trios**." Like appulses, they are most interesting when the bodies are bright and are not at small elongation from the Sun.

For **meteor showers**, ZHR (zenithal hourly rate) is an estimate of the number to be seen under ideal conditions at the peak time if the radiant were overhead. Actual rates may be very different. Peak times are uncertain; it's advisable to start watching the night before. Meteors are usually most abundant in the morning hours.

### Paired scenes

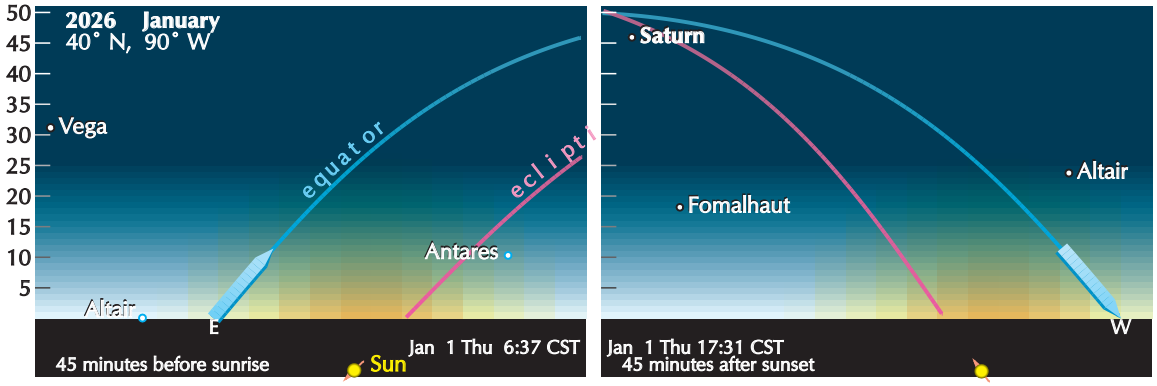
These pages show the ten "best" days in the month for opportunities to see bright bodies (Moon, major planets, first-magnitude stars) in the morning or evening ends of the night.

That is, a ranking of the days has been calculated, based on the presence of these bodies in the scene, their brightness, and their convenient altitude above the horizon and elongation (angular distance from the Sun).

So for some days only the morning scene, or only the evening scene, is "good." Nevertheless the pair is shown, because it is interesting to see the opposite horizons at the two ends of the day.

The pink curve is the ecliptic. The blue curve is the celestial equator, and the large arrow on it shows how far the sky will rotate over the next hour.

The pictures are for latitude 40° north. They would not be much different for most of the USA or Europe; but for locations such as Australia the scenes would be very different and the "best" days different.



# MINIMAL GLOSSARY

Terms used in astronomy are fully explained in our book *Albedo to Zodiac*. Here are quick-and-dirty definitions of a few essentials.

**altitude**: angular distance upward from the horizon.

**apex of Earth's way:** direction forward in Earth's orbit.

**asteroids**: small solar-system bodies, also called minor planets.

**astronomical unit (AU)**: the Sun-Earth distance (about 150,000,000 kilometers or 93,000,000 miles), used for expressing distances within the solar system.

**azimuth**: angular distance around or parallel to the horizon, usually measured from the north counter-clockwise. For instance, east is 90°.

**celestial equator**: the plane in which Earth rotates, and the line around the map of the sky showing this plane.

**declination**: angular distance north or south of the celestial equator.

**dwarf planets**: a few bodies, such as Pluto and Ceres, intermediate in size between major planets (such as Earth) and minor planets (such as asteroids).

**eccentricity**: the measure of the shape of an orbit. A circle has eccentricity zero, a long narrow ellipse has eccentricity approaching 1.

**ecliptic**: the plane in which Earth revolves around the Sun, and the line around the map of the sky showing this plane.

**elongation**: angular distance from the Sun. When a planet's elongation is negative (westward), it is in the morning sky.

**equinox**: the March equinox is when the Sun, traveling on the ecliptic, crosses the celestial equator northward, and the September equinox is when it crosses southward.

**inclination** of an orbit: its angle to the ecliptic plane.

**Julian date**: a count of days since 4713 BC, simple to use in calculations instead of years-months-days-hours.

**latitude**: on Earth, angular distance north or south of the equator; in the sky, angular distance north or south of the ecliptic.

**longitude**: on Earth, angular distance around from the zero or Greenwich meridian; in the sky, angular distance around or parallel to the ecliptic, measured from the vernal equinox point.

**magnitude**: the astronomical way of measuring brightness; it was originally an order, from "first magnitude" down. The magnitudes of the brightest stars are around 1 or 0 or even negative; of the faintest visible to the naked eye, about 5.

**node**: where one plane crosses another. Ascending node: where it crosses northward.

**occultation**: when a body, such as the Moon, hides another, such as a star.

**opposition** of a planet: when it is in the direction outward from the Sun, as seen from Earth, and appears approximately nearest and brightest. It may be somewhat north or south of the exact opposite point.

**precession**: a slow change in the map positions of everything in the sky, caused by the wobbling of Earth's rotational axis. It makes the vernal equinox point move about 1° westward along the ecliptic in 72 years.

**right ascension (RA)**: angular distance around the sky along or parallel to the celestial equator, measured from the vernal equinox point. Can be measured in 360 degrees, but is usually measured in 24 hours.

**sidereal period** of a planet: the time it takes to revolve around the Sun, in relation to the "starry" (sidereal) background.

**solstice**: the June solstice is when the Sun appears farthest north, and the December solstice is when it appears farthest south.

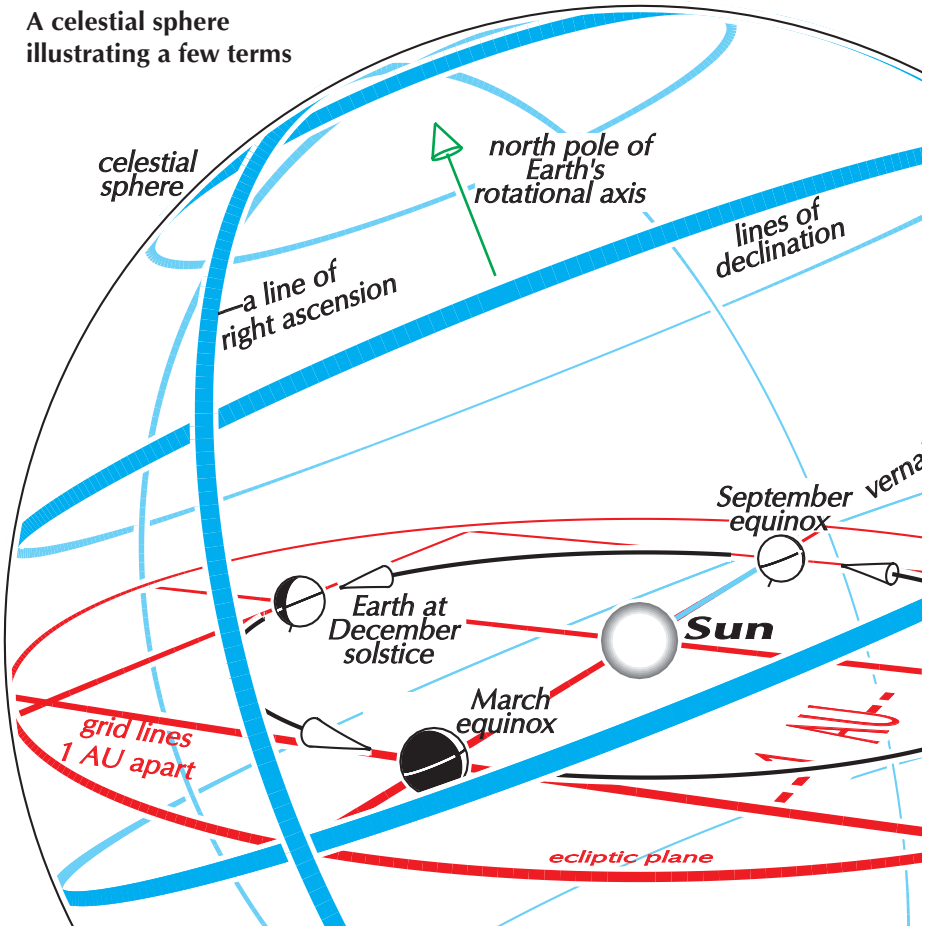
**stationary** moment: when a planet ceases to move eastward or westward, at the beginning or end of its apparent retrograde path.

**synodic period** of a planet: the time it takes to travel around the sky, as seen from Earth which is itself moving; for instance, the time from one opposition to the next.

**universal time (UT)**: the time by the Sun at the zero or Greenwich meridian of longitude on Earth.

**vernal equinox point**: where the ecliptic crosses the celestial equator northward. It is the origin (zero point) for mapping all positions in the sky.

**A celestial sphere illustrating a few terms**



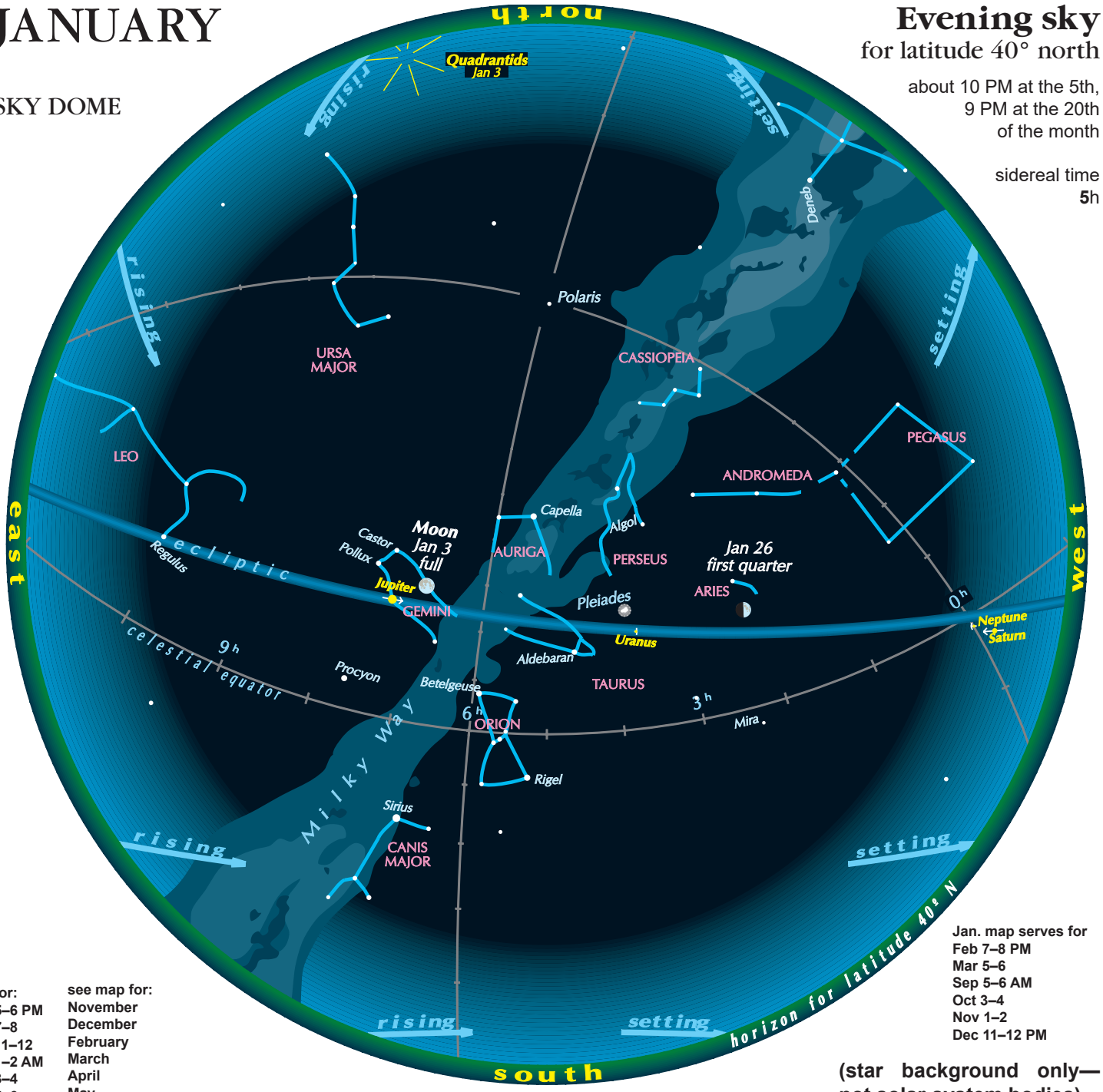
# JANUARY

## SKY DOME

## Evening sky
for latitude 40° north

about 10 PM at the 5th,
9 PM at the 20th
of the month

sidereal time
**5**h




| for: | see map for: |
|---|---|
| 5–6 PM | November |
| 7–8 | December |
| 11–12 | February |
| 1–2 AM | March |
| 3–4 | April |
| 5–6 | May |

Jan. map serves for
Feb 7–8 PM
Mar 5–6
Sep 5–6 AM
Oct 3–4
Nov 1–2
Dec 11–12 PM

**(star background only—not solar-system bodies)**

### Horizon scenes

In pictures like that on the facing page, angular distances are true from a center, which I usually set a little below the horizon. This reminds us that we are on a spherical planet. (The center could be on the horizon, making that a straight line; or at the zenith, making the horizon a circle.)

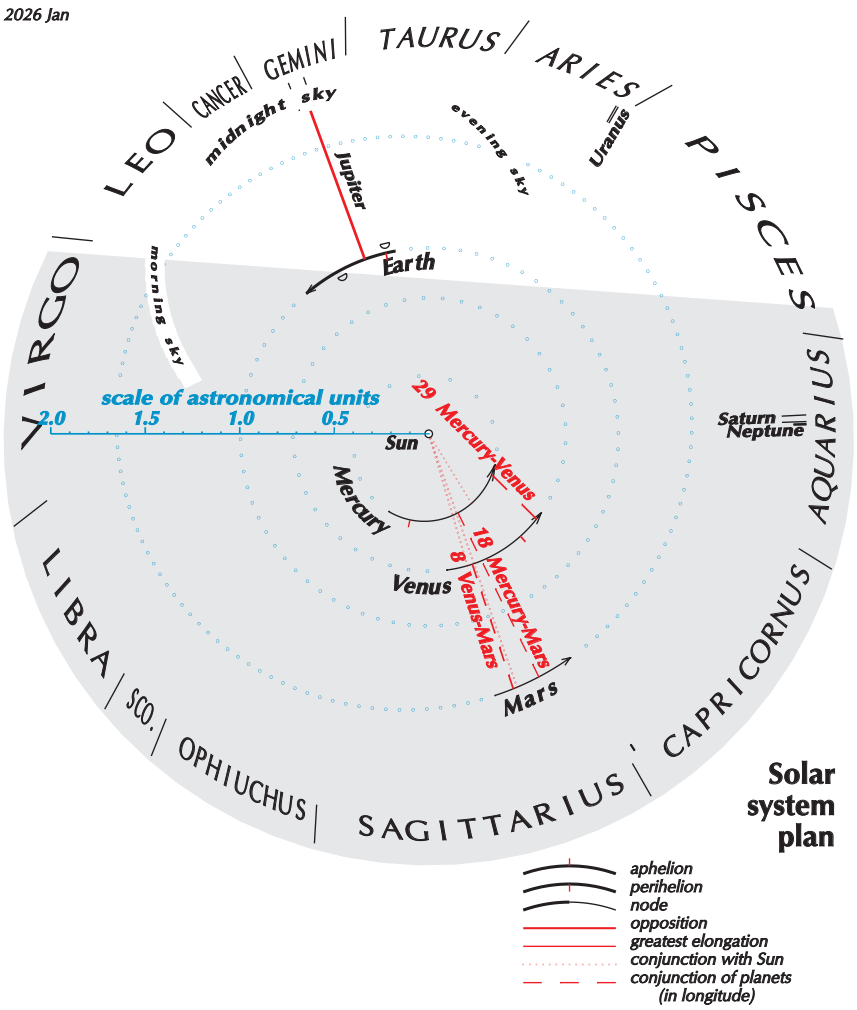
The flying Moon is shown, twice real size, at the picture time and the same time 1 and 2 days before and after. Its position is affected by parallax: seen from farther south, it would appear farther north. The arrows between positions are without parallax (as seen from Earth's center), showing the difference parallax makes.

The Sun is shown, also at twice size, even if underground. Arrows through the Sun and planets show their movement over 5 days, in relation to the starry background. Venus and Saturn are drawn at 150 times scale, so that you can see Venus's crescent shape and the current orientation of Saturn's rings; other planets have symbols sized for brightness so that they can be compared with the stars.

The curving form-lines that I use for constellations are thick for more conspicuous constellations, thin for others, which in other pictures are omitted.

A broad arrow on the celestial equator shows how far the sky will rotate in the next hour, carrying stars up from the eastern and down to the western horizon.

The Milky Way and dimmer planets and stars are unlikely to be visible in twilight or near the horizon. They are shown because they aid perception of where we are looking out into our solar system and galaxy.




In these views from ecliptic north, arrows (thinner when south of the ecliptic plane) are the paths of the four inner planets. Dots along the rest of the orbits are 5 days apart (and are black for the part of its course that a planet has trodden since the beginning of the year).

Semicircles show the sunlit side of the new and full Moon (vastly exaggerated in size and distance).

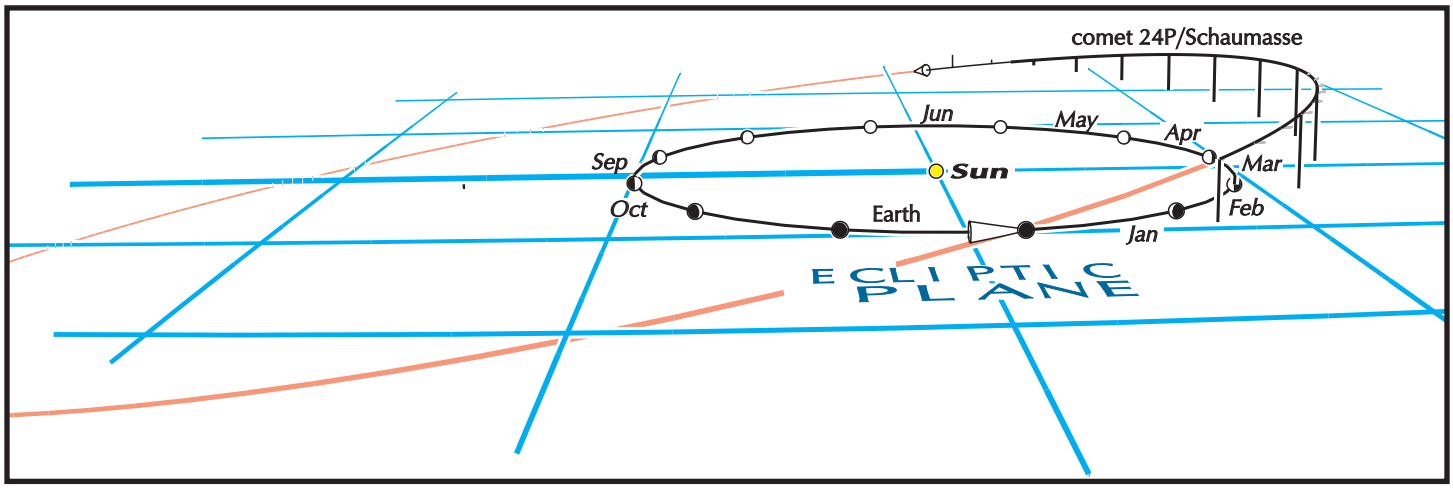
Pairs of lines point outward to the more remote planets.

Phenomena such as perihelia (represented by ticks) and conjunctions (represented by lines between planets) are at dates that can be found in the list.

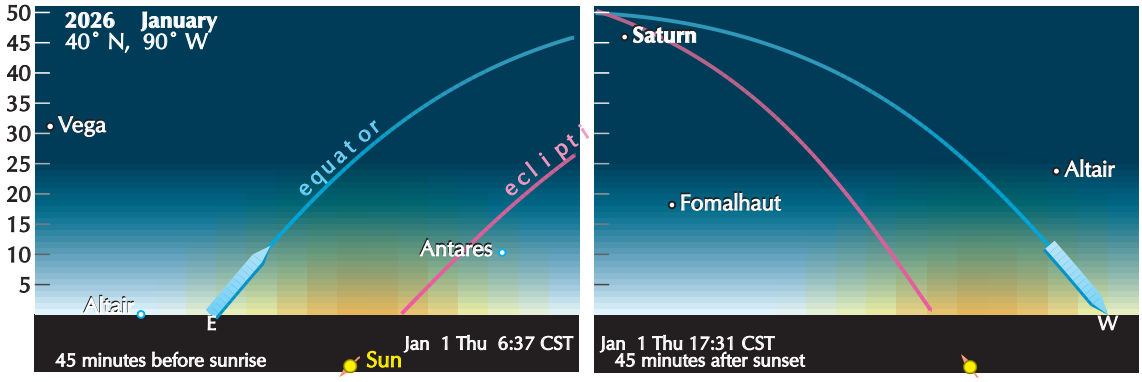
Gray covers the half of the universe below the horizon around 10 PM at mid-month (as seen from the equator).

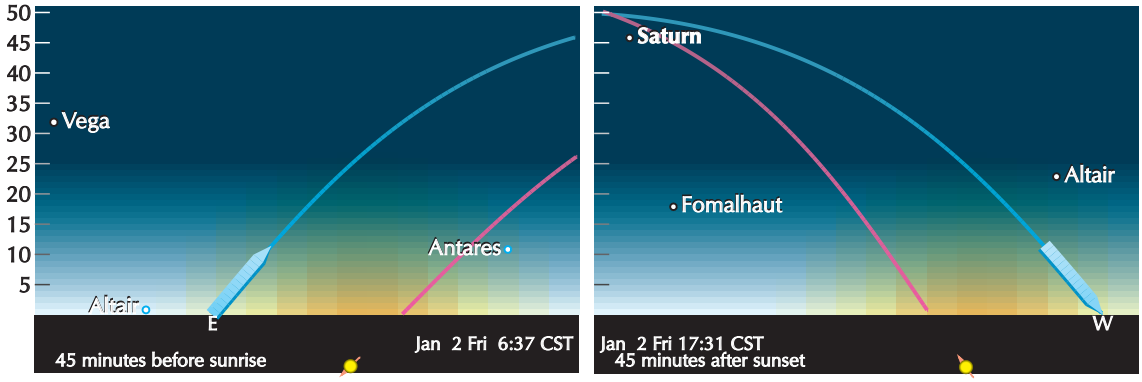
The zodiacal constellations are in directions from the Earth at mid-month (not from the Sun).

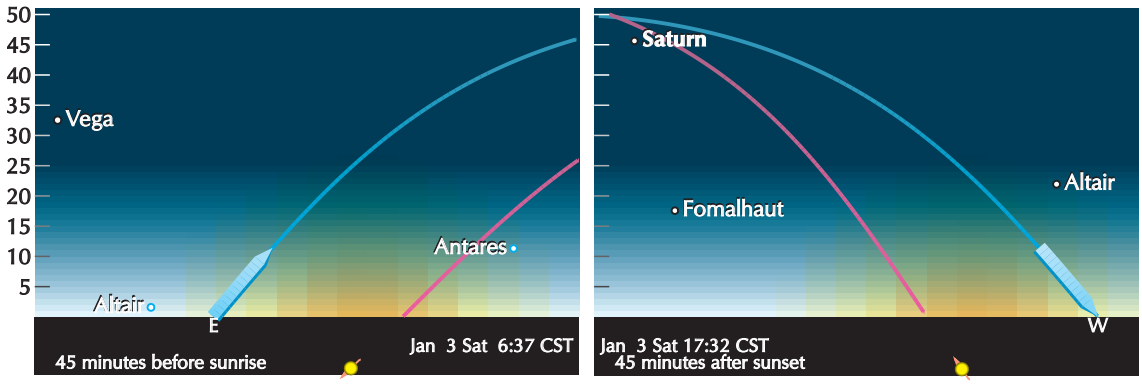
**Space view showing the orbit of a comet and the part that it travels this year. The ecliptic plane is represented by a grid of lines on it at intervals of 1 AU (astronomical unit, Sun-Earth distance). The thicker line, with Aries symbol, is the vernal equinox direction. The viewpoint is 6 AU from the Sun and 10° north of the plane. Stalks from the comet to the plane are at the start of each month. The Sun's size is exaggerated by 5, the Earth's by 500.**

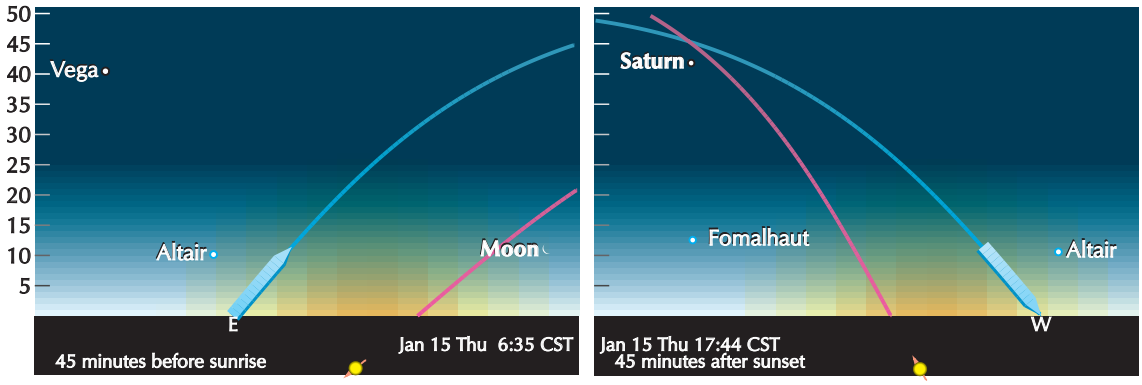


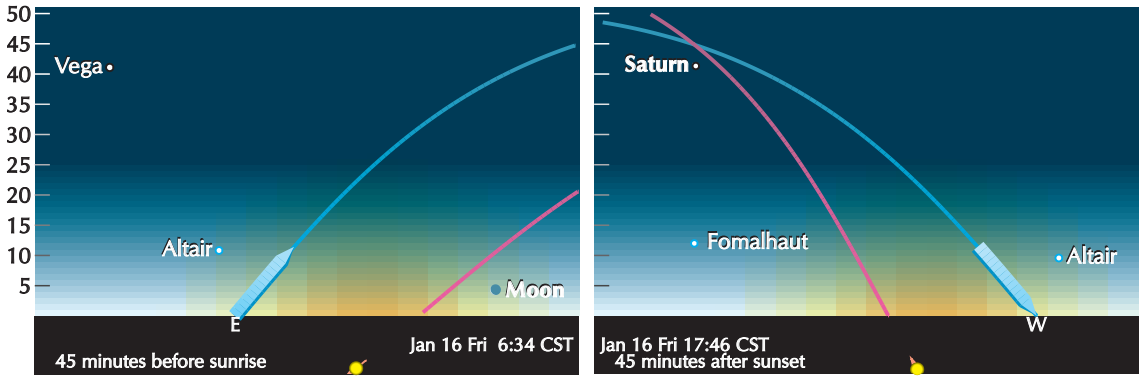
| 2026 JD 246- | | | | UT | 2026 JANUARY |
|---|---|---|---|---|---|
| 1041.5 | Jan | 1 | Thu | | Gregorian calendar Jan 1 = Julian calendar 2025 Dec 19 |
| 1042.402 | Jan | 1 | Thu | 21:39 | Moon at perigee; distance 56.50 Earth-radii |
| 1043.229 | Jan | 2 | Fri | 18 | Moon 3.8° N of M35 cluster; 169° and 170° from Sun in evening sky; magnitudes -12.6 and 5.3 |
| 1043.919 | Jan | 3 | SAT | 10:03 | Full Moon |
| 1044.042 | Jan | 3 | SAT | 13 | Quadrantid meteors; ZHR 80; near Full Moon |
| 1044.242 | Jan | 3 | SAT | 18 | Earth at perihelion; 0.9833 AU from the Sun |
| 1044.438 | Jan | 3 | SAT | 23 | Moon 6.2° S of Castor; 172° and 168° from Sun in morning sky; magnitudes -12.7 and 1.5 |
| 1044.5 | Jan | 4 | SUN | 0 | Moon 3.6° NNE of Jupiter; 171° and 173° from Sun in morning midnight sky; magnitudes -12.6 and -2.7 |
| 1044.646 | Jan | 4 | SUN | 4 | Moon 2.99° S of Pollux; 169° and 168° from Sun in morning sky; magnitudes -12.6 and 1.2 |
| 1044.807 | Jan | 4 | SUN | | Latest sunrise, at latitude 40° north |
| 1045.646 | Jan | 5 | Mon | 4 | Moon 1.52° NE of Beehive Cluster; 156° and 157° from Sun in morning sky; magnitudes -12.2 and 3.7 |
| 1046.961 | Jan | 6 | Tue | 11 | Mercury at aphelion; 0.4667 AU from the Sun |
| 1047.166 | Jan | 6 | Tue | 16 | Venus at superior conjunction with the Sun; 1.711 AU from Earth; latitude -1.67° |
| 1047.250 | Jan | 6 | Tue | 18 | Moon 0.56° ENE of Regulus; 136° from Sun in morning sky; magnitudes -11.6 and 1.4 |
| 1047.381 | Jan | 6 | Tue | 21 | Mercury at southernmost declination, -24.38° |
| 1047.975 | Jan | 7 | Wed | 11:24 | Moon at descending node; longitude 160.3° |
| 1048.646 | Jan | 8 | Thu | 4 | Venus 0.17° N of Mars; 1° from Sun in evening sky; magnitudes -3.9 and 1.2 |
| 1050.007 | Jan | 9 | Fri | 12 | Mars at conjunction with the Sun; 2.403 AU from Earth; latitude -1.59° |
| 1050.855 | Jan | 10 | SAT | 9 | Jupiter at opposition in longitude; magnitude -2.7; declination 22.2° |
| 1051.158 | Jan | 10 | SAT | 15:48 | Last quarter Moon |
| 1051.479 | Jan | 10 | SAT | 24 | Moon 1.51° SSW of Spica; 86° and 87° from Sun in morning sky; magnitudes -9.9 and 1.0 |
| 1051.538 | Jan | 11 | SUN | 1 | Mars and Jupiter at heliocentric opposition; longitudes 290.2° and 110.2° |
| 1054.369 | Jan | 13 | Tue | 21 | Moon at apogee; distance 63.57 Earth-radii |
| 1054.5 | Jan | 14 | Wed | | Julian calendar 2026 Jan 1 |
| 1055.354 | Jan | 14 | Wed | 21 | Moon 0.59° SE of Antares; 45° from Sun in morning sky; magnitudes -7.8 and 1.0 |
| 1058.792 | Jan | 18 | SUN | 7 | Mercury 0.96° S of Mars; 3° and 2° from Sun in morning sky; magnitudes -1.2 and 1.2 |
| 1058.875 | Jan | 18 | SUN | 9 | Mercury, Venus, and Mars within circle of diameter 5.00°; only about 1° from the Sun; magnitudes -1, -4, 1 |


2026 January
40° N, 90° W
Vega
equator
ecliptic
Antares
Altair
E
45 minutes before sunrise
Sun
Jan 1 Thu 6:37 CST
Saturn
Altair
Fomalhaut
W
Jan 1 Thu 17:31 CST
45 minutes after sunset

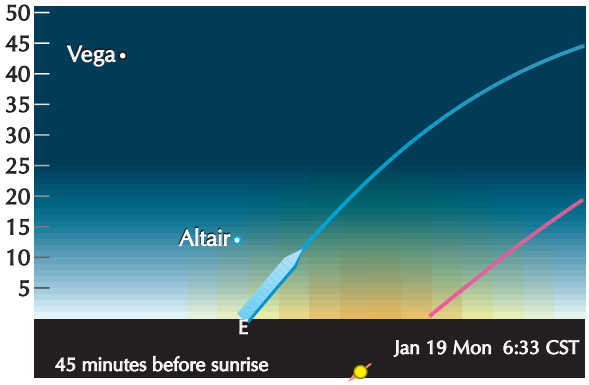

Vega
Antares
Altair
E
45 minutes before sunrise
Jan 2 Fri 6:37 CST
Saturn
Altair
Fomalhaut
W
Jan 2 Fri 17:31 CST
45 minutes after sunset


Vega
Antares
Altair
E
45 minutes before sunrise
Jan 3 Sat 6:37 CST
Saturn
Altair
Fomalhaut
W
Jan 3 Sat 17:32 CST
45 minutes after sunset


Vega
Altair
Moon
E
45 minutes before sunrise
Jan 15 Thu 6:35 CST
Saturn
Fomalhaut
Altair
W
Jan 15 Thu 17:44 CST
45 minutes after sunset


Vega
Altair
Moon
E
45 minutes before sunrise
Jan 16 Fri 6:34 CST
Saturn
Fomalhaut
Altair
W
Jan 16 Fri 17:46 CST
45 minutes after sunset

| | | | | | |
|---|---|---|---|---|---|
| 1059.142 | Jan | 18 | SUN | 15 | Moon, Mercury, and Mars within circle of diameter 2.54°; only about 3° from the Sun; magnitudes -4, -1, 1 |
| 1059.167 | Jan | 18 | SUN | 16 | Moon 2.54° SE of Mars; 4° and 2° from Sun in morning sky; magnitudes -4.3 and 1.2 |
| 1059.188 | Jan | 18 | SUN | 17 | Moon 1.55° SE of Mercury; 4° and 3° from Sun in morning sky; magnitudes -4.3 and -1.2 |
| 1059.258 | Jan | 18 | SUN | 18 | Moon, Venus, and Mars within circle of diameter 5.15°; only about 1° from the Sun; magnitudes -4, -4, 1 |
| | | | | | _____ |
| 1059.328 | Jan | 18 | SUN | 19:52 | New Moon; beginning of lunation 1275 |
| 1059.542 | Jan | 19 | Mon | 1 | Moon, Mercury, and Venus within circle of diameter 4.74°; only about 2° from the Sun; magnitudes -4, -1, -4 |
| 1059.625 | Jan | 19 | Mon | 3 | Moon 2.06° SE of Venus; 5° and 3° from Sun in evening sky; magnitudes -4.4 and -3.9 |
| 1060.388 | Jan | 19 | Mon | 21 | Sun enters Capricornus, at longitude 299.81° on the ecliptic |
| 1060.573 | Jan | 20 | Tue | 2 | Sun enters the astrological sign Aquarius, i.e. its longitude is 300° |
| 1062.148 | Jan | 21 | Wed | 16 | Mercury at superior conjunction with the Sun; 1.417 AU from Earth; latitude -6.70° |
| 1062.503 | Jan | 22 | Thu | 0:04 | Moon at ascending node; longitude 339.3° |
| 1063.292 | Jan | 22 | Thu | 19 | Venus at aphelion; 0.7282 AU from the Sun |
| 1063.576 | Jan | 23 | Fri | 2 | Pluto at conjunction with the Sun; 36.419 AU from Earth; latitude -3.89° |
| 1063.896 | Jan | 23 | Fri | 10 | Moon 3.8° NNW of Saturn; 54° from Sun in evening sky; magnitudes -8.5 and 1.1 |
| 1063.900 | Jan | 23 | Fri | 10 | Moon, Saturn, and Neptune within circle of diameter 3.93°; about 55° from the Sun in the evening sky; magnitudes -9, 1, 8 |
| 1064.063 | Jan | 23 | Fri | 14 | Moon 3.2° NNW of Neptune; 56° from Sun in evening sky; magnitudes -8.6 and 7.9 |
| | | | | | _____ |
| 1066.699 | Jan | 26 | Mon | 4:47 | First quarter Moon |
| 1067.214 | Jan | 26 | Mon | 17 | Mercury at southernmost latitude from the ecliptic plane, -7.0° |
| 1068.208 | Jan | 27 | Tue | 17 | Moon 5.3° NNW of Uranus; 110° from Sun in evening sky; magnitudes -10.9 and 5.7 |
| 1068.242 | Jan | 27 | Tue | 18 | Moon, Uranus, and the Pleiades within circle of diameter 5.40°; about 111° from the Sun in the evening sky; magnitudes -11, 6, 3 |
| 1068.417 | Jan | 27 | Tue | 22 | Moon 1.12° N of Pleiades; 113° and 112° from Sun in evening sky |
| 1070.104 | Jan | 29 | Thu | 15 | Mercury 0.68° SE of Venus; 6° from Sun in evening sky; magnitudes -1.2 and -3.9 |
| 1070.407 | Jan | 29 | Thu | 21:46 | Moon at perigee; distance 57.36 Earth-radii |
| 1070.625 | Jan | 30 | Fri | 3 | Moon 3.9° N of M35 cluster; 142° from Sun in evening sky; magnitudes -11.9 and 5.3 |
| 1071.667 | Jan | 31 | SAT | 4 | Moon 3.8° NNE of Jupiter; 156° from Sun in evening sky; magnitudes -12.2 and -2.6 |
| 1071.854 | Jan | 31 | SAT | 9 | Moon 6.2° S of Castor; 159° and 157° from Sun in evening sky; magnitudes -12.3 and 1.5 |
| 1072.063 | Jan | 31 | SAT | 14 | Moon 2.96° S of Pollux; 162° and 161° from Sun in evening sky; magnitudes -12.4 and 1.2 |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Vega
Altair
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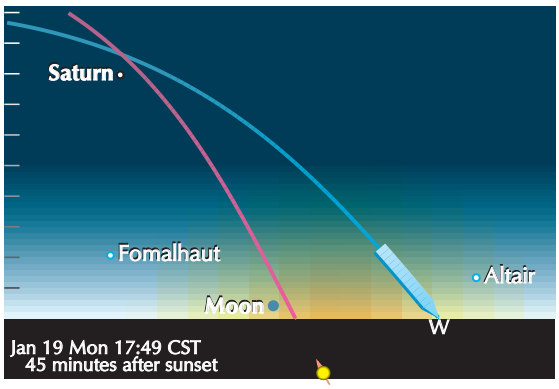
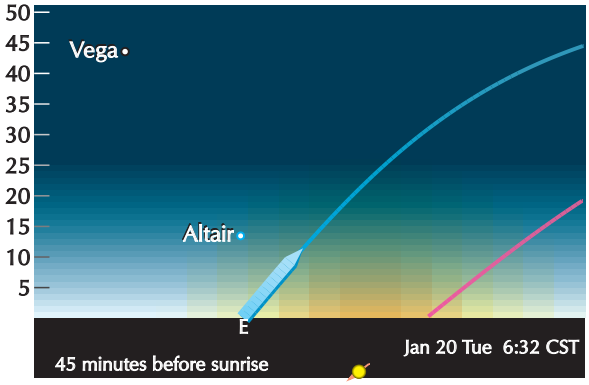
45 minutes before sunrise
Jan 19 Mon 6:33 CST


Saturn
Fomalhaut
Moon
Altair
W
Jan 19 Mon 17:49 CST
45 minutes after sunset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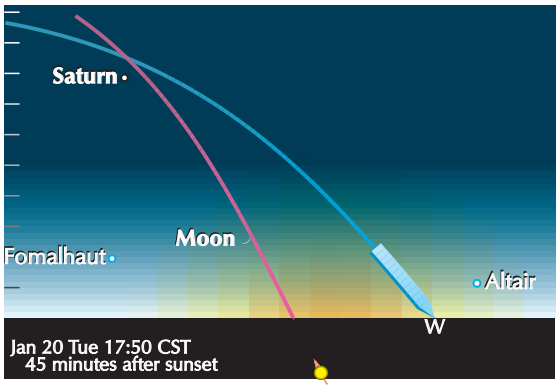
Jan 20 Tue 6:32 CST


Saturn
Moon
Fomalhaut
Altair
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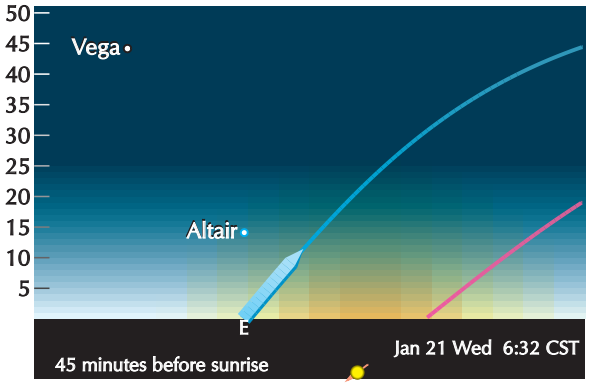
Jan 20 Tue 17:50 CST
45 minutes after sunset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Vega
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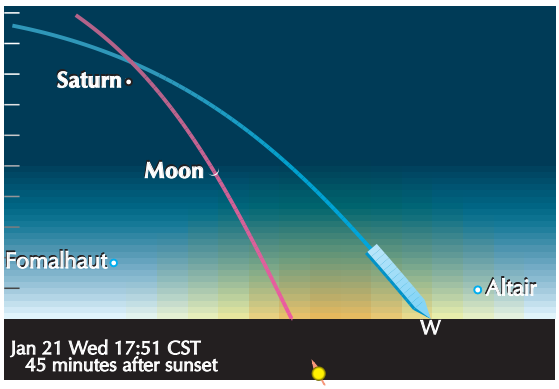
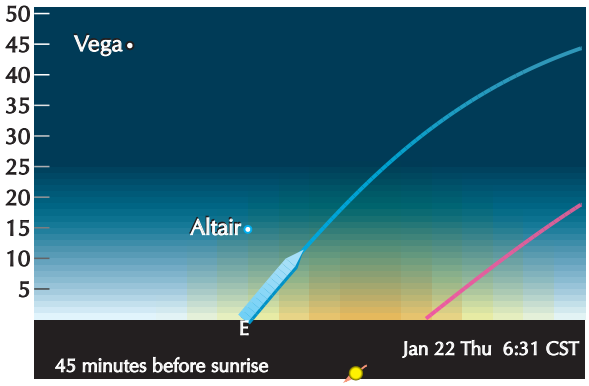
45 minutes before sunrise
Jan 21 Wed 6:32 CST


Saturn
Moon
Fomalhaut
Altair
W
Jan 21 Wed 17:51 CST
45 minutes after sunset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Vega
Altair
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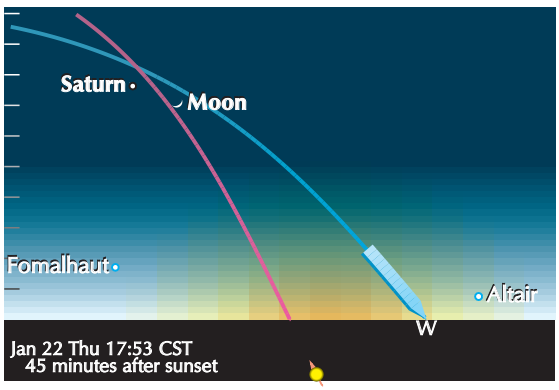
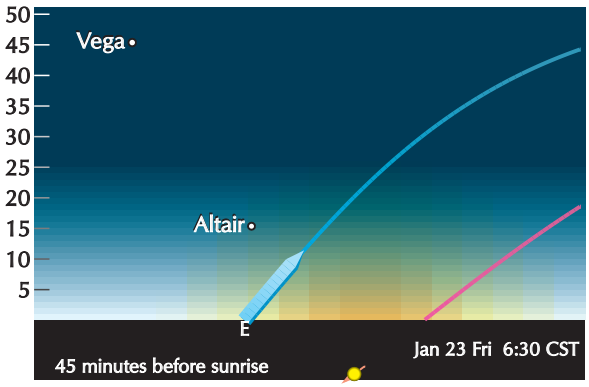
45 minutes before sunrise
Jan 22 Thu 6:31 CST


Saturn
Moon
Fomalhaut
Altair
W
Jan 22 Thu 17:53 CST
45 minutes after sunset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Vega
Altair
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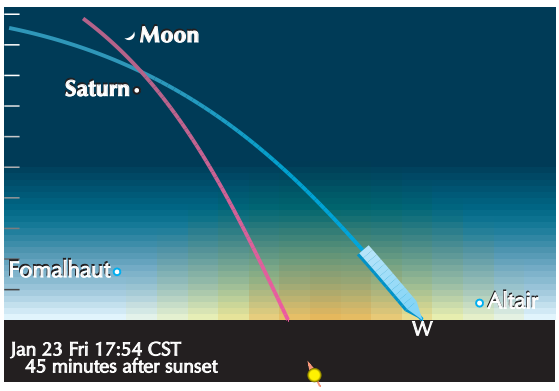
45 minutes before sunrise
Jan 23 Fri 6:30 CST

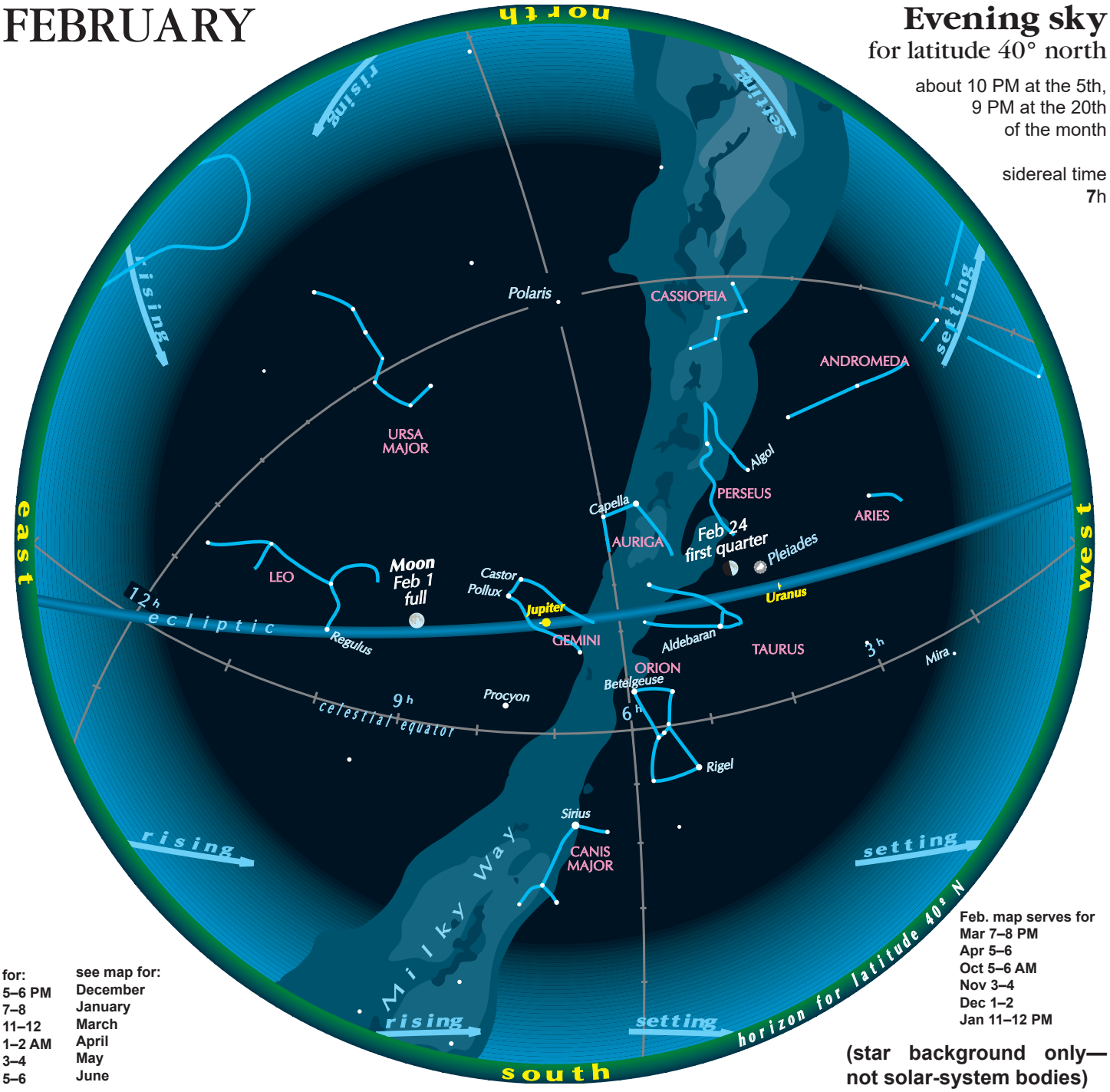

Moon
Saturn
Fomalhaut
Altair
W
Jan 23 Fri 17:54 CST
45 minutes after sunset

# FEBRUARY

## Evening sky
for latitude 40° north

about 10 PM at the 5th,
9 PM at the 20th
of the month

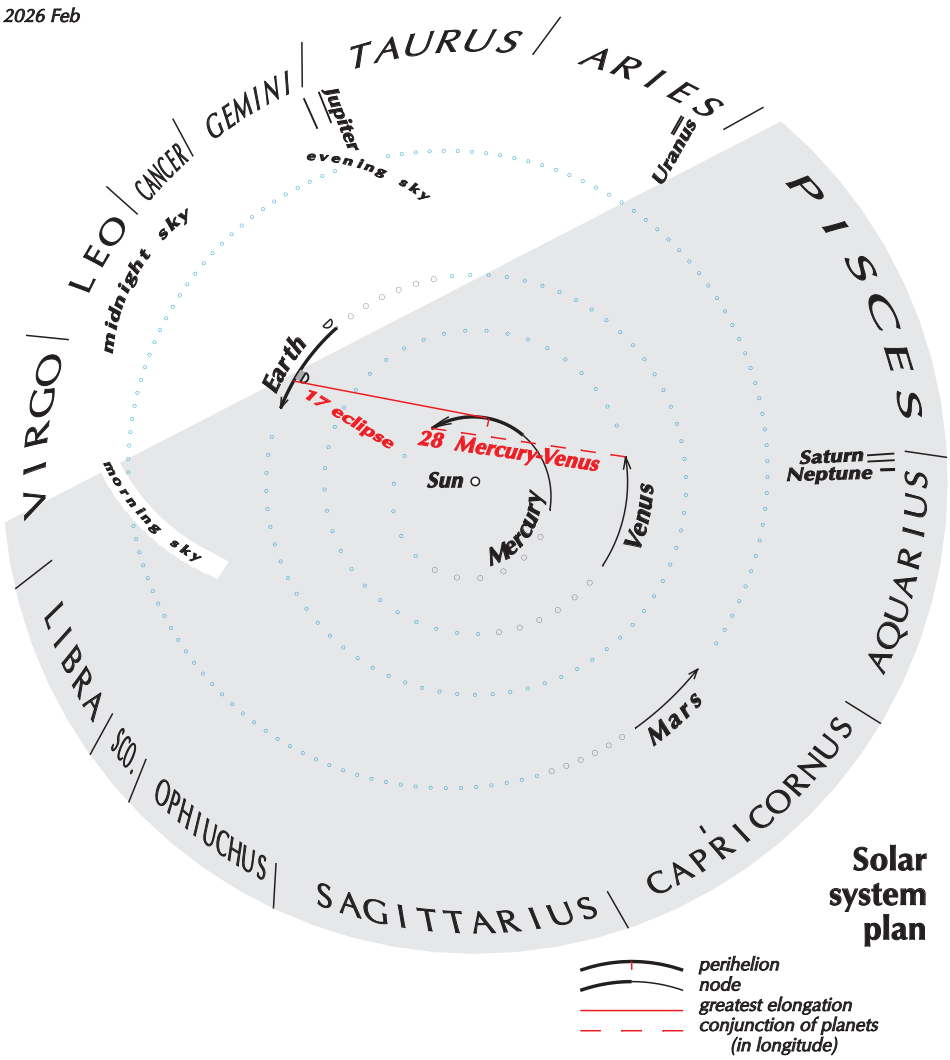
sidereal time
**7**h

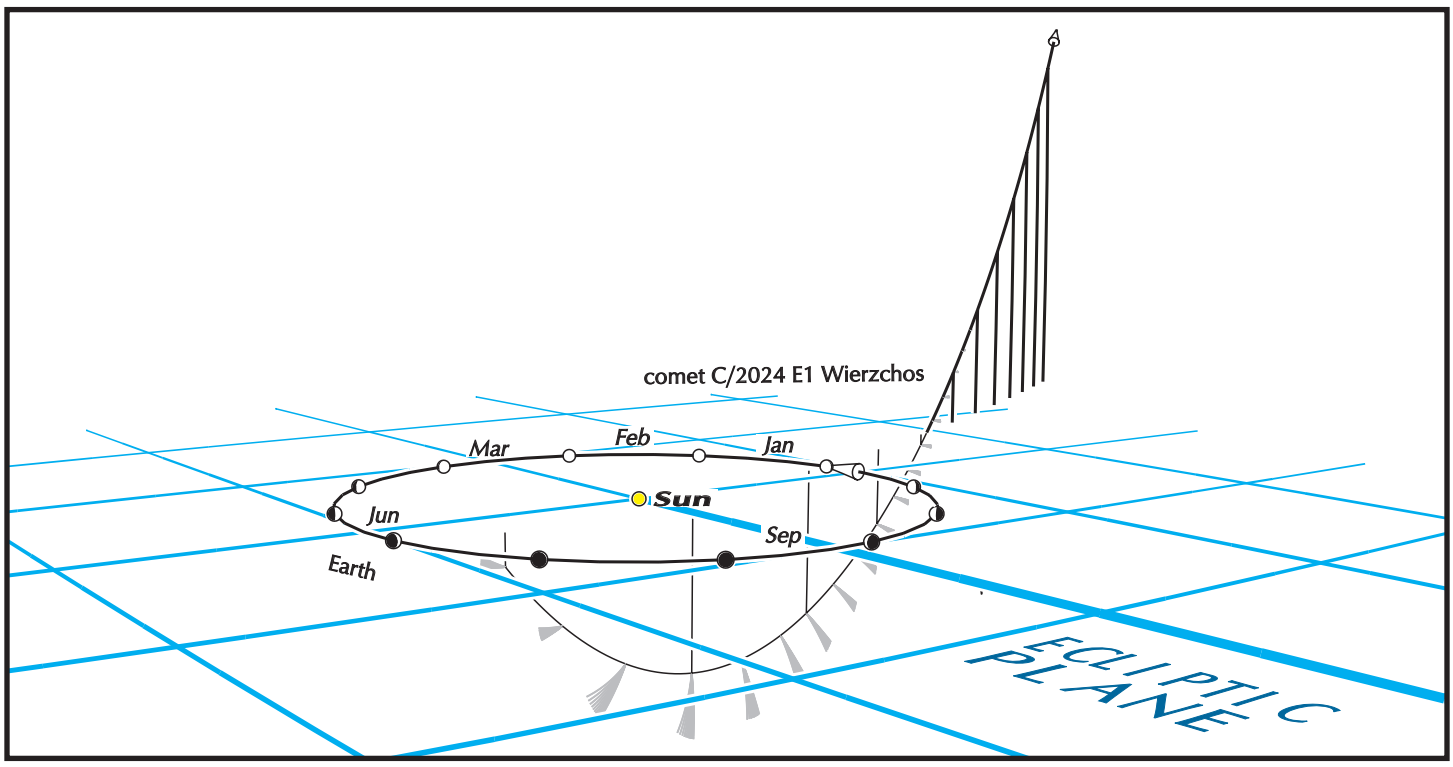



| for: | see map for: |
|---|---|
| 5–6 PM | December |
| 7–8 | January |
| 11–12 | March |
| 1–2 AM | April |
| 3–4 | May |
| 5–6 | June |

**Feb. map serves for**
Mar 7–8 PM
Apr 5–6
Oct 5–6 AM
Nov 3–4
Dec 1–2
Jan 11–12 PM

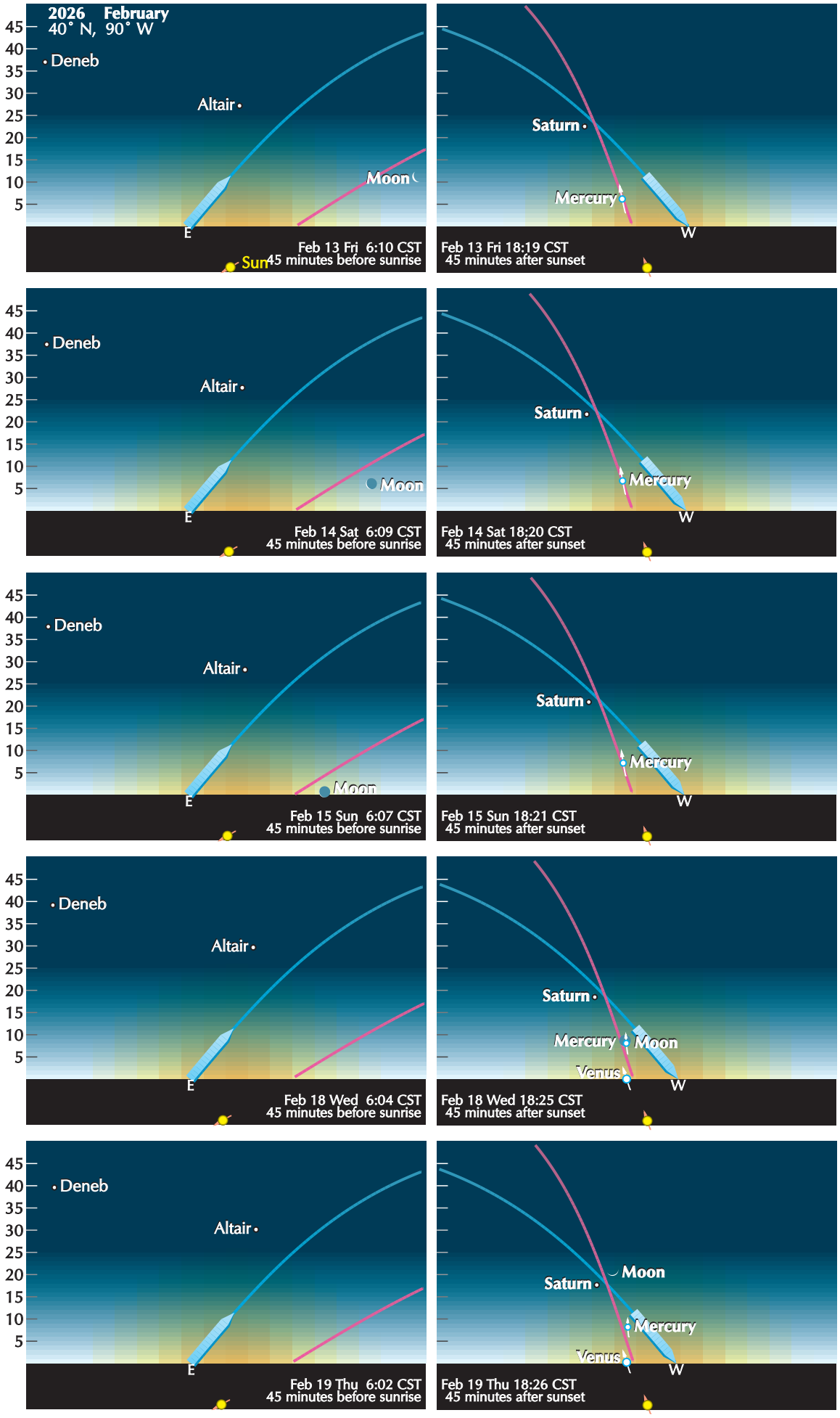
**(star background only—not solar-system bodies)**


2026 Feb
TAURUS
ARIES
GEMINI
CANCER
LEO
VIRGO
LIBRA
SCO.
OPHIUCHUS
SAGITTARIUS
CAPRICORNUS
AQUARIUS
PISCES
Jupiter
evening sky
Uranus
midnight sky
Earth
17 eclipse
28 Mercury-Venus
Sun
Mercury
Venus
Mars
Saturn
Neptune
morning sky
Solar system plan
perihelion
node
greatest elongation
conjunction of planets (in longitude)


comet C/2024 E1 Wierzchos
Mar
Feb
Jan
Sun
Jun
Sep
Earth
ECLIPTIC PLANE

2026 FEBRUARY

| | | | | | |
|---|---|---|---|---|---|
| 1073.083 | Feb | 1 | SUN | 14 | Moon 1.48° NE of Beehive Cluster; 175° from Sun in evening midnight sky; magnitudes -12.7 and 3.7 |
| 1073.423 | Feb | 1 | SUN | 22:09 | Full Moon |
| 1073.5 | Feb | 2 | Mon | | Groundhog Day |
| 1074.688 | Feb | 3 | Tue | 5 | Moon 0.54° ENE of Regulus; 164° from Sun in morning sky; magnitudes -12.4 and 1.4 |
| 1075.305 | Feb | 3 | Tue | 19:19 | Moon at descending node; longitude 159.0° |
| 1075.467 | Feb | 3 | Tue | 23 | Uranus stationary in longitude; resumes direct motion |
| 1075.550 | Feb | 4 | Wed | 1 | Uranus stationary in right ascension; resumes direct motion |
| 1078.833 | Feb | 7 | SAT | 8 | Moon 1.68° SSW of Spica; 114° from Sun in morning sky; magnitudes -10.9 and 1.0 |
| 1081.030 | Feb | 9 | Mon | 12:44 | Last quarter Moon |
| 1082.205 | Feb | 10 | Tue | 17 | Moon at apogee; distance 63.43 Earth-radii |
| 1082.688 | Feb | 11 | Wed | 5 | Moon 0.75° SE of Antares; 72° from Sun in morning sky; magnitudes -9.3 and 1.0 |
| 1082.865 | Feb | 11 | Wed | 9 | The equation of time is at a minimum of -14.22 minutes |
| 1085.433 | Feb | 13 | Fri | 22 | Venus at southernmost latitude from the ecliptic plane, -3.4° |
| 1085.5 | Feb | 14 | SAT | | St. Valentine's Day |
| 1086.273 | Feb | 14 | SAT | 19 | Mercury at ascending node through the ecliptic plane |
| 1087.705 | Feb | 16 | Mon | 5 | Uranus at east quadrature, 90° from the Sun |
| 1088.166 | Feb | 16 | Mon | 16 | Sun enters Aquarius, at longitude 327.99° on the ecliptic |
| 1088.292 | Feb | 16 | Mon | 19 | Moon 0.79° SE of Mars; 9° from Sun in morning sky; magnitudes -4.8 and 1.2 |
| 1089.001 | Feb | 17 | Tue | 12:02 | New Moon; beginning of lunation 1276; annular eclipse of the Sun |
| 1089.5 | Feb | 18 | Wed | | 1st day of Ramadan (1447 A.H.) |
| 1089.5 | Feb | 18 | Wed | | Ash Wednesday |
| 1089.764 | Feb | 18 | Wed | 6:21 | Moon at ascending node; longitude 338.9° |
| 1089.854 | Feb | 18 | Wed | 9 | Moon 1.59° NNW of Venus; 10° from Sun in evening sky; magnitudes -5.1 and -3.9 |
| 1090.161 | Feb | 18 | Wed | 16 | Sun enters the astrological sign Pisces, i.e. its longitude is 330° |
| 1090.479 | Feb | 18 | Wed | 24 | Moon 0.20° E of Mercury; 18° from Sun in evening sky; magnitudes -5.8 and -0.5 |
| 1090.946 | Feb | 19 | Thu | 11 | Mercury at perihelion; 0.3075 AU from the Sun |
| 1091.231 | Feb | 19 | Thu | 18 | Mercury at easternmost elongation; 18.1° from Sun in evening sky; magnitude -0.4 |
| 1091.342 | Feb | 19 | Thu | 20 | Moon, Saturn, and Neptune within circle of diameter 4.08°; about 29° from the Sun in the evening sky; magnitudes -7, 1, 8 |
| 1091.354 | Feb | 19 | Thu | 21 | Moon 4.1° NNW of Saturn; 29° and 30° from Sun in evening sky; magnitudes -6.8 and 1.1 |
| 1091.375 | Feb | 19 | Thu | 21 | Moon 3.3° NNW of Neptune; 30° from Sun in evening sky; magnitudes -6.8 and 7.9 |


2026 February
40° N, 90° W
Deneb
Altair
Moon
Sun
E
Feb 13 Fri 6:10 CST
45 minutes before sunrise
Saturn
Mercury
W
Feb 13 Fri 18:19 CST
45 minutes after sunset
Deneb
Altair
Moon
E
Feb 14 Sat 6:09 CST
45 minutes before sunrise
Saturn
Mercury
W
Feb 14 Sat 18:20 CST
45 minutes after sunset
Deneb
Altair
Moon
E
Feb 15 Sun 6:07 CST
45 minutes before sunrise
Saturn
Mercury
W
Feb 15 Sun 18:21 CST
45 minutes after sunset
Deneb
Altair
E
Feb 18 Wed 6:04 CST
45 minutes before sunrise
Saturn
Mercury
Moon
Venus
W
Feb 18 Wed 18:25 CST
45 minutes after sunset
Deneb
Altair
E
Feb 19 Thu 6:02 CST
45 minutes before sunrise
Saturn
Moon
Mercury
Venus
W
Feb 19 Thu 18:26 CST
45 minutes after sunset

| | | | | | |
|---|---|---|---|---|---|
| 1092.354 | Feb | 20 | Fri | 21 | Saturn 0.83° SE of Neptune; 29° from Sun in evening sky; magnitudes 1.1 and 7.9 |
| 1095.458 | Feb | 23 | Mon | 23 | Moon 5.4° N of Uranus; 83° and 82° from Sun in evening sky; magnitudes -9.9 and 5.7 |
| 1095.458 | Feb | 23 | Mon | 23 | Moon, Uranus, and the Pleiades within circle of diameter 5.42°; about 83° from the Sun in the evening sky; mag. -10, 6, 3 |
| 1095.646 | Feb | 24 | Tue | 4 | Moon 1.19° N of Pleiades; 85° from Sun in evening sky |

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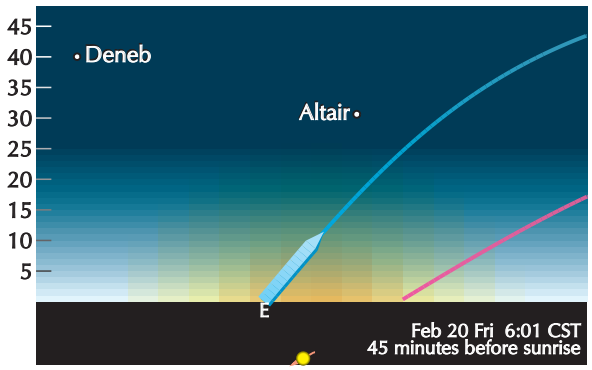
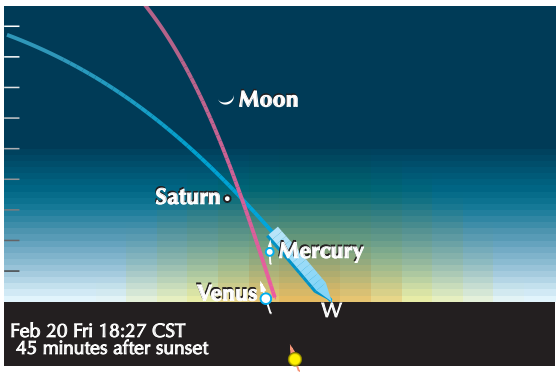
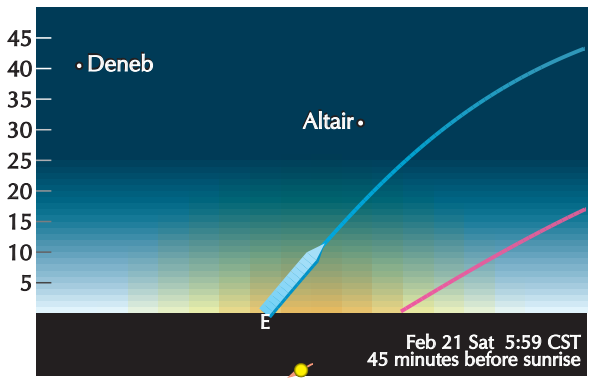
| | | | | | |
|---|---|---|---|---|---|
| 1096.019 | Feb | 24 | Tue | 12:28 | First quarter Moon |
| 1096.475 | Feb | 24 | Tue | 23:25 | Moon at perigee; distance 58.03 Earth-radii |
| 1097.195 | Feb | 25 | Wed | 17 | Mercury stationary in right ascension; starts retrograde motion |
| 1097.458 | Feb | 25 | Wed | 23 | Moon at northernmost declination in year, 28.43° |
| 1097.780 | Feb | 26 | Thu | 7 | Mercury stationary in longitude; starts retrograde motion |
| 1097.917 | Feb | 26 | Thu | 10 | Moon 4.0° N of M35 cluster; 115° from Sun in evening sky; magnitudes -11.1 and 5.3 |
| 1098.833 | Feb | 27 | Fri | 8 | Moon 3.9° NNE of Jupiter; 127° from Sun in evening sky; magnitudes -11.4 and -2.5 |
| 1099.167 | Feb | 27 | Fri | 16 | Moon 6.1° S of Castor; 131° from Sun in evening sky; magnitudes -11.5 and 1.5 |
| 1099.208 | Feb | 27 | Fri | 17 | Middle of eclipse season: Sun is at same longitude as Moon's ascending node, 339.1° |
| 1099.396 | Feb | 27 | Fri | 22 | Moon 2.93° S of Pollux; 134° from Sun in evening sky; magnitudes -11.6 and 1.2 |
| 1099.417 | Feb | 27 | Fri | 22 | Mercury 4.5° NNW of Venus; 13° from Sun in evening sky; magnitudes 1.6 and -3.9 |
| 1099.431 | Feb | 27 | Fri | 22 | Mars at southernmost latitude from the ecliptic plane, -1.8° |
| 1100.438 | Feb | 28 | SAT | 23 | Moon 1.51° NE of Beehive Cluster; 148° and 147° from Sun in evening sky; magnitudes -12.0 and 3.7 |


45
40
35
30
25
20
15
10
5
Deneb
Altair
E
Feb 20 Fri 6:01 CST
45 minutes before sunrise


Moon
Saturn
Mercury
Venus
W
Feb 20 Fri 18:27 CST
45 minutes after sunset


45
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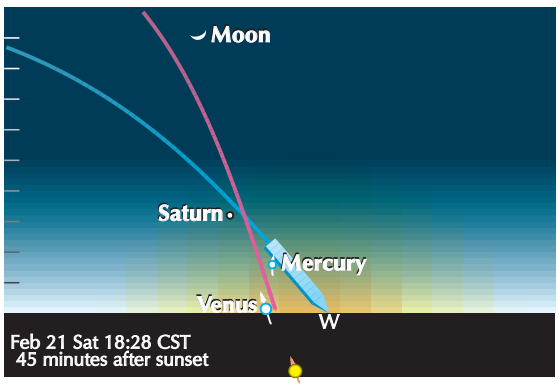
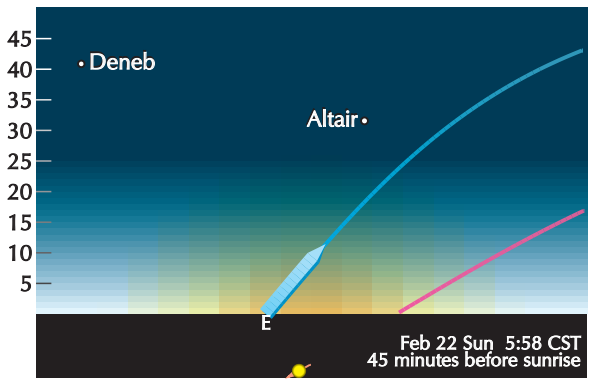
Deneb
Altair
E
Feb 21 Sat 5:59 CST
45 minutes before sunrise


Moon
Saturn
Mercury
Venus
W
Feb 21 Sat 18:28 CST
45 minutes after sunset


45
40
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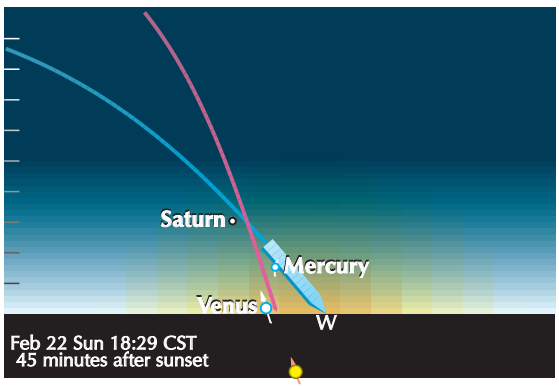
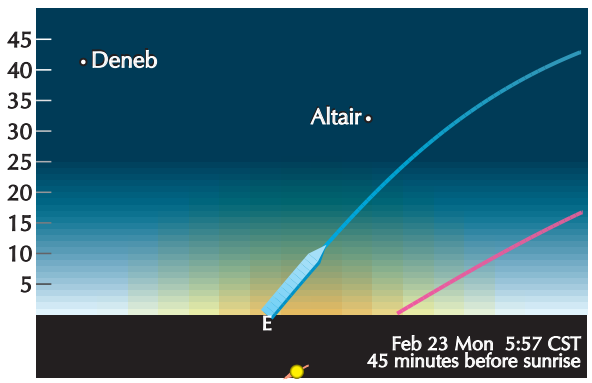
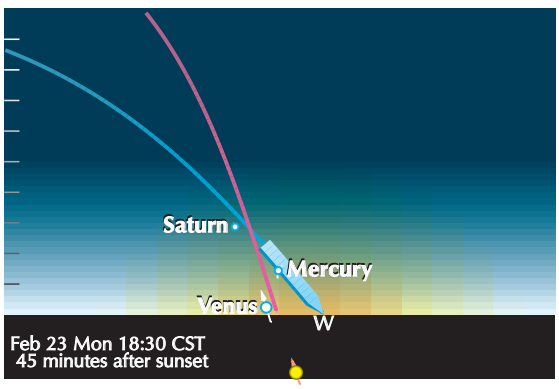
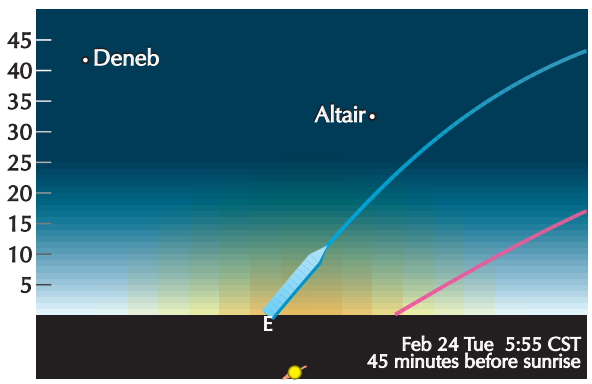
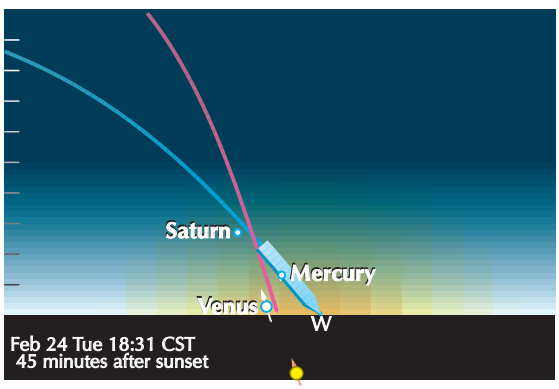
5
Deneb
Altair
E
Feb 22 Sun 5:58 CST
45 minutes before sunrise


Saturn
Mercury
Venus
W
Feb 22 Sun 18:29 CST
45 minutes after sunset


45
40
35
30
25
20
15
10
5
Deneb
Altair
E
Feb 23 Mon 5:57 CST
45 minutes before sunrise


Saturn
Mercury
Venus
W
Feb 23 Mon 18:30 CST
45 minutes after sunset


45
40
35
30
25
20
15
10
5
Deneb
Altair
E
Feb 24 Tue 5:55 CST
45 minutes before sunrise

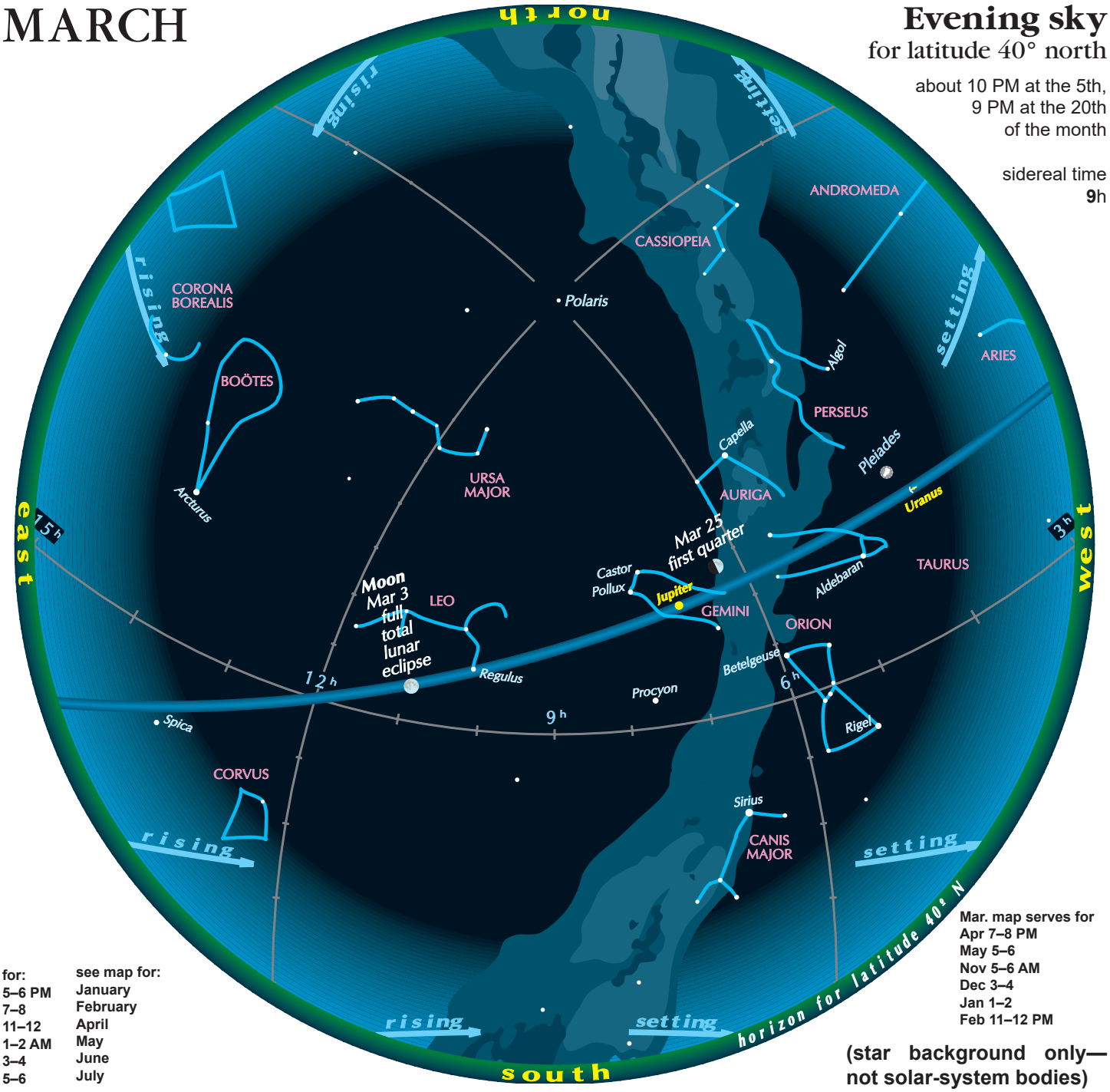

Saturn
Mercury
Venus
W
Feb 24 Tue 18:31 CST
45 minutes after sunset

# MARCH

## Evening sky
for latitude 40° north

about 10 PM at the 5th,
9 PM at the 20th
of the month

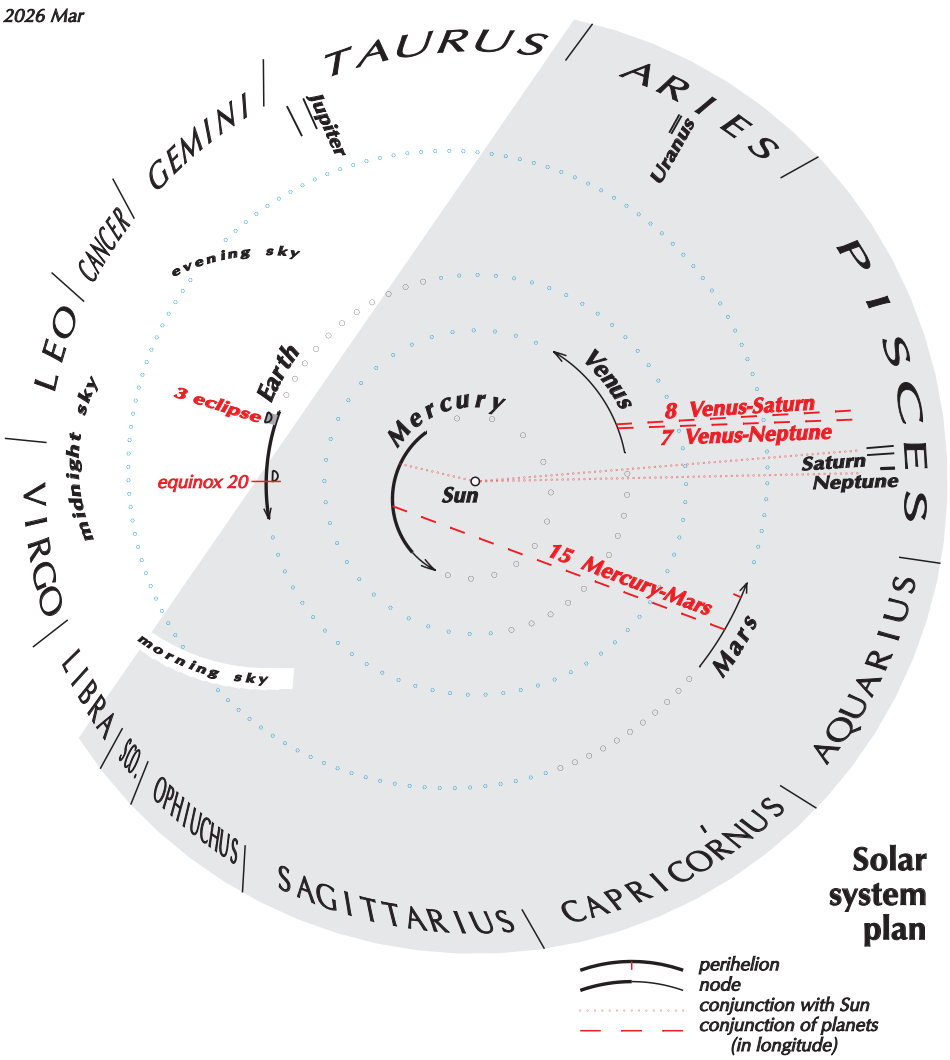
sidereal time
**9**h




| for: | see map for: |
|---|---|
| 5–6 PM | January |
| 7–8 | February |
| 11–12 | April |
| 1–2 AM | May |
| 3–4 | June |
| 5–6 | July |

Mar. map serves for
Apr 7–8 PM
May 5–6
Nov 5–6 AM
Dec 3–4
Jan 1–2
Feb 11–12 PM

**(star background only—not solar-system bodies)**




**Darkness and colors on the eclipsed Moon**

The **penumbra** is very faint. This is not surprising: from all parts of it, at least some part of the brilliatnt Sun would be visible, so it is essentially like daylight just after sunrise on the Earth. The outer part of the penumbra is imperceptible to the eye, so the beginning of penumbral eclipse is an academic event. The inner half or more of the penumbra is perceptible as a slight graying. It is said to become perceptible when moon's edge is at least 70% of the way across the penumbra, but has been glimpsed earlier. and photographic techniques can reveal it at only 24% of the way.

The **umbra**, by contrast, begins with an edge that is almost hard, and noticeably part of a circle (thus proving to the ancient Greeks that the Earth is a globe).

Though the umbra is the "total shadow", from within which no part of the Sun can be seen directly, it is generally not plain black, because sunlight is refracted into it through the atmosphere all around the Earth - around the continuous ring of the sunrise-and-sunset line. (Seen from the Moon, this appears as a thin red ring around a black Earth.) The amount by which the light is reduced and reddened depends on clouds, haze, volcanic ash, and pollution, all around this geographical band; so it varies from eclipse to eclipse and from part to part of the Moon, being generally but irregularly darker toward the center of the umbra (therefore toward the Moon's north edge if it is lying south of the ecliptic).

A detailed way to record the variations of the umbra is to note times at which various craters pass out and in of detectability.

The standard way to record and compare the overall variation is to use the **Danjon scale,** proposed by André Danjon, and intended to apply if possible to the *middle* of the eclipse. *L* stands for "luminosity".

L0: very dark eclipse, Moon almost invisible, especially in mid-totality.
L1: dark eclipse, gray or brownish coloration, details distinguishable only with difficulty.
L2: deep red or rust-colored eclipse, umbra usually having a very dark center and relatively bright outer rim.
L3: brick-red eclipse, umbra usually having a yellow or bright gray rim.
L4: strikingly bright copper-red or orange eclipse, with very bright bluish tint where umbra and penumbra meet.

2026 MARCH

| | | | | | |
|---|---|---|---|---|---|
| 1101.152 | Mar | 1 | SUN | 16 | Mercury at northernmost latitude from the ecliptic plane, 7.0° |
| 1102.063 | Mar | 2 | Mon | 14 | Moon 0.45° ENE of Regulus; 169° and 168° from Sun in evening sky; magnitudes -12.5 and 1.4 |
| 1102.692 | Mar | 3 | Tue | 4:37 | Moon at descending node; longitude 159.0° |

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| | | | | | |
|---|---|---|---|---|---|
| 1102.985 | Mar | 3 | Tue | 11:38 | Full Moon; total eclipse of the Moon |
| 1106.208 | Mar | 6 | Fri | 17 | Moon 1.71° SSW of Spica; 142° from Sun in morning sky; magnitudes -11.7 and 1.0 |
| 1106.956 | Mar | 7 | SAT | 11 | Mercury at inferior conjunction with the Sun; 0.627 AU from Earth; latitude 6.18° |
| 1107.000 | Mar | 7 | SAT | 12 | Venus 0.07° N of Neptune; 14° from Sun in evening sky; magnitudes -3.9 and 8.0 |
| 1107.125 | Mar | 7 | SAT | 15 | Venus, Saturn, and Neptune within circle of diameter 1.48°; about 15° from the Sun in the evening sky; magnitudes -4, 1, 8 |
| 1107.5 | Mar | 8 | SUN | | Clocks forward 1 hour (America) |
| 1108.063 | Mar | 8 | SUN | 14 | Venus 0.91° NNW of Saturn; 15° from Sun in evening sky; magnitudes -3.9 and 1.0 |
| 1110.021 | Mar | 10 | Tue | 13 | Moon 0.73° S of Antares; 100° from Sun in morning sky; magnitudes -10.4 and 1.0 |
| 1110.072 | Mar | 10 | Tue | 14 | Moon at apogee; distance 63.40 Earth-radii |
| 1110.594 | Mar | 11 | Wed | 2 | Jupiter stationary in right ascension; resumes direct motion |
| 1110.625 | Mar | 11 | Wed | 3 | Jupiter stationary in longitude; resumes direct motion |

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| | | | | | |
|---|---|---|---|---|---|
| 1110.903 | Mar | 11 | Wed | 9:40 | Last quarter Moon |
| 1111.375 | Mar | 11 | Wed | 21 | Moon at southernmost declination in year, -28.41° |
| 1111.756 | Mar | 12 | Thu | 6 | Sun enters Pisces, at longitude 351.67° on the ecliptic |
| 1113.016 | Mar | 13 | Fri | 12 | Jupiter at northernmost declination, 22.94° |
| 1115.313 | Mar | 15 | SUN | 20 | Mercury 3.4° NNW of Mars; 16° and 15° from Sun in morning sky; magnitudes 2.2 and 1.2 |
| 1116.5 | Mar | 17 | Tue | 0:00 | Day and night equal, at latitude 40° north |
| 1116.5 | Mar | 17 | Tue | | St. Patrick's Day |
| 1117.100 | Mar | 17 | Tue | 14 | Moon, Mercury, and Mars within circle of diameter 4.01°; about 17° from the Sun in the morning sky; magnitudes -6, 2, 1 |
| 1117.142 | Mar | 17 | Tue | 15:24 | Moon at ascending node; longitude 339.0° |
| 1117.188 | Mar | 17 | Tue | 17 | Moon 1.81° SE of Mercury; 17° and 18° from Sun in morning sky; magnitudes -5.8 and 1.7 |
| 1117.375 | Mar | 17 | Tue | 21 | Moon 1.37° NNW of Mars; 15° from Sun in morning sky; magnitudes -5.5 and 1.2 |

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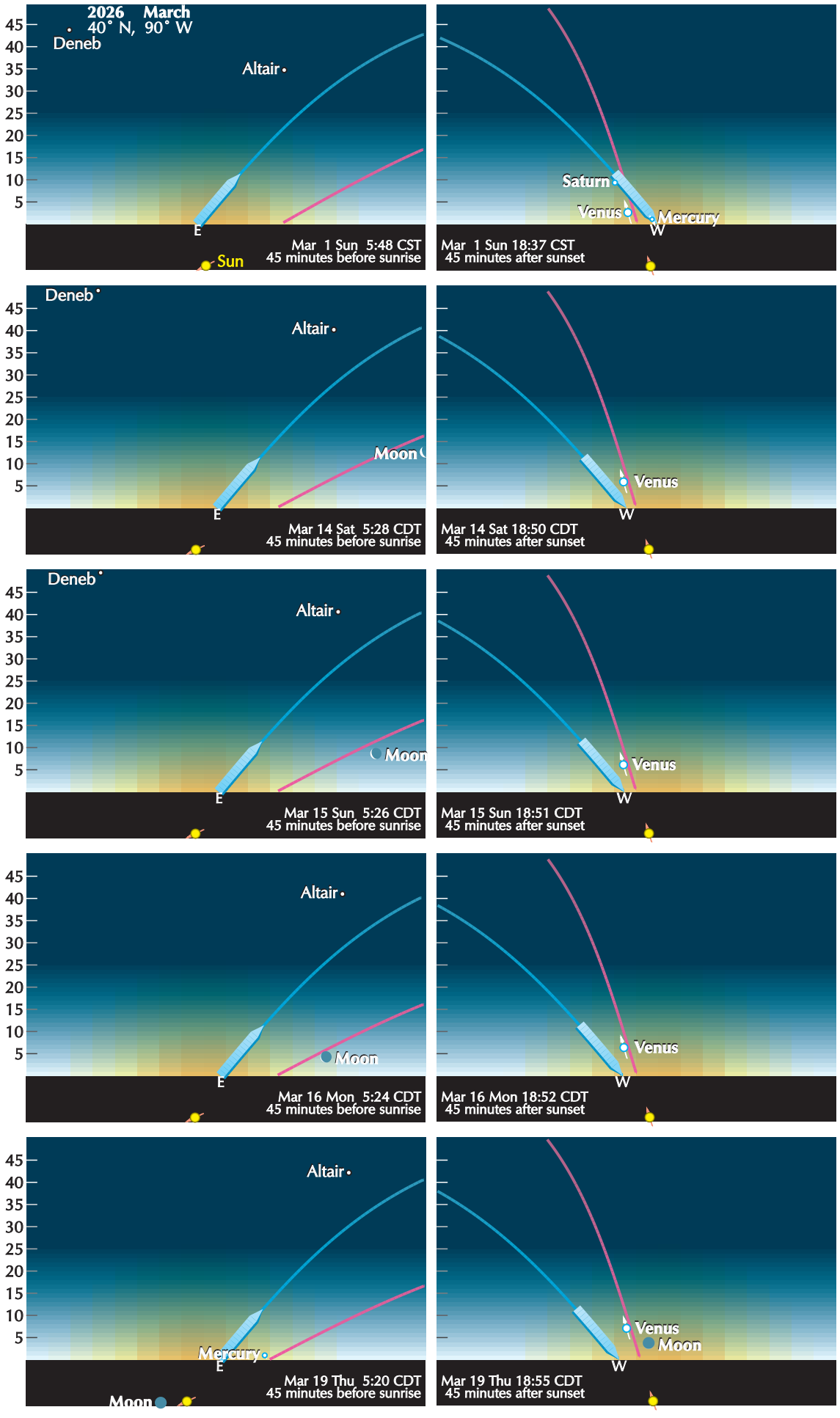
| | | | | | |
|---|---|---|---|---|---|
| 1118.559 | Mar | 19 | Thu | 1:25 | New Moon; beginning of lunation 1277 |
| 1118.792 | Mar | 19 | Thu | 7 | Moon 3.3° NNW of Neptune; 4° and 3° from Sun in evening sky; magnitudes -4.3 and 8.0 |
| 1118.900 | Mar | 19 | Thu | 10 | Moon, Saturn, and Neptune within circle of diameter 4.36°; only about 5° from the Sun; magnitudes -4, 1, 8 |
| 1118.958 | Mar | 19 | Thu | 11 | Moon 4.4° NNW of Saturn; 6° from Sun in evening sky; magnitudes -4.6 and 0.9 |


2026 March
40° N, 90° W
Deneb
Altair
Sun
Mar 1 Sun 5:48 CST
45 minutes before sunrise
Saturn
Venus
Mercury
Mar 1 Sun 18:37 CST
45 minutes after sunset
Deneb
Altair
Moon
Mar 14 Sat 5:28 CDT
45 minutes before sunrise
Venus
Mar 14 Sat 18:50 CDT
45 minutes after sunset
Deneb
Altair
Moon
Mar 15 Sun 5:26 CDT
45 minutes before sunrise
Venus
Mar 15 Sun 18:51 CDT
45 minutes after sunset
Altair
Moon
Mar 16 Mon 5:24 CDT
45 minutes before sunrise
Venus
Mar 16 Mon 18:52 CDT
45 minutes after sunset
Altair
Mercury
Moon
Mar 19 Thu 5:20 CDT
45 minutes before sunrise
Venus
Moon
Mar 19 Thu 18:55 CDT
45 minutes after sunset

| | | | | | |
|---|---|---|---|---|---|
| 1119.321 | Mar | 19 | Thu | 20 | Mercury stationary in right ascension; resumes direct motion |
| 1119.896 | Mar | 20 | Fri | 10 | Moon 4.1° NNW of Venus; 18° from Sun in evening sky; magnitudes -5.8 and -3.9 |
| 1120.115 | Mar | 20 | Fri | 14:45 | Sun enters the astrological sign Aries, i.e. its longitude is 0° |
| 1120.115 | Mar | 20 | Fri | 14:45 | March or vernal (northern spring) equinox |
| 1120.312 | Mar | 20 | Fri | 19 | Mercury stationary in longitude; resumes direct motion |
| 1121.973 | Mar | 22 | SUN | 11 | Neptune at conjunction with the Sun; 30.879 AU from Earth; latitude -1.35° |
| 1121.989 | Mar | 22 | SUN | 11:43 | Moon at perigee; distance 57.52 Earth-radii |
| 1122.742 | Mar | 23 | Mon | 6 | Moon, Uranus, and the Pleiades within circle of diameter 5.32°; about 57° from the Sun in the evening sky; magnitudes -9, 6, 3 |
| 1122.750 | Mar | 23 | Mon | 6 | Moon 5.3° N of Uranus; 56° from Sun in evening sky; magnitudes -8.7 and 5.8 |
| 1122.896 | Mar | 23 | Mon | 10 | Moon 1.18° N of Pleiades; 58° from Sun in evening sky |
| 1124.553 | Mar | 25 | Wed | 1 | Mercury at descending node through the ecliptic plane |
| 1124.874 | Mar | 25 | Wed | 9 | Saturn at conjunction with the Sun; 10.489 AU from Earth; latitude -2.35° |
| 1125.146 | Mar | 25 | Wed | 16 | Moon 3.9° N of M35 cluster; 88° and 87° from Sun in evening sky; magnitudes -10.1 and 5.3 |

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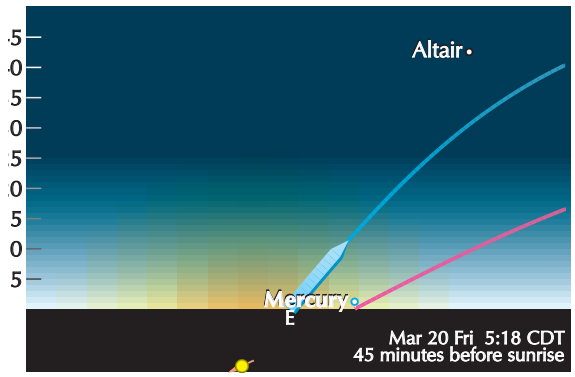
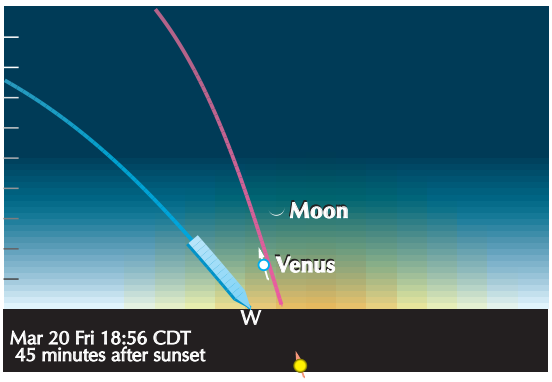
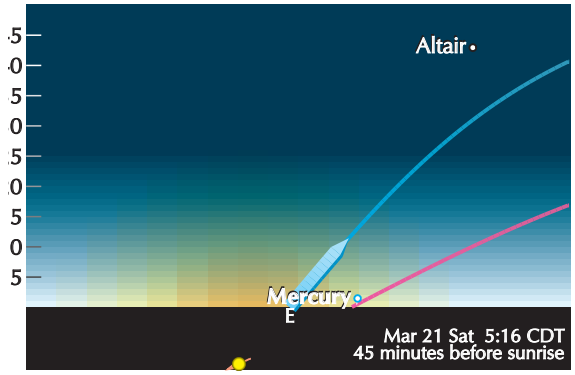
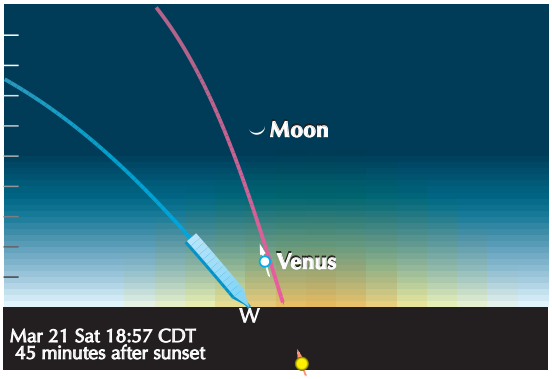
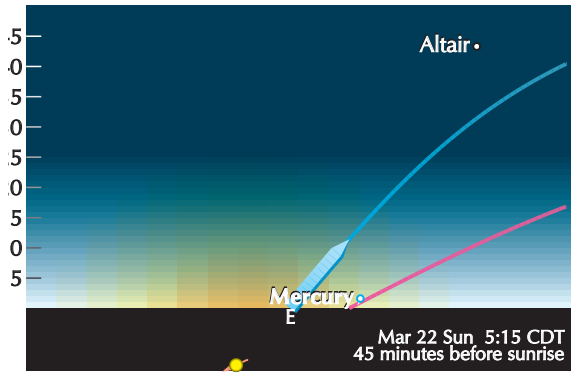
| | | | | | |
|---|---|---|---|---|---|
| 1125.304 | Mar | 25 | Wed | 19:18 | First quarter Moon |
| 1125.801 | Mar | 26 | Thu | 7 | Mars at perihelion; 1.3813 AU from the Sun |
| 1126.083 | Mar | 26 | Thu | 14 | Moon 3.8° NNE of Jupiter; 100° from Sun in evening sky; magnitudes -10.5 and -2.3 |
| 1126.353 | Mar | 26 | Thu | 20 | Saturn crosses equator northward |
| 1126.396 | Mar | 26 | Thu | 22 | Moon 6.2° SSW of Castor; 104° from Sun in evening sky; magnitudes -10.7 and 1.5 |
| 1126.625 | Mar | 27 | Fri | 3 | Moon 2.98° S of Pollux; 107° from Sun in evening sky; magnitudes -10.8 and 1.2 |
| 1127.688 | Mar | 28 | SAT | 5 | Moon 1.44° NNE of Beehive Cluster; 121° and 120° from Sun in evening sky; magnitudes -11.2 and 3.7 |
| 1128.5 | Mar | 29 | SUN | | Clocks forward 1 hour (Britain) |
| 1128.5 | Mar | 29 | SUN | | Palm Sunday |
| 1129.354 | Mar | 29 | SUN | 21 | Moon 0.43° ENE of Regulus; 141° from Sun in evening sky; magnitudes -11.7 and 1.4 |
| 1129.984 | Mar | 30 | Mon | 11:37 | Moon at descending node; longitude 158.8° |

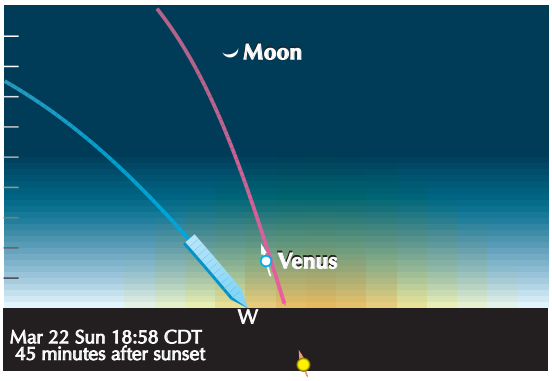

Altair
Mercury
E
Mar 20 Fri 5:18 CDT
45 minutes before sunrise

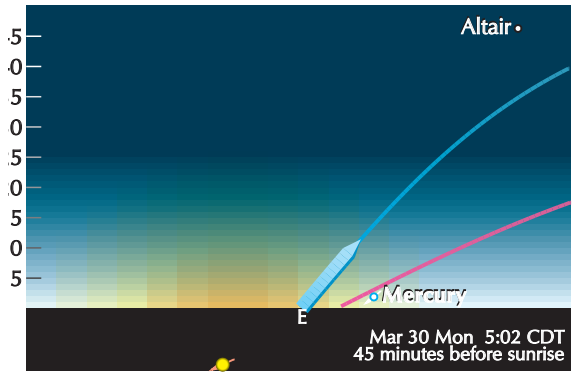

Moon
Venus
W
Mar 20 Fri 18:56 CDT
45 minutes after sunset

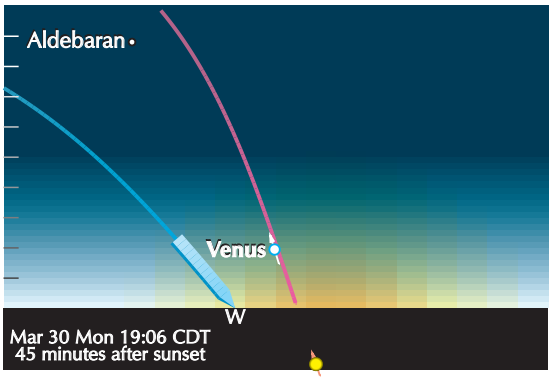

Altair
Mercury
E
Mar 21 Sat 5:16 CDT
45 minutes before sunrise

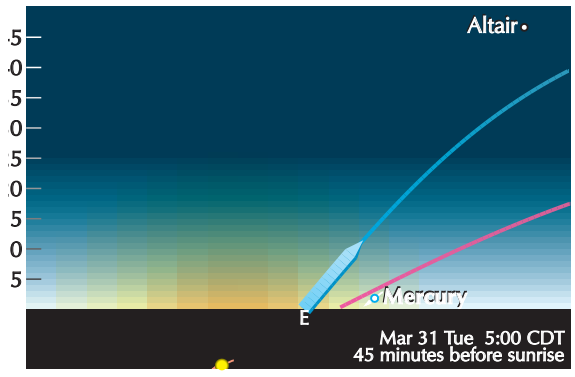

Moon
Venus
W
Mar 21 Sat 18:57 CDT
45 minutes after sunset

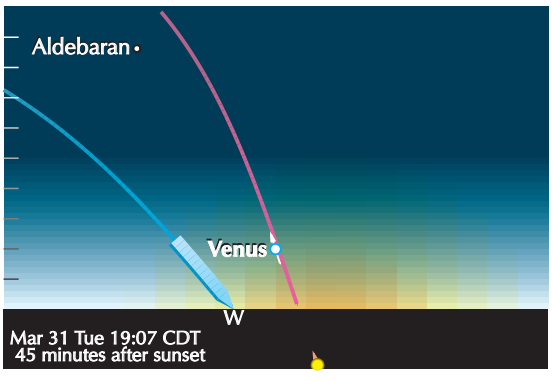

Altair
Mercury
E
Mar 22 Sun 5:15 CDT
45 minutes before sunrise


Moon
Venus
W
Mar 22 Sun 18:58 CDT
45 minutes after sunset


Altair
Mercury
E
Mar 30 Mon 5:02 CDT
45 minutes before sunrise

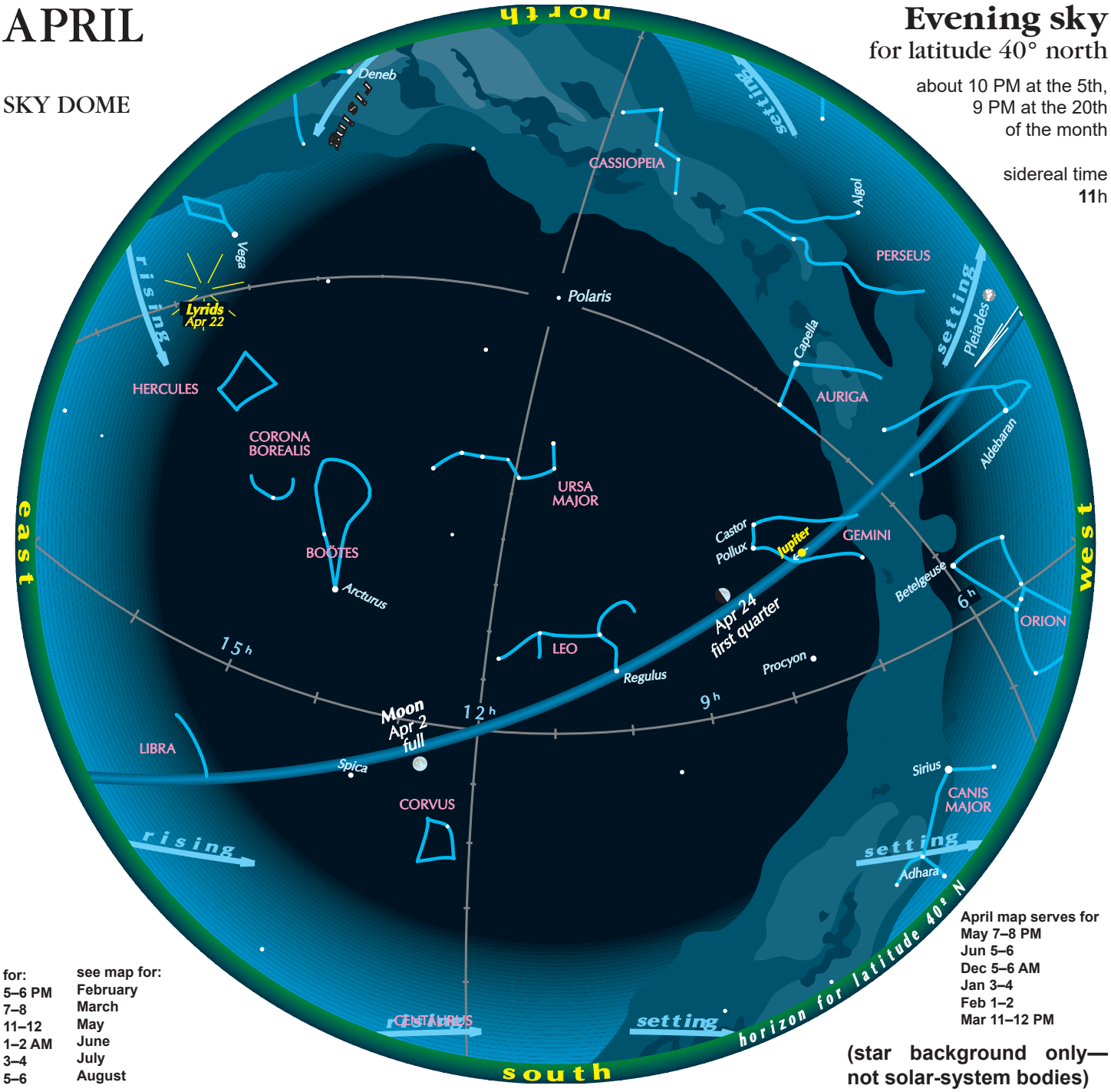

Aldebaran
Venus
W
Mar 30 Mon 19:06 CDT
45 minutes after sunset


Altair
Mercury
E
Mar 31 Tue 5:00 CDT
45 minutes before sunrise


Aldebaran
Venus
W
Mar 31 Tue 19:07 CDT
45 minutes after sunset

# APRIL

## SKY DOME




## Evening sky
for latitude 40° north

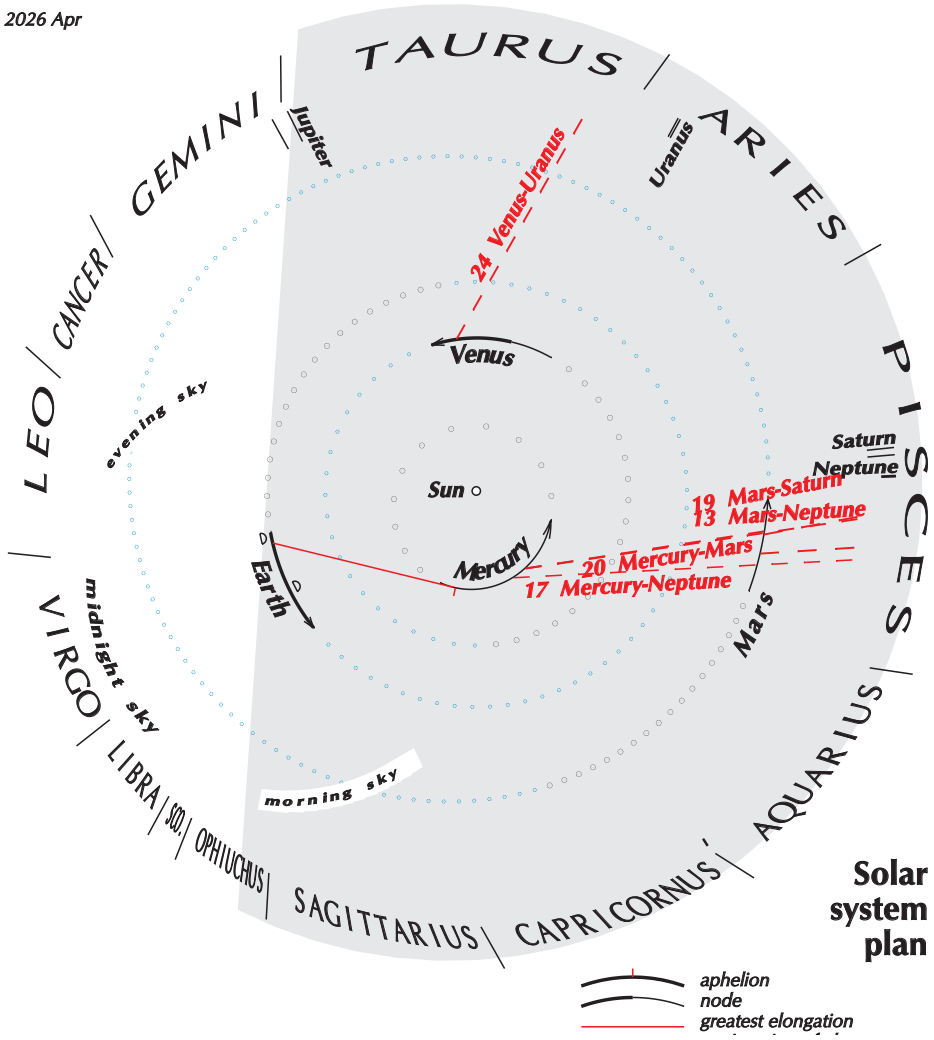
about 10 PM at the 5th,
9 PM at the 20th
of the month

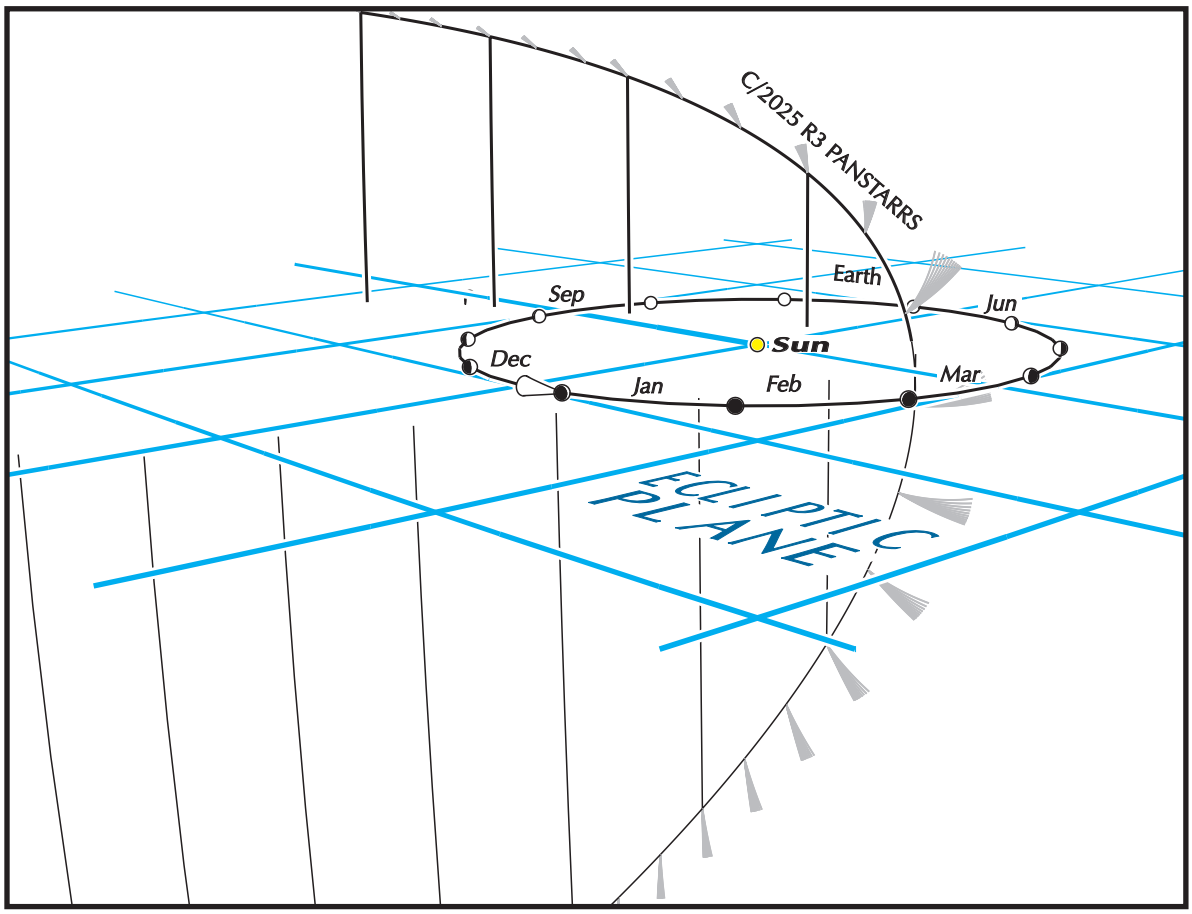
sidereal time
**11**h

| for: | see map for: |
|---|---|
| 5–6 PM | February |
| 7–8 | March |
| 11–12 | May |
| 1–2 AM | June |
| 3–4 | July |
| 5–6 | August |

**April map serves for**
May 7–8 PM
Jun 5–6
Dec 5–6 AM
Jan 3–4
Feb 1–2
Mar 11–12 PM

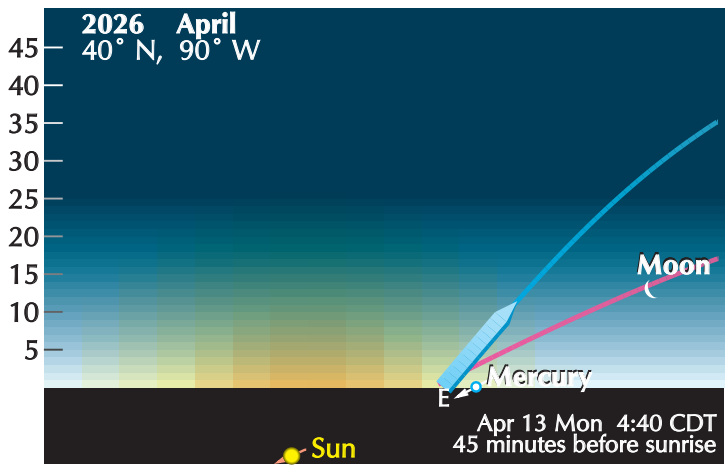
**(star background only—not solar-system bodies)**

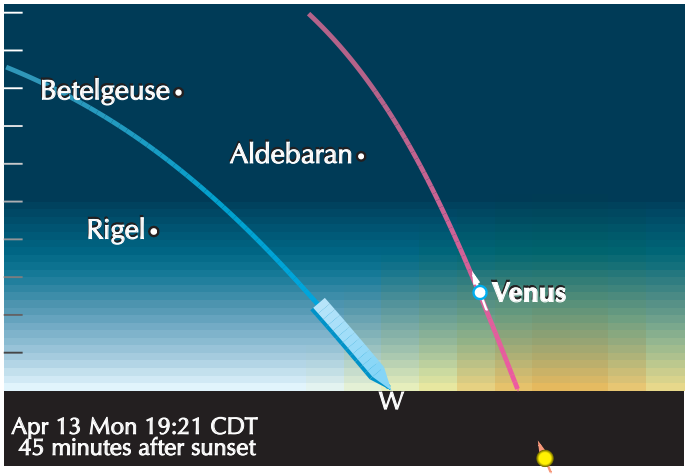

2026 Apr
TAURUS
GEMINI
CANCER
LEO
VIRGO
LIBRA
SCO.
OPHIUCHUS
SAGITTARIUS
CAPRICORNUS
AQUARIUS
PISCES
ARIES
Jupiter
Uranus
24 Venus-Uranus
Venus
evening sky
Sun
Saturn
Neptune
19 Mars-Saturn
13 Mars-Neptune
Mercury
20 Mercury-Mars
17 Mercury-Neptune
Earth
Mars
midnight sky
morning sky
Solar system plan
aphelion
node
greatest elongation

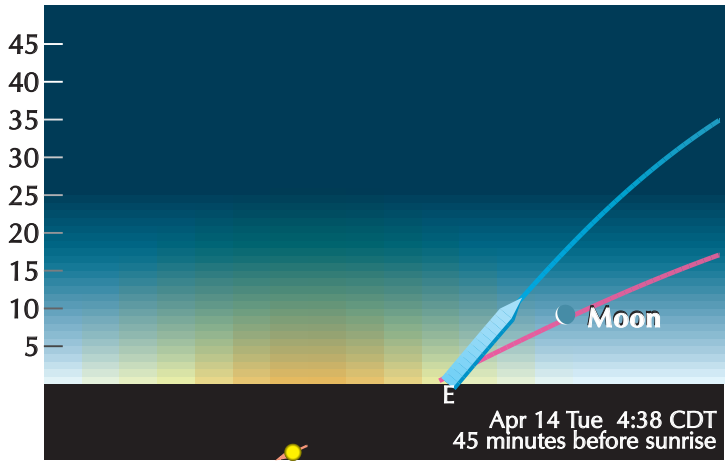

C/2025 R3 PANSTARRS
Earth
Sep
Jun
Sun
Dec
Jan
Feb
Mar
ECLIPTIC PLANE

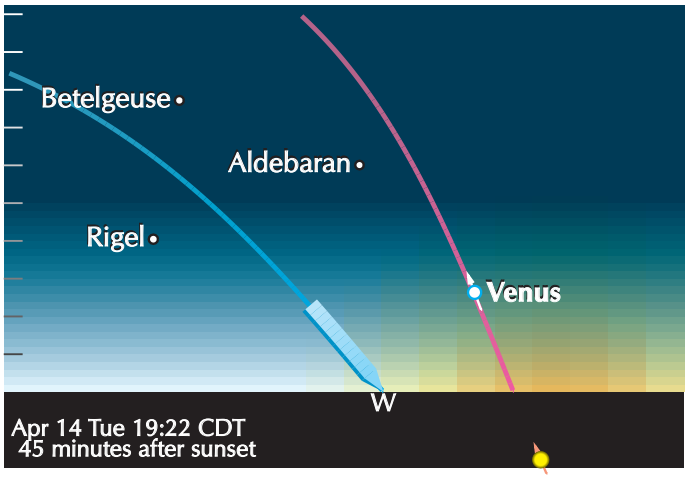
2026 APRIL

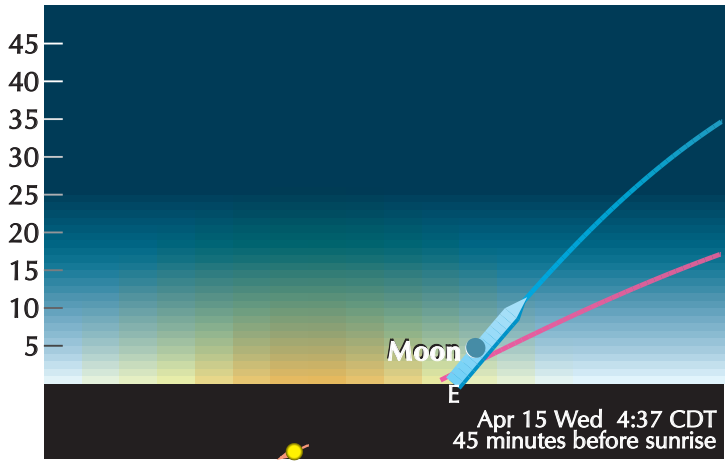
| | | | | | |
|---|---|---|---|---|---|
| 1131.5 | Apr | 1 | Wed | | Passover begins at sundowny |
| 1132.592 | Apr | 2 | Thu | 2:12 | Full Moon |
| 1133.5 | Apr | 3 | Fri | | Good Friday |
| 1133.563 | Apr | 3 | Fri | 2 | Moon 1.69° SSW of Spica; 168° and 169° from Sun in morning sky; magnitudes -12.3 and 1.0 |
| 1134.434 | Apr | 3 | Fri | 22 | Mercury at westernmost elongation; 27.8° from Sun in morning sky; magnitude 0.3 |
| 1134.931 | Apr | 4 | SAT | 10 | Mercury at aphelion; 0.4667 AU from the Sun |
| 1135.5 | Apr | 5 | SUN | | Easter |
| 1136.429 | Apr | 5 | SUN | 22 | Jupiter at east quadrature, 90° from the Sun |
| 1137.354 | Apr | 6 | Mon | 21 | Moon 0.65° SE of Antares; 126° and 127° from Sun in morning sky; magnitudes -11.2 and 1.0 |
| 1137.848 | Apr | 7 | Tue | 8 | Moon at apogee; distance 63.49 Earth-radii |
| 1140.704 | Apr | 10 | Fri | 4:54 | Last quarter Moon |
| 1141.724 | Apr | 11 | SAT | 5 | Venus at ascending node through the ecliptic plane |
| 1143.255 | Apr | 12 | SUN | 18 | Mars crosses equator northward |
| 1143.750 | Apr | 13 | Mon | 6 | Mars 0.32° NNW of Neptune; 21° from Sun in morning sky; magnitudes 1.2 and 8.0 |
| 1143.875 | Apr | 13 | Mon | 9 | Mars, Saturn, and Neptune within circle of diameter 4.49°; about 19° from the Sun in the morning sky; magnitudes 1, 1, 8 |
| 1144.489 | Apr | 13 | Mon | 23:45 | Moon at ascending node; longitude 338.1° |
| 1146.105 | Apr | 15 | Wed | 15 | The equation of time is 0 |
| 1146.125 | Apr | 15 | Wed | 15 | Moon 4.6° NNW of Mercury; 25° from Sun in morning sky; magnitudes -6.5 and 0.0 |
| 1146.142 | Apr | 15 | Wed | 15 | Moon, Mercury, and Neptune within circle of diameter 4.59°; about 24° from the Sun in the morning sky; magnitudes -6, 0, 8 |
| 1146.242 | Apr | 15 | Wed | 18 | Moon, Mercury, and Mars within circle of diameter 5.06°; about 23° from the Sun in the morning sky; magnitudes -6, 0, 1 |
| 1146.292 | Apr | 15 | Wed | 19 | Moon 3.5° NNW of Neptune; 23° from Sun in morning sky; magnitudes -6.3 and 7.9 |
| 1146.300 | Apr | 15 | Wed | 19 | Moon, Mars, and Neptune within circle of diameter 3.66°; about 22° from the Sun in the morning sky; magnitudes -6, 1, 8 |
| 1146.417 | Apr | 15 | Wed | 22 | Moon 3.3° NNW of Mars; 21° from Sun in morning sky; magnitudes -6.1 and 1.2 |
| 1146.442 | Apr | 15 | Wed | 23 | Moon, Saturn, and Neptune within circle of diameter 5.45°; about 21° from the Sun in the morning sky; magnitudes -6, 1, 8 |
| 1146.558 | Apr | 16 | Thu | 1 | Moon, Mars, and Saturn within circle of diameter 4.67°; about 20° from the Sun in the morning sky; magnitudes -6, 1, 1 |
| 1146.604 | Apr | 16 | Thu | 3 | Moon 4.7° NNW of Saturn; 19° from Sun in morning sky; magnitudes -5.9 and 0.9 |
| 1147.604 | Apr | 17 | Fri | 3 | Mercury 1.32° SE of Neptune; 24° from Sun in morning sky; magnitudes -0.0 and 7.9 |
| 1147.667 | Apr | 17 | Fri | 4 | Mercury, Saturn, and Neptune within circle of diameter 4.81°; about 23° from the Sun in the morning sky; magnitudes 0, 1, 8 |

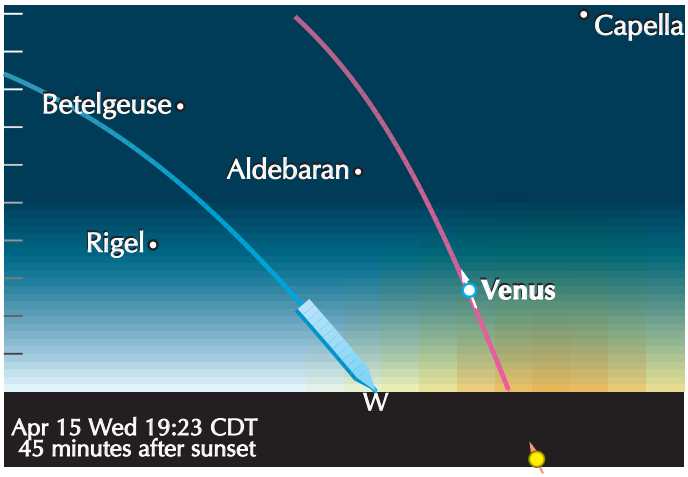

2026 April
40° N, 90° W
45
40
35
30
25
20
15
10
5
Moon
Mercury
E
Sun
Apr 13 Mon 4:40 CDT
45 minutes before sunrise

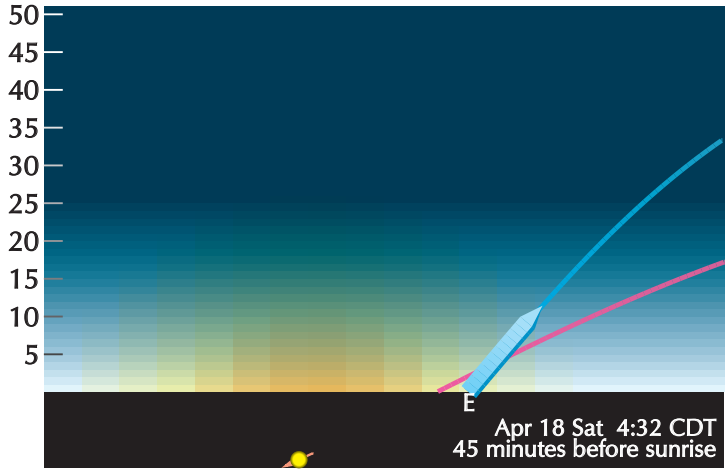

Betelgeuse
Aldebaran
Rigel
Venus
W
Apr 13 Mon 19:21 CDT
45 minutes after sunset

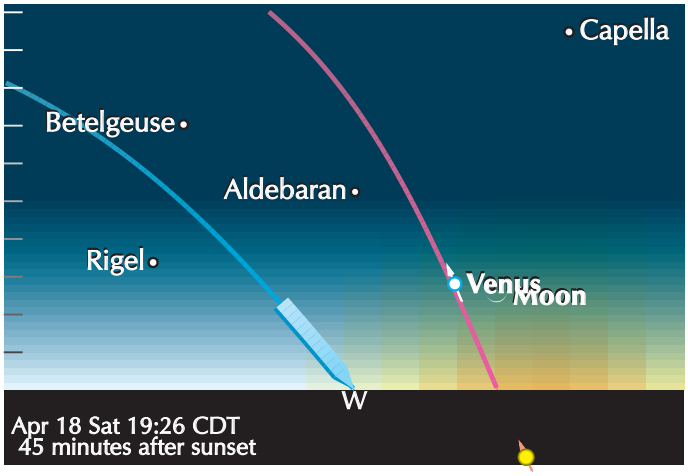

45
40
35
30
25
20
15
10
5
Moon
E
Apr 14 Tue 4:38 CDT
45 minutes before sunrise


Betelgeuse
Aldebaran
Rigel
Venus
W
Apr 14 Tue 19:22 CDT
45 minutes after sunset

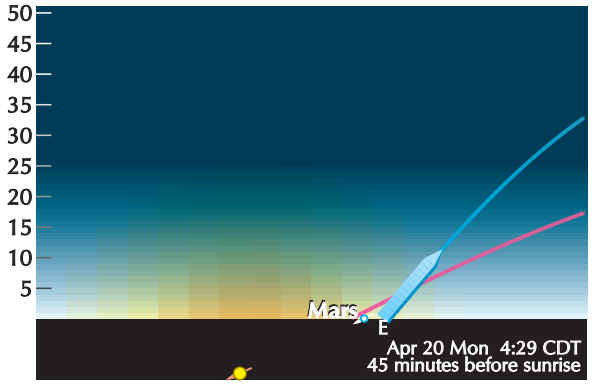

45
40
35
30
25
20
15
10
5
Moon
E
Apr 15 Wed 4:37 CDT
45 minutes before sunrise

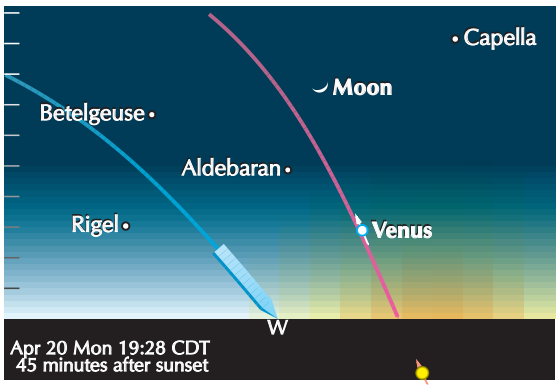

Capella
Betelgeuse
Aldebaran
Rigel
Venus
W
Apr 15 Wed 19:23 CDT
45 minutes after sunset

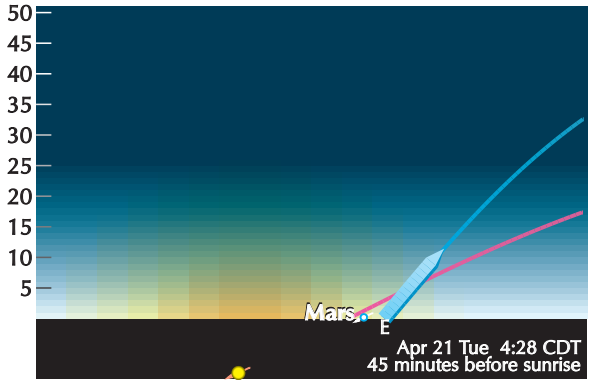

50
45
40
35
30
25
20
15
10
5
E
Apr 18 Sat 4:32 CDT
45 minutes before sunrise

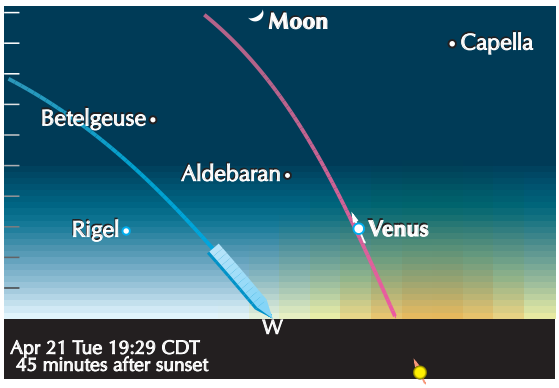

Capella
Betelgeuse
Aldebaran
Rigel
Venus
Moon
W
Apr 18 Sat 19:26 CDT
45 minutes after sunset

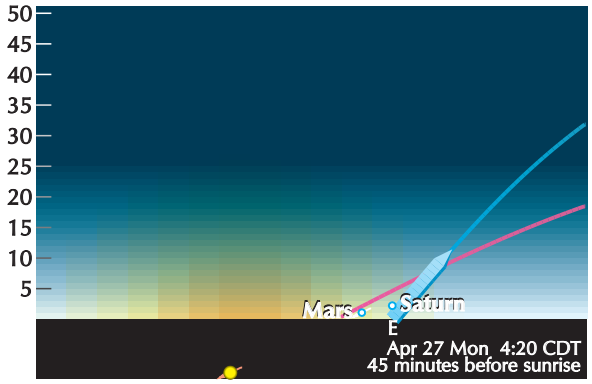
| | | | | | |
|---|---|---|---|---|---|
| 1147.875 | Apr | 17 | Fri | 9 | Mercury, Mars, and Neptune within circle of diameter 3.19°; about 23° from the Sun in the morning sky; magnitudes 0, 1, 8 |
| | | | | | _____ |
| 1147.995 | Apr | 17 | Fri | 11:53 | New Moon; beginning of lunation 1278 |
| 1149.734 | Apr | 19 | SUN | 6 | Sun enters Aries, at longitude 29.19° on the ecliptic |
| 1149.790 | Apr | 19 | SUN | 6:58 | Moon at perigee; distance 56.70 Earth-radii |
| 1149.792 | Apr | 19 | SUN | 7 | Moon 4.6° NNW of Venus; 25° from Sun in evening sky; magnitudes -6.5 and -3.9 |
| 1150.158 | Apr | 19 | SUN | 16 | Moon, Uranus, and the Pleiades within circle of diameter 5.22°; about 31° from the Sun in the evening sky; magnitudes -7, 6, 3 |
| 1150.167 | Apr | 19 | SUN | 16 | Moon 5.2° N of Uranus; 31° and 30° from Sun in evening sky; magnitudes -7.0 and 5.8 |
| 1150.229 | Apr | 19 | SUN | 18 | Moon 1.08° N of Pleiades; 31° from Sun in evening sky |
| 1150.438 | Apr | 19 | SUN | 23 | Mars 1.19° NNW of Saturn; 22° from Sun in morning sky; magnitudes 1.2 and 0.9 |
| 1150.567 | Apr | 20 | Mon | 2 | Sun enters the astrological sign Taurus, i.e. its longitude is 30° |
| 1151.000 | Apr | 20 | Mon | 12 | Mercury 0.46° SE of Saturn; 23° from Sun in morning sky; magnitudes -0.2 and 0.9 |
| 1151.458 | Apr | 20 | Mon | 23 | Mercury, Mars, and Saturn within circle of diameter 1.65°; about 23° from the Sun in the morning sky; magnitudes 0, 1, 1 |
| 1151.479 | Apr | 20 | Mon | 24 | Mercury 1.65° SE of Mars; 22° from Sun in morning sky; magnitudes -0.2 and 1.2 |
| 1152.396 | Apr | 21 | Tue | 22 | Moon 3.7° N of M35 cluster; 61° from Sun in evening sky; magnitudes -8.9 and 5.3 |
| 1152.958 | Apr | 22 | Wed | 11 | Lyrid meteors; ZHR 18; 2 days before First Quarter Moon |
| 1153.479 | Apr | 22 | Wed | 24 | Moon 3.5° NNE of Jupiter; 75° from Sun in evening sky; magnitudes -9.6 and -2.1 |
| 1153.646 | Apr | 23 | Thu | 4 | Moon 6.4° S of Castor; 78° from Sun in evening sky; magnitudes -9.7 and 1.5 |
| 1153.875 | Apr | 23 | Thu | 9 | Moon 3.2° S of Pollux; 81° and 80° from Sun in evening sky; magnitudes -9.8 and 1.2 |
| 1154.562 | Apr | 24 | Fri | 1 | Neptune crosses equator northward |
| 1154.583 | Apr | 24 | Fri | 2 | Venus 0.75° NNW of Uranus; 26° from Sun in evening sky; magnitudes -3.9 and 5.8 |
| | | | | | _____ |
| 1154.606 | Apr | 24 | Fri | 2:32 | First quarter Moon |
| 1154.917 | Apr | 24 | Fri | 10 | Moon 1.29° NE of Beehive Cluster; 94° and 93° from Sun in evening sky; magnitudes -10.3 and 3.7 |
| 1155.083 | Apr | 24 | Fri | 14 | Venus 3.4° SE of the Pleiades; 26° from Sun in evening sky |
| 1155.183 | Apr | 24 | Fri | 16 | Mercury at southernmost latitude from the ecliptic plane, -7.0° |
| 1155.660 | Apr | 25 | SAT | 4 | Winter solstice for Mars north hemisphere |
| 1156.125 | Apr | 25 | SAT | 15 | Venus, Uranus, and the Pleiades within circle of diameter 4.24°; about 25° from the Sun in the evening sky; magnitudes -4, 6, 3 |
| 1156.583 | Apr | 26 | SUN | 2 | Moon 0.33° E of Regulus; 115° and 114° from Sun in evening sky; magnitudes -10.9 and 1.4 |
| 1157.109 | Apr | 26 | SUN | 14:37 | Moon at descending node; longitude 157.4° |
| 1160.833 | Apr | 30 | Thu | 8 | Moon 1.66° SSW of Spica; 164° from Sun in evening sky; magnitudes -12.2 and 1.0 |

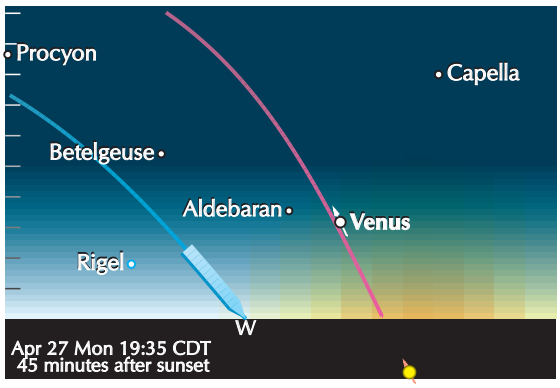

50
45
40
35
30
25
20
15
10
5
Mars
E
Apr 20 Mon 4:29 CDT
45 minutes before sunrise

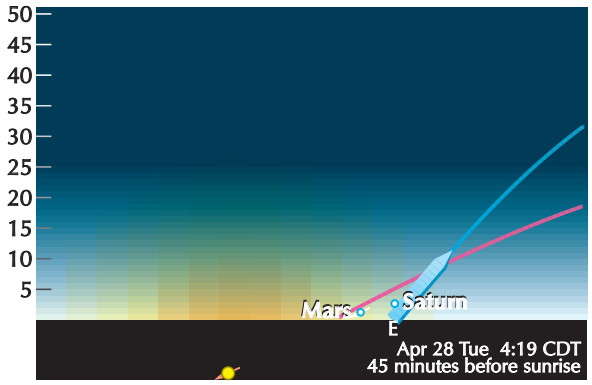

Capella
Moon
Betelgeuse
Aldebaran
Rigel
Venus
W
Apr 20 Mon 19:28 CDT
45 minutes after sunset

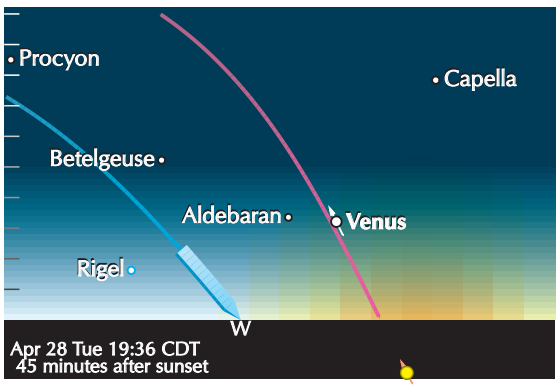

50
45
40
35
30
25
20
15
10
5
Mars
E
Apr 21 Tue 4:28 CDT
45 minutes before sunrise

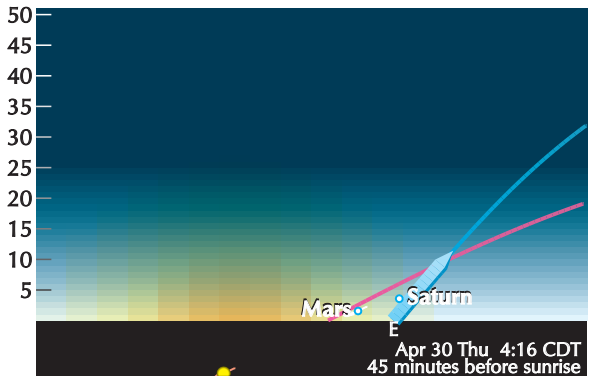

Moon
Capella
Betelgeuse
Aldebaran
Rigel
Venus
W
Apr 21 Tue 19:29 CDT
45 minutes after sunset

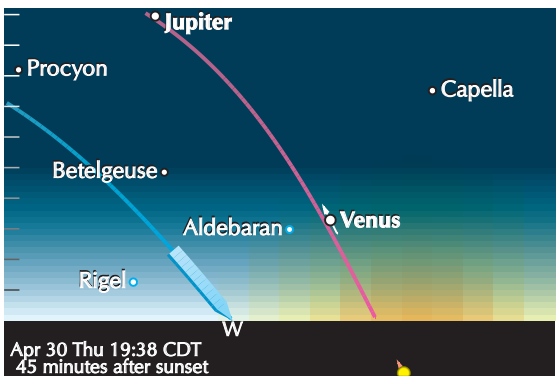

50
45
40
35
30
25
20
15
10
5
Mars
Saturn
E
Apr 27 Mon 4:20 CDT
45 minutes before sunrise


Procyon
Capella
Betelgeuse
Aldebaran
Venus
Rigel
W
Apr 27 Mon 19:35 CDT
45 minutes after sunset


50
45
40
35
30
25
20
15
10
5
Mars
Saturn
E
Apr 28 Tue 4:19 CDT
45 minutes before sunrise

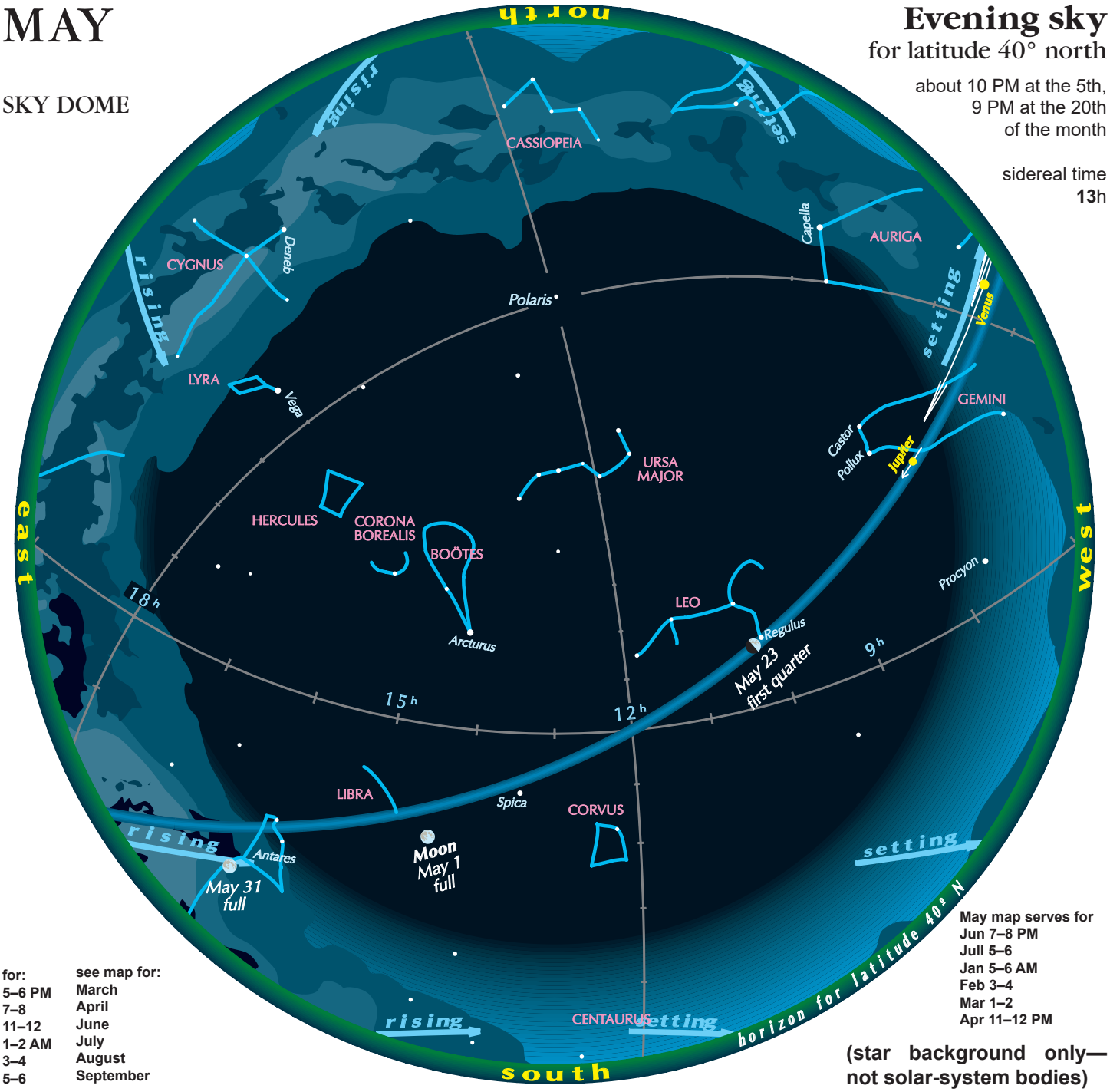

Procyon
Capella
Betelgeuse
Aldebaran
Venus
Rigel
W
Apr 28 Tue 19:36 CDT
45 minutes after sunset


50
45
40
35
30
25
20
15
10
5
Mars
Saturn
E
Apr 30 Thu 4:16 CDT
45 minutes before sunrise


Jupiter
Procyon
Capella
Betelgeuse
Aldebaran
Venus
Rigel
W
Apr 30 Thu 19:38 CDT
45 minutes after sunset

# MAY

## SKY DOME




# Evening sky
## for latitude 40° north

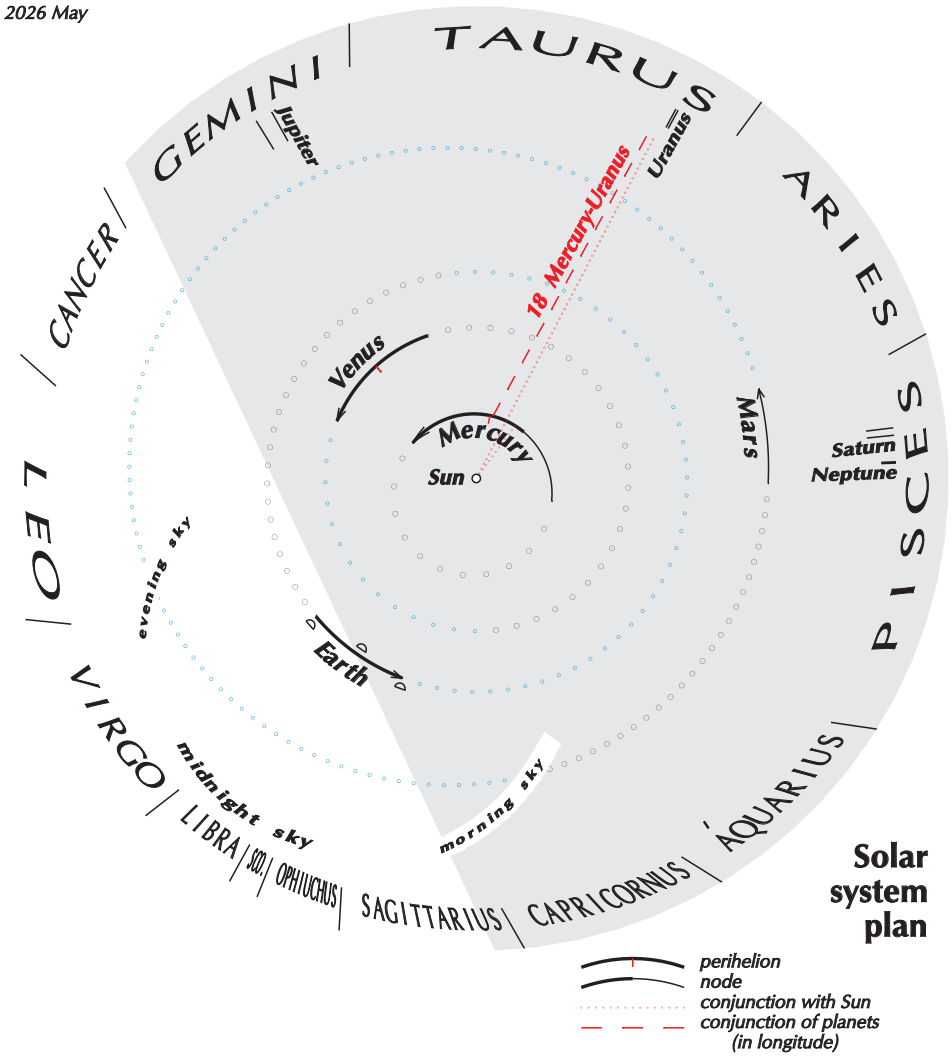
about 10 PM at the 5th,
9 PM at the 20th
of the month

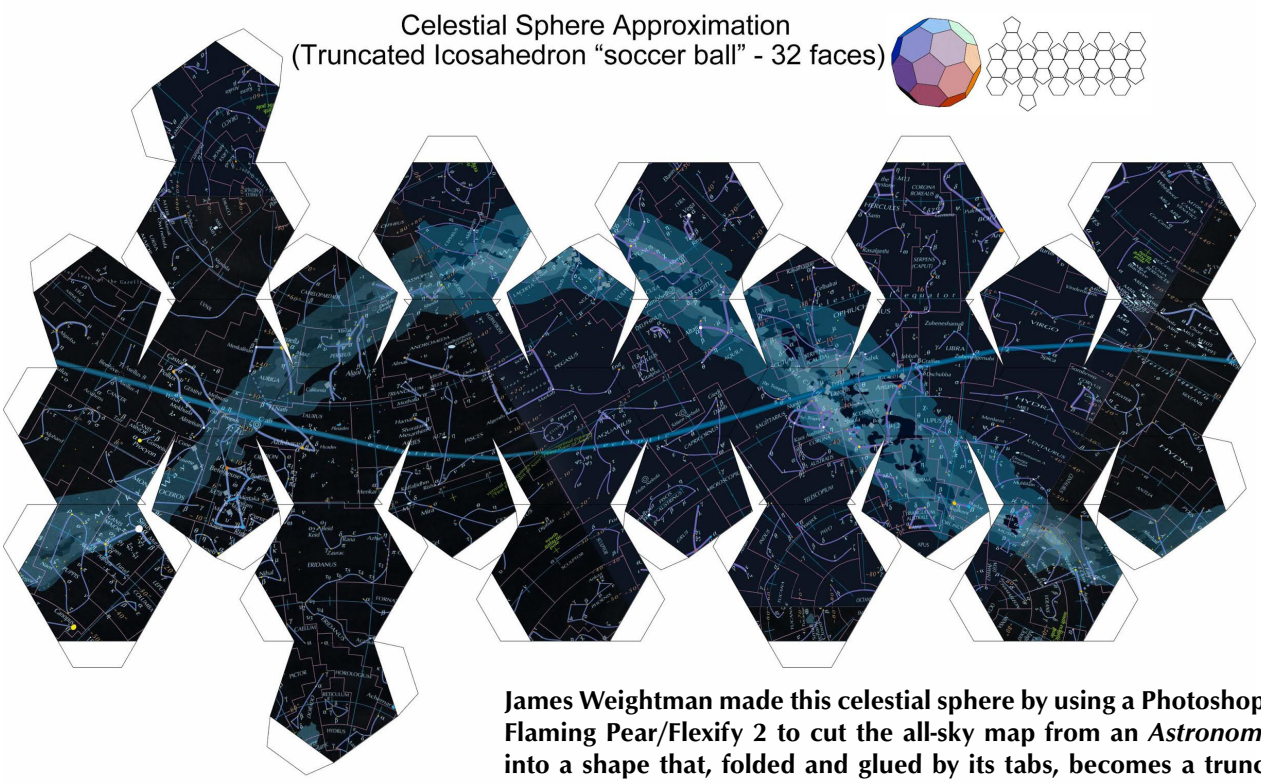
sidereal time
**13**h

| for: | see map for: |
|---|---|
| 5–6 PM | March |
| 7–8 | April |
| 11–12 | June |
| 1–2 AM | July |
| 3–4 | August |
| 5–6 | September |

**May map serves for**
**Jun 7–8 PM**
**Jull 5–6**
**Jan 5–6 AM**
**Feb 3–4**
**Mar 1–2**
**Apr 11–12 PM**

**(star background only—not solar-system bodies)**




**James Weightman made this celestial sphere by using a Photoshop plugin called Flaming Pear/Flexify 2 to cut the all-sky map from an *Astronomical Calendar* into a shape that, folded and glued by its tabs, becomes a truncated icosahedron. An icosahedron has 20 faces; truncating it, that is, cutting off its pyramid-like corners, causes it to have 32 faces, a closer approximation to the sphere.**

2026 MAY

| | | | | | |
|---|---|---|---|---|---|
| 1162.225 | May | 1 | Fri | 17:24 | Full Moon |
| 1162.854 | May | 2 | SAT | 9 | Venus 6.4° N of Aldebaran; 28° and 29° from Sun in evening sky; magnitudes -3.9 and 0.9 |
| 1163.167 | May | 2 | SAT | 16 | Uranus 4.2° SE of the Pleiades; 18° and 19° from Sun in evening sky |
| 1164.646 | May | 4 | Mon | 4 | Moon 0.52° SE of Antares; 153° from Sun in morning sky; magnitudes -11.9 and 1.0 |
| 1165.442 | May | 4 | Mon | 23 | Moon at apogee; distance 63.63 Earth-radii |
| 1166.406 | May | 5 | Tue | 22 | Mars and Neptune at heliocentric conjunction; longitude 2.1° |
| 1166.425 | May | 5 | Tue | 22 | Pluto stationary in longitude; starts retrograde motion |
| 1166.5 | May | 6 | Wed | 0 | Eta Aquarid meteors; ZHR 50; 4 days before Last Quarter Moon |
| 1168.349 | May | 7 | Thu | 20 | Pluto stationary in right ascension; starts retrograde motion |

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| | | | | | |
|---|---|---|---|---|---|
| 1170.384 | May | 9 | SAT | 21:13 | Last quarter Moon |
| 1171.692 | May | 11 | Mon | 4:37 | Moon at ascending node; longitude 335.9° |
| 1173.223 | May | 12 | Tue | 17 | Mars and Saturn at heliocentric conjunction; longitude 6.4° |
| 1173.771 | May | 13 | Wed | 7 | Moon 3.7° NNW of Neptune; 49° from Sun in morning sky; magnitudes -8.2 and 7.9 |
| 1174.243 | May | 13 | Wed | 18 | Mercury at ascending node through the ecliptic plane |
| 1174.250 | May | 13 | Wed | 18 | Moon 5.1° NNW of Saturn; 43° from Sun in morning sky; magnitudes -7.8 and 0.9 |
| 1174.546 | May | 14 | Thu | 1 | The equation of time is at a maximum of 3.64 minutes |
| 1174.851 | May | 14 | Thu | 8 | Sun enters Taurus, at longitude 53.57° on the ecliptic |
| 1175.092 | May | 14 | Thu | 14 | Mercury at superior conjunction with the Sun; 1.323 AU from Earth; latitude 0.63° |
| 1175.396 | May | 14 | Thu | 22 | Moon 4.7° NNW of Mars; 27° from Sun in morning sky; magnitudes -6.7 and 1.2 |
| 1175.615 | May | 15 | Fri | 3 | Venus at perihelion; 0.7184 AU from the Sun |

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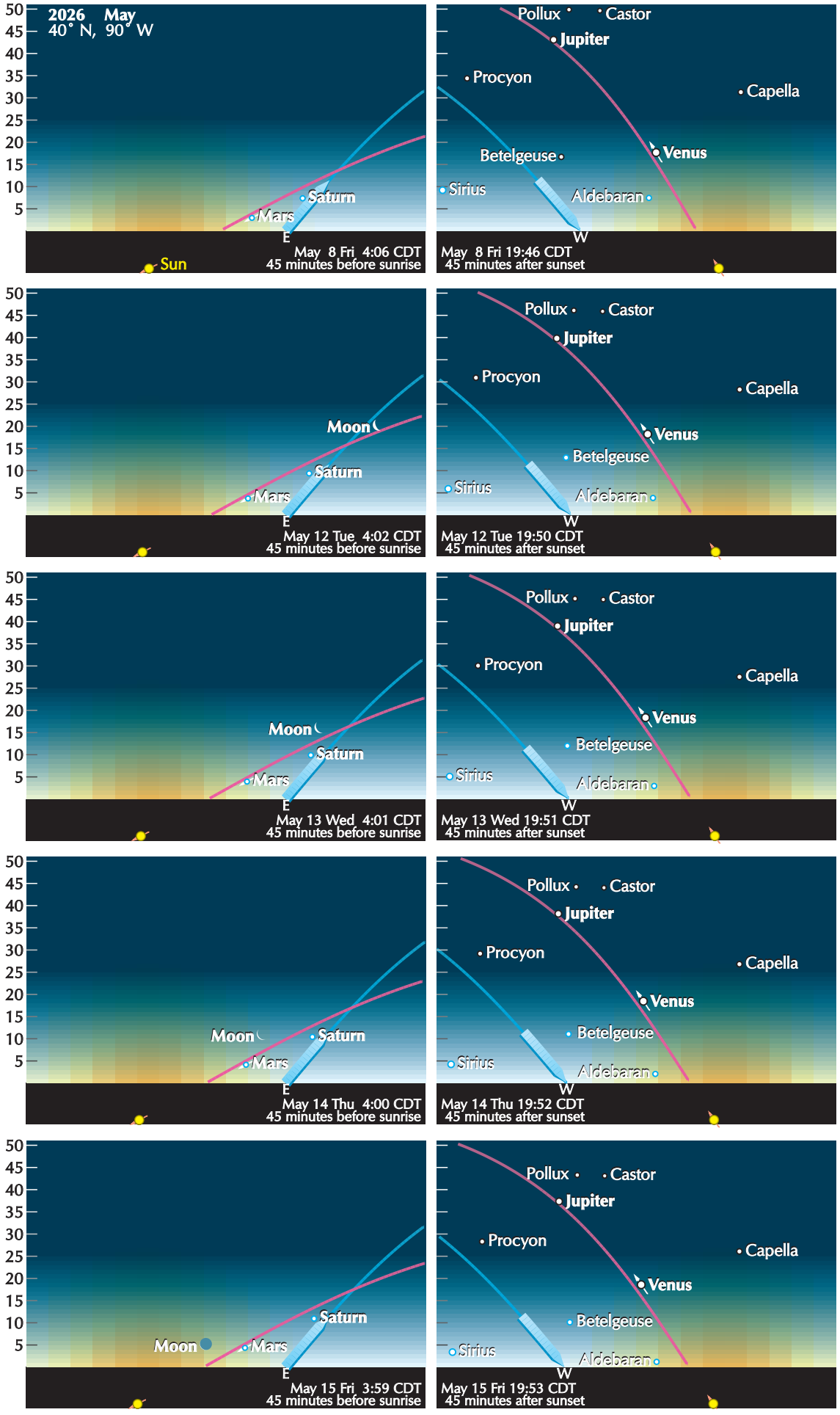
| | | | | | |
|---|---|---|---|---|---|
| 1177.335 | May | 16 | SAT | 20:02 | New Moon; beginning of lunation 1279 |
| 1177.542 | May | 17 | SUN | 1 | Moon, Mercury, and the Pleiades within circle of diameter 4.40°; only about 5° from the Sun; magnitudes -5, -2, 3 |
| 1177.542 | May | 17 | SUN | 1 | Mercury, Uranus, and the Pleiades within circle of diameter 4.30°; only about 5° from the Sun; magnitudes -2, 6, 3 |
| 1177.563 | May | 17 | SUN | 2 | Moon 4.4° N of Mercury; 6° and 3° from Sun in evening sky; magnitudes -4.7 and -2.0 |
| 1177.646 | May | 17 | SUN | 4 | Moon 1.00° N of Pleiades; 7° and 6° from Sun in evening sky |
| 1177.658 | May | 17 | SUN | 4 | Moon, Uranus, and the Pleiades within circle of diameter 5.16°; about 6° from the Sun in the evening sky; magnitudes -5, 6, 3 |
| 1177.658 | May | 17 | SUN | 4 | Moon, Mercury, and Uranus within circle of diameter 5.16°; only about 5° from the Sun; magnitudes -5, -2, 6 |
| 1177.708 | May | 17 | SUN | 5 | Moon 5.2° N of Uranus; 7° and 5° from Sun in evening sky; magnitudes -4.8 and 5.8 |
| 1178.073 | May | 17 | SUN | 13:45 | Moon at perigee; distance 56.14 Earth-radii; only 17.7 hours after new Moon |


2026 May
40° N, 90° W
50
45
40
35
30
25
20
15
10
5
Saturn
Mars
E
Sun
May 8 Fri 4:06 CDT
45 minutes before sunrise
Pollux
Castor
Jupiter
Procyon
Capella
Venus
Betelgeuse
Sirius
Aldebaran
W
May 8 Fri 19:46 CDT
45 minutes after sunset
Moon
May 12 Tue 4:02 CDT
45 minutes before sunrise
May 12 Tue 19:50 CDT
45 minutes after sunset
May 13 Wed 4:01 CDT
45 minutes before sunrise
May 13 Wed 19:51 CDT
45 minutes after sunset
May 14 Thu 4:00 CDT
45 minutes before sunrise
May 14 Thu 19:52 CDT
45 minutes after sunset
May 15 Fri 3:59 CDT
45 minutes before sunrise
May 15 Fri 19:53 CDT
45 minutes after sunset

| | | | | | |
|---|---|---|---|---|---|
| 1178.229 | May | 17 | SUN | 18 | Mercury 3.4° SE of the Pleiades; 4° and 5° from Sun in evening sky |
| 1178.5 | May | 18 | Mon | 0 | Mercury 0.90° NNW of Uranus; 4° from Sun in evening sky; magnitudes -1.9 and 5.8 |
| 1178.916 | May | 18 | Mon | 10 | Mercury at perihelion; 0.3075 AU from the Sun |
| 1179.604 | May | 19 | Tue | 3 | Moon 2.95° N of Venus; 33° and 32° from Sun in evening sky; magnitudes -7.1 and -4.0 |
| 1179.700 | May | 19 | Tue | 5 | Moon, Venus, and M35 cluster within circle of diameter 3.69°; about 33° from the Sun in the evening sky; magnitudes -7, -4, 5 |
| 1179.771 | May | 19 | Tue | 7 | Moon 3.6° N of M35 cluster; 35° and 34° from Sun in evening sky; magnitudes -7.3 and 5.3 |
| 1180.958 | May | 20 | Wed | 11 | Moon 6.6° S of Castor; 51° and 52° from Sun in evening sky; magnitudes -8.4 and 1.5 |
| 1181.104 | May | 20 | Wed | 15 | Moon 3.0° NNE of Jupiter; 53° and 52° from Sun in evening sky; magnitudes -8.5 and -1.9 |
| 1181.167 | May | 20 | Wed | 16 | Moon 3.4° SSW of Pollux; 54° from Sun in evening sky; magnitudes -8.5 and 1.2 |
| 1181.521 | May | 21 | Thu | 1 | Venus 0.76° N of M35 cluster; 32° from Sun in evening sky; magnitudes -4.0 and 5.3 |
| 1181.524 | May | 21 | Thu | 1 | Sun enters the astrological sign Gemini, i.e. its longitude is 60° |
| 1182.188 | May | 21 | Thu | 17 | Moon 1.03° NE of Beehive Cluster; 67° from Sun in evening sky; magnitudes -9.2 and 3.7 |
| 1182.235 | May | 21 | Thu | 18 | Venus at northernmost declination, 25.08° |
| 1182.458 | May | 21 | Thu | 23 | Mercury 6.8° NNW of Aldebaran; 9° and 11° from Sun in evening sky; magnitudes -1.5 and 0.9 |
| 1183.102 | May | 22 | Fri | 14 | Uranus at conjunction with the Sun; 20.477 AU from Earth; latitude -0.17° |
| 1183.833 | May | 23 | SAT | 8 | Moon 0.39° SE of Regulus; 88° from Sun in evening sky; magnitudes -10.1 and 1.4 |

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| | | | | | |
|---|---|---|---|---|---|
| 1183.966 | May | 23 | SAT | 11:11 | First quarter Moon |
| 1184.144 | May | 23 | SAT | 15:28 | Moon at descending node; longitude 154.7° |
| 1184.5 | May | 24 | SUN | | Whit Sunday |
| 1188.083 | May | 27 | Wed | 14 | Moon 1.80° SSW of Spica; 138° from Sun in evening sky; magnitudes -11.5 and 1.0 |
| 1189.121 | May | 28 | Thu | 15 | Mercury at northernmost latitude from the ecliptic plane, 7.0° |
| 1190.042 | May | 29 | Fri | 13 | Jupiter 6.3° S of Pollux; 45° and 46° from Sun in evening sky; magnitudes -1.9 and 1.2 |

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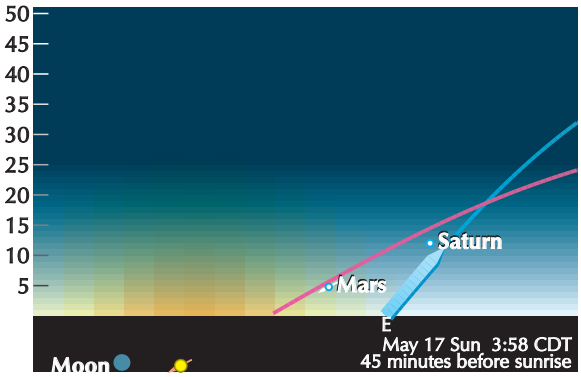
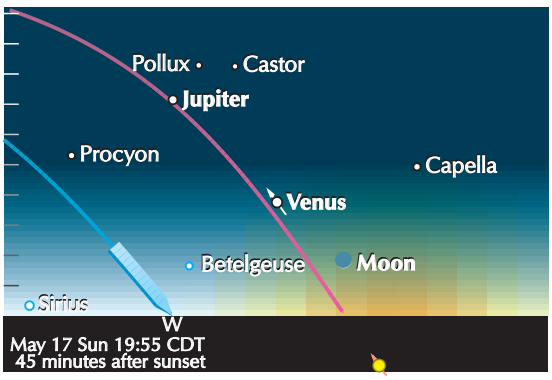
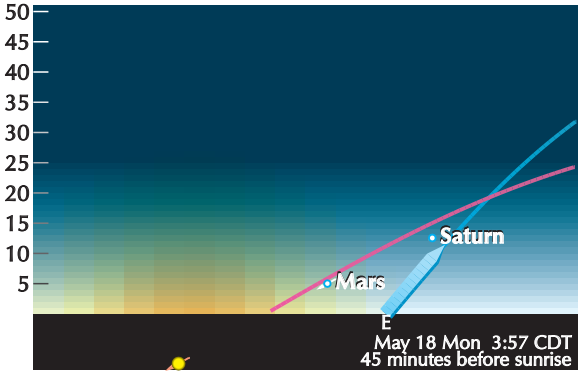
| | | | | | |
|---|---|---|---|---|---|
| 1191.865 | May | 31 | SUN | 8:46 | Full Moon |
| 1191.896 | May | 31 | SUN | 10 | Moon 0.42° SE of Antares; 175° from Sun in evening midnight sky; magnitudes -12.4 and 1.0 |


50
45
40
35
30
25
20
15
10
5
Saturn
Mars
E
Moon
May 17 Sun 3:58 CDT
45 minutes before sunrise


Pollux
Castor
Jupiter
Procyon
Capella
Venus
Betelgeuse
Moon
Sirius
W
May 17 Sun 19:55 CDT
45 minutes after sunset


50
45
40
35
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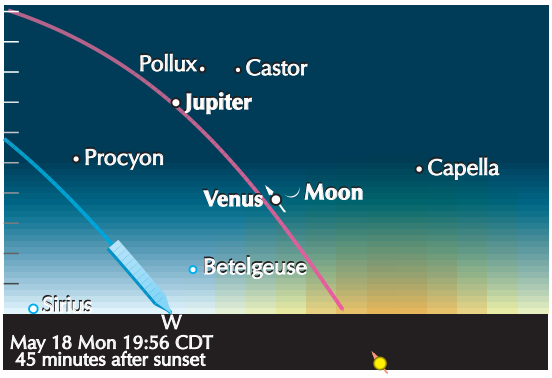
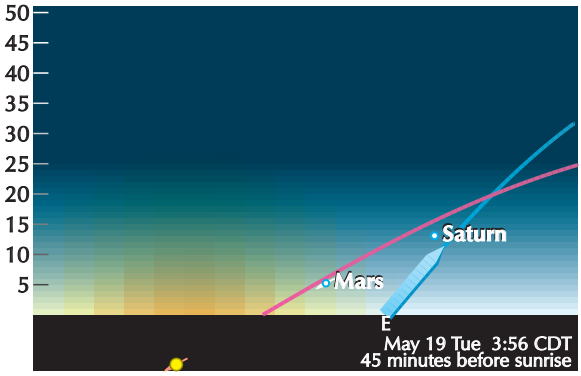
5
Saturn
Mars
E
May 18 Mon 3:57 CDT
45 minutes before sunrise


Pollux
Castor
Jupiter
Procyon
Capella
Venus
Moon
Betelgeuse
Sirius
W
May 18 Mon 19:56 CDT
45 minutes after sunset


50
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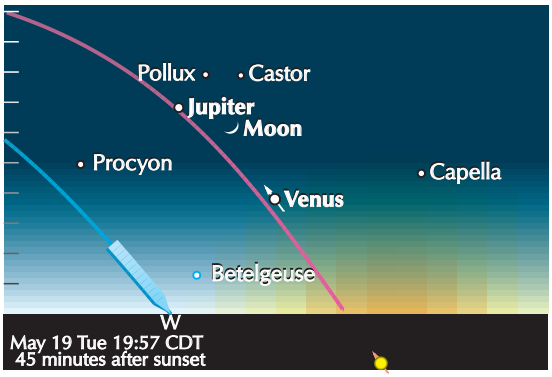
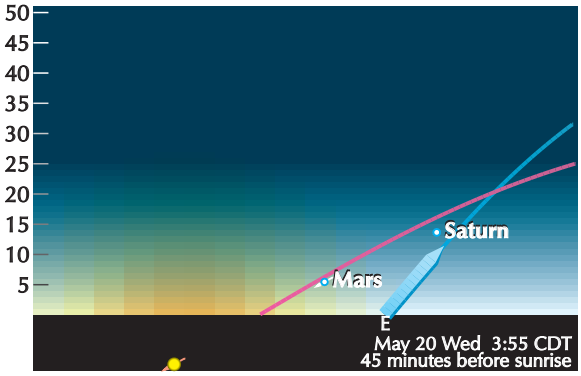
15
10
5
Saturn
Mars
E
May 19 Tue 3:56 CDT
45 minutes before sunrise


Pollux
Castor
Jupiter
Moon
Procyon
Capella
Venus
Betelgeuse
W
May 19 Tue 19:57 CDT
45 minutes after sunset


50
45
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35
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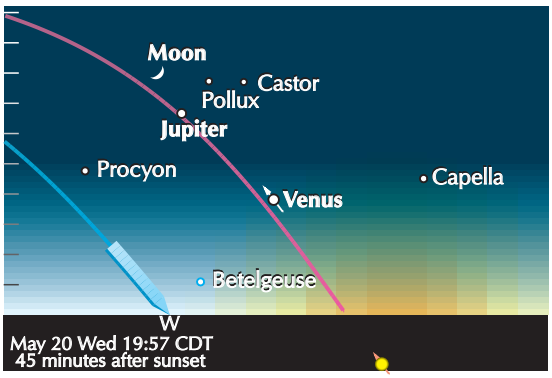
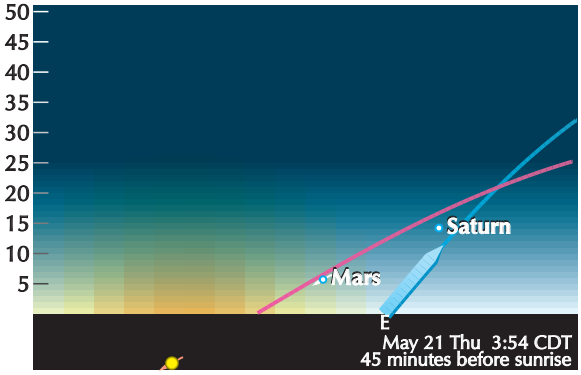
15
10
5
Saturn
Mars
E
May 20 Wed 3:55 CDT
45 minutes before sunrise


Moon
Castor
Pollux
Jupiter
Procyon
Capella
Venus
Betelgeuse
W
May 20 Wed 19:57 CDT
45 minutes after sunset


50
45
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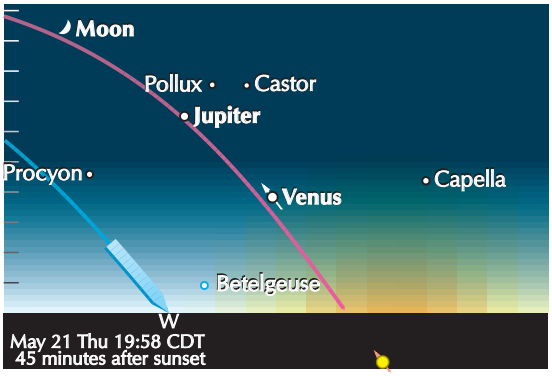
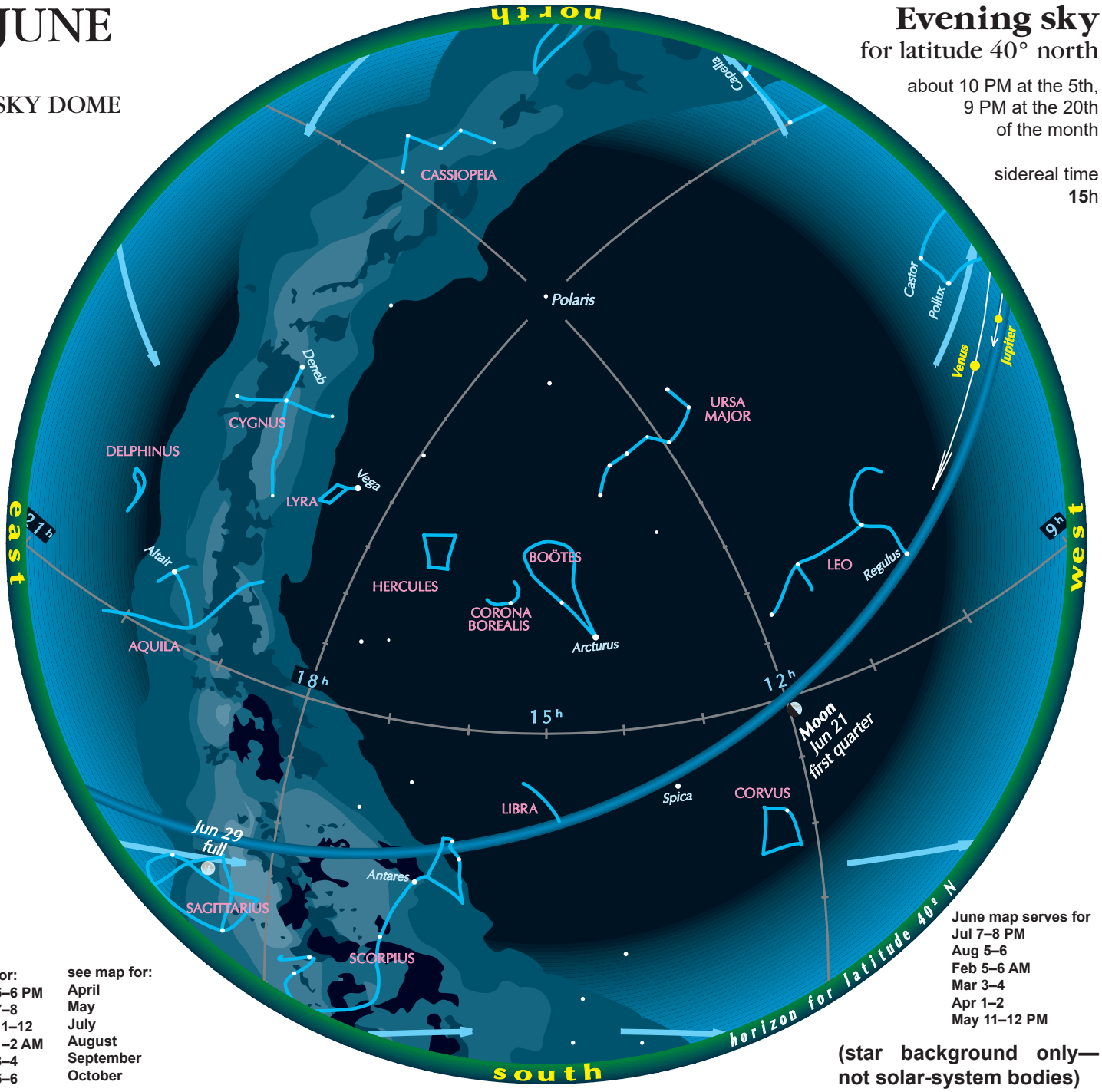
5
Saturn
Mars
E
May 21 Thu 3:54 CDT
45 minutes before sunrise


Moon
Pollux
Castor
Jupiter
Procyon
Capella
Venus
Betelgeuse
W
May 21 Thu 19:58 CDT
45 minutes after sunset

# JUNE

## SKY DOME




## Evening sky
for latitude 40° north

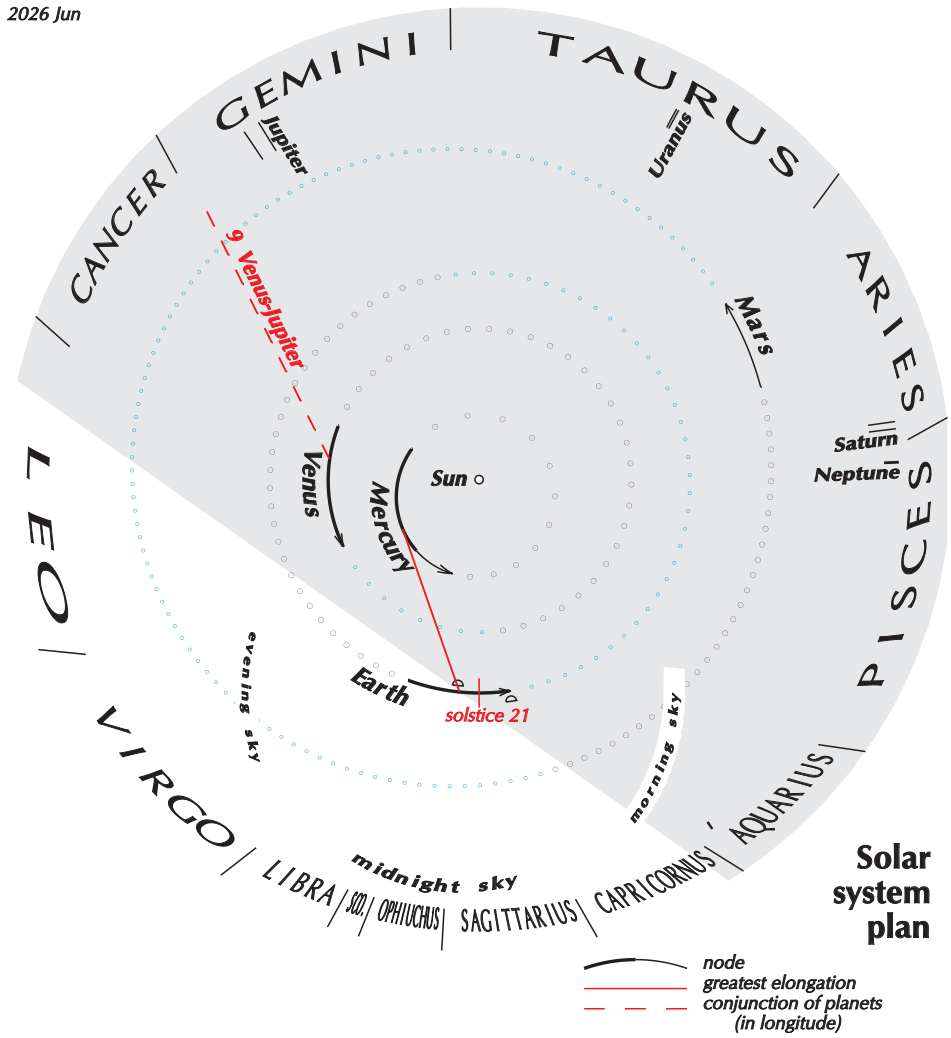
about 10 PM at the 5th,
9 PM at the 20th
of the month

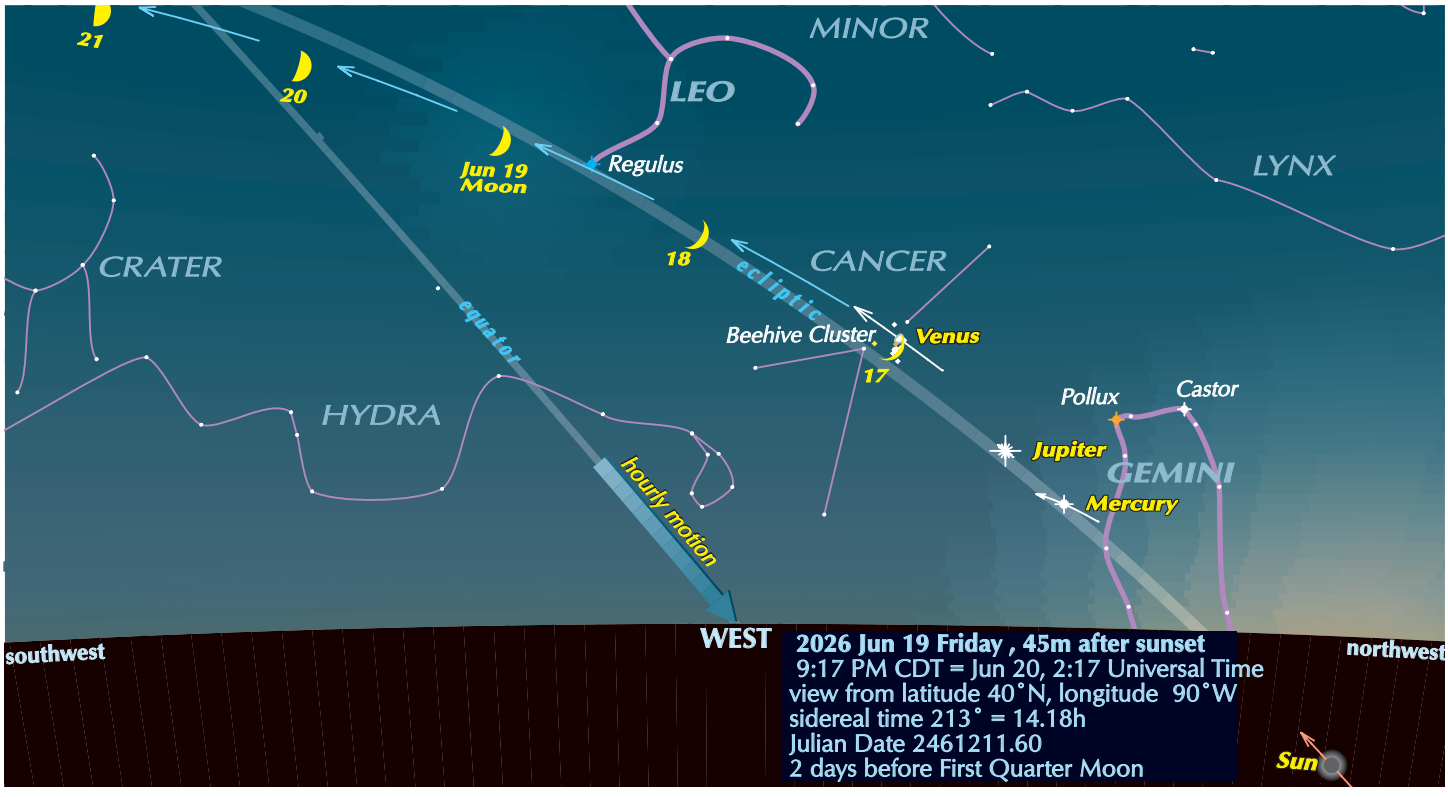
sidereal time
**15**h

| for: | see map for: |
|---|---|
| 5–6 PM | April |
| 7–8 | May |
| 11–12 | July |
| 1–2 AM | August |
| 3–4 | September |
| 5–6 | October |

June map serves for
Jul 7–8 PM
Aug 5–6
Feb 5–6 AM
Mar 3–4
Apr 1–2
May 11–12 PM

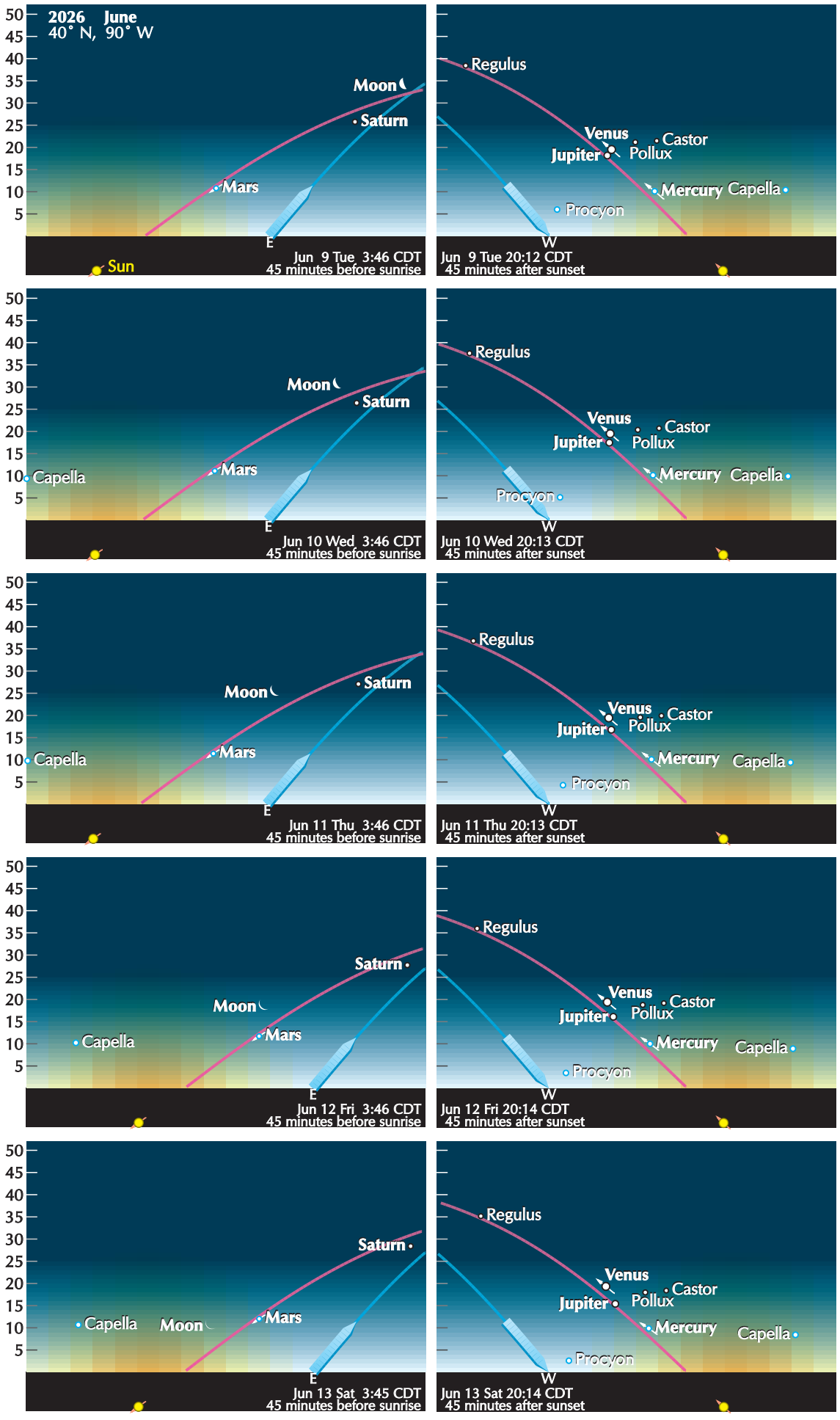
**(star background only—not solar-system bodies)**


2026 Jun
GEMINI
TAURUS
ARIES
PISCES
AQUARIUS
CAPRICORNUS
SAGITTARIUS
OPHIUCHUS
LIBRA
VIRGO
LEO
CANCER
Jupiter
Uranus
Mars
Saturn
Neptune
9 Venus-Jupiter
Venus
Mercury
Sun
Earth
solstice 21
evening sky
morning sky
midnight sky
Solar system plan
node
greatest elongation
conjunction of planets (in longitude)

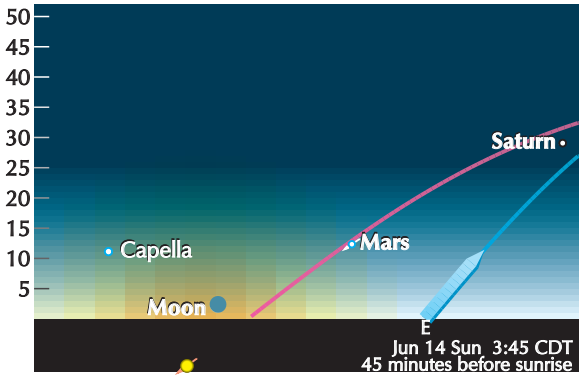

21
20
Jun 19 Moon
Regulus
LEO
MINOR
LYNX
CRATER
18
ecliptic
CANCER
Beehive Cluster
Venus
17
equator
HYDRA
Pollux
Castor
Jupiter
GEMINI
Mercury
hourly motion
WEST
southwest
northwest
2026 Jun 19 Friday , 45m after sunset
9:17 PM CDT = Jun 20, 2:17 Universal Time
view from latitude 40°N, longitude 90°W
sidereal time 213° = 14.18h
Julian Date 2461211.60
2 days before First Quarter Moon
Sun

2026 JUNE

| | | | | | |
|---|---|---|---|---|---|
| 1192.706 | Jun | 1 | Mon | 5 | Moon at apogee; distance 63.71 Earth-radii; only 20.2 hours after full Moon |
| 1193.304 | Jun | 1 | Mon | 19 | Mercury at northernmost declination, 25.60° |
| 1194.438 | Jun | 2 | Tue | 23 | Mercury 1.26° N of M35 cluster; 20° from Sun in evening sky; magnitudes -0.4 and 5.3 |
| 1197.225 | Jun | 5 | Fri | 17 | Venus at northernmost latitude from the ecliptic plane, 3.4° |
| 1198.763 | Jun | 7 | SUN | 6:19 | Moon at ascending node; longitude 332.9° |
| 1198.917 | Jun | 7 | SUN | 10 | Daytime Arietid meteors; ZHR 30 |
| 1199.5 | Jun | 8 | Mon | 0 | Venus 4.7° S of Pollux; 36° and 37° from Sun in evening sky; magnitudes -4.0 and 1.2 |
| 1199.918 | Jun | 8 | Mon | 10:02 | Last quarter Moon |
| 1201.167 | Jun | 9 | Tue | 16 | Moon 4.0° NNW of Neptune; 75° from Sun in morning sky; magnitudes -9.5 and 7.9 |
| 1201.354 | Jun | 9 | Tue | 21 | Venus 1.61° NNE of Jupiter; 37° from Sun in evening sky; magnitudes -4.0 and -1.9 |
| 1201.813 | Jun | 10 | Wed | 8 | Moon 5.6° NNW of Saturn; 67° and 66° from Sun in morning sky; magnitudes -9.1 and 0.9 |
| 1204.292 | Jun | 12 | Fri | 19 | Moon 5.4° NNW of Mars; 33° from Sun in morning sky; magnitudes -7.2 and 1.3 |
| 1204.520 | Jun | 13 | SAT | 0 | The equation of time is 0 |
| 1205.083 | Jun | 13 | SAT | 14 | Moon 1.00° N of Pleiades; 23° from Sun in morning sky |
| 1205.200 | Jun | 13 | SAT | 17 | Moon, Uranus, and the Pleiades within circle of diameter 5.22°; about 21° from the Sun in the morning sky; magnitudes -6, 6, 3 |
| 1205.250 | Jun | 13 | SAT | 18 | Moon 5.2° N of Uranus; 20° from Sun in morning sky; magnitudes -6.1 and 5.8 |
| 1205.688 | Jun | 14 | SUN | | Earliest sunrise, at latitude 40° north |
| 1206.472 | Jun | 14 | SUN | 23:20 | Moon at perigee; distance 56.01 Earth-radii; only 3.6 hours before new Moon |
| 1206.621 | Jun | 15 | Mon | 2:55 | New Moon; beginning of lunation 1280 |
| 1207.188 | Jun | 15 | Mon | 17 | Moon 3.5° N of M35 cluster; 9° and 8° from Sun in evening sky; magnitudes -5.0 and 5.3 |
| 1207.328 | Jun | 15 | Mon | 20 | Mercury at easternmost elongation; 24.5° from Sun in evening sky; magnitude 0.6 |
| 1208.354 | Jun | 16 | Tue | 21 | Moon 6.7° SSW of Castor; 25° and 27° from Sun in evening sky; magnitudes -6.5 and 1.5 |
| 1208.375 | Jun | 16 | Tue | 21 | Moon 2.56° NNE of Mercury; 25° and 24° from Sun in evening sky; magnitudes -6.5 and 0.7 |
| 1208.5 | Jun | 17 | Wed | | 1st day of Muslim year (1448 A.H.) |
| 1208.583 | Jun | 17 | Wed | 2 | Moon 3.6° S of Pollux; 28° from Sun in evening sky; magnitudes -6.7 and 1.2 |
| 1208.854 | Jun | 17 | Wed | 9 | Moon 2.47° NNE of Jupiter; 32° and 31° from Sun in evening sky; magnitudes -7.0 and -1.8 |
| 1209.375 | Jun | 17 | Wed | 21 | Moon 0.37° ENE of Venus; 39° from Sun in evening sky; magnitudes -7.5 and -4.0 |


2026 June
40° N, 90° W
Moon
Saturn
Mars
Sun
E
Jun 9 Tue 3:46 CDT
45 minutes before sunrise
Regulus
Venus
Castor
Jupiter
Pollux
Mercury
Capella
Procyon
W
Jun 9 Tue 20:12 CDT
45 minutes after sunset
Jun 10 Wed 3:46 CDT
45 minutes before sunrise
Jun 10 Wed 20:13 CDT
45 minutes after sunset
Jun 11 Thu 3:46 CDT
45 minutes before sunrise
Jun 11 Thu 20:13 CDT
45 minutes after sunset
Jun 12 Fri 3:46 CDT
45 minutes before sunrise
Jun 12 Fri 20:14 CDT
45 minutes after sunset
Jun 13 Sat 3:45 CDT
45 minutes before sunrise
Jun 13 Sat 20:14 CDT
45 minutes after sunset

| | | | | | |
|---|---|---|---|---|---|
| 1209.5 | Jun | 18 | Thu | 0 | Moon, Venus, and Beehive within circle of diameter 2.51°; about 40° from the Sun in the evening sky; magnitudes -8, -4, 4 |
| 1209.563 | Jun | 18 | Thu | 2 | Moon 0.87° NE of Beehive Cluster center, 41° from Sun in evening sky; magnitudes -7.7 and 3.7 |
| 1210.479 | Jun | 18 | Thu | 24 | Mercury 6.5° SSW of Pollux; 24° and 27° from Sun in evening sky; magnitudes 0.8 and 1.2 |
| 1211.146 | Jun | 19 | Fri | 16 | Moon 0.45° SE of Regulus; 62° from Sun in evening sky; magnitudes -8.9 and 1.4 |
| 1211.249 | Jun | 19 | Fri | 17:58 | Moon at descending node; longitude 151.9° |
| 1211.604 | Jun | 20 | SAT | 3 | Venus 0.70° NNE of Beehive Cluster center, 39° from Sun in evening sky; magnitudes -4.0 and 3.7 |
| 1212.522 | Jun | 21 | SUN | 1 | Mercury at descending node through the ecliptic plane |
| 1212.849 | Jun | 21 | SUN | 8:23 | Sun enters the astrological sign Cancer, i.e. its longitude is 90° |
| 1212.849 | Jun | 21 | SUN | 8:23 | June (northern summer) solstice |
| 1213.404 | Jun | 21 | SUN | 22 | Sun enters Gemini, at longitude 90.53° on the ecliptic |
| | | | | | _____ |
| 1213.413 | Jun | 21 | SUN | 21:55 | First quarter Moon |
| 1215.313 | Jun | 23 | Tue | 20 | Moon 1.98° SSW of Spica; 112° from Sun in evening sky; magnitudes -10.8 and 1.0 |
| 1217.021 | Jun | 25 | Thu | 13 | Mercury 3.7° WSW of Jupiter; 22° and 25° from Sun in evening sky; magnitudes 1.5 and -1.8; quasi-conjunction |
| 1219.146 | Jun | 27 | SAT | 16 | Moon 0.47° SE of Antares; 154° from Sun in evening sky; magnitudes -11.9 and 1.0 |
| 1219.315 | Jun | 27 | SAT | | Latest sunset, at latitude 40° north |
| 1219.777 | Jun | 28 | SUN | 7 | Moon at apogee; distance 63.69 Earth-radii |
| 1220.578 | Jun | 29 | Mon | 2 | Mercury stationary in right ascension; starts retrograde motion |
| 1220.875 | Jun | 29 | Mon | 9 | Mars, Uranus, and the Pleiades within circle of diameter 5.34°; about 36° from the Sun in the morning sky; magnitudes 1, 6, 3 |
| 1220.917 | Jun | 29 | Mon | 10 | Mars 4.4° SE of the Pleiades; 37° and 38° from Sun in morning sky |
| 1221.230 | Jun | 29 | Mon | 18 | Mercury stationary in longitude; starts retrograde motion |
| | | | | | _____ |
| 1221.498 | Jun | 29 | Mon | 23:57 | Full Moon |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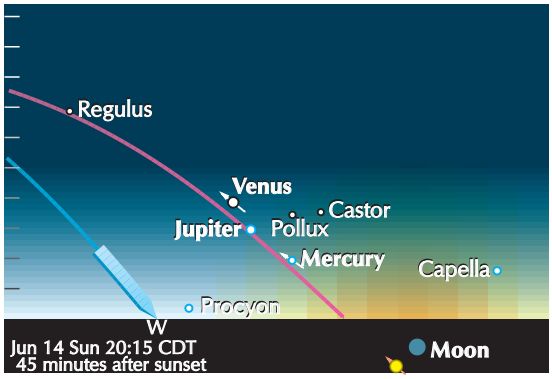
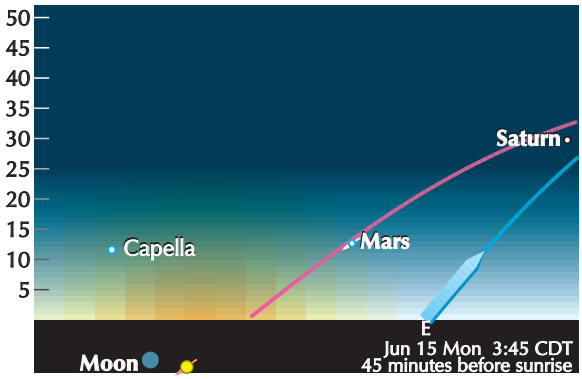
Saturn
Capella
Mars
Moon
E
Jun 14 Sun 3:45 CDT
45 minutes before sunrise


Regulus
Venus
Castor
Jupiter
Pollux
Mercury
Capella
Procyon
W
Jun 14 Sun 20:15 CDT
45 minutes after sunset
Moon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Saturn
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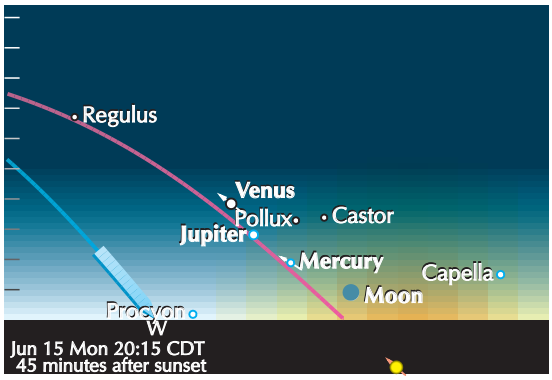
Jun 15 Mon 3:45 CDT
45 minutes before sunrise


Regulus
Venus
Pollux
Castor
Jupiter
Mercury
Capella
Moon
Procyon
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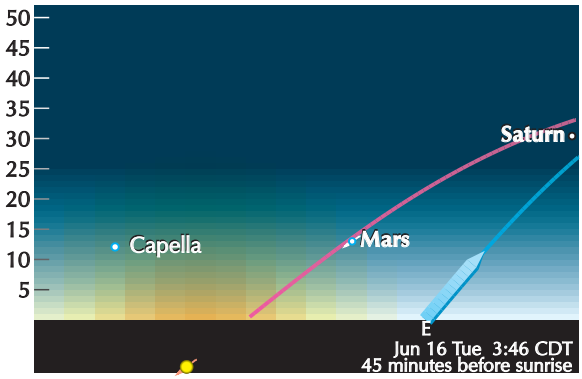
Jun 15 Mon 20:15 CDT
45 minutes after sunset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Saturn
Capella
Mars
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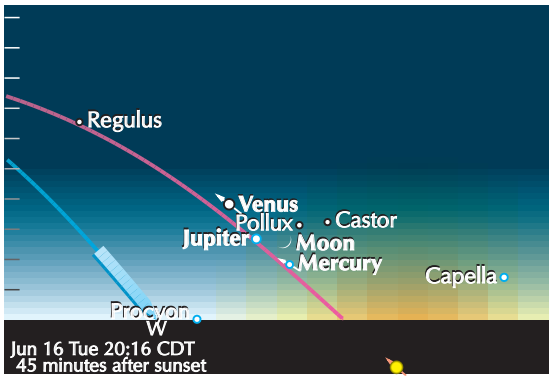
Jun 16 Tue 3:46 CDT
45 minutes before sunrise


Regulus
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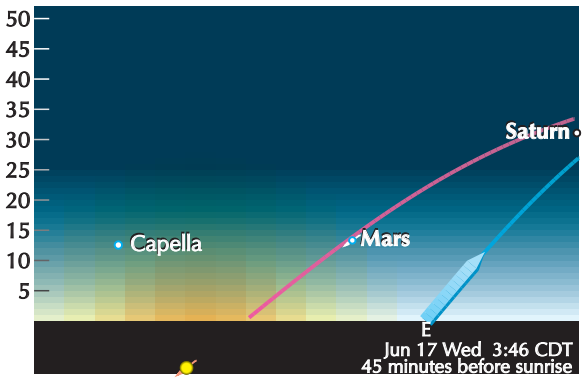
Castor
Jupiter
Moon
Mercury
Capella
Procyon
W
Jun 16 Tue 20:16 CDT
45 minutes after sunset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Saturn
Capella
Mars
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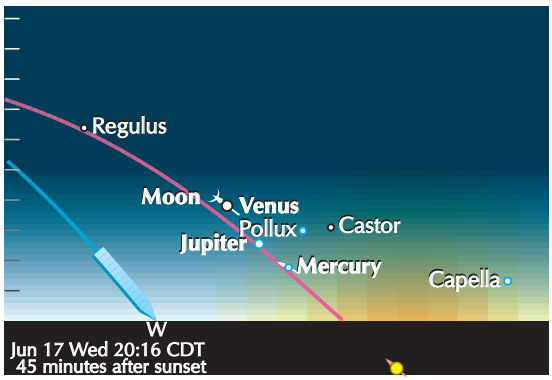
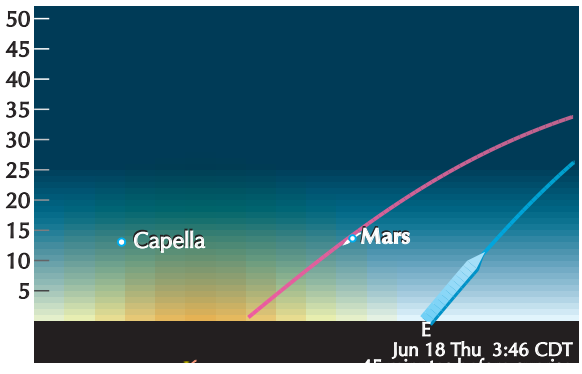
Jun 17 Wed 3:46 CDT
45 minutes before sunrise


Regulus
Moon
Venus
Pollux
Castor
Jupiter
Mercury
Capella
W
Jun 17 Wed 20:16 CDT
45 minutes after sunset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Capella
Mars
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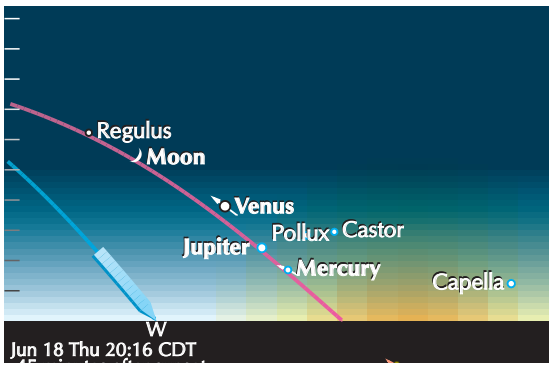
Jun 18 Thu 3:46 CDT


Regulus
Moon
Venus
Pollux
Castor
Jupiter
Mercury
Capella
W
Jun 18 Thu 20:16 CDT

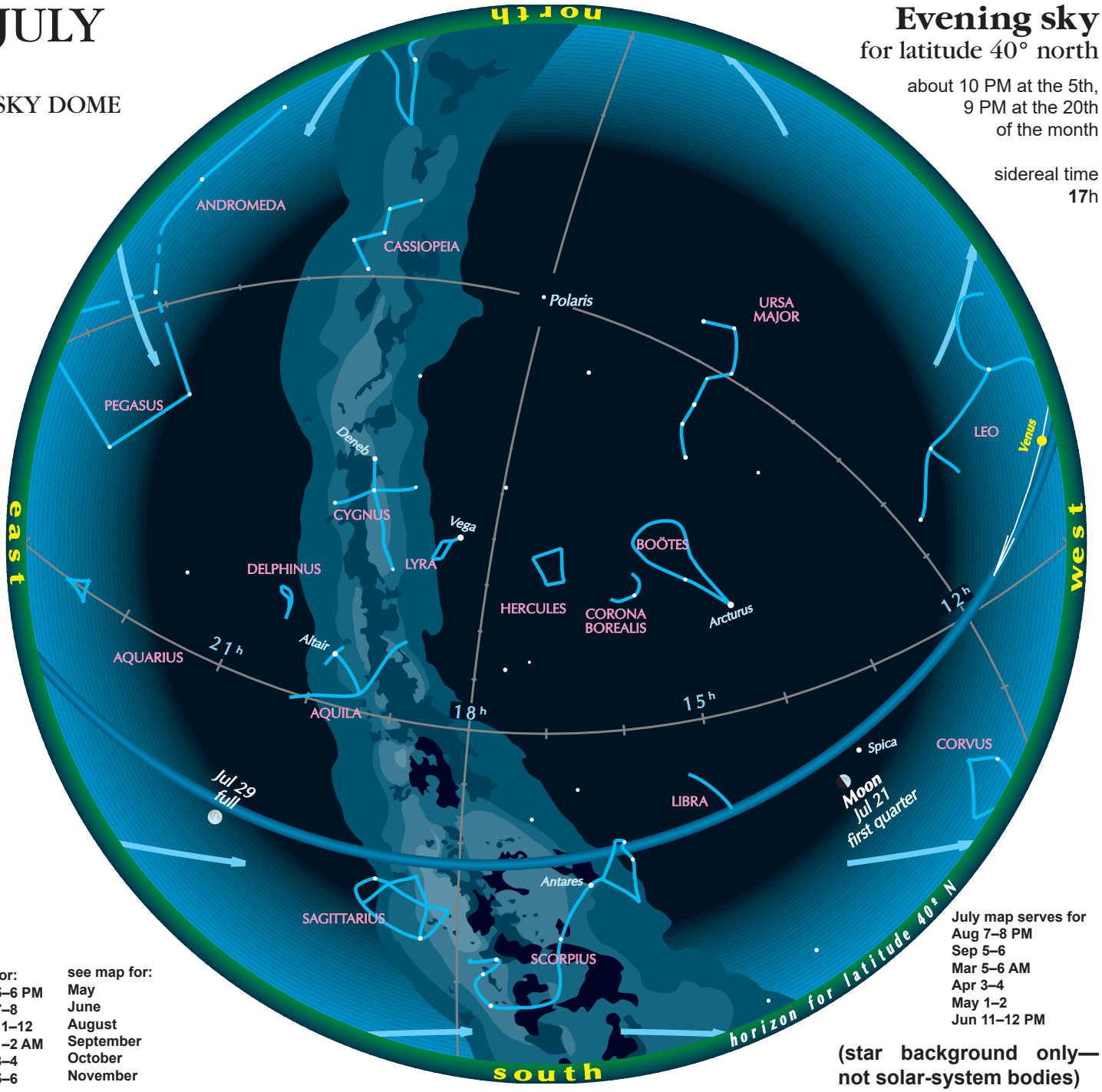
# JULY

## SKY DOME

## Evening sky
for latitude 40° north

about 10 PM at the 5th,
9 PM at the 20th
of the month

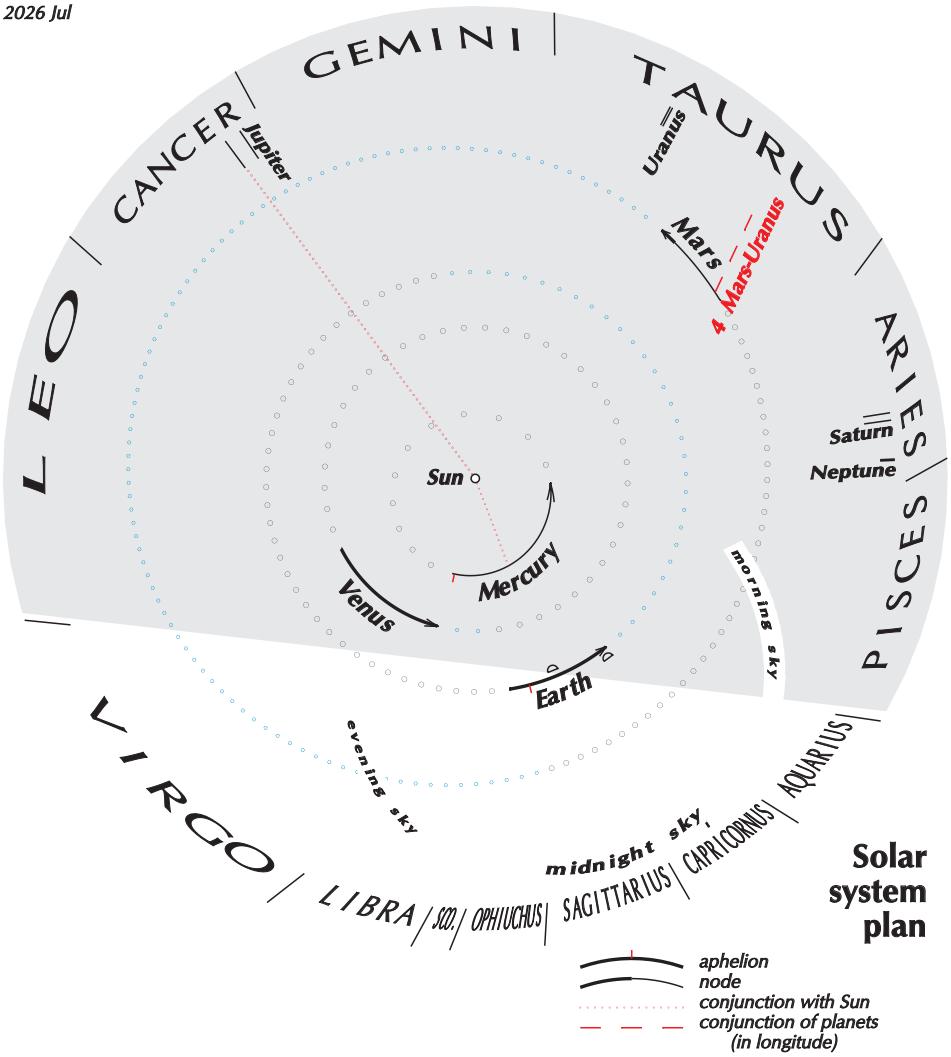
sidereal time
**17**h




| for: | see map for: |
|---|---|
| 5–6 PM | May |
| 7–8 | June |
| 11–12 | August |
| 1–2 AM | September |
| 3–4 | October |
| 5–6 | November |

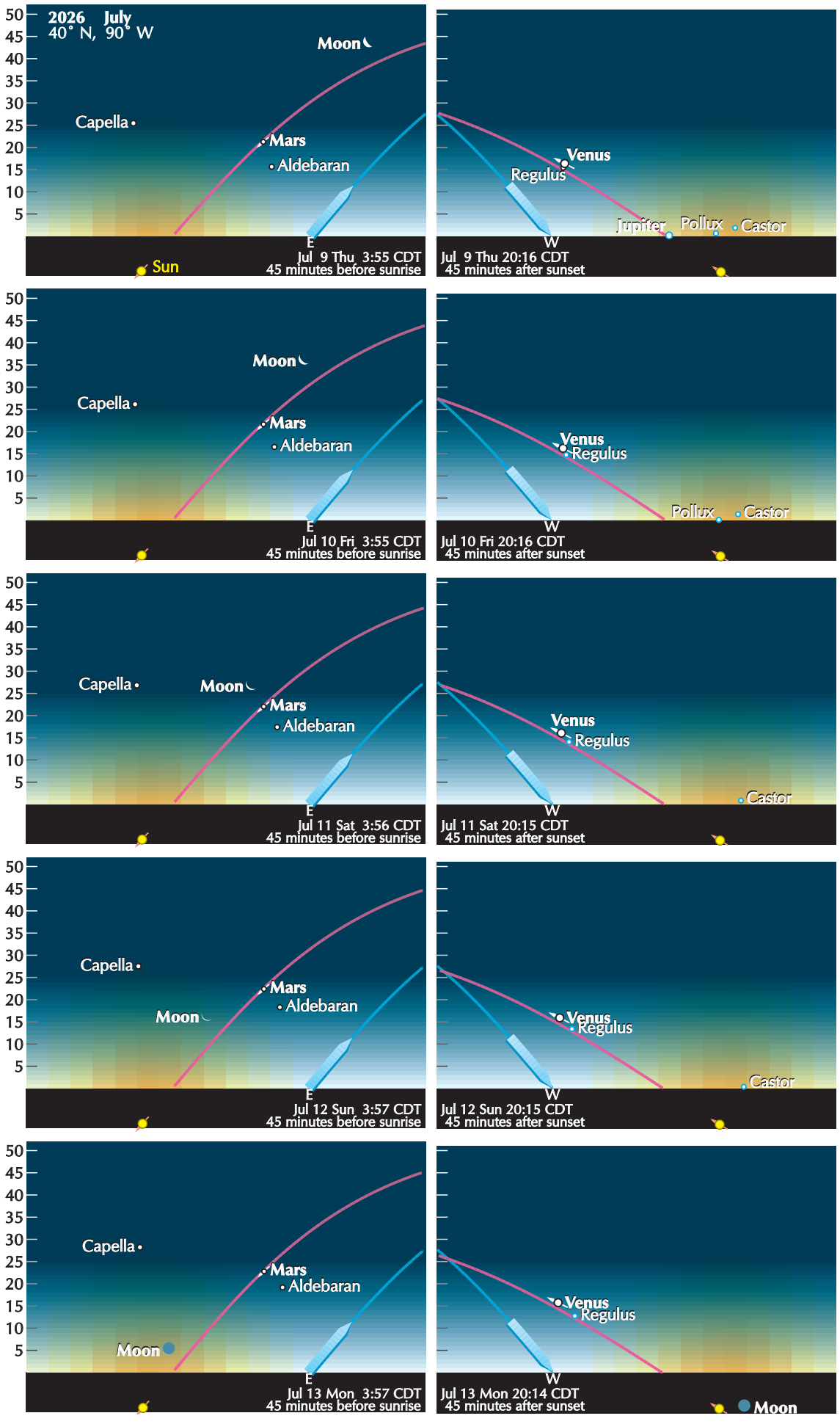
**July map serves for**
**Aug 7–8 PM**
**Sep 5–6**
**Mar 5–6 AM**
**Apr 3–4**
**May 1–2**
**Jun 11–12 PM**

**(star background only—not solar-system bodies)**


2026 Jul
GEMINI
TAURUS
CANCER
ARIES
LEO
PISCES
VIRGO
LIBRA
SCO.
OPHIUCHUS
SAGITTARIUS
CAPRICORNUS
AQUARIUS
Jupiter
Uranus
Mars
4 Mars-Uranus
Saturn
Neptune
Sun
Mercury
Venus
Earth
morning sky
evening sky
midnight sky
Solar system plan
aphelion
node
conjunction with Sun
conjunction of planets (in longitude)

2026 JULY

| | | | | | |
|---|---|---|---|---|---|
| 1222.901 | Jul | 1 | Wed | 10 | Mercury at aphelion; 0.4667 AU from the Sun |
| 1225.771 | Jul | 4 | SAT | 7 | Mars 0.11° SE of Uranus; 38° from Sun in morning sky; magnitudes 1.3 and 5.8 |
| 1225.827 | Jul | 4 | SAT | 7:52 | Moon at ascending node; longitude 330.7° |
| 1227.945 | Jul | 6 | Mon | 11 | Saturn at west quadrature, 90° from the Sun |
| 1228.247 | Jul | 6 | Mon | 18 | Earth at aphelion; 1.0167 AU from the Sun |
| 1228.458 | Jul | 6 | Mon | 23 | Moon 4.2° NNW of Neptune; 101° and 100° from Sun in morning sky; magnitudes -10.5 and 7.9 |
| 1228.815 | Jul | 7 | Tue | 8 | Neptune stationary in longitude; starts retrograde motion |
| 1229.208 | Jul | 7 | Tue | 17 | Moon 6.0° NNW of Saturn; 91° from Sun in morning sky; magnitudes -10.2 and 0.8 |
| 1229.312 | Jul | 7 | Tue | 19:30 | Last quarter Moon |
| 1229.516 | Jul | 8 | Wed | 0 | Neptune stationary in right ascension; starts retrograde motion |
| 1231.458 | Jul | 9 | Thu | 23 | Venus 0.97° NNE of Regulus; 43° and 42° from Sun in evening sky; magnitudes -4.1 and 1.4 |
| 1232.5 | Jul | 11 | SAT | 0 | Moon 1.18° N of Pleiades; 48° and 49° from Sun in morning sky |
| 1232.750 | Jul | 11 | SAT | 6 | Moon 5.3° N of Uranus; 45° from Sun in morning sky; magnitudes -8.0 and 5.8 |
| 1233.083 | Jul | 11 | SAT | 14 | Moon 5.3° N of Mars; 40° from Sun in morning sky; magnitudes -7.7 and 1.3 |
| 1234.556 | Jul | 13 | Mon | 1 | Mercury at inferior conjunction with the Sun; 0.573 AU from Earth; latitude -6.20° |
| 1234.563 | Jul | 13 | Mon | 2 | Mars 5.3° N of Aldebaran; 41° from Sun in morning sky; magnitudes 1.3 and 0.9 |
| 1234.646 | Jul | 13 | Mon | 4 | Moon 3.5° N of M35 cluster; 18° from Sun in morning sky; magnitudes -5.9 and 5.3 |
| 1234.832 | Jul | 13 | Mon | 7:57 | Moon at perigee; distance 56.31 Earth-radii |
| 1235.813 | Jul | 14 | Tue | 8 | Moon 6.8° S of Castor; 4° and 10° from Sun in evening sky; magnitudes -4.4 and 1.5 |
| 1235.906 | Jul | 14 | Tue | 9:44 | New Moon; beginning of lunation 1281 |
| 1236.021 | Jul | 14 | Tue | 13 | Moon 3.6° S of Pollux; 3° and 7° from Sun in evening sky; magnitudes -4.4 and 1.2 |
| 1236.688 | Jul | 15 | Wed | 5 | Moon 1.91° NNE of Jupiter; 11° from Sun in evening sky; magnitudes -5.2 and -1.8 |
| 1236.942 | Jul | 15 | Wed | 11 | Moon, Jupiter, and Beehive within circle of diameter 4.47°; about 13° from the Sun in the evening sky; magnitudes -6, -2, 4 |
| 1236.979 | Jul | 15 | Wed | 12 | Moon 0.72° NE of Beehive Cluster center; 15° from Sun in evening sky; magnitudes -5.6 and 3.7 |
| 1238.520 | Jul | 17 | Fri | 0:28 | Moon at descending node; longitude 150.2° |
| 1238.542 | Jul | 17 | Fri | 1 | Moon 0.58° SE of Regulus; 36° from Sun in evening sky; magnitudes -7.3 and 1.4 |
| 1239.146 | Jul | 17 | Fri | 16 | Moon 1.83° SSW of Venus; 44° from Sun in evening sky; magnitudes -7.8 and -4.1 |
| 1242.579 | Jul | 21 | Tue | 2 | Sun enters Cancer, at longitude 118.36° on the ecliptic |


2026 July
40° N, 90° W
Moon
Capella
Mars
Aldebaran
Sun
E
Jul 9 Thu 3:55 CDT
45 minutes before sunrise
Venus
Regulus
Jupiter
Pollux
Castor
W
Jul 9 Thu 20:16 CDT
45 minutes after sunset
Jul 10 Fri 3:55 CDT
45 minutes before sunrise
Jul 10 Fri 20:16 CDT
45 minutes after sunset
Jul 11 Sat 3:56 CDT
45 minutes before sunrise
Jul 11 Sat 20:15 CDT
45 minutes after sunset
Jul 12 Sun 3:57 CDT
45 minutes before sunrise
Jul 12 Sun 20:15 CDT
45 minutes after sunset
Jul 13 Mon 3:57 CDT
45 minutes before sunrise
Jul 13 Mon 20:14 CDT
45 minutes after sunset

| | | | | | |
|---|---|---|---|---|---|
| 1242.604 | Jul | 21 | Tue | 3 | Moon 2.16° SSW of Spica; 86° from Sun in evening sky; magnitudes -9.9 and 1.0 |

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| | | | | | |
|---|---|---|---|---|---|
| 1242.962 | Jul | 21 | Tue | 11:05 | First quarter Moon |
| 1243.152 | Jul | 21 | Tue | 16 | Mercury at southernmost latitude from the ecliptic plane, -7.0° |
| 1244.300 | Jul | 22 | Wed | 19 | Sun enters the astrological sign Leo, i.e. its longitude is 120° |
| 1245.216 | Jul | 23 | Thu | 17 | Mercury stationary in right ascension; resumes direct motion |
| 1245.455 | Jul | 23 | Thu | 23 | Mercury stationary in longitude; resumes direct motion |
| 1246.417 | Jul | 24 | Fri | 22 | Moon 0.59° SE of Antares; 128° from Sun in evening sky; magnitudes -11.2 and 1.0 |
| 1246.503 | Jul | 25 | SAT | 0 | Mars at ascending node through the ecliptic plane |
| 1247.191 | Jul | 25 | SAT | 17 | Moon at apogee; distance 63.59 Earth-radii |
| 1247.677 | Jul | 26 | SUN | 4 | The equation of time is at a minimum of -6.56 minutes |
| 1247.989 | Jul | 26 | SUN | 12 | Asteroid 3 Juno at opposition in longitude; magnitude 9.2 |
| 1248.261 | Jul | 26 | SUN | 18 | Saturn stationary in longitude; starts retrograde motion |
| 1248.386 | Jul | 26 | SUN | 21 | Pluto at opposition in longitude; magnitude 14.4; declination -23.3° |
| 1249.399 | Jul | 27 | Mon | 22 | Saturn stationary in right ascension; starts retrograde motion |
| 1251.017 | Jul | 29 | Wed | 12 | Jupiter at conjunction with the Sun; 6.301 AU from Earth; latitude 0.56° |

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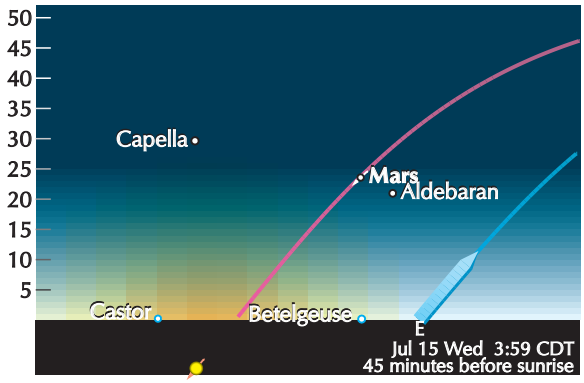
|---|---|---|---|---|---|
| 1251.108 | Jul | 29 | Wed | 14:36 | Full Moon |
| 1252.667 | Jul | 31 | Fri | 4 | Southern Delta Aquarid meteors; ZHR 25; 2 days after Full Moon |
| 1252.996 | Jul | 31 | Fri | 11:54 | Moon at ascending node; longitude 329.8° |
| 1253.278 | Jul | 31 | Fri | 19 | Venus at descending node through the ecliptic plane |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Capella
Mars
Aldebaran
Castor
Betelgeuse
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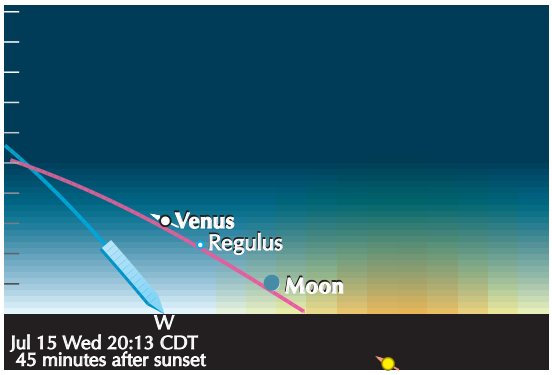
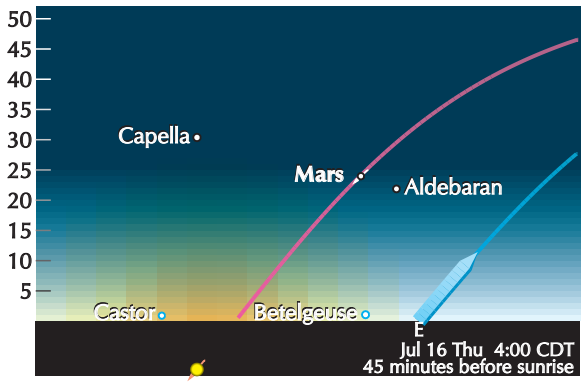
Jul 15 Wed 3:59 CDT
45 minutes before sunrise


Venus
Regulus
Moon
W
Jul 15 Wed 20:13 CDT
45 minutes after sunset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Capella
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Betelgeuse
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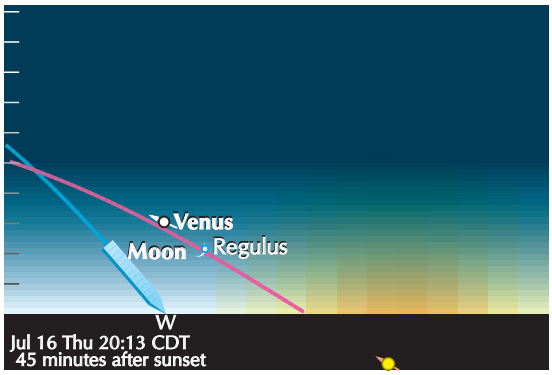
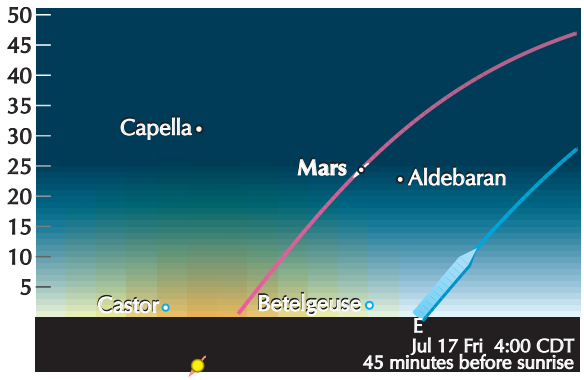
Jul 16 Thu 4:00 CDT
45 minutes before sunrise


Venus
Moon
Regulus
W
Jul 16 Thu 20:13 CDT
45 minutes after sunset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Castor
Betelgeuse
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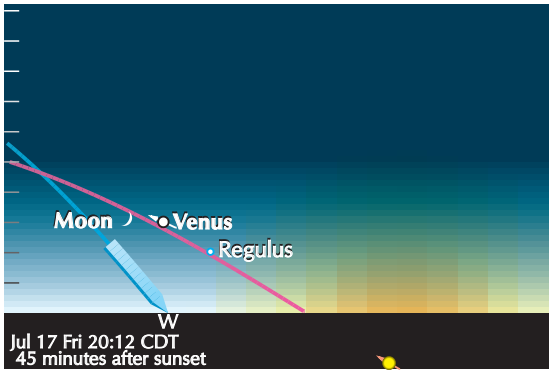
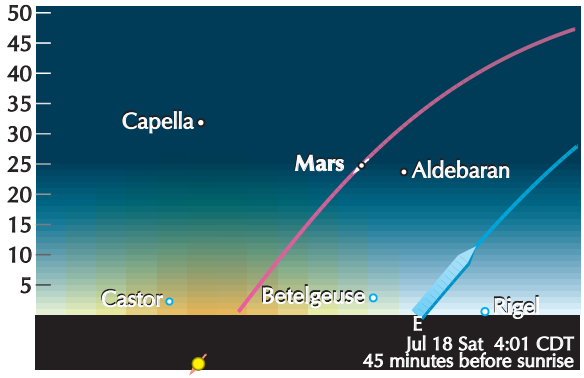
Jul 17 Fri 4:00 CDT
45 minutes before sunrise


Moon
Venus
Regulus
W
Jul 17 Fri 20:12 CDT
45 minutes after sunset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Capella
Mars
Aldebaran
Castor
Betelgeuse
Rigel
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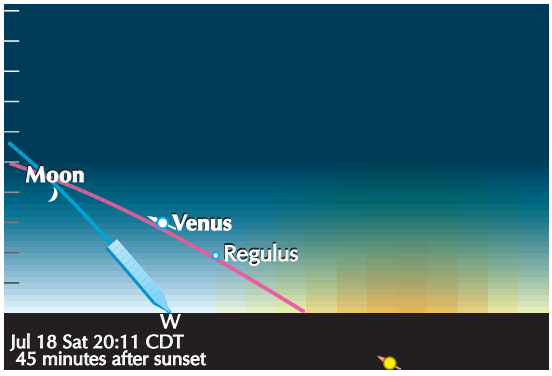
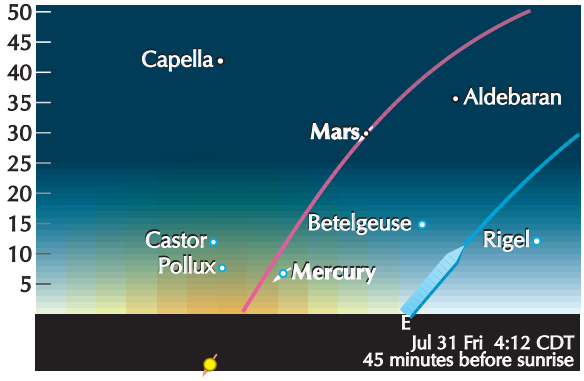
Jul 18 Sat 4:01 CDT
45 minutes before sunrise


Moon
Venus
Regulus
W
Jul 18 Sat 20:11 CDT
45 minutes after sunset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Capella
Aldebaran
Mars
Betelgeuse
Castor
Pollux
Mercury
Rigel
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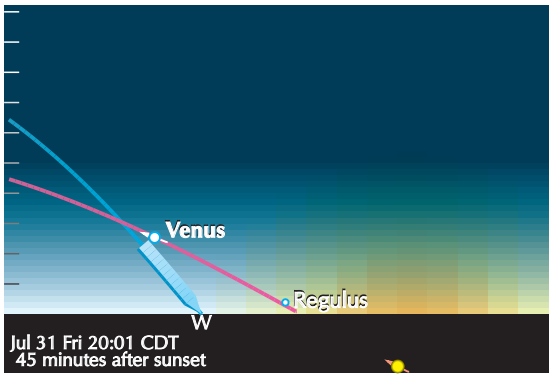
Jul 31 Fri 4:12 CDT
45 minutes before sunrise

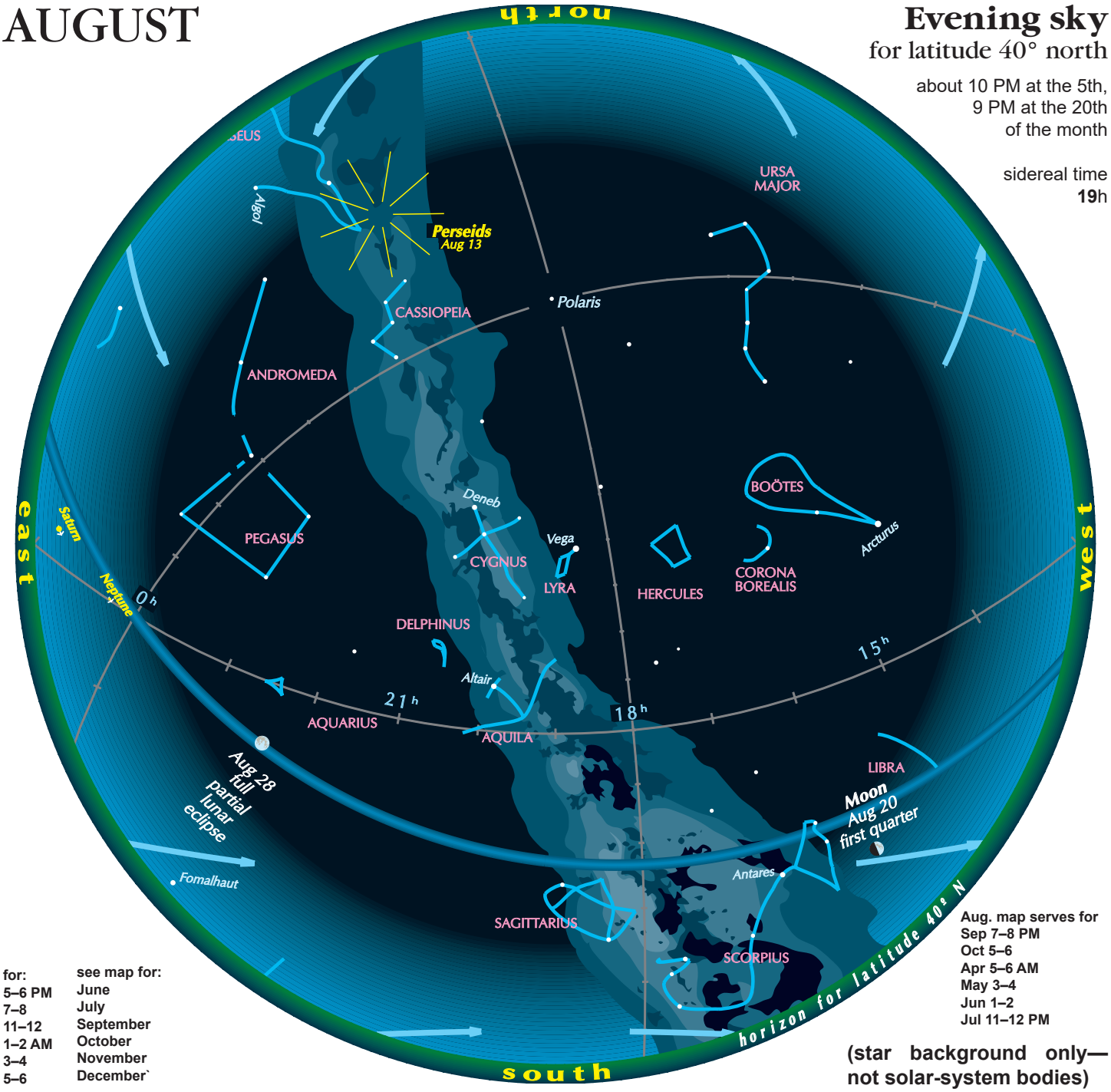

Venus
Regulus
W
Jul 31 Fri 20:01 CDT
45 minutes after sunset

# AUGUST

## Evening sky
for latitude 40° north

about 10 PM at the 5th,
9 PM at the 20th
of the month

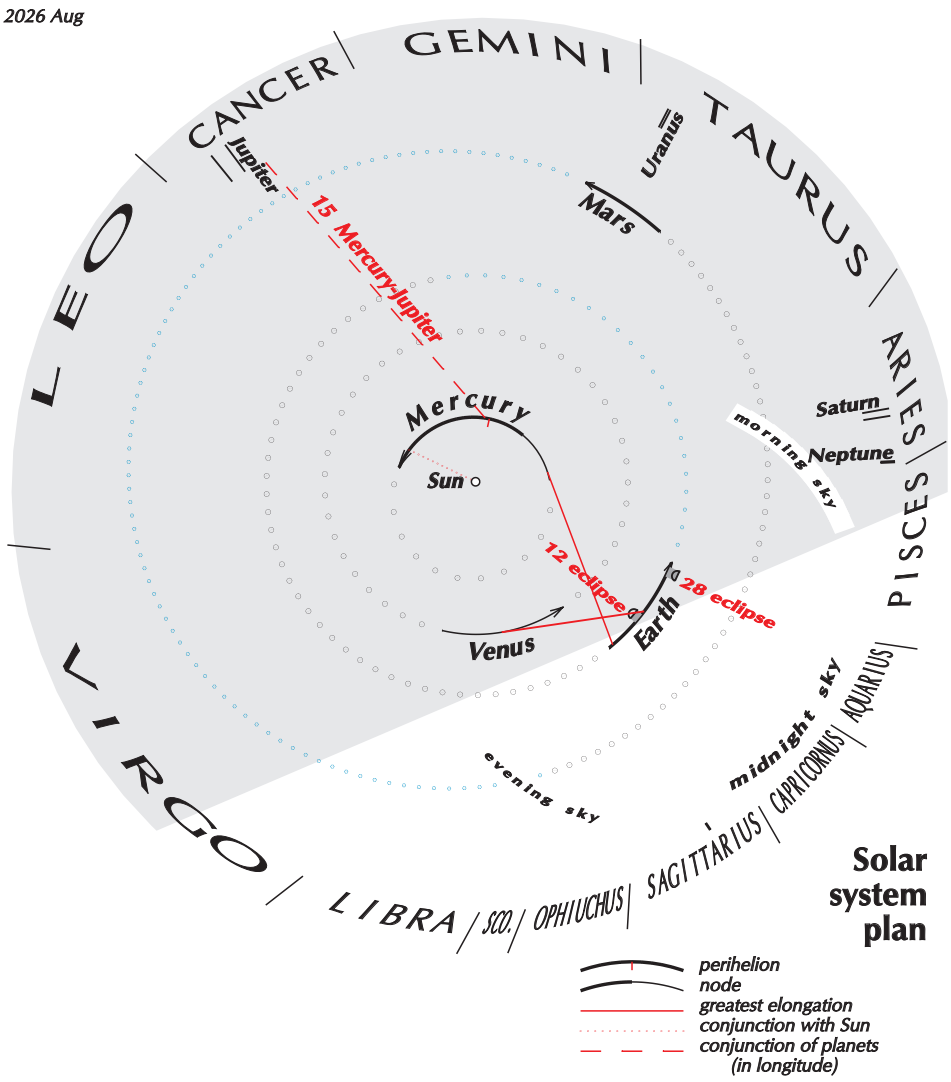
sidereal time
**19**h

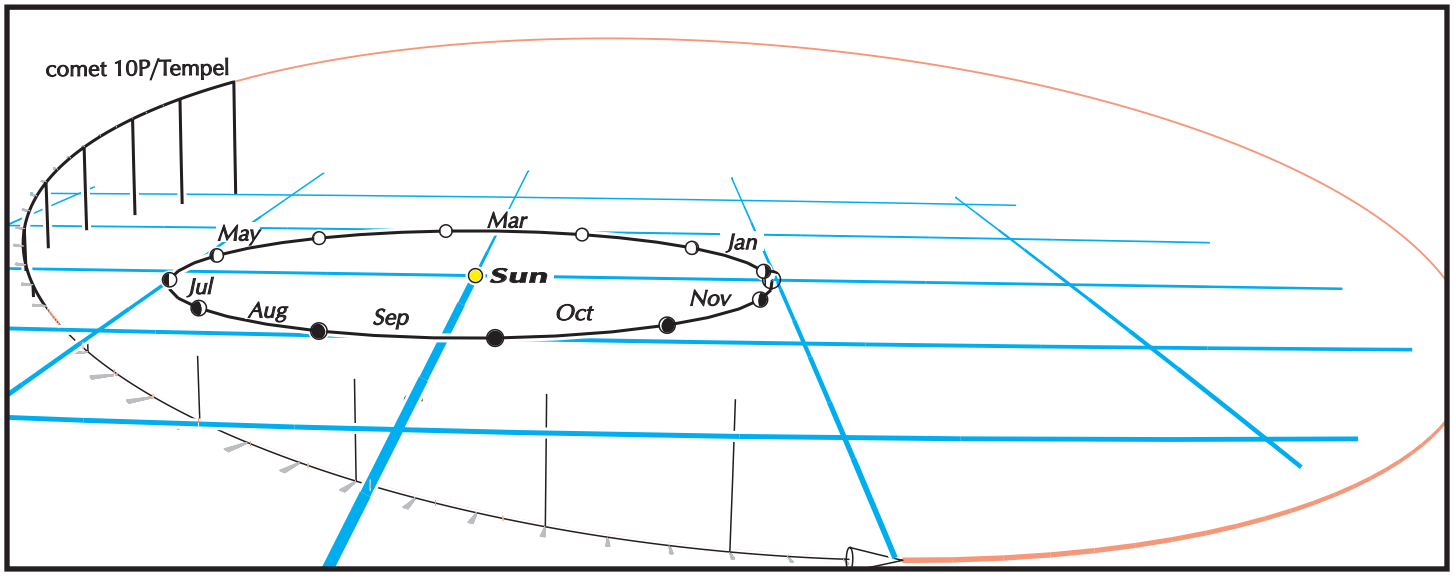



| for: | see map for: |
|---|---|
| 5–6 PM | June |
| 7–8 | July |
| 11–12 | September |
| 1–2 AM | October |
| 3–4 | November |
| 5–6 | December` |

**Aug. map serves for**
Sep 7–8 PM
Oct 5–6
Apr 5–6 AM
May 3–4
Jun 1–2
Jul 11–12 PM

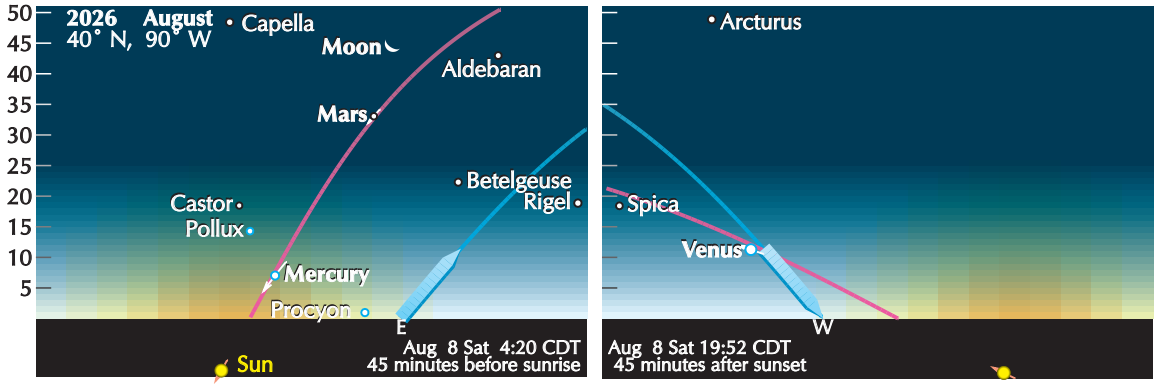
**(star background only—not solar-system bodies)**

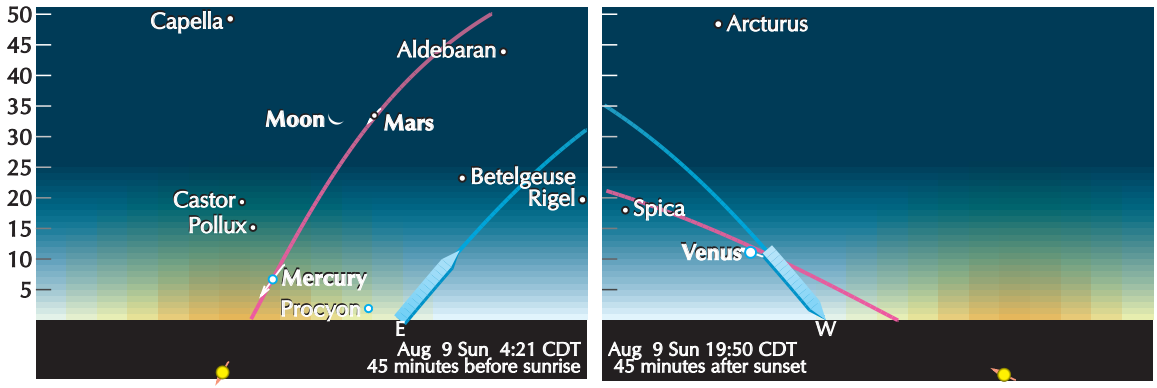

2026 Aug
GEMINI
CANCER
TAURUS
LEO
ARIES
VIRGO
PISCES
LIBRA
SCO.
OPHIUCHUS
SAGITTARIUS
CAPRICORNUS
AQUARIUS
Jupiter
15 Mercury-Jupiter
Uranus
Mars
Saturn
Neptune
morning sky
Mercury
Sun
12 eclipse
28 eclipse
Earth
Venus
midnight sky
evening sky
Solar system plan
perihelion
node
greatest elongation
conjunction with Sun
conjunction of planets (in longitude)

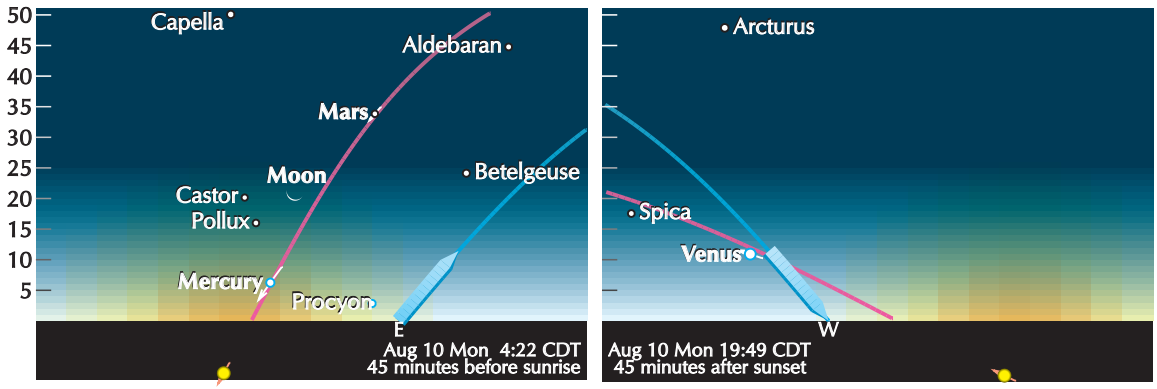

comet 10P/Tempel
May
Mar
Jan
Jul
Sun
Aug
Sep
Oct
Nov

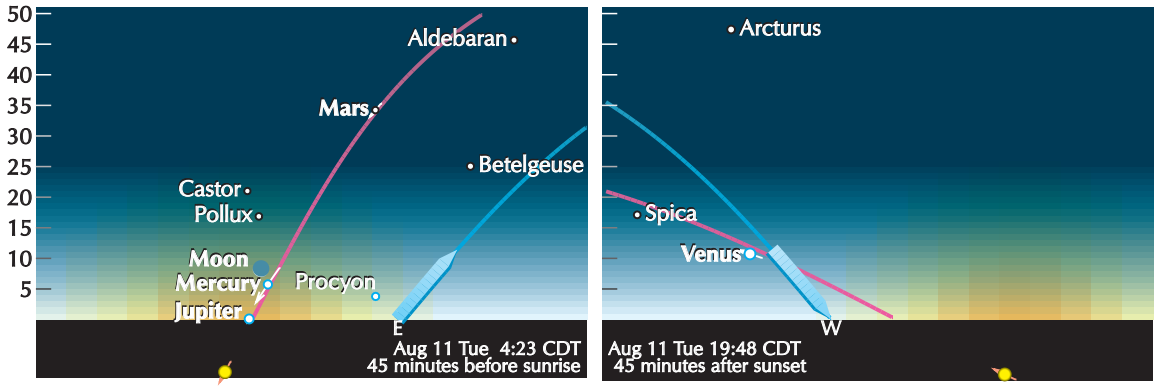
2026 AUGUST

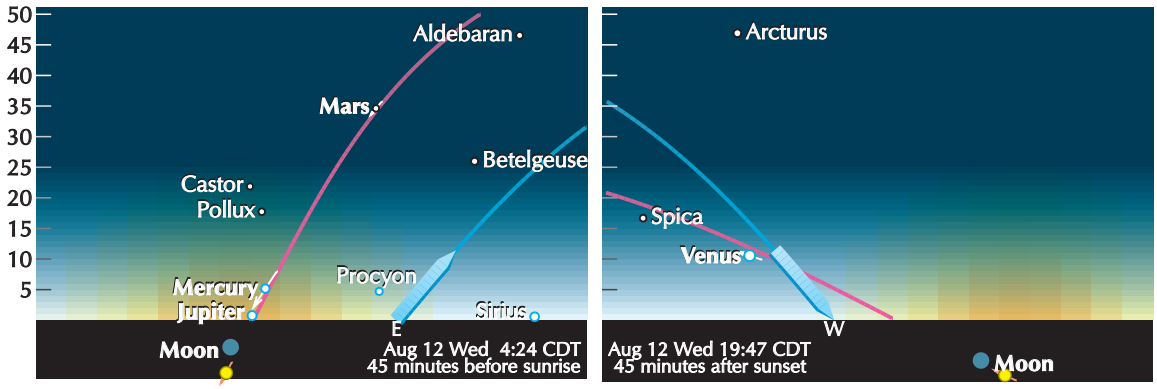
| | | | | | |
|---|---|---|---|---|---|
| 1254.833 | Aug | 2 | SUN | 8 | Mercury at westernmost elongation; 19.5° from Sun in morning sky; magnitude 0.2 |
| 1255.688 | Aug | 3 | Mon | 5 | Moon 4.4° NNW of Neptune; 127° from Sun in morning sky; magnitudes -11.3 and 7.8 |
| 1256.458 | Aug | 3 | Mon | 23 | Moon 6.2° NNW of Saturn; 117° from Sun in morning sky; magnitudes -11.0 and 0.6 |
| 1256.875 | Aug | 4 | Tue | 9 | Jupiter 0.82° SSW of Beehive Cluster center; 4° and 5° from Sun in morning sky; magnitudes -1.8 and 3.7 |
| 1258.598 | Aug | 6 | Thu | 2:22 | Last quarter Moon |
| 1258.750 | Aug | 6 | Thu | 6 | Mercury 7.6° S of Pollux; 19° and 21° from Sun in morning sky; magnitudes -0.4 and 1.2 |
| 1259.813 | Aug | 7 | Fri | 8 | Moon 1.29° N of Pleiades; 74° and 75° from Sun in morning sky |
| 1260.146 | Aug | 7 | Fri | 16 | Moon 5.4° N of Uranus; 70° from Sun in morning sky; magnitudes -9.3 and 5.7 |
| 1261.771 | Aug | 9 | SUN | 7 | Moon 4.4° N of Mars; 48° from Sun in morning sky; magnitudes -8.1 and 1.3 |
| 1261.858 | Aug | 9 | SUN | 9 | Moon, Mars, and M35 cluster within circle of diameter 4.89°; about 46° from the Sun in the morning sky; magnitudes -8, 1, 5 |
| 1262.021 | Aug | 9 | SUN | 13 | Moon 3.6° N of M35 cluster; 44° and 45° from Sun in morning sky; magnitudes -7.9 and 5.3 |
| 1262.212 | Aug | 9 | SUN | 17 | Mercury at ascending node through the ecliptic plane |
| 1262.971 | Aug | 10 | Mon | 11:18 | Moon at perigee; distance 56.96 Earth-radii |
| 1263.208 | Aug | 10 | Mon | 17 | Moon 6.8° SSW of Castor; 28° and 29° from Sun in morning sky; magnitudes -6.7 and 1.5 |
| 1263.409 | Aug | 10 | Mon | 22 | Sun enters Leo, at longitude 138.28° on the ecliptic |
| 1263.438 | Aug | 10 | Mon | 23 | Moon 3.6° S of Pollux; 25° and 26° from Sun in morning sky; magnitudes -6.5 and 1.2 |
| 1264.104 | Aug | 11 | Tue | 15 | Moon 1.99° NNE of Mercury; 16° from Sun in morning sky; magnitudes -5.6 and -0.9 |
| 1264.342 | Aug | 11 | Tue | 20 | Moon, Mercury, and Beehive within circle of diameter 4.23°; about 13° from the Sun in the morning sky; magnitudes -5, -1, 4 |
| 1264.417 | Aug | 11 | Tue | 22 | Moon 0.79° NE of Beehive Cluster center; 11° and 12° from Sun in morning sky; magnitudes -5.2 and 3.7 |
| 1264.458 | Aug | 11 | Tue | 23 | Moon, Jupiter, and Beehive within circle of diameter 1.87°; about 11° from the Sun in the morning sky; magnitudes -5, -2, 4 |
| 1264.521 | Aug | 12 | Wed | 1 | Moon 1.35° NNE of Jupiter; 10° from Sun in morning sky; magnitudes -5.0 and -1.8 |
| 1265.208 | Aug | 12 | Wed | 17 | Perseid meteors; ZHR 100; near New Moon |
| 1265.234 | Aug | 12 | Wed | 17:36 | New Moon; beginning of lunation 1282; total eclipse of the Sun |
| 1265.318 | Aug | 12 | Wed | 20 | Venus dichotomy (D-shape) |
| 1265.915 | Aug | 13 | Thu | 9:57 | Moon at descending node; longitude 149.8° |
| 1265.958 | Aug | 13 | Thu | 11 | Moon 0.56° S of Regulus; 10° and 9° from Sun in evening sky; magnitudes -5.0 and 1.4 |
| 1266.625 | Aug | 14 | Fri | 3 | Mercury, Jupiter, and Beehive within circle of diameter 2.30°; about 13° from the Sun in the morning sky; magnitudes -1, -2, 4 |


2026 August
40° N, 90° W
Capella
Moon
Aldebaran
Mars
Betelgeuse
Rigel
Castor
Pollux
Mercury
Procyon
Sun
E
Aug 8 Sat 4:20 CDT
45 minutes before sunrise
Arcturus
Spica
Venus
W
Aug 8 Sat 19:52 CDT
45 minutes after sunset


Capella
Aldebaran
Moon
Mars
Betelgeuse
Rigel
Castor
Pollux
Mercury
Procyon
E
Aug 9 Sun 4:21 CDT
45 minutes before sunrise
Arcturus
Spica
Venus
W
Aug 9 Sun 19:50 CDT
45 minutes after sunset


Capella
Aldebaran
Mars
Moon
Betelgeuse
Castor
Pollux
Mercury
Procyon
E
Aug 10 Mon 4:22 CDT
45 minutes before sunrise
Arcturus
Spica
Venus
W
Aug 10 Mon 19:49 CDT
45 minutes after sunset


Aldebaran
Mars
Betelgeuse
Castor
Pollux
Moon
Mercury
Jupiter
Procyon
E
Aug 11 Tue 4:23 CDT
45 minutes before sunrise
Arcturus
Spica
Venus
W
Aug 11 Tue 19:48 CDT
45 minutes after sunset


Aldebaran
Mars
Betelgeuse
Castor
Pollux
Mercury
Jupiter
Procyon
Sirius
Moon
E
Aug 12 Wed 4:24 CDT
45 minutes before sunrise
Arcturus
Spica
Venus
W
Aug 12 Wed 19:47 CDT
45 minutes after sunset
Moon

| | | | | | |
|---|---|---|---|---|---|
| 1266.708 | Aug | 14 | Fri | 5 | Mercury 0.45° S of Beehive Cluster center; 14° from Sun in morning sky; magnitudes -1.1 and 3.7 |
| 1266.885 | Aug | 14 | Fri | 9 | Mercury at perihelion; 0.3075 AU from the Sun |
| 1267.458 | Aug | 14 | Fri | 23 | Mars 0.62° S of M35 cluster; 50° from Sun in morning sky; magnitudes 1.3 and 5.3 |
| 1267.755 | Aug | 15 | SAT | 6 | Venus at easternmost elongation; 45.9° from Sun in evening sky; magnitude -4.3 |
| 1267.958 | Aug | 15 | SAT | 11 | Mercury 0.55° NNE of Jupiter; 13° from Sun in morning sky; magnitudes -1.2 and -1.8 |
| 1268.163 | Aug | 15 | SAT | 16 | Mars at northernmost declination, 23.70° |
| 1268.813 | Aug | 16 | SUN | 8 | Moon 1.87° SSW of Venus; 46° from Sun in evening sky; magnitudes -7.9 and -4.3 |
| 1269.732 | Aug | 17 | Mon | 6 | Mars and Uranus at heliocentric conjunction; longitude 62.5° |
| 1269.958 | Aug | 17 | Mon | 11 | Moon 2.25° SSW of Spica; 60° from Sun in evening sky; magnitudes -8.7 and 1.0 |

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|---|---|---|---|---|---|
| 1272.615 | Aug | 20 | Thu | 2:45 | First quarter Moon |
| 1273.729 | Aug | 21 | Fri | 6 | Moon 0.70° SE of Antares; 102° from Sun in evening sky; magnitudes -10.4 and 1.0 |
| 1274.856 | Aug | 22 | SAT | 9 | Moon at apogee; distance 63.44 Earth-radii |
| 1275.370 | Aug | 22 | SAT | 21 | Middle of eclipse season: Sun is at same longitude as Moon's descending node, 149.8° |
| 1275.597 | Aug | 23 | SUN | 2 | Sun enters the astrological sign Virgo, i.e. its longitude is 150° |
| 1277.090 | Aug | 24 | Mon | 14 | Mercury at northernmost latitude from the ecliptic plane, 7.0° |
| 1278.063 | Aug | 25 | Tue | 14 | Mercury 1.30° NNE of Regulus; 3° and 2° from Sun in morning sky; magnitudes -1.8 and 1.4 |
| 1280.202 | Aug | 27 | Thu | 17 | Mercury at superior conjunction with the Sun; 1.362 AU from Earth; latitude 6.74° |
| 1280.282 | Aug | 27 | Thu | 18:46 | Moon at ascending node; longitude 329.8° |

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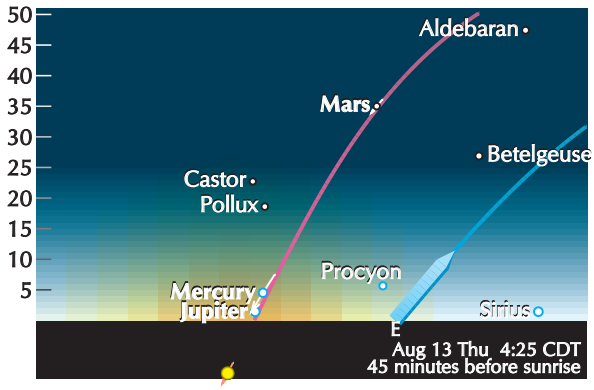
| | | | | | |
|---|---|---|---|---|---|
| 1280.680 | Aug | 28 | Fri | 4:19 | Full Moon; partial eclipse of the Moon |
| 1281.426 | Aug | 28 | Fri | 22 | Uranus at west quadrature, 90° from the Sun |
| 1282.875 | Aug | 30 | SUN | 9 | Moon 4.3° NNW of Neptune; 153° from Sun in morning sky; magnitudes -12.0 and 7.8 |
| 1283.625 | Aug | 31 | Mon | 3 | Moon 6.3° NNW of Saturn; 144° from Sun in morning sky; magnitudes -11.8 and 0.5 |


50
45
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35
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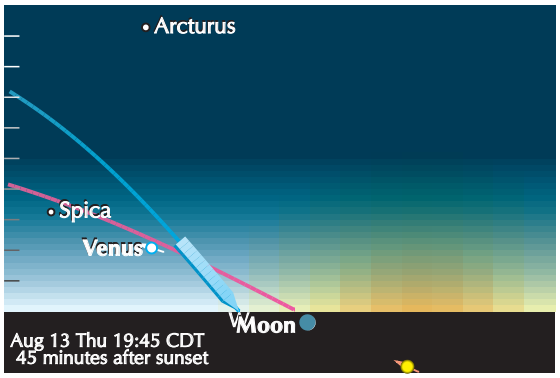
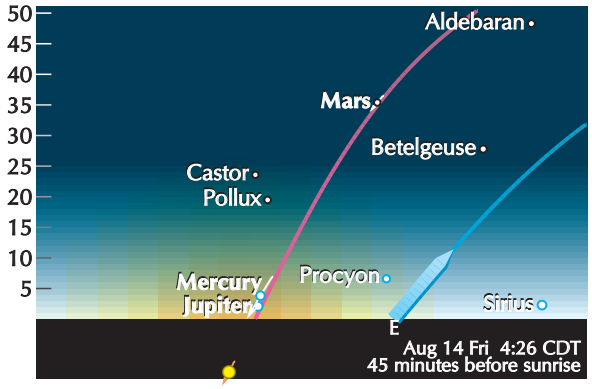
25
20
15
10
5
Aldebaran
Mars
Betelgeuse
Castor
Pollux
Procyon
Mercury
Jupiter
Sirius
E
Aug 13 Thu 4:25 CDT
45 minutes before sunrise


Arcturus
Spica
Venus
Moon
W
Aug 13 Thu 19:45 CDT
45 minutes after sunset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10
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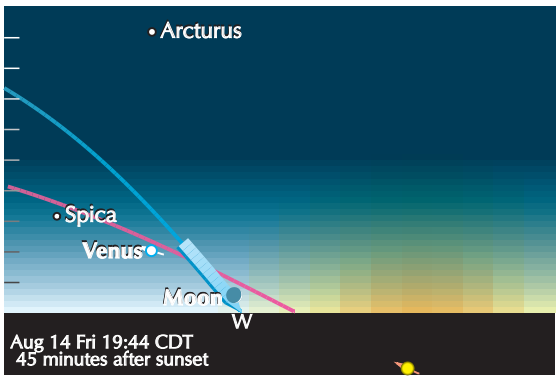
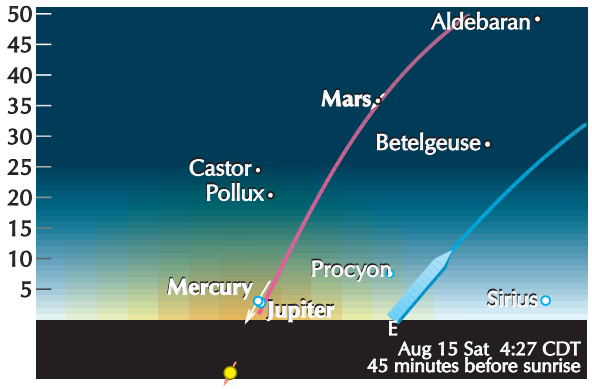
Aldebaran
Mars
Betelgeuse
Castor
Pollux
Mercury
Jupiter
Procyon
Sirius
E
Aug 14 Fri 4:26 CDT
45 minutes before sunrise


Arcturus
Spica
Venus
Moon
W
Aug 14 Fri 19:44 CDT
45 minutes after sunset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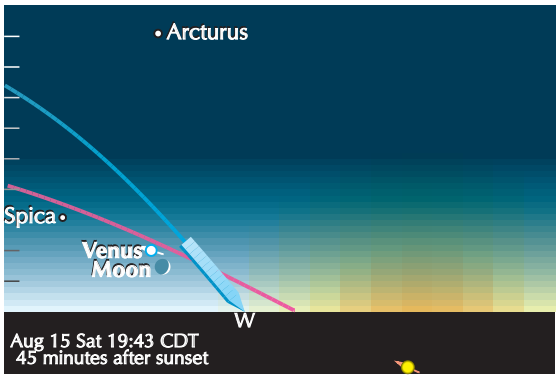
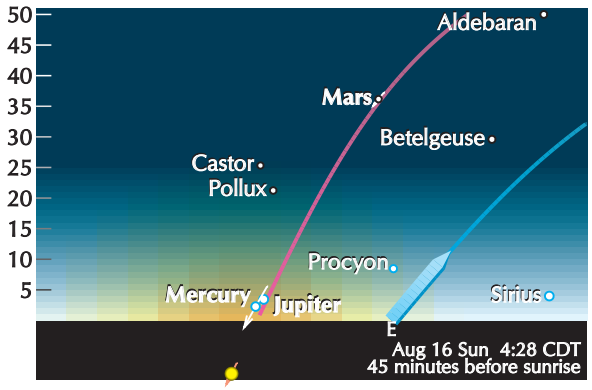
Aldebaran
Mars
Betelgeuse
Castor
Pollux
Mercury
Jupiter
Procyon
Sirius
E
Aug 15 Sat 4:27 CDT
45 minutes before sunrise


Arcturus
Spica
Venus
Moon
W
Aug 15 Sat 19:43 CDT
45 minutes after sunset


50
45
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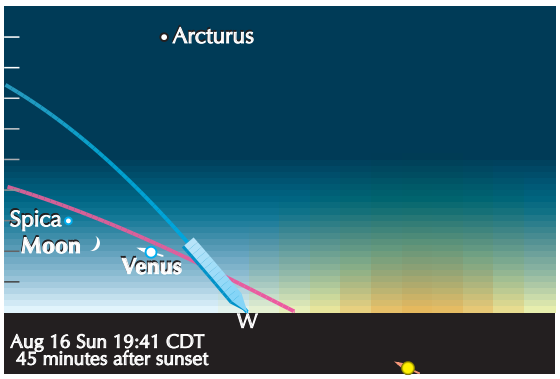
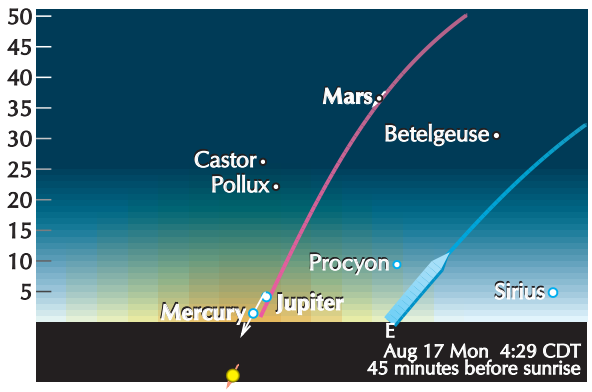
20
15
10
5
Aldebaran
Mars
Betelgeuse
Castor
Pollux
Mercury
Jupiter
Procyon
Sirius
E
Aug 16 Sun 4:28 CDT
45 minutes before sunrise


Arcturus
Spica
Moon
Venus
W
Aug 16 Sun 19:41 CDT
45 minutes after sunset


50
45
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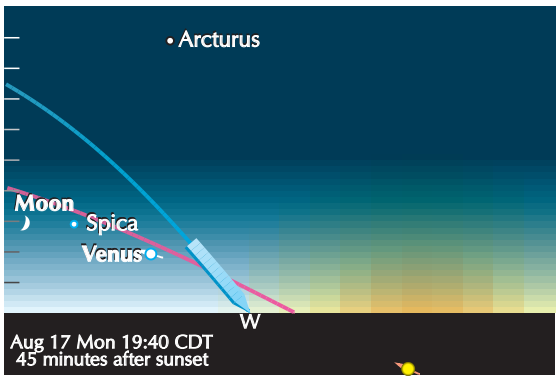
15
10
5
Mars
Betelgeuse
Castor
Pollux
Procyon
Mercury
Jupiter
Sirius
E
Aug 17 Mon 4:29 CDT
45 minutes before sunrise

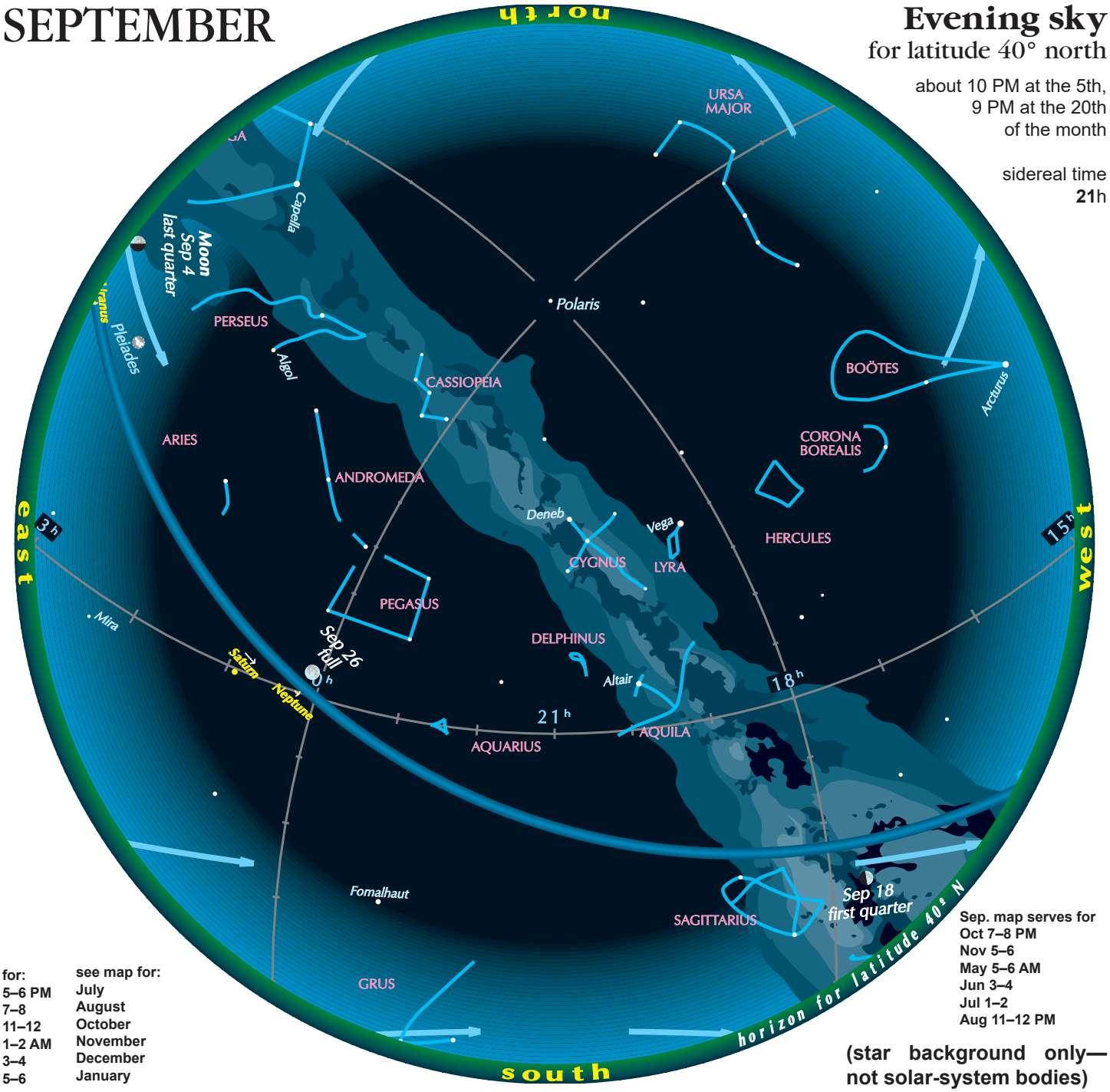

Arcturus
Moon
Spica
Venus
W
Aug 17 Mon 19:40 CDT
45 minutes after sunset

# SEPTEMBER

## Evening sky
for latitude 40° north

about 10 PM at the 5th,
9 PM at the 20th
of the month

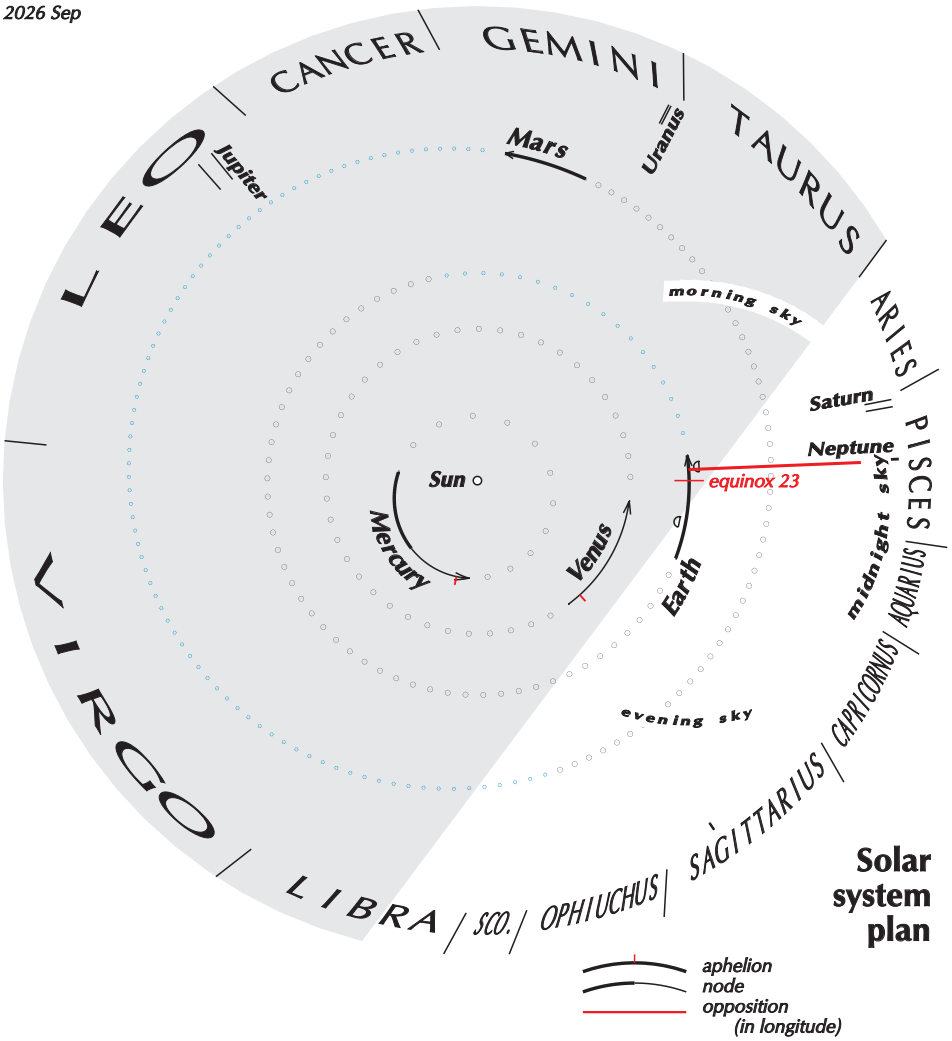
sidereal time
**21**h



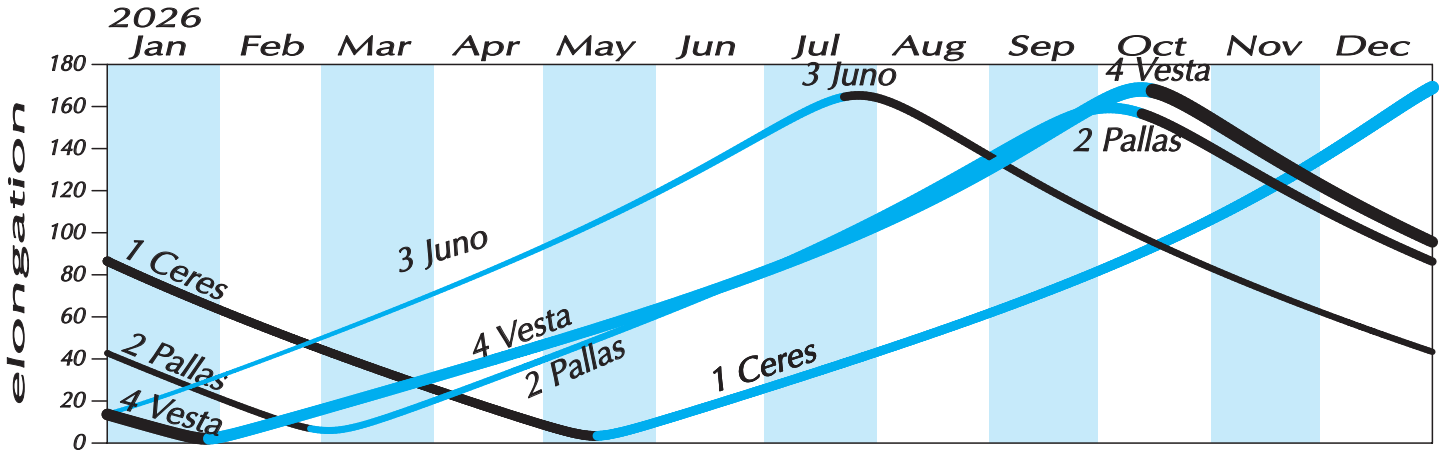

| for: | see map for: |
|---|---|
| 5–6 PM | July |
| 7–8 | August |
| 11–12 | October |
| 1–2 AM | November |
| 3–4 | December |
| 5–6 | January |

Sep. map serves for
Oct 7–8 PM
Nov 5–6
May 5–6 AM
Jun 3–4
Jul 1–2
Aug 11–12 PM

**(star background only—not solar-system bodies)**

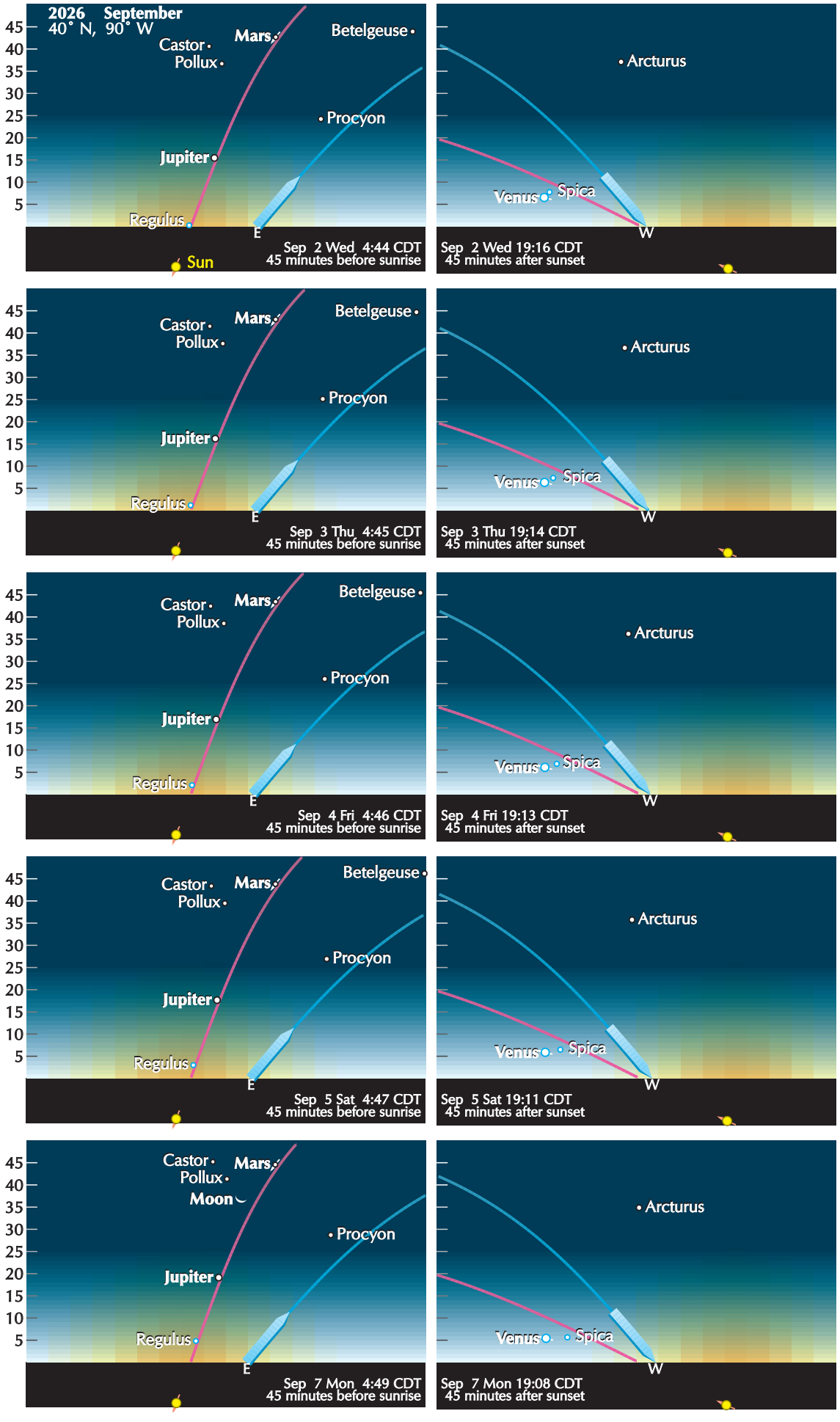



**Favorability graph for asteroids, as for the planets (page 3). The curve for each asteroid is blue when it is in the morning sky, black when in the evening sky, thicker when the asteroid is brighter.**



2026 SEPTEMBER

| | | | | | |
|---|---|---|---|---|---|
| 1285.058 | Sep | 1 | Tue | 13 | The equation of time is 0 |
| 1285.521 | Sep | 2 | Wed | 1 | Venus 1.48° SSW of Spica; 45° from Sun in evening sky; magnitudes -4.5 and 1.0 |
| 1287.042 | Sep | 3 | Thu | 13 | Moon 1.26° N of Pleiades; 100° and 101° from Sun in morning sky |
| 1287.417 | Sep | 3 | Thu | 22 | Moon 5.4° N of Uranus; 95° and 96° from Sun in morning sky; magnitudes -10.4 and 5.7 |
| 1287.827 | Sep | 4 | Fri | 7:51 | Last quarter Moon |
| 1287.993 | Sep | 4 | Fri | 12 | Venus at aphelion; 0.7282 AU from the Sun |
| 1289.313 | Sep | 5 | SAT | 20 | Moon 3.6° N of M35 cluster; 70° and 71° from Sun in morning sky; magnitudes -9.4 and 5.3 |
| 1290.333 | Sep | 6 | SUN | 20 | Moon 2.96° NNE of Mars; 57° from Sun in morning sky; magnitudes -8.7 and 1.2 |
| 1290.364 | Sep | 6 | SUN | 20:44 | Moon at perigee; distance 57.74 Earth-radii |
| 1290.542 | Sep | 7 | Mon | 1 | Moon 6.8° S of Castor; 54° from Sun in morning sky; magnitudes -8.5 and 1.5 |
| 1290.750 | Sep | 7 | Mon | 6 | Moon 3.6° S of Pollux; 51° from Sun in morning sky; magnitudes -8.3 and 1.2 |
| 1291.771 | Sep | 8 | Tue | 7 | Moon 0.77° NE of Beehive Cluster center; 38° from Sun in morning sky; magnitudes -7.4 and 3.7 |
| 1292.208 | Sep | 8 | Tue | 17 | Moon shows minimum libration for the year, 3.48° |
| 1292.313 | Sep | 8 | Tue | 20 | Moon 0.88° NE of Jupiter; 30° and 31° from Sun in morning sky; magnitudes -6.9 and -1.8 |
| 1293.303 | Sep | 9 | Wed | 19:17 | Moon at descending node; longitude 149.8° |
| 1293.354 | Sep | 9 | Wed | 21 | Moon 0.63° S of Regulus; 17° from Sun in morning sky; magnitudes -5.7 and 1.4 |
| 1294.188 | Sep | 10 | Thu | 17 | Uranus 6.9° NW of Aldebaran; 102° and 98° from Sun in morning sky; magnitudes 5.7 and 0.9; quasi-conjunction |
| 1294.200 | Sep | 10 | Thu | 17 | Uranus stationary in right ascension; starts retrograde motion |
| 1294.204 | Sep | 10 | Thu | 17 | Uranus stationary in longitude; starts retrograde motion |
| 1294.344 | Sep | 10 | Thu | 20 | Uranus at northernmost declination, 21.10° |
| 1294.643 | Sep | 11 | Fri | 3:26 | New Moon; beginning of lunation 1283 |
| 1295.5 | Sep | 12 | SAT | | Rosh Hashanah, 1st day of Hebrew year 5787 A.M. |
| 1295.688 | Sep | 12 | SAT | 5 | Moon 3.4° SSW of Mercury; 13° from Sun in evening sky; magnitudes -5.3 and -0.6 |
| 1297.333 | Sep | 13 | SUN | 20 | Moon 2.21° SSW of Spica; 33° from Sun in evening sky; magnitudes -7.0 and 1.0 |
| 1298.000 | Sep | 14 | Mon | 12 | Moon 0.52° NE of Venus; 41° from Sun in evening sky; magnitudes -7.6 and -4.5 |
| 1299.365 | Sep | 15 | Tue | 21 | Neptune crosses equator southward |
| 1300.491 | Sep | 16 | Wed | 24 | Mercury at descending node through the ecliptic plane |
| 1300.625 | Sep | 17 | Thu | 3 | Sun enters Virgo, at longitude 174.26° on the ecliptic |
| 1301.063 | Sep | 17 | Thu | 14 | Moon 0.65° SE of Antares; 76° and 75° from Sun in evening sky; magnitudes -9.4 and 1.0 |


2026 September
40° N, 90° W
Mars
Betelgeuse
Castor
Pollux
Procyon
Jupiter
Regulus
Sun
E
Sep 2 Wed 4:44 CDT
45 minutes before sunrise
Arcturus
Venus
Spica
W
Sep 2 Wed 19:16 CDT
45 minutes after sunset
Sep 3 Thu 4:45 CDT
45 minutes before sunrise
Sep 3 Thu 19:14 CDT
45 minutes after sunset
Sep 4 Fri 4:46 CDT
45 minutes before sunrise
Sep 4 Fri 19:13 CDT
45 minutes after sunset
Sep 5 Sat 4:47 CDT
45 minutes before sunrise
Sep 5 Sat 19:11 CDT
45 minutes after sunset
Moon
Sep 7 Mon 4:49 CDT
45 minutes before sunrise
Sep 7 Mon 19:08 CDT
45 minutes after sunset

| | | | | | |
|---|---|---|---|---|---|
| 1301.167 | Sep | 17 | Thu | 16 | Mars 5.9° S of Pollux; 61° from Sun in morning sky; magnitudes 1.2 and 1.2 |

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| | | | | | |
|---|---|---|---|---|---|
| 1302.363 | Sep | 18 | Fri | 20:43 | First quarter Moon |
| 1302.440 | Sep | 18 | Fri | 23 | Venus shows greatest illuminated extent, 318 square seconds |
| 1302.627 | Sep | 19 | SAT | 3 | Moon at apogee; distance 63.38 Earth-radii |
| 1306.231 | Sep | 22 | Tue | 18 | Venus brightest; magnitude -4.56° |
| 1306.505 | Sep | 23 | Wed | 0:07 | Sun enters the astrological sign Libra, i.e. its longitude is 180° |
| 1306.505 | Sep | 23 | Wed | 0:07 | September (northern autumn) equinox |
| 1307.612 | Sep | 24 | Thu | 2:41 | Moon at ascending node; longitude 329.6° |
| 1309.5 | Sep | 26 | SAT | 0:00 | Day and night equal, at latitude 40° north |
| 1309.559 | Sep | 26 | SAT | 1 | Neptune at opposition in longitude; magnitude 7.8; declination -0.1° |
| 1309.854 | Sep | 26 | SAT | 9 | Mercury 0.89° NNE of Spica; 21° from Sun in evening sky; magnitudes -0.1 and 1.0 |
| 1310.130 | Sep | 26 | SAT | 15 | Venus at southernmost latitude from the ecliptic plane, -3.4° |
| 1310.146 | Sep | 26 | SAT | 16 | Moon 4.3° NNW of Neptune; 177° and 178° from Sun in morning midnight sky; magnitudes -12.7 and 7.8 |

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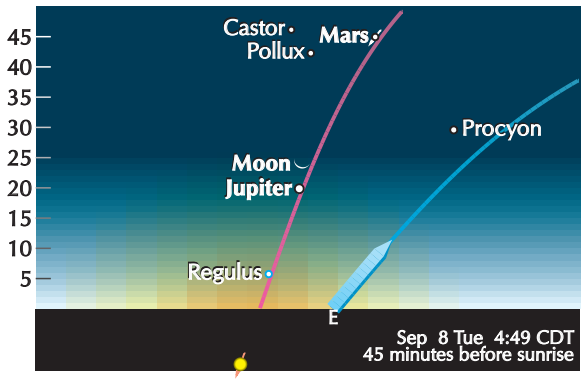
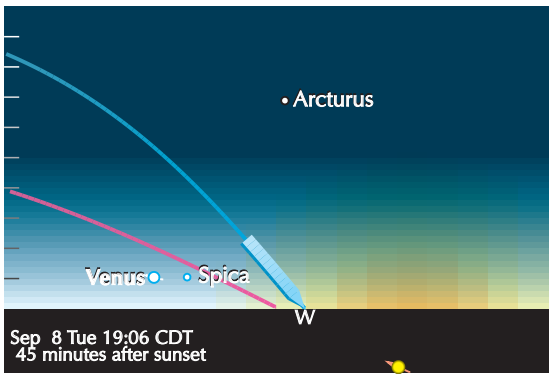
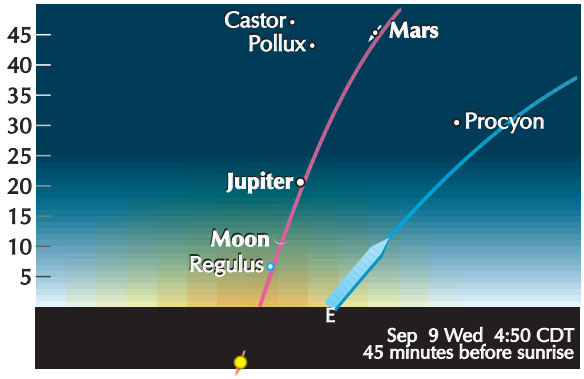
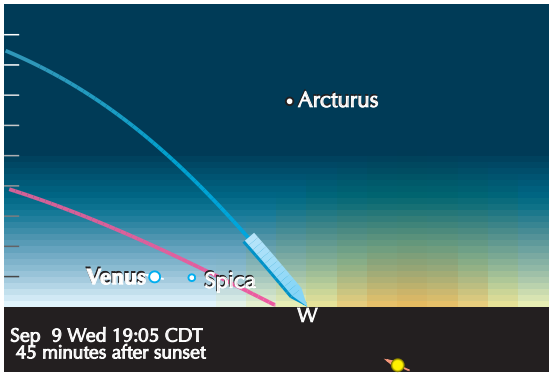
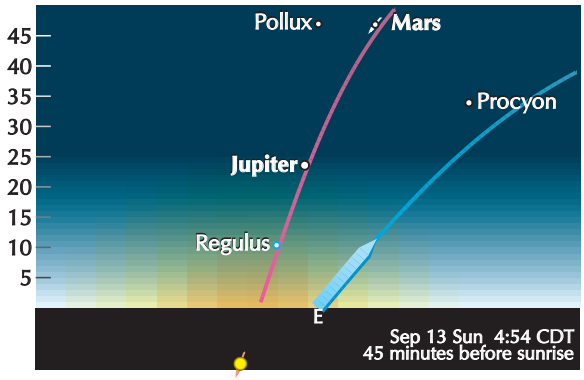
| | | | | | |
|---|---|---|---|---|---|
| 1310.201 | Sep | 26 | SAT | 16:49 | Full Moon |
| 1310.792 | Sep | 27 | SUN | 7 | Moon 6.2° NNW of Saturn; 172° from Sun in morning midnight sky; magnitudes -12.5 and 0.3 |
| 1310.869 | Sep | 27 | SUN | 9 | Mercury at aphelion; 0.4667 AU from the Sun |
| 1313.850 | Sep | 30 | Wed | 8 | Spring equinox for Mars north hemisphere |
| 1314.271 | Sep | 30 | Wed | 19 | Moon 1.14° N of Pleiades; 127° from Sun in morning sky |

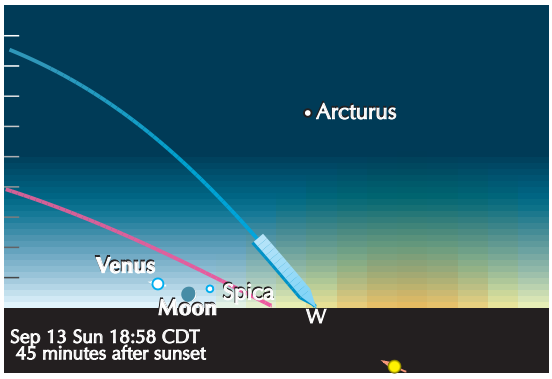

Castor
Pollux
Mars
Procyon
Moon
Jupiter
Regulus
45
40
35
30
25
20
15
10
5
E
Sep 8 Tue 4:49 CDT
45 minutes before sunrise

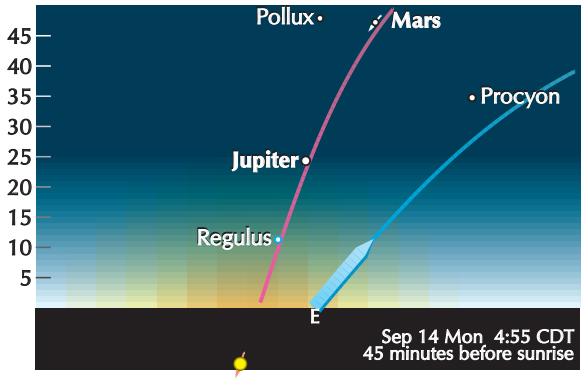

Arcturus
Venus
Spica
W
Sep 8 Tue 19:06 CDT
45 minutes after sunset

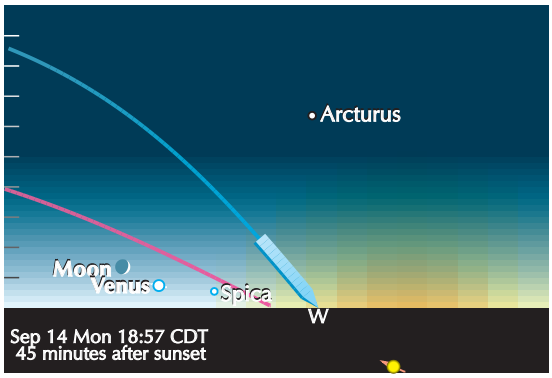

Castor
Pollux
Mars
Procyon
Jupiter
Moon
Regulus
45
40
35
30
25
20
15
10
5
E
Sep 9 Wed 4:50 CDT
45 minutes before sunrise

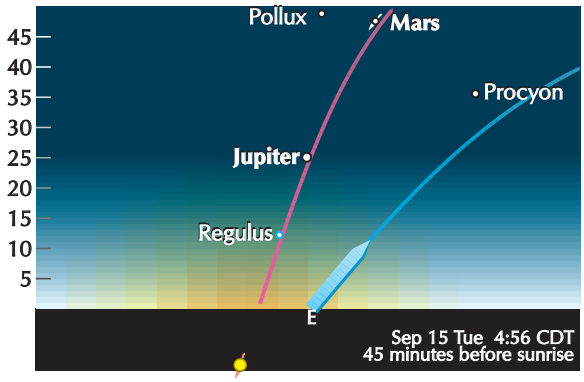

Arcturus
Venus
Spica
W
Sep 9 Wed 19:05 CDT
45 minutes after sunset

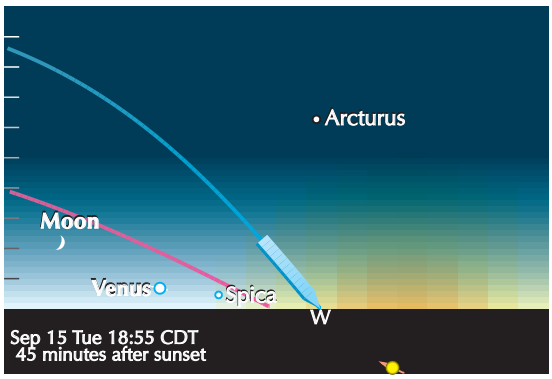

Pollux
Mars
Procyon
Jupiter
Regulus
45
40
35
30
25
20
15
10
5
E
Sep 13 Sun 4:54 CDT
45 minutes before sunrise


Arcturus
Venus
Moon
Spica
W
Sep 13 Sun 18:58 CDT
45 minutes after sunset


Pollux
Mars
Procyon
Jupiter
Regulus
45
40
35
30
25
20
15
10
5
E
Sep 14 Mon 4:55 CDT
45 minutes before sunrise

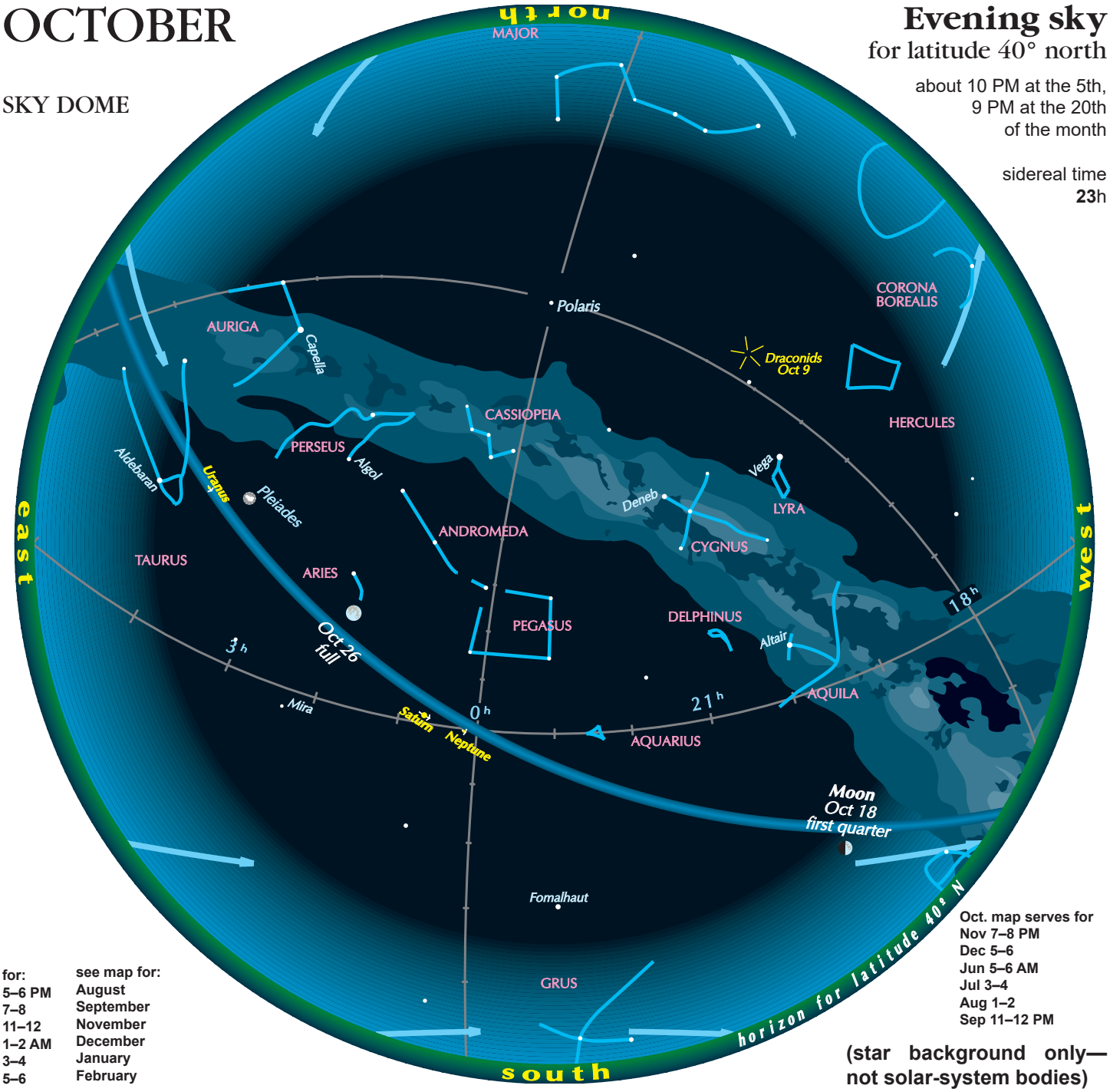

Arcturus
Moon
Venus
Spica
W
Sep 14 Mon 18:57 CDT
45 minutes after sunset


Pollux
Mars
Procyon
Jupiter
Regulus
45
40
35
30
25
20
15
10
5
E
Sep 15 Tue 4:56 CDT
45 minutes before sunrise


Arcturus
Moon
Venus
Spica
W
Sep 15 Tue 18:55 CDT
45 minutes after sunset

# OCTOBER

## SKY DOME




# Evening sky
## for latitude 40° north

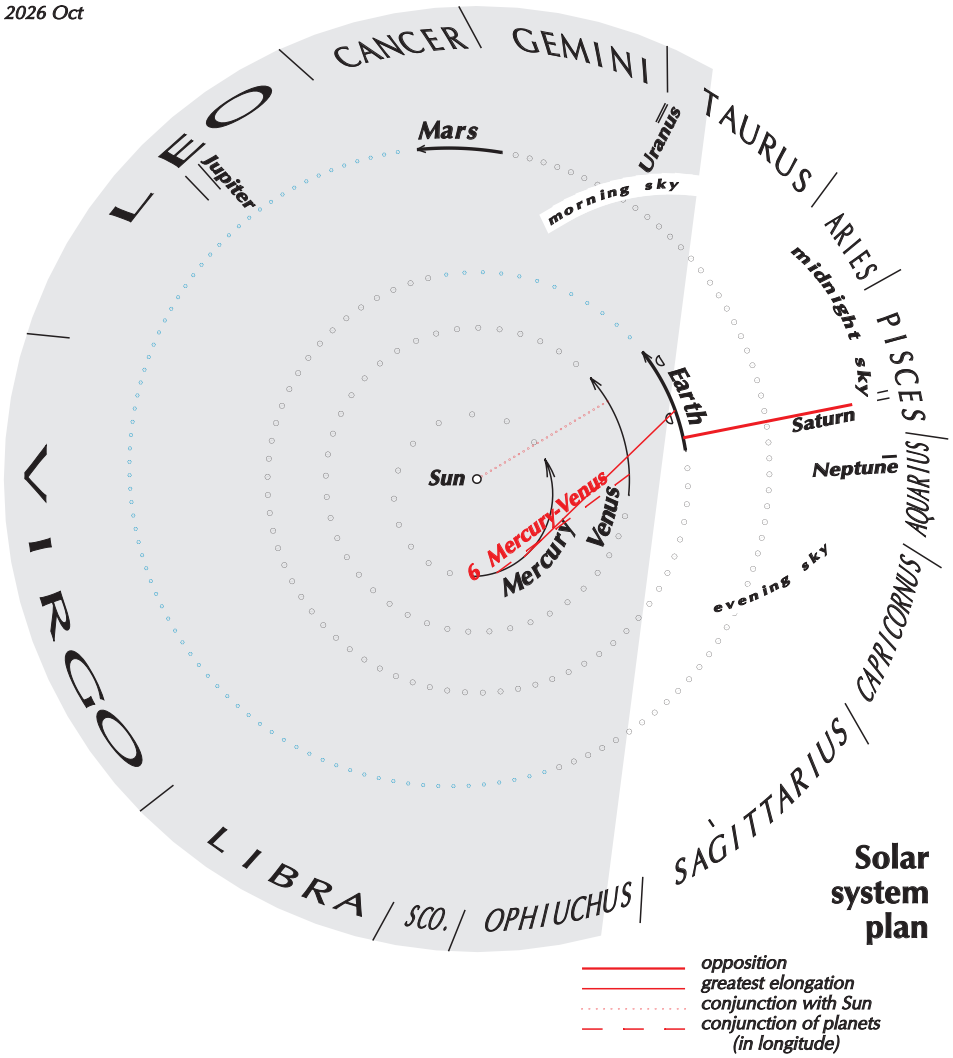
about 10 PM at the 5th,
9 PM at the 20th
of the month

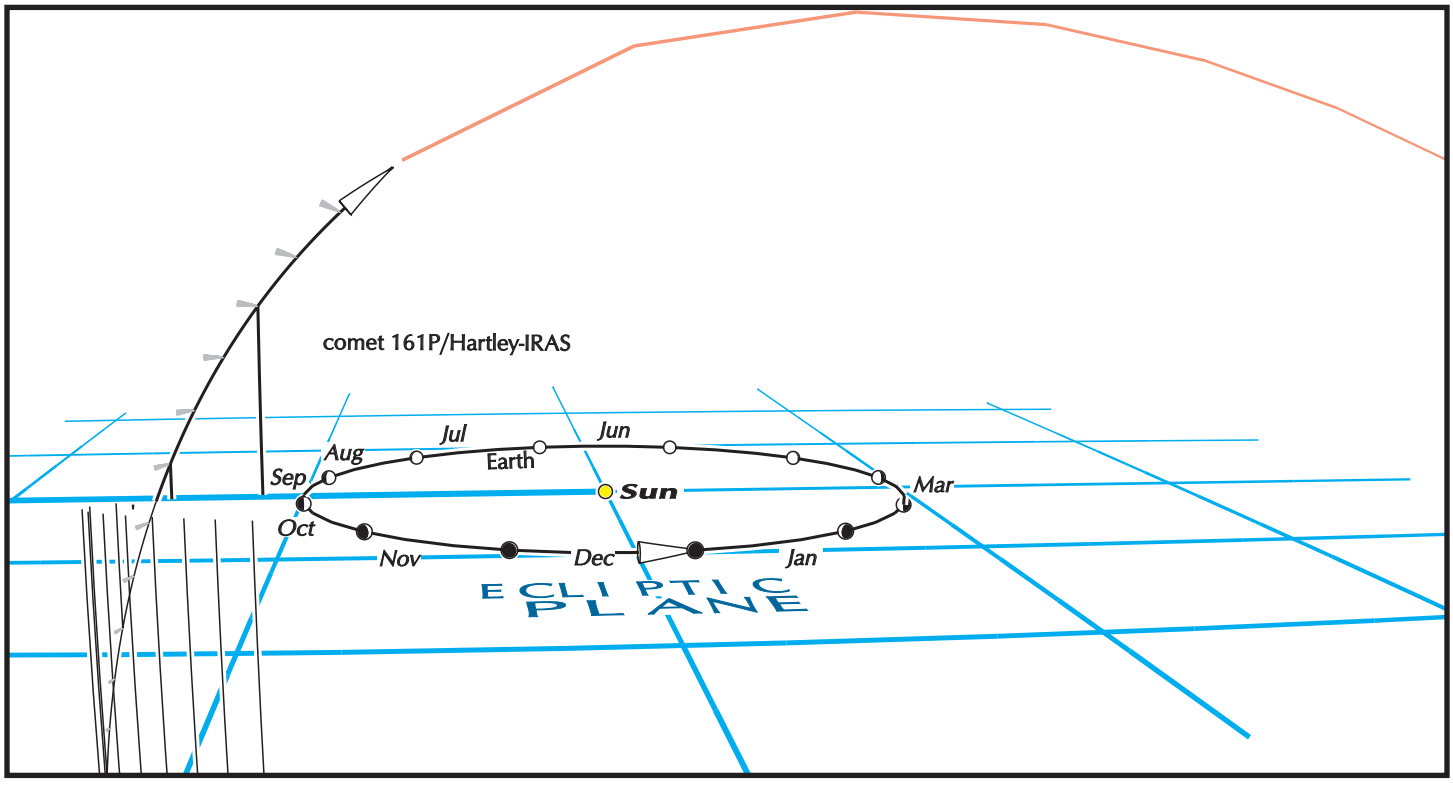
sidereal time
**23**h

| for: | see map for: |
|---|---|
| 5–6 PM | August |
| 7–8 | September |
| 11–12 | November |
| 1–2 AM | December |
| 3–4 | January |
| 5–6 | February |

**Oct. map serves for**
**Nov 7–8 PM**
**Dec 5–6**
**Jun 5–6 AM**
**Jul 3–4**
**Aug 1–2**
**Sep 11–12 PM**

**(star background only—not solar-system bodies)**


2026 Oct
CANCER
GEMINI
TAURUS
ARIES
PISCES
AQUARIUS
CAPRICORNUS
SAGITTARIUS
OPHIUCHUS
SCO.
LIBRA
VIRGO
LEO
Mars
Jupiter
Uranus
morning sky
midnight sky
Earth
Saturn
Neptune
Sun
6 Mercury-Venus
Mercury
Venus
evening sky
Solar system plan
opposition
greatest elongation
conjunction with Sun
conjunction of planets (in longitude)


comet 161P/Hartley-IRAS
Aug
Jul
Jun
Sep
Earth
Sun
Mar
Oct
Nov
Dec
Jan
ECLIPTIC PLANE

2026 OCTOBER

| | | | | | |
|---|---|---|---|---|---|
| 1314.646 | Oct | 1 | Thu | 4 | Moon 5.3° N of Uranus; 122° from Sun in morning sky; magnitudes -11.2 and 5.6 |
| 1315.366 | Oct | 1 | Thu | 20:47 | Moon at perigee; distance 57.91 Earth-radii |
| 1316.068 | Oct | 2 | Fri | 14 | Venus stationary in right ascension; starts retrograde motion |
| 1316.521 | Oct | 3 | SAT | 1 | Moon 3.4° N of M35 cluster; 97° from Sun in morning sky; magnitudes -10.5 and 5.3 |
| 1316.800 | Oct | 3 | SAT | 7 | Venus stationary in longitude; starts retrograde motion |

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| | | | | | |
|---|---|---|---|---|---|
| 1317.059 | Oct | 3 | SAT | 13:25 | Last quarter Moon |
| 1317.771 | Oct | 4 | SUN | 7 | Moon 6.9° SSW of Castor; 81° from Sun in morning sky; magnitudes -9.8 and 1.5 |
| 1318.000 | Oct | 4 | SUN | 12 | Moon 3.7° S of Pollux; 78° from Sun in morning sky; magnitudes -9.7 and 1.2 |
| 1318.013 | Oct | 4 | SUN | 12 | Saturn at opposition in longitude; magnitude 0.3; declination 2.0° |
| 1318.771 | Oct | 5 | Mon | 7 | Moon 1.10° NNE of Mars; 68° from Sun in morning sky; magnitudes -9.2 and 1.1 |
| 1319.000 | Oct | 5 | Mon | 12 | Moon, Mars, and Beehive within circle of diameter 3.42°; about 66° from the Sun in the morning sky; magnitudes -9, 1, 4 |
| 1319.021 | Oct | 5 | Mon | 13 | Moon 0.61° NNE of Beehive Cluster center; 64° and 65° from Sun in morning sky; magnitudes -9.1 and 3.7 |
| 1319.898 | Oct | 6 | Tue | 10 | Asteroid 2 Pallas at opposition in longitude; magnitude 8.2 |
| 1319.958 | Oct | 6 | Tue | 11 | Moon 0.36° E of Jupiter; 52° and 53° from Sun in morning sky; magnitudes -8.4 and -1.9 |
| 1320.233 | Oct | 6 | Tue | 18 | Venus at southernmost declination, -21.30° |
| 1320.555 | Oct | 7 | Wed | 1:19 | Moon at descending node; longitude 149.1° |
| 1320.646 | Oct | 7 | Wed | 4 | Moon 0.60° S of Regulus; 44° from Sun in morning sky; magnitudes -7.8 and 1.4 |
| 1320.688 | Oct | 7 | Wed | 5 | Mercury 5.0° NNE of Venus; 25° from Sun in evening sky; magnitudes -0.0 and -4.5 |
| 1322.167 | Oct | 8 | Thu | 16 | Draconid meteors; ZHR 5; 2 days before New Moon |
| 1323.468 | Oct | 9 | Fri | 23 | Pluto at southernmost declination, -23.64° |

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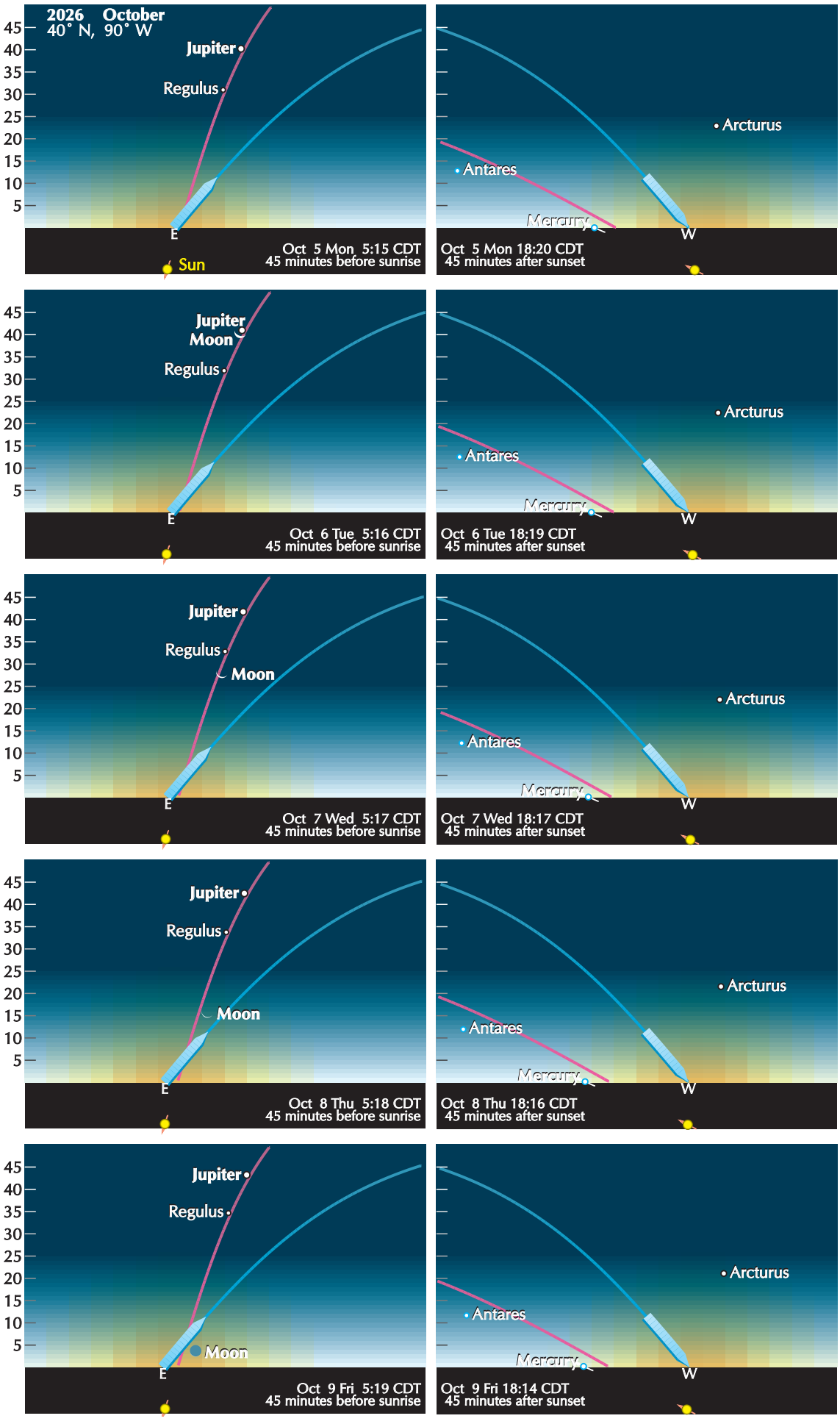
| | | | | | |
|---|---|---|---|---|---|
| 1324.159 | Oct | 10 | SAT | 15:49 | New Moon; beginning of lunation 1284 |
| 1324.708 | Oct | 11 | SUN | 5 | Moon 2.18° SSW of Spica; 8° and 7° from Sun in evening sky; magnitudes -4.7 and 1.0 |
| 1325.042 | Oct | 11 | SUN | 13 | Mars 0.10° S of Beehive Cluster center; 71° from Sun in morning sky; magnitudes 1.1 and 3.7 |
| 1325.708 | Oct | 12 | Mon | 5 | Moon 2.84° NNE of Venus; 19° and 20° from Sun in evening sky; magnitudes -5.8 and -4.3 |
| 1325.911 | Oct | 12 | Mon | 10 | Mercury at easternmost elongation; 25.2° from Sun in evening sky; magnitude -0.0 |
| 1326.189 | Oct | 12 | Mon | 17 | Asteroid 4 Vesta at opposition in longitude; magnitude 6.3 |
| 1326.313 | Oct | 12 | Mon | 20 | Moon 2.05° S of Mercury; 26° and 25° from Sun in evening sky; magnitudes -6.4 and 0.0 |
| 1328.396 | Oct | 14 | Wed | 22 | Moon 0.47° SE of Antares; 49° from Sun in evening sky; magnitudes -8.0 and 1.0 |


2026 October
40° N, 90° W
Jupiter
Regulus
Sun
Oct 5 Mon 5:15 CDT
45 minutes before sunrise
Arcturus
Antares
Mercury
Oct 5 Mon 18:20 CDT
45 minutes after sunset
Jupiter
Moon
Regulus
Oct 6 Tue 5:16 CDT
45 minutes before sunrise
Oct 6 Tue 18:19 CDT
45 minutes after sunset
Jupiter
Regulus
Moon
Oct 7 Wed 5:17 CDT
45 minutes before sunrise
Oct 7 Wed 18:17 CDT
45 minutes after sunset
Jupiter
Regulus
Moon
Oct 8 Thu 5:18 CDT
45 minutes before sunrise
Oct 8 Thu 18:16 CDT
45 minutes after sunset
Jupiter
Regulus
Moon
Oct 9 Fri 5:19 CDT
45 minutes before sunrise
Oct 9 Fri 18:14 CDT
45 minutes after sunset

| | | | | | |
|---|---|---|---|---|---|
| 1329.146 | Oct | 15 | Thu | 15 | Pluto stationary in longitude; resumes direct motion |
| 1329.419 | Oct | 15 | Thu | 22 | Pluto stationary in right ascension; resumes direct motion |
| 1330.454 | Oct | 16 | Fri | 23 | Moon at apogee; distance 63.44 Earth-radii |
| 1331.121 | Oct | 17 | SAT | 15 | Mercury at southernmost latitude from the ecliptic plane, -7.0° |

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| | | | | | |
|---|---|---|---|---|---|
| 1332.175 | Oct | 18 | SUN | 16:12 | First quarter Moon |
| 1334.871 | Oct | 21 | Wed | 8:54 | Moon at ascending node; longitude 328.1° |
| 1334.875 | Oct | 21 | Wed | 9 | Orionid meteors; ZHR 20; 3 days after First Quarter Moon |
| 1336.902 | Oct | 23 | Fri | 10 | Sun enters the astrological sign Scorpius, i.e. its longitude is 210° |
| 1337.5 | Oct | 24 | SAT | 0 | Moon 4.3° NNW of Neptune; 152° from Sun in evening sky; magnitudes -12.0 and 7.8 |
| 1337.651 | Oct | 24 | SAT | 4 | Venus at inferior conjunction with the Sun; 0.273 AU from Earth; latitude -2.45° |
| 1337.797 | Oct | 24 | SAT | 7 | Mercury stationary in longitude; starts retrograde motion |
| 1337.989 | Oct | 24 | SAT | 12 | Mercury stationary in right ascension; starts retrograde motion |
| 1338.042 | Oct | 24 | SAT | 13 | Moon 6.1° NNW of Saturn; 158° from Sun in evening sky; magnitudes -12.2 and 0.4 |
| 1338.5 | Oct | 25 | SUN | | Clocks back 1 hour (Britain) |

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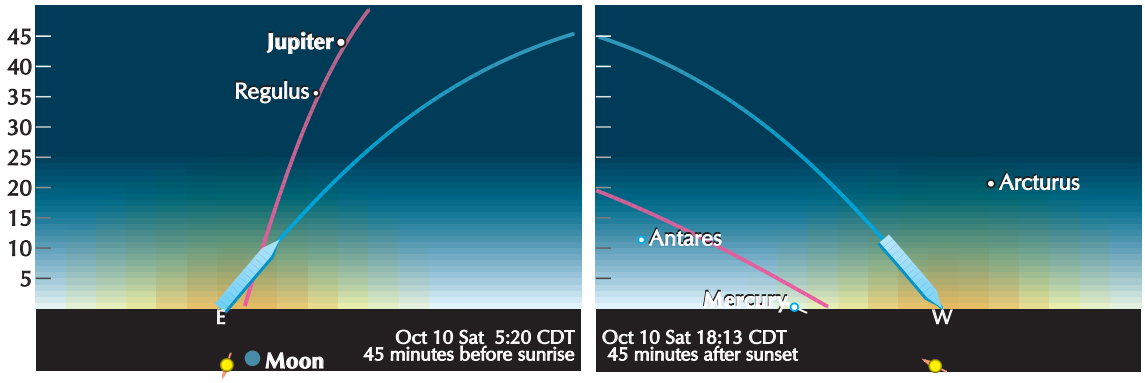
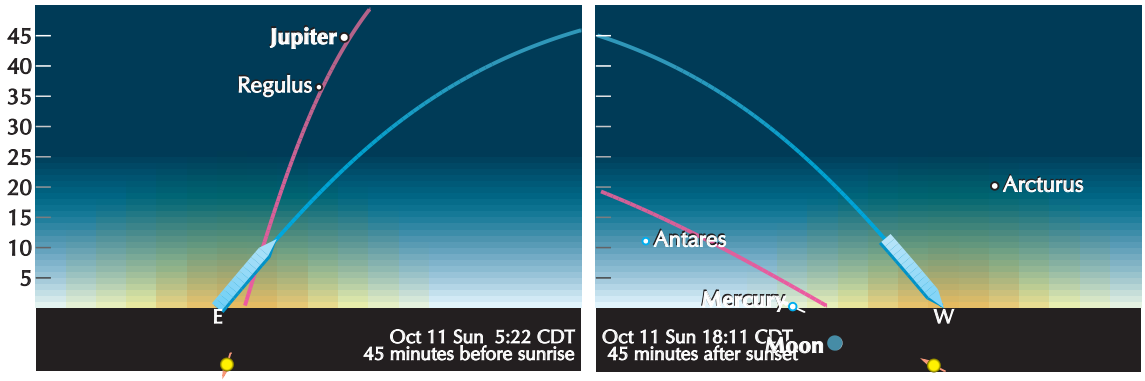
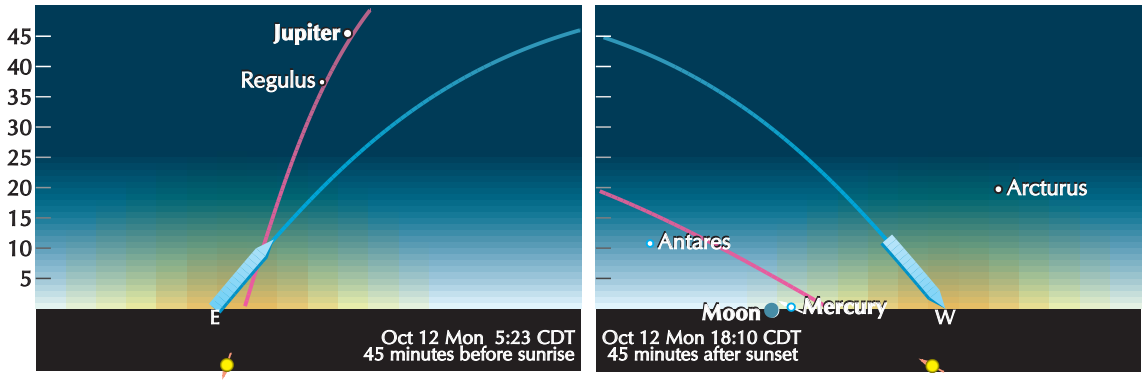
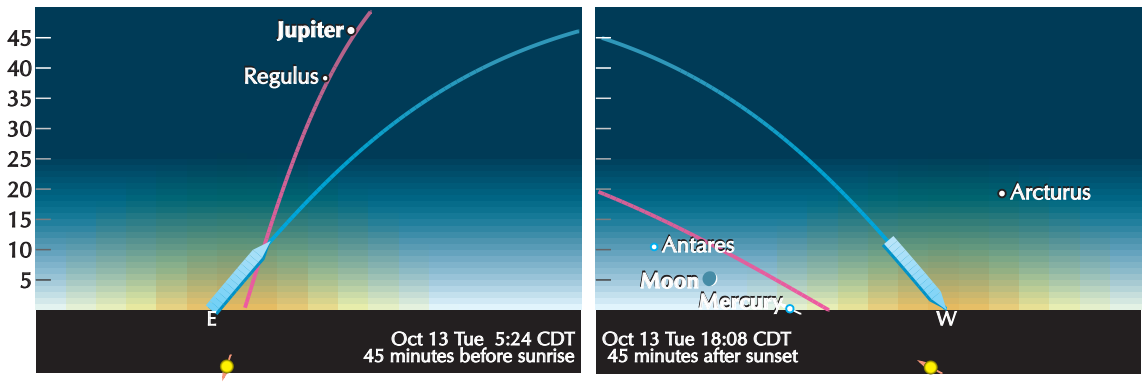
| | | | | | |
|---|---|---|---|---|---|
| 1339.675 | Oct | 26 | Mon | 4:12 | Full Moon |
| 1341.583 | Oct | 28 | Wed | 2 | Moon 1.00° N of Pleiades; 154° from Sun in morning sky |
| 1341.896 | Oct | 28 | Wed | 10 | Moon 5.2° N of Uranus; 149° and 150° from Sun in morning sky; magnitudes -12.0 and 5.6 |
| 1342.257 | Oct | 28 | Wed | 18:11 | Moon at perigee; distance 57.13 Earth-radii |
| 1343.792 | Oct | 30 | Fri | 7 | Moon 3.2° NNE of M35 cluster; 124° from Sun in morning sky; magnitudes -11.3 and 5.3 |
| 1344.5 | Oct | 31 | SAT | | Halloween |
| 1344.823 | Oct | 31 | SAT | 8 | Sun enters Libra, at longitude 217.90° on the ecliptic |
| 1345.000 | Oct | 31 | SAT | 12 | Moon 7.1° SSW of Castor; 108° and 107° from Sun in morning sky; magnitudes -10.8 and 1.5 |
| 1345.229 | Oct | 31 | SAT | 18 | Moon 3.9° S of Pollux; 105° from Sun in morning sky; magnitudes -10.7 and 1.2 |

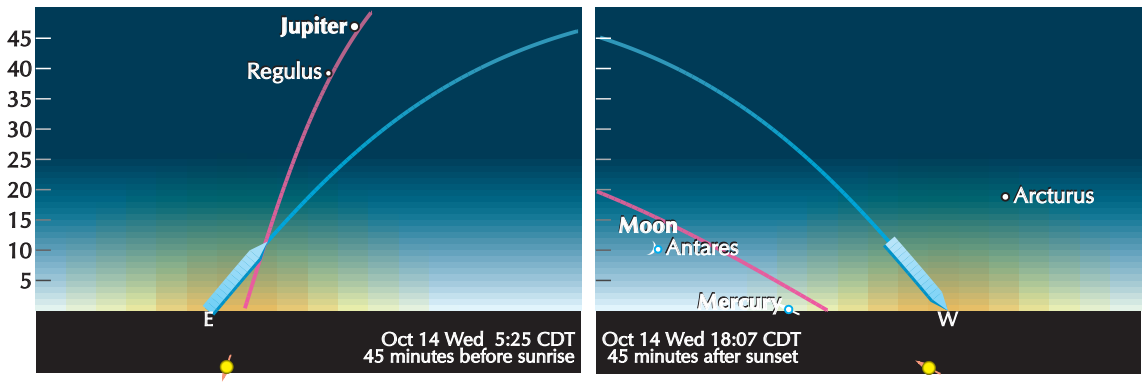
**The Earth Apple (Erdapel), made by Martin Behaim at Nürnberg in 1492.**


45
40
35
30
25
20
15
10
5
Jupiter
Regulus
E
Moon
Oct 10 Sat 5:20 CDT
45 minutes before sunrise
Arcturus
Antares
Mercury
W
Oct 10 Sat 18:13 CDT
45 minutes after sunset


45
40
35
30
25
20
15
10
5
Jupiter
Regulus
E
Oct 11 Sun 5:22 CDT
45 minutes before sunrise
Arcturus
Antares
Mercury
W
Oct 11 Sun 18:11 CDT
45 minutes after sunset
Moon


45
40
35
30
25
20
15
10
5
Jupiter
Regulus
E
Oct 12 Mon 5:23 CDT
45 minutes before sunrise
Arcturus
Antares
Moon
Mercury
W
Oct 12 Mon 18:10 CDT
45 minutes after sunset


45
40
35
30
25
20
15
10
5
Jupiter
Regulus
E
Oct 13 Tue 5:24 CDT
45 minutes before sunrise
Arcturus
Antares
Moon
Mercury
W
Oct 13 Tue 18:08 CDT
45 minutes after sunset

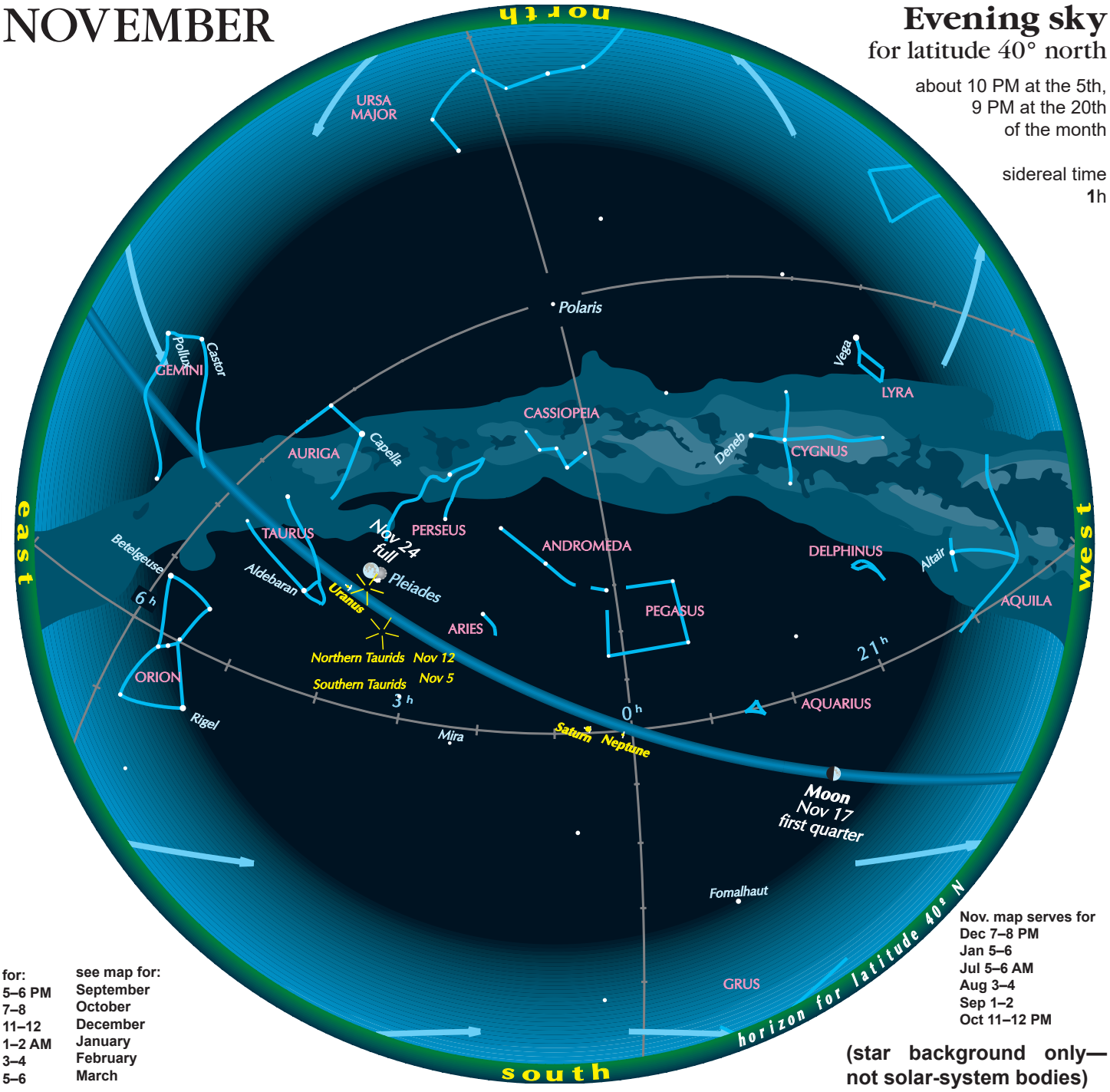

45
40
35
30
25
20
15
10
5
Jupiter
Regulus
E
Oct 14 Wed 5:25 CDT
45 minutes before sunrise
Arcturus
Moon
Antares
Mercury
W
Oct 14 Wed 18:07 CDT
45 minutes after sunset

# NOVEMBER

## Evening sky
for latitude 40° north

about 10 PM at the 5th,
9 PM at the 20th
of the month

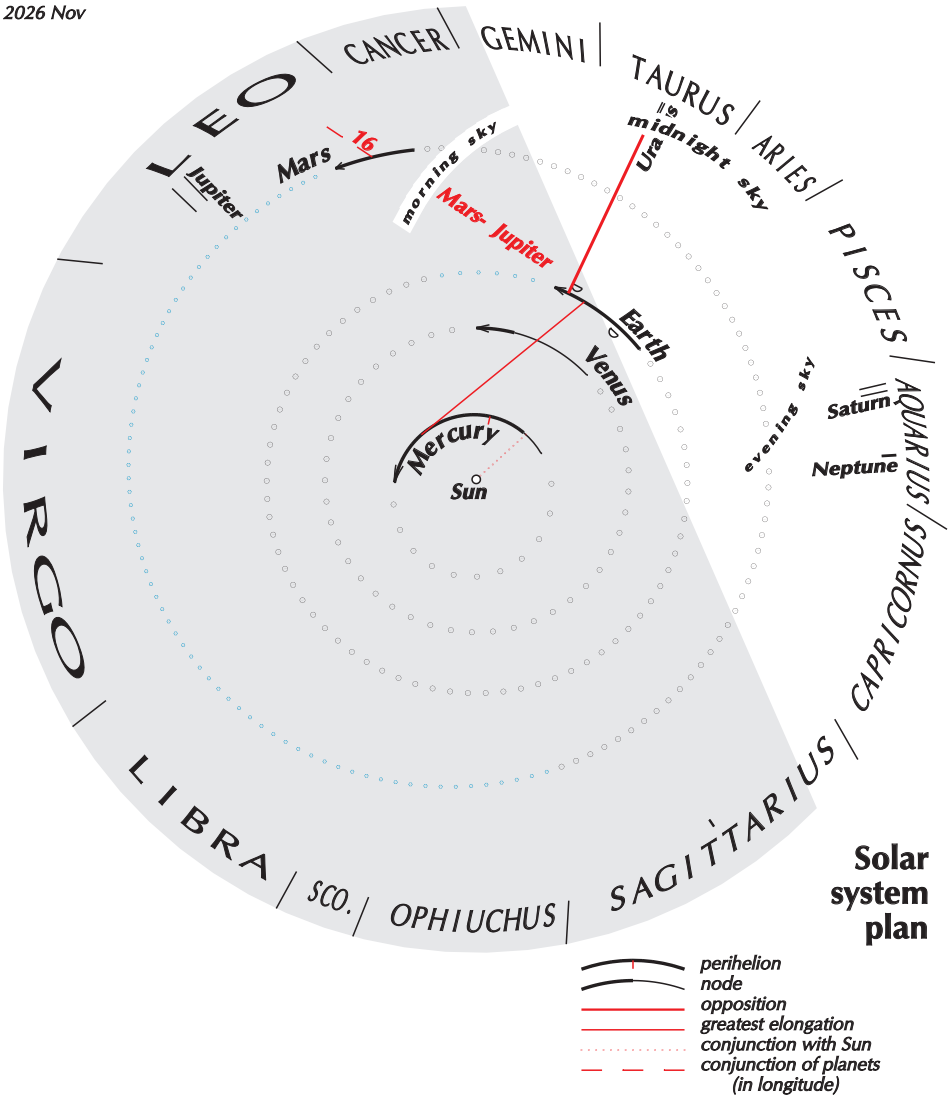
sidereal time
**1**h




| for: | see map for: |
|---|---|
| 5–6 PM | September |
| 7–8 | October |
| 11–12 | December |
| 1–2 AM | January |
| 3–4 | February |
| 5–6 | March |

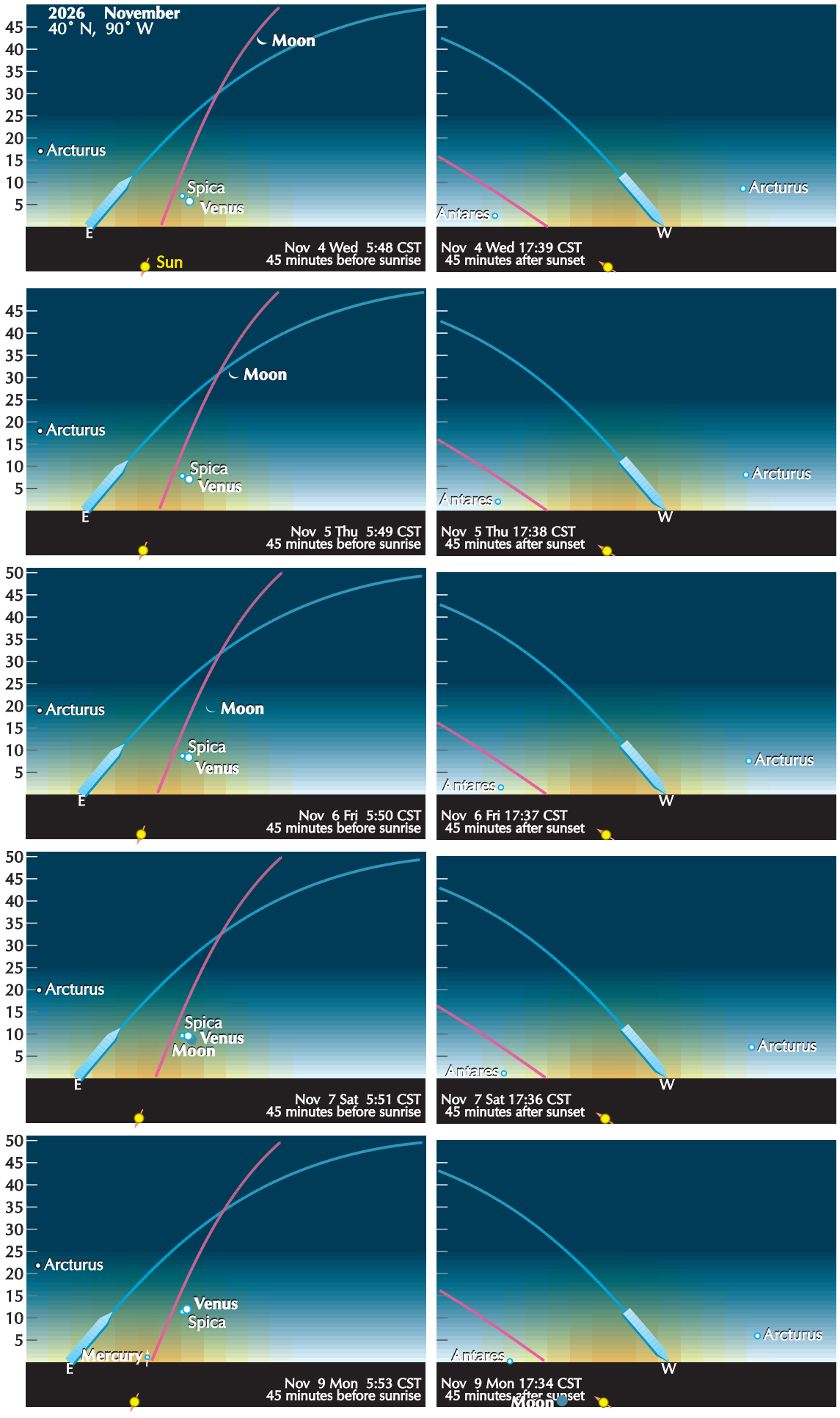
Nov. map serves for
Dec 7–8 PM
Jan 5–6
Jul 5–6 AM
Aug 3–4
Sep 1–2
Oct 11–12 PM

**(star background only—not solar-system bodies)**

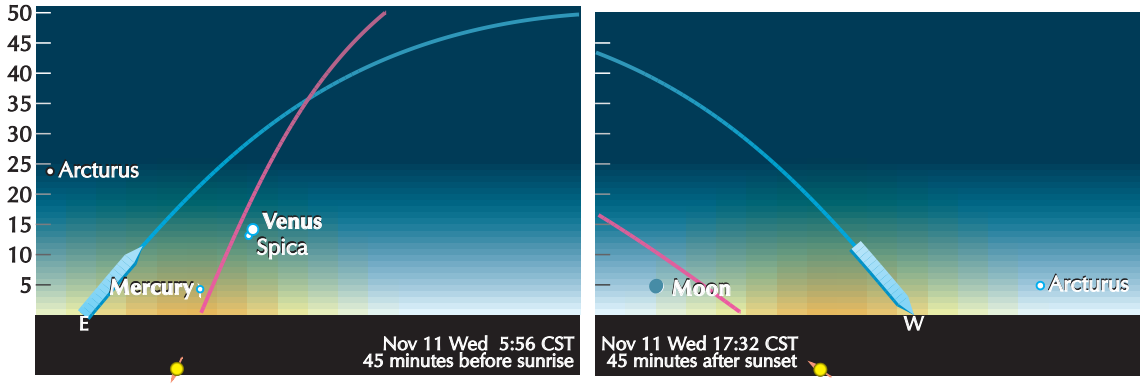

2026 Nov
LEO
CANCER
GEMINI
TAURUS
ARIES
PISCES
AQUARIUS
CAPRICORNUS
SAGITTARIUS
OPHIUCHUS
SCO.
LIBRA
VIRGO
Mars
16
Jupiter
morning sky
Mars- Jupiter
midnight sky
Ura
Earth
Venus
Mercury
Sun
evening sky
Saturn
Neptune
Solar system plan
perihelion
node
opposition
greatest elongation
conjunction with Sun
conjunction of planets (in longitude)

2026 NOVEMBER

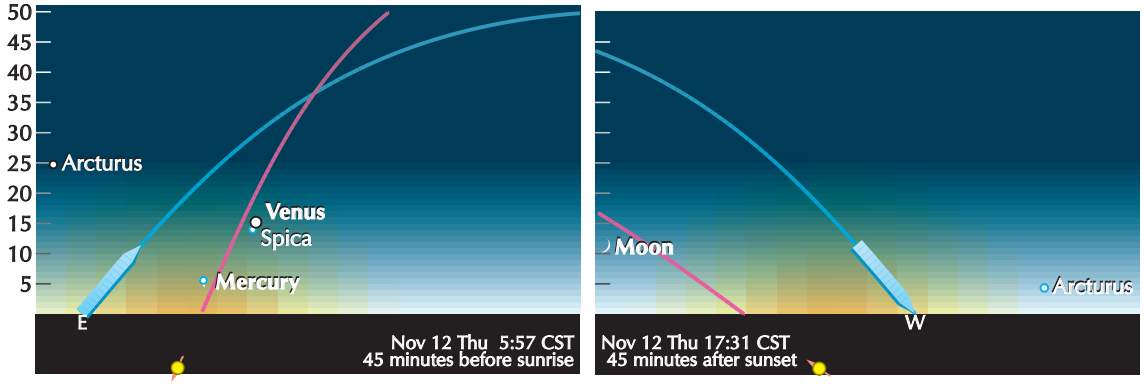
| | | | | | |
|---|---|---|---|---|---|
| 1345.5 | Nov | 1 | SUN | | Clocks back 1 hour (America) |
| 1346.250 | Nov | 1 | SUN | 18 | Moon 0.45° NE of Beehive Cluster center; 91° and 92° from Sun in morning sky; magnitudes -10.3 and 3.7 |
| 1346.353 | Nov | 1 | SUN | 20:29 | Last quarter Moon |
| 1347.083 | Nov | 2 | Mon | 14 | Moon 0.98° SSW of Mars; 81° from Sun in morning sky; magnitudes -9.8 and 0.9 |
| 1347.442 | Nov | 2 | Mon | 23 | Moon, Mars, and Jupiter within circle of diameter 5.05°; about 78° from the Sun in the morning sky; magnitudes -10, 1, -2 |
| 1347.479 | Nov | 2 | Mon | 24 | Moon 0.63° SE of Jupiter; 76° from Sun in morning sky; magnitudes -9.6 and -2.0 |
| 1347.627 | Nov | 3 | Tue | 3:02 | Moon at descending node; longitude 146.9° |
| 1347.841 | Nov | 3 | Tue | 8 | The equation of time is at a maximum of 16.49 minutes |
| 1347.875 | Nov | 3 | Tue | 9 | Moon 0.77° SSW of Regulus; 71° from Sun in morning sky; magnitudes -9.4 and 1.4 |
| 1349.096 | Nov | 4 | Wed | 14 | Mercury at inferior conjunction with the Sun; 0.674 AU from Earth; latitude -0.79° |
| 1349.917 | Nov | 5 | Thu | 10 | Southern Taurid meteors; ZHR 7; 4 days before New Moon |
| 1350.181 | Nov | 5 | Thu | 16 | Mercury at ascending node through the ecliptic plane |
| 1351.958 | Nov | 7 | SAT | 11 | Moon 0.96° SSW of Venus; 22° from Sun in morning sky; magnitudes -6.1 and -4.4 |
| 1352.000 | Nov | 7 | SAT | 12 | Moon, Venus, and Spica within circle of diameter 2.19°; about 21° from the Sun in the morning sky; magnitudes -6, -4, 1 |
| 1352.000 | Nov | 7 | SAT | 12 | Moon 2.19° SSW of Spica; 21° from Sun in morning sky; magnitudes -6.0 and 1.0 |
| 1352.5 | Nov | 8 | SUN | | Diwali, Hindu Festival of Lights |
| 1353.042 | Nov | 8 | SUN | 13 | Moon 5.7° SSW of Mercury; 10° and 9° from Sun in morning sky; magnitudes -4.9 and 2.7 |
| 1353.793 | Nov | 9 | Mon | 7:01 | New Moon; beginning of lunation 1285 |
| 1354.021 | Nov | 9 | Mon | 13 | Venus 1.16° WSW of Spica; 24° and 23° from Sun in morning sky; magnitudes -4.5 and 1.0; quasi-conjunction |
| 1354.854 | Nov | 10 | Tue | 8 | Mercury at perihelion; 0.3075 AU from the Sun |
| 1355.5 | Nov | 11 | Wed | | Veterans' or Remembrance Day |
| 1355.708 | Nov | 11 | Wed | 5 | Moon 0.32° SE of Antares; 22° from Sun in evening sky; magnitudes -6.0 and 1.0 |
| 1356.129 | Nov | 11 | Wed | 15 | Venus stationary in right ascension; resumes direct motion |
| 1356.875 | Nov | 12 | Thu | 9 | Northern Taurid meteors; ZHR 5; 3 days after New Moon |
| 1357.882 | Nov | 13 | Fri | 9 | Mercury stationary in right ascension; resumes direct motion |
| 1358.158 | Nov | 13 | Fri | 16 | Mercury stationary in longitude; resumes direct motion |
| 1358.244 | Nov | 13 | Fri | 18 | Moon at apogee; distance 63.60 Earth-radii |
| 1358.516 | Nov | 14 | SAT | 0 | Venus stationary in longitude; resumes direct motion |
| 1360.604 | Nov | 16 | Mon | 3 | Mars 1.19° NNE of Jupiter; 88° from Sun in morning sky; magnitudes 0.7 and -2.1 |
| 1361.991 | Nov | 17 | Tue | 11:47 | First quarter Moon |
| 1361.993 | Nov | 17 | Tue | 11:50 | Moon at ascending node; longitude 325.2° |


2026 November
40° N, 90° W
Moon
Arcturus
Spica
Venus
Sun
E
W
Antares
Nov 4 Wed 5:48 CST
45 minutes before sunrise
Nov 4 Wed 17:39 CST
45 minutes after sunset
Nov 5 Thu 5:49 CST
45 minutes before sunrise
Nov 5 Thu 17:38 CST
45 minutes after sunset
Nov 6 Fri 5:50 CST
45 minutes before sunrise
Nov 6 Fri 17:37 CST
45 minutes after sunset
Nov 7 Sat 5:51 CST
45 minutes before sunrise
Nov 7 Sat 17:36 CST
45 minutes after sunset
Mercury
Nov 9 Mon 5:53 CST
45 minutes before sunrise
Nov 9 Mon 17:34 CST
45 minutes after sunset

| | | | | | |
|---|---|---|---|---|---|
| 1362.125 | Nov | 17 | Tue | 15 | Leonid meteors; ZHR 15; near First Quarter Moon |
| 1362.900 | Nov | 18 | Wed | 10 | Jupiter at west quadrature, 90° from the Sun |
| 1364.239 | Nov | 19 | Thu | 18 | Mars at west quadrature, 90° from the Sun |
| 1364.875 | Nov | 20 | Fri | 9 | Moon 4.4° NNW of Neptune; 124° from Sun in evening sky; magnitudes -11.3 and 7.8 |
| 1365.059 | Nov | 20 | Fri | 13 | Mercury at northernmost latitude from the ecliptic plane, 7.0° |
| 1365.354 | Nov | 20 | Fri | 21 | Moon 6.1° NNW of Saturn; 130° from Sun in evening sky; magnitudes -11.4 and 0.6 |
| 1365.473 | Nov | 20 | Fri | 23 | Mercury at westernmost elongation; 19.6° from Sun in morning sky; magnitude -0.5 |
| 1366.421 | Nov | 21 | SAT | 22 | Venus at ascending node through the ecliptic plane |
| 1366.808 | Nov | 22 | SUN | 7 | Sun enters the astrological sign Sagittarius, i.e. its longitude is 240° |
| 1368.034 | Nov | 23 | Mon | 13 | Sun enters Scorpius, at longitude 241.24° on the ecliptic |
| 1369.021 | Nov | 24 | Tue | 13 | Moon 1.03° NNE of Pleiades; 175° and 176° from Sun in evening midnight sky |
| | | | | | _____ |
| 1369.121 | Nov | 24 | Tue | 14:54 | Full Moon |
| 1369.142 | Nov | 24 | Tue | 15 | Moon, Uranus, and the Pleiades within circle of diameter 5.46°; about 175° from the Sun in the evening sky; mag -13, 6, 3 |
| 1369.229 | Nov | 24 | Tue | 18 | Moon 5.1° N of Uranus; 175° and 179° from Sun in morning midnight sky; magnitudes -12.7 and 5.6 |
| 1369.5 | Nov | 25 | Wed | 0 | Mars, Jupiter, and Regulus within circle of diameter 3.72°; about 94° from the Sun in the morning sky; magnitudes 1, -2, 1 |
| 1370.386 | Nov | 25 | Wed | 21:15 | Moon at perigee; distance 56.34 Earth-radii |
| 1370.436 | Nov | 25 | Wed | 22 | Uranus at opposition in longitude; mag 5.6; declination 20.7° |
| 1370.5 | Nov | 26 | Thu | | Thanksgiving |
| 1370.708 | Nov | 26 | Thu | 5 | Mars 1.72° NNE of Regulus; 94° from Sun in morning sky; magnitudes 0.6 and 1.4 |
| 1371.146 | Nov | 26 | Thu | 16 | Moon 3.1° N of M35 cluster; 151° and 152° from Sun in morning sky; magnitudes -12.1 and 5.3 |
| 1372.282 | Nov | 27 | Fri | 19 | Venus brightest; magnitude -4.65° |
| 1372.313 | Nov | 27 | Fri | 20 | Moon 7.3° SSW of Castor; 135° and 134° from Sun in morning sky; magnitudes -11.7 and 1.5 |
| 1372.542 | Nov | 28 | SAT | 1 | Moon 4.2° S of Pollux; 132° from Sun in morning sky |
| 1373.521 | Nov | 29 | SUN | 1 | Moon 0.23° E of Beehive Cluster center; 119° from Sun in morning sky; magnitudes -11.2 and 3.7 |
| 1374.086 | Nov | 29 | SUN | 14 | Venus shows greatest illuminated extent, 340 square seconds |
| 1374.648 | Nov | 30 | Mon | 3:33 | Moon at descending node; longitude 143.8° |
| 1374.853 | Nov | 30 | Mon | 8 | Sun enters Ophiuchus, at longitude 248.14° on the ecliptic |
| 1374.875 | Nov | 30 | Mon | 9 | Moon 1.10° S of Jupiter; 101° from Sun in morning sky |
| 1374.900 | Nov | 30 | Mon | 10 | Moon, Mars, and Jupiter within circle of diameter 5.17°; about 100° from the Sun in the morning sky; magnitudes -11, 0, -2 |
| 1375.042 | Nov | 30 | Mon | 13 | Moon, Jupiter, and Regulus within circle of diameter 3.44°; about 100° from the Sun in the morning sky; mag -11, -2, 1 |
| 1375.125 | Nov | 30 | Mon | 15 | Moon 1.08° S of Regulus; 98° from Sun in morning sky |
| 1375.200 | Nov | 30 | Mon | 17 | Moon, Mars, and Regulus within circle of diameter 3.00°; about 97° from the Sun in the morning sky; mag -10, 0, 1 |
| 1375.229 | Nov | 30 | Mon | 18 | Moon 3.0° SSW of Mars; 97° from Sun in morning sky; |


50
45
40
35
30
25
20
15
10
5
Arcturus
Venus
Spica
Mercury
E
Nov 11 Wed 5:56 CST
45 minutes before sunrise


Moon
Arcturus
W
Nov 11 Wed 17:32 CST
45 minutes after sunset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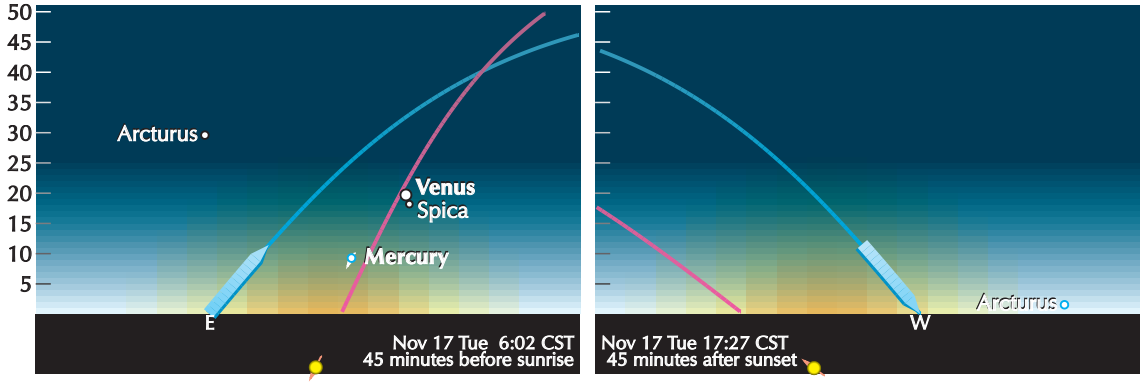
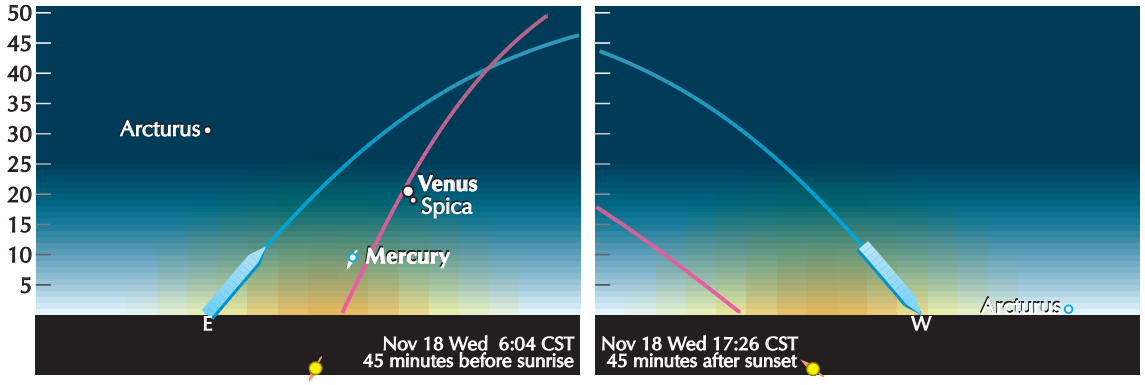
45
40
35
30
25
20
15
10
5
Arcturus
Venus
Spica
Mercury
E
Nov 12 Thu 5:57 CST
45 minutes before sunrise

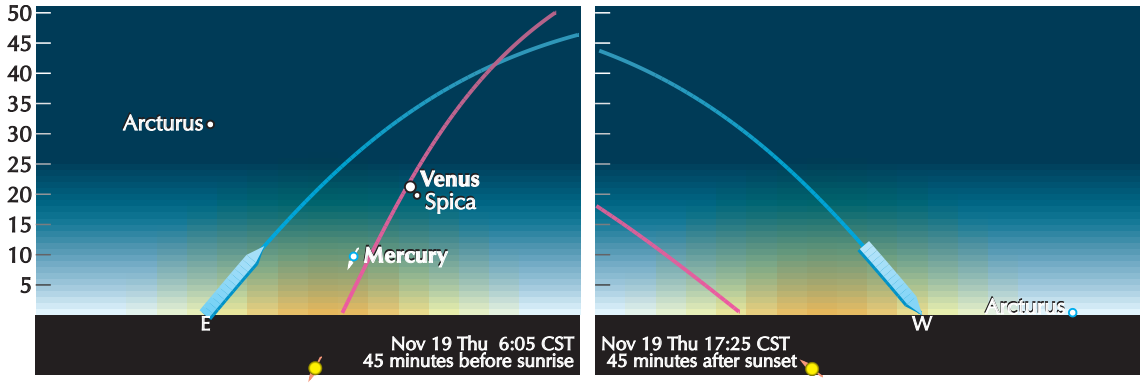

Moon
Arcturus
W
Nov 12 Thu 17:31 CST
45 minutes after sunset


50
45
40
35
30
25
20
15
10
5
Arcturus
Venus
Spica
Mercury
E
Nov 17 Tue 6:02 CST
45 minutes before sunrise


Arcturus
W
Nov 17 Tue 17:27 CST
45 minutes after sunset


50
45
40
35
30
25
20
15
10
5
Arcturus
Venus
Spica
Mercury
E
Nov 18 Wed 6:04 CST
45 minutes before sunrise

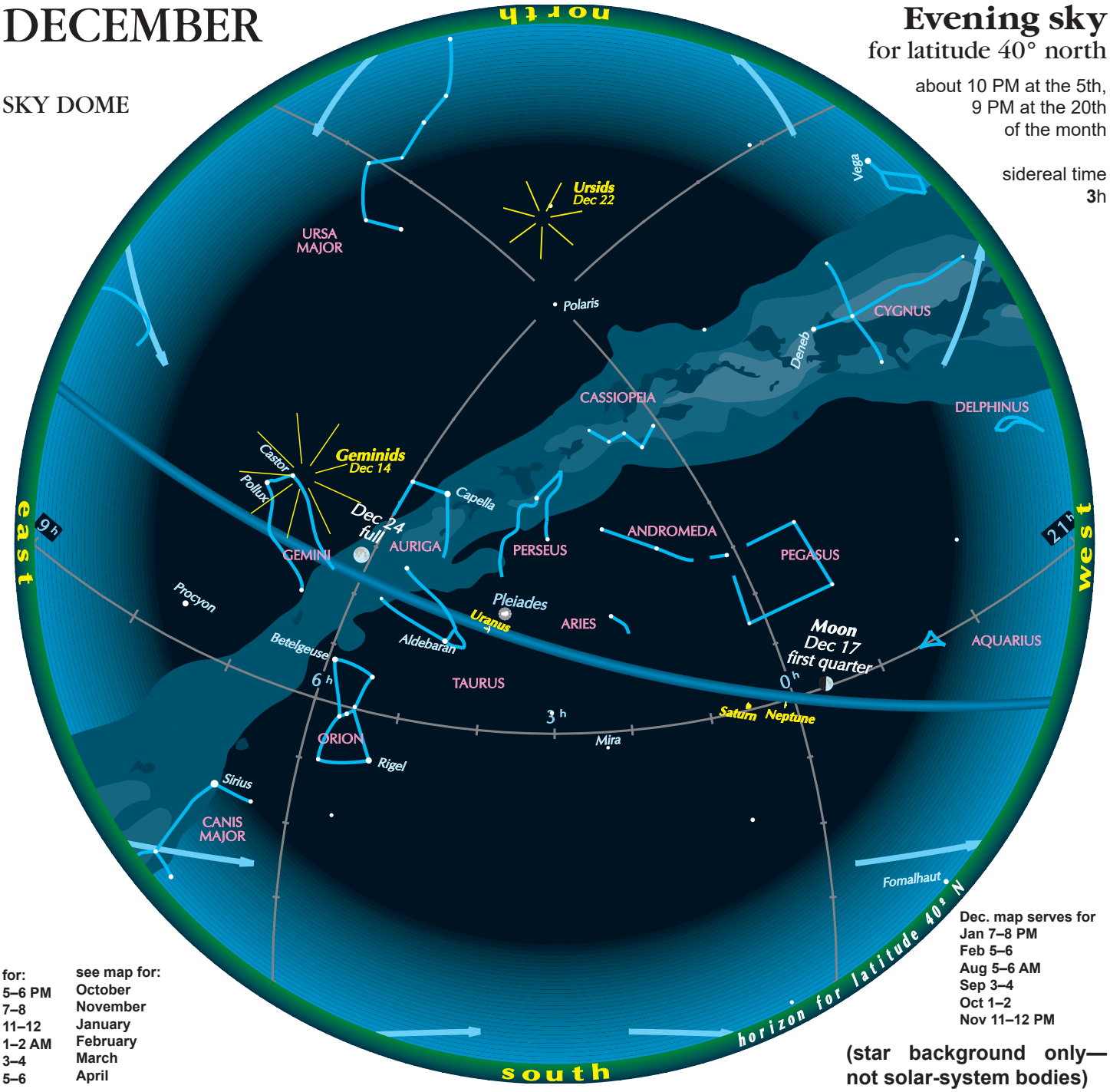

Arcturus
W
Nov 18 Wed 17:26 CST
45 minutes after sunset


50
45
40
35
30
25
20
15
10
5
Arcturus
Venus
Spica
Mercury
E
Nov 19 Thu 6:05 CST
45 minutes before sunrise


Arcturus
W
Nov 19 Thu 17:25 CST
45 minutes after sunset

# DECEMBER

## SKY DOME




**Evening sky**
for latitude 40° north

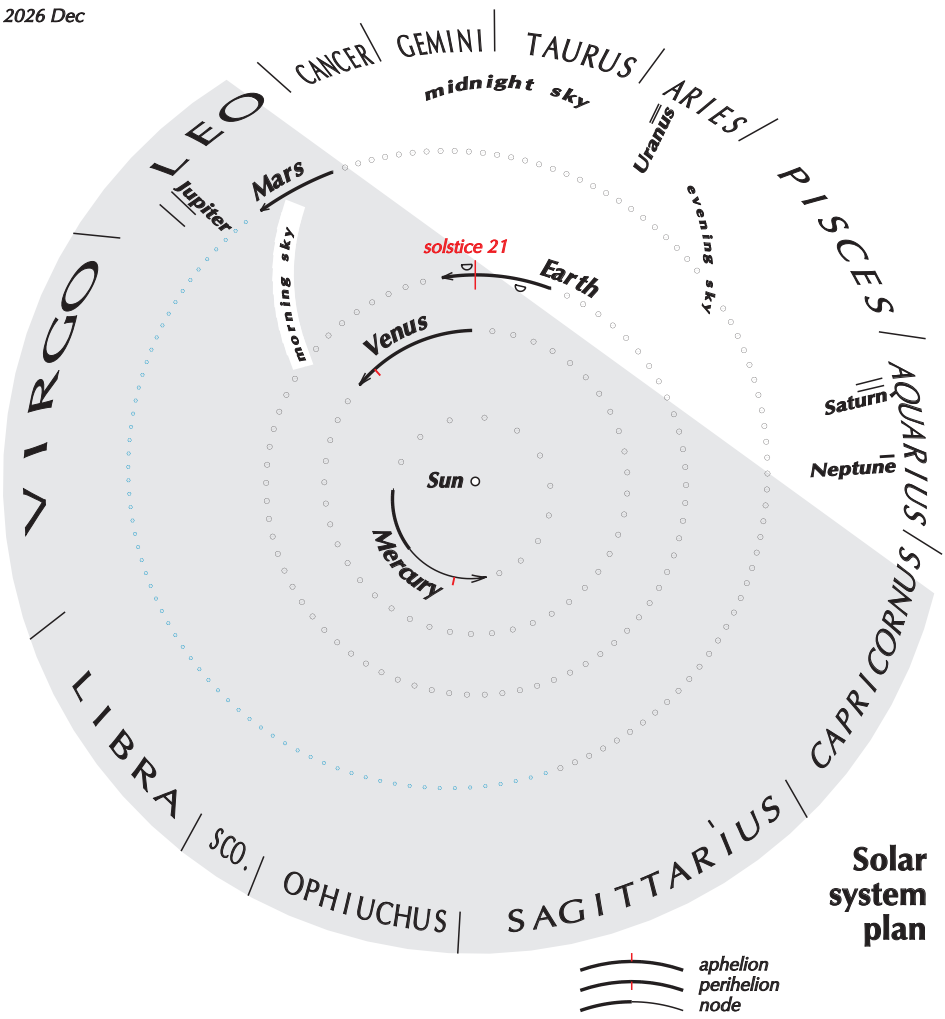
about 10 PM at the 5th,
9 PM at the 20th
of the month

sidereal time
**3**h

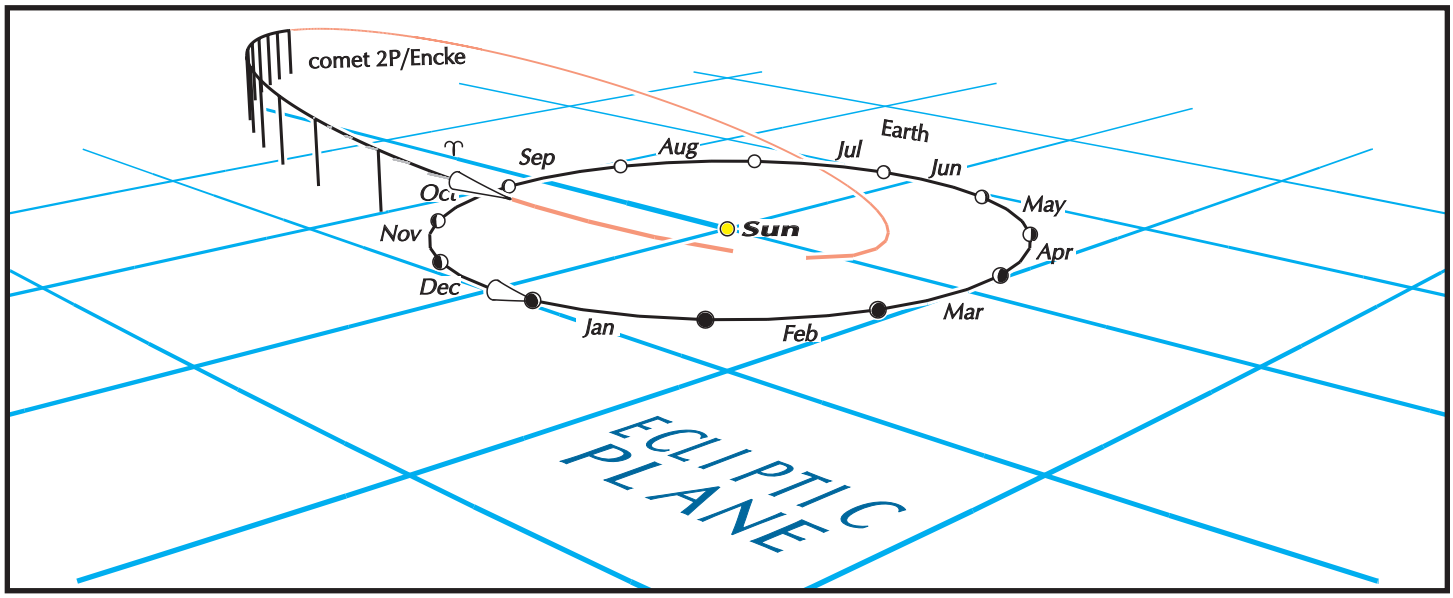
| for: | see map for: |
|---|---|
| 5–6 PM | October |
| 7–8 | November |
| 11–12 | January |
| 1–2 AM | February |
| 3–4 | March |
| 5–6 | April |

**Dec. map serves for**
**Jan 7–8 PM**
**Feb 5–6**
**Aug 5–6 AM**
**Sep 3–4**
**Oct 1–2**
**Nov 11–12 PM**

**(star background only—not solar-system bodies)**

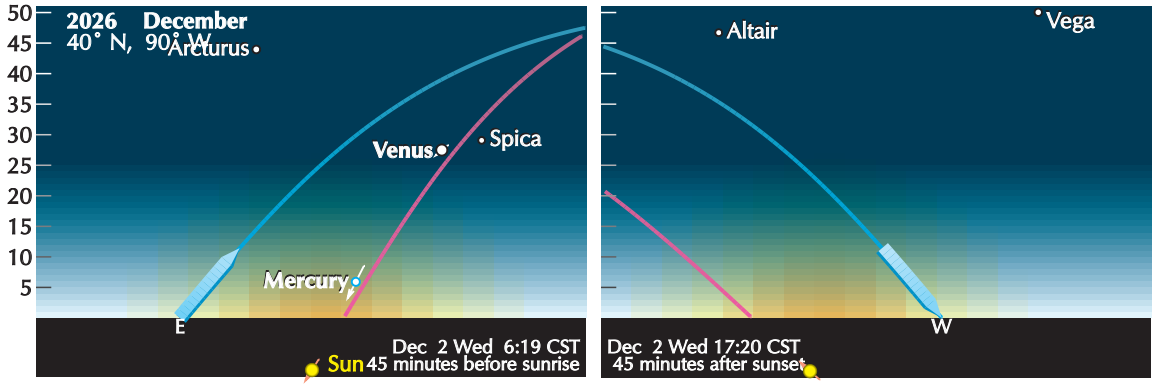


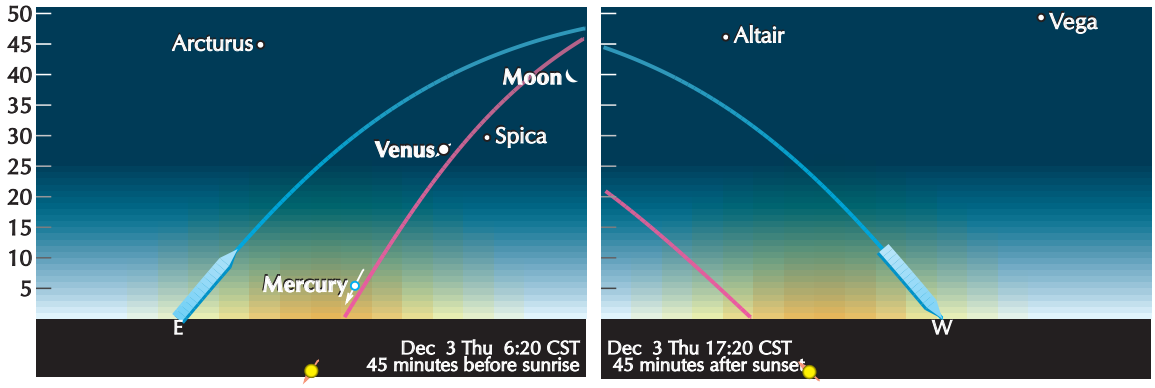

**Solar system plan**

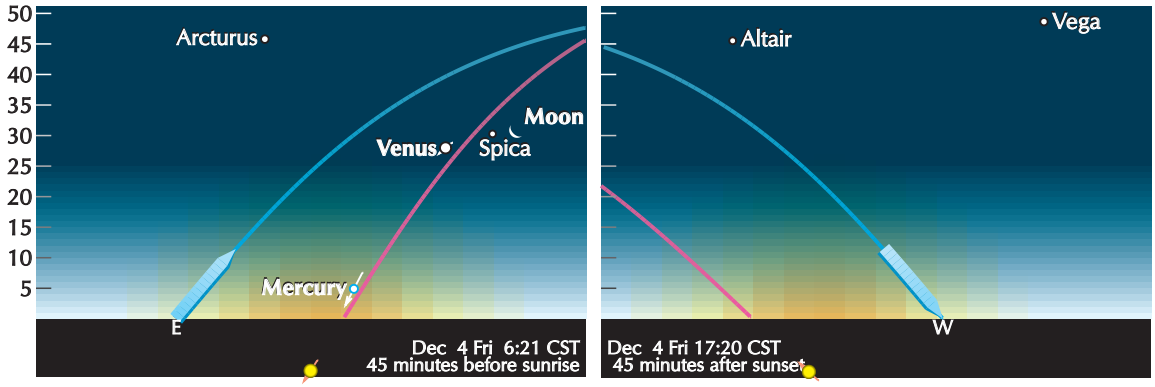


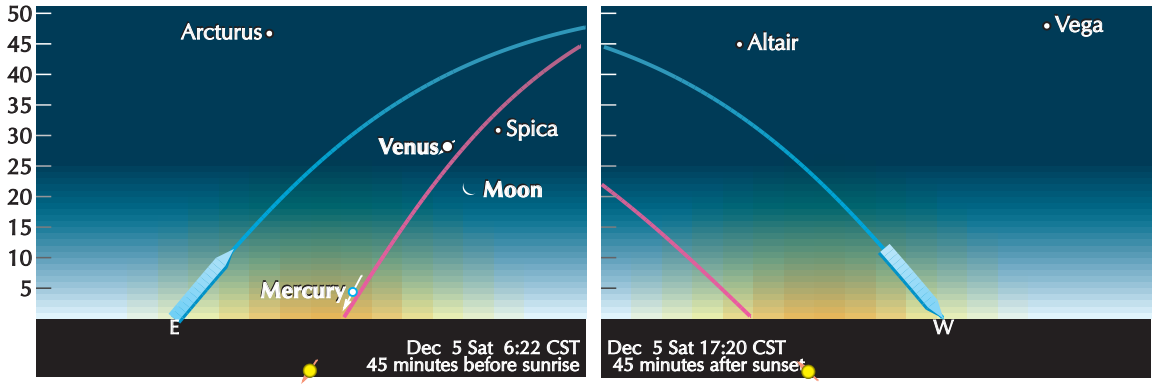
2026 DECEMBER

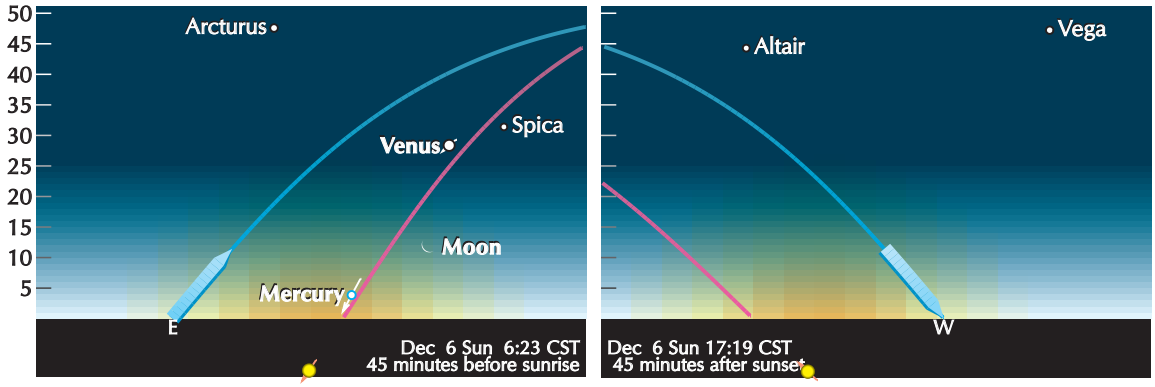
| | | | | | |
|---|---|---|---|---|---|
| 1375.756 | Dec | 1 | Tue | 6:09 | Last quarter Moon |
| 1379.250 | Dec | 4 | Fri | 18 | Moon 2.36° SSW of Spica; 48° from Sun in morning sky; magnitudes -8.1 and 1.0 |
| 1379.729 | Dec | 5 | SAT | 6 | Moon 6.6° SSW of Venus; 43° from Sun in morning sky; magnitudes -7.7 and -4.6 |
| 1382.191 | Dec | 7 | Mon | | Earliest sunset, at latitude 40° north |
| 1382.354 | Dec | 7 | Mon | 21 | Moon 5.7° S of Mercury; 14° and 13° from Sun in morning sky; magnitudes -5.3 and -0.6 |
| 1383.000 | Dec | 8 | Tue | 12 | Moon 0.44° SE of Antares; 8° from Sun in morning sky; magnitudes -4.6 and 1.0 |
| 1383.536 | Dec | 9 | Wed | 0:52 | New Moon; beginning of lunation 1286 |
| 1385.125 | Dec | 10 | Thu | 15 | Saturn 6.4° ENE of Neptune; 109° and 103° from Sun in evening sky; magnitudes 0.8 and 7.9; quasi-conjunction |
| 1385.449 | Dec | 10 | Thu | 23 | Saturn stationary in longitude; resumes direct motion |
| 1385.780 | Dec | 11 | Fri | 7 | Moon at apogee; distance 63.72 Earth-radii; farthest in year |
| 1386.437 | Dec | 11 | Fri | 22 | Saturn stationary in right ascension; resumes direct motion |
| 1387.295 | Dec | 12 | SAT | 19 | Neptune stationary in longitude; resumes direct motion |
| 1387.375 | Dec | 12 | SAT | 21 | Jupiter 3.2° WNW of Regulus; 114° and 111° from Sun in morning sky; magnitudes -2.3 and 1.4; quasi-conjunction |
| 1387.504 | Dec | 13 | SUN | 0 | Jupiter stationary in longitude; starts retrograde motion |
| 1387.729 | Dec | 13 | SUN | 6 | Mercury 4.7° NNE of Antares; 11° and 12° from Sun in morning sky; magnitudes -0.7 and 1.0 |
| 1387.804 | Dec | 13 | SUN | 7 | Neptune stationary in right ascension; resumes direct motion |
| 1387.967 | Dec | 13 | SUN | 11 | Jupiter stationary in right ascension; starts retrograde motion |
| 1388.460 | Dec | 13 | SUN | 23 | Mercury at descending node through the ecliptic plane |
| 1388.708 | Dec | 14 | Mon | 5 | Geminid meteors; ZHR 150; 3 days before First Quarter Moon |
| 1389.046 | Dec | 14 | Mon | 13:06 | Moon at ascending node; longitude 322.2° |
| 1391.737 | Dec | 17 | Thu | 5:42 | First quarter Moon |
| 1392.229 | Dec | 17 | Thu | 18 | Moon 4.6° NNW of Neptune; 96° from Sun in evening sky; magnitudes -10.3 and 7.9 |
| 1392.708 | Dec | 18 | Fri | 5 | Moon 6.2° NNW of Saturn; 101° and 102° from Sun in evening sky; magnitudes -10.6 and 0.8 |
| 1393.129 | Dec | 18 | Fri | 15 | Sun enters Sagittarius, at longitude 266.70° on the ecliptic |
| 1393.958 | Dec | 19 | SAT | 11 | Moon shows maximum libration for the year, 9.66° |
| 1396.368 | Dec | 21 | Mon | 20:49 | December (northern winter) solstice |
| 1396.368 | Dec | 21 | Mon | 20:49 | Sun enters the astrological sign Capricornus, i.e. its longitude is 270° |
| 1396.479 | Dec | 21 | Mon | 24 | Moon 1.03° N of Pleiades; 150° from Sun in evening sky |
| 1396.600 | Dec | 22 | Tue | 2 | Moon, Uranus, and the Pleiades within circle of diameter 5.18°; about 151° from the Sun in the evening sky; mag. -12, 6, 3 |
| 1396.646 | Dec | 22 | Tue | 4 | Moon 5.2° N of Uranus; 152° from Sun in evening sky; magnitudes -12.2 and 5.6 |
| 1397.042 | Dec | 22 | Tue | 13 | Ursid meteors; ZHR 10; 2 days before Full Moon |


2026 December
40° N, 90° W
Arcturus
Venus
Spica
Mercury
E
Dec 2 Wed 6:19 CST
Sun 45 minutes before sunrise
Altair
Vega
W
Dec 2 Wed 17:20 CST
45 minutes after sunset


Arcturus
Moon
Venus
Spica
Mercury
E
Dec 3 Thu 6:20 CST
45 minutes before sunrise
Altair
Vega
W
Dec 3 Thu 17:20 CST
45 minutes after sunset


Arcturus
Moon
Venus
Spica
Mercury
E
Dec 4 Fri 6:21 CST
45 minutes before sunrise
Altair
Vega
W
Dec 4 Fri 17:20 CST
45 minutes after sunset

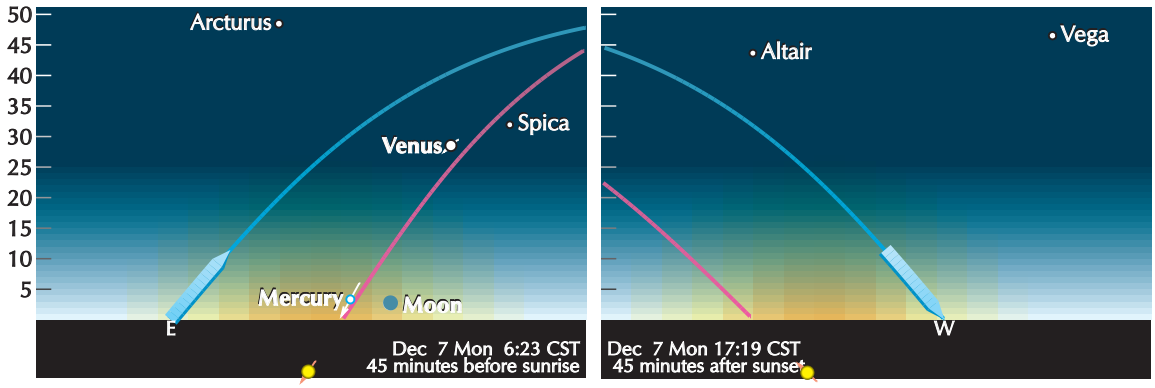

Arcturus
Venus
Spica
Moon
Mercury
E
Dec 5 Sat 6:22 CST
45 minutes before sunrise
Altair
Vega
W
Dec 5 Sat 17:20 CST
45 minutes after sunset

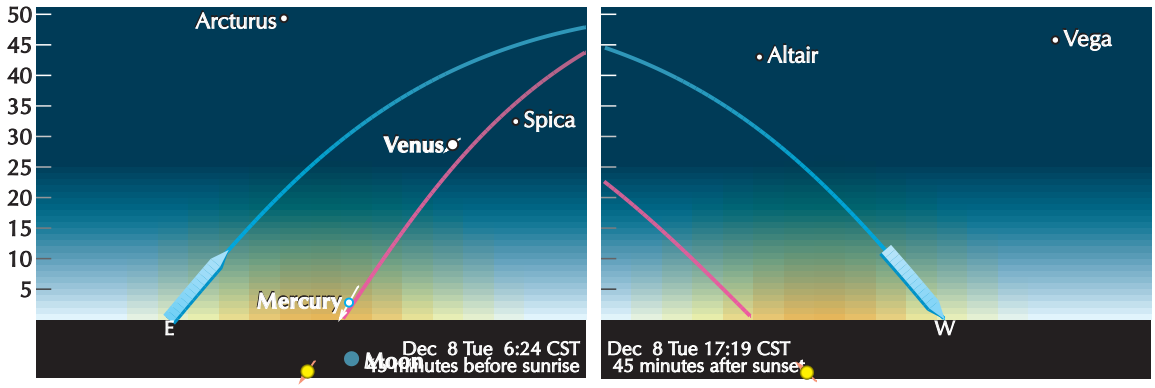

Arcturus
Venus
Spica
Moon
Mercury
E
Dec 6 Sun 6:23 CST
45 minutes before sunrise
Altair
Vega
W
Dec 6 Sun 17:19 CST
45 minutes after sunset

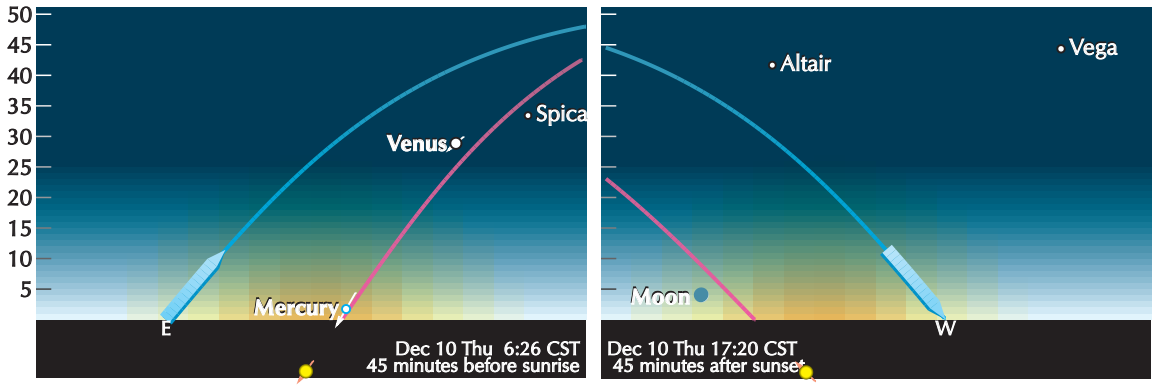
| | | | | | |
|---|---|---|---|---|---|
| 1398.562 | Dec | 24 | Thu | 1:29 | Full Moon |
| 1398.604 | Dec | 24 | Thu | 3 | Moon 2.99° N of M35 cluster; 176° and 179° from Sun in morning midnight sky; magnitudes -12.8 and 5.3 |
| 1398.838 | Dec | 24 | Thu | 8 | Mercury at aphelion; 0.4667 AU from the Sun |
| 1398.860 | Dec | 24 | Thu | 8:39 | Moon at perigee; distance 55.92 Earth-radii; nearest in year; only 7.2 hours after full Moon |
| 1399.5 | Dec | 25 | Fri | | Christmas |
| 1399.750 | Dec | 25 | Fri | 6 | Moon 7.4° S of Castor; 163° and 160° from Sun in morning sky; magnitudes -12.5 and 1.5 |
| 1399.882 | Dec | 25 | Fri | 9 | The equation of time is 0 |
| 1399.958 | Dec | 25 | Fri | 11 | Moon 4.3° S of Pollux; 160° and 159° from Sun in morning sky; magnitudes -12.4 and 1.2 |
| 1400.362 | Dec | 25 | Fri | 21 | Venus at perihelion; 0.7185 AU from the Sun |
| 1400.917 | Dec | 26 | SAT | 10 | Moon 0.28° SE of Beehive Cluster center; 147° from Sun in morning sky; magnitudes -12.0 and 3.7 |
| 1401.831 | Dec | 27 | SUN | 7:56 | Moon at descending node; longitude 141.4° |
| 1402.208 | Dec | 27 | SUN | 17 | Moon 1.42° SSW of Jupiter; 129° from Sun in morning sky; magnitudes -11.5 and -2.4 |
| 1402.258 | Dec | 27 | SUN | 18 | Moon, Jupiter, and Regulus within circle of diameter 3.55°; about 128° from the Sun in the morning sky; magnitudes -11, -2, 1 |
| 1402.458 | Dec | 27 | SUN | 23 | Moon 1.31° S of Regulus; 126° from Sun in morning sky; magnitudes -11.4 and 1.4 |
| 1403.083 | Dec | 28 | Mon | 14 | Moon 4.7° SSW of Mars; 118° and 117° from Sun in morning sky; magnitudes -11.1 and -0.1 |
| 1404.141 | Dec | 29 | Tue | 15 | Mercury at southernmost declination, -24.85° |
| 1404.474 | Dec | 29 | Tue | 23 | Saturn at east quadrature, 90° from the Sun |
| | | | | | _____ |
| 1405.292 | Dec | 30 | Wed | 18:60 | Last quarter Moon |

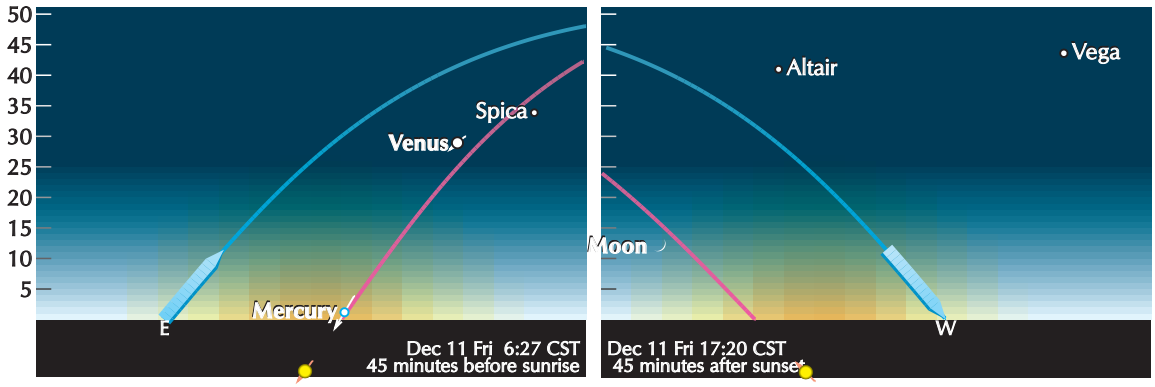
## 2027 JANUARY

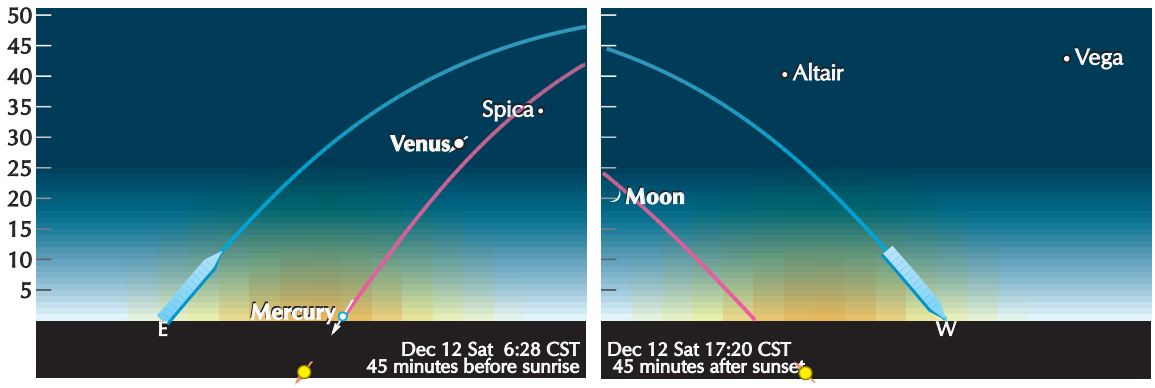
| | | | | | |
|---|---|---|---|---|---|
| 1406.5 | Jan | 1 | Fri | | Gregorian calendar Jan 1 = Julian calendar 2026 Dec 19 |


Arcturus
Spica
Venus
Mercury
Moon
E
Dec 7 Mon 6:23 CST
45 minutes before sunrise
Altair
Vega
W
Dec 7 Mon 17:19 CST
45 minutes after sunset


Arcturus
Spica
Venus
Mercury
E
Dec 8 Tue 6:24 CST
45 minutes before sunrise
Altair
Vega
W
Dec 8 Tue 17:19 CST
45 minutes after sunset


Spica
Venus
Mercury
E
Dec 10 Thu 6:26 CST
45 minutes before sunrise
Altair
Vega
Moon
W
Dec 10 Thu 17:20 CST
45 minutes after sunset


Spica
Venus
Mercury
E
Dec 11 Fri 6:27 CST
45 minutes before sunrise
Altair
Vega
Moon
W
Dec 11 Fri 17:20 CST
45 minutes after sunset


Spica
Venus
Mercury
E
Dec 12 Sat 6:28 CST
45 minutes before sunrise
Altair
Vega
Moon
W
Dec 12 Sat 17:20 CST
45 minutes after sunset

# SUN, EARTH, AND SEASONS

The Sun's daily arc across your sky shifts gradually northward from December until June, then back south from June to December. The cause is that the spinning Earth maintains an attitude tilted by 23.4° to the ecliptic plane in which it travels around the Sun. (This is called the obliquity of Earth's rotational axis.)

At the March equinox, the Sun, appearing to travel along the ecliptic, reaches the point (in Pisces) where it crosses the celestial equator into the northern celestial hemisphere. It passes overhead at noon for all places along Earth's equator. Night and day are everywhere of equal length—hence "equi-nox." The hemispheres receive equal sunlight. Earth's two poles are equidistant from the Sun, the north pole leaning backward from the direction of travel. This is the spring or vernal equinox for our northern hemisphere; but it is the fall or autumn equinox for the southern.

At the June (or northern summer) solstice, Earth's north pole is tilted toward the Sun at the maximal 23.4° angle. The Sun as seen from Earth reaches the point on the ecliptic that is farthest north (23.4°) of the celestial equator; its northward progress "stalls" (sol-stitium). It passes overhead for places along the Tropic of Cancer. For the northern hemisphere, days are longest, nights shortest.

At the September equinox (autumn or fall equinox for the northern hemisphere), the Sun reaches the other point (in Virgo) where it crosses the equator, into the southern celestial hemisphere. It again passes overhead along Earth's equator. The two poles are again equidistant from the Sun, the north pole now leaning forward. Again the hemispheres receive equal sunlight, and day and night are equal.

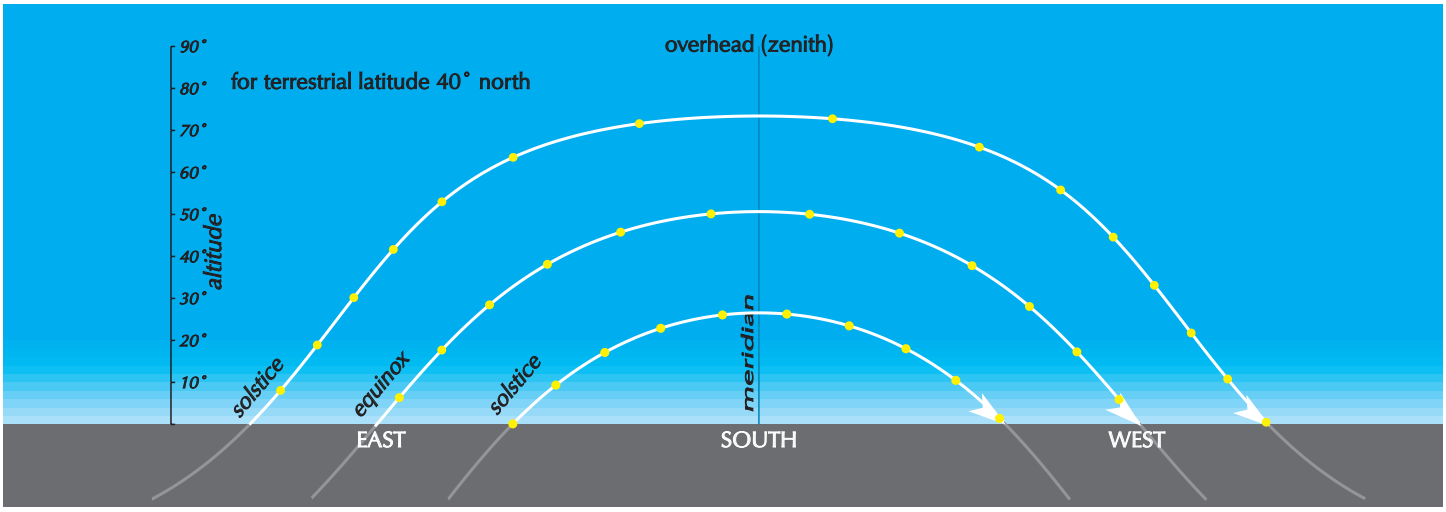
At the December (or northern winter) solstice, the Sun appears farthest south of the celestial equator. It passes overhead along the Tropic of Capricorn. Earth's north pole leans maximally away from the Sun. For northern lands, daylight is shortest.

For our north pole, the Sun at the equinoxes has no altitude, appearing to run all around the horizon; it is in the sky permanently from March to September; and not at all from September to March. For lands poleward of the Arctic and Antarctic circles, these 24-hour days and 24-hour nights persist for up to 6 months. For lands between the tropics, the Sun is sometimes north and sometimes south of overhead. For north-temperate latitudes (such as 40° north), the Sun makes a slanting arch which always passes south of overhead. From March to September this arch is longer and higher, so that the Sun is in the sky more than half the time; it is higher than average at each time of day; its light arrives through less atmosphere and at a steeper angle, so is more concentrated per area of ground.

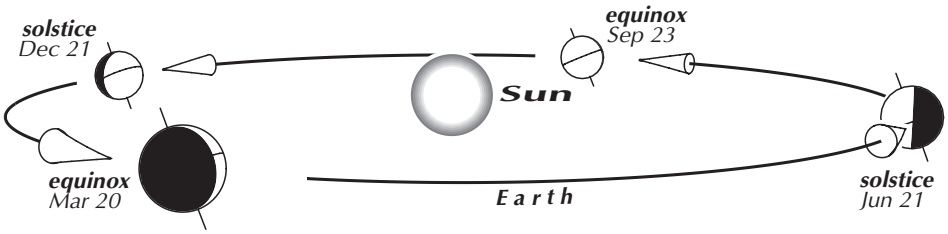
These four cardinal events fall on calendar dates that gradually change. The March equinox was until 2007 on March 21 or 20; is now only on the 20th; in 2044 it will begin falling sometimes on the 19th. The June solstice was until 1975 on June 22 or 21; then only on June 21; in 2012 it began falling sometimes on June 20. The September equinox until 1931 fell sometimes on Sep. 24; since 1968 only on Sep. 23 or 22. The December solstice until 1697 fell on Dec. 20 or 21; from 1702 it has been on Dec. 21 or 22; will next slip back to Dec. 20 in 2080.

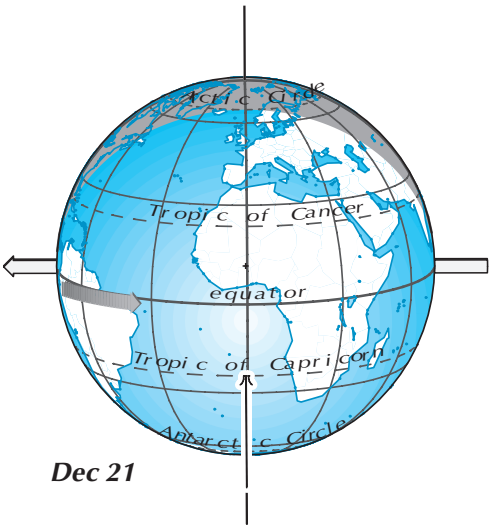
Daylight begins and ends when the top of the Sun is visible. And the Sun's apparent height is raised by refraction when it is near the horizon. So the actual dates when day and night hours are most nearly equal are before the spring equinox and after the autumn equinox, by about 3 days at latitude 40° north; and the total of daytime in the year is longer than nighttime.

**The Sun's arc through the daytime sky, at the equinoxes and solstices, for places at latitude 40°. The Sun's disk is shown at hourly intervals, and is exaggerated 4 times in size. The projection, based simply on altitude and azimuth, makes the horizon appear as a straight line; if instead we used a polar projection based on the middle of the sky, the horizon would be a circle and the Sun's arcs would be less curved.**

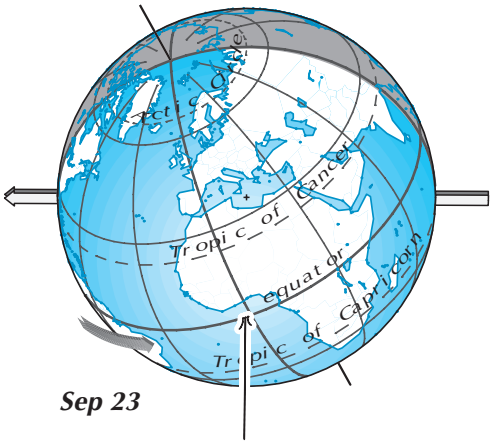


**Earth at the equinoxes and solstices. The Sun's size is exaggerated 20 times, the Earth's 1,500 times.**



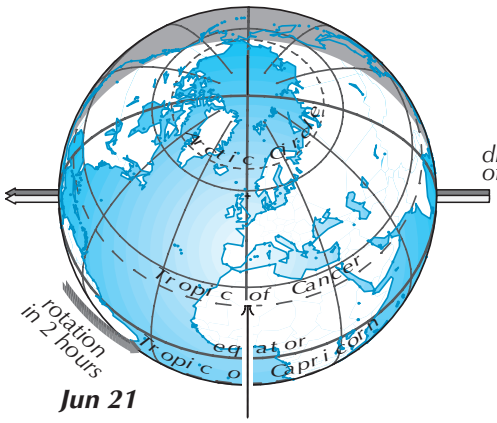

*Dec 21*



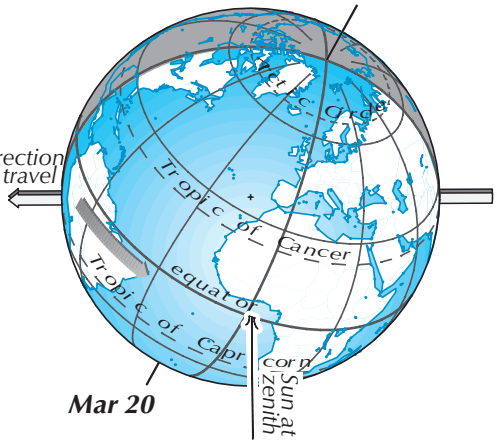

*Sep 23*

**Earth at the equinoxes and solstices, seen from the direction of the Sun (actually, from 35° above the Sun's viewpoint, so as to be able to show some of Earth's night side) and from a distance of 60 Earth-radii. The thick arrow is a "rail" along which the planet is riding in its orbit at its speed of about 2,574,000 km per day; each projecting part of the arrow is a distance the Earth advances in one minute (around 1,800 km). An arrow above the equator shows how fast Earth rotates (15° per hour) around its axis (shown by sticks at the poles). A trident represents the vertical beam of sunlight, striking where the Sun is at the zenith at noon.**

**We show the Earth at 12h UT on the day of the event: the hour when the 0° longitude line (Greenwich) faces the Sun. This is 6 PM local time at longitude 90° west, in the Central time-zone of the USA: well after sunrise in summer, well before it in winter. The terminator (day-night boundary) at both solstices touches the Arctic and Antarctic circles—giving 24-hour sunlight in summer, 24-hour night in winter. The slope of the terminator shows that, in summer, daylight lasts longer for places at higher latitudes (such as Canada) than for those nearer the equator (such as Florida); but sunlight arrives at lower angles.**




*Jun 21*




*Mar 20*

**Sun-Earth distance, perihelion and aphelion**

In its slightly elliptical orbit, Earth reaches these innermost and outermost points in early January and early July.

The average distance between the centers of Sun and Earth (the astronomical unit, AU) is 149,597,871 kilometers (92,955,807 miles). The eccentricity of the orbit is 0.017. So at perihelion and aphelion the Sun-Earth distance is less or more by only 0.017 AU.

This is about 2,540,000 km, or 270 times the width of the Earth—small compared with the average distance. Light takes about 8 minutes to travel from Sun to Earth, and about 8 seconds for the extra distance at aphelion.

Mainly because of the swinging of Earth and Moon around their barycenter or common center of mass (which is 1,738 km under Earth's surface), the minimum Sun-Earth distance varies: up to about 0.00005 AU or 7,500 km greater (near new Moon) or smaller (near full Moon).

And the date of perihelion varies, from about Jan. 1 22h at last quarter Moon (when the Moon is ahead of us) as in 1989, to Jan. 5 8h near first quarter as in 2020.

The aphelion distance varies to about 0.0001 AU more or less, and the date varies from July 3 6 UT to July 6 24 UT.

All this relatively slight change in distance from the Sun has little effect on warmth and is not the cause of our seasons. Indeed, we happen to be nearest to the Sun in the middle of our north-hemisphere winter. By contrast, Mars varies greatly in distance from the Sun and this has great effect on its seasons.

**The Sun's progress through the constellations**

The Sun appears—or would, if we could see past it to the stars—to progress from Sagittarius into Capricornus on Jan. 19; into Aquarius on Feb. 16; and so on through the 12 constellations of the zodiac. That is, it crosses the constellation boundaries as used in astronomy. These lines, giving definition to the traditional areas of the celestial sphere's 88 constellations, were partly worked out by Benjamin Gould in 1875, and in 1930 were completed by Eugène Delporte and adopted by the International Astronomical Union.

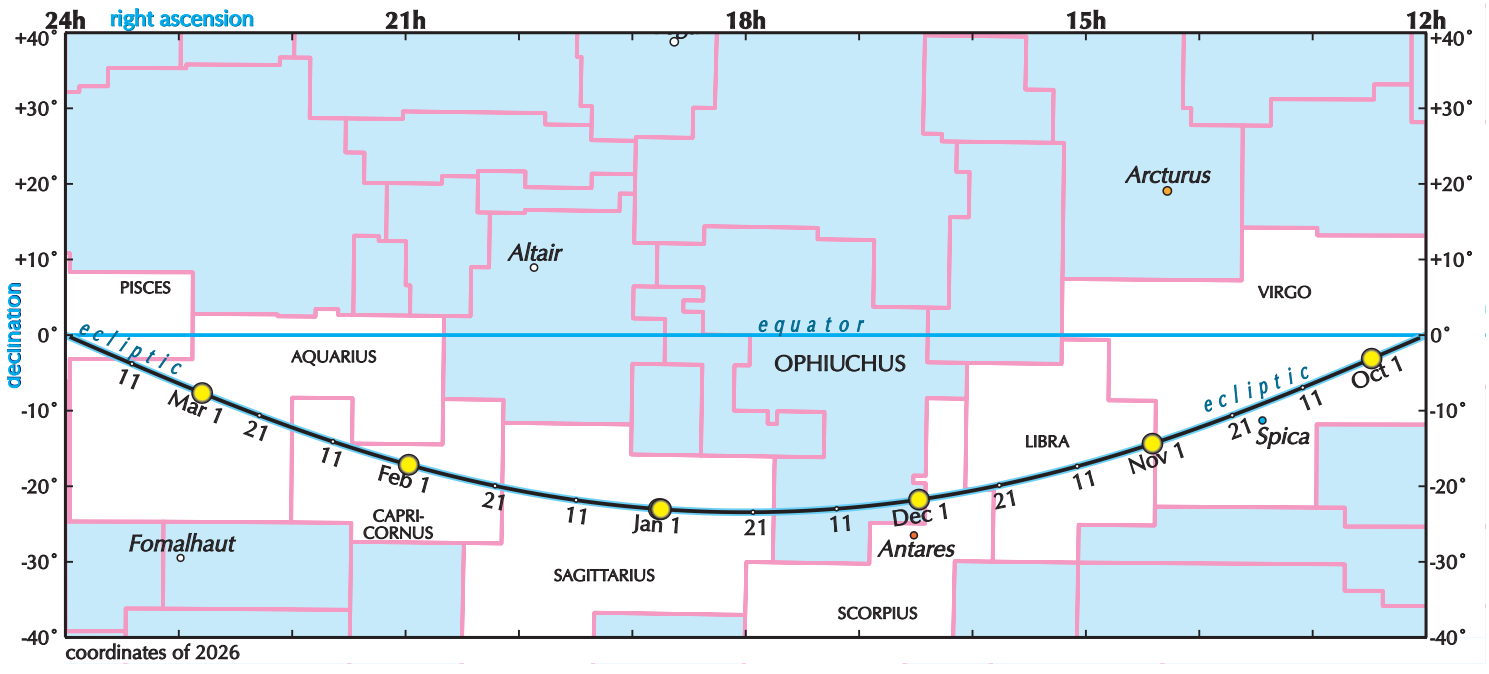
The constellations have irregular shapes and sizes. Scorpius lies mostly south of the Sun's path, more of which passes through Ophiuchus; so Ophiuchus is in effect a 13th zodiacal constellation. The lengths of the ecliptic lying inside the constellations are: Capricornus 28.18°, Aquarius 23.68°, Pisces 37.52°, Aries 24.38°, Taurus 36.96°, Gemini 27.83°, Cancer 19.92°, Leo 35.98°, Virgo 43.64°, Libra 23.34°, Scorpius 6.90°, Ophiuchus 18.57°, Sagittarius 33.1°. (Total, 360°.) Virgo is easily the longest. The Sun spends proportionate time in each constellation.

Because of precession—the shifting westward, at about 14° per thousand years, of the point where the Sun appears at the March equinox—the longitudes of these crossing-points from the equinox point slowly increase. So the dates when the Sun reaches them become, each year, a few hours later.

By a different system, still used in astrology, the zodiac is divided into 12 equal 30°-wide "signs," fixed in relation to the moving March equinox. When the Sun's longitude is 0°, 90°, 180°, and 270°—that is, at the March equinox, June solstice, September equinox, and December solstice—it is said to enter the signs Aries, Cancer, Libra, Capricorn. This is why the March equinox point is traditionally called the First Point of Aries. The tropics of Cancer and Capricorn, lines of latitude around the Earth at 23.4° north and south, were so named because the Sun was overhead on them as it reached the June and December solstices.

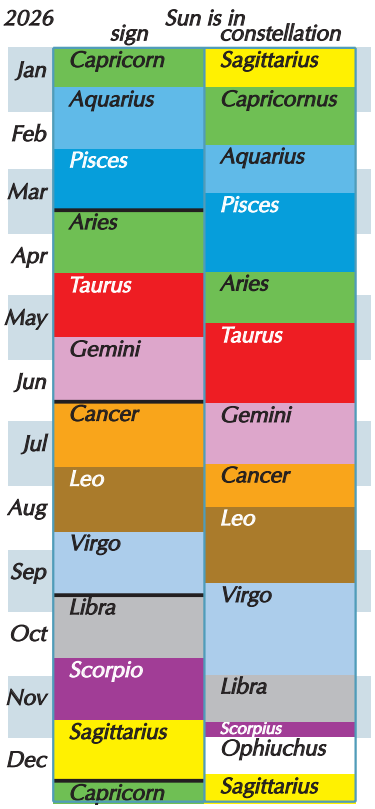
But precession has by now made this system out of date with the Sun's actual position by about two thousand years; that is, by the width of about one whole constellation. When astrology says the Sun is entering the sign Aquarius, it is actually entering the next constellation back westward, Capricornus; and so on, roughly.

"Roughly," as the diagram shows, because of the unequal lengths of the astronomical constellations. Most interesting is what has recently happened near the June solstice.



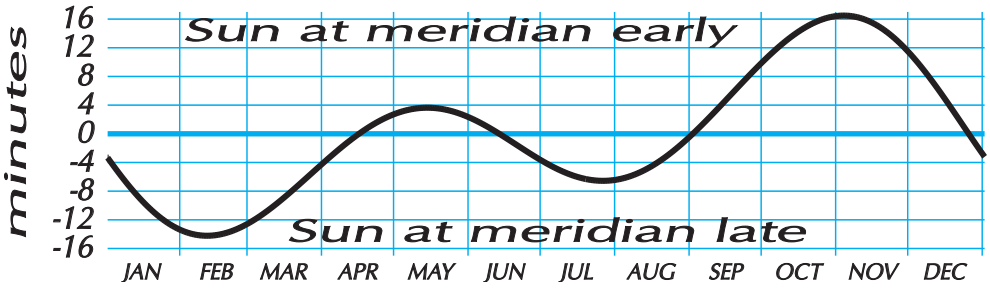
The Sun, reaching longitude 90° and its most northerly point, is said to enter the sign Cancer. The real position of this point moved back through Gemini to the Taurus border. In 1990 (Jan. 1, according to the calculation of Jean Meeus) the longitude of the constellation boundary crossed 90°. So up to 1989, the Sun at the instant of the solstice was in Gemini, one constellation back from what astrology says, as with all the other correspondences; but from 1990 on, the Sun at this instant is still briefly in Taurus, the *second* constellation back. With the centuries, the rest of the signs will similarly become two constellations out of date; then three; and so on over the 25,800-year cycle of precession.

**Dates when the Sun enters the 30-degree-wide signs, and the astronomical constellations.**




### Equation of time

This is the difference between apparent solar time (the time when the Sun arrives at, for instance, the noon meridian) and mean time: the time it would arrive there if it went around the sky at constant speed—which it does not, because of the ellipticity and inclination of Earth's orbit. For more about this, see www.universalworkshop.com/the-equation-of-time/




### Clock shifting

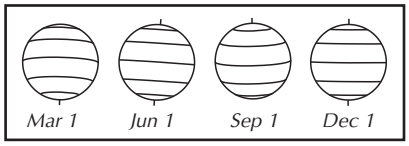
Governments require us to change our clocks by one hour, from standard time to "daylight saving time," between a date in spring and a date in autumn. The mnemonic is: "Spring forward, Fall back." In the USA, the dates are the 2nd Sunday in March and the first Sunday in November. In Europe: last Sunday in March, last Sunday in October. About 300 countries and territories have their own rules. In 2026,

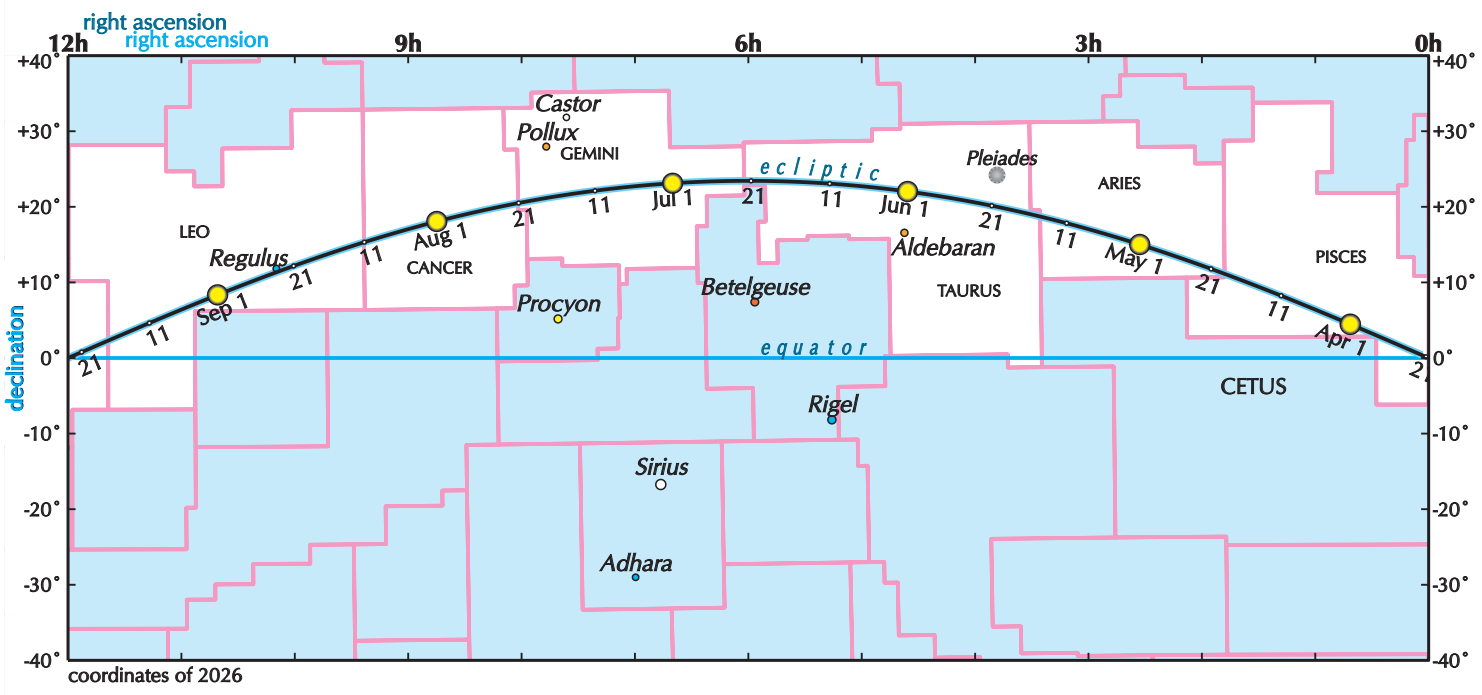
USA March 8, November 1 Europe March 29, October 25

For the history of this artificial time, its relation to natural time and to latitudes, and my opinion of it, see www.universalworkshop.com/clock-shifting-times/

### The Sun's tilt

Its north pole is most inclined (7.25°) away from Earth on March 6, and most toward us on Sep. 8.



# MOON

The Moon moves across the starry background each hour a little more than its own apparent width of half a degree. Each day, it moves on average 13.2° (not much less than an hour of right ascension, which is 15°). Each month, it moves on average 401°, or $1^{1}/_{9}$ times around the sky—thus, from its January 1 position around and past this position to the February 1 position.

So in the year it travels 13.38 times around the sky (passing most stars 13 and some 14 times). But from our moving viewpoint as we orbit the Sun, the Moon seems to travel around us only 12.3 times. That is, it passes 12 or 13 times through each of its phases in relation to the Sun, such as new Moon or full Moon.

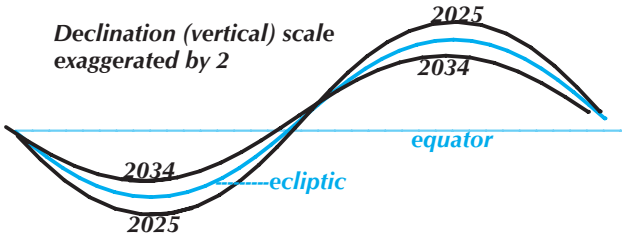
It does not circle around Earth's equator (as many small satellites circle around larger planets) but behaves more like a companion planet, traveling roughly in the same plane as the Earth. Its orbit is inclined about 5° to the Earth's (varying between 4.995° and 5.295° with a period of about half a year). So it appears to follow the ecliptic, departing up to about 5° north or south of it.

But this orbital plane continually twists (precesses), so that the two nodes, where the orbit crosses the ecliptic, migrate back (westward) at about 19° a year (migrating all around in 18.61 years). This year the ascending node moves from Aquarius into Capricornus; and, in the opposite region, the descending node moves through Leo to the border with Cancer.

This determines how far north and south the Moon ranges in the sky.

There are "flat" years, such as 2015 and 2034, when the ascending node is in Virgo where the ecliptic descends through the celestial equator, so that the Moon's path curves to less than 19° north and south (roughly the 23.5° inclination of the ecliptic *minus* the 5° inclination of the Moon).

About 9 years later come "hilly" years such as 2025 or

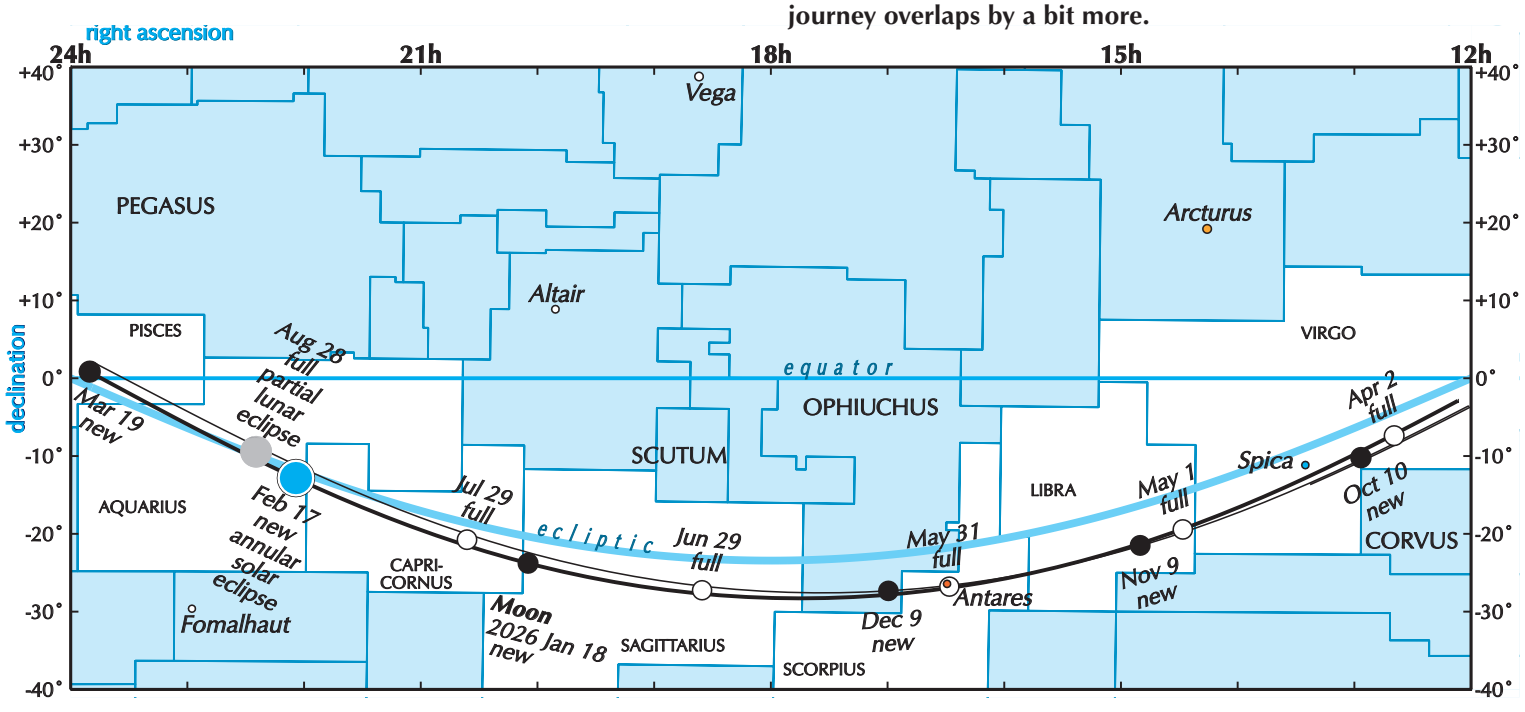



2034, when the ascending node is in Pisces where the ecliptic also ascends, so that the Moon can reach its farthest possible north and south, 28.72° (the obliquity of the ecliptic *plus* that of the Moon).

Halfway between these are "ecliptic-like" years, when the ascending node is near the top or bottom of the ecliptic, so that the Moon's path is like a copy of the ecliptic: rising and falling like it about 23° north and south, but displaced west (2011) or east (2019).

2025 was hilly, and 2026 is slightly less so. The ascending node in Pisces-Capricornus causes the Moon to reach northern and southern extreme declinations of about 28.4°.

**Chart of the Moon's path. Each year it travels 13.4 times around the sky, from west to east (right to left), through the 12 constellations of the zodiac, also Ophiuchus (it can touch Cetus, Orion, Auriga, Hydra, Sextans, Crater, Corvus, Scutum, Pegasus). The two nodes—points where the path crosses the ecliptic—shift gradually westward. We show only the paths for January (thick line) and December (thin). The Moon itself is shown at the instants when it is new (black) and full (white), at 5 times its true size. In each synodic month or lunation (29.5 days), the Moon goes from a new-Moon position all around the sky and on to the next new-Moon position; in each calendar month of 30 or 31 days, its journey overlaps by a bit more.**



The traveling Moon cuts out a swath, which is widest near the nodes where the orbit is being dragged along, narrowest halfway between the nodes. But in 2025 the Moon's path missed all of them.

The swath is really wider than in the chart, for two reasons: the width of the Moon itself, about half a degree; and parallax. That is, as seen from places at the north end of the Earth, the Moon appears nearly a degree farther south (or, from the south of the Earth, nearly a degree farther north). Stars within this swath can get occulted (hidden) by the Moon, as seen from at least some part of Earth. Four of the stars in the occultable band—Aldebaran, Regulus, Spica, Antares—are of first magnitude. In 2026 the Moon's path lies across the Pleiades cluster and near to Pollux, Regulus, Spica, and Antares.

The orbit is not only tilted but eccentric (elliptical), as the plan shows. Whereas the nodes move backward, the near and far positions, perigee and apogee, migrate generally forward—about twice as fast, but irregularly: forward for 5-7 perigees, then backward for 1-3. They progress all the way around in 8.85 years, thus on average 40° a year. This year perigee oscillates between about 48° and 108°: the Moon is nearest, largest, and moving fastest when traveling in the Taurus region.

Thus the egg-shape of the orbit rotates jerkily counterclockwise (as seen from the north). Looked at perpendicularly as well as edge on, the Moon during the year sweeps out a swath. It is narrow near apogee, because the Moon's apogee distance scarcely changes; wide near perigee, because the perigee distance varies markedly; it is also wide in the quadrants between, where the precessing orbit slopes in and out. Approaching perigee, the Moon is on the inner edge of the swath in January, the outer edge in December; after perigee, vice versa.

Putting the two swaths together, we realize that the Moon carves out a torus ("doughnut") of space whose width varies in two dimensions.

As the two pairs of positions—the two nodes and the two apsides (perigee and apogee)—revolve in opposite directions, they meet and pass quite frequently. In 2026 they are about at right angles from each other; the nearer-in half of the orbit is also the north-of-ecliptic half.

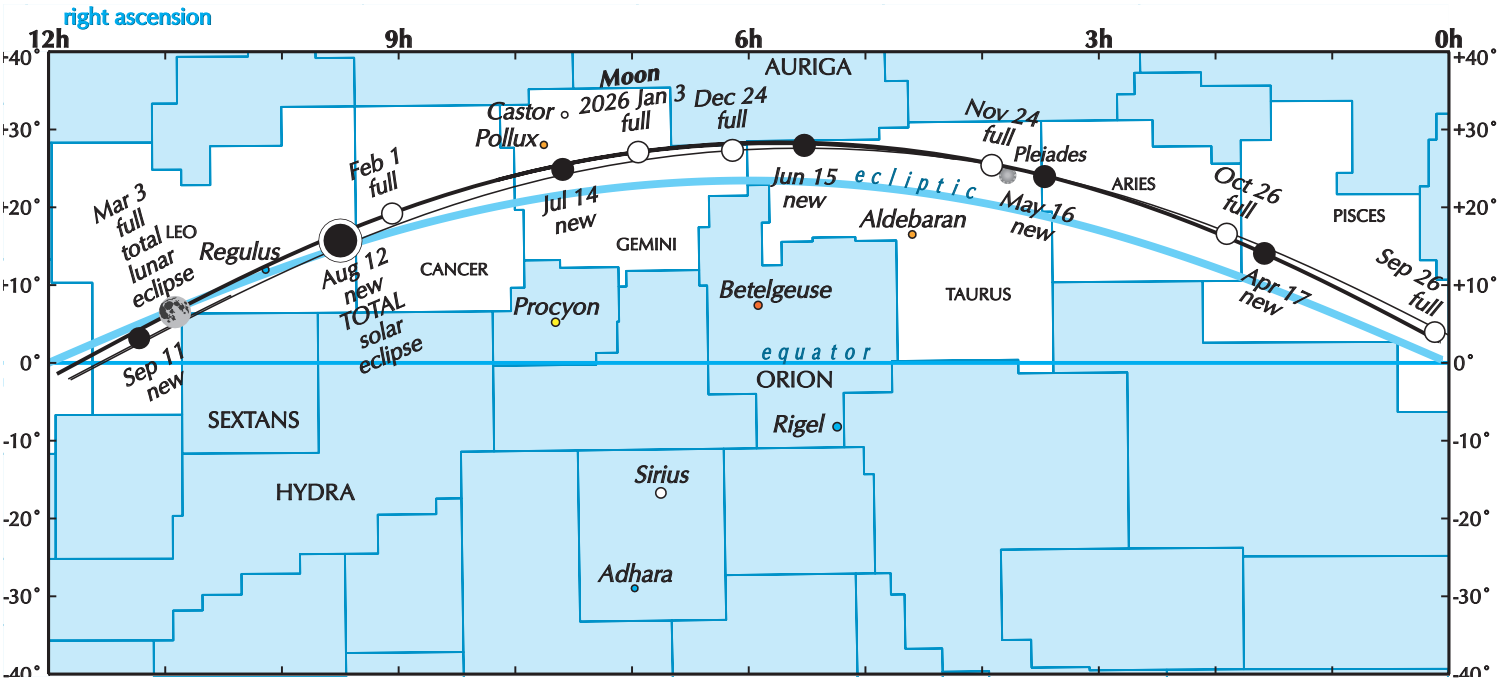
Eclipses have to take place near the nodes. This year, the Moon arrives near enough to those nodes in February and August to cause a central solar eclipse, but in February the distance is too great for the eclipse to be total.

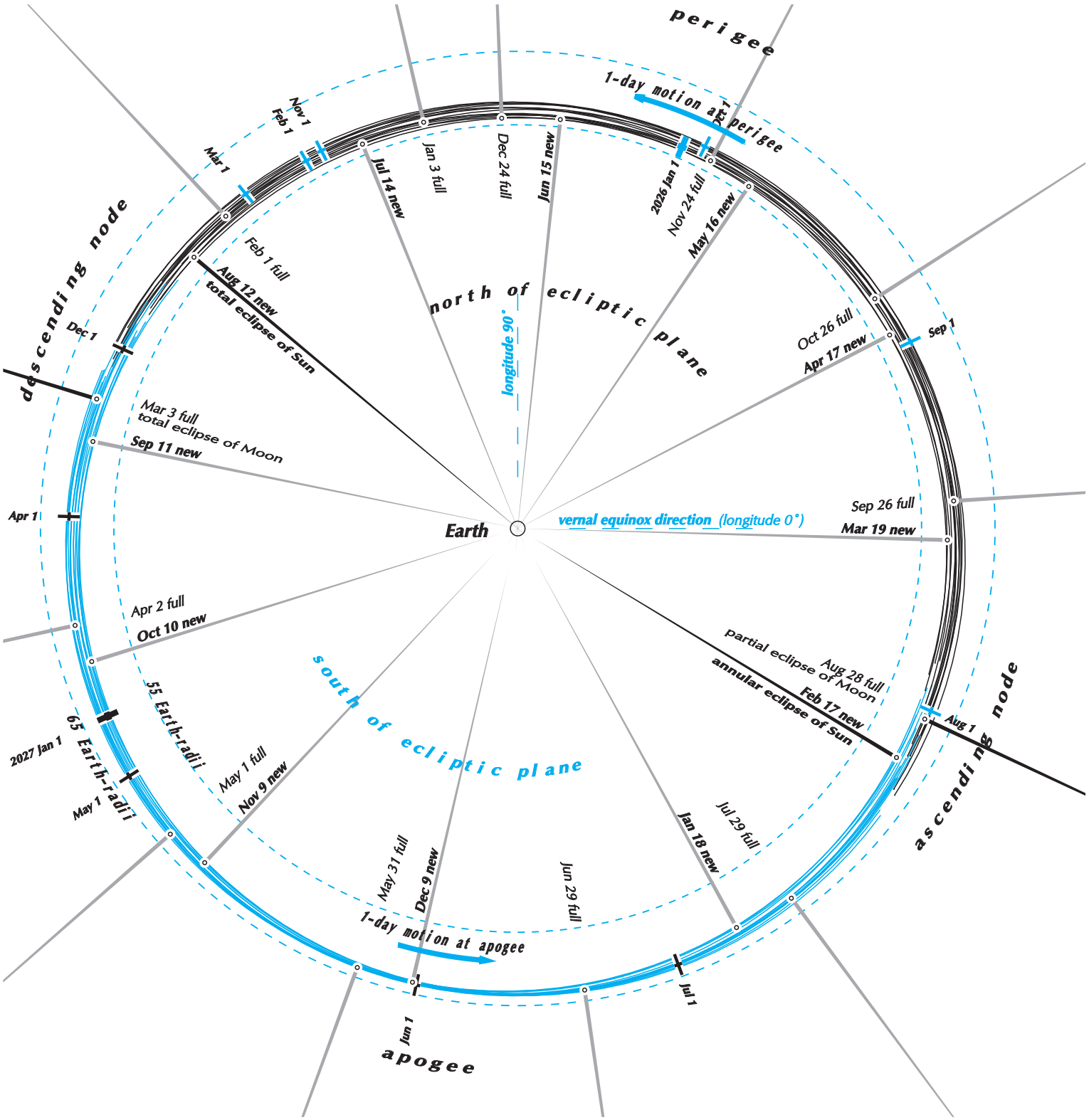
All this describes the Moon's orbit as it appears from the Earth, as if the Earth were fixed. In this frame of reference, the Moon's motion looks like a near-circle many times repeated. In the wider frame in which Earth and Moon together are journeying around the Sun, the same motion looks like a single near-circle, so much vaster that the deflections in the Moon's path are ironed out and the whole path is never even convex toward the Sun! (See the MOON'S ORBIT section in the *Astronomical Companion*.)

There is, as the distance-graph shows, a remarkable relation between the extremes of distance and the syzygies (new and full Moons).

The average period from new to new is the synodic month of 29.53 days. The average period of the distance-wave (perigee to perigee) is the anomalistic month—two days shorter, at 27.55. The result is like a "beat" between two trains of sound-waves. There is a time of year when new Moon is coinciding with perigee, and full Moon with apogee. Last year it was in April. This year it has shifted to May-June. Then, 6½ months later, comes a time when the reverse happens: *full* Moon occurs near perigee: last year in November-December, now at the end of December . Each year, each of these times shifts later by a bit more than a month.

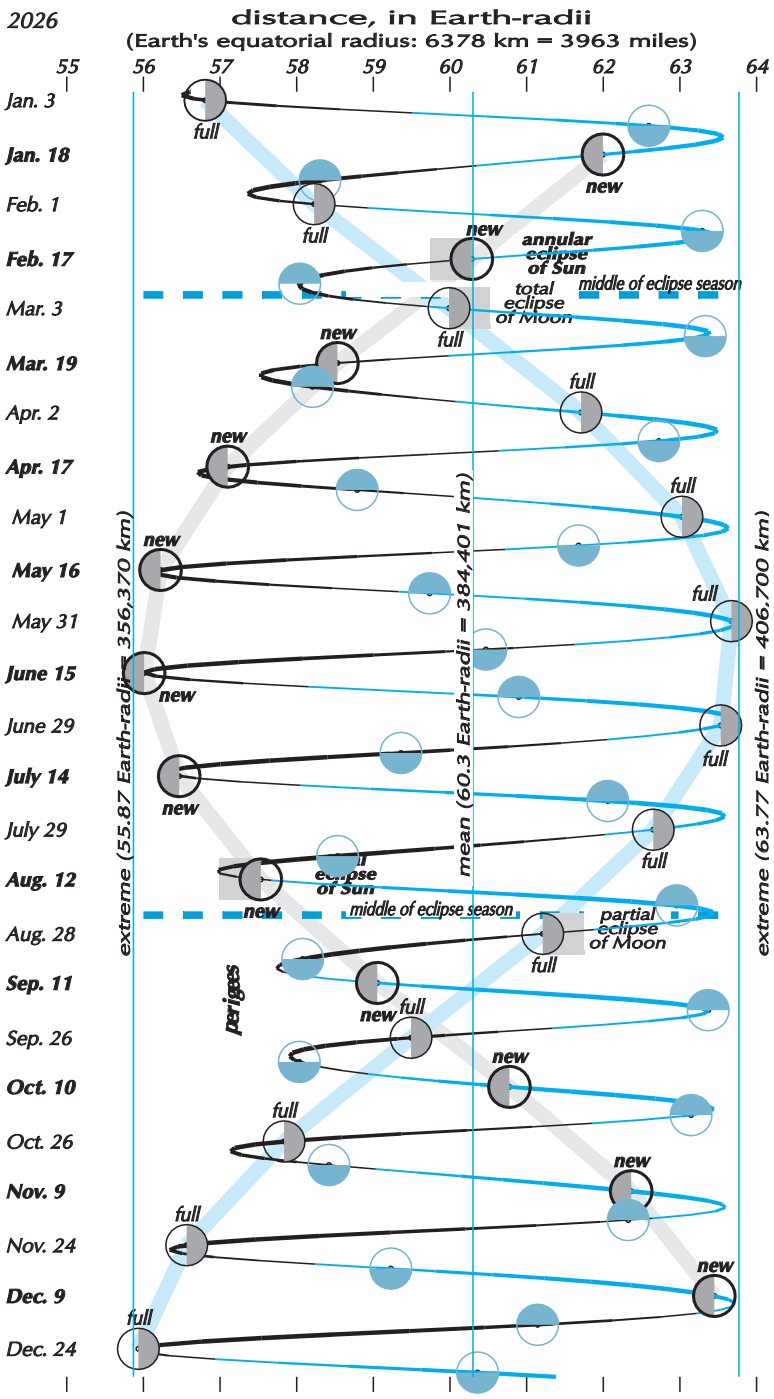
At the syzygies, the three bodies are in a straight line, Sun-Moon-Earth or Sun-Earth-Moon. The Moon's instantaneous orbit is squeezed toward this line: it becomes a more eccentric ellipse, with nearer-in perigee, farther-out apogee. The effect is less when the Moon is farther out, Earth's pull on it being less; the apogee distance increases, but not by much.






**Plan of the Moon's movements projected on the plane of its orbit, as seen from the north; with the Earth held still (so that the Sun is imagined to be going around also, once in the year, 389 times farther away than the Moon's average distance). Where the Moon is north of the ecliptic plane, its path is shown black; where south, blue. At 0h UT on the 1st of each month, a bar across the orbit shows the Moon's position (and a short bar along shows its motion over the hour before and the hour after).**

**At instants of new and full Moon, the Moon is drawn, true to scale, plus its umbra, or cone of total shadow. This points radially away from Earth at full Moon, toward Earth's center at new Moon. Notice the pattern made by the tips of the new-Moon umbrae, reaching to or through Earth only when the Moon is on the perigee (near-in) side of its orbit. This shows that eclipses of the Sun can become total only on that side; on the other side, they can be no more than annular.**




**Graph of the Moon's varying distance. 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). The curve from Moon to Moon is black when the Moon is north of the ecliptic, blue when south; and thicker when farther north or south.**

**For the mean distance, Allen's *Astrophysical Quantities* (1999) gives 384,401±1 km (60.27 ER, 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"!**

At perigee, however, the Moon, if it happens to be directly toward or away from the Sun, comes nearer in toward us than its average distance by about twice the diameter of the Earth.

This enhances any total solar eclipse that occurs near to perigee.

Tides, too, are strongly affected by the relation between perigee and syzygy. High tide comes twice a day, once under the Moon (actually, behind it, because friction with the seabed and coasts delays the water by irregular amounts) and once when the Moon is on the Earth's opposite side.

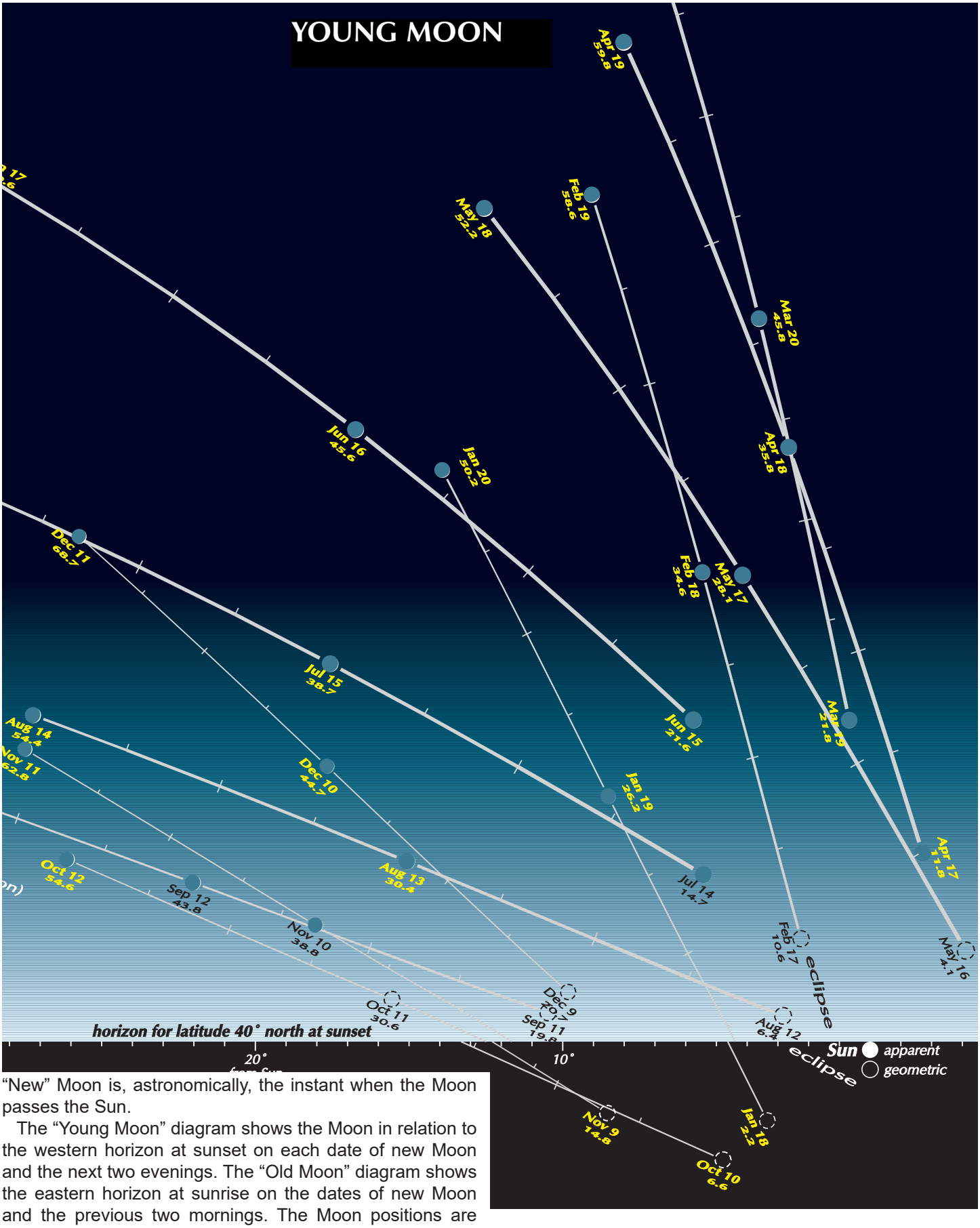
The Sun, too, has a tidal pull on the Earth, rather less than half that of the Moon. So at or just after the new and full Moons of each month, when Sun, Moon and Earth are in line, the tide is amplified into a "spring tide" (from the "jump" sense of *spring*).

There is a tidal swelling on *both* sides of the Earth. So, whether spring tide is at a new or a full Moon, there is one flood tide under the noonday Sun, the other at midnight. But one kind of midnight spring tide is moonlit, the other swells in darkness.

When the Moon is near—at perigee—its tidal pull is greater. Moreover, perigees, as we have seen, are much nearer perigees when they coincide with new or full Moon. Thus when these times of coincidence arrive, we expect the tides of greatest amplitude: *highest high tides* and lowest low tides of the year. These perigean spring tides may cause coastal flooding, especially if coinciding also with storms at sea; possibly they trigger earthquakes and volcanoes.

Dates of closest coincidence,
with difference in hours, and Moon distance

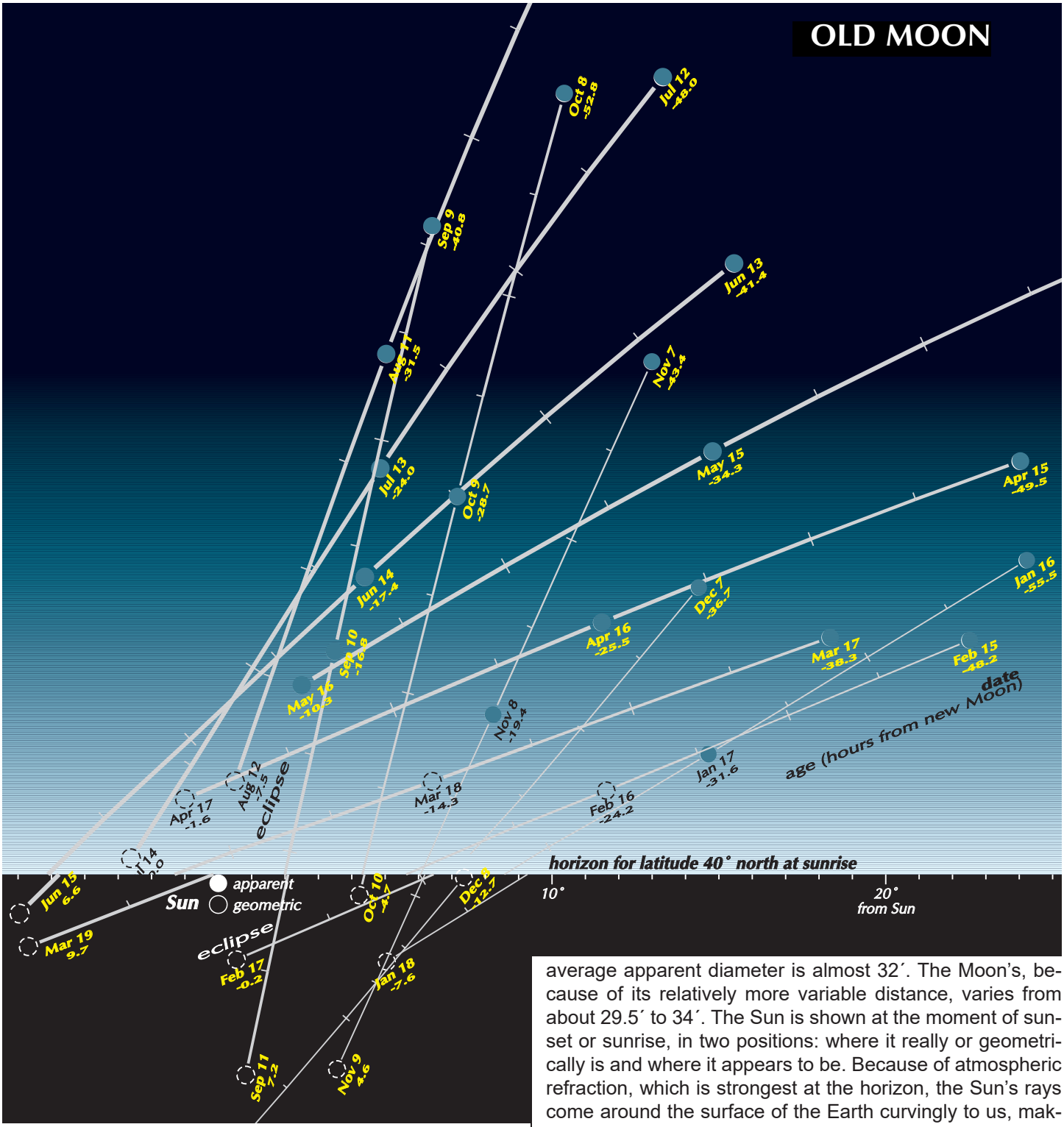
| perigee | syzygy | | hours | km |
|---|---|---|---|---|
| May 17 13:45 | May 16 20: 2 | New | -17.7hr | 358091km |
| Jun 14 23:20 | Jun 15 2:55 | New | 3.6hr | 357216km |
| Dec 24 8:39 | Dec 24 1:29 | Full | -7.2hr | 356669km |




"New" Moon is, astronomically, the instant when the Moon passes the Sun.

The "Young Moon" diagram shows the Moon in relation to the western horizon at sunset on each date of new Moon and the next two evenings. The "Old Moon" diagram shows the eastern horizon at sunrise on the dates of new Moon and the previous two mornings. The Moon positions are plotted by altitude from the horizon and azimuth (distance parallel to the horizon) from the Sun.

The view is from an eastern American location, latitude 40° north, longitude 75° west. The Moon's position is corrected for the parallax from this location. (Seen from the equator, the Moon would appear about 0.6° farther north.) And the position is corrected for atmospheric refraction, which, near the horizon, raises it as much as half a degree.




An hour later, the sunset horizon will be considerably higher (or the sunrise horizon lower).

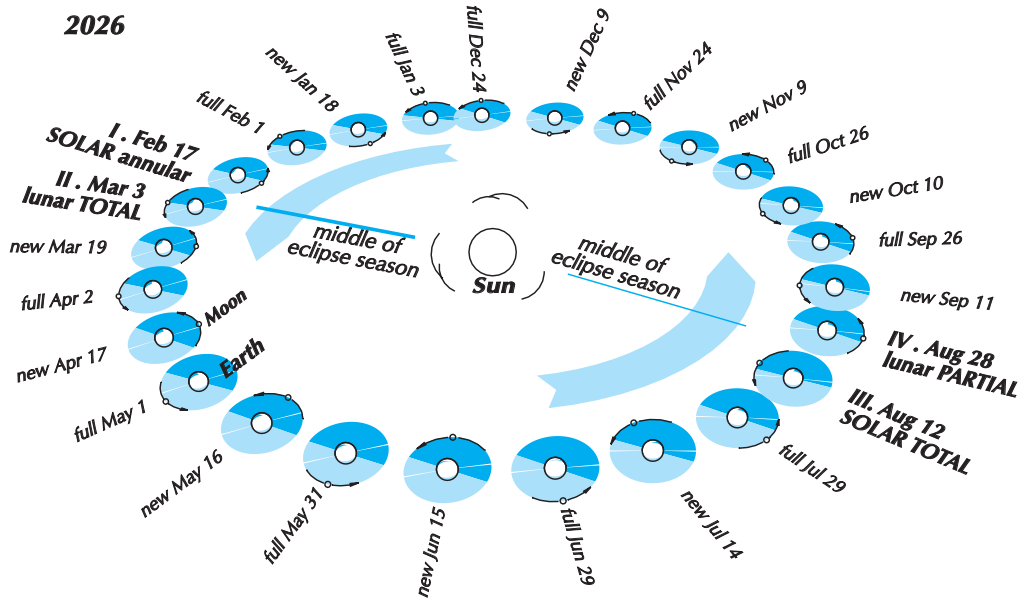
The Moon's illuminated crescent is drawn with the correct thickness. The un-sunlit side is shown in gray, as if visible by earthshine—which it often is in a clear sky when neither too far down in the glare, nor too far in the other direction where the Earth does not reflect enough light to it. Only a dashed circle is drawn when the Moon is less than 7° from the Sun or 3° above the horizon, assuming these minimum limits for detectability.

The lines of the Moon's track onward from day to day are drawn thicker when the Moon is nearer. Sun and Moon are both drawn to the general scale of 6 mm to 1°. The Sun's average apparent diameter is almost 32′. The Moon's, because of its relatively more variable distance, varies from about 29.5′ to 34′. The Sun is shown at the moment of sunset or sunrise, in two positions: where it really or geometrically is and where it appears to be. Because of atmospheric refraction, which is strongest at the horizon, the Sun's rays come around the surface of the Earth curvingly to us, making the Sun appear about half a degree higher. And day prevails if the merest speck of the Sun shows at the horizon; so sunset and sunrise are defined as the instants when the *top* of the Sun, not its center, appears to be on the horizon.

For more northerly latitudes on Earth, imagine the horizon tilted down on the left. For the north pole, it would be vertical. At the equator, Sun and Moon rise and set about vertically. In the southern hemisphere, their tracks slope the opposite way.

Trying to see the Moon as near as possible to its new moment is a fine sport, and is useful. Calendars such as the Jewish and Muslim have lunar months, beginning with the evening when the Moon can first be seen.

# ECLIPSES




**Earth and Moon at each date of "syzygy", new or full Moon, when they in line with the Sun. The plane of the Moon's orbit is shown, darker blue for the half north of the ecliptic. This plane gradually rotates backward. There is an eclipse if the Moon is new or full when near ascending or descending node through the ecliptic plane. Small arrows show the Moon's course over 7 days.**

**The Sun's size is exaggerated by 15, Earth's and Moon's by 600; the Earth-Moon distance by 40; the inclination of the Moon's orbit is exaggerated from 5° to 10°.**

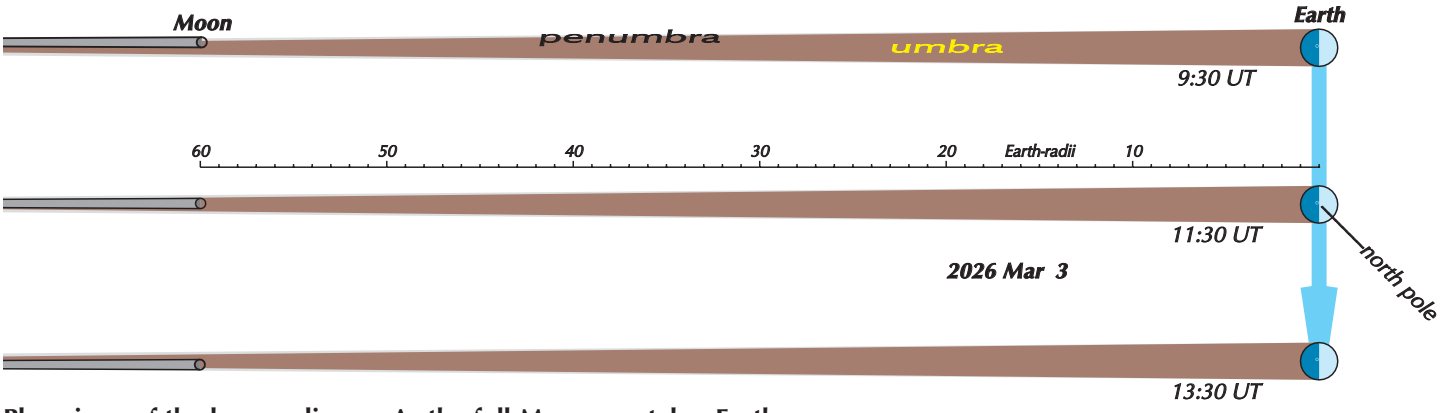
In 2026, as in most years, there are two eclipse seasons. Each brings a a solar and then a lunar eclipse.

An eclipse season is a span of days during which new and full Moon occur close to the ascending or descending node of the Moon's orbit. Sometimes there can be extra eclipses, for two reasons: part of a third eclipse season overlaps the beginning or end of the year; or an eclipse is near enough to the center of a season that it is flanked by two marginal eclipses. So there can be 5 eclipses, as in 2019 and 2028; or 6, as in 2020 and 2029; or 7, as in 1982 and 2038. (See the long "bead curtain" chart in our *Under-Standing of Eclipses*.)

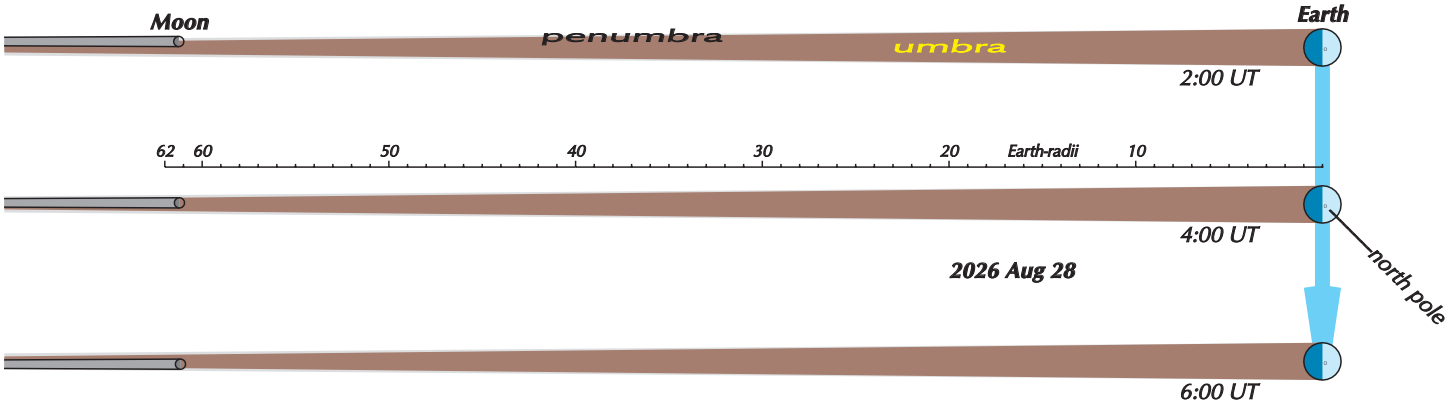
In 2026, both solar eclipses come about 10 days before the middle of their eclipse seasons. The Moon's central shadow crosses a small southern, and then a larger northern, slice of Earth's surface. But the Moon's distance at the time causes the eclipse to be annular in February, total in August.

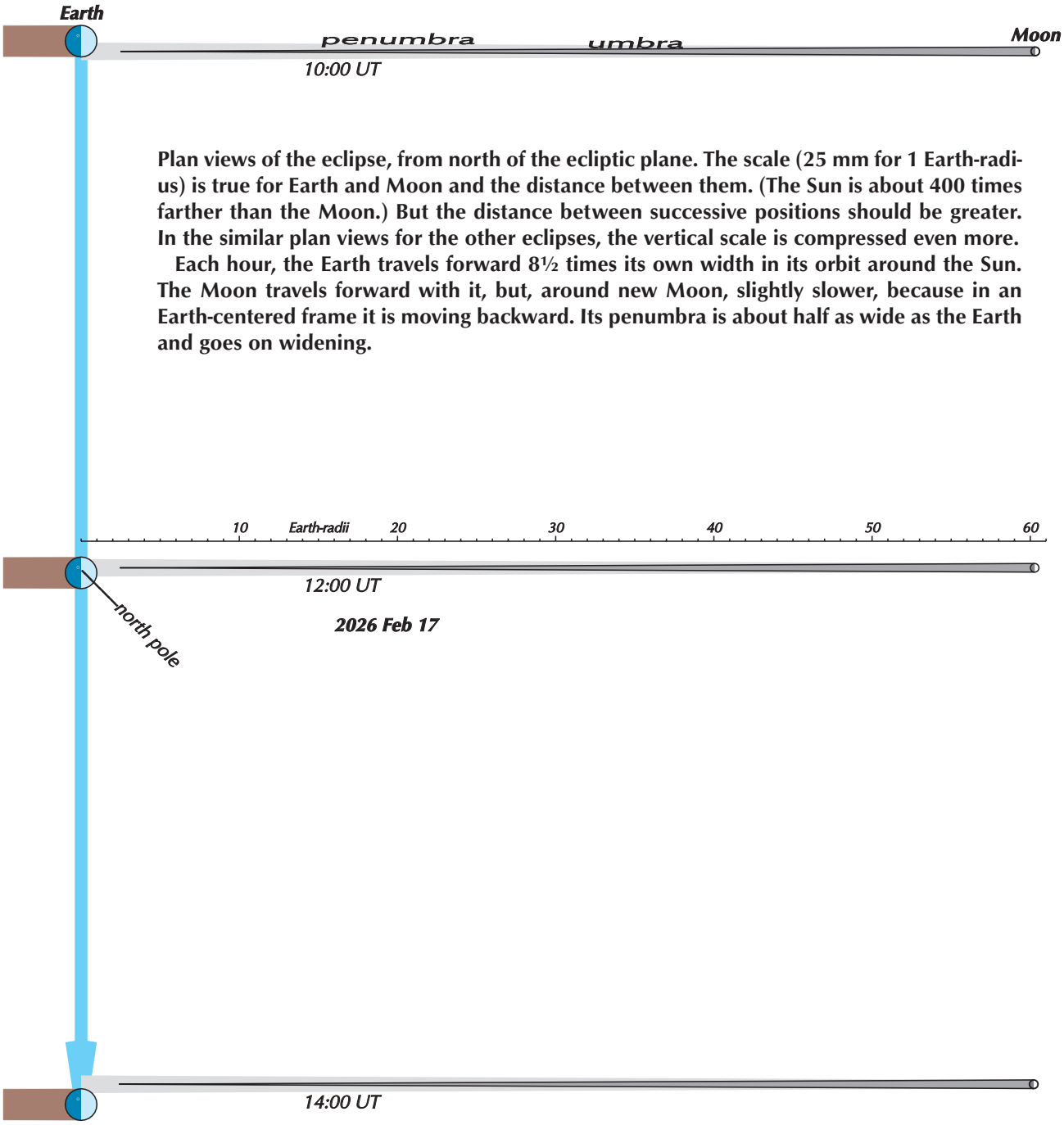
The lunar eclipses come about 4 and 5 days after the middle of their seasons. The difference is enough that in March, but not in August, the Moon passes totally inside Earth's shadow.

The August 12 track of total solar eclipse favors Greenland and Spain. The lunar eclipses are visible from hemispheres centered over the Pacific and South America.




**Plan views of the lunar eclipses. As the full Moon overtakes Earth on the outside, it encounters Earth's penumbra and then umbra.**

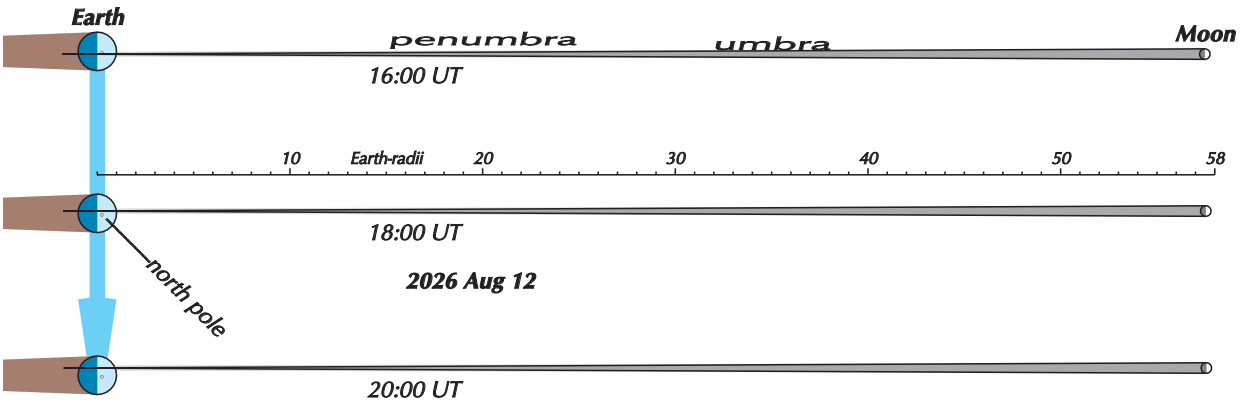





**Plan views of the eclipse, from north of the ecliptic plane. The scale (25 mm for 1 Earth-radius) is true for Earth and Moon and the distance between them. (The Sun is about 400 times farther than the Moon.) But the distance between successive positions should be greater. In the similar plan views for the other eclipses, the vertical scale is compressed even more.**

**Each hour, the Earth travels forward 8½ times its own width in its orbit around the Sun. The Moon travels forward with it, but, around new Moon, slightly slower, because in an Earth-centered frame it is moving backward. Its penumbra is about half as wide as the Earth and goes on widening.**

**Because of the Moon's varying distance, its umbra reaches as far as Earth's surface, where a total eclipse is seen, or stops short, so that the eclipse is an annular.**

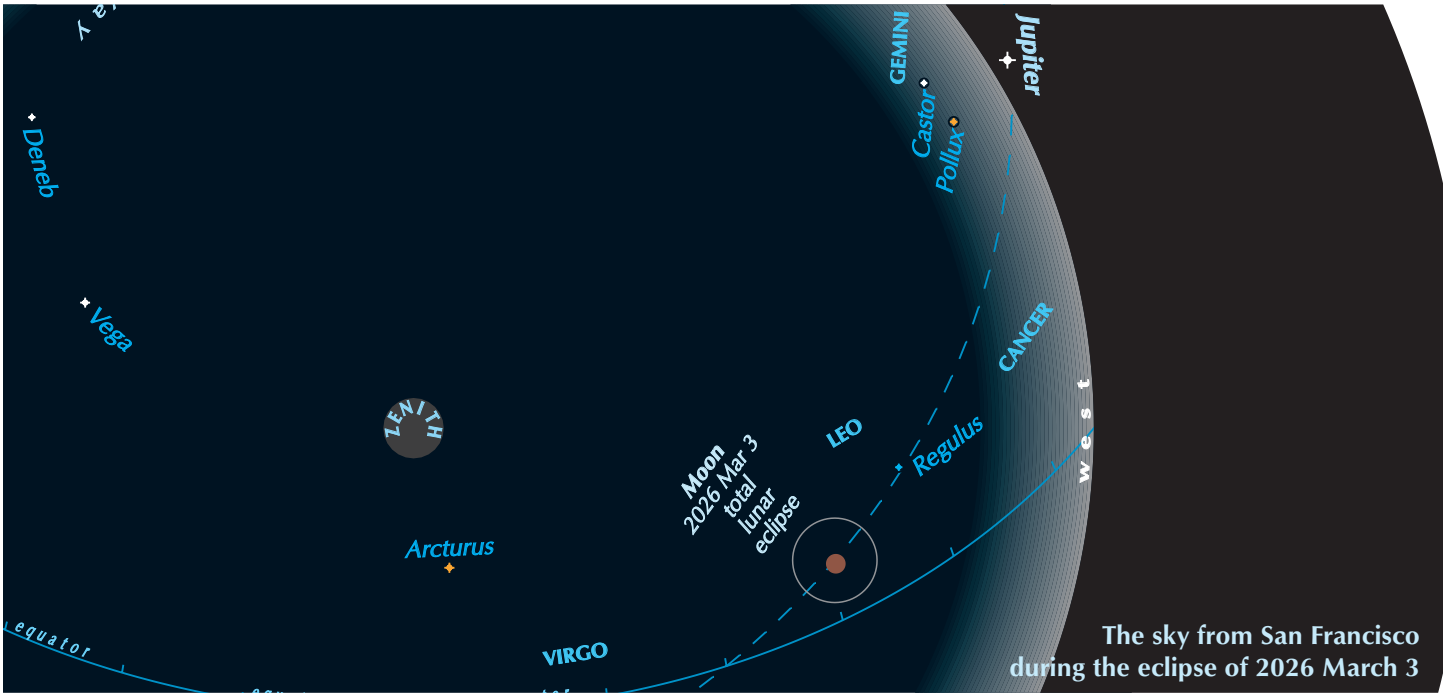


**II—total eclipse of the Moon, March 3**

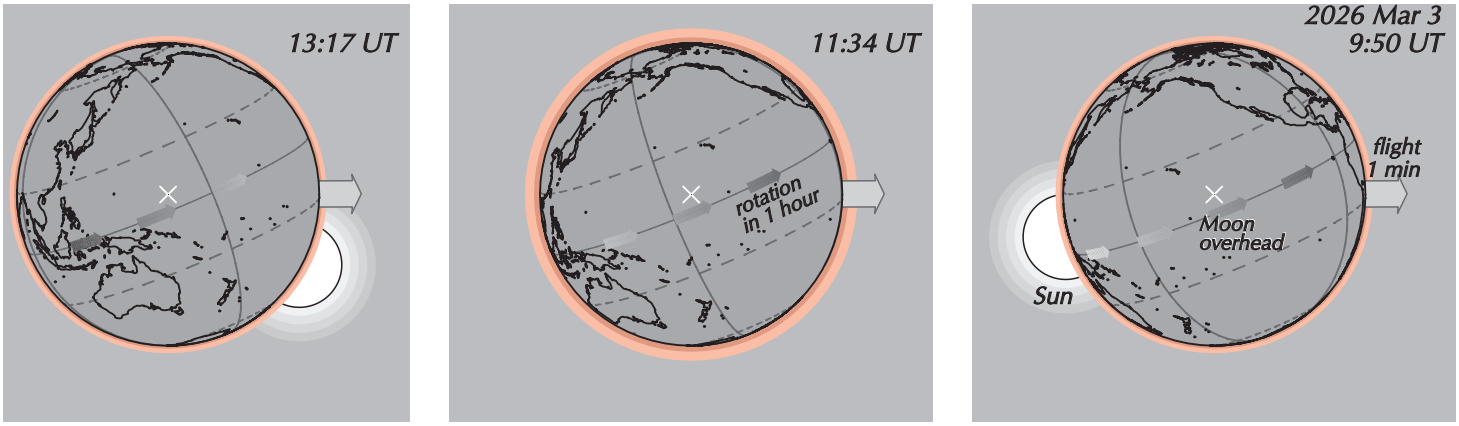
The Moon comes around to its full position, opposite to the Sun, less than 7 hours after descending southward through the ecliptic plane, so it passes quite deeply through the northern half of Earth's shadow.

The whole eclipse is seen from the western US coast, western Canada, Alaska, northeast Siberia, New Zealand, and the east coast of Australia. For the rest of North America, the Moon sets during earlier stages of the eclipse. For China, India, and Russia it rises during later stages.

The penumbra or outer shadow is scarcely noticeable. The exciting moment is when the crisp edge of the umbra or total shadow touches the edge of the advancing Moon.




**The full Moon's glare is greatly reduced during a total lunar eclipse, but much less so during partial eclipse and not at all during penumbral eclipse.**




**Views from the Moon toward Earth and Sun. The viewpoint is for an observer lying on his back on the midpoint of the Moon, with the Earth at the zenith. The event, which is for us an eclipse of the Moon, is for this man-on-the-Moon an eclipse of the Sun. If he were to move farther north, the Earth would appear farther south. The orientation of the pictures is with the ecliptic (the plane of Earth's motion) horizontal. Thus the northern hemisphere of the Earth tilts backward in (northern) spring. The Moon-inhabitant sees the Earth apparently moving backward (to the left or east): it is really traveling forward, but the Moon, at the full stage of its orbit, is overtaking the Earth on the outside. He also sees the Sun's path slanting to the ecliptic at about 5° because that is the angle at which the Moon itself is cutting across the ecliptic. Around the Earth appears a thin ring of light refracted and reddened by the atmosphere.**

**The practical purpose of the diagrams is to show which parts of the Earth can see the eclipse: all those on the side facing the Moon. In each diagram, lands on the right are about to move out of sight: for them the Moon is setting and the Sun is about to rise at the same time. Lands on the left have just come into view of the Moon at the end of their day. Places that appear in all three pictures see the whole course of the eclipse.**

**Timetables of the eclipse seasons**

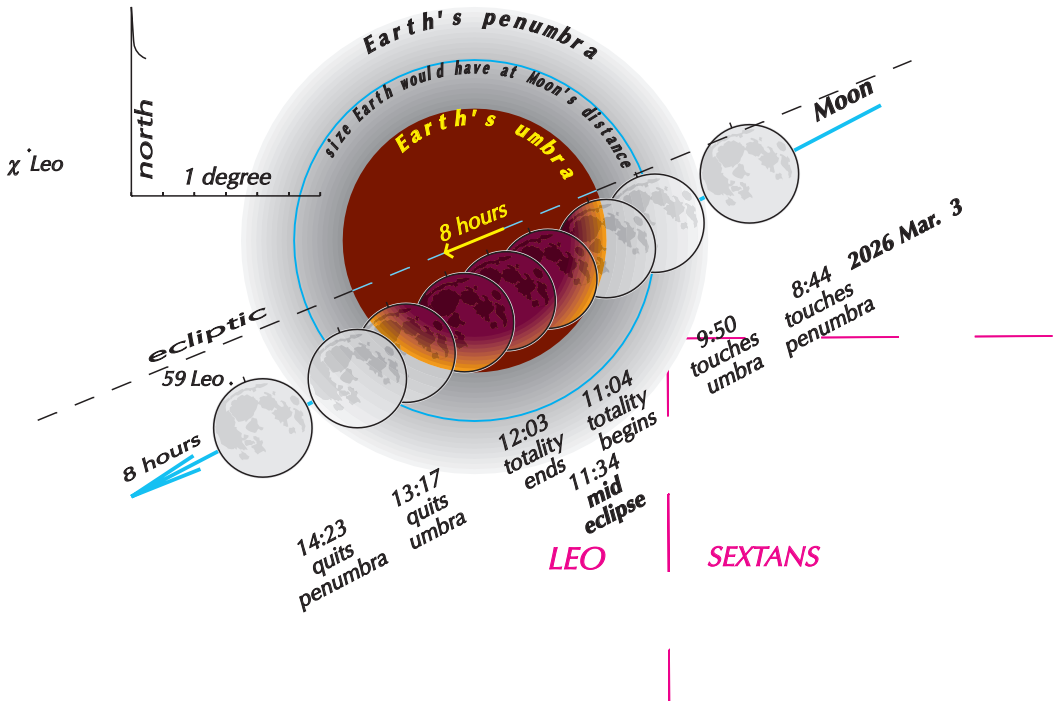
All times are in Universal Time (UT)

**Convert to your clock time: see pages 6-7. UT times of 6 or less will be in the previous calendar day for America.**

**II: total lunar eclipse, March 3**

eclipse 27 of the 71 in lunar saros series 133
gamma -0.38, magnitude 1.151.18
duration of totality 58 minutes

| | |
|---|---|
| Feb 27 17 | middle of eclipse season: Sun at same longitude as Moon's ascending node |
| Mar 3 04:37 | Moon at descending node |
| Mar 3 08:44 | first contact of Moon with Earth's penumbra |
| Mar 3 09:50 | first contact of Moon with Earth's umbra |
| Mar 3 11:04 | total eclipse begins |
| Mar 3 11:34 | greatest eclipse |
| Mar 3 11:38 | full Moon (opposite to Sun in ecliptic longitude) |
| Mar 3 12:03 | total eclipse ends |
| Mar 3 13:17 | last contact of Moon with Earth's umbra |
| Mar 3 14:23 | last contact of Moon with Earth's penumbra |
| Mar 10 14 | Moon at apogee |




**Views toward the Moon at successive stages of its encounter with the Earth's shadow. This is what can be seen from almost everywhere on the night side of the Earth. The umbra and penumbra are represented by cross-sections through them at the distance where the Moon is. They are visible only where they fall on the Moon. The umbra has a fairly abrupt edge; its darkness and color vary with atmospheric conditions around the Earth. The penumbra is imperceptible except in its inner part. The umbra gets narrower as it goes farther away; the penumbra, wider. A circle between them represents the size of the body casting the shadows: the Earth we are standing on. Arrows show the motion of the shadow and the Moon over a span of 8 hours. The Moon moves faster because it takes only a month to go around the sky, while the shadow (like the Sun opposite to it) takes a year. However, since the shadow does move along somewhat during the eclipse, the diagram, representing the relation of the Moon to the circular umbra and penumbra, cannot be exactly true in all respects: the Moons ought to be slightly wider apart. Any star or planet shown in the field is plotted in relation to the Moon and shadow at the middle moment of the eclipse, and as seen from the center of the Earth.**

**I — annular eclipse of the Sun, February 17**

The Moon will slide northward at its ascending node through the ecliptic plane about 18 hours after it reaches its new position between Sun and Earth, so that its shadow sweeps a northern fraction of the planet.

The advancing edge of the Moon's penumbra or outer shadow reaches Earth's surface at 9:59 Universal Time near the northern coast of South America. An observer here would see the Sun rise with the beginning of a nick out of its advancing edge. The shadow spreads onto the surface, covering northwest Africa, then western and central Europe, Scandinavia, and northern Russia. Within these regions, everyone sees the Sun partly covered, though those near to the shadow's outer limit, such as in central Italy, may scarcely notice the dimming of daylight.

But the axis of the shadow almost misses Earth altogether, and the umbra does not reach far enough along this axis to touch the surface. So penguins on or near the shores of Antarctica see sunlight coming past the whole profile of the Moon: annular eclipse.

The quantity called gamma expresses how near an eclipse is to being central. It is the fraction of Earth's radius by which the axis of the shadow misses the center of the Moon; 0 would be perfectly central. Eclipse magnitude: for example, 1.18 means that at mid eclipse the umbra reaches out across the whole Moon and an additional 0.18 of the Moon's diameter.

**I: annular solar eclipse, February 17**

eclipse 61 in solar saros series 121
gamma -0.97, magnitude 0.97

| | | |
|---|---|---|
| Feb 10 | 17 | Moon at apogee |
| Feb 17 | 09:58 | first contact of penumbra |
| Feb 17 | 12:02 | new Moon (conjunction with Sun in ecliptic longitude) |
| Feb 17 | 12:13 | greatest eclipse |
| Feb 17 | 14:13 | last contact of penumbra |
| Feb 18 | 06:20 | Moon at ascending node |
| Feb 24 | 23 | Moon at perigee |

**Eye safety**

***DO NOT LOOK DIRECTLY TOWARD THE SUN***, except when it is totally eclipsed. Some safe ways during partial eclipse are:

--**Projected** image through a pinhole onto a sheet of something white and fairly stiff.

--**Reflected** image from a small flat mirror onto a fairly distant white surface (fuzzier than the projected image but easier for a larger number of people to see).

--Looking through **No. 14 welder's glass** (or No. 12 if the Sun is dim).

--Eclipse-viewing spectacles if they are from a provider you know you can trust.

Less safe: projected image through a telescope, monocular, or binocular.

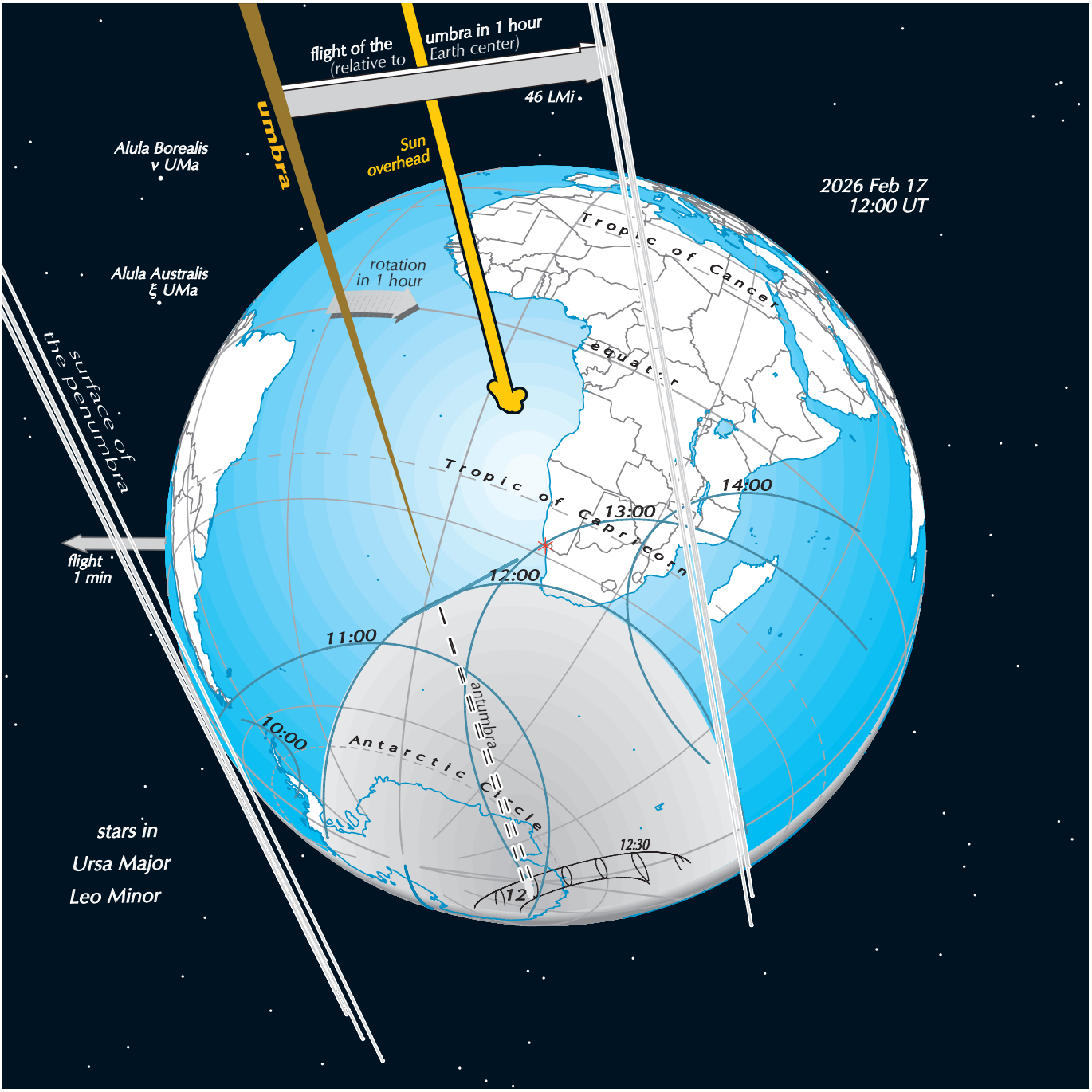
Do NOT use smoked glass, exposed film, crossed polarizing filters, colored water. They may seem to dim the Sun, but infrared rays get through.

Do NOT look through a telescope unless you really know what you are doing. Any filter should be over the front of the telescope, NOT covering the eyepiece.

When the Sun is dim (low or through cloud) still take only BRIEF naked-eye looks. Retinal damage can happen without hurting.

**There is nothing dangerous about sunlight during total eclipse**. It's just that we normally have an instinct not to look at the Sun; during an eclipse we are interested in doing so. During totality, it's safe (and gorgeous) to look!

At every eclipse thousands of people in the path needlessly miss the experience, while others suffer eye-damage. THERE IS NO NEED TO DO EITHER!




Earth as the Moon's shadow crosses it. The viewpoint is 12 Earth-radii from the Earth's center. So the Moon is about 5 times farther back, along the shadow which it casts; the Sun is about 400 times farther. The cone of the penumbra or partial shadow spreads as it goes away from the Moon. The cone of the umbra or total shadow tapers. On Feb. 12 it ends far short of the "fundamental plane", the plane through Earth's center perpendicular to the shadow. On Aug. 12 it would reach well beyond that plane.

The large gray patch, faint at its outer edge, is the footprint of the penumbra at the time of the picture. It is about twice as wide as the Moon and a little more than half as wide as the Earth. Curves mark its outline at other times. Together these curves define the limit of partial eclipse.

The outlines of the umbra and antumbra on the ground are shown at 10-minute intervals, and their envelope forms the tracks of totality and annularity.

The arrow showing Earth's flight, and the "Sun overhead" arrow, are in the ecliptic plane. The umbra and the "Sun overhead" arrow travel in opposite directions; where they pass at the same meridian of longitude, mid eclipse happens at local noon. Compare "flight of the Earth in 1 minute" and "flight of the umbra in 1 hour"; you see that really, in relation to the Sun, the Moon is moving forward with the Earth, but slightly slower.

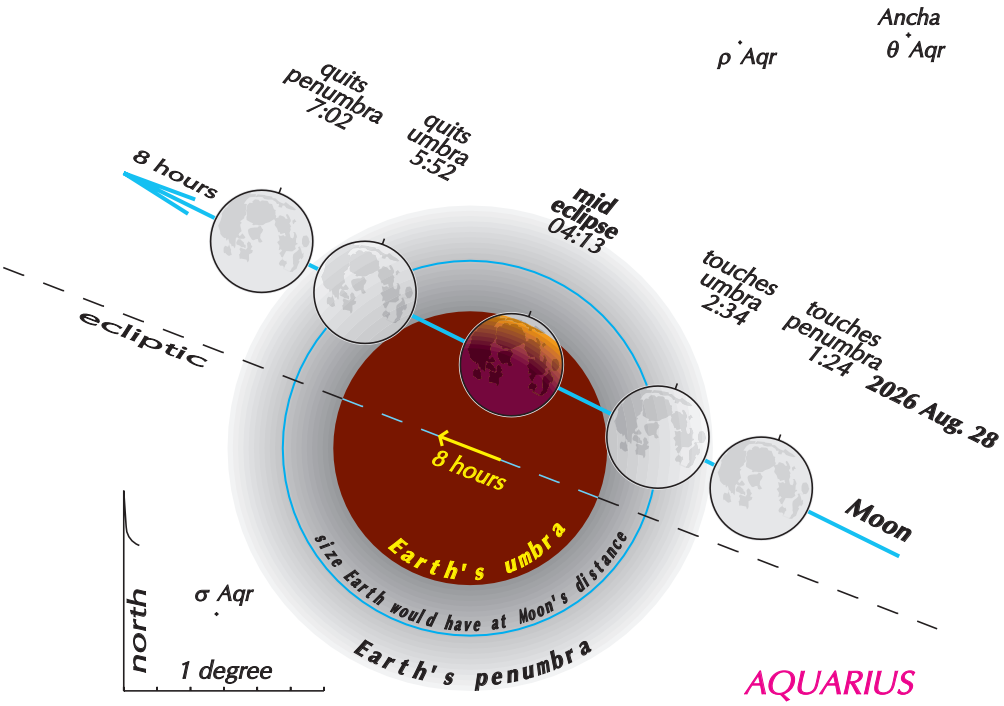
**IV — partial eclipse of the Moon, August 28**

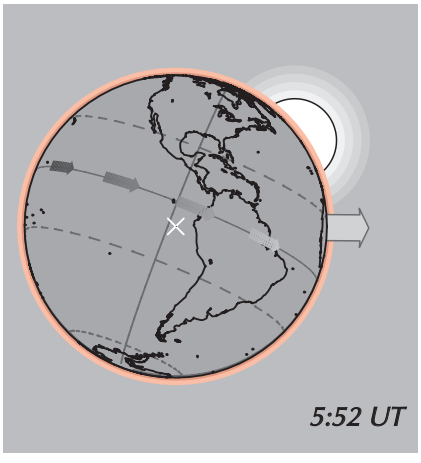
The Moon reaches its full position, opposite to the Sun, about 11 hours after sliding northward through the ecliptic, so it passes through the northern half of Earth's shadow. The time difference from the node passage is 2 hours shorter than on March 3, so the Moon dips less deeoly into the shadow and the eclipse never becomes total.

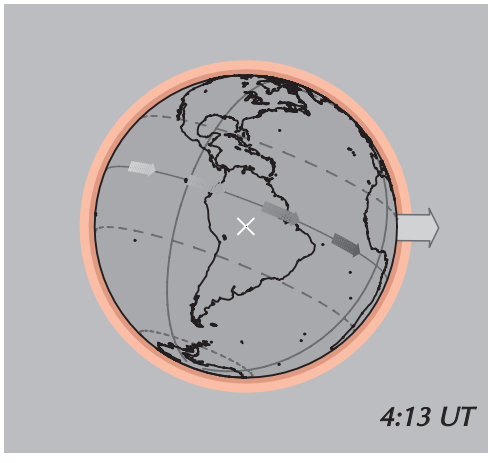
Coastal lands of western Europe will see the eclipse shortly before sunrise, as the full Moon, going down to the opposite western horizon, meets the Earth's shadow.

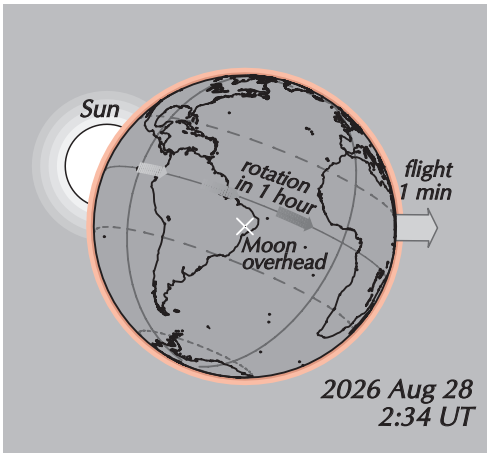
For America the Moon will be up in the night sky for the whole course of the eclipse.

The penumbra or outer shadow is scarcely noticeable. The exciting moment is when the crisp edge of the umbra or total shadow touches the edge of the advancing Moon.



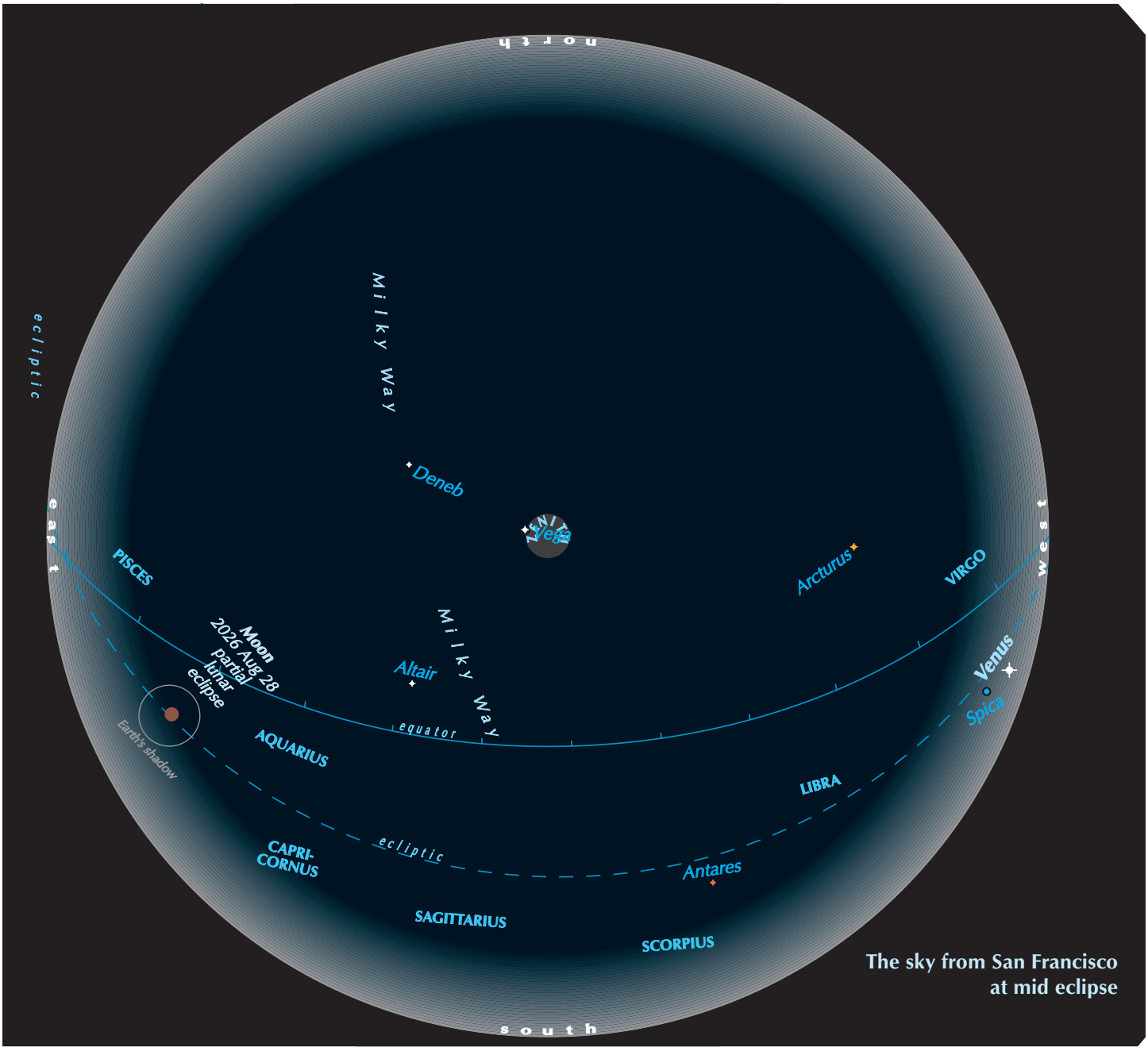



**IV: partial lunar eclipse, August 28**

eclipse 30 of the 83 in lunar saros series 138
gamma 0.41, magnitude 0.93
duration of partial eclipse 198 minutes

| | | |
|---|---|---|
| Aug 22 | 09:14 | Moon at apogee |
| Aug 22 | 21 | middle of eclipse season: Sun at same longitude as Moon's ascending node |
| Aug 27 | 18:46 | Moon at ascending node |
| Aug 28 | 01:24 | first contact of Moon with Earth's penumbra |
| Aug 28 | 02:34 | first contact of Moon with Earth's umbra |
| Aug 28 | 04:13 | greatest eclipse |
| Aug 28 | 04:19 | full Moon (opposite to Sun in ecliptic longitude) |
| Aug 28 | 05:52 | last contact of Moon with Earth's umbra |
| Aug 28 | 07:02 | last contact of Moon with Earth's penumbra |




**Moon glare is greatly reduced during the total phase of lunar eclipse, so that bright stars and planets may appear. Glare is much less reduced during other phases. Dimmer and abstract features are for the "mind's eye."**

**III — Total eclipse of the Sun, August 12**

The Moon slopes southward through the ecliptic plane almost 21 hours before arriving at its new position, between us and the Sun, so its shadow encounters our southern hemisphere.

So much for the geometry. The timing, around 18 UT, means that the Sun is highest along the midline of North America.

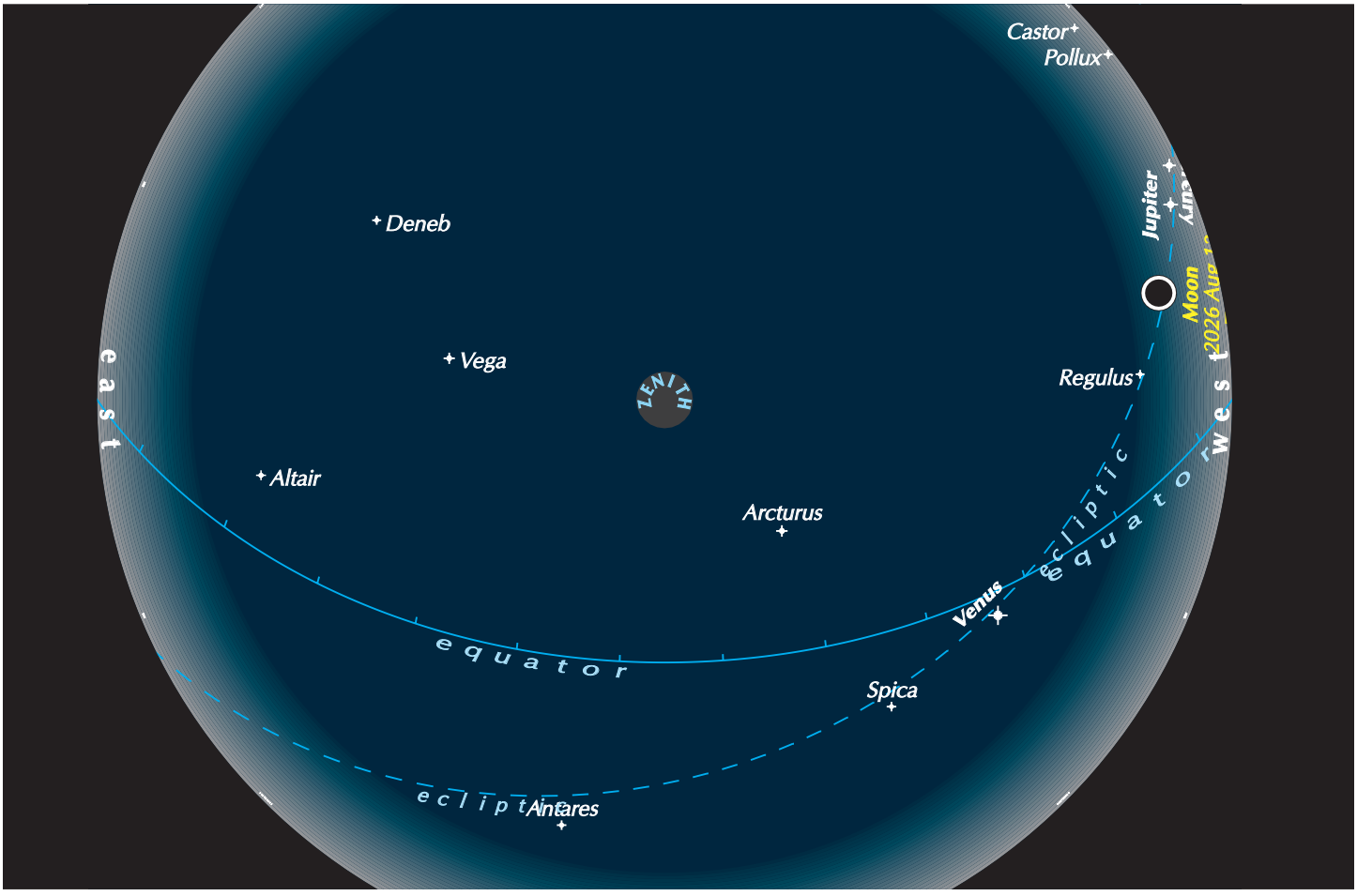
Near the September equinox, Earth travels with its north pole tilted forward, causing the shadow's southeastward trend across Earth's geography.

The surface of the shadow meets Earth's surface at 15:35 UT near Alaska. Observers here will see the Sun rise with the beginning of a nick out of its leading edge. The shadow spreads onto the surface; by 16 UT, it covers Alaska and Yukon; then it sweeps over almost all of Canada plus the northeastern US. All over this region, everyone sees the Sun partly covered, though for those near to the shadow's southern edge the notch out of the Sun is small and daylight is scarcely dimmed.

Meanwhile, the umbra or core of the shadow takes a parallel course that is shorter and curved, because near to the northernmost point of the globe in the ecliptic sense; if any farther north, it would merely touch that point, if any farther, it would miss. The outline of the total shadow at any one moment is elongated, because that the eclipsed Sun seen from within it is low toward the horizon. This shadow glides over the many glaciers and fjords of northeastern Greenland, touches the southwest of Iceland, and just before sunset takes in a large swathe of northern Spain, with a small corner of Portugal. It ends in the Mediterranean near the Balearic Islands.

The explosive spectacle of total eclipse, racing from west to east, will meet the many pilgrims walking from east to west along the Camino de Santiago, which leads from the French border through uplamnd Spain to the Galician northwest.

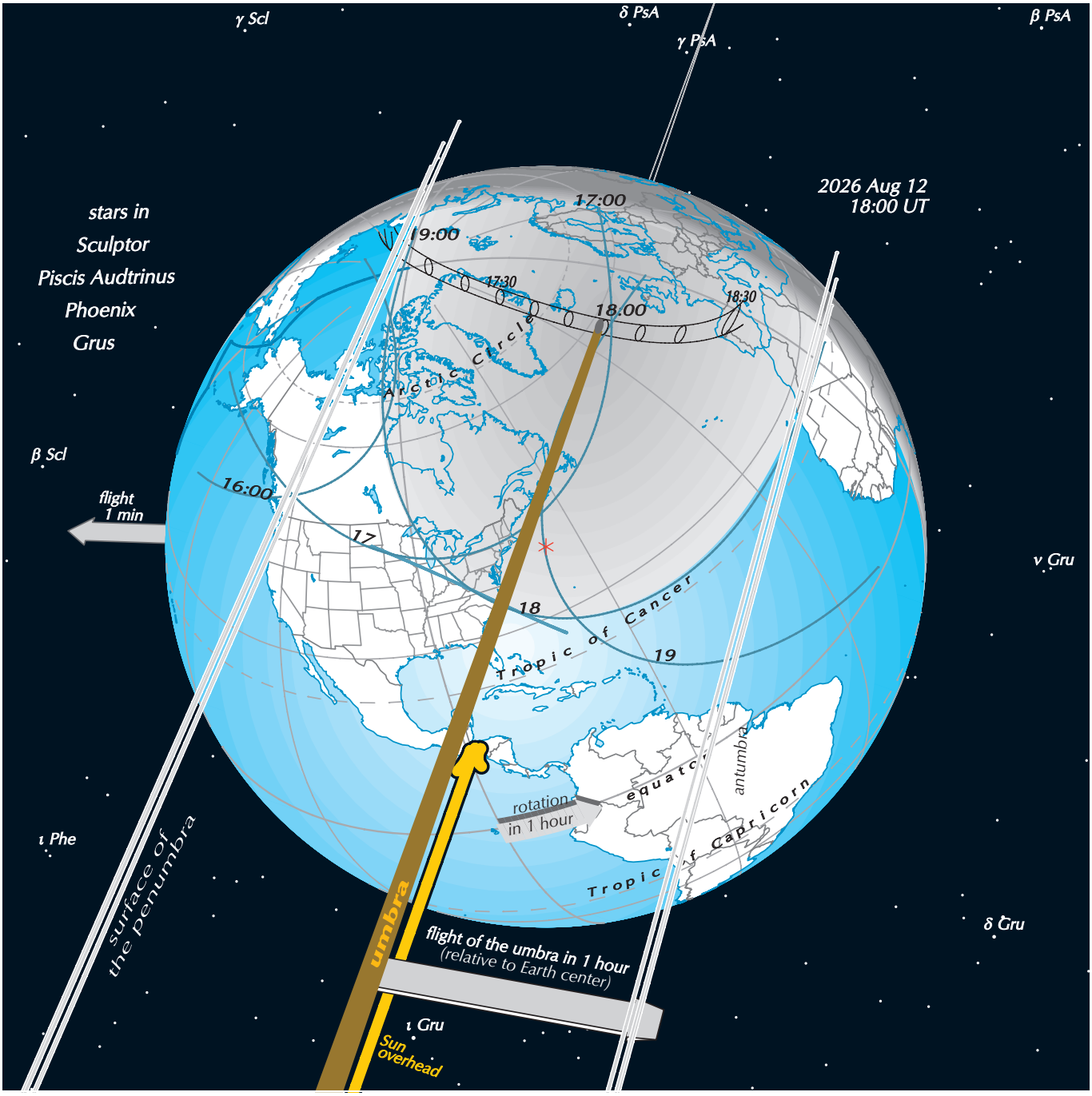
The outer shadow departs from Earth's surface about 20 UT at sunset in the Atlantic off west Africa.

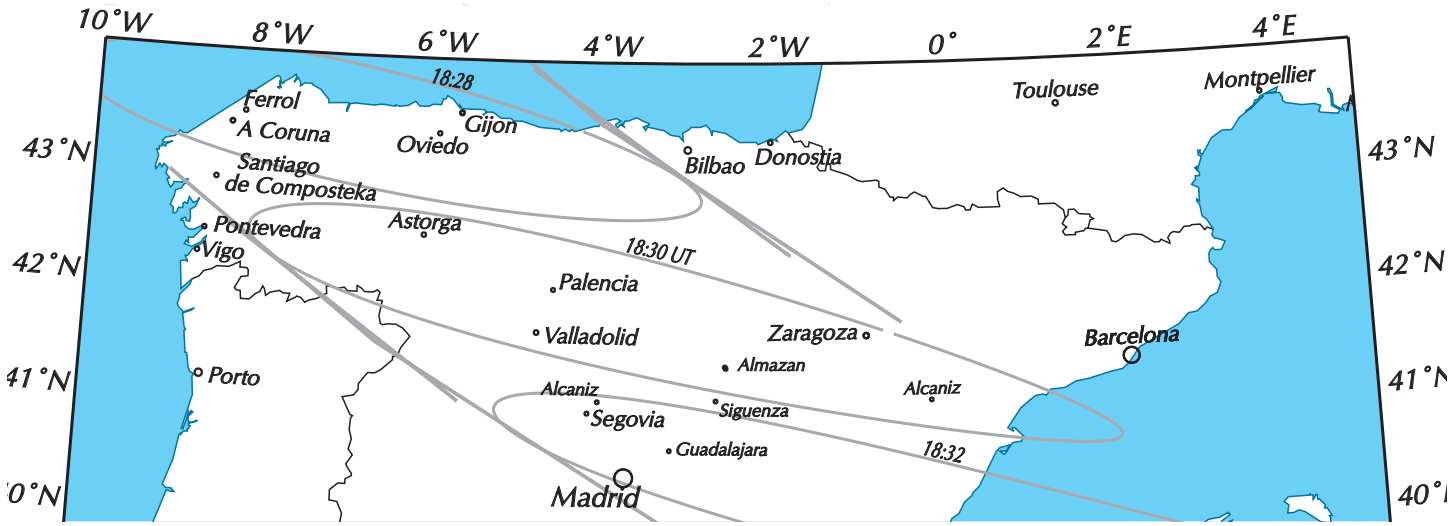



**III: total eclipse of the Sun, August 12**

eclipse 48 of the 71 in solar saros series 126
gamma 0.81, magnitude `.04

| | | |
|---|---|---|
| Aug 10 | 11:18 | Moon at perigee |
| Aug 12 | 15:35 | first contact of penumbra |
| Aug 12 | 17:36 | new Moon (conjunction with Sun in ecliptic longitude) |
| Aug 12 | 17:03 | first contact of umbra |
| Aug 12 | 17:47 | greatest eclipse |
| Aug 12 | 18:35 | last contact of umbra |
| Aug 12 | 19:59 | last contact of penumbra |
| Aug 13 | 09:57 | Moon at descending node |


γ Scl
δ PsA
γ PsA
β PsA
2026 Aug 12
18:00 UT
stars in
Sculptor
Piscis Audtrinus
Phoenix
Grus
17:00
19:00
17:30
18:00
18:30
Arctic Circle
16:00
17
18
19
Tropic of Cancer
Tropic of Capricorn
equator
antumbra
rotation
in 1 hour
β Scl
flight
1 min
ν Gru
ι Phe
δ Gru
surface of
the penumbra
umbra
flight of the umbra in 1 hour
(relative to Earth center)
ι Gru
Sun
overhead


10°W
8°W
6°W
4°W
2°W
0°
2°E
4°E
43°N
42°N
41°N
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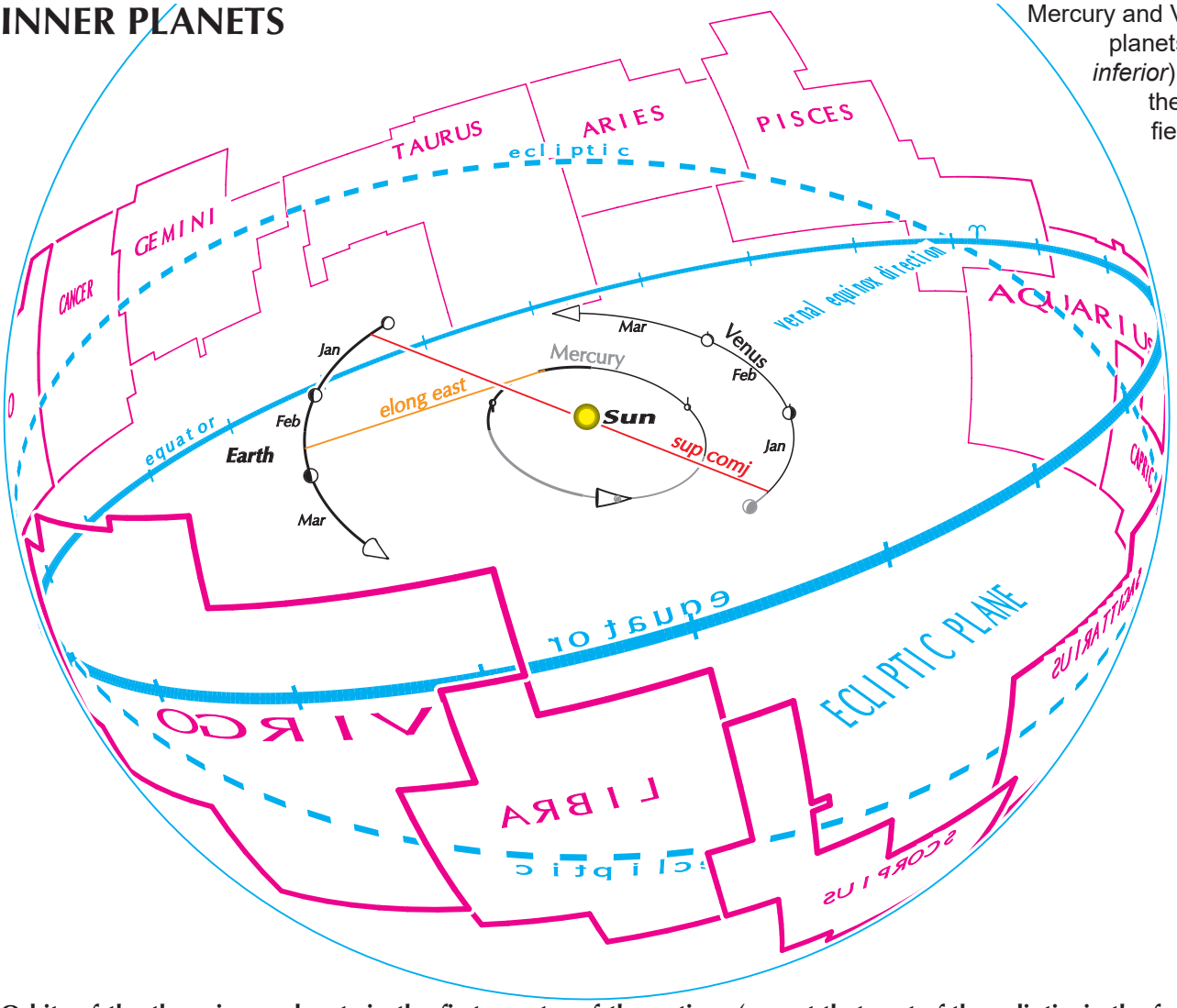
18:28
Ferrol
A Coruna
Gijon
Oviedo
Bilbao
Donostia
Toulouse
Montpellier
Santiago
de Compostela
Pontevedra
Vigo
Astorga
18:30 UT
Palencia
Valladolid
Zaragoza
Barcelona
Almazan
Porto
Alcaniz
Segovia
Siguenza
Alcaniz
Guadalajara
18:32
Madrid

# INNER PLANETS

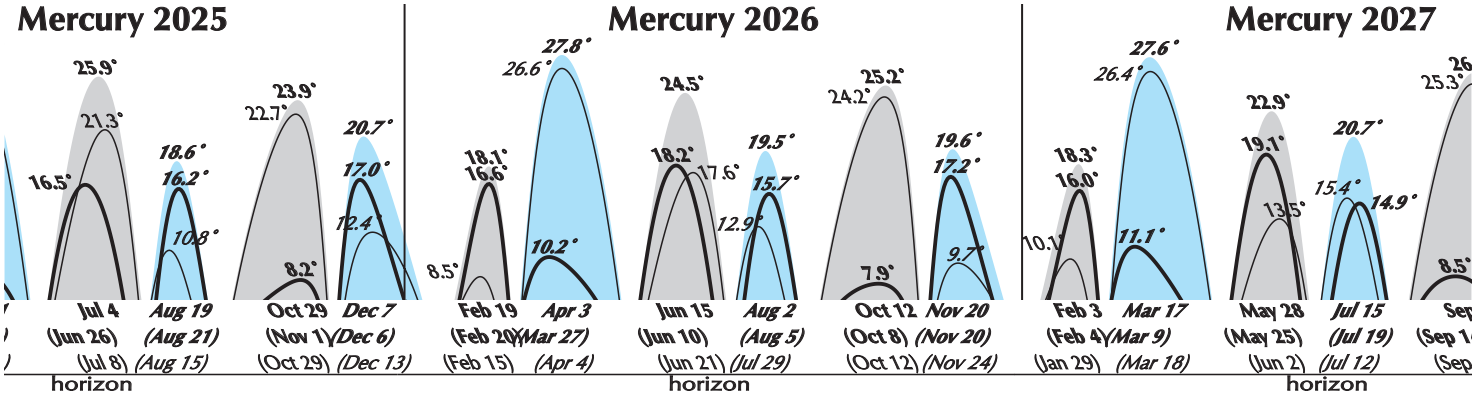
Mercury and Venus are the planets lower (Latin *inferior*) than Earth in the gravitational field of the Sun.

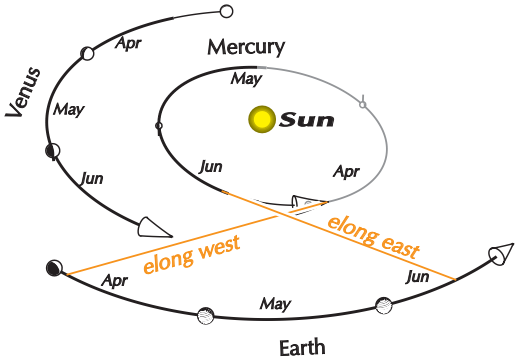



**Orbits of the three inner planets in the first quarter of the year, seen from a viewpoint 6 astronomical units (AU, Sun-Earth distances) from the Sun. On an imaginary sphere, 2 AU out, are shown the planes of the equator and ecliptic, and the boundaries of the zodiacal constellations. The planets move nearly in the ecliptic plane, so as seen from the Earth they appear against the background of these constellations (except that part of the ecliptic, in the foreground, lies in Ophiuchus rather than Scorpius). Globes represent the planets at the start of each month. Their size is exaggerated 500 times, the Sun's only 10 times. When a planet is in or north of the ecliptic plane, its path is drawn with a thicker line. When it is in the morning sky (west of the Sun) as seen from the Earth, its course is shown in gray.**

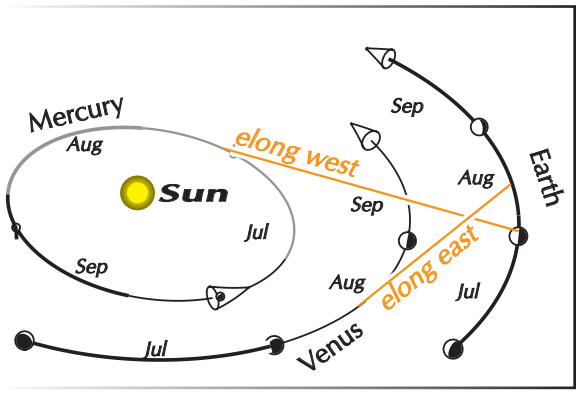
| Mercury | |
|---|---|
| mean distance from Sun | 0.39 AU |
| sidereal period 0.24 year = | 88 days |
| synodic period | 116 days |
| eccentricity | 0.206 |
| inclination | 7° |
| diameter | 4,880 km |

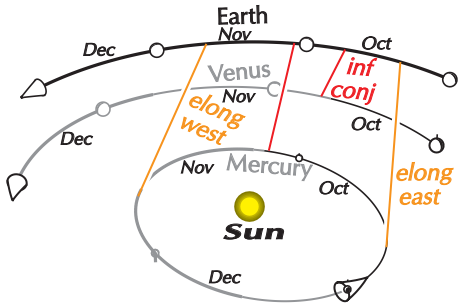
| Venus | |
|---|---|
| mean distance from Sun | 0.72 AU |
| sidereal period 0.62 year = | 225 days |
| synodic period | 584 days |
| eccentricity | 0.007 |
| inclination | 3.4° |
| diameter | 12,100 km |






**Continuations of the motions of Mercury, Venus, and Earth in the other quarters of the year. The Earth goes around the Sun once in the year, but Venus 1.625 times and Mercury 4.15 times.**

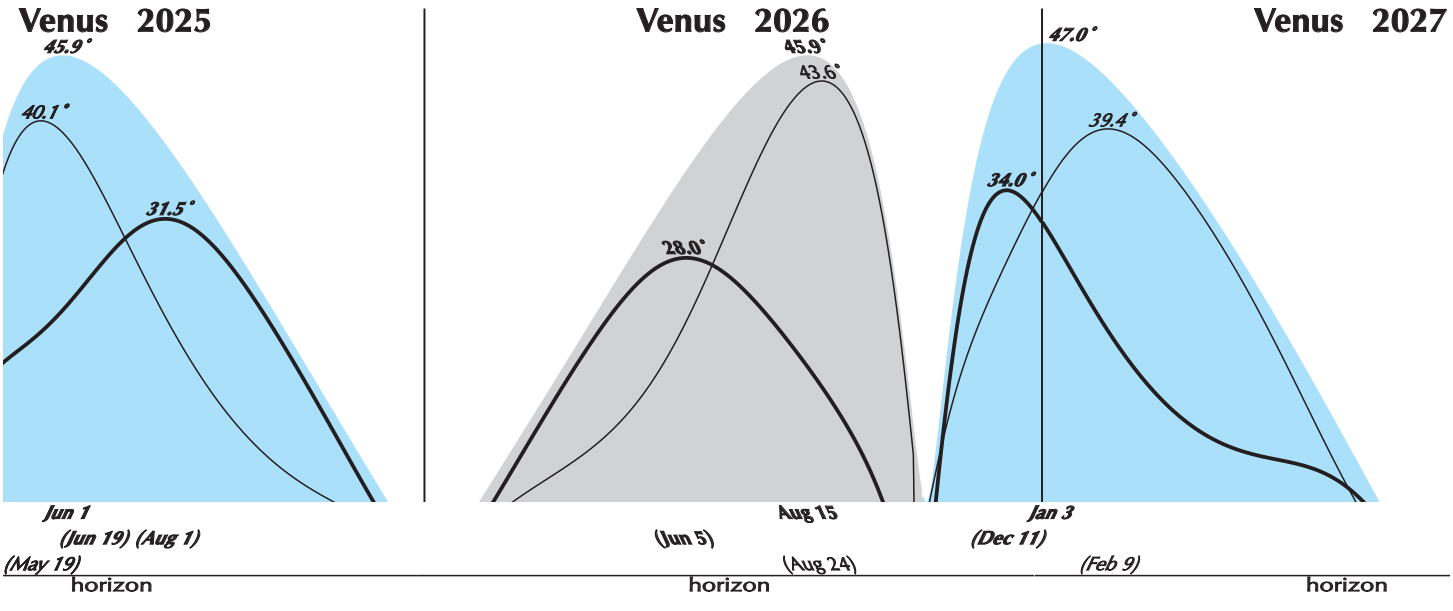



George III made drawings and calculations of Venus's 1769 transit of the Sun, and watched it from the King's Observatory he had founded that year between Richmond and Kew. He accurately predicted the transits of 1874 and 2004. A mass of his papers made public in 2016 revealed that the "mad" king who "lost America," considered dull and called by Thomas Paine "the royal brute," was compassionate, intelligent, interested in science, and bi-polar—all to an extreme degree.

**Apparitions compared. Gray areas represent evening apparitions (eastward elongation); blue, morning apparitions (westward). The top figures are the maximum elongations, reached at the top dates shown beneath.**

**Curves show the altitude of the planet above the horizon at sunrise or sunset, for latitude 40° north (thick line) and 35° south (thin), with maxima reached at the parenthesized dates below (40° north bold).**



# MERCURY

The solar system's innermost and fastest-moving major planet is also the smallest: only 1.4 times wider than the Moon. It orbits the Sun 4.15 times a year, but from our moving viewpoint it appears to go around 3.15 times. Its orbit is the most tilted (inclined 7° to the ecliptic plane) and most elliptical (eccentricity 0.206, where 0 means circular). (Pluto is smaller, and more tilted and eccentric in orbit, but is no longer considered a major planet. A planet nearer to the Sun, Vulcan, was once suspected but never found.)

Each year, Mercury makes three apparitions in the evening sky, often part of a fourth, and similarly in the morning sky. These excursions are, because of the eccentric orbit, unequal. The angular distance (elongation) to which Mercury goes out from the Sun is greater if it is near aphelion (greatest physical distance), when Mercury is at great elongation Earth's southern hemisphere is favored, because aphelion is in the direction where Mercury is south of the ecliptic. Often, when Mercury is at great elongation, it gets as high as 26° above the sunset or sunrise horizon for our southern hemisphere, but for the northern it gets less than half as high, going out at a low angle to the horizon.

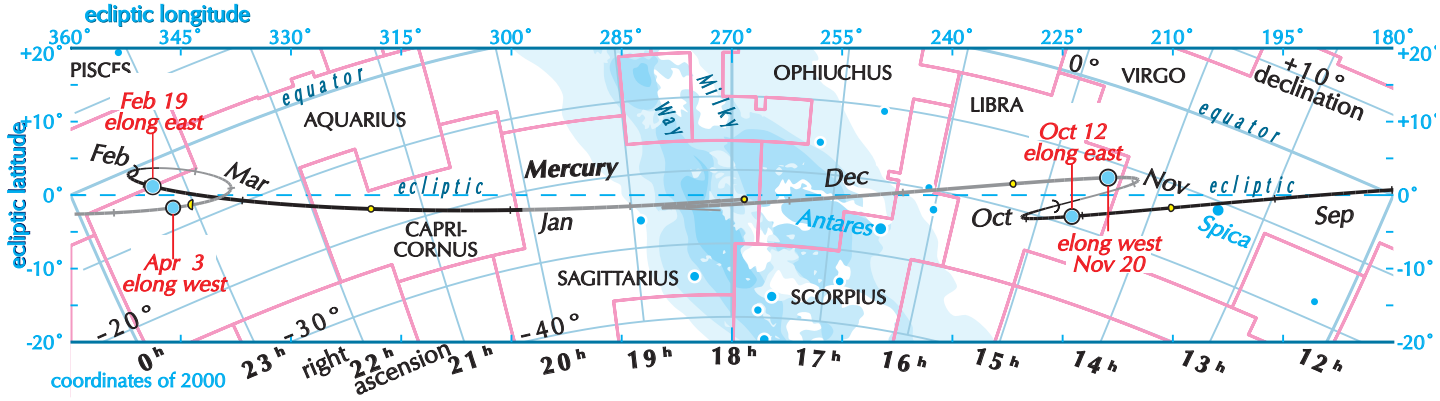
Around inferior conjunction, when Mercury rushes westward between us and the Sun, its retrograde path traces loops well north or south of the ecliptic, because of the orbit's inclination.

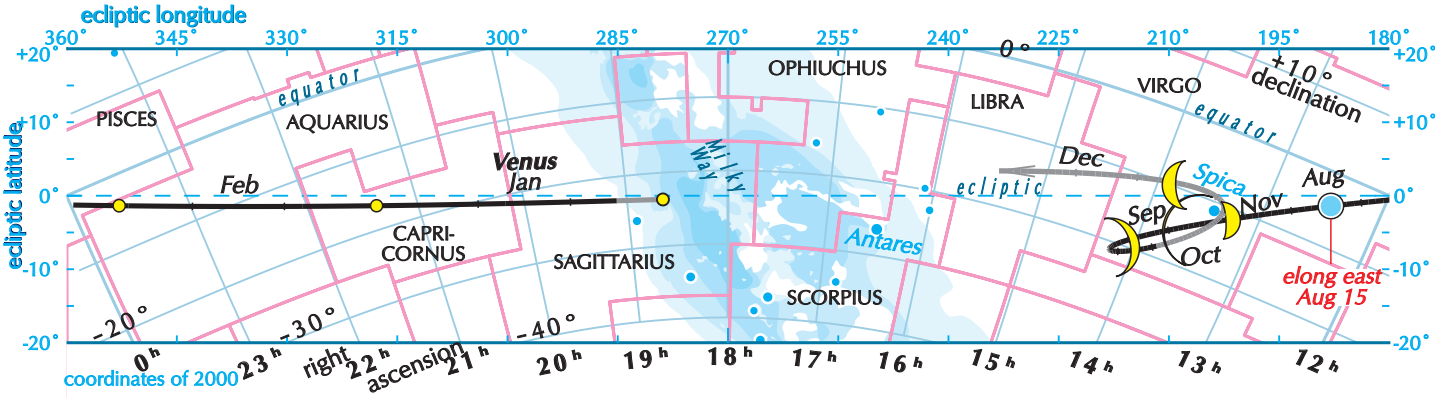
This year, as shown by our comparative graph of the apparitions, north-hemisphere observers have a good chance of seeing Mercury in the evening sky around February 19 or June 15, or the morning sky around August 2 or November 20.

For the southern hemisphere, Mercury gets twice as high, in the dawn around April 3 or the dusk around October 12. These are, for the northern hemisphere, examples of the "Mercury perversity": the "mercurial" little planet leaps out to a great elongation from the Sun, but at an unhelpfully low angle.

**Maps of the planets' paths, plotted in ecliptic latitude and longitude to save vertical space. The more familiar grid of equatorial coordinates (lines of declination and right ascension) is also shown, slanting and curving in relation to the ecliptic system. At day 1 of each month, the disk of the planet is drawn, exaggerated 600 times in size. Ticks are at days 11 and 21. Dashes along the ecliptic are 2° long. When the planet is in the morning sky, its course is shown in gray. Transition from black to gray is at inferior conjunction, when the planet passes in front of the Sun; transition from gray to black is at superior conjunction.**

**Mercury and Venus stay within 28° and 48° of the Sun, so they start and end each calendar year in the south.**



# VENUS

Earth's "sister" is only slightly smaller (diameter 12,100 km versus Earth's 12,756) but fiercely different. Under a complete blanket of thick cloud is a dense hot carbon dioxide atmosphere. Venus rotates backward (clockwise as seen from the north) and slowly, in 243 Earth-days. The rotation is upright, without inclination to the orbit; and the planet is almost perfectly spherical; so there is almost no variation by season.

Venus is the major planet to which we come nearest, though Mars can be almost as near, and Mercury is nearest for more of the time.

Nearness, size, and surface of high albedo (whiteness, reflectivity) make Venus at almost all times the brightest celestial body after the Sun and Moon. It can be glimpsed in daylight, is typically the first "star" noticed as the sky dims toward a solar eclipse, and can be seen up to several hours after sunset or before sunrise. Early cultures saw it as separate Morning and Evening Stars, and many associated it with a great goddess of love and generation.

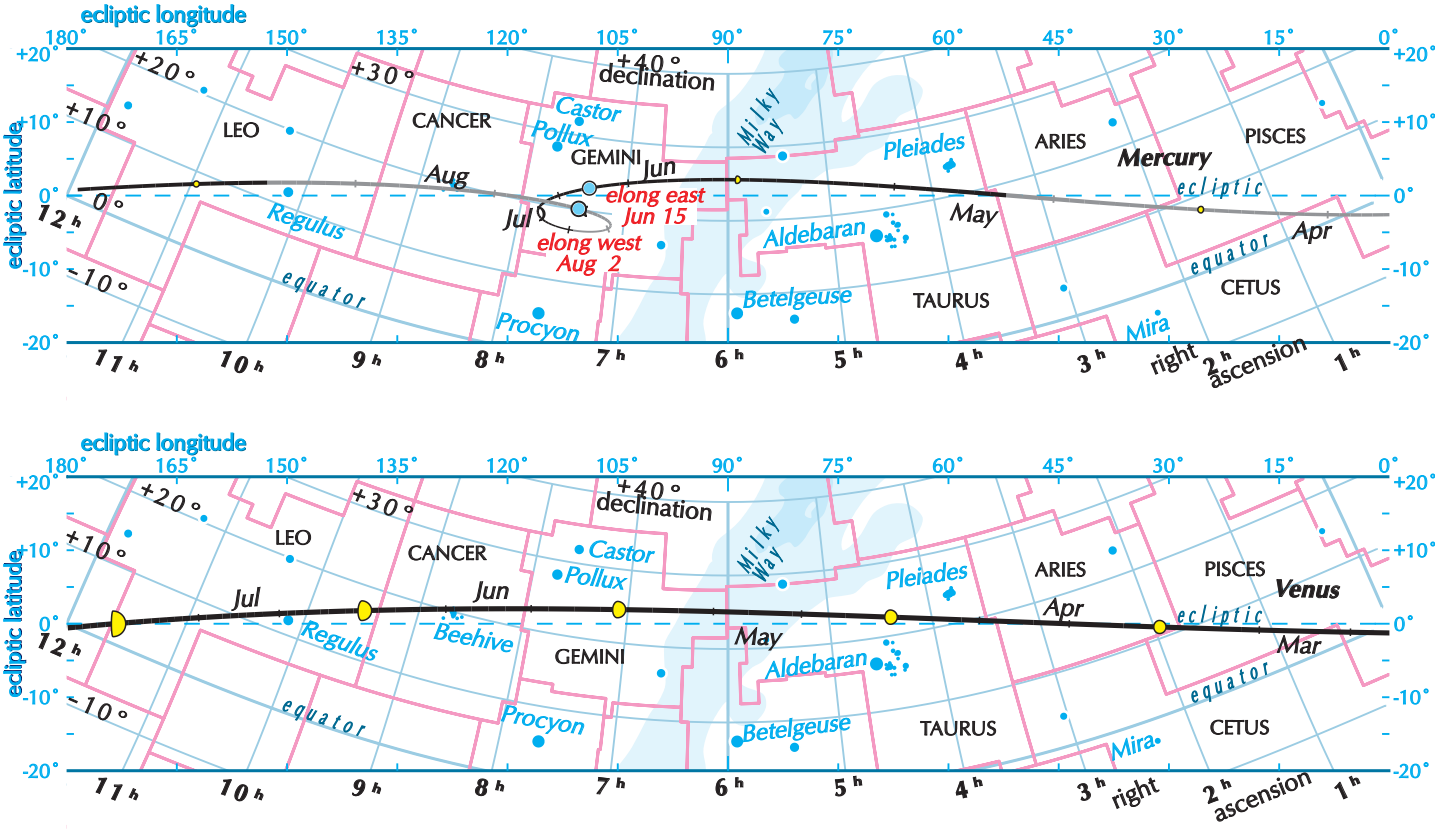
Venus travels in a nearly perfect circle, 13 times around the Sun in 8 Earth-years, so that as seen from Earth it appears to make 5 circuits around the sky. (5, 8, 13 are consecutive numbers in the Fibonacci series, which shows up in many details of nature.) This 8-year cycle was known to the Babylonians and the Maya. Each year of the cycle has a distinctive pattern.

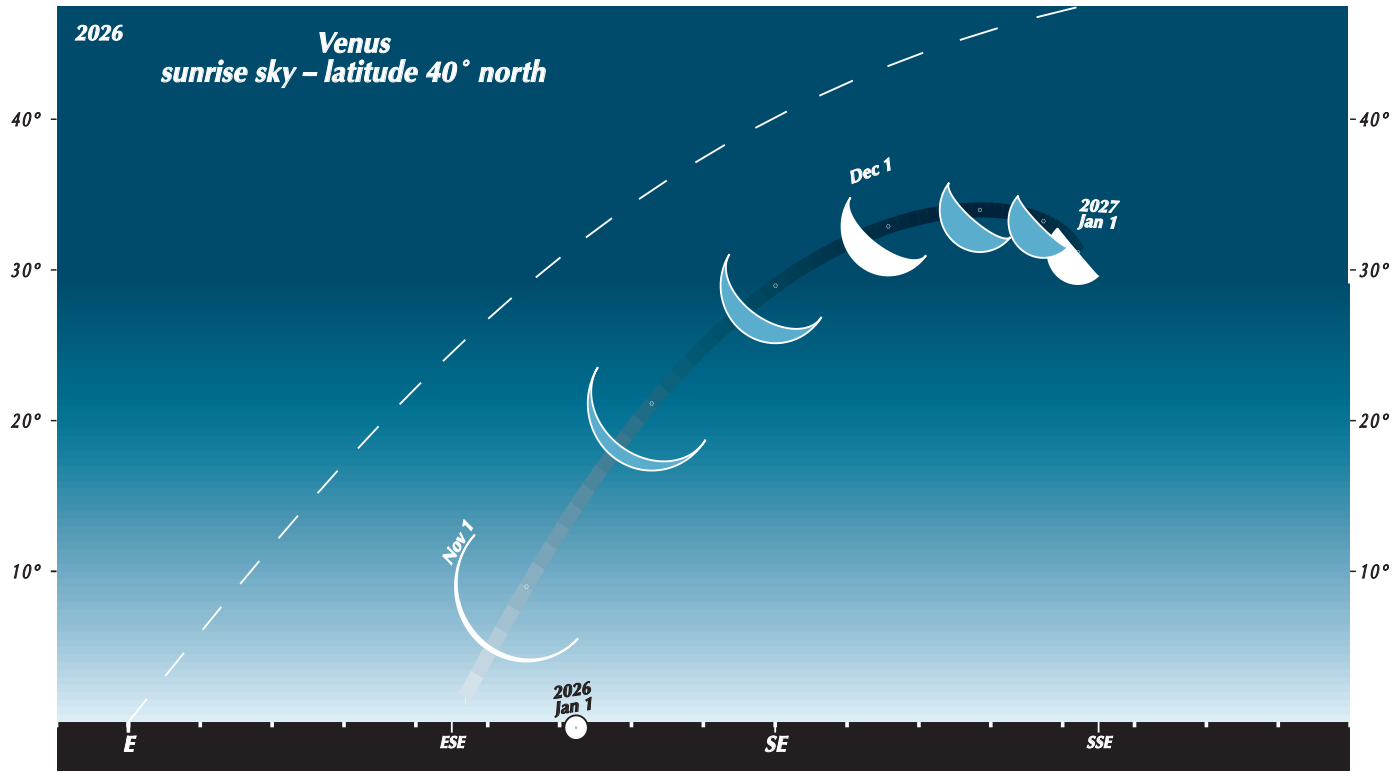
In this year of the cycle, the phenomena of 2018 recur in 2026, only about 2.4 days earlier.

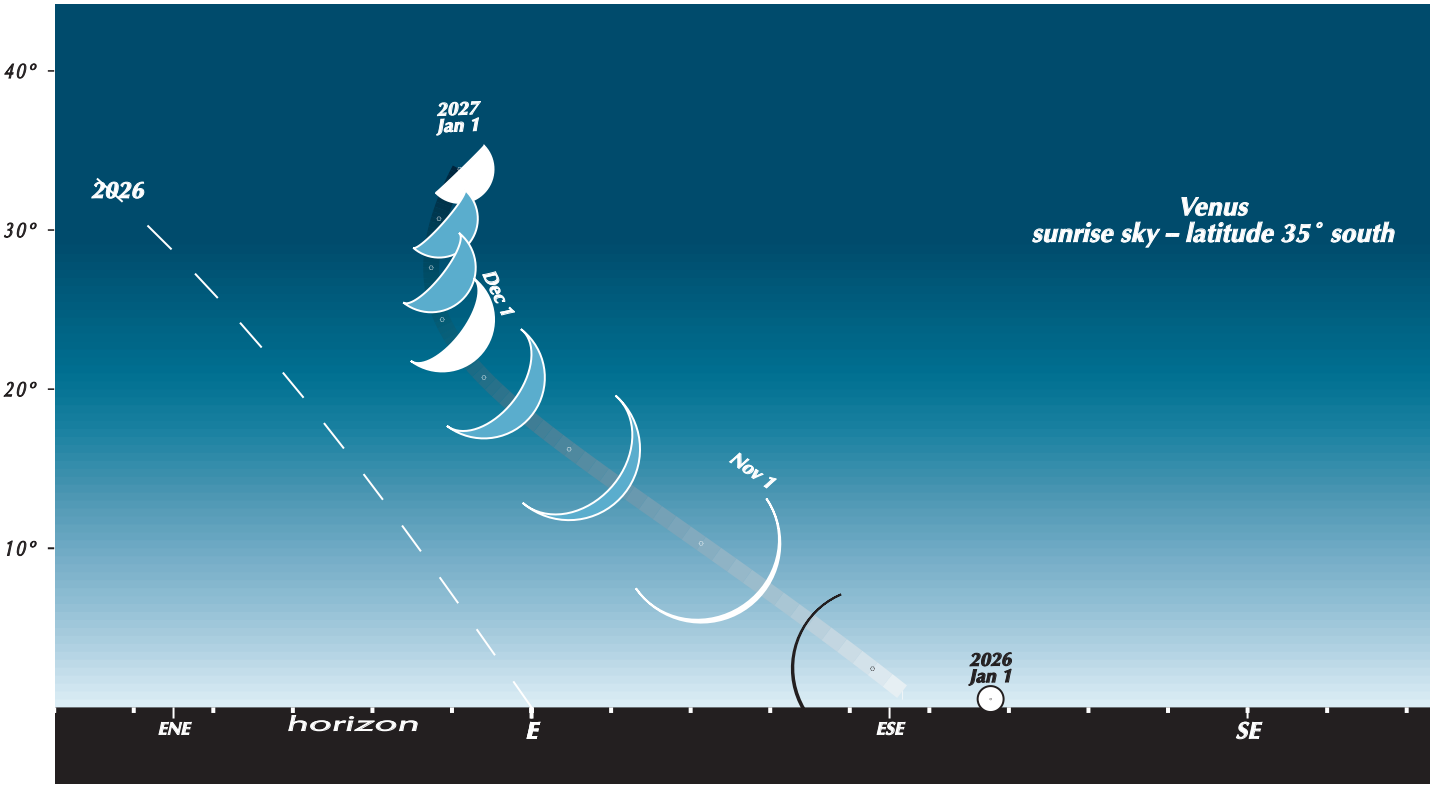
Venus is in the evening sky for the larger part of the year, from January 6 onward, reaching a greatest eastward elongation on August 15, rather southerly, near the star Spica in Virgo. Then the "evening star" sinks toward the sunset, to pass south of the Sun on October 24.

By the end of the year, Venus is high in the morning sky, about to reach its peak of western elongation on 2027 January 3.

Very full and colorfully illustrated information on Venus, planet and goddess, is in our book *Venus, a Longer View*. www.universalworkshop.com/Venus





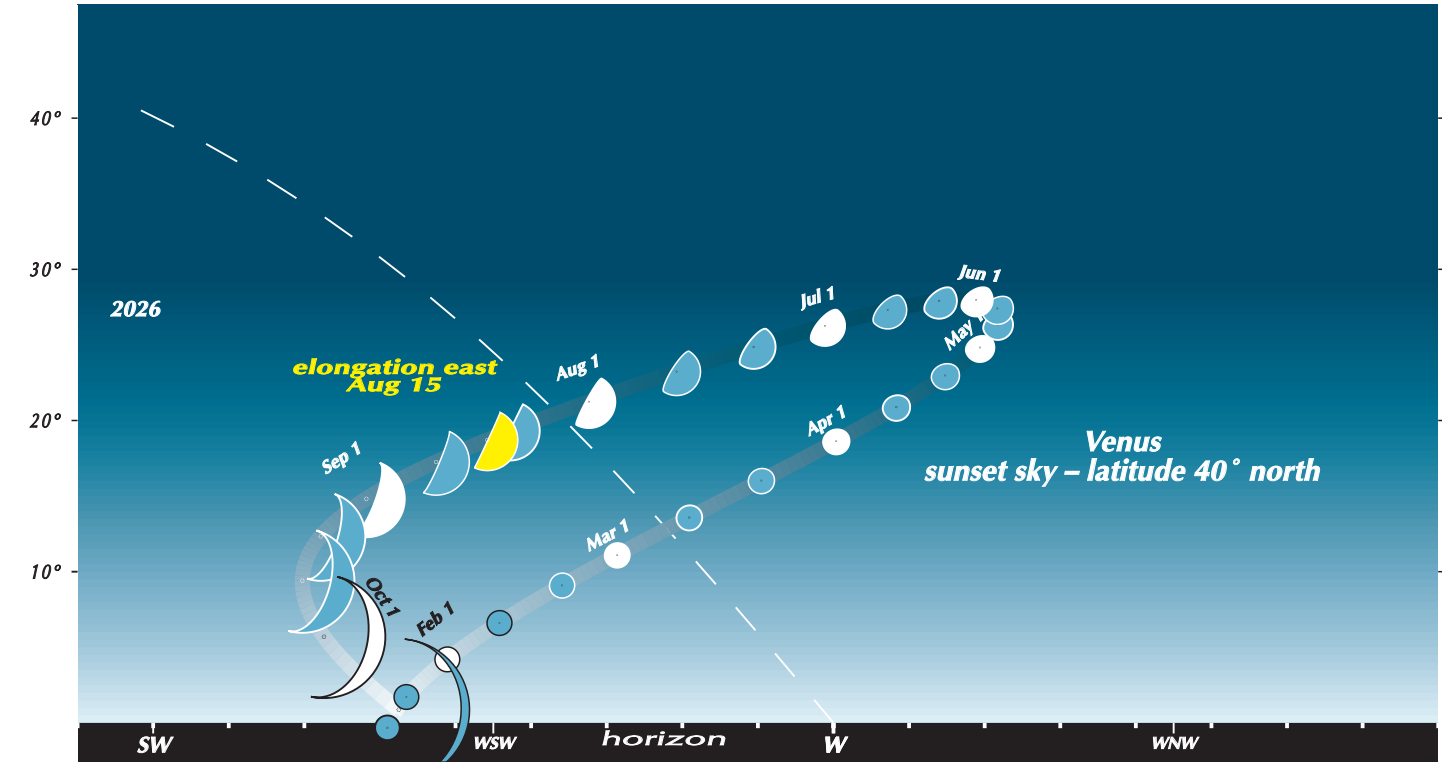



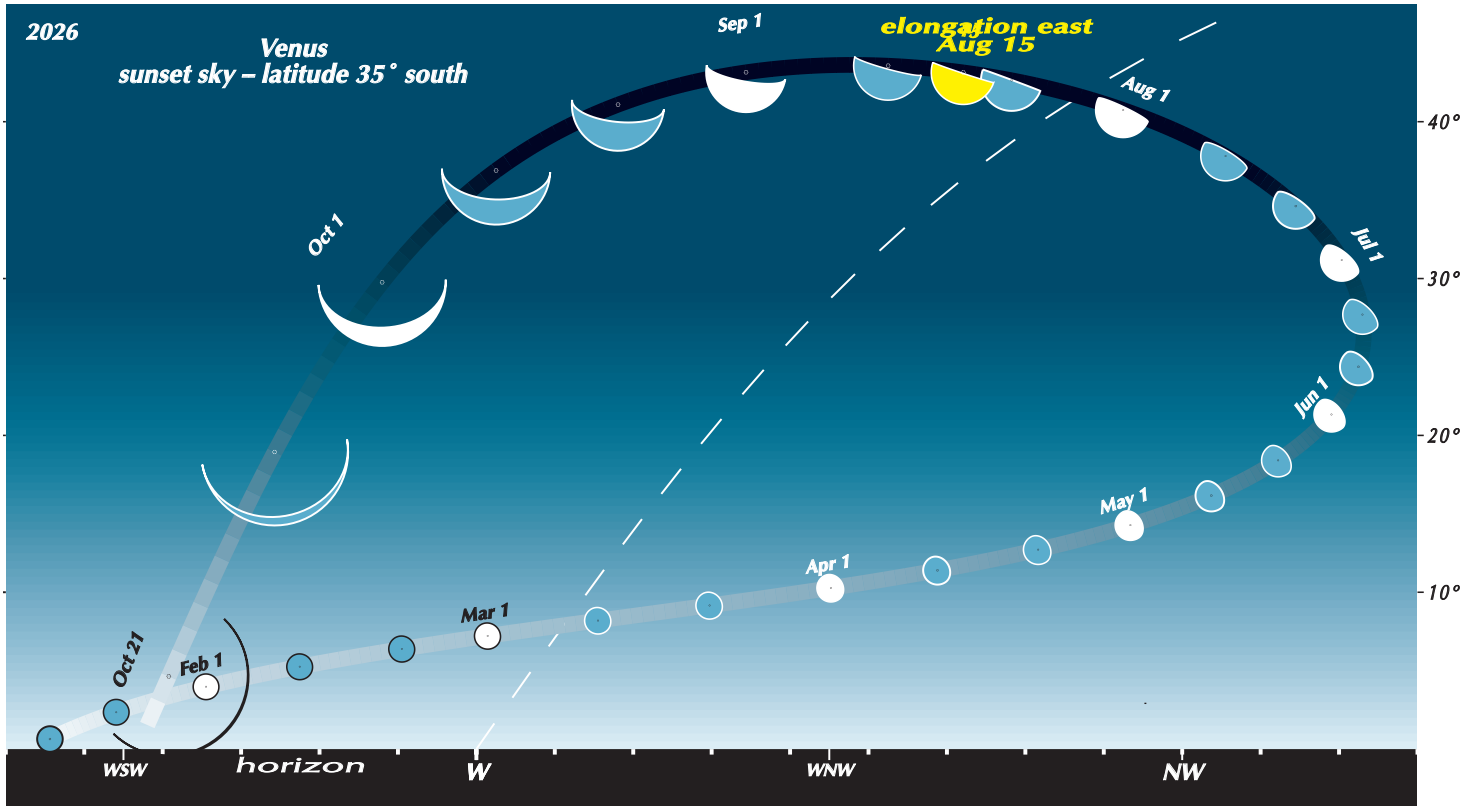

These are the visits of Mercury and Venus to the morning and evening skies, as they appear at sunset and sunrise for latitudes 40° north and 35° south.

You can imagine the changed situation at, say, an hour after sunset by mentally raising the horizon-line about 12°. The sky will be darker, but the planets will be lower.

Longitude makes little difference, because planets do not change their positions as fast as the Moon—even Venus never moves more than about a degree a day.

Latitude makes a great difference. If you are farther north, you must imagine the horizon tilted up on the south like a seesaw, around the Sun's position as a pivot. Or, which is the same thing, you will find the equator and also the trajectories of Mercury and Venus lying flatter. If you are at the north pole, the equator is the horizon, and the planets' travels south of the equator are below the horizon. Conversely as you move south, the horizon tilts down at its south end; in Ecuador or Uganda on the terrestrial equator, the celestial equator is vertical, and the planets' sallies, too, are roughly vertical. For South Africa or New Zealand, the celestial



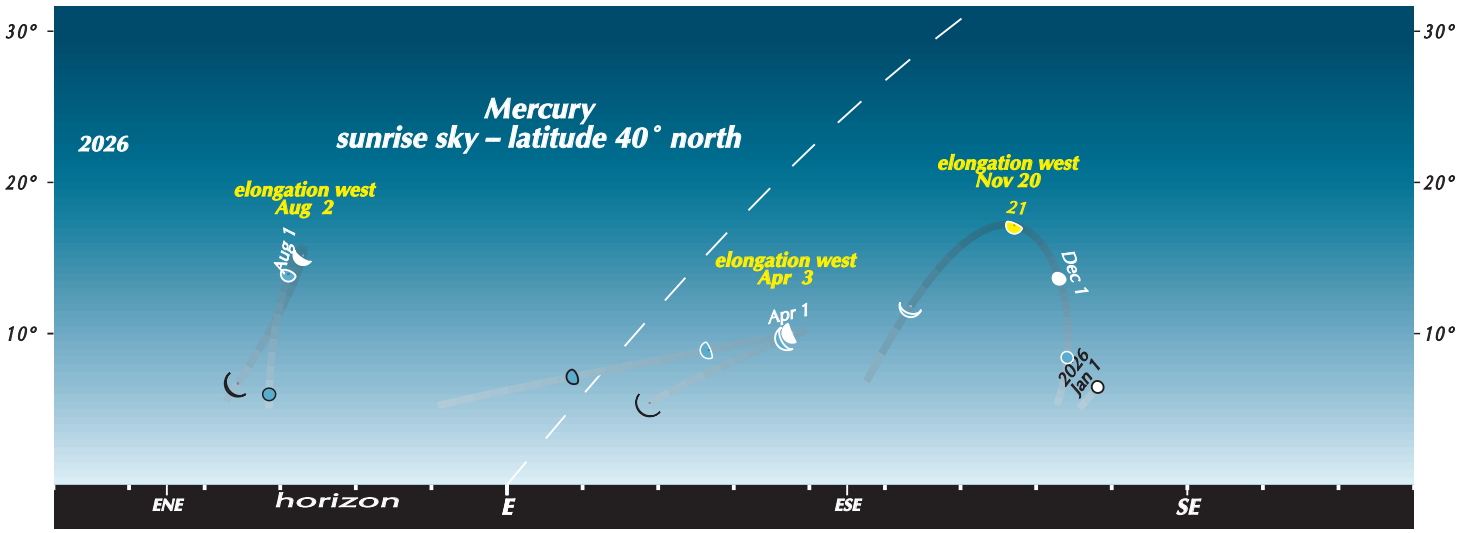



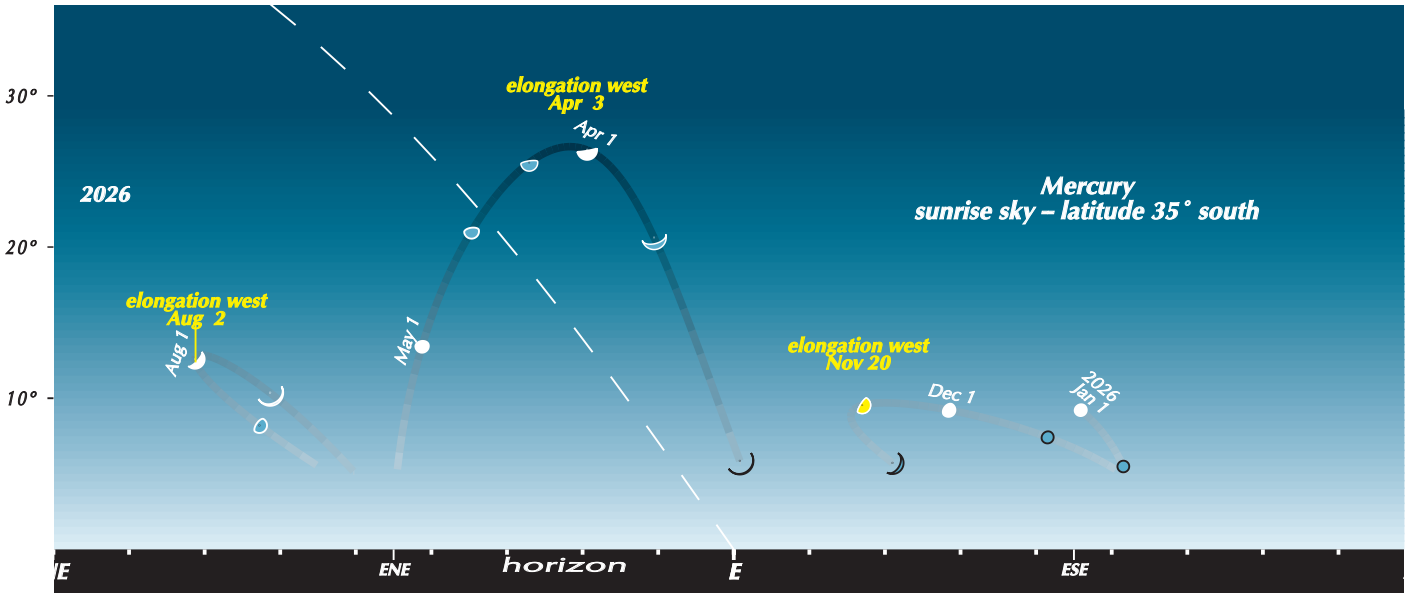

equator slopes in the opposite direction and so do the planets, leaping from the Sun generally rightward into the evening sky and leftward into the morning.

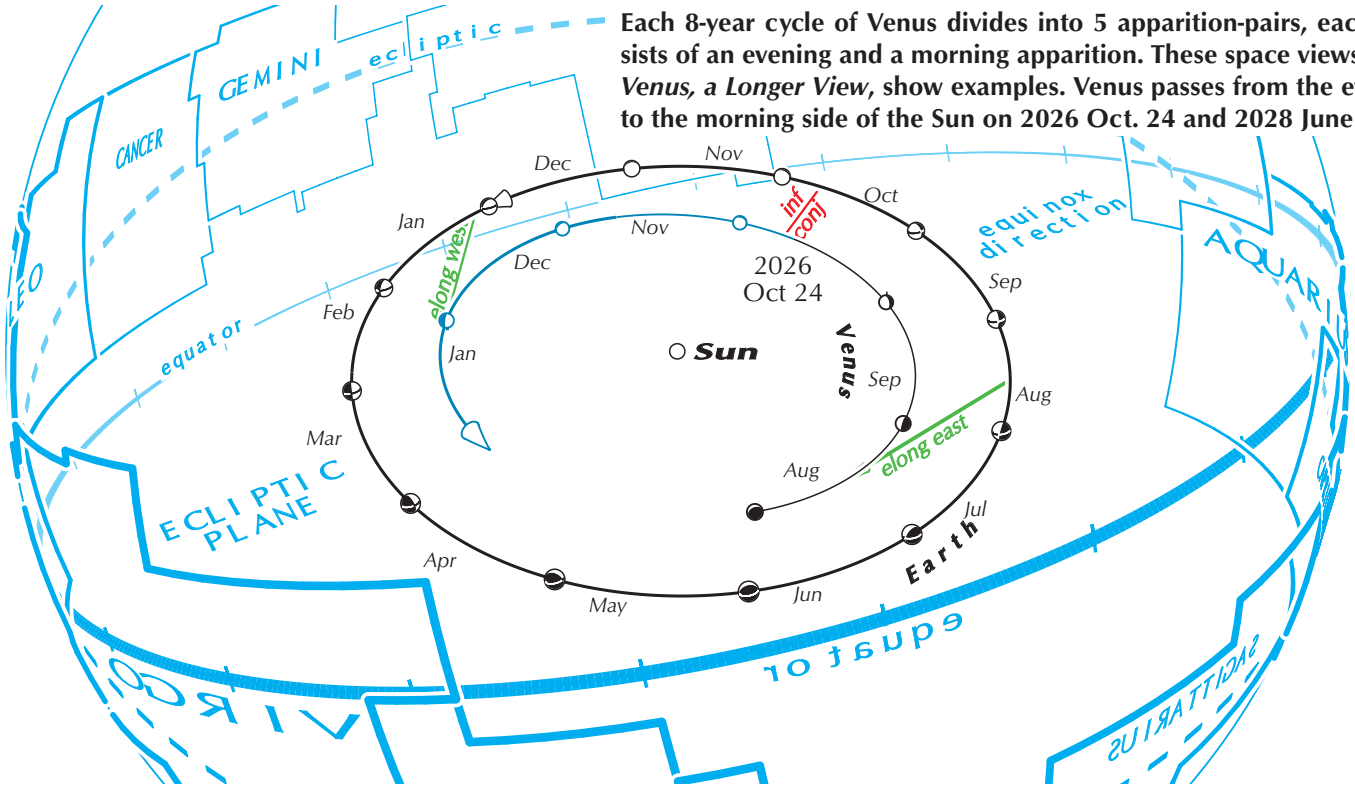
The coordinate system used is simple altazimuth. Ticks along the horizon are 5° apart. The scale is 2 mm to 1°. The planets are exaggerated 600 times in size. Each image of Mercury or Venus is like a view of this spot in the sky through a powerful telescope.

The planet images are at the 1st, 11th, and 21st of each month. Dots show the actual positions of the planets for every day. These dots give a truer idea of the planets' actual sizes—though even they can be up to 9 times too large in Mercury's case. Mercury is cut off when it is below 5° of altitude; Venus is followed all the way down to the horizon.

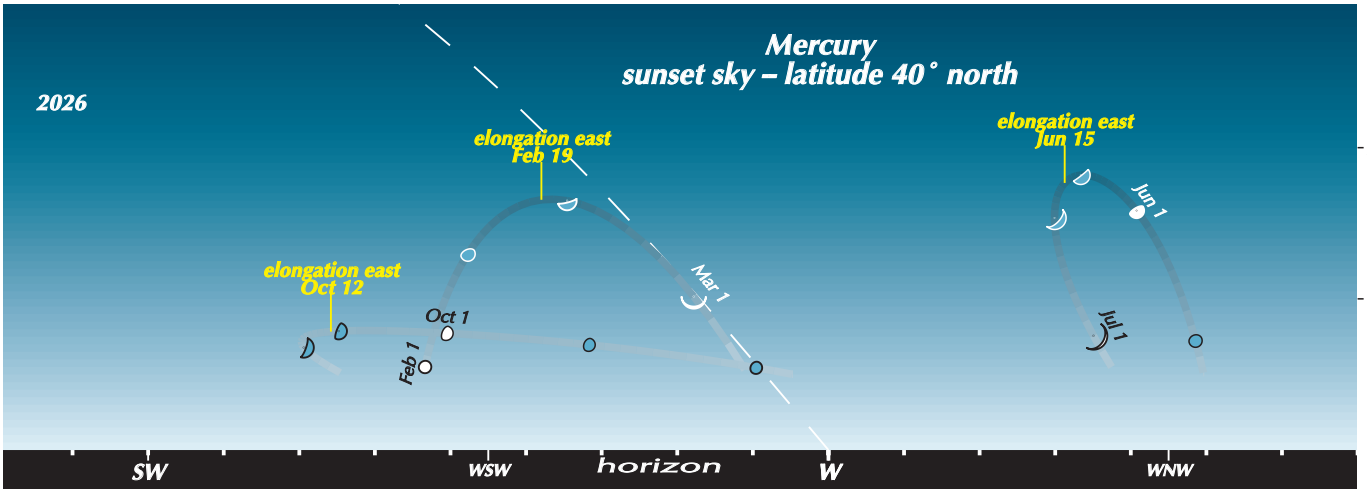
Dashes on the celestial equator are 2° long, but do not represent fixed points on the equator, since the horizon is always moving in relation to it. The ecliptic cannot be shown, since it is in a slightly different altazimuth position each day. It always runs through the Sun, toward which the planets' illuminated crescents face.

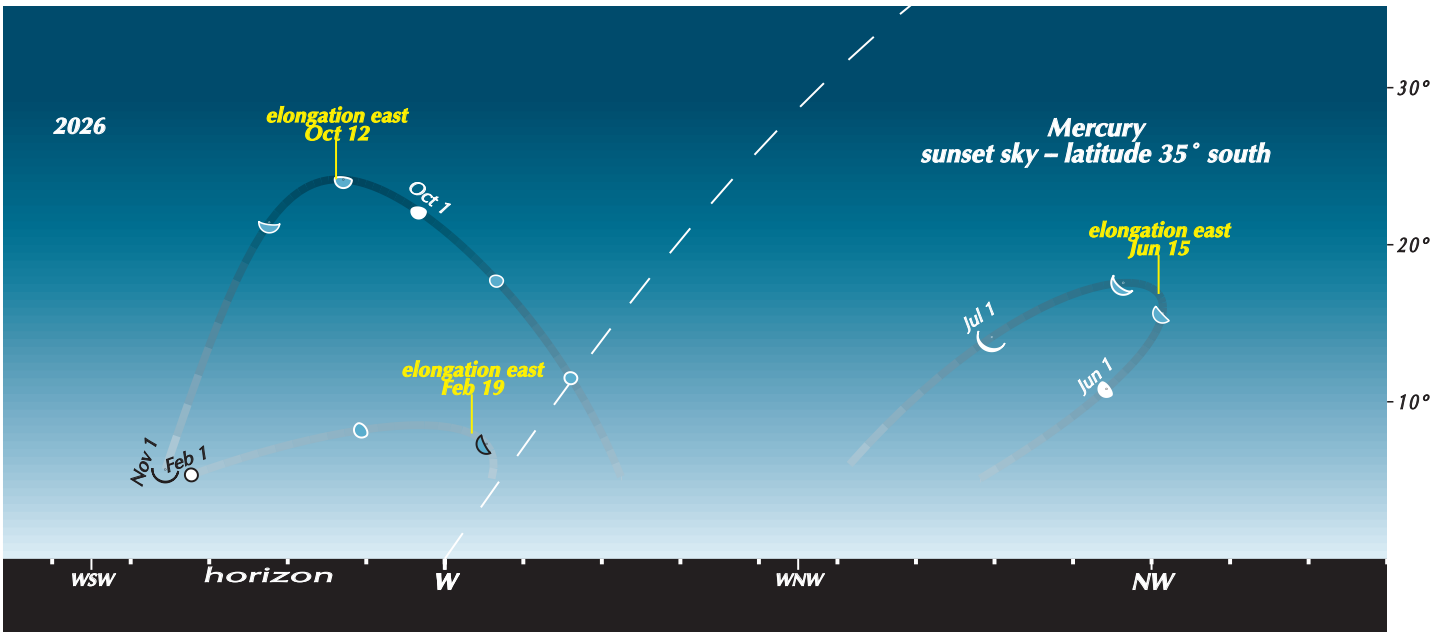


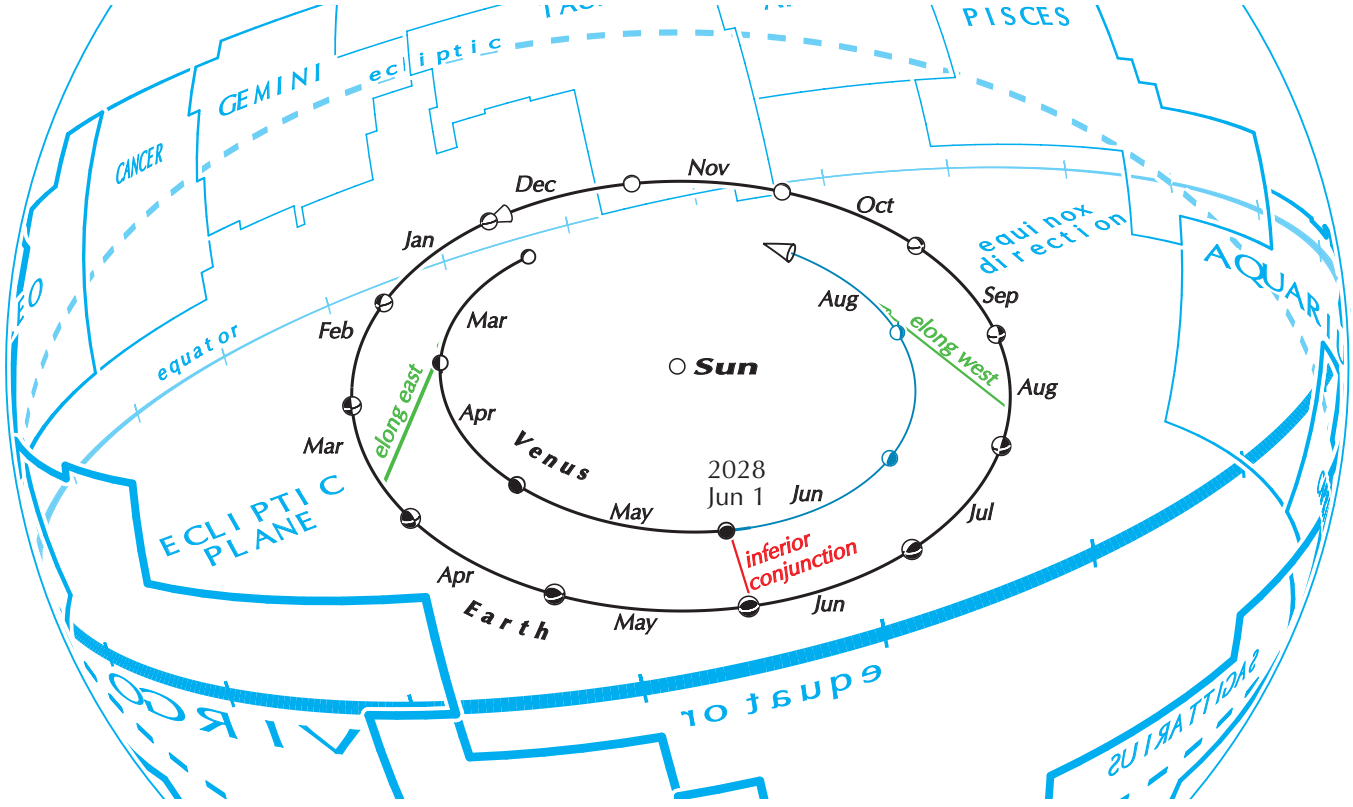




**Each 8-year cycle of Venus divides into 5 apparition-pairs, each consists of an evening and a morning apparition. These space views, from *Venus, a Longer View*, show examples. Venus passes from the evening to the morning side of the Sun on 2026 Oct. 24 and 2028 June 1.**


Mercury
sunset sky – latitude 40° north
2026
elongation east
Feb 19
elongation east
Jun 15
elongation east
Oct 12
Oct 1
Feb 1
Mar 1
Jun 1
Jul 1
20°
10°
SW
WSW
horizon
W
WNW


2026
elongation east
Oct 12
Oct 1
Mercury
sunset sky – latitude 35° south
elongation east
Jun 15
elongation east
Feb 19
Jul 1
Jun 1
Nov 1
Feb 1
30°
20°
10°
WSW
horizon
W
WNW
NW


PISCES
GEMINI
ecliptic
CANCER
equinox direction
AQUARIUS
equator
ECLIPTIC PLANE
Dec
Nov
Oct
Jan
Sep
Feb
Mar
Aug
Sun
elong west
elong east
Apr
Venus
2028
Jun 1
Jun
May
Jul
inferior conjunction
Earth
equator
VIRGO
SAGITTARIUS

# MARS

The fourth planet is a little more than half as wide as Earth. It is one and a half times farther out from the Sun, and takes nearly twice as long to travel around its orbit. (Kepler's third law of planetary motion: period squared equals average distance cubed; in which period is in Earth years and distance is in astronomical units or Sun-Earth distances.)

The result is that Mars has "good" and "poor" years—opposition and non-opposition—in rough alternation. We overtake it at opposition, the stage where it appears directly outward from the Sun, therefore on the meridian at midnight and nearest, largest, and brightest. We next do so 2.13 years later on average.

So the oppositions come in each second year but progressively later, and after 7 oppositions two years are skipped.

The oppositions are spaced around the orbit. The nearest ones fall in August, in the rather southerly Aquarius part of the ecliptic zone, because that is the direction of the perihelion, the near-in point of Mars' fairly eccentric orbit. 2003 Aug. 28 fell only $1^{3/4}$ days before perihelion, and was the nearest opposition in several thousand years.

**Phenomena.** Columns: right ascension (hours, minutes) and declination (degrees, minutes), for epoch 2000; distance from Sun and Earth, in astronomical units; elongation from Sun (degrees; negative = westward); magnitude; diameter in seconds.

| Mars 2026 | | | RA(2000) | dec | hedis | gedis | elo | mag | diam |
|---|---|---|---|---|---|---|---|---|---|
| Jan 1 | 0 | | 18 56 | -23 43 | 1.429 | 2.411 | 2 | 1.2 | 3.9 |
| Jan 9 | 12 | conjunc.with Sun | 19 24 | -22 59 | 1.420 | 2.403 | 1 | 1.2 | 3.9 |
| Feb 27 | 22 | max.lat.south | 22 2 | -13 14 | 1.386 | 2.343 | -11 | 1.2 | 4.0 |
| Mar 16 | 14 | elong.15 W + | 22 52 | -8 26 | 1.382 | 2.319 | -15 | 1.2 | 4.0 |
| Mar 26 | 7 | perihelion | 23 20 | -5 28 | 1.381 | 2.304 | -17 | 1.2 | 4.1 |
| Apr 12 | 18 | on equat.,to nor. | 0 10 | 0 0 | 1.383 | 2.276 | -21 | 1.2 | 4.1 |
| Jul 25 | 0 | ascending node | 5 9 | 22 55 | 1.471 | 2.025 | -44 | 1.3 | 4.6 |
| Aug 15 | 16 | max.declin.north | 6 12 | 23 42 | 1.499 | 1.933 | -50 | 1.3 | 4.8 |
| Nov 19 | 18 | west quadrature | 10 1 | 14 16 | 1.613 | 1.275 | -90 | 0.7 | 7.3 |
| Dec 21 | 12 | 1- AU from Earth | 10 43 | 11 14 | 1.640 | 1.000 | -112 | 0.1 | 9.4 |
| Jan 1 | 0 | | 10 51 | 10 54 | 1.647 | 0.914 | -120 | -0.1 | 10.2 |

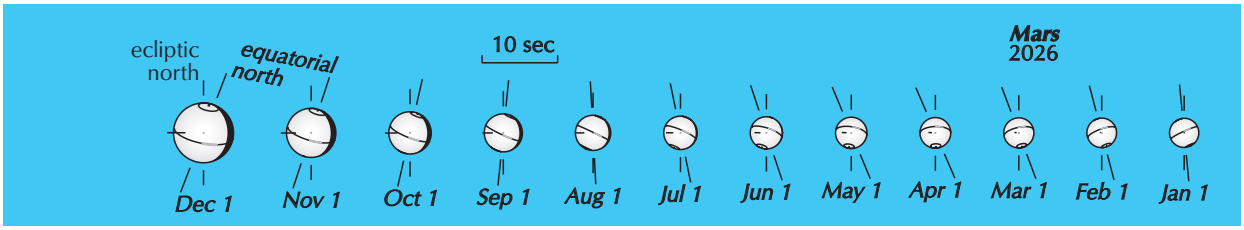
2026 is a non-opposition year. After passing behind the Sun on Jan. 9, Mars remains all year in the morning sky, distant from us, and appearing to travel a long, straight, obscure course around 220° of the ecliptic.

In August it is northernmost, in Gemini, but still nearly twice as far away from us as the Sun and below magnitude 1 in brightness.

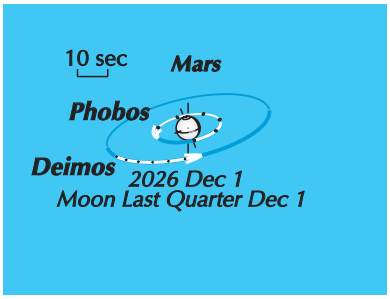
In December, as we begin to overtake Mars on the inside, it brightens rapidly toward its 2027 opposition, and begins to rise into view before midnight.

## oppositions

| | |
|---|---|
| 2010 Jan 29 | 2020 Oct 13 |
| 2012 Mar 3 | 2022 Dec 8 |
| 2014 Apr 8 | |
| 2016 May 22 | 2025 Jan 16 |
| 2018 Jul 27 | 2027 Feb |

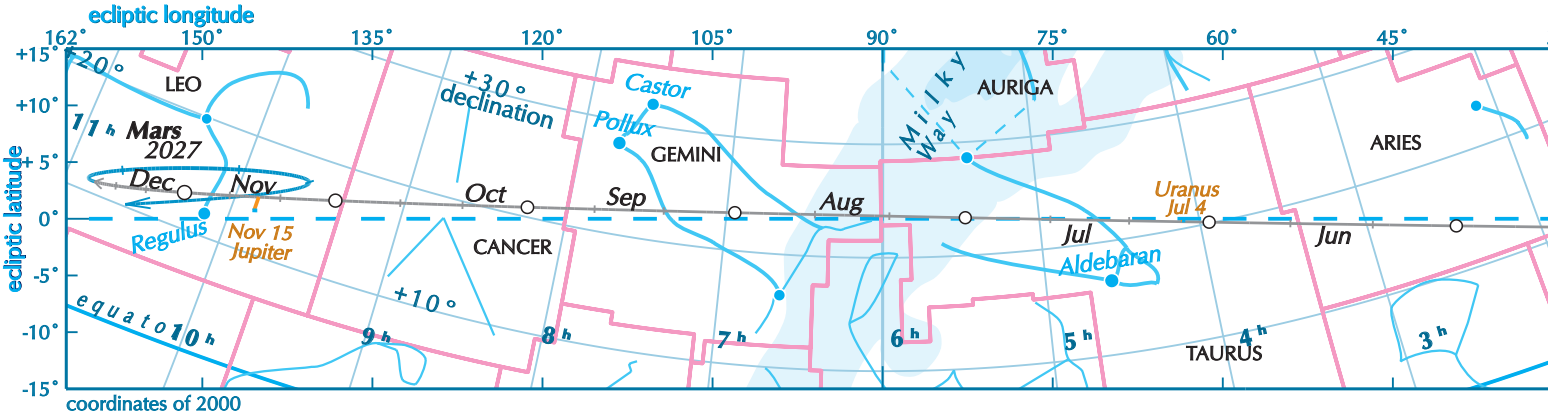


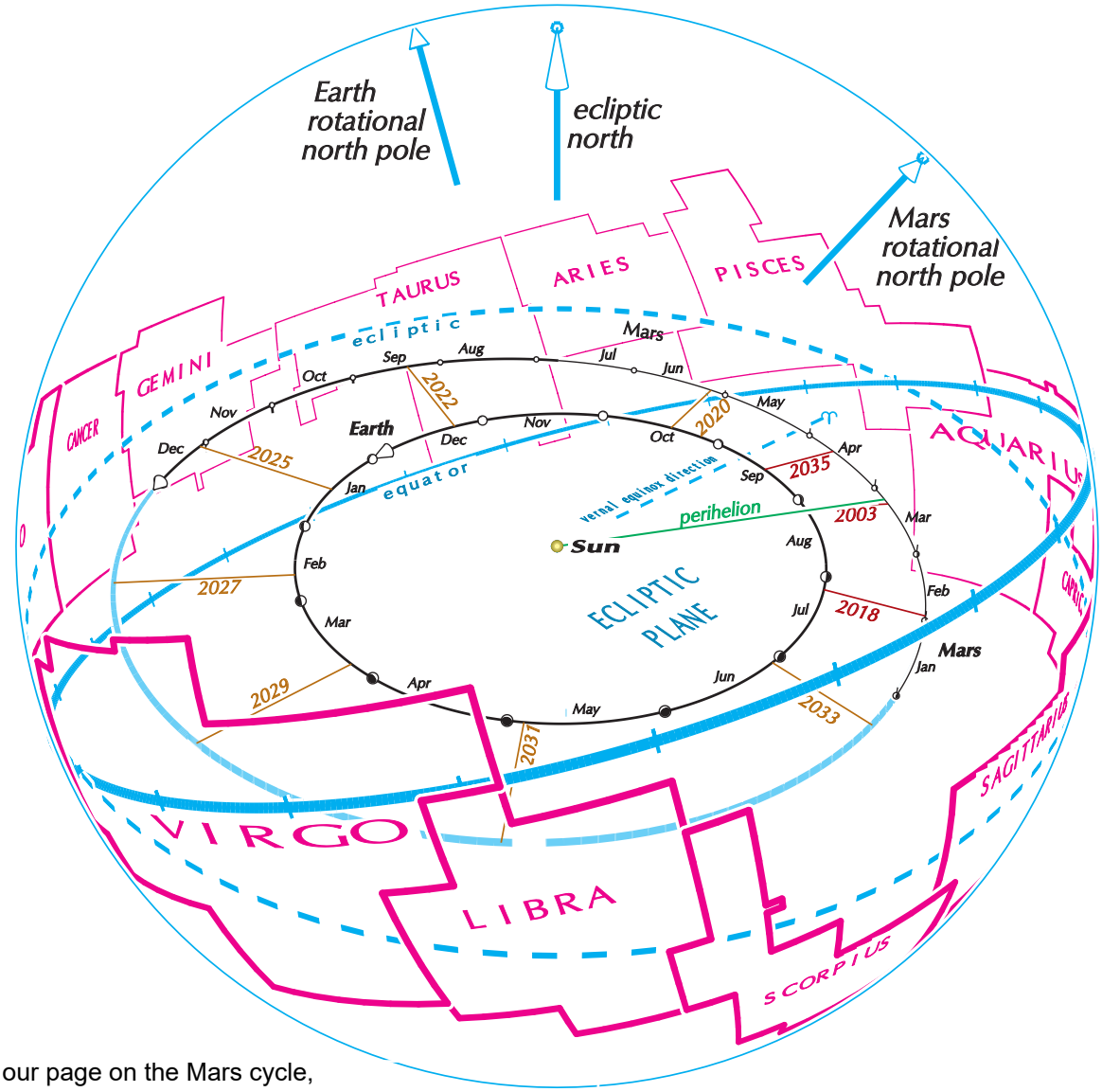

**Mars disk.** Arrow on the equator shows rotation in 2 hours. Line points to Sun.




**The satellites move in almost circular orbits, in planes slightly varying from Mars's equator. Their tracks are shown in white for 6 hours, starting at 0h UT.**

**Phobos orbits in only 7.65 hours, Deimos in 30.3 hours. Since Mars rotates in 24.6 hours, Phobos travels more than three times *faster* than the planet's surface: seen by a Martian, Deimos goes over slowly from east to west (more than 2 days from rising to setting); Phobos goes in the opposite direction, rising in the west and setting in the east, twice a day! The satellites are exaggerated 30 times in size.**

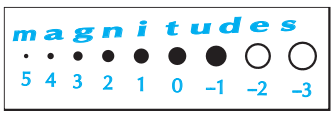


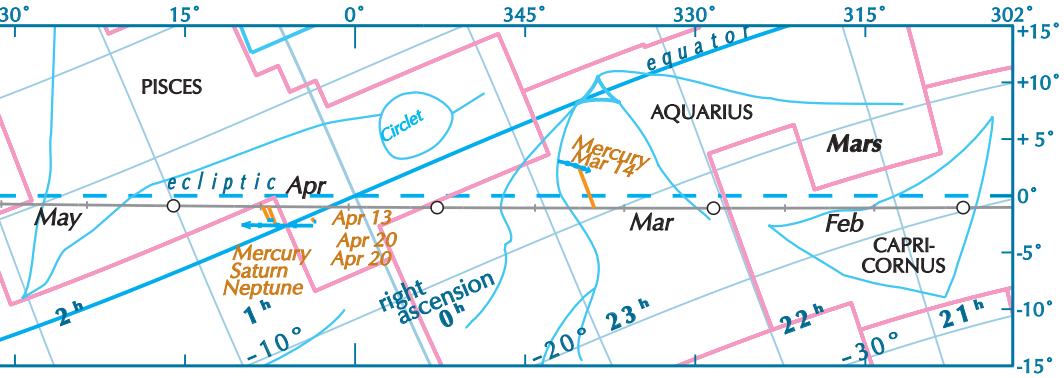



See our page on the Mars cycle,
https://www.universalworkshop.com/the-mars-cycle/

**Both are elongated: dimensions of Phobos are 27x22x19 kilometers, and Deimos 15x12x11 (as against the 6800 km diameter of Mars). So they are shown as ellipses. They rotate synchronously, keep the same face to Mars. Phobos and Deimos are about 13 and 14 magnitudes fainter than Mars.**

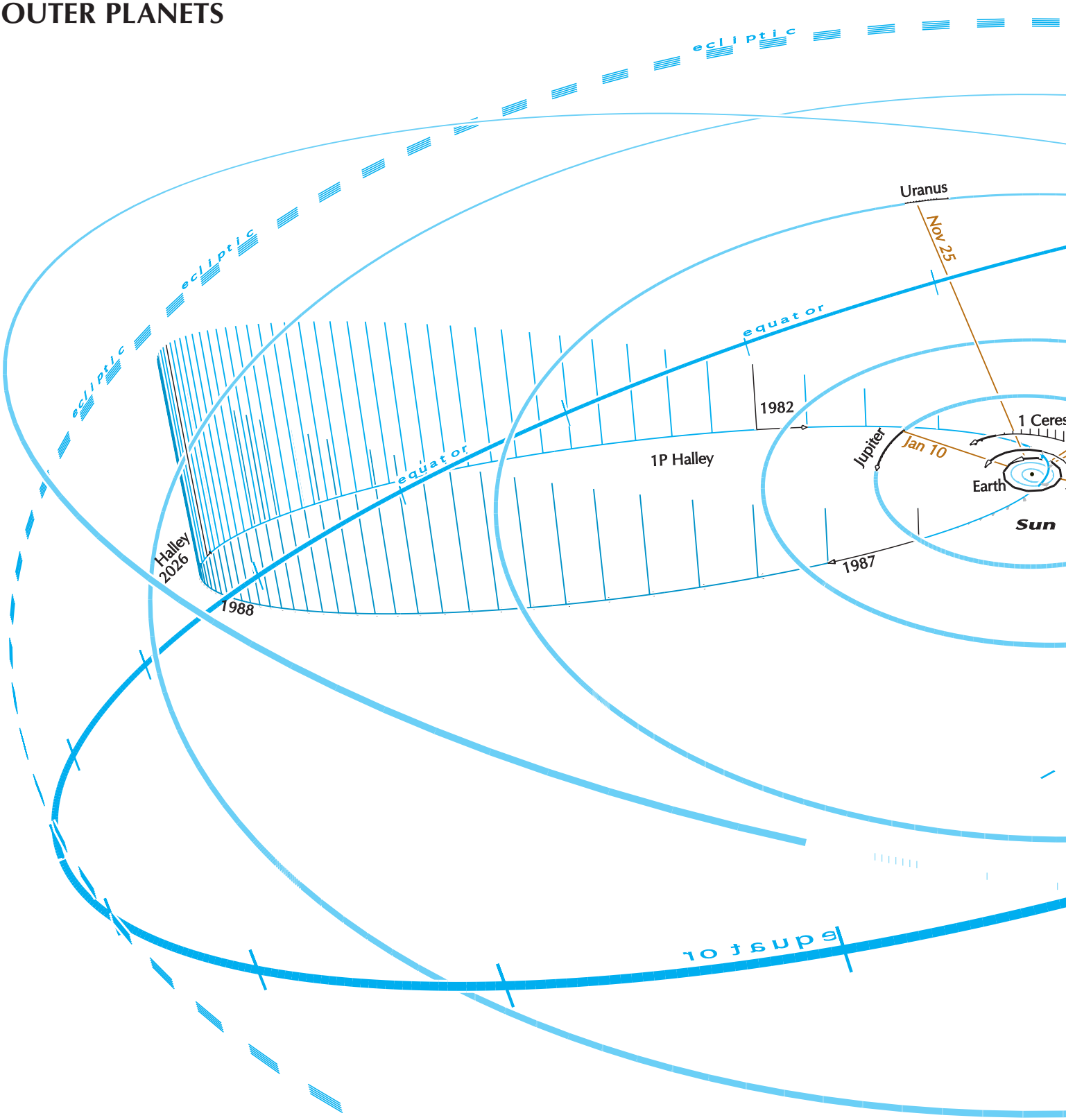
| | |
|---|---|
| mean dist. from sun | 1.52 AU |
| sidereal period | 1.88 years = 687 days |
| synodic period | 2.13 years = 780 days |
| eccentricity | .093 |
| inclination | 1.9° |
| diameter | 6,790 km |
| satellites | 2 |



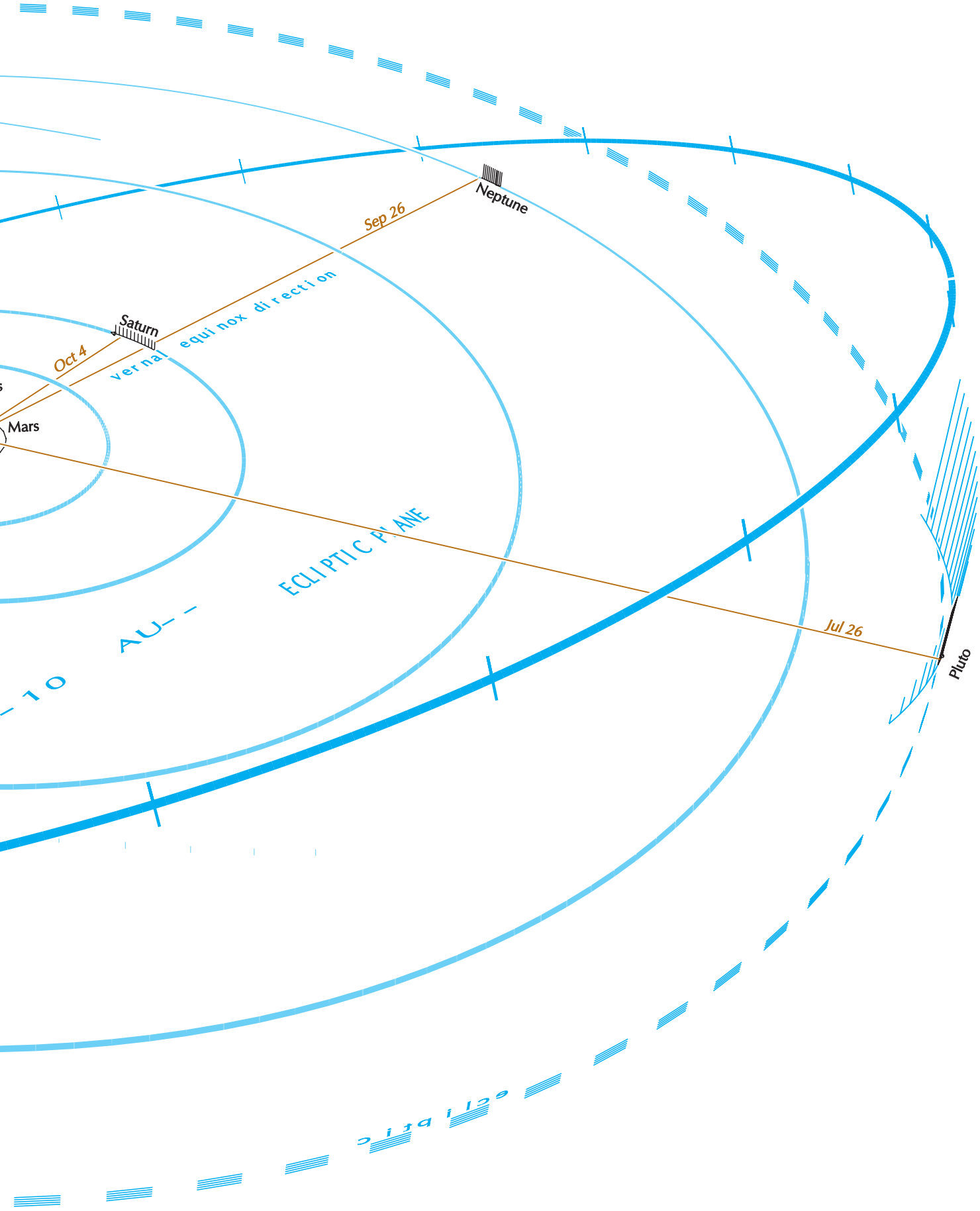

**Map of Mars's track against the starry background, ecliptic-based like the Mercury and Venus maps. The scale is 1.5 mm to 1°. The track is drawn in gray when Mars is in the morning sky (after conjunction with the Sun). Part of the track for the next year is included (different color). Short lines connect Mars to other planets when they appear closest.**

# OUTER PLANETS




**Space view of the planetary system. The major planets' orbits are shown in blue, their paths for this year (omitting Mercury and Venus) in black, with stalks to the ecliptic plane at monthly intervals. The lines from Earth to the planets are at their oppositions. Also shown are a few minor bodies (of which there could be thousands in the picture): dwarf planets Ceres (the largest of the Main Belt asteroids, between Mars and Jupiter) and Pluto (the most prominent of the trans-Neptunian objects; it crossed outward over Neptune's orbit in 1999); and Comet 1P Halley, which at its last visit was first observed in 1982, was at perihelion in 1986, at aphelion in 2023, and is still more than 35.2 AU from the Sun. The viewpoint is 100 AU from the Sun. The equatorial and ecliptic planes are represented by circles around the sky at 35 AU from the Sun.**

**The four giant planets are now spread around more than a quarter of the sky. From Neptune to Jupiter, the span of ecliptic longitude increases from 107.9° at the beginning of the year to 135.2° at the end.**


Neptune
Sep 26
Saturn
equinox direction
vernal
Oct 4
Mars
ECLIPTIC PLANE
Jul 26
Pluto
AU
10
ecliptic

# JUPITER

| | | | |
|---|---|---|---|
| mean dist. from Sun | 5.2 AU | inclination | 1.3° |
| sidereal period | 11.86 years | diameter | 143,000 km |
| synodic period | 399 days | satellites | 95 |
| eccentricity | .048 | | |

| Jupiter 2026 | | RA(2000) | dec | hedis | gedis | elo | mag | diam |
|---|---|---|---|---|---|---|---|---|
| Jan 10 | 9 opposition | 7 27 | 22 11 | 5.215 | 4.232 | -180 | -2.7 | 46.5 |
| Mar 11 | 2 stat.in r.a.>dir. | 7 6 | 22 56 | 5.237 | 4.745 | 115 | -2.4 | 41.4 |
| Mar 11 | 3 stat.in long>dir. | 7 6 | 22 56 | 5.237 | 4.746 | 115 | -2.4 | 41.4 |
| Mar 13 | 12 max.declin.north | 7 6 | 22 56 | 5.238 | 4.781 | 112 | -2.4 | 41.1 |
| Apr 5 | 22 east quadrature | 7 10 | 22 50 | 5.246 | 5.150 | 90 | -2.2 | 38.2 |
| Jul 29 | 12 conjunc.with Sun | 8 36 | 19 7 | 5.286 | 6.301 | 0 | -1.8 | 31.2 |
| Jul 30 | 15 farthest fr.Earth | 8 37 | 19 4 | 5.286 | 6.301 | -1 | -1.8 | 31.2 |
| Nov 18 | 10 west quadrature | 9 54 | 13 32 | 5.322 | 5.230 | -90 | -2.1 | 37.6 |
| Dec 13 | 0 stat.in long>retr | 9 58 | 13 18 | 5.330 | 4.854 | -114 | -2.3 | 40.5 |
| Dec 13 | 11 stat.in r.a.>retr | 9 58 | 13 18 | 5.330 | 4.847 | -114 | -2.3 | 40.6 |

The giant planet has nearly 3 times the mass of all the others together (though less than 1/1000 of the Sun's). It takes nearly 12 years to go around the Sun. Each year, it advances about 30°, spending roughly a year in each zodiacal constellation.

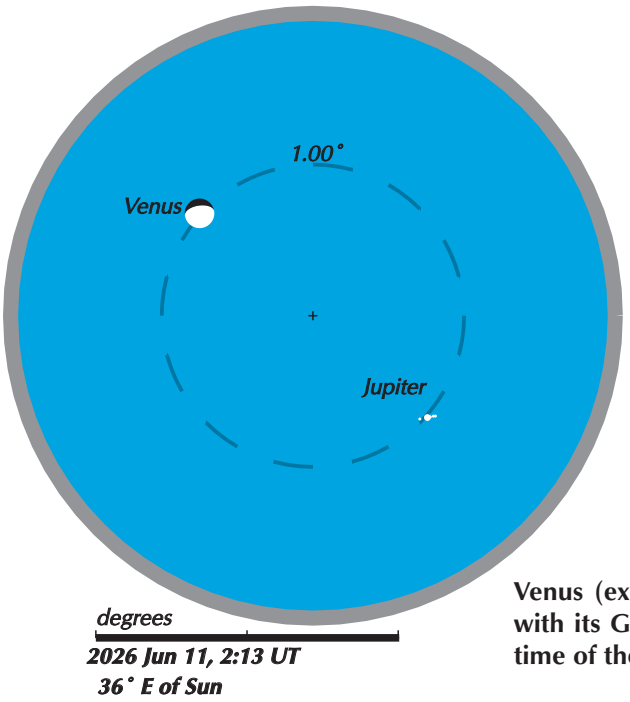
So the Earth takes a bit more than 13 months to catch up and again pass Jupiter at opposition. (This is Jupiter's "synodic" or seen-from-Earth period.) The oppositions advance from January to February and so on, also moving later in each month, so that occasionally a month is skipped; and, after 11 oppositions, a year is skipped, as 2013, 2025, and 2037. The retrograde loops centered on oppositions run along the planet's celestial track like kinks along a flicked rope. The cycle of oppositions has to start with Jupiter in Gemini, to which Earth faces outward in January.

2025 was a no-opposition year, so 2026 is the start of a new cycle. The opposition, early in January, is a fine one for north-hemisphere observers. Jupiter is on the northern arch of the ecliptic, or even slightly above it, being in the part of its orbit that is north of the ecliptic plane. The golden planet is about at its nearest to us and appears widest and brightest. With its retinue of satellites, it is almost in front of the star delta Geminorum whose Arabic name, Wasat, means the "middle" of one of the twins.

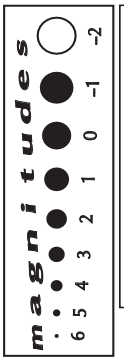
As we pass Jupiter, it appears to move backward in Gemini until March 11; then resumes its stately eastward progress, into Cancer. For nearly half of the year, it dominates the early and middle hours of the night sky, until sinking into the lower evening sky and meeting there on June 9 the even brighter Venus.

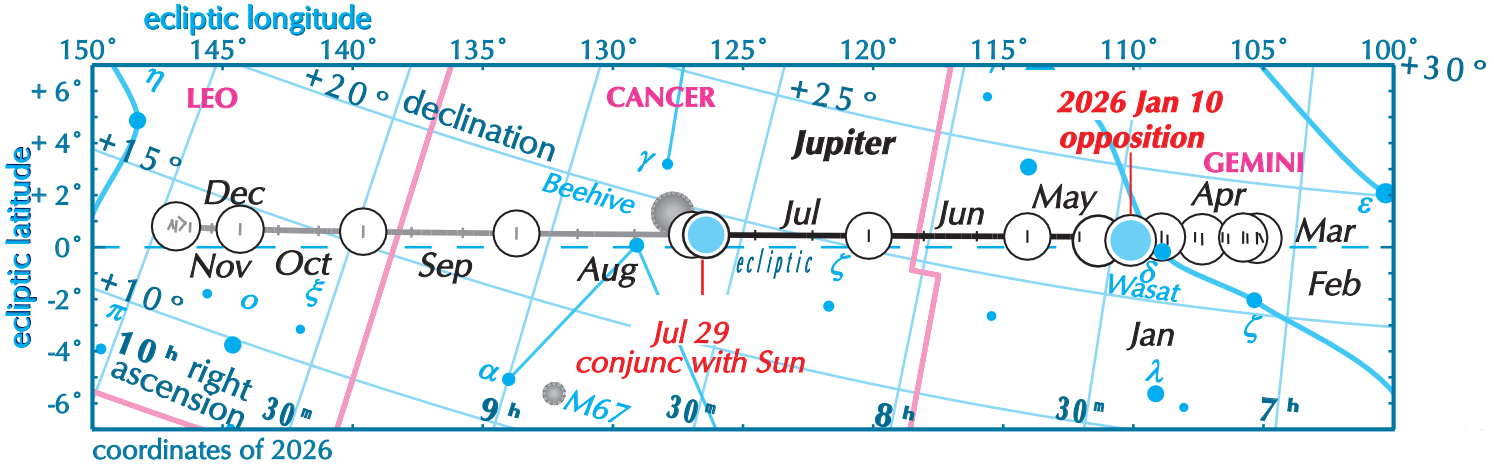
Jupiter passes behind the Sun on July 29, against the distant background of the Praesepe or Beehive star cluster in the middle of Cancer.

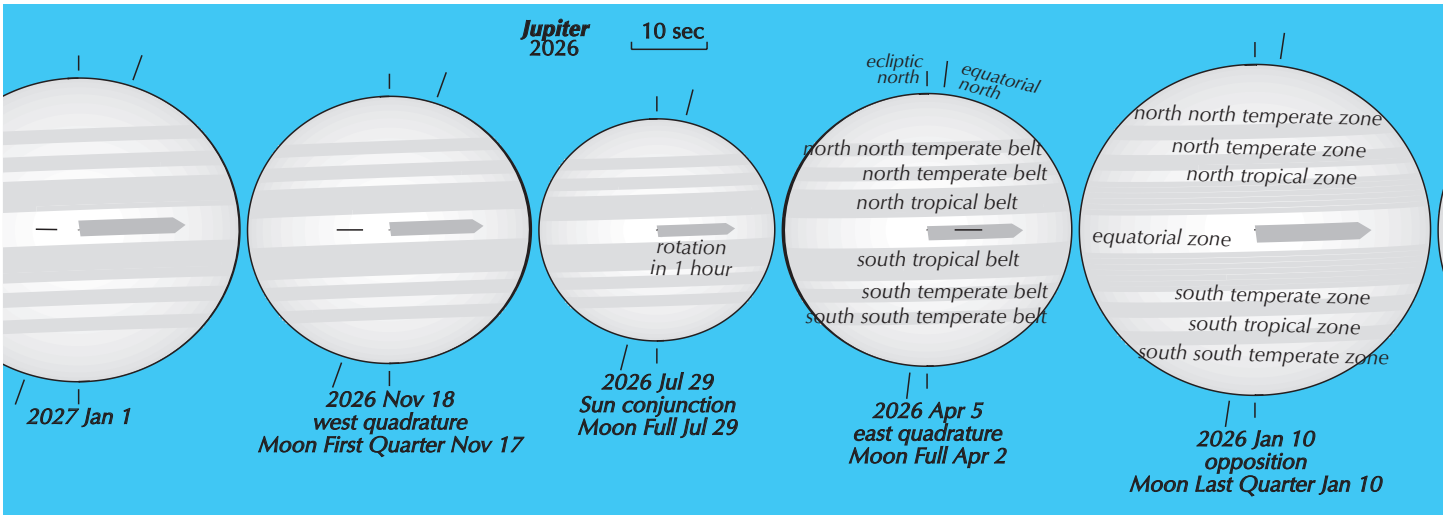
From August, Jupiter is conspicuous in the pre-dawn sky. On December 13 it comes to the apparent halt that is the beginning of its next retrograde loop, leading to the opposition of 2027 Feb. 11,



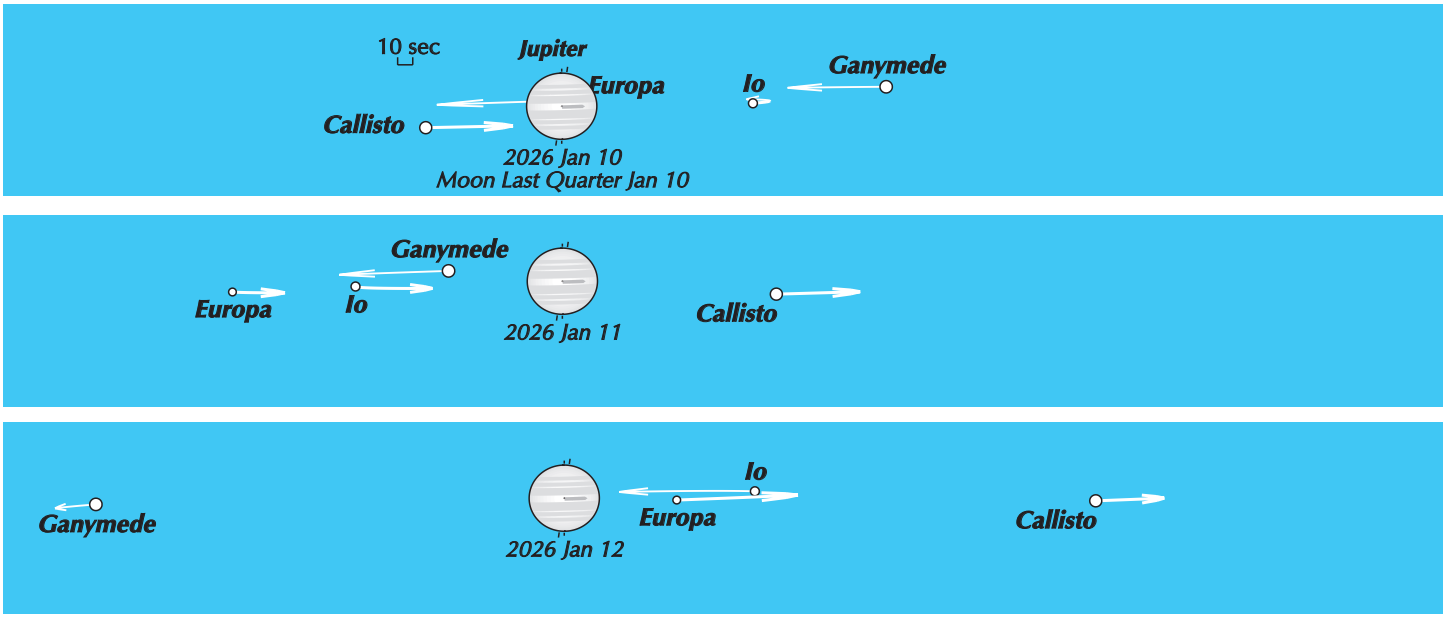

**Venus (exaggerated 10 times in size) and Jupiter with its Galilean satellites, seen 2° apart near the time of their conjunction.**






**Jupiter at start and end of the year and when farthest (Sun-conjunction). Shown are the planet's light "zones" and darker "belts." Ecliptic north is up, and a longer line shows the direction to equatorial north.**



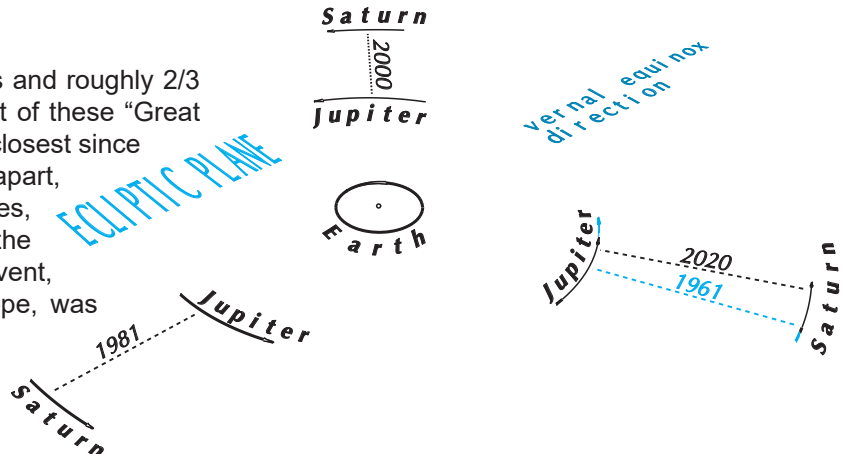

**The four major or "Galilean" satellites of Jupiter (among Galileo's first discoveries with his telescope, in Jan. 1610), on the day of the planet's opposition and the next two days. Their movements are shown from 0h to 6h UT: by North American clocks, 5 or more hours earlier, so in the early night of the previous date. Ecliptic north is at top. The satellites are exaggerated 5 times in size. They move almost in circles, almost exactly in the plane of Jupiter's equator, which is tilted about 3° to the plane of its orbit. This plane pointed straight at us in 2021, so that the satellites appeared to move in straight lines. Since then the plane has passed south of us.**

### Jupiter-Saturn conjunctions

Jupiter overtakes Saturn roughly each 20 years and roughly 2/3 of the way onward around the circle. The latest of these "Great Conjunctions" was on 2020 Dec. 21. It was the closest since 1623. The two came to within a tenth of a degree apart, and could be seen, with their families of satellites, in one telescope field. It happened rather low in the evening sky, 30° from the Sun. But the 1623 event, shortly after the 1609 invention of the telescope, was less than half as far out, 13°, in the sunset sky.

Jupiter is now ahead of Saturn by about 107° at the start of the year and 125° at the end. For a great deal more about Great Conjunctions, see

www.universalworkshop.com/conjunctions-of-jupiter-and-saturn/



# SATURN

| | | | |
|---|---|---|---|
| mean dist. from sun | 9.5 AU | inclination | 2.5° |
| sidereal period | 29.46 years | diameter | 120,500 km |
| synodic period | 378 days | satellites | 274 |
| eccentricity | .056 | | |

| Saturn 2026 | | RA(2000) | dec | hedis | gedis | elo | mag | diam |
|---|---|---|---|---|---|---|---|---|
| Mar 25 | 9 conjunc.with Sun | 0 21 | -0 4 | 9.493 | 10.489 | 2 | 0.9 | 15.8 |
| Mar 26 | 20 on equat.,to nor. | 0 21 | 0 0 | 9.492 | 10.489 | -2 | 0.9 | 15.8 |
| Jul 6 | 11 west quadrature | 0 57 | 3 27 | 9.461 | 9.406 | -90 | 0.8 | 17.6 |
| Jul 26 | 18 stat.in long>retr | 0 58 | 3 30 | 9.455 | 9.075 | -109 | 0.7 | 18.3 |
| Jul 27 | 22 stat.in r.a.>retr | 0 58 | 3 30 | 9.455 | 9.057 | -110 | 0.7 | 18.3 |
| Oct 4 | 12 opposition | 0 46 | 1 58 | 9.434 | 8.434 | -177 | 0.3 | 19.6 |
| Dec 10 | 23 stat.in long>dir. | 0 33 | 0 48 | 9.413 | 9.046 | 109 | 0.8 | 18.3 |
| Dec 11 | 22 stat.in r.a.>dir. | 0 33 | 0 49 | 9.413 | 9.062 | 108 | 0.8 | 18.3 |
| Dec 29 | 23 east quadrature | 0 34 | 1 1 | 9.407 | 9.356 | 90 | 0.8 | 17.7 |

The sixth planet was the outermost—beyond it only the sphere of the stars—until the discovery of Uranus in 1781.

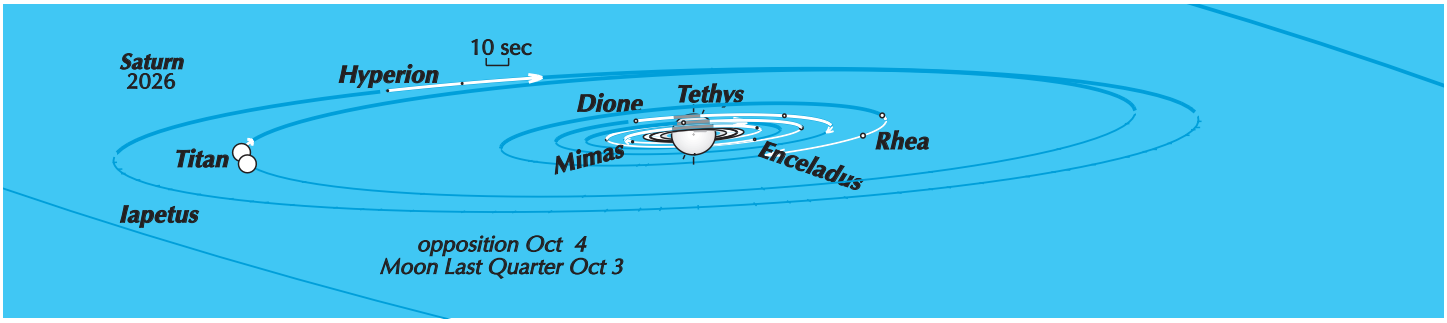
In everything except its superb rings, Saturn ranks second to Jupiter: 0.8 times as wide, 0.3 as massive, hence 0.5 as dense—lighter than water. It is 1.8 times farther from the Sun, thus appears on average 0.4 as wide and about 3 magnitudes dimmer. Moving through space 0.7 times as fast, it takes 2.5 times as long, nearly 30 years, to finish an orbit. (5 revolutions of Jupiter equal about 2 of Saturn.) Jupiter spends about one year in each zodiacal constellation; Saturn averages 2½. Its events as seen from Earth, such as opposition, fall about 13 days later each year.

Saturn spent 2025 moving to and fro between Aquarius and Pisces. 2026 is an unusual year in which the planet's course, because here lying 2° south of the ecliptic, takes it across a corner of the non-zodiacal constellation Cetus, the whale. Most of the July-to-December retrograde loop, and the opposition itself in October, are in Cetus.

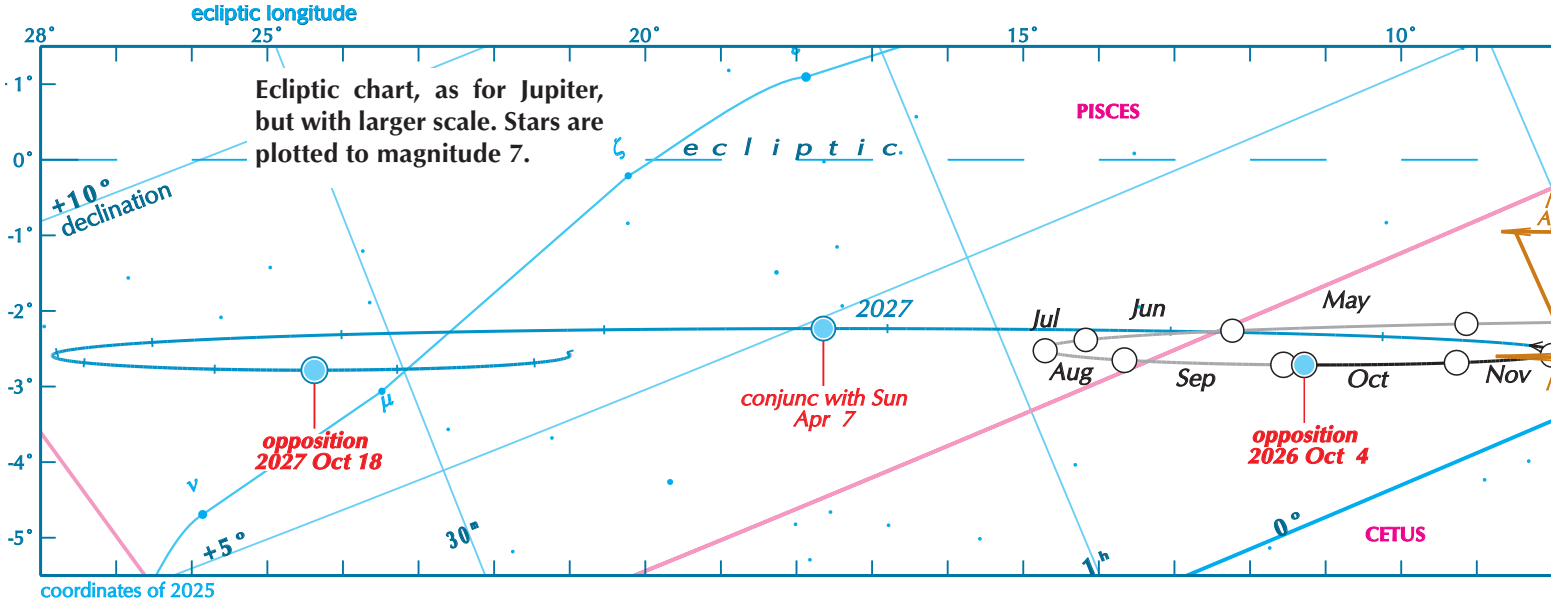
At first, Saturn is high in the evening sky, but sinks toward the sunset and in March is lost behind the Sun. At the same time it crosses the equator into the northern celestial hemisphere, to remain there for about half of its orbit.

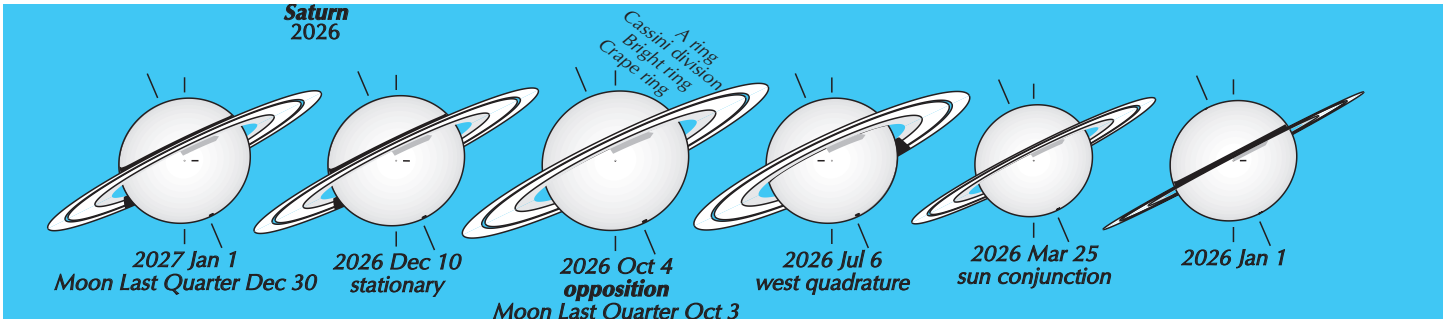
After emerging into the morning sky, it meets there in April Mars and Mercury. In July it is 90° out from the Sun, hovering at the beginning of the retrograde path.

Saturn is on the inward curve of its orbit (slightly more elliptical than Jupiter's). It was at aphelion in 2018, will reach perihelion in 2032. So at opposition on Oct. 4 it is a few million kilometers nearer than last year. The ball of the planet appears 19.6" wide; the rings are 2.29 times wider. Saturn's magnitude at opposition is 0.3, slightly brighter than last year's dim 0.6; it can be as bright as -0.48, as in 2002, 2031, and 2032..



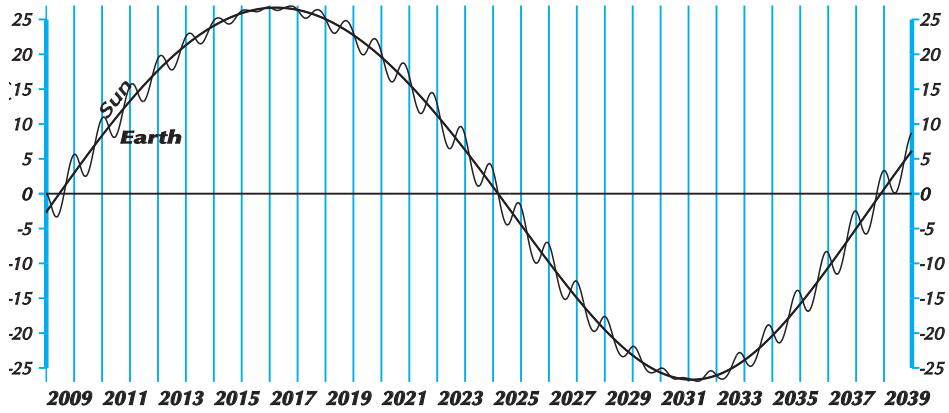

**Major satellites of Saturn. They are drawn at 0h and 12h UT of the day of opposition, exaggerated 10 times in size. In contrast with the picture for Jupiter, it is more convenient to have equatorial north at the top. The shorter line from the planet points to ecliptic north. Saturn's equatorial plane, which is also the plane of the rings and inner satellites, is almost parallel to Earth's equatorial plane. The orbits of the inner satellites, like the rings, were most open toward us in 2017, were edge-on in 2025, and are opening out as the plane aims north of us.**



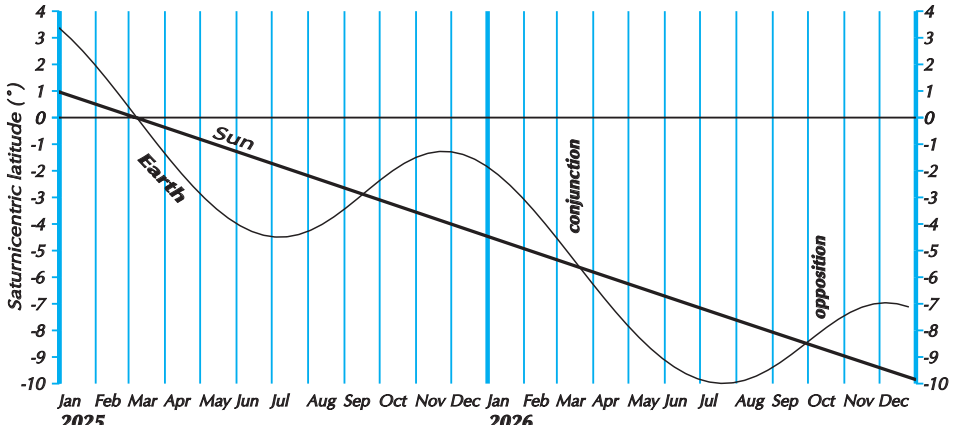


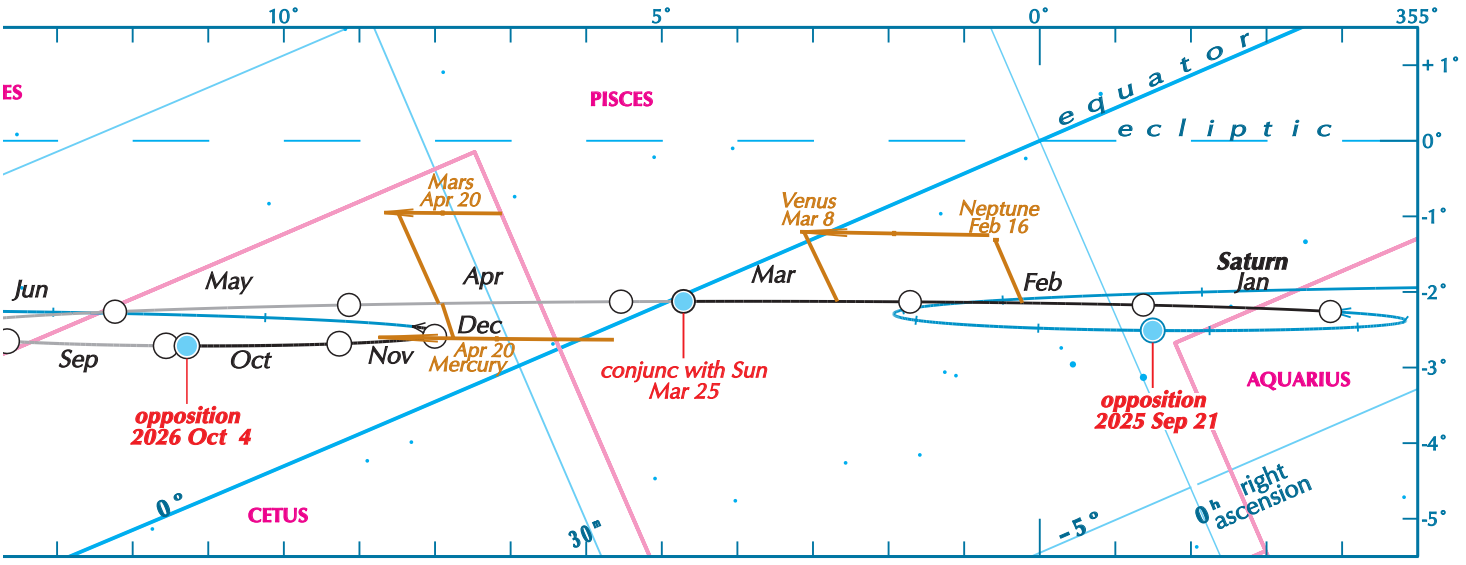

**Saturn and rings this year. Times around east and west quadrature are better than opposition for seeing the shadow of or on the rings, and eclipses of the satellites.**

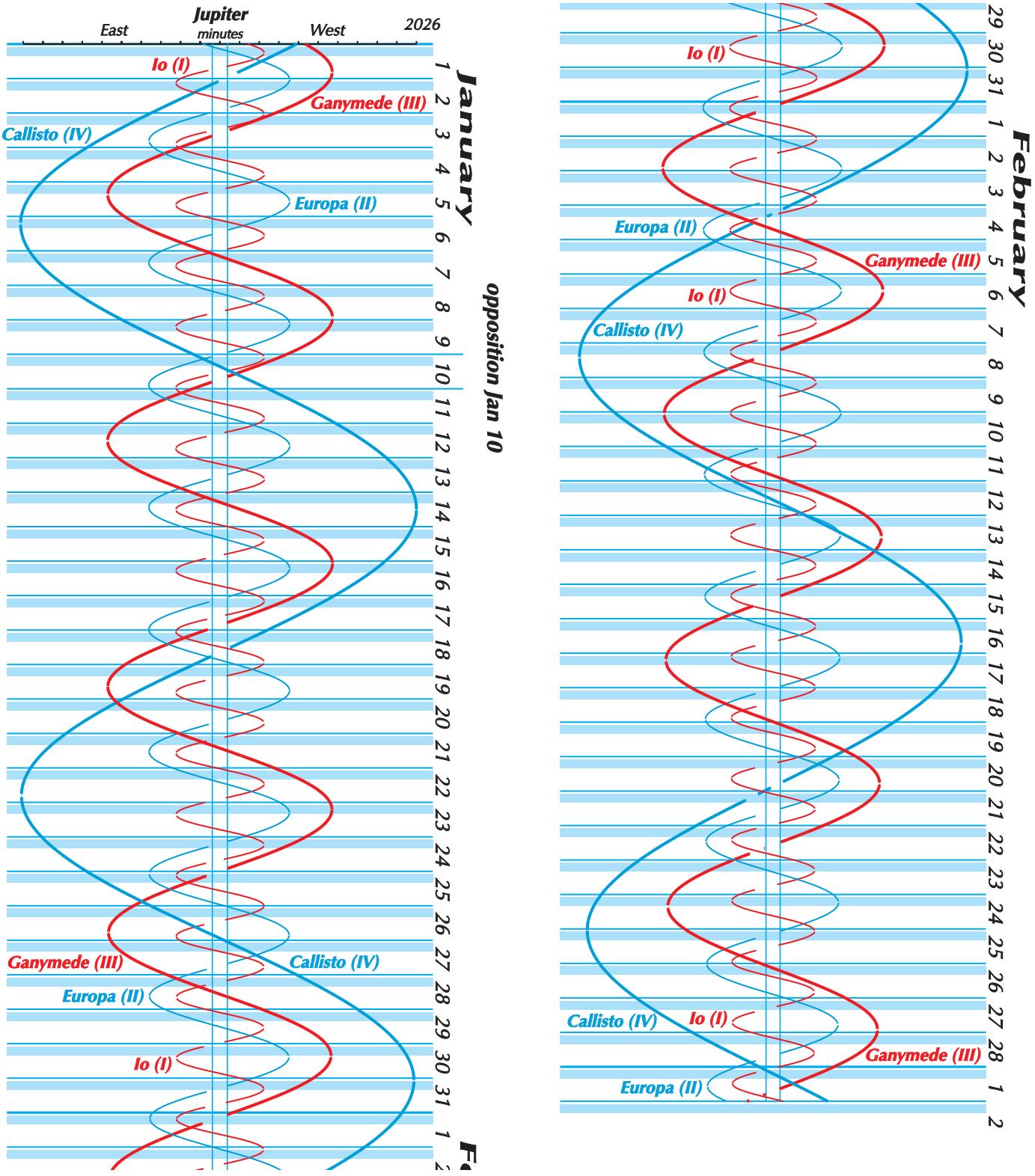
The rings, revolving in the plane of the planet's equator, were edge-on to Sun and Earth in 2009, a triple event because of its timing. Then the rings' northern face was sunlit and open toward us, most so in 2017. In March 2025 they return through edge-on. The southern side continues to open wider toward us until 2031.




**Latitude of Sun and Earth as seen from Saturn. For the Sun, two lines very close together represent its width of about 0.1° as seen from Saturn. The oscillation of Earth's view of Saturn is caused by Earth's own circling around the Sun. At dates of opposition and Sun-conjunction, Earth and Sun are both in the plane of Saturn's equator and rings.**



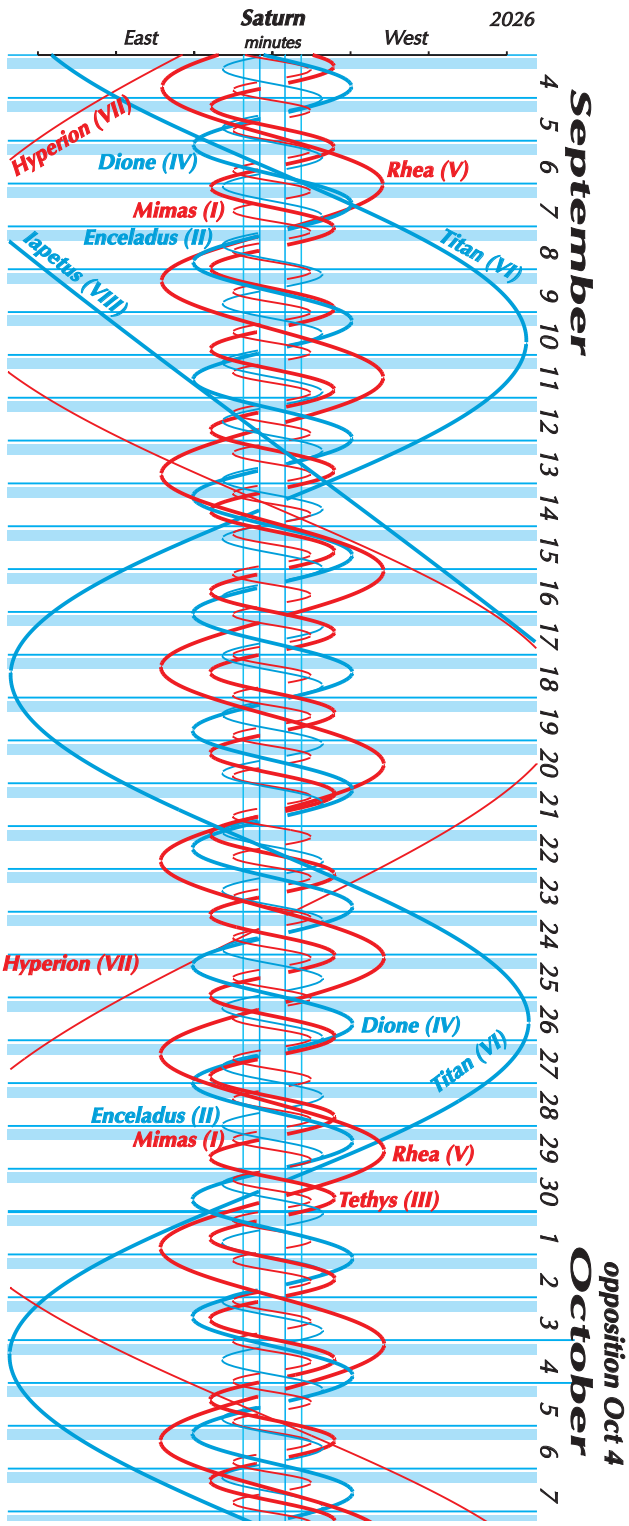



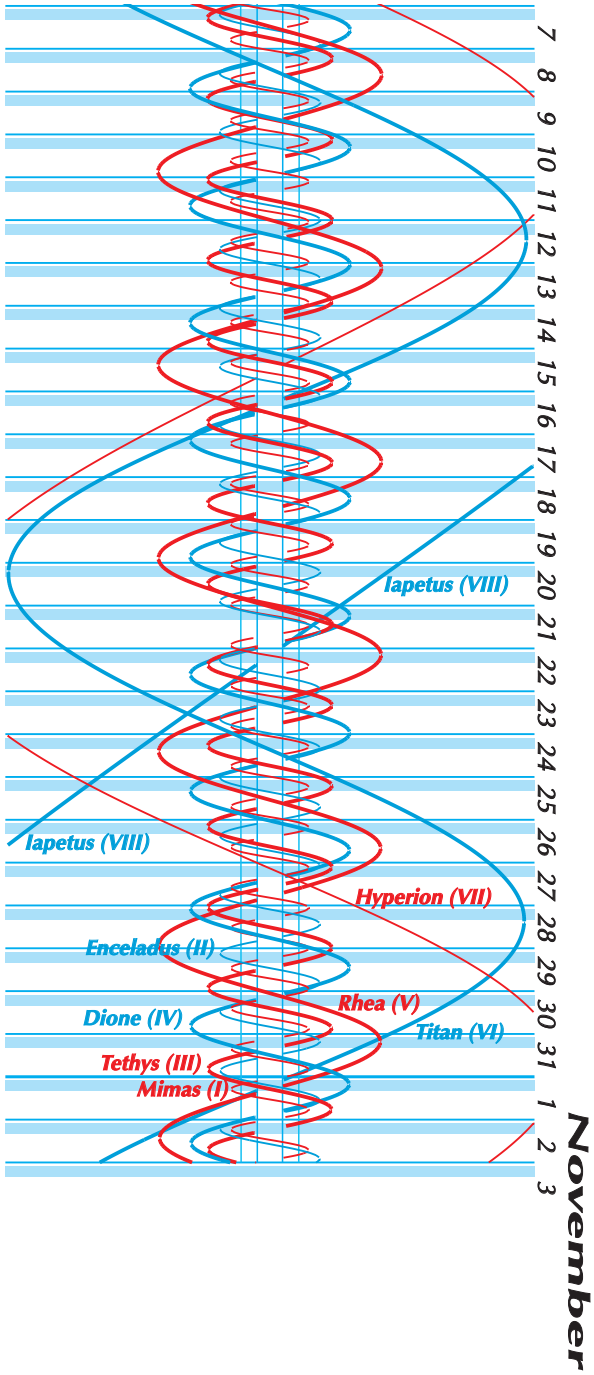



Corkscrew graphs of the major satellites of Jupiter and Saturn, for spans of 60 days around the planets' oppositions. The cross dimension is apparent distance from the planet's center. The scale bar at the top shows this distance in minutes of arc. The pair of lines down the middle represents the planet's width. For Saturn, an outer pair of lines shows the width of the rings. The curves are red for the odd-numbered satellites, and thick for the larger ones (Jupiter's over 4,000 km in diameter, Saturn's over 1,000 km).

Each cross line is at 0h UT. This is 7 PM EST (8 PM EDT). Thus the light blue bar roughly represents night in eastern America, starting in the evening of the previous date. In Europe this night-bar would be higher, centered on the cross-line; farther west in America, it should be slightly lower.

Jupiter is 143,000 km wide. The distances of the satellites from its center are: Io 422,000 km, Europa 671,000, Ganymede 1,070,000, Callisto 1,880,000. In apparent width, Jupiter varies from 31″ when farthest from us, at Sun-conjunction, to 48″ when nearest, at opposition. The apparent width of the satellite-system swells and shrinks likewise.




East is to the left, because north is to the top. If you're about to look in an inverting telescope, turn the picture around.

The satellites, orbiting their planet in the "direct" or typical solar-system way, pass on the near side when going from east to west (through their inferior conjunctions with the planet), so that (1) they transit the planet and (2) their shadows transit it. When going the other way they pass behind it, and then their curves are interrupted wherever they are (3) occulted behind the planet or (4) eclipsed in its shadow. Jupiter's major satellites go through these events at every revolution, except for the most distant, Callisto. It generally passes clear north or south of the planet, but had a series of eclipses from 2013 July 28 to 2016 July 21.

Near opposition, planet and satellites loom largest but get in front of their own shadows, so it is good also to look many days before or after, when the shadows are cast more sharply east or west. The best times for such phenomena are near the planet's quadratures (90° from the Sun), when its shadow is cast most sharply east or west.

# URANUS AND NEPTUNE

| URANUS | |
|---|---|
| mean dist. from sun | 19.2 AU |
| sidereal period | 84.0 years |
| synodic period | 370 days |
| eccentricity | .047 |
| inclination | .77° |
| equat.diameter | 51,118 km |
| satellites | 28 |

| NEPTUNE | |
|---|---|
| mean dist. from sun | 30 AU |
| sidereal period | 165 years |
| synodic period | 367 days |
| eccentricity | .009 |
| inclination | 1.8° |
| equat.diameter | 49,568 km |
| satellites | 16 |

The family of six known planets first increased on 1781 March 13, when William Herschel, a German musician living at Bath in England, discovered what he took for a comet: it was the planet soon named Uranus. It is just above the naked-eye brightness limit and had been at least 20 times plotted on maps as a star.

By 1844, small discrepancies in its motion suggested that there was a yet more remote planet, which Uranus would have passed in 1821. Urbain Leverrier in France calculated its position, as a result of which Galle and d'Arrest at Berlin telescopically found Neptune on the evening of 1846 Sep. 23. It used to be considered that John Couch Adams had equal credit. He had been earlier in working on the solution, but had bad luck with the British astronomy establishment, and his work did not lead to the discovery.

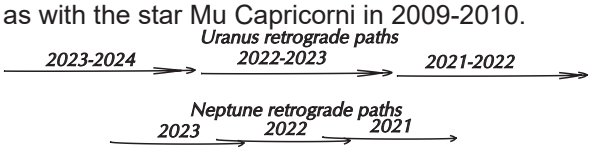
Uranus and Neptune creep along vast orbits, 19 and 30 times Earth's distance from the Sun, at 6.8 and 5.5 kilometers a second, advancing only about 4° and 2° a year. So their yearly events, such as oppositions, fall about 4 and 2 days later. After their unseen conjunction of 1821, Uranus pulled all around the sky to its first observed overtaking of Neptune, in 1993. In 2011 Neptune finished its first orbit since discovery. In 2026, Uranus is from 60.5° to 62.5° ahead of Neptune.

Both planets were in the southern celestial hemisphere from 1969 until Uranus crossed the equator in 2011-2012. This was a triple event because of retrograding: northward 2011 Apr. 9, back south Oct. 16, north again 2012 Jan. 28. Neptune now follows suit, northward Apr. 24, south Sep. 25; the final crossing to the north will be 2027 Feb. 26.

Uranus and Neptune are traveling south of the ecliptic. Uranus was at southernmost latitude in 2007 and will be at ascending node in 2029. Neptune's orbit is inclined 1° more, but its apparent difference from the ecliptic is reduced by its distance. It descended through the ecliptic in 2003 and will not reach its 1.77° southernmost latitude till 2044. In years near the nodes, the planets' forward and backward paths become almost straight lines. From 2000 to 2007 Neptune remained near enough to the ecliptic that at each inferior conjunction it was occulted by the 1/2°-wide Sun (an event that of course we could not observe).

Uranus is at a distance such that the apparent retrograde parts of its path are just short of 5 months long. They almost kiss: the point where Uranus turned back last year is close to that to which it retreats this year. (And to that of last year's Sun-conjunction, halfway between them in time.)

Neptune's retrograde paths are a week longer, and overlap. This even more distant planet is further toward being like a "fixed" star. The overlapping means that Neptune goes five times past any adjacent star—a quintuple conjunction, as with the star Mu Capricorni in 2009-2010.



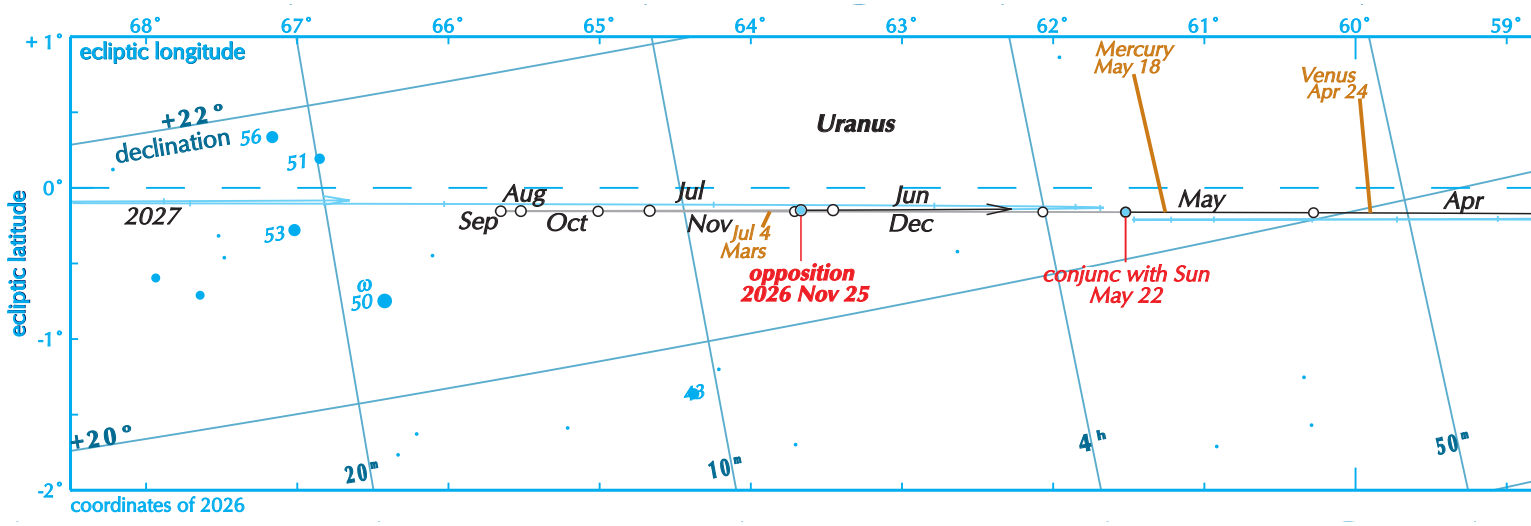

**Retrograde paths of Uranus and Neptune in successive years, from each first stationary point back to the second.**

Uranus was at aphelion in 2009 (20.099 AU from the Sun) and will be at perihelion in 2050, so it is still at greater than average distance. Neptune was at aphelion in 1959 and will be at perihelion in 2042. But these are non-simple events, because Neptune's orbit, the nearest to circular after Venus's, has a ripple (explained in the "Neptune's circular yet wavy orbit" section of *Uranus, Neptune, Pluto*).

These giant planets are not much different in size, and despite Neptune's 50% greater distance their apparent widths at opposition are not much different 3.8" and 2.3". But the difference between their magnitudes of 5.6 and 7.8 means that the star-like image of Uranus is findable by a keen naked eye on a good night, whereas Neptune is 7 times fainter.

Close up, Uranus may be more greenly blue than Nep-

**Ecliptic charts, at scale 2 cm per degree. Tracks are gray when the planets are in the morning sky. Lines to other planets are at dates of appulse (closest conjunction).**



tune, but in telescopes these colors are subtle. Uranus's surface is bland, Neptune's shows more activity. Neptune is slightly smaller, but more massive, hence denser.

Uranus is the odd planet in that it rotates "on its side": almost perpendicularly to the plane of its orbit (and ours). (Which of its poles is really "north"?—for more on this problem, see "north" in our glossary *Albedo to Zodiac*.) Its equatorial plane becomes edge-on to the Sun each 42nd year; this Uranian equinox happened (for the 3rd time since discovery) on 2007 Dec. 16.

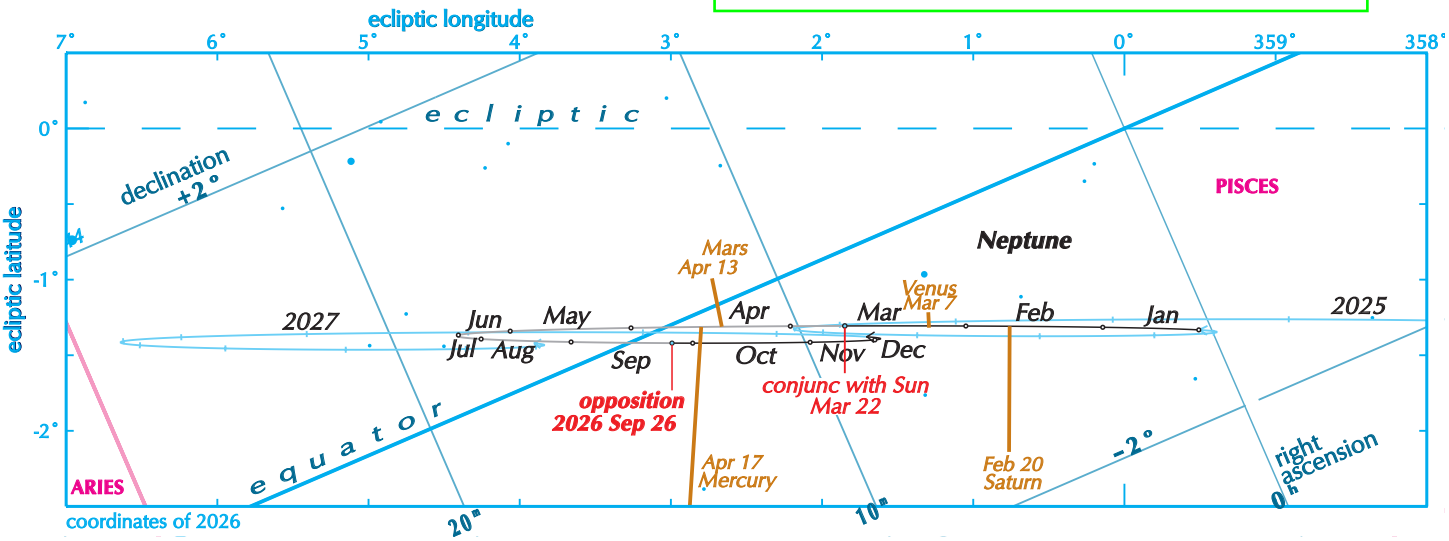
Uranus's first two satellites, Titania and Oberon, were also discovered by Herschel, in 1787; he suspected a ring in 1789, but the thin rings were really discovered in 1977, and 13 are now known. Rings and chief satellites revolve in the planet's equatorial plane. Transits of the satellites and their shadows across the planet were first observed in 2006, and were possible for about 3 years.

| Uranus 2026 | | | RA(2026) | dec | hedis | gedis | elo | mag | diam |
|---|---|---|---|---|---|---|---|---|---|
| Feb 3 | 23 | stat.in long>dir. | 3 41 | 19 24 | 19.5 | 19.250 | 102 | 5.7 | 3.6 |
| Feb 4 | 1 | stat.in r.a.>dir. | 3 41 | 19 24 | 19.5 | 19.251 | 102 | 5.7 | 3.6 |
| Feb 16 | 5 | east quadrature | 3 41 | 19 26 | 19.5 | 19.457 | 90 | 5.7 | 3.6 |
| May 22 | 14 | conjunc.with Sun | 3 58 | 20 18 | 19.5 | 20.477 | 0 | 5.8 | 3.4 |
| Aug 28 | 22 | west quadrature | 4 15 | 21 5 | 19.4 | 19.421 | -90 | 5.7 | 3.6 |
| Sep 10 | 17 | stat.in r.a.>retr | 4 15 | 21 6 | 19.4 | 19.205 | -102 | 5.7 | 3.6 |
| Sep 10 | 17 | stat.in long>retr | 4 15 | 21 6 | 19.4 | 19.205 | -102 | 5.7 | 3.6 |
| Nov 25 | 22 | opposition | 4 7 | 20 44 | 19.4 | 18.444 | -180 | 5.6 | 3.8 |

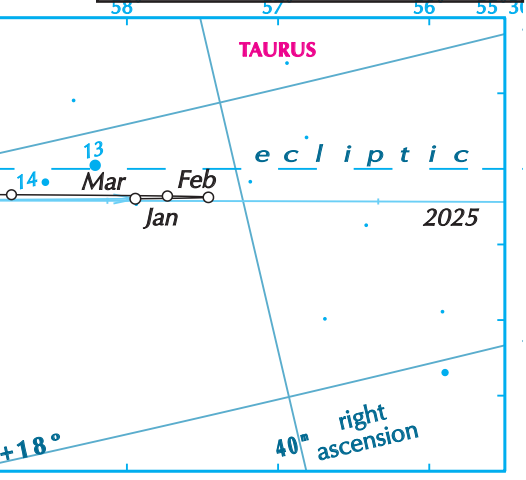
| Neptune 2026 | | | RA(2000) | dec | hedis | gedis | elo | mag | diam |
|---|---|---|---|---|---|---|---|---|---|
| Mar 22 | 11 | conjunc.with Sun | 0 9 | -0 28 | 29.9 | 30.879 | 1 | 8.0 | 2.2 |
| Apr 24 | 1 | on equat.,to nor. | 0 13 | 0 0 | 29.9 | 30.740 | -31 | 7.9 | 2.2 |
| Jun 25 | 23 | west quadrature | 0 18 | 0 29 | 29.9 | 29.863 | -90 | 7.9 | 2.2 |
| Jul 7 | 8 | stat.in long>retr | 0 18 | 0 30 | 29.9 | 29.673 | -101 | 7.9 | 2.3 |
| Jul 8 | 0 | stat.in r.a.>retr | 0 18 | 0 30 | 29.9 | 29.661 | -101 | 7.9 | 2.3 |
| Sep 15 | 21 | on equat.,to sou. | 0 14 | 0 0 | 29.9 | 28.888 | -170 | 7.8 | 2.3 |
| Sep 26 | 1 | opposition | 0 13 | -0 7 | 29.9 | 28.876 | -179 | 7.8 | 2.3 |
| Dec 12 | 19 | stat.in long>dir. | 0 8 | -0 38 | 29.9 | 29.675 | 101 | 7.9 | 2.3 |
| Dec 13 | 7 | stat.in r.a.>dir. | 0 8 | -0 38 | 29.9 | 29.684 | 100 | 7.9 | 2.3 |
| Dec 23 | 12 | east quadrature | 0 8 | -0-37 | 29.9 | 29.860 | 90 | 7.9 | 2.2 |

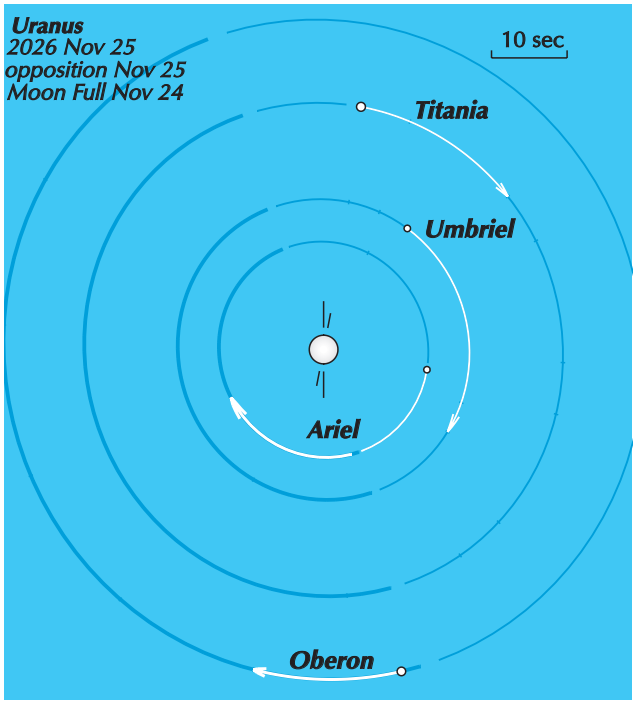
'You are now sailed into the north of my lady's opinion; where you will hang like an icicle on a Dutchman's beard...

Shakespeare, Twelfth Night, Act 2, Scene 2

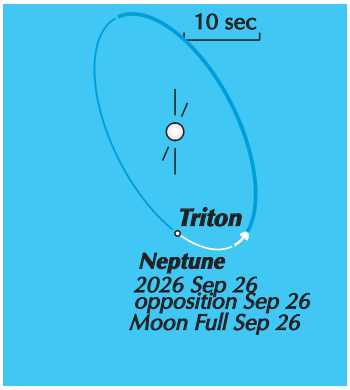



There is far more to be said about the discovery story of the outer planets, and the interlocking patterns of their motions. It's all in our book *Uranus, Neptune: A Longer View*.




**Major satellites. Their tracks are shown in white for one UT day. The satellites' sizes are exaggerated by 10. The longer pointers above the planets are to the north celestial pole (at top), the shorter to the north ecliptic pole.**



# ASTEROIDS

The age of the asteroids began on 1801 Jan. 1, when Giuseppe Piazzi, at Palermo in Sicily, discovered what he and the astronomers of Europe hoped was the “missing planet” in the wide gap between Mars and Jupiter. He named it Ceres, for the Roman goddess of the harvest and patroness of Sicily. Three more were discovered in the next few years, and also named for classical goddesses: Pallas, Juno, Vesta.

There was a pause till 1845, when the 5th was found. Then as these small bodies became numerous they were no longer called planets but *asteroids*, “star-like,” because they did not show perceptible disks like the planets; later, more officially *minor planets*. Thousands are discovered each year, and there must be millions that are over a few meters in size. They receive temporary designations, then numbers when their orbits are securely known.

Most circulate in a Main Belt between Mars and Jupiter, but there are peculiar classes that go nearer in, some across Earth’s orbit, or farther out. All are below naked-eye brightness except sometimes 4 Vesta.

The First Four are reliably observable each year, though 3 Juno is usually the dimmest and is surpassed by various others from lower down the list that happen to be at favorable oppositions. These Main Belt asteroids have periods of between 3 and 5 years. In each of their circuits of the sky they miss opposition in the year when they pass the direction outward from Earth’s December-January position.

Last year, none of the Four achieved opposition; this year, all do except for Ceres.

**Orbital and other facts.**
**q: perihelion distance.**
**a: mean distance.**
**Q: aphelion distance.**
**e: eccentricity.**
**P: period.**
**i: inclination.**

| name | discov. | diam. | q | a | Q | e | P | i |
|---|---|---|---|---|---|---|---|---|
| | | km | AU | AU | AU | | years | |
| 1 Ceres | 1801 | 939 | 2.55 | 2.77 | 2.98 | 0.08 | 4.60 | 11 |
| 2 Pallas | 1802 | 511 | 2.13 | 2.77 | 3.41 | 0.23 | 4.61 | 35 |
| 3 Juno | 1804 | 254 | 1.98 | 2.67 | 3.35 | 0.26 | 4.36 | 13 |
| 4 Vesta | 1807 | 525 | 2.15 | 2.36 | 2.57 | 0.09 | 3.63 | 7 |

**1 Ceres** is so much larger than the other asteroids that it has been re-classified as a dwarf planet, along with Pluto (formerly regarded as a major planet) and the trans-Neptunian bodies Eris, Haumea, Makemake, and possibly others - all larger than Ceres but far more distant.

Ceres was at opposition on 2025 Oct. 2, so much south of the Pisces part of the ecliptic that it appeared in Cetus. In 2026 it slides steadily northward, in both the ecliptic and the equatorial senses. On Sep. 13 it reaches ascending node on the northernmost stretch of the ecliptic, at the beginning of Gemini. On Nov. 21 it curves, even farther north, into the retrograde loop that will culminate in the next opposition on 2027 Jan. 7.

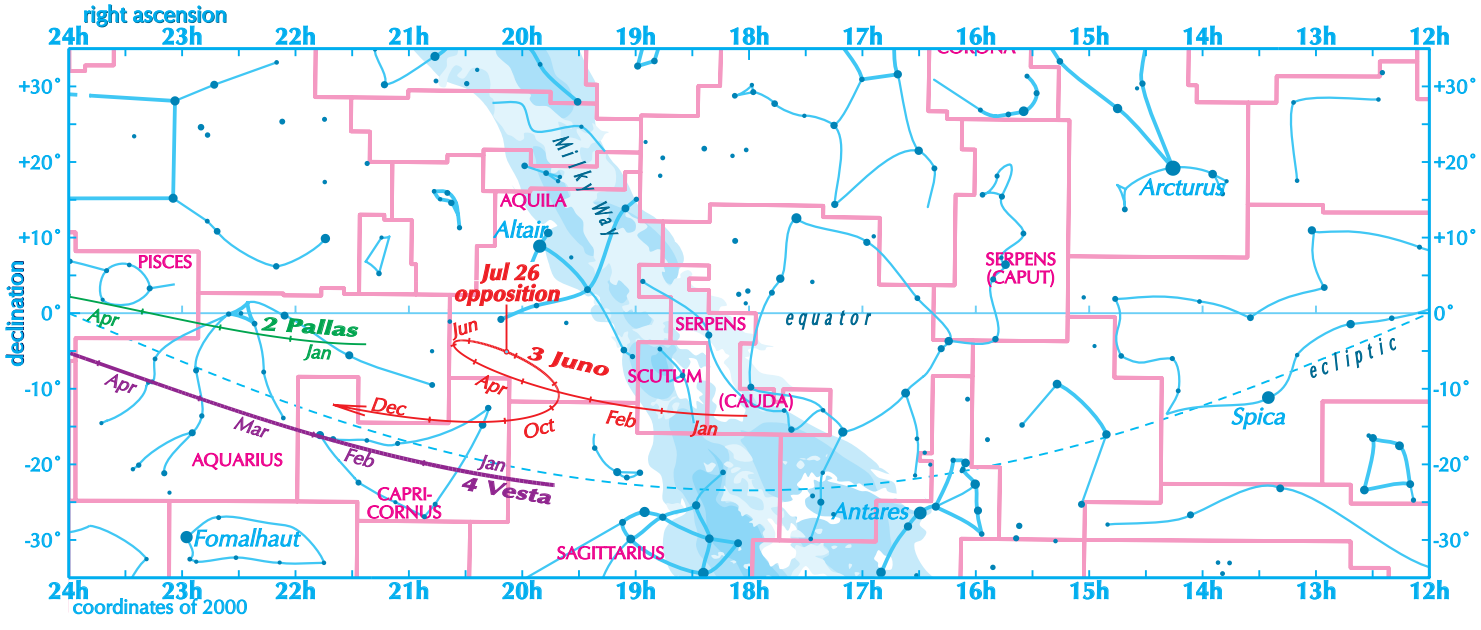
**2 Pallas** has an orbit of higher inclination (35°) than other large asteroids. So we often look steeply north or south to it from the ecliptic plane, causing it to make extravagant apparent loops. But the north-south extremes are half canceled by another factor: the orbit’s orientation, with descending node not far west of the vernal equinox point, puts Pallas usually nearer to our celestial equator than to the ecliptic.

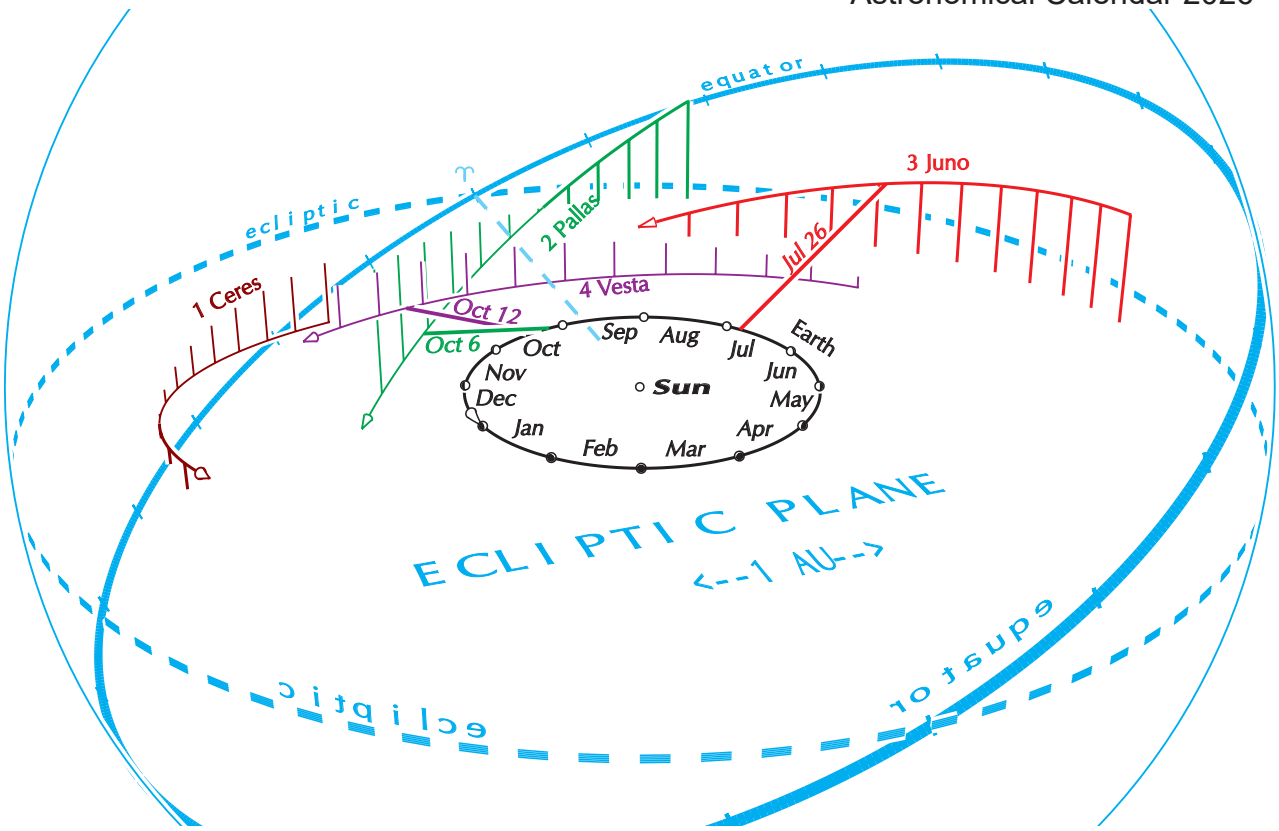
Pallas continues the long southward slope of its orbit, descending across the ecliptic on May 27. It is also on the orbit’s inward curve, to perihelion on 2027 Oct. 16. Whereas at the 2025 Aug. 7 opposition it was 2.5 AU from us and a very dim magnitude 9.4, this year on Oct. 6 it will be 1.85 AU away and slightly brighter at 8.2.

**3 Juno**, though among the first asteroids discovered, and though named for the queen of Roman goddesses, is smaller than the others of the First Four, and is in most years surpassed in brightness by at least one of those discovered later.

Juno was at opposition on 2025 May 14 in Serpens (Caput). It then advanced across the “serpent-holder” constellation Ophiuchus and the other part (Cauda) of the serpent he holds, and now makes its retrograde loop, near the

**Asteroids’ paths in the year, drawn thicker when brighter. Ticks are at start of each month.**



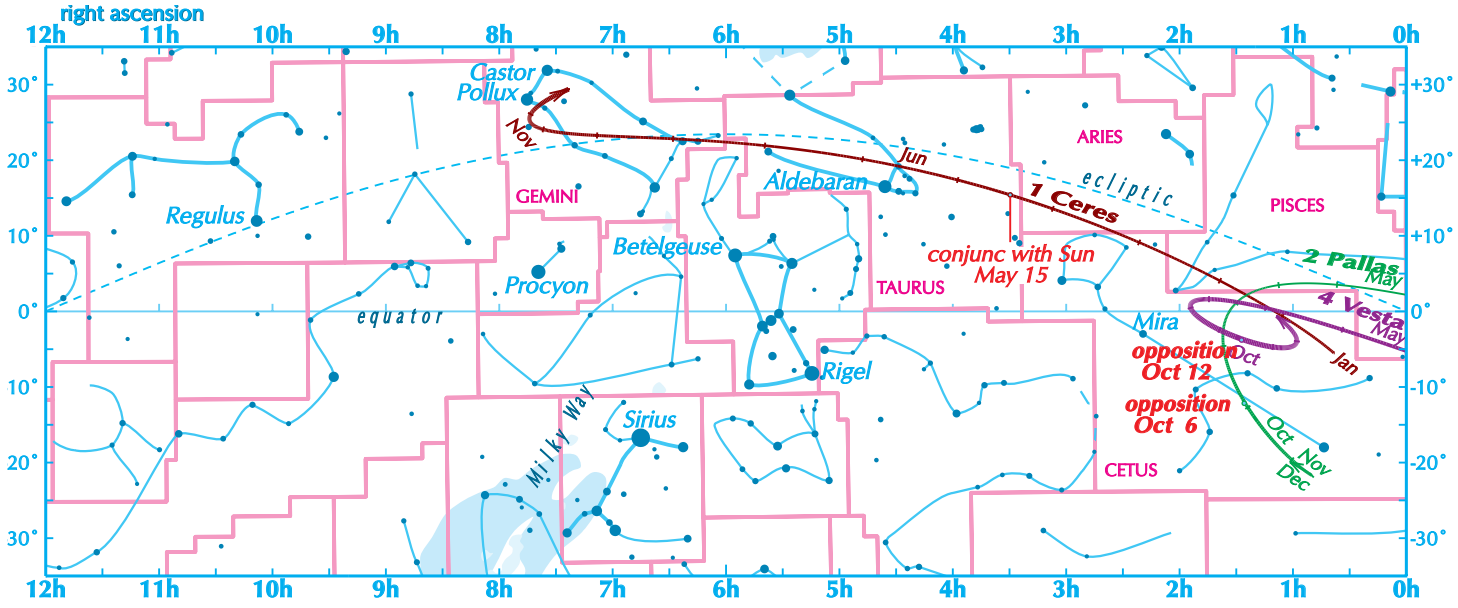


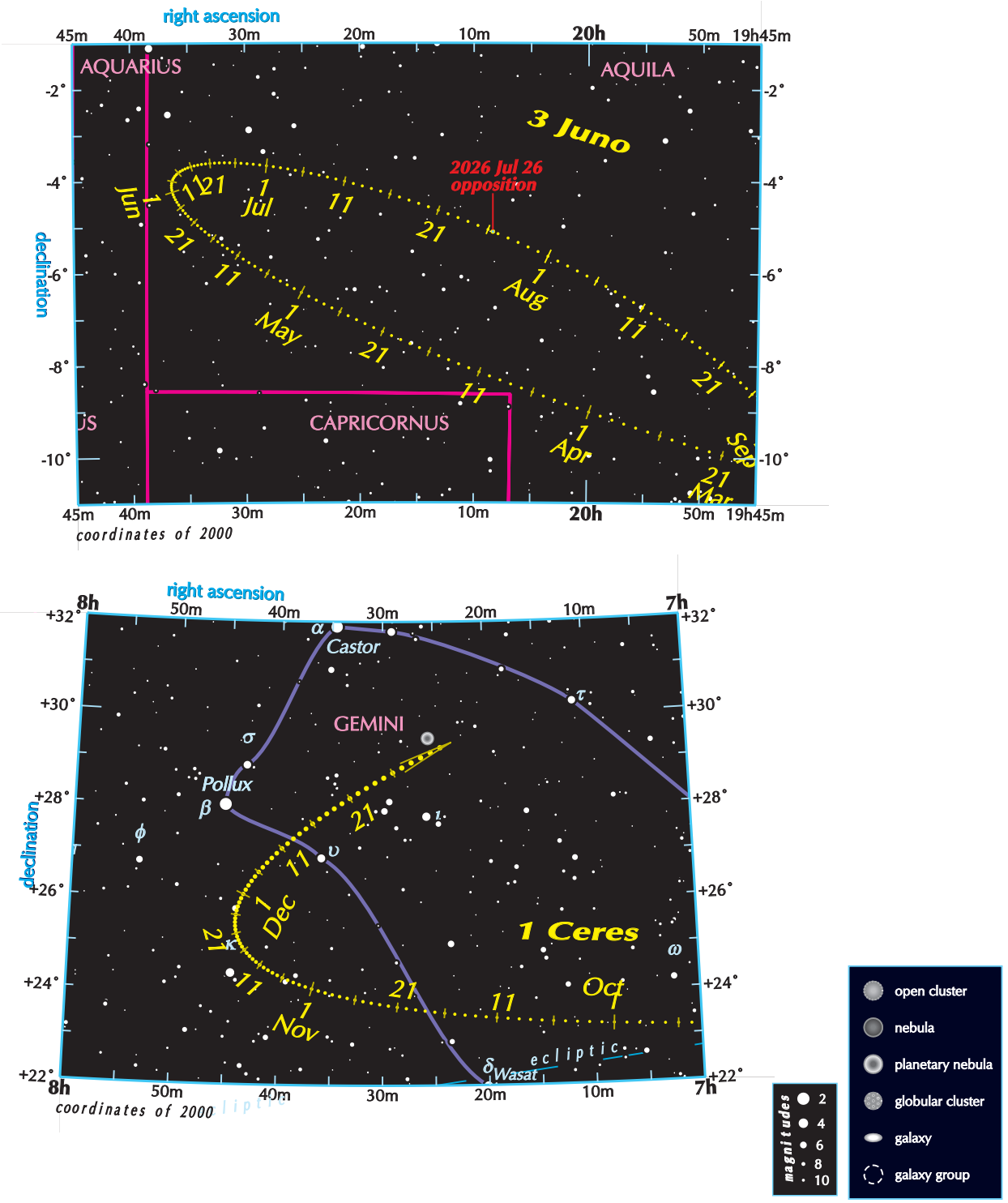

**A sphere 3.5 AU in radius, seen from a viewpoint 10.5 AU from the Sun and 25° north of the ecliptic. Stalks to the ecliptic plane are at the start of each month. Lines connect Earth and asteroid at dates of oppositon.**

equator as always, in Aquila, just north of the Sagittarius-Capricornus boundary. Juno was at aphelion only 23 days after the 2025 opposition, and will be at perihelion 2027 Aug. 12, so at the 2026 opposition it is brighter by 1.0 magnitude. It will next attain magnitude 7 in 2031 Oct.

**4 Vesta**, though only the 4th asteroid discovered, is the second largest, slightly wider than Pallas but considerably more massive. It is, at most times, the brightest (though Ceres when brightest is 0.1 magnitude brighter than Vesta when faintest). This results from a combination of: size; distance (it is usually nearer in than Ceres and Pallas, its aphelion being slightly farther out than Ceres's perihelion); and high "albedo" or reflectivity—that is, Vesta has a light-colored surface. It is aptly named for the Roman goddess of the hearth. Vestal virgins guarded the sacred flame. The inventor of strike-anywhere matches named them vestas.

Vesta was at opposition 2025 May 2 on the Virgo-Libra border. Having traveled far around the southern ecliptic zone, it goes into its retrograde loop in Cetus—crossing the paths of several of her sisters in the belly of the Whale. Vesta is 0.5 AU more distant than last time, and 0.7 magnitude less bright.

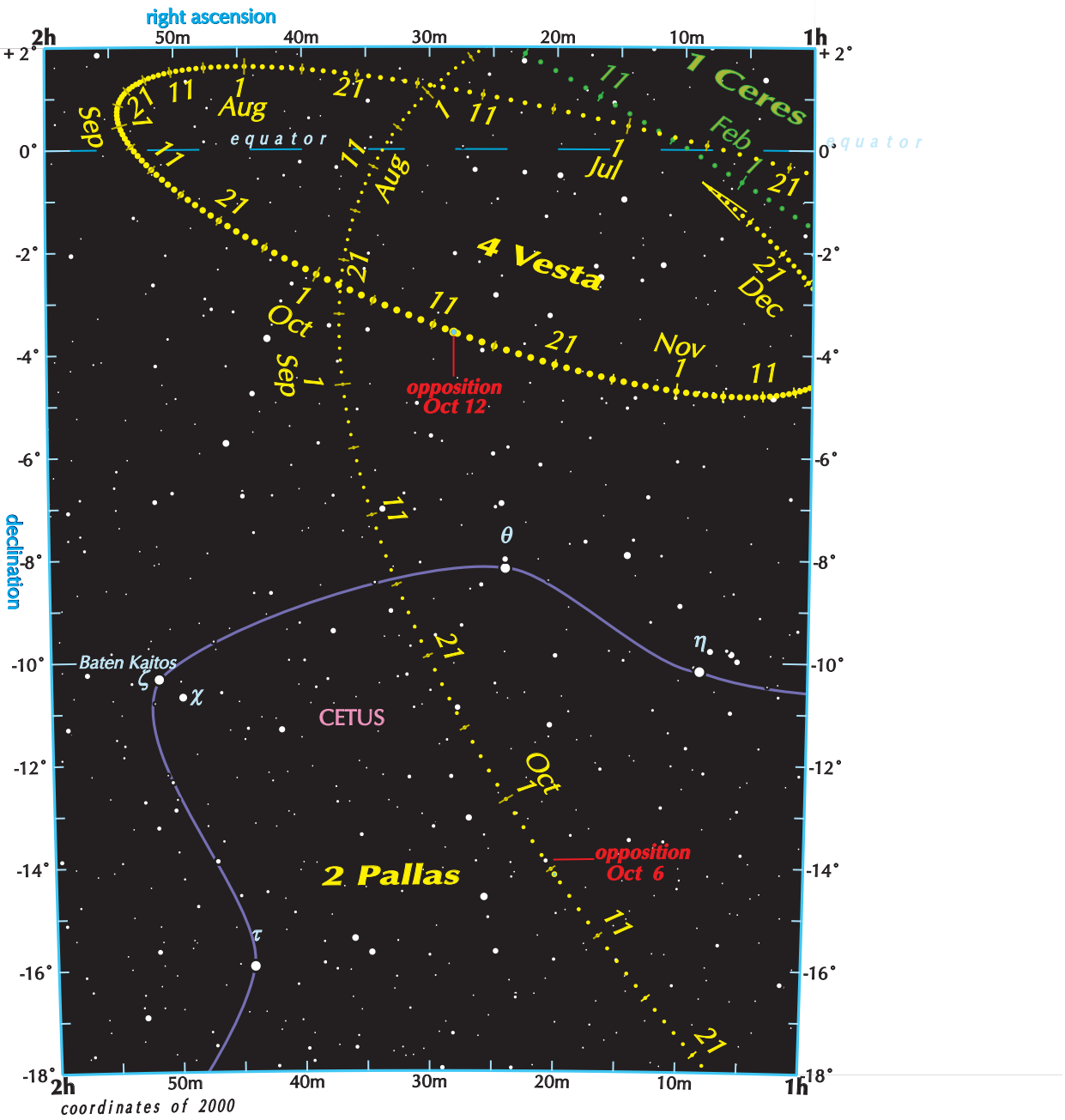




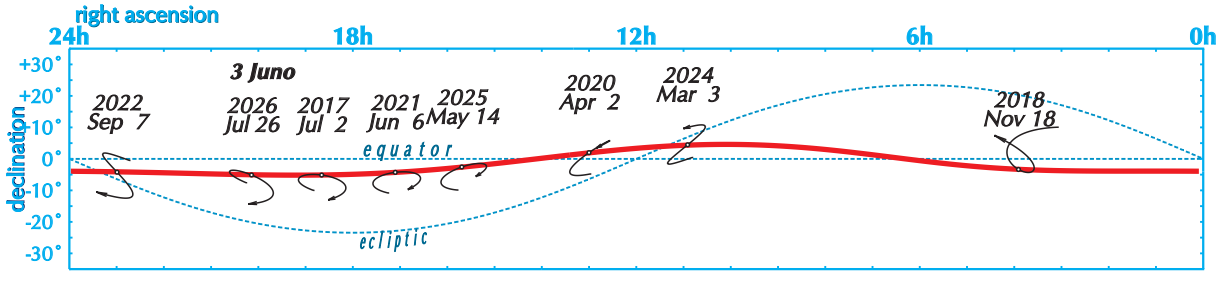

**Main phenomena.** Columns: right ascension (hours, minutes) and declination (degrees, minutes), for epoch 2000; distance from Sun and Earth, in astronomical units; elongation from Sun (degrees; negative = westward); magnitude.

| | RA(2000) | decl | hedis | gedis | elo | mag |
|---|---|---|---|---|---|---|
| 1 Ceres | | | | | | |
| May 15 2 conjunc.with Sun | 3 31 | 15 30 | 2.787 | 3.795 | 3 | 8.7 |
| 2 Pallas | | | | | | |
| Mar 2 3 conjunc.with Sun | 22 43 | -1 41 | 3.229 | 4.213 | -6 | 10.0 |
| Oct 6 10 opposition | 1 21 | -14 1 | 2.808 | 1.851 | -159 | 8.2 |
| 3 Juno | | | | | | |
| Jul 26 12 opposition | 20 10 | -5 2 | 2.796 | 1.802 | 165 | 9.2 |
| 4 Vesta | | | | | | |
| Jan 28 9 conjunc.with Sun | 20 46 | -20 9 | 2.227 | 3.211 | 2 | 7.6 |
| Oct 12 17 opposition | 1 29 | -3 26 | 2.466 | 1.481 | -168 | 6.3 |

Opposition is the center of the couple of months when an asteroid is nearest and brightest (and appears to be retrograding in the sky as we overtake it). So its exact date does not greatly matter. Opposition dates given here are calculated in longitude, as for the planets; in other sources they may be slightly different because calculated in right ascension.




**Juno's oppositions always occur near the celestial equator. Shown are Juno's paths during each retrograde loop, from a month before to a month after the date of opposition. The smooth curve is the locus of Juno's oppositions, which always happen within about 5° of the celestial equator. This remarkable hugging of Earth's equatorial plane derives from the orbital plane's relation to the ecliptic. It does not happen for other asteroids, some of which have very "hilly" opposition-locus lines. —Inspired by Jean Meeus, *Mathematical Astronomy Morsels* (1997), p. 240-245.**



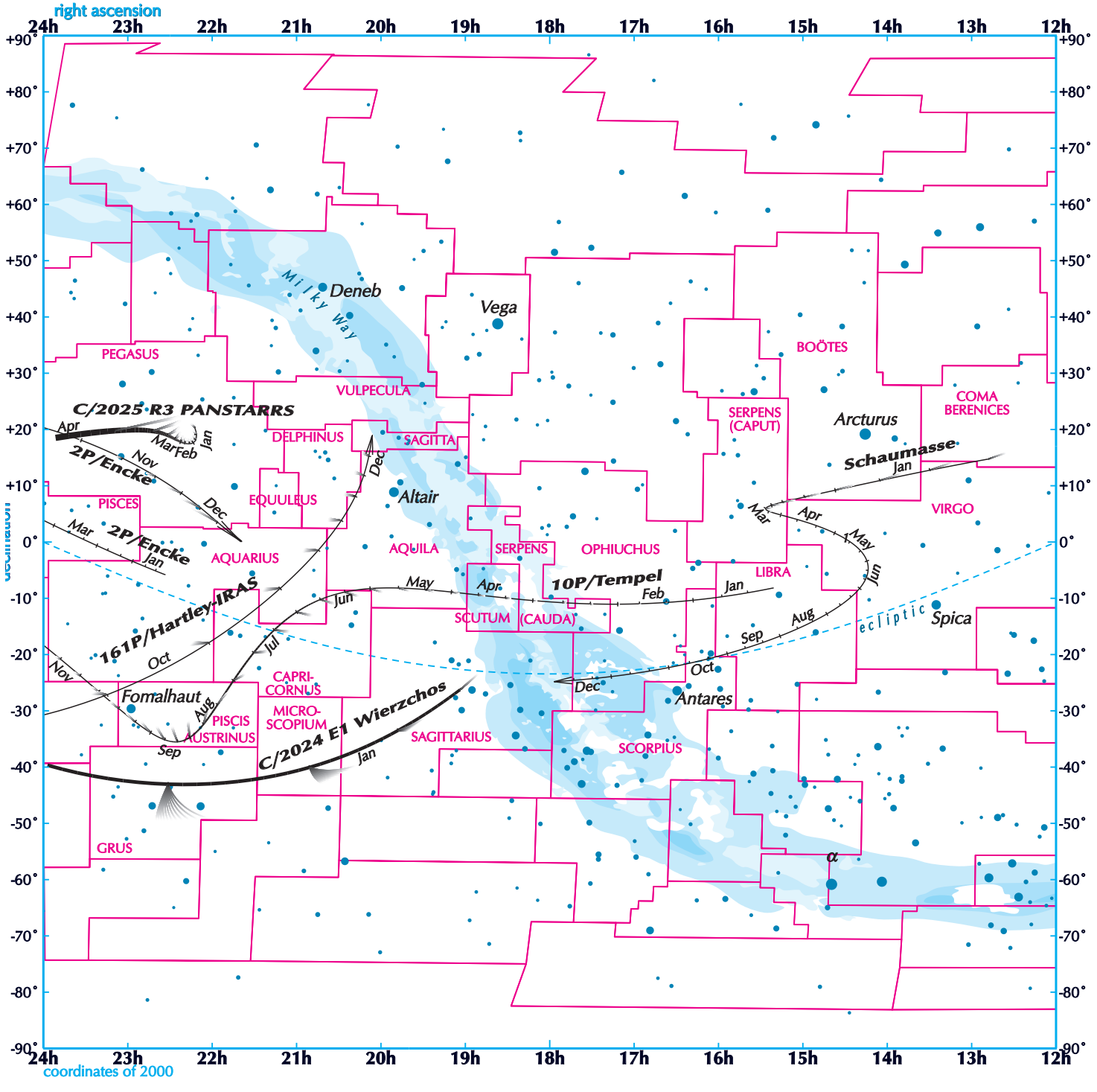
# COMETS

The comets featured here are a few that are likely to become observable with binoculars or small telescopes. They may reach sufficient brightness when sufficiently far from the glare of the Sun. (Brightness and angular distance from the Sun are expressed as “magnitude” and “elongation,” explained in the Minimal Glossary on page11.)

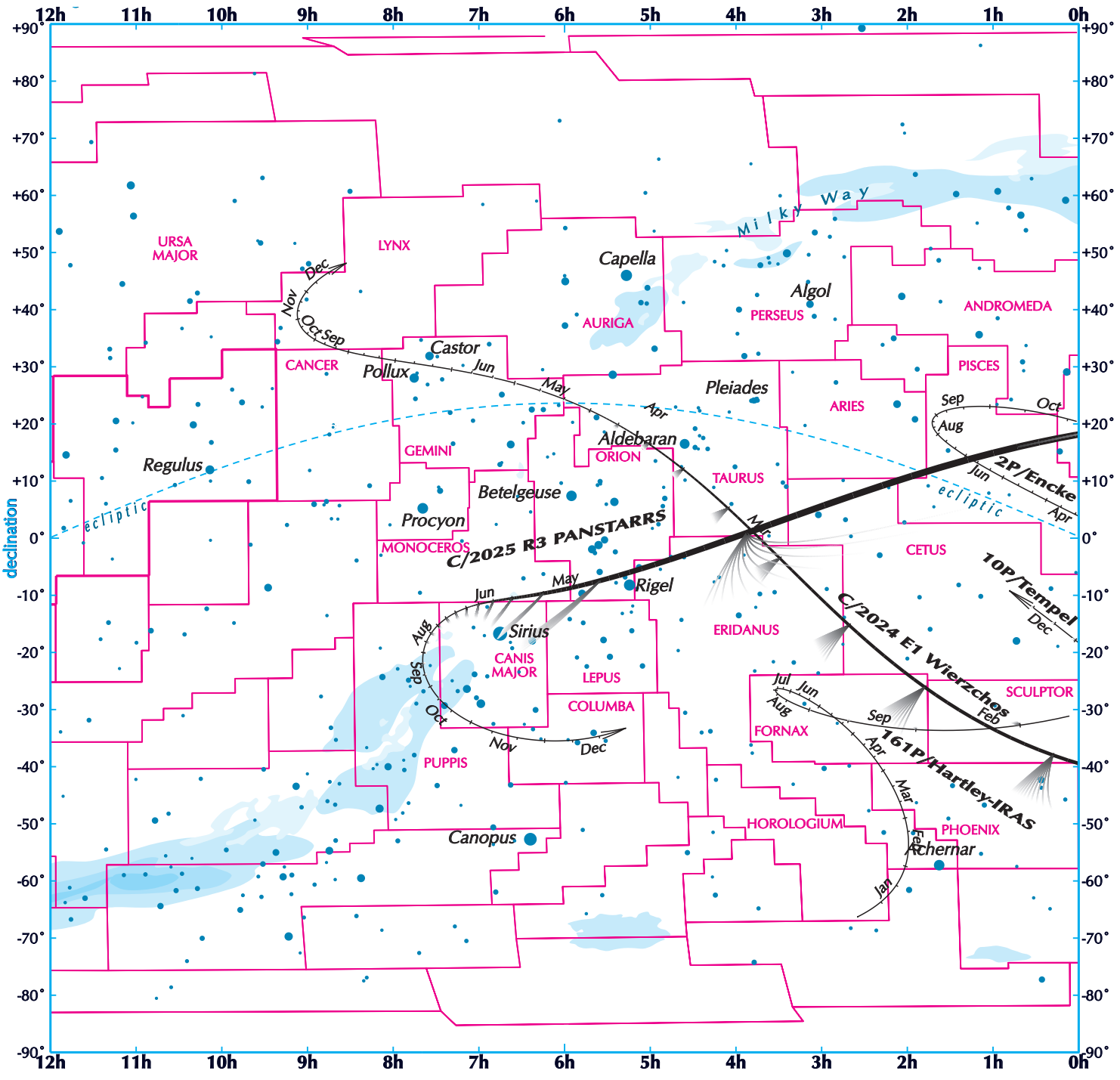
Bu, for comets, predictions are notoriously unreliable, because of their behavior as they travel nearer to the Sun. Unlike asteroids, which are “flying mountains”, the nucleus of a comet is a “dirty snowball” of dust held together by ice. Heat causes these to be driven off from the surface, forming the cloudy head, the straight gas tail, and the curving dust tail. This happens in variable amounts and directions, because of factors such as the shape, strength, and spin of the nucleus.

A diffuse object is less distinguishable from the sky’s background light than a point source. So a comet with total magnitude 2 is less discernible than a star of that magnitude.

**Comets’ paths in the year, drawn thicker when brighter. Ticks are at start of days 1, 11, and 21 of each month.**



Comets are classified as periodic if they are known to be in elliptical orbits, bringing them back to perihelion in a relatively short time: by convention, less than 200 years. Long-period or non-periodic comets, in larger or even parabolic or hyperbolic orbits, coming from the outer solar system or even from outside it, arrive unpredictably. They have not been worn out by repeated passages near the Sun, so among them are the few spectacular or even daylight comets.



C/2024 E1 Wierzchos was discovered by Kacper W. Wierzchos in images taken at the Mount Lemmon Observatory, northeast of Tucson, Arizona, on 2024 March 3.

In a parabolic orbit with a steep inclination of 75°, it rushed from the north, and in December of 2025 made a swift curve south of the Sun. On Jan. 20 at perihelion about 0.6 AU from the Sun and 1.4 AU from Earth it could reach magnitude about 7, well south of the ecliptic in Sagittarius. Traveling northward through Cetus to Taurus, in March it reaches elongation as high as 63° in the evening sky but fades past magnitude 8.

C/2025 R3 PANSTARRS was discovered on 2025 Sep. 8 in an image taken by the Panoramic Survey Telescope and Rapid Response System, on Mount Haleakala in Hawaii. It comes from the north in an apparently hyperbolic orbit (eccentricity 1.001) of steep and retrograde inclination (125°).

In the first quarter of 2026, it is coming almost straight toward us, thus appearing almost stationary in Pegasus, at large elongation from the Sun but dimmer than magnitude 8. Between Apr. 8 and May 16 it is within 1 AU of Earth, nearest (0.484 AU) on Apr. 26. At its Apr. 19 perihelion it is at 0.5 AU, half way between us and the Sun. It may reach magnitude 2, but 20° or less south of the Sun. On May 1 it crosses the equator southward in Eridanus, and on May 8 passes close north of Rigel, so that the star may be seen beside or through the tail. The same may happen with Sirius, around which the comet makes a wide loop into Columba, where on Dec. 4 it is farthest south (declination -36°).

10P/Tempel, formerly called Tempel 2, is one of several comets discovered or co-discovered by Ernst Wilhelm Tempel; this one, from Milan on 1873 July 4. It is one of the most reliably predictable of comets. Its period of about 5.2 years is one of the shortest, so it has been observed on at least 20 of its visits. The orbit's aphelion is well short of Jupiter, so avoids major perturbation and has changed only gradually for at least 300 years. At favorable appearances the comet reaches a brightness of magnitude 8; on top of that it quite often has jumps in brightness of 2 or 3 magnitudes, usually a week or two after perihelion. The perihelion point is outside, and somewhat south of, the July part of Earth's orbit.

This time the comet is due to arrive there on August 2. So as we overtake it in July it appears to dive south, and then at the perihelion we have gone past and are looking back, at a distance of 0.41 AU, and see it in the "southern fish" constellation, Piscis Austrinus. It may grow no brighter than magnitude 9. After turning at a southernmost declination of -35° on Sep. 12, on Oct. 17 the comet, with tail leading, passes close south of Fomalhaut.

24P/Schaumasse was discovered on 1911 Dec. 1 by Alexandre Schaumasse at Nice in southern France. It is in an orbit of low inclination (11.5°), bring it through a perihelion 0.18 AU outside and north of the January-February part of Earth's orbit. With a period of about 8 years, it is now in the 14th of its returns.

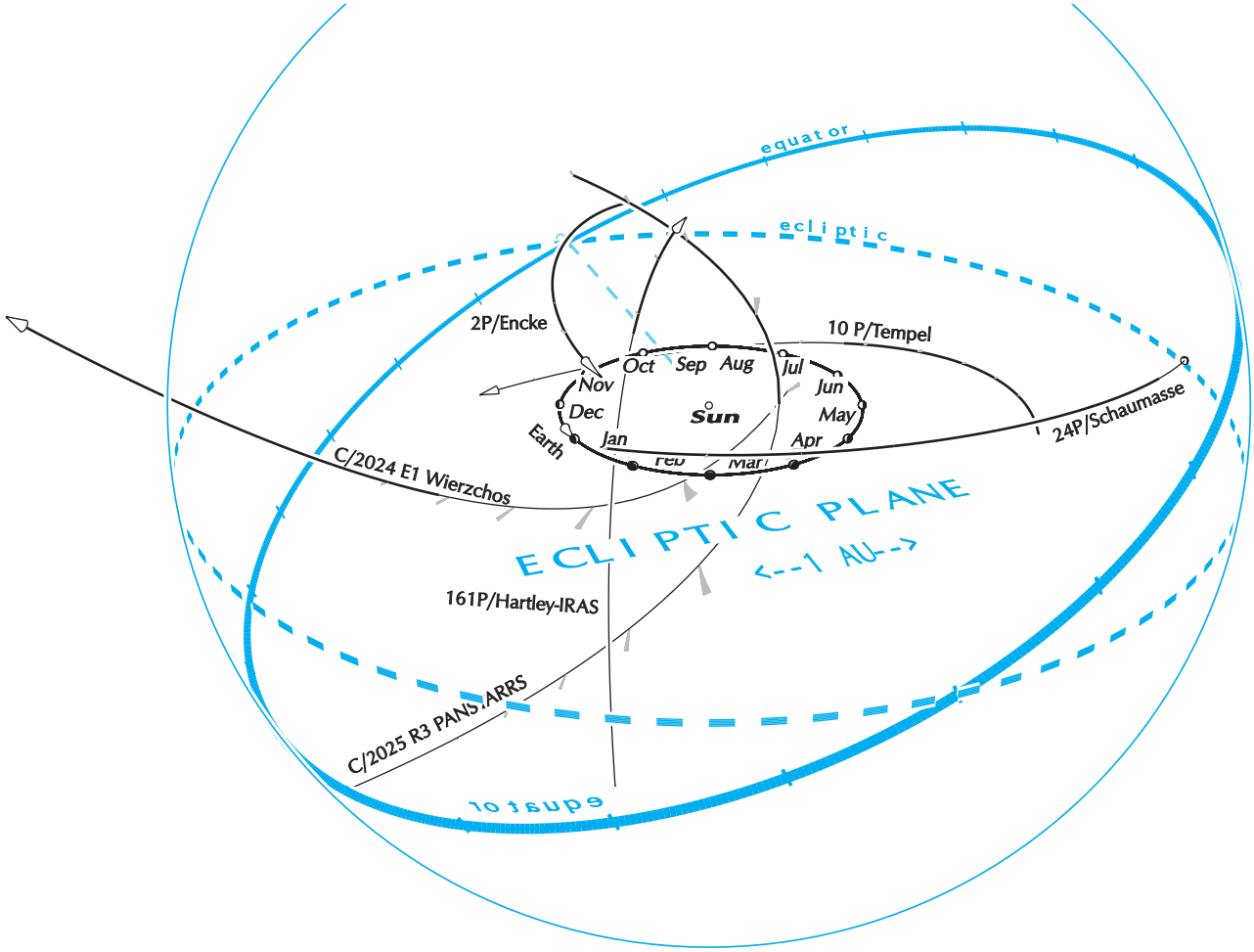
And it is timed to be one of the most favorable. The comet aims to arrive at perihelion on 2026 Jan. 8. It was recovered on 2025 Aug. 24 by Alan Hale. In the early January days around perihelion, it will be 0.59 AU from Earth, may reach magnitude 9 or 8. It will be 95° or so out in the morning sky, moving from Coma Berenices across a northern corner of Virgo into Boötes.

In May it hesitates into a retrograde and southward path because we are watching it depart outward toward its October descending node through the ecliptic.

161P/Hartley-IRAS was discovered on 1983 Nov. 4 by Malcolm Hartley of the Siding Spring observatory in Australia (discoverer or co-discoverer of 11 other comets), but first reported on Nov. 11 by British astronomers using the Infra-Red Astronomy Satellite. It was undergoing an outburst that made it as bright as magnitude 7.5. As with other newly arriving comets, its orbit was taken to be parabolic, but more observations proved it to be elliptical, though unusually long (21.5 years), so there has been only one previous return, in 2005. And the orbit is almost perpendicular to the ecliptic and slightly retrograde (inclination 95°). The descending node is just outside the orbit of Jupiter, whose gravitation will have done the deflecting into shorter orbit. And the ascending node is about 0.5 AU outside the September part of our orbit. The comet aims to arrive there in late 2026, making for a relatively favorable visit of the perihelic-opposition kind.

For the first nine months of 2026 the comet rushes northward, seeming from our viewpoints along out circular orbit to take a looping course in several southerly constellations. It is nearest to us, 0.7 AU, on Oct. 10, probably reaching magnitude 10 or better. It will ascend through the ecliptic on Oct. 25 to perihelion on Dec. 20.

2P/Encke is of all comets the second most familiar. 1P/Halley with its lifetime-like period of 76 years has made 30 recorded visits (starting in 240 B.C.); Encke's is now making its 63rd, because of its period of only 3.3 years (the shortest known, except for 3200 Phaethon, the asteroid-or-dead-comet that gives us the Geminid meteors). Like Halley's it is named not for a discoverer but for the thinker who revealed its nature. When interest in comets surged after the first successfully predicted return, that of Halley's in 1759, one of the most productive searchers was Pierre Méchain; he found this comet in 1786; it was rediscovered in 1795 by Caroline Herschel, and in 1805 by Pons, Huth, and Bouvard. (The 3.3-year period means that similar apparitions come roughly each third time, or 10th year; in these three discovery years the comet followed about the same favorable path.) When Pons yet again discovered it in 1818, Johann Franz Encke (then 27 and an assistant at a Swiss observatory) calculated the orbit on a better basis than he had before, connected it (in six weeks' work) with the three comets out of the past, and predicted an 1822 return. This came about so exactly that the comet was called Encke's. Since then it has been seen every time except wartime 1944. We now number it "2P" as sec-




**Comets' trajectories in this year, seen in the same sphere of space and from the same viewpoint as for the asteroids. Comet orbits are more dramatically varied. Space views for individual comets are on some other pages.**

ond, after Halley's, to join the set of predictably periodic comets. Its orbit though small is very elongated, from within the orbit of Mercury to more than 4/5 of the way to Jupiter. In 1913 it was (at the suggestion of E.E. Barnard) found and photographed at aphelion, thus becoming the first "annual" comet, essentially detectable in any part of its orbit. It may have been in this orbit for thousands of years, protected from perturbations by not going out as far as Jupiter; yet no ancient observations of it have been found. Diffuse dust from it appears as the Taurid complex of meteor streams (daylight Zeta Perseids and Beta Taurids of June, North and South Taurids of October-November). It was Fred Whipple who in 1940 connected the Taurid meteors to Comet Encke, and in 1983 he connected the Geminids to 3200 Phaethon.

The 2026 visit is a near-replica of 2016; Comet Encke is heading for a perihelion early in the next year. It was out at aphelion, 4.09 AU from the Sun, on 2025 June 5; at the start of 2026 is still 3.75 AU from the Sun and 4.2 from Earth, and very dim. As it takes its curving course inward toward us, it appears on the map of the sky to move at first slowly from Aquarius into Pisces. On March 15 we are looking across the Sun at it. Then, as our viewpoint circles around our own orbit, we see it in August go into an apparent loop backward and, because nearer to us, northward. On Oct. 5 it comes within 1 AU of us, and on Oct. 11 it is at opposition, well up in the evening sky, with Saturn nearby.

It may still be as dim as magnitude 16, but is still getting nearer to both Sun and Earth, and by the end of the year it could reach magnitude 9. Or not. It may have become an even more worn-out comet, with less ice and dust to spray out into sunlight.

# METEORS

These meteor showers are mentioned in our calendar. Here are more data about them.

| | longit. | | active | radiant | drift | ZHR | vel | r |
|---|---|---|---|---|---|---|---|---|
| QUA | 283.15 Jan 4 | Quadrantids | Dec28-Jan12 | 230 49 | 2.4-0.2 | 80 | 41 | 2.1 |
| LYR | 32.32 Apr 22 | Lyrids | Apr14-Apr30 | 271 34 | 4.4 0.0 | 18 | 49 | 2.1 |
| ETA | 45.50 May 5 | Eta Aquarids | Apr19-May28 | 338 -1 | 3.5 0.4 | 50 | 66 | 2.4 |
| ARI | 76.70 Jun 7 | Daytime Arietids | May14-Jun24 | 43 24 | 0.0 0.0 | 30 | 38 | 2.8 |
| SDA | 128.00 Jul 31 | Southern Delta Aquarids | Jul12-Aug23 | 340 -16 | 3.0 0.2 | 25 | 41 | 2.5 |
| PER | 140.00 Aug 12 | Perseids | Jul17-Aug24 | 48 58 | 5.6 0.2 | 100 | 59 | 2.2 |
| DRA | 195.40 Oct 8 | Draconids | Oct 6-Oct10 | 262 54 | 0.0 0.0 | 5 | 20 | 2.6 |
| ORI | 208.00 Oct 21 | Orionids | Oct 2-Nov 7 | 95 16 | 2.6 0.1 | 20 | 66 | 2.5 |
| STA | 223.00 Nov 5 | Southern Taurids | Sep20-Nov20 | 52 15 | 2.9 0.2 | 7 | 27 | 2.3 |
| NTA | 230.00 Nov 12 | Northern Taurids | Oct20-Dec10 | 58 22 | 3.6 0.2 | 5 | 29 | 2.3 |
| LEO | 235.27 Nov 17 | Leonids | Nov 6-Nov30 | 152 22 | 2.4-0.3 | 10 | 71 | 2.5 |
| GEM | 262.20 Dec 14 | Geminids | Dec 4-Dec20 | 112 33 | 4.0-0.1 | 150 | 35 | 2.6 |
| URS | 270.70 Dec 22 | Ursids | Dec17-Dec26 | 217 76 | 0.0-0.4 | 10 | 33 | 2.8 |

**First column: standard abbreviation. Longit.: solar longitude. Peak times can be uncertain. Radiant: in degrees of right ascension and declination. Drift: in degrees per day. ZHR: zenithal hourly rate. vel: velocity entering atmosphere (km/sec). r: population index, the proportion of bright and faint meteors. r 2.0 or less: more meteors brighter than average; r 3.0 or higher: more faint. For sporadic meteors, r is typically 2.9-3.1.**

About 40 are included in the **International Meteor Organization**'s yearly description,
www.imo.net/files/meteor-shower/cal2026.pdf
But some are sparse or of debatable existence. The usual "big three" are the Quadrantids, Perseids, and Geminids. This year they respectively are near to last quarter, first quarter, and full Moon.

**Meteoroids** are bits of solid matter out in space. Encountering Earth's atmosphere, they are vaporized by friction, emitting light that is seen as **meteors** or "shooting stars"; sometimes leaving luminous **trains** for some minutes. **Fireballs** are of magnitude -3 or brighter; **bolides** cause sounds. Remnants large enough to reach the ground are **meteorites**. Most meteoroids are small — pebbles or dust — and have separated from comets (a few from asteroids), typically centuries ago. They orbit around the Sun in **streams**, appearing as **showers** when Earth passes through them at about the same dates each year.

Meteors of a shower can appear anywhere in the sky, but their apparent paths radiate from a **radiant** point or small area. For instance, a meteor of late November whose path can be traced back to Leo is a Leonid; otherwise, it is a **sporadic** meteor. Radiants drift slightly from day to day, because the direction from which the meteors appear to come changes as Earth proceeds around its orbit.

Particles are ejected from comets with differing directions and speeds, so their orbits diverge and streams become vastly wider than the Earth. So a shower may be active over weeks, though for part of this time it may have been detected only by camera or radar. A shower's **peak** may be broad and indefinite or as sharp as hours or minutes. Particles' orbits can be perturbed by the gravity of the planets, and the stream may contain clumps, causing meteor **storms**, and sub-streams, causing subsidiary peaks. The times we give, predictions by experts based on past evidence, may be only best guesses. The calendar dates can vary by a day because of leap years. So a more constant way to express the point in Earth's orbit at which a stream crosses it is the **longitude of the Sun**. Over centuries, the peak dates drift later through the year because of the precession of Earth's axis.

Counts of meteors per hour are the raw data. A shower's estimated **zenithal hourly rate (ZHR)** is the average number that one observer could see at the peak time if the radiant were overhead and conditions perfect. Actual counts are liable to be lower. Observations help to define a stream's radiant, peak date, composition, orbit, and origin.

Meteors hitting Earth's front — because traveling in retrograde orbits — are seen after midnight and enter the atmosphere at higher speeds. Meteor observing tends to be best before morning twilight!

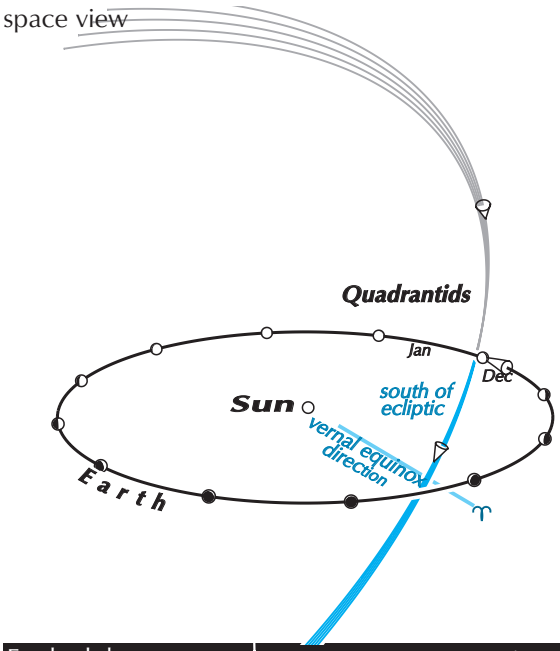
Through most of the year, there are meteors coming at low rates from a large area roughly opposite to the Sun (culminating about 1 AM local time). Formerly they were treated as many minor showers, but since 2006 they have been treated as a general **Antihelion Source**.

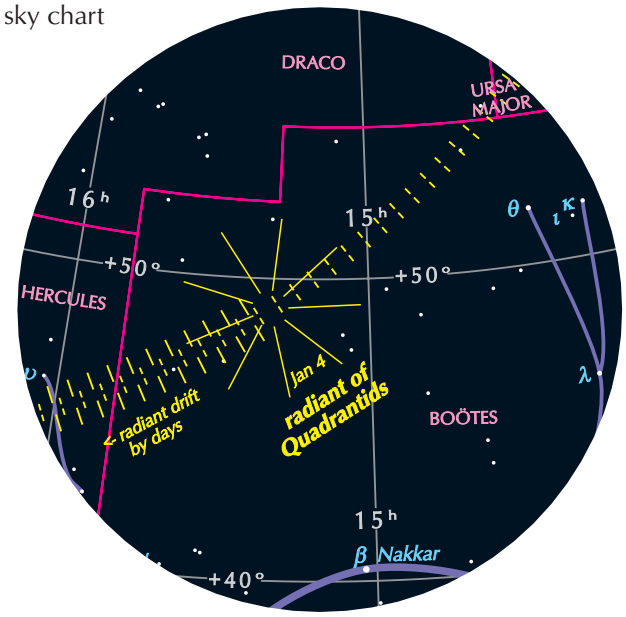
A radiant at or below the horizon can produce long bright trails across the upper atmosphere. However, the lower the radiant, the fewer meteors from it aim above the horizon, so more meteors are seen when the radiant is at least 25° up.

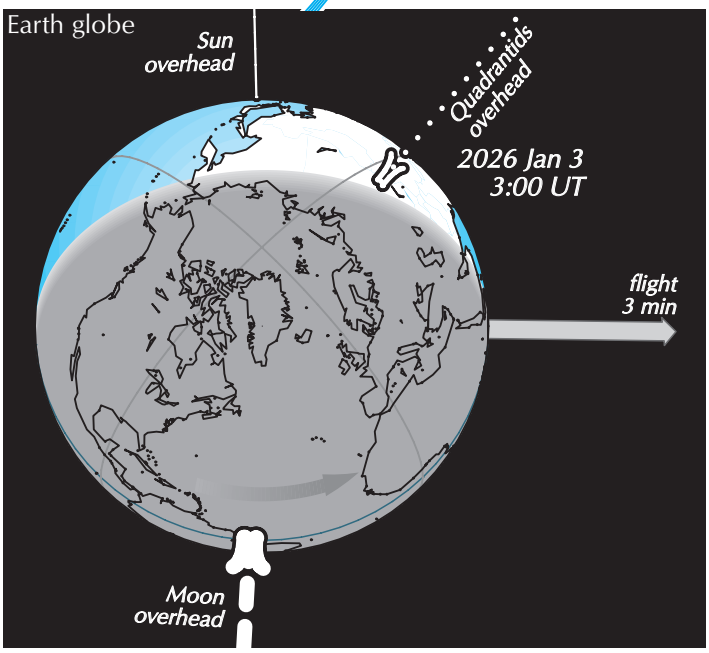
The other factors are atmospheric conditions and the **Moon**: its glare drowns the dimmer meteors. A first quarter Moon sets around midnight, so does not spoil morning observation; last quarter Moon rises around midnight.

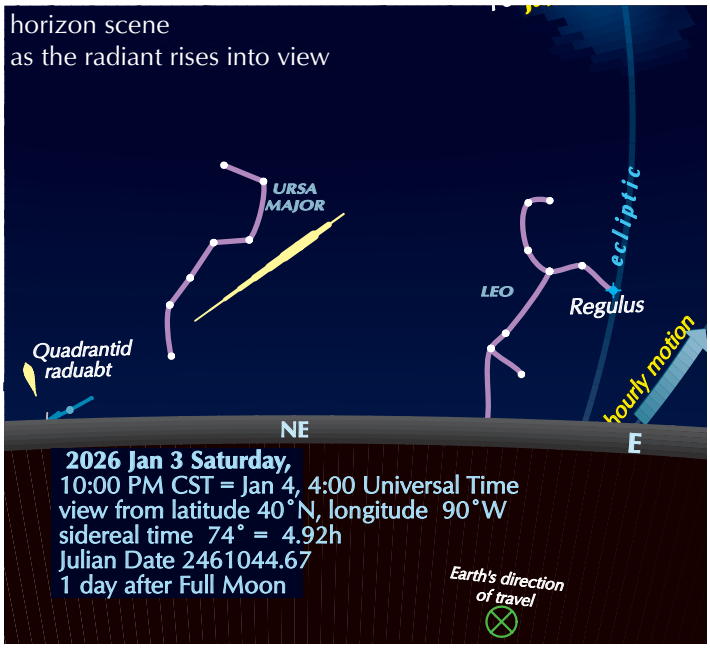
Wrap warmly; be comfortable, as on a reclining chair; perhaps face east and gaze up at about 45°. Count the shower members seen in an hour. Record sporadics separately. If there's more than one of you, keep separate counts.

The clearinghouse for meteor information is the International Meteor Organization. If seriously interested, and if you'd like to report your counts, explore www.imo.net.




Jan 4: **Quadrantids**, named from a defunct constellation, Quadrans Muralis, the "wall quadrant", in a star-poor region east of the Big Dipper. The meteors come to us from the north (inclination 72° to the ecliptic) and slightly behind, so their relative speed is medium. For people north of latitude 41°, the radiant is in the sky all the time. It is low to the northern horizon in the early night, swings up in the northeast, is nearly overhead toward dawn. Though the ZHR is 120, the rate varies from 60 to 200. The main peak is fairly sharp. Faint Quadrantids caused by small particles may peak half a day earlier; there may be another peak some hours later, detected partly by radio observations. This year: near Full Moon,

Apr. 22: **Lyrids**. Derived from Comet C/1861 G1 Thatcher, which was seen only in 1861, having a period of 415 years. Coming down at about 80° into Earth's orbit, they are medium-slow; some are spectacularly bright; 20-25% leave persistent trains. The radiant, on the Lyra-Hercules border not far from Vega, is above the northeast horizon by 10 PM and overhead by 4 AM. The ZHR is usually around 15-20, but there were outbursts in 1803, 1922 (96/hour), 1982 (250/hour for a few minutes). The shower has the longest history, beginning with a Chinese chronicle of 687 BC (when the peak was on March 25) and summarized in Gary Kronk's invaluable book *Meteor Showers*. The shower has a narrow peak. This year: 2 days before first Quarter Moon.

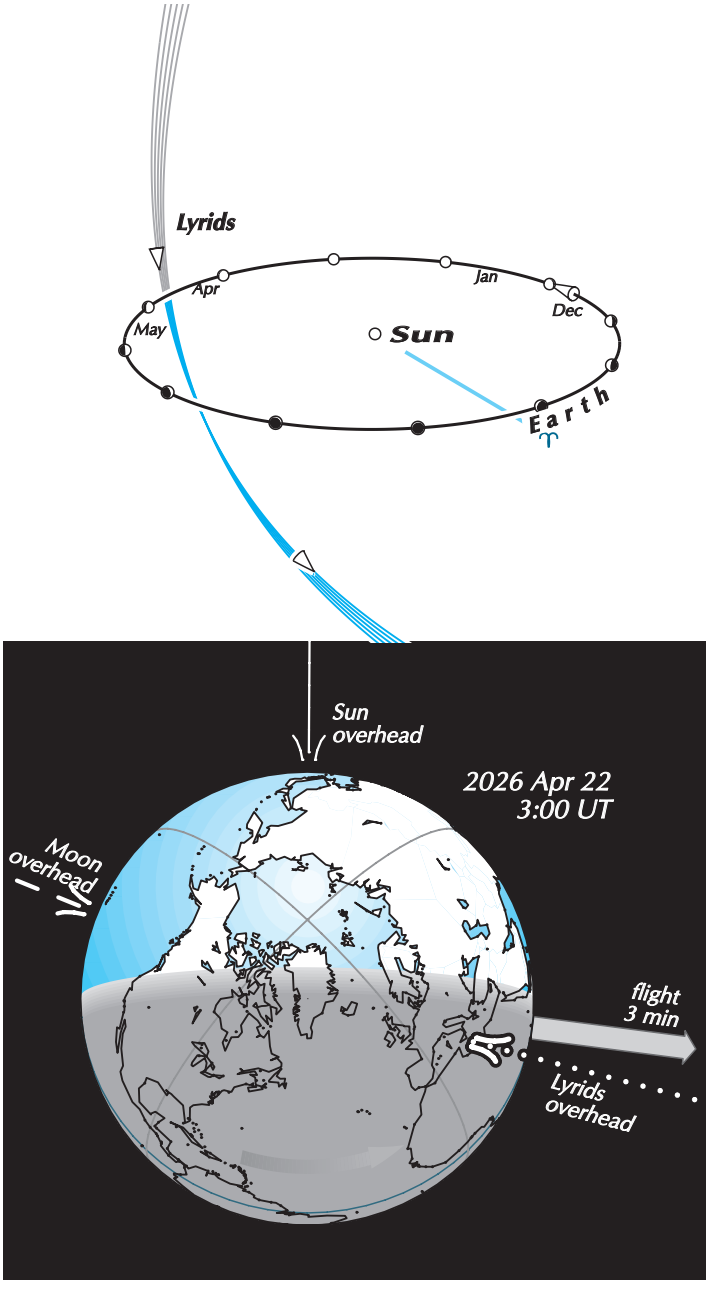
May 5: **Eta Aquarids** are debris from the most famous comet, 1P Halley, which last came by in 1986 and will return in 2061. Its retrograde orbit crosses over the October part of Earth's orbit and back out just under the May part; so we see sister showers, the Orionids of October (inward) and the Eta Aquarids (outward). In both, the meteors are very swift (nearly head-on to Earth), often leaving trains; and there seem to be sub-streams spread over several days, with different average sizes of particles. The main radiant, near the Urn or Water-Jar or Y of Aquarius, is just south of the celestial equator. For latitude 40° north it rises about 2 AM and is highest toward 8 AM. For the southern hemisphere, now in autumn, there are more hours of viewing before dawn twilight, and Australians have said this is the best shower

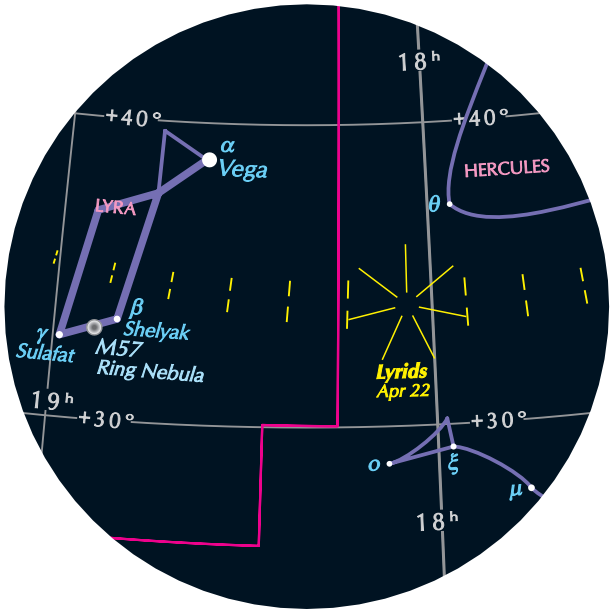
of their year. Hourly rates can be as low as 10 for northerners, as high as 85 for southerners. There is thought to be a 12-year periodicity caused by Jupiter, with one of the low-rate times in 2014-2016. Yet the 2013 May 6 Eta Aquarids were exceptionally strong, up to 140 an hour; meteor scientists think this extra dust separated from the comet three or four thousand years ago. See our www.universalworkshop.com/halley-meteors**. This year:** 4 days before Last Quarter Moon.

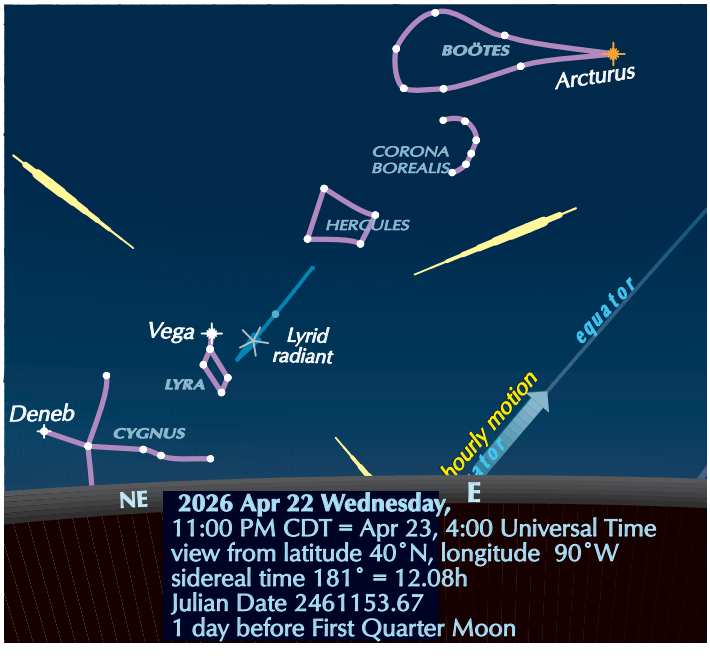
June 7: **Daytime Arietids**. This shower is worth mentioning as the strongest example of a meteor stream that comes at us from the general direction of the Sun, therefore is barely observable except by radar. Yet some meteors from the radiant can be above the horizon in morning twilight, and the IMO has a project to collect and combine counts. The parent body may be the near-Earth asteroid 1566 Icarus.

July 31: **Southern Delta Aquarids.** Formerly there was thought to be a diffuse group, the Southern peaking around July 30 and the Northern Aug. 7. But the Northern stream has been found to be merely part of the Antihelion Source. The Aquarids are better for southerly observers, though for latitude 40° north the radiant is in the sky most of the night, highest around 2 AM. The meteors appear sparse, because they are spread widely, but may add up to one of the most massive of streams. Mostly faint, a few bright; 5-10% leave persistent trains; they move medium-slowly, because coming in sideways across Earth's orbit.

Aug. 12: **Perseids**. Their morbid nickname "St. Lawrence's Tears" — he was martyred on a hot gridiron 258 Aug. 10 — may date back only to 1839. Long regarded as our most reliably great shower, now rivaled by the Geminids. Derived from Comet 109P Swift-Tuttle, which, with period around 130 years, appeared in 69 BC, AD 188, 1737, 1862, and 1992. The radiant, in the region where Perseus meets Cassiopeia and Camelopardalis, is in the sky all night (for northern latitudes), at first low in the northeast, overhead toward 6 AM. The orbit is steeply inclined to Earth's (113°, technically retrograde), hence passes near no other planet and is little perturbed. Records of the shower go back to China in AD 36 (when it was in July), Europe in 811. The



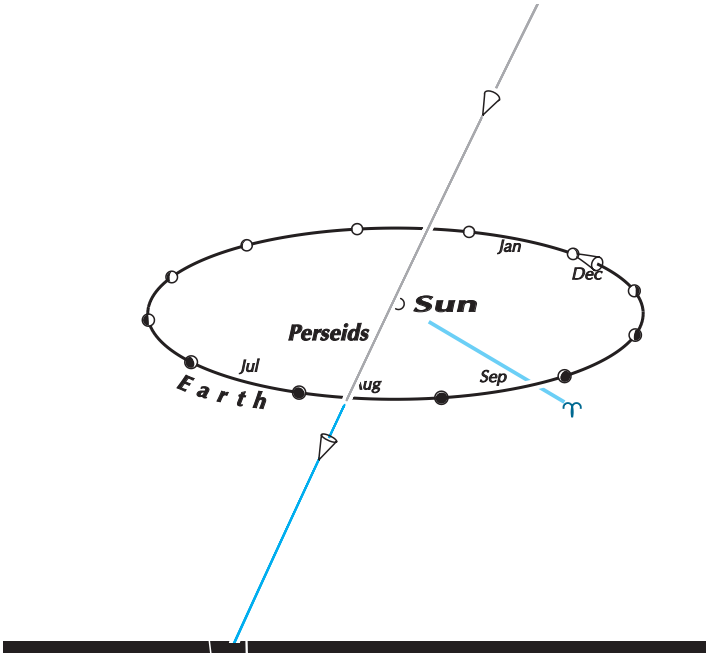



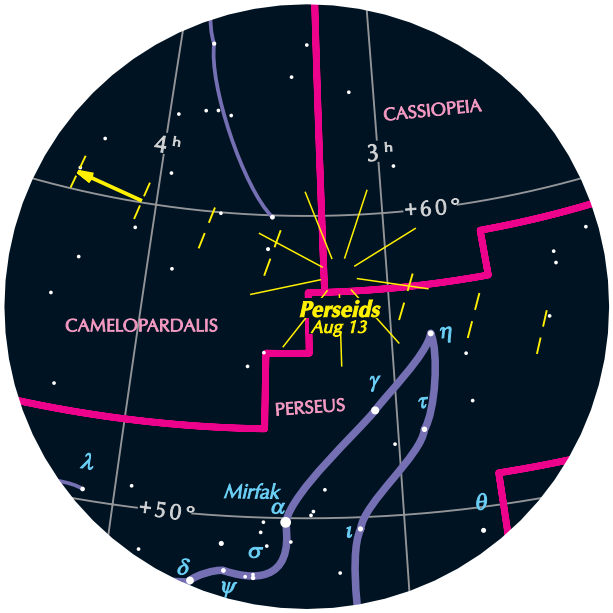
1866 occurrence was the first for which the link with a comet was made, by Schiaparelli. There were some amazing Perseid outbursts in 1980, the 1990s, and 2004. Numbers tend to rise slowly to the peak of 50 or more per hour, then drop faster. Sometimes two peaks have been noticed, or more. The meteors are swift, which helps to distinguish them from the far less numerous Aquarids and Capricornids of the same time. Many are bright; white, yellow, green, red, orange; leave spectacular long-lasting trains; end in flares.

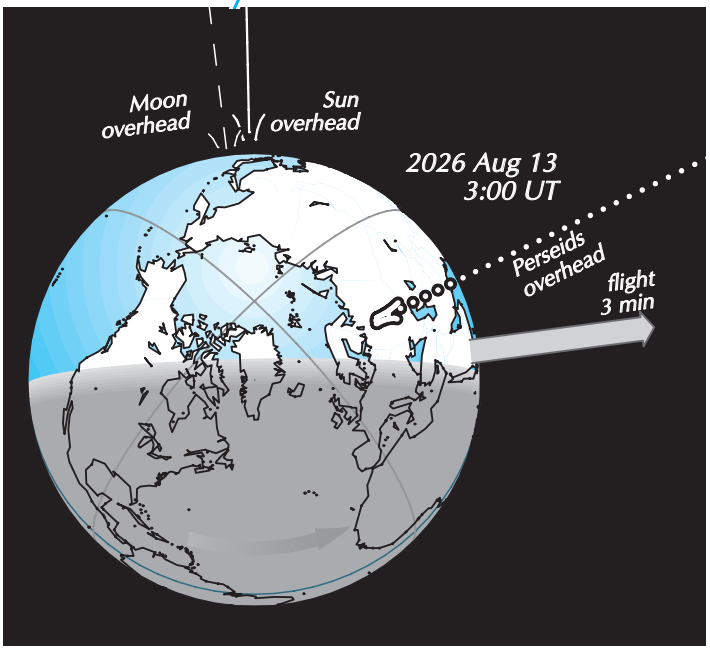
Oct. 8: **Draconids**, also called Giacobinids, because derived from Comet 21P Giacobini-Zinner, which in its 6.6-year orbit passes close to Earth's, last doing so in 2018. The radiant is in the Lozenge or head of Draco, only 13° from the north ecliptic pole, so that unlike other radiants it scarcely shifts from day to day. Descending steeply into the plane of the ecliptic, and from not far out, the meteors are slow-moving. Most are faint, some brilliant, some fragment easily. The radiant is high in the early night, low to the northern horizon 3-6 AM. In many years no Draconids are seen; in others the ZHR reaches 20 or 400. There have been storms near the comet's perihelion, as in 1926 (a Draconid fireball "lit up the sky"), 1933, 1946 (15 days after the comet passed; up to 10,000 an hour seen in the southwestern USA in full moonlight), 1985, 2005. This year: near new Moon.

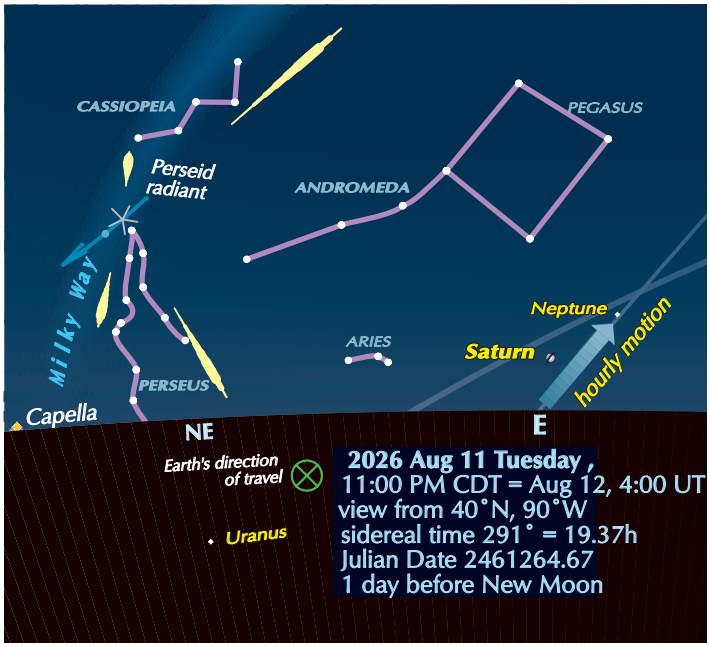
Oct. 21: **Orionids** are part of the stream coming inward along the approximate orbit of Halley's Comet, to be seen on the way out as the Eta Aquarids of May. The Orionid radiant, in the club of giant Orion near the feet of the Gemini twins, rises around 9-10 PM for mid-northern latitudes and is low till after midnight. Orionids are, like the Eta Aquarids, swift; they are sometimes bright, and more than half leave persistent trains. The ZHR can rise to 70, and sometimes there is more than one peak; there could be a strong sub-peak around Oct. 17. There were strong showers 2006-2009, but there may be a 12-year cycle (caused by Jupiter), 2014-16 being a "trough." This year: 3 days after First Quarter Moon.

Nov. 5, **Southern Taurids**, and Nov. 12, **Northern Taurids**: a complex of streams derived from 2P Encke, the comet with the shortest period (3.3 years) and most frequent visits. The meteors radiate from a large area that moves east along



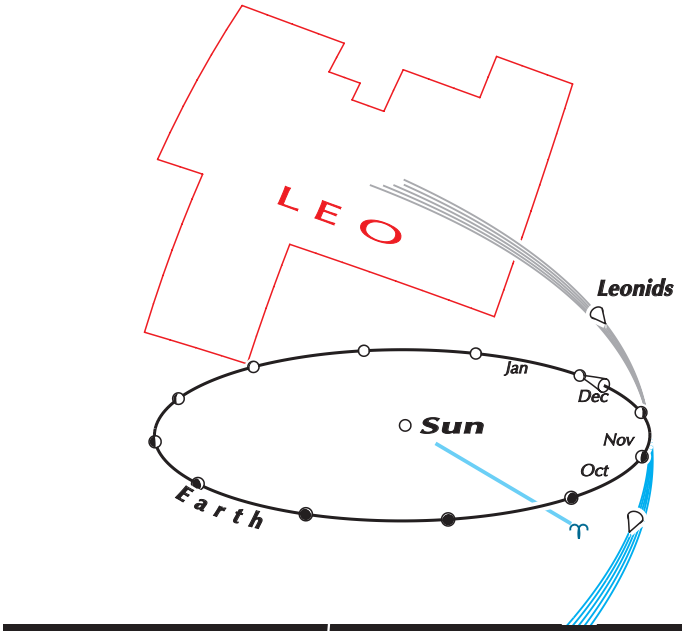



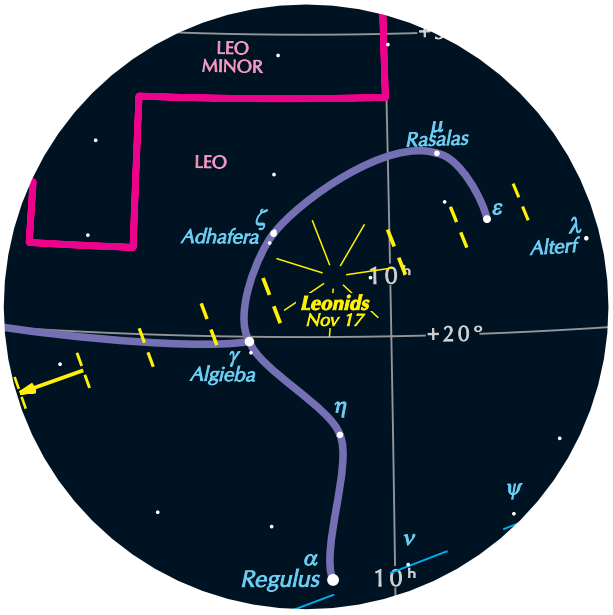



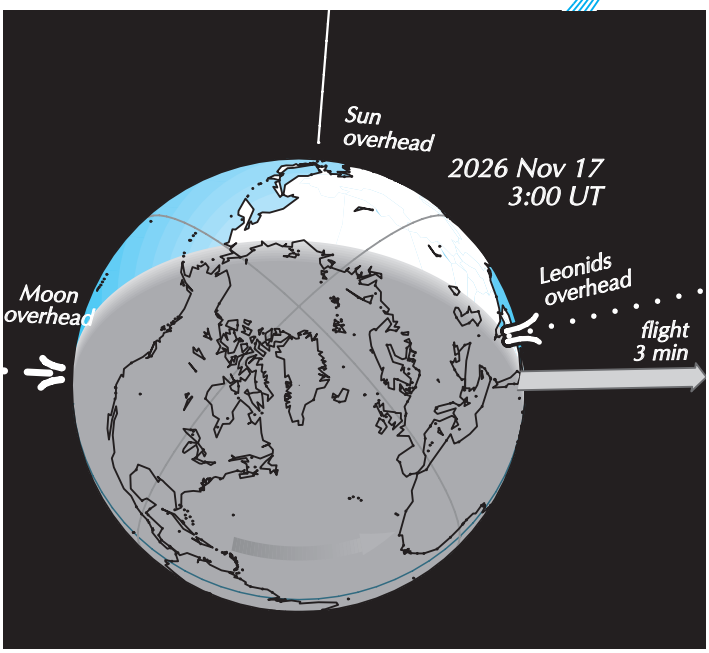



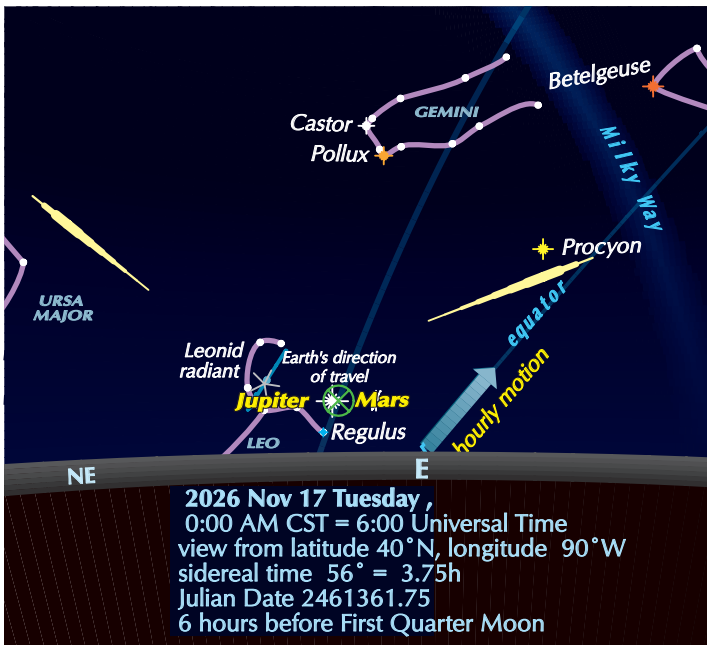
the ecliptic from Pisces through Aries into Taurus and is in view most of the long autumn night, highest about midnight. Spread over this time, they appear sparse on most nights. Because the general orbit lies in the inner solar system, with outer end near Jupiter, the stream has become perturbed into branches, which can scarcely be distinguished by visual observers. The most abundant component, the Southern, has an additional peak around Oct. 13, which used to be considered the main one. In some years we pass through a Taurid "swarm" with bright meteors from large particles; in 2005 they were popularly dubbed "Halloween fireballs", and a flash seen on the Moon was thought to be a Taurid impact. Taurids appear slow, because they are coming in across our orbit from behind. As the stream goes back out, it encounters Earth's daytime side and thus produces meteors detectable only as radio showers, the Zeta Perseids and Beta Taurids of June.

Nov. 17: **Leonids**, the most dramatically variable of all. Following the path of Comet 55P Tempel-Tuttle, they strike Earth's atmosphere slightly north of head-on (the inclination is 162°) and pierce it at almost the highest theoretical speed for meteors belonging to the solar system. So the shower is a morning one: the radiant, in the head of Leo (also called the "Sickle"), rises about 11 PM and is highest about 6 AM. Leonids are often bright, bluish; most leave persistent trains. Often only 5 to 20 per hour are seen at the maximum, but fantastic storms happen, usually but not always near the times of the comet's perihelion in its 33-year orbit. Many were vaguely recorded in early annals (902, Arabic "Year of the Stars"). In 1833, thousands per hour, woke people from their beds in eastern North America. This inspired Denison Olmsted to understand radiants and the periodic orbiting of the particles, thus founding meteor science. 1966 Nov. 17 was the most intense meteor storm known. At Kitt Peak in Arizona, Dennis Milon recorded 160,000 per hour for about 20 minutes; that is, over 40 per second! The comet's last visit was in 1998, the last storm in 2002. This year: near First Quarter Moon.



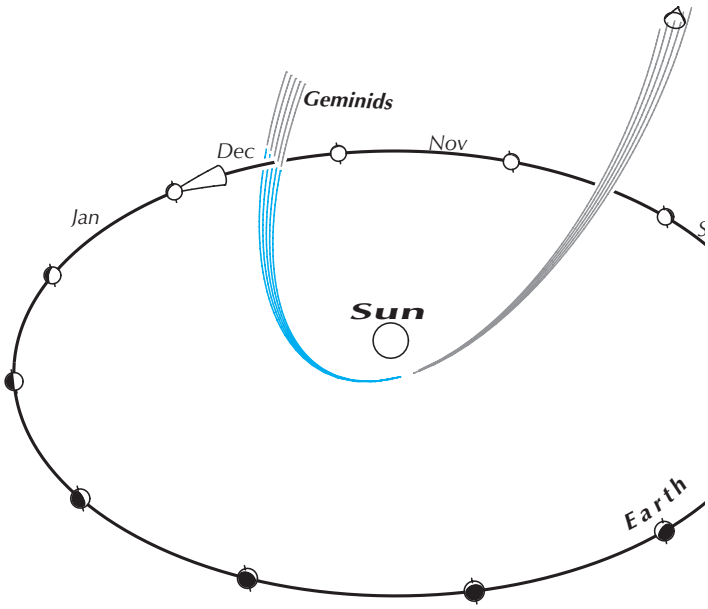



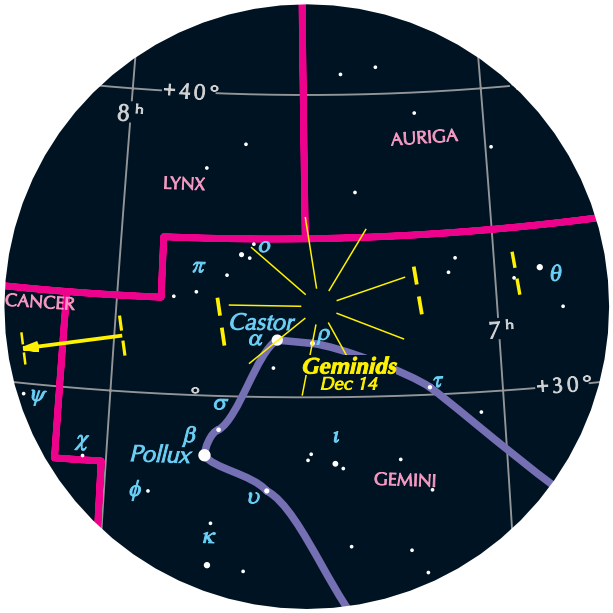



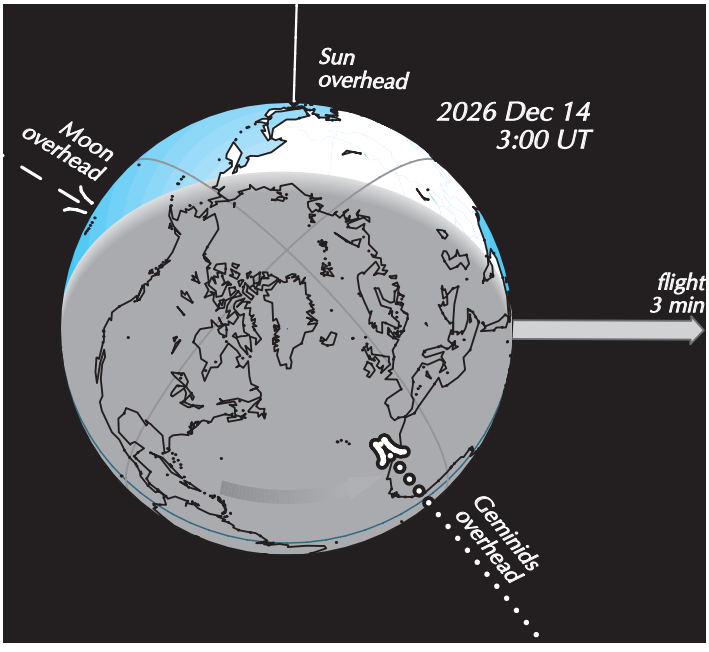



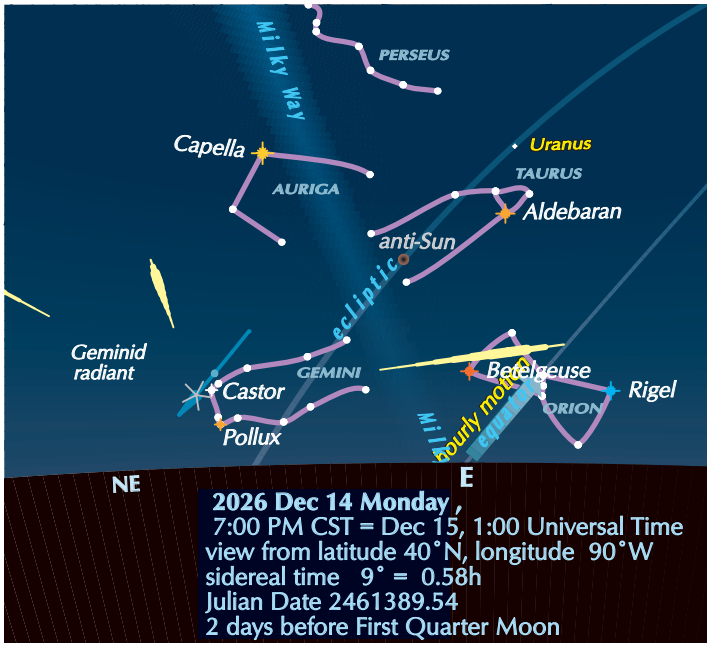
Dec. 14: **Geminids** have in recent decades rivaled the Perseids as most reliable among the annual showers. Instead of a sharp peak they have a “plateau” of about 22 hours, during which from 50 to 130 an hour may be seen. Their radiant, near Castor, is up for almost all of the long (northern) winter night, highest at 2 AM (so I once did a “star vigil”, logging Geminids and waiting for the constellations that first set to come back around into view). Geminids are medium-slow because coming sideways into Earth’s orbit. Their orbit is short, so it was puzzling that no parent comet was known, till in 1983 Fred Whipple pointed out that 1983 TB, discovered with the IRAS satellite, was in a “virtually coincident” orbit. Later named 3200 Phaethon, it is an asteroid (or possibly the denuded remains of a comet), 5 km wide, with a 1.52-year orbit, shorter than any comet’s, passing over Earth’s orbit by less than 1/10 of the Moon’s distance (its last close approach was in 2017), then dipping 3 times nearer than Mercury to the Sun. This rocky origin may explain the nature of the Geminids: mostly bright, very few leaving trains. This year: 3 days before First Quarter Moon.

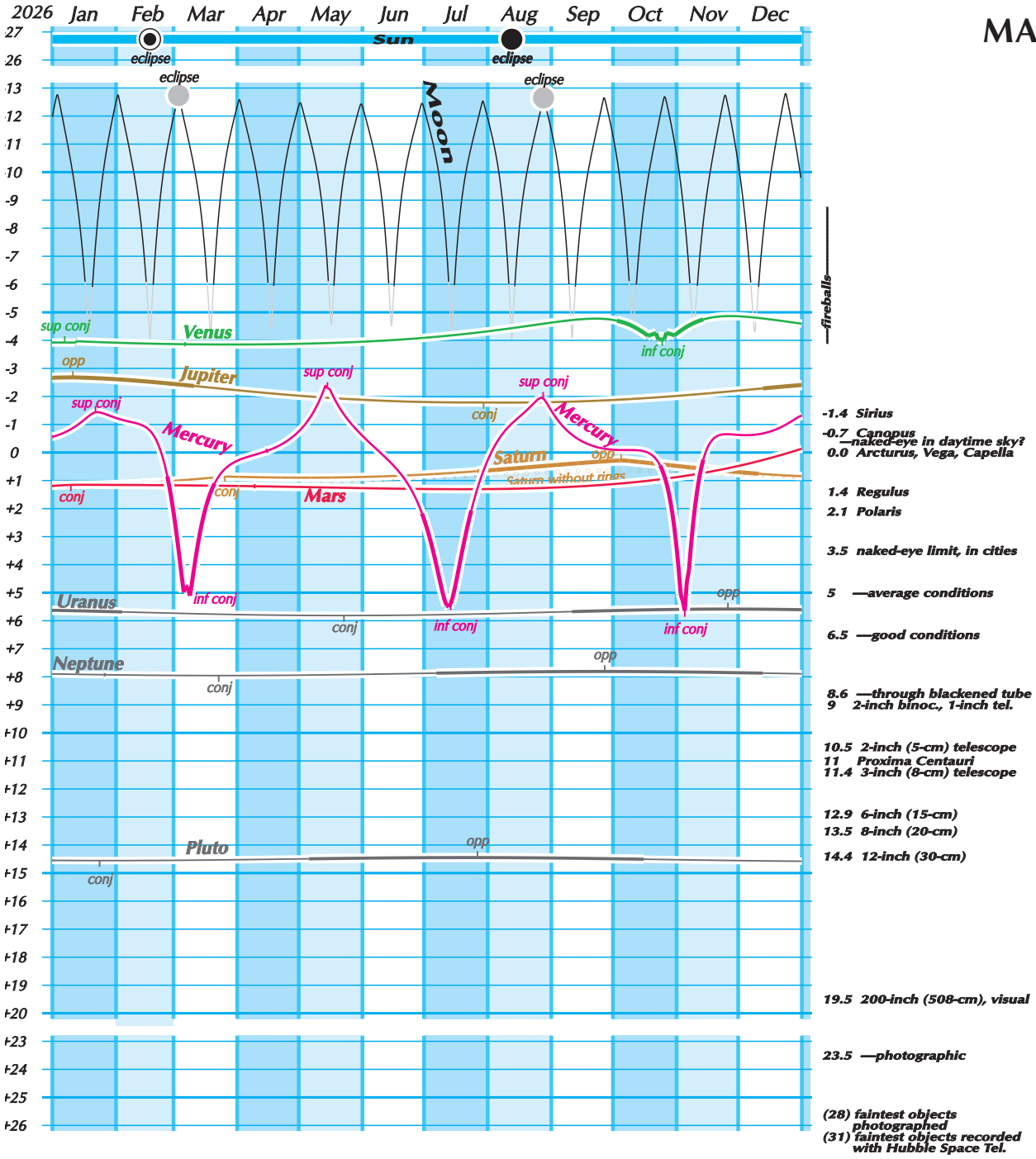
Dec. 22: **Ursids** radiate from near Kokab, the β star of Ursa Minor, at the other end of the Little Dipper from Polaris. They were also called (before names were regulated by the International Astronomical Union) Ursa-Minorids or Umids (would a shower from Ursa Major be Umads?). This radiant is (for latitude 40° north) in the sky all night, fairly low over the north horizon in the early night, almost overhead by dawn. These interesting and under-observed meteors fill a long cold winter-solstice night; it could be an even better pretext for a Star Vigil than the night of the Geminids! The parent comet is 8P Tuttle, which at intervals of 13.5 years drops steeply from the north through a perihelion close to Earth’s orbit; its last perihelion was in August 2021. (Comet and meteors revolve almost in the plane of the Milky Way, though in the opposite direction to that of the stars.) The meteors are of medium speed, mostly faint but with a few fireballs; during the shower’s brief peak 9 or 10 per hour may be seen, up to 50 especially when the comet is near; in 1945 and 1986 the rate was over 100. This year: 2 days before Full Moon.






Magnitude is the astronomical way of measuring brightness. Each magnitude is roughly 2.5 times brighter than the one below it. (Magnitude 5 is exactly 100 times brighter than magnitude 10.) This graph shows the apparent magnitude (that is, as seen from Earth) of solar-system bodies.

Ticks on the Mercury and Venus curves mark superior conjunctions with the Sun (upward ticks) and inferior conjunctions (downward). For other bodies they mark opposition (upward) and conjunction with the Sun (downward).

Superior planets (Mars outward) are brightest near opposition. At superior conjunction Venus brightens slightly, Mercury greatly, because presenting full faces toward us, though we can't see Mercury past the Sun. Venus is brightest near maxima of elongation. Planets other than Venus are on an upward slope of brightness when seen in the morning sky, downward in the evening sky.

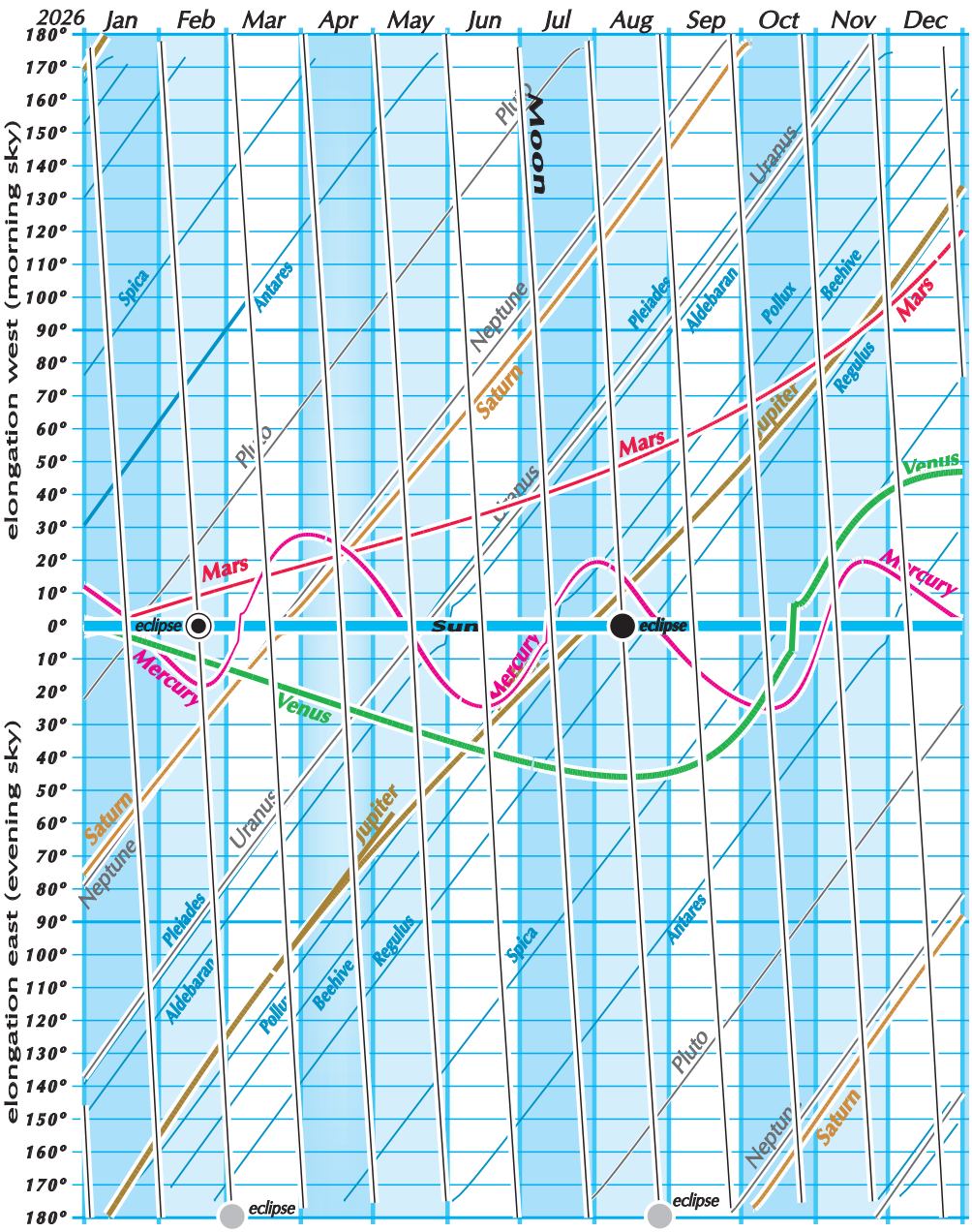
The curves are drawn slightly thicker when the bodies are retrograding, this being the time when Earth is closer to them. A dotted curve shows the brightness of the ball of Saturn alone, without the rings. They increase or decrease the brightness, depending on whether we are seeing their sunlit or dark side.

The Moon at first and third quarter is not, as one might suppose, half as bright as full (which would put it only 0.75 magnitude lower on the graph) but only about 1/11 as bright (2.6 magnitudes lower). See *Ast. Companion*, MOONLIGHT.

Magnitudes given are visual. Photographic magnitudes are about 0.7 to 0.9 greater (fainter); the peak sensitivity for traditional astronomical film is slightly blue-ward from that for the human eye. Magnitudes are calculated taking into account phase-angle (the angle Sun-body-Earth; hence, the part of the body that is not in shadow).

Large amateur telescopes are now reaching to magnitudes fainter than 24.

# ELONGATION




Try rotating the page so that the month names are at the right. There are two ways to look at it:

—Planets revolving around a star, as seen from one of those planets. Mercury and Venus spiral around the Sun. The others slip always backward (Mars slowest), because, being farther out than us, they are losing the race with us around the Sun. The Moon, blazing repeatedly across the foreground, describes a kind of time-cylinder around us.

—Imagine the diagram cut in half along the Sun-line, and put back the other way around: 0° (the Sun-line) at left and right, and 180° down the center. The Sun-line now represents the dawn horizon (on the left) and the sunset horizon (on the right). The line down the new middle (180°) is the meridian at midnight; the graph has become a graph of the night, from sunset to sunrise. On the new right, the superior planets sink into the sunset horizon; Mercury bobs out and drops back; the young Moon leaps repeatedly out. In the new middle, the superior planets cross the midnight meridian at their oppositions. On the new left, the dawn horizon, the superior planets emerge from their conjunctions with the Sun; Mercury keeps bobbing out; Venus heaves out for most of the year; the waning Moon dives repeatedly. Mars is the exception, failing to cross the 0° line in some years and the 180° line in others.

A crossing of lines represents a conjunction. A crossing of the 0° line is a conjunction with the Sun; of the 180° line, an opposition. At 90° east or west of the Sun, a planet is said to be at east or west “quadrature.” The Moon is new when it crosses 0°; full at 180°; at first and last quarter when it is 90° east or west. The graph reveals the times when the Moon joins groupings of planets and stars.

The greatest elongation for Venus can vary from about 45.4° to 47.3°. In 2026 it reaches 46° east on Aug. 15. The greatest for Mercury varies between 17.87° and 27.83.

Elongation really means angular distance measured from the Sun in any direction, not just along the ecliptic (difference in longitude). Even at conjunction, a planet is usually a little north or south of the Sun; at opposition it is north or south of the anti-Sun point. So elongation usually doesn’t exactly reach 0° or 180°; instead, the lines on the graph curl away a little before reaching these limits, then after a jump resume on the other side.

Stars, too, have elongation from the moving Sun. Shown are the five bright stars and two clusters (Pleiades and Beehive or Praesepe) near the ecliptic, often seen in conjunctions with the Moon and planets. They serve to relate the rest of this time-diagram to the spatial background of the sky. Pollux, lying more than 7° north of the ecliptic, cannot have elongation less than that. Stars farther from the ecliptic would curl away even more; a star at the ecliptic pole always has elongation 90°.

The graph strictly shows the bodies’ angular relations to the Sun, not to each other. Yet it serves to reveal times when they move side by side or in contrary directions, leave large parts of the sky bare, or gather in knots (visited fleetingly by the Moon).

# RISING AND SETTING

This graph shows times when the Sun, Moon, and planets rise and set, for latitude 40° north, longitude 0°. (The times would differ little for other longitudes, much more for other latitudes.) These are mean solar times, roughly the same as Standard Time for your time zone.

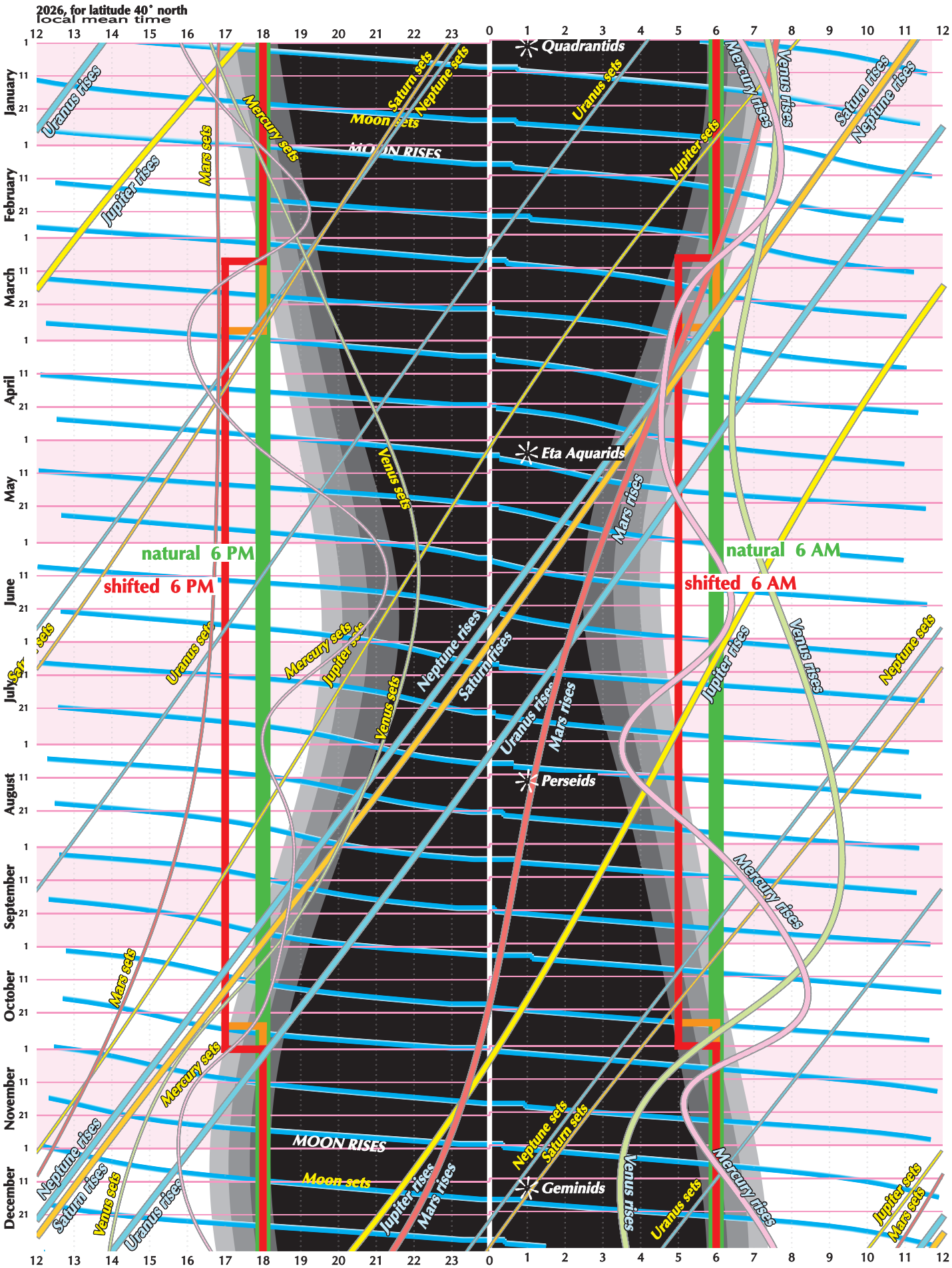
Midnight is in the middle because we choose to show night undivided. Each day-line ends at the midnight point where the next day starts, so there is really just one time-line, a cut and flattened helix.

The dark hourglass-shaped area is night, between the curves of sunset and sunrise. The three gray bands are civil, nautical, and astronomical twilight, defined as being when the Sun is less than 6°, 12°, and 18° below the horizon.

The Moon is in the sky at times between its rising and setting curves. It is new around the date when it sets at sunset; full when it rises at sunset. Dimmer objects are drowned out by full moonlight.

Major meteor showers, such as the Quadrantids in January, are symbolized by bursts of radiating lines, at 1 AM, rather than at their predicted peak times (which can be uncertain) or the times when their radiants are highest (which can be in daylight). In general, meteor showers are strongest after midnight. See the METEORS section for more on these showers and others.

Vertical red lines represent clock 6 PM and 6 AM, displaced by government rule an hour earlier in summer, when sunrise is earlier. The dates of displacement are for the USA; other countries have different rules. For more information on, and my opinion of, this interference with time, see www.universalworkshop.com/clock-shifting-times/


2026, for latitude 40° north
local mean time
January
February
March
April
May
June
July
August
September
October
November
December
Quadrantids
Eta Aquarids
Perseids
Geminids
natural 6 PM
shifted 6 PM
natural 6 AM
shifted 6 AM
MOON RISES
Moon sets
Uranus rises
Uranus sets
Jupiter rises
Jupiter sets
Mars sets
Mercury sets
Saturn sets
Neptune sets
Mercury rises
Venus rises
Saturn rises
Neptune rises
Venus sets
Mars rises
Neptune rises
Saturn rises
Uranus rises
Jupiter rises
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Saturn rises
Venus sets
Uranus rises
Jupiter rises
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Neptune sets
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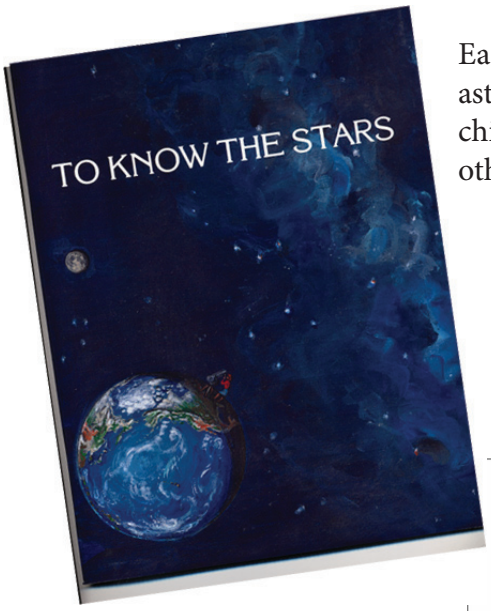
Venus rises
Uranus sets
Mercury rises
Jupiter sets
Mars sets

Useful supplements to the Astronomical Calendar from www.universalworkshop.com

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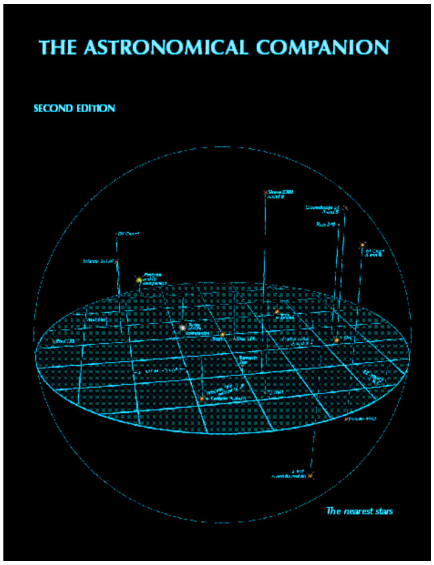
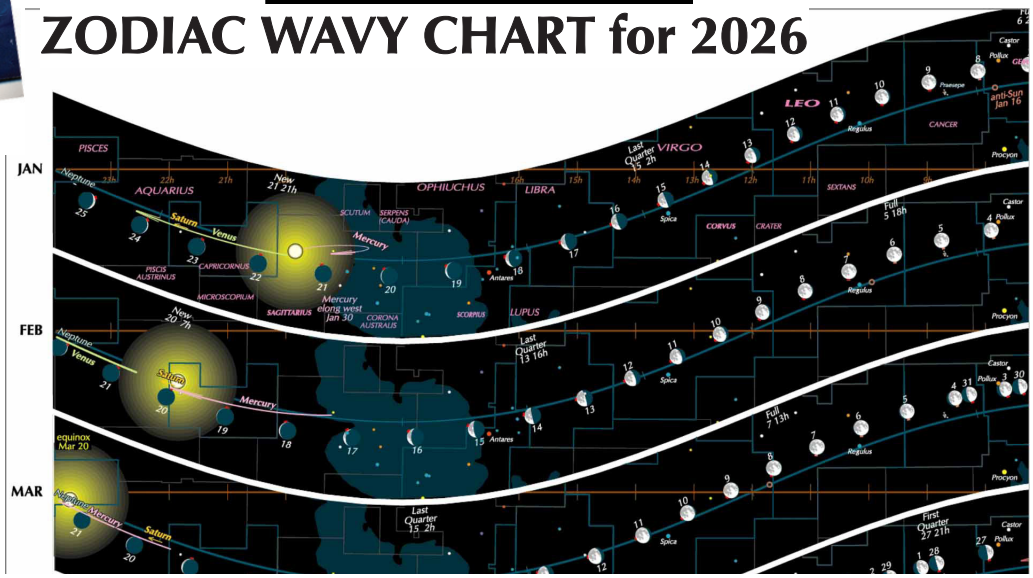
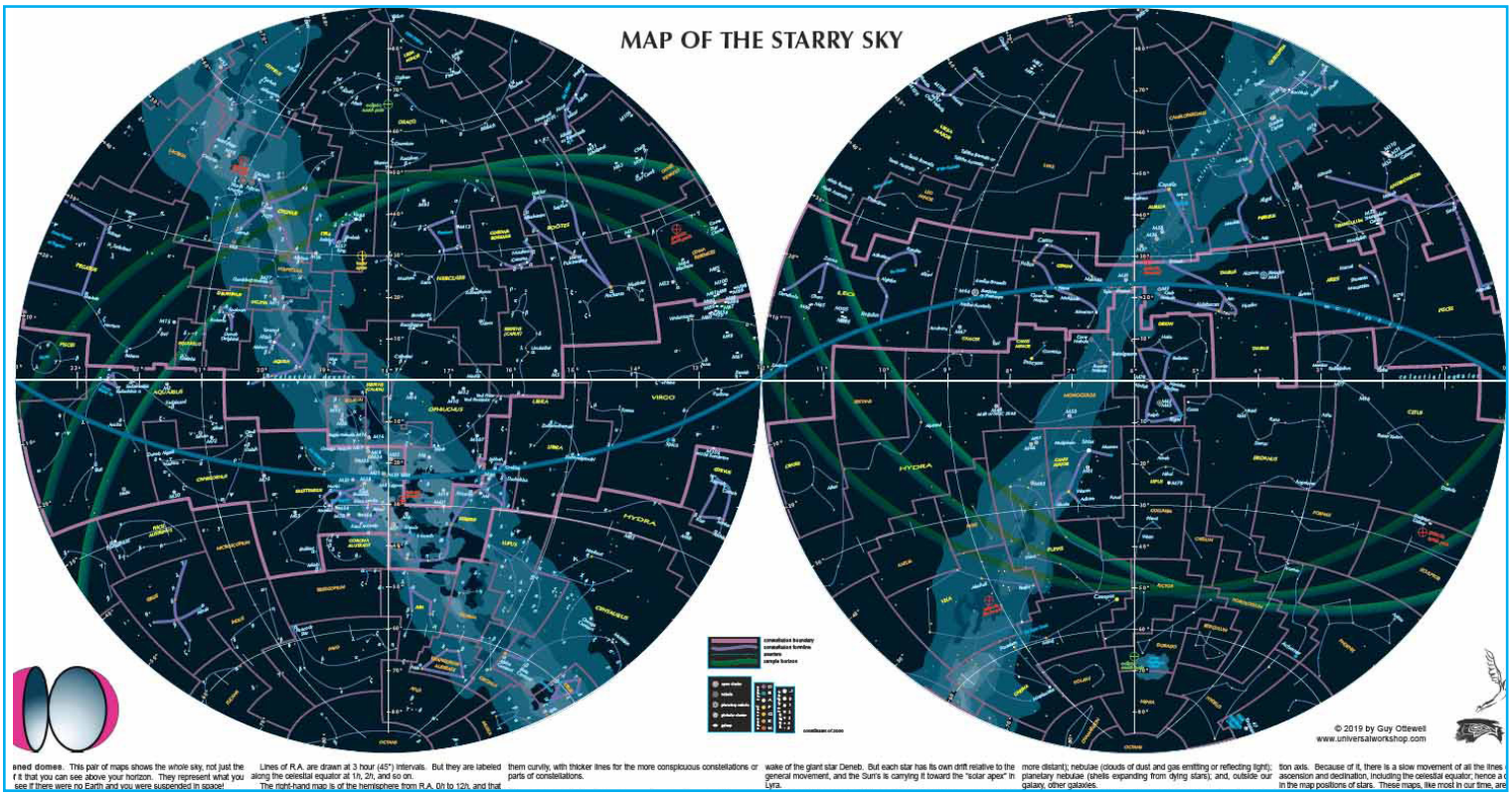



General guide to astronomy with large pages and many three-dimensional pictures

## ZODIAC WAVY CHART for 2026

Wall poster (2 by 3 feet) showing where the Sun, Moon, and planets are in relation to the stars, throughout the year




Wall poster (3 by 2 feet) of the whole celestial sphere