Annual Astronomical Events Almanac

ALMANAC

365

events per year

Eclipses, oppositions, conjunctions, and the cycles you can plan around

An evergreen reference to the predictable rhythms of the sky.

How to use this almanac

This almanac covers the **predictable annual rhythms** of the sky — the events that happen every year on a regular schedule. Specific dates shift slightly year to year, but the patterns are reliable: when each planet reaches opposition, when each meteor shower peaks, when seasonal events occur, what kinds of eclipses are coming.

Use this as a planning reference. For exact dates of upcoming events in any given year, check the resources listed at the back of this guide — TimeAndDate.com, NASA Eclipse Web Site, Sky & Telescope's monthly columns, and the RASC Observer's Handbook are the gold standards.

> **Companion guides**
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> This almanac is a high-level reference. For deeper coverage of specific event types, see the **Annual Meteor Shower Calendar** (full per-shower details), the **Solar Observing Guide** (detailed eclipse safety and upcoming eclipse paths), the **Planet Observing Guide** (per-planet observing windows), and the **Aurora Observing Guide** (for solar storm events). All are part of the What's Up Tonight library.

Solar system events

The annual rhythm of Earth, Sun, and Moon

Equinoxes and solstices

March equinox (around March 20)	Sun crosses the celestial equator going north. Day and night equal length everywhere on Earth (theoretically). Spring begins in Northern Hemisphere; autumn in Southern. Statistically the best time of year for aurora.
June solstice (around June 21)	Sun reaches northernmost declination (~23.4°N). Longest day in Northern Hemisphere; shortest in Southern. Sun never rises north of Arctic Circle (polar day) and never sets in the southern equivalent.
September equinox (around September 22)	Sun crosses celestial equator going south. Equal day/night again. Autumn in Northern Hemisphere; spring in Southern. The other statistical aurora-favorable time.
December solstice (around December 21)	Sun reaches southernmost declination (~23.4°S). Shortest day in Northern Hemisphere; longest in Southern. The polar nights begin/end at the Arctic and Antarctic circles.

Earth's orbital extremes

Perihelion (around January 4)	Earth closest to Sun (~147 million km). Counter-intuitively, this happens during Northern Hemisphere winter. Earth's seasons are caused by axial tilt, not orbital distance.
Aphelion (around July 4)	Earth farthest from Sun (~152 million km). Northern Hemisphere summer. The 3.4% distance variation has minor effect on insolation but is dwarfed by the seasonal effect of axial tilt.

Lunar events

Supermoons	When the full Moon coincides with perigee (Moon's closest approach to Earth), it appears about 14% larger and 30% brighter than at apogee. There are typically 3–4 supermoons per year. The visual effect is subtle in person but obvious in side-by-side photographs.
Micromoons	The opposite — full Moon at apogee. Smaller and dimmer than average. Same number per year as supermoons.
Lunar standstills	Once every 18.6 years, the Moon's orbital plane reaches a maximum tilt to Earth's, causing the moonrise position to swing further north and south than usual. The major lunar standstill occurred 2024–2025 and won't repeat until ~2043.

Earthshine season	Most prominent on thin crescent Moons in **spring evenings** (Northern Hemisphere) — March-May. The geometry favors more sunlight bouncing off Earth's daylight side toward the Moon, illuminating its dark side faintly.

Eclipses

Solar and lunar eclipse cycles

Eclipse basics

Eclipses happen when the Sun, Earth, and Moon align. Solar eclipses (Moon between Sun and Earth) occur at New Moon. Lunar eclipses (Earth between Sun and Moon) occur at Full Moon. They don't happen every month because the Moon's orbit is tilted ~5° to the ecliptic — alignments only happen during 'eclipse seasons' that occur about every 6 months.

Solar eclipses	**Total** — Moon completely covers Sun (only along narrow path of totality, ~100 km wide). **Annular** — Moon is too far from Earth to fully cover Sun, leaving a 'ring of fire'. **Partial** — Moon partially covers Sun (visible across wider region). **Hybrid** — alternates between annular and total along the path.
Lunar eclipses	**Total** — Earth's full shadow (umbra) covers Moon, often producing a copper-red 'blood Moon' from refracted sunset light. **Partial** — Earth's umbra covers part of Moon. **Penumbral** — Moon enters only Earth's outer shadow (subtle, often unimpressive). Visible from anywhere on Earth's night side.
Frequency	About 4–7 eclipses per year total (solar + lunar combined). Solar eclipses are technically more common but visible from any one location far less often than lunar. A given location sees a total solar eclipse roughly once every 350–400 years on average.

Saros cycle

Eclipses repeat in cycles called **Saros** — every 18 years 11 days 8 hours, almost the same Sun-Earth-Moon geometry recurs. So if a total solar eclipse happens today, another one happens 18 years and 11 days from now — but shifted ~120° west in longitude due to the 8-hour offset. Three saros cycles (about 54 years) brings the eclipse back to the same general region of Earth.

Notable upcoming eclipses (post-2024)

Mar 14, 2025	Total lunar eclipse. Visible across the Americas. (Past — included for cycle reference.)
Sep 7, 2025	Total lunar eclipse. Visible from Asia, Africa, Europe, Australia.
Mar 3, 2026	Total lunar eclipse. Visible from Asia, Pacific, Australia, western Americas.
Aug 12, 2026	Total solar eclipse. Path through Iceland, Spain, Portugal. North America sees partial only.
Aug 2, 2027	Total solar eclipse. Path through Egypt and Saudi Arabia. 6 minutes 23 seconds of totality — longest of the 21st century.

Jul 22, 2028	Total solar eclipse. Path through Australia and New Zealand. Sydney in the path.
Mar 30, 2033	Total solar eclipse. Path through Alaska. Major North American eclipse for those who can reach it.
Aug 12, 2045	Total solar eclipse. Path across western and southern continental US. Longest US totality (over 6 minutes) until the 22nd century.

For complete eclipse data

NASA Eclipse Web Site (eclipse.gsfc.nasa.gov) is the definitive resource — every solar and lunar eclipse from 1500 BCE to 3000 CE with detailed maps and circumstances. **TimeAndDate.com** provides simpler interactive maps for upcoming events. **Xavier Jubier's interactive Google Maps eclipse pages** let you click your exact location for personalized circumstances.

Planetary events

Oppositions, conjunctions, elongations

Oppositions (best time to observe outer planets)

Mars	Every ~26 months. Mars is more than twice as bright at opposition than at conjunction. The 'great oppositions' (when Mars is also near perihelion in its own orbit) occur every ~17 years. Recent: 2018, 2020 (decent), 2022, 2025 (Jan 16 in Gemini, fair). Next great opposition: 2033–2035 window.
Jupiter	Annual, every ~13 months. Disk is large year-round; opposition just makes it slightly larger and brighter. Current oppositions cycle through Taurus → Gemini → Cancer → Leo over the next several years.
Saturn	Annual, every ~12.5 months. Notable because the ring tilt cycles through opposition position each year. The ring opening cycle peaks every ~15 years; we're rising from the 2025 edge-on position toward maximum tilt around 2032.
Uranus	Annual, mid-November typically. Drifts slowly through the zodiac (84-year orbital period). Currently in Taurus, moving very slowly.
Neptune	Annual, late September typically. Slowly through Pisces.
Pluto (dwarf planet)	Annual, mid-July typically. Currently in Capricornus, soon entering Aquarius.

Greatest elongations (Mercury and Venus)

Inner planets never appear far from the Sun. Their visibility cycles through 'apparitions' between successive conjunctions. **Greatest elongation** is when the planet appears farthest from the Sun — the only times they're easy to find.

Mercury	6 elongations per year, alternating evening (east of Sun) and morning (west of Sun). Mercury's evening apparitions favor Northern Hemisphere viewers in spring; morning apparitions in fall. Maximum separation 18-28°.
Venus	Two elongations per 584-day synodic cycle — one evening, one morning. Each apparition lasts about 9 months. Venus reaches up to 47° from the Sun at greatest elongation. The 'evening star' periods are more memorable; the 'morning star' periods favor early risers.

Notable conjunctions and groupings

When planets appear close together in the sky (a few degrees or less). Annual occurrences include:

Crescent Moon + Venus	A few times per year, the thin crescent Moon passes within a degree or two of Venus — striking pre-dawn or post-sunset views. Often the two brightest objects after Sun and Moon, side by side.

Jupiter-Saturn conjunctions	Occur every ~20 years. The 2020 'great conjunction' brought them within 0.1° of each other — they appeared as a single elongated 'star.' Next: 2040 (within ~1°).
Triple conjunctions	Mars, Jupiter, Saturn occasionally line up in groupings of three. These get media attention but are visually subtle — the planets are still 1-5° apart, not touching.
Planet-bright-star conjunctions	Specific bright stars frequently align with planets — Aldebaran (Taurus), Regulus (Leo), Spica (Virgo), Antares (Scorpius) all sit near the ecliptic. When a planet passes a bright star within 1°, it's worth a look.

Occultations

When the Moon passes in front of a star or planet. Lunar occultations of planets happen regularly — bright planets like Venus, Jupiter, Saturn are occulted by the Moon several times per year for various locations. Lunar occultations of bright stars (Aldebaran, Regulus, Spica, Antares) cycle through periods when each star is close enough to the ecliptic to be occultable.

How to observe	Watch the bright object disappear behind the Moon's dark limb (entering occultation), then reappear from the opposite limb. The disappearance is sharp — under a second. Specific timing depends on your exact location.
Where to find predictions	**Lunar Occultation Workbench** (occultation.org) — comprehensive predictions. **IOTA** (International Occultation Timing Association) coordinates serious timing observations that contribute to lunar limb profile science.

Meteor showers (summary)

The annual meteor calendar at a glance

Twelve major annual showers occur on essentially the same dates each year. See the **Annual Meteor Shower Calendar** in the library for complete per-shower observing details. Quick reference here:

January 3-4	Quadrantids — ZHR 110, short sharp peak.
April 22-23	Lyrids — ZHR 18, occasional outbursts.
May 5-6	Eta Aquariids — ZHR 50, southern-favored, Halley's debris.
July 30	Delta Aquariids — ZHR 25, southern-favored.
August 12-13	**Perseids — ZHR 100, the year's most popular shower.**
October 8-9	Draconids — ZHR 10 (occasional outbursts).
October 21-22	Orionids — ZHR 25, Halley's other shower.
November 5-12	South & North Taurids — ZHR 5 each, but famous for fireballs.
November 17-18	Leonids — ZHR 15 (occasional storms when comet 55P near).
December 13-14	**Geminids — ZHR 150, the year's strongest reliable shower.**
December 22-23	Ursids — ZHR 10, circumpolar from northern latitudes.

Solar cycle events

Solar maximum	Peak of the 11-year solar cycle. Maximum sunspots, flares, CMEs, aurora frequency. Cycle 25 maximum 2024–2025; we're currently near peak. Cycle 26 maximum predicted ~2035.
Solar minimum	Quietest part of the cycle. Few or no sunspots for weeks; aurora rare. Last minimum was 2019; next around 2030.
Aurora season	Statistically peaks at equinoxes (March, September) due to magnetic geometry. Solar maximum amplifies all aurora frequencies.

Annual reference resources

Where to find current-year specifics

Specific dates for the events described above shift slightly year to year. For exact dates for any given year, consult these references — all updated annually:

RASC Observer's Handbook	**The gold standard.** Annual ~350-page reference published by the Royal Astronomical Society of Canada. Every relevant event for the year, plus tutorials, finder charts, and observing programs. ~$30. Used by serious amateurs across North America.
Sky & Telescope's monthly columns	**skyandtelescope.org**. 'This Week's Sky at a Glance' updated weekly. Monthly issues of the magazine include detailed star charts and event tables. The most accessible American astronomy publication.
BBC Sky at Night magazine	**skyatnightmagazine.com**. UK-focused but globally useful. Monthly star charts, equipment reviews, observing programs. Tied to the long-running BBC TV show.
TimeAndDate.com	**timeanddate.com/astronomy**. Free interactive eclipse maps, sunrise/sunset for any location, Moon phase calendars. Best for quick lookups.
NASA Eclipse Web Site	**eclipse.gsfc.nasa.gov**. Definitive eclipse predictions from 1500 BCE to 3000 CE. Detailed maps, timing, magnitudes for every eclipse.
Stellarium (free)	Desktop planetarium showing exactly what the sky looks like at any time from any location. Includes planet positions, satellite tracking, comet positions (with downloadable orbital elements). The single most useful tool for active observers.
In-the-Sky.org	**in-the-sky.org**. Comprehensive event calendar for any year — eclipses, oppositions, conjunctions, meteor showers, lunar phases. Filterable by event type. UK-based but works globally.
Heavens-Above	**heavens-above.com**. Best for satellite passes (ISS, Tiangong, Starlink) and comet/asteroid current positions.
AAVSO	**aavso.org**. American Association of Variable Star Observers — variable star current brightness, finder charts, alerts for variable star events (T CrB outburst when it happens).

Companion guides in this library

For deeper coverage of specific event categories, see: **Annual Meteor Shower Calendar**, **Solar Observing Guide**, **Planet Observing Guide**, **Aurora Observing Guide**, **Comet Observing Guide**, **Moon Map and Observing Guide**, **ISS & Satellite Observing Guide**. This almanac is the high-level overview; those provide the working details.