Courtesy of SKY & TELESCOPE

A Long-Awaited Total Lunar Eclipse

This month Earth's umbral shadow covers the Moon for the first time since 2022.

Like hands and feet, eclipses come in pairs. During the month of March we'll experience a total lunar eclipse followed by a partial solar eclipse. Both are visible in North America although the latter will be limited to a few locations along the East Coast.

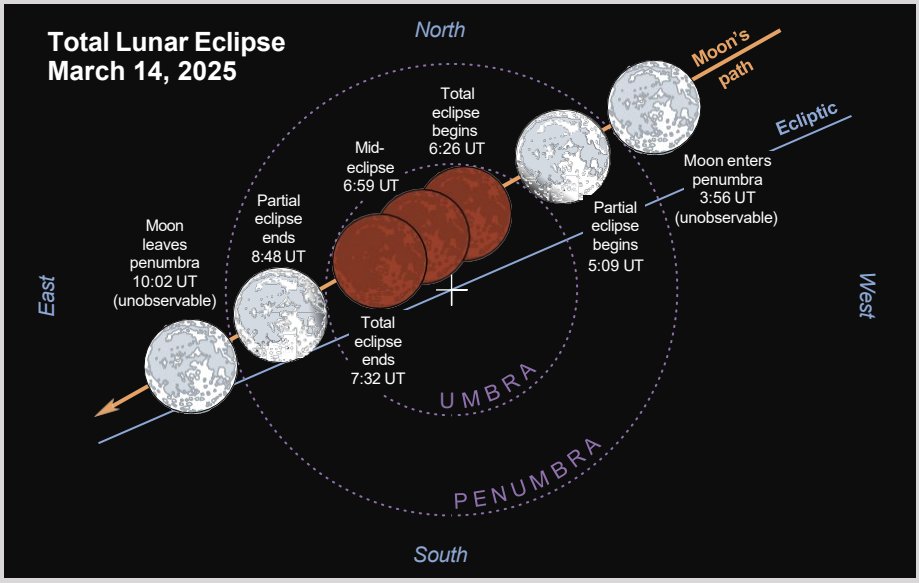
The Moon's orbit is tilted by about 5° to the *ecliptic*, the plane of Earth's orbit around the Sun. As the Moon revolves around our planet it alternately dips above and below that plane, intersecting it at two points called *nodes*. For a lunar eclipse to occur, the Moon must be full at the same time it crosses a node. When these circumstances are met the Sun, Earth, and Moon neatly line up in that order, and the Moon passes through our planet's shadow as it does on the night of March 13–14. At new Moon, two weeks later, it cuts through that plane again, but this time it passes between the Earth and Sun, generating a solar eclipse.

Observers across the Americas have the best seats in the house for the lunar eclipse. All 50 U.S. states will see the entire event, though western Alaska and Hawai'i miss the start of the penumbral phase. The partial eclipse begins at 1:09 a.m. EDT on March 14th, with totality lasting from 2:26 a.m. to 3:32 a.m. EDT. Mid-eclipse occurs at 2:59 a.m. EDT. From the West Coast, the partial phase begins at 10:09 p.m. PDT on the 13th, with mid-eclipse occurring almost exactly at midnight, at 11:59 p.m. PDT. Western European observers will see the totally eclipsed Moon setting in morning twilight, while on the other side of the world, New Zealanders get to watch the Moon rise totally eclipsed.

This won't be a particularly deep eclipse because the entire lunar disk misses the center of Earth's umbral shadow. During totality we should expect to see the northern portion of the Moon glow brighter than the southern due to the former's proximity to the umbral shadow's northern edge.

⇧This set of photos from the most recent total lunar eclipse on November 8, 2022, show the Moon shortly before totality (right), during totality (center), and shortly after (left).

En route to the umbra, the Moon passes through Earth's outer shadow, called the *penumbra*. Here, sunlight and shadow mix to produce a filmy, gray shading across the lunar disk. Watch for the penumbral shadow to become noticeable along the southeastern (sky direction) portion of the lunar disk starting around 4:30 UT. During the September 2024 partial lunar eclipse,



* Subtract 4 hours from the above UT to arrive at EDT

LUNAR ECLIPSE IMAGES: BOB KING; LUNAR ECLIPSE DIAGRAM: LEAH TISCIONE / S&T; SOURCE: FRED ESPENAK

the penumbra was much more obvious on my camera's live-view screen compared to what my eyes saw. I recommend this approach as a good way to monitor the Moon's progress during the event's early phases.

The umbra takes its first nibble of the Moon at 5:09 UT — the start of partial eclipse. Well before totality, attentive observers will notice the shadowed portion of the lunar disk glowing smoky-red from sunlight refracted by Earth's atmosphere. Excitement mounts as totality approaches. When the last sunlit sliver of Moon is swallowed by the umbra at 6:26 UT, you can almost imagine a chorus of "wows!" rising skyward from eclipse watchers.

During the eclipse, the Moon is relatively far from Earth and just a few days shy of apogee, which occurs on March 17th. As a result, the smallish lunar disk spends a generous 66 minutes crossing the northern portion of the umbra. Absent direct sunlight, the eclipsed orb always looks small and subdued to my eye compared to the boisterous brilliance of the full Moon. The eerie darkness that descends over the landscape during totality further adds to the contemplative mood of this leisurely paced show.

Dedicated observers use the five-point Danjon scale (in which 0 is darkest, 4 is lightest) to estimate the brightness and color of the eclipsed Moon — qualities linked to the clarity of Earth's atmosphere. Major volcanic eruptions can pollute the air with aerosols that strongly darken the Moon (see page 58).

Photographing a lunar eclipse is straightforward. Indeed, with the capabilities of modern DSLR and mirrorless cameras, you hardly need a tripod for the partial phases. But a sturdy support is essential when the Moon dwindles to a crescent and especially during totality when exposures are longer. A tracking mount ensures good photos during all phases, particularly with longer lenses. While a smartphone works for handheld shots, most devices render the lunar disk disappointingly small. Instead, set up a telescope and either hold your phone's lens up to the eyepiece, or purchase an adapter to attach it directly. This *afocal* method yields screen-filling images you'll be eager to share on social media.

You can also use a telescope on a tracking mount to shoot a close-up video of the eclipse to see if you can capture flashes from meteoroids striking the lunar surface. If you own a smart telescope, put it to work creating a time-lapse or video while you sit back and watch the event unfold with binoculars or a second scope.

Sky & Telescope Senior Contributing Editor Roger Sinnott encourages observers to record the times when specific craters enter and exit the umbral shadow. The umbra is larger than pure geometry predicts because of atmospheric effects, which vary from eclipse to eclipse. For instructions, check out Roger's article at **https://is.gd/lunartiming.**

On eclipse night, you'll want to bundle up warmly. Even in early spring, temperatures in some regions may drop below freezing late at night. But imagine what it's like on the Moon's surface as Earth blocks the light and heat from the Sun. During the May 2022 total lunar eclipse, the Thermal Infrared Sensor instruments on the Landsat 8 and 9 satellites recorded rapidly plummeting temperatures on the Moon as it slid into Earth's shadow. The temperature dropped from a toasty 97°C (207°F) down to −93°C. The data also revealed that different features cooled at different rates. Craters tended to hold onto their heat longer than their surroundings.

After mid-eclipse at 6:59 UT, the Moon slowly drifts out of the umbra and back into sunlight starting at 7:32 UT. The event concludes when the Moon exits Earth's penumbral shadow at 10:02 UT. From beginning to end, the eclipse lasts 366 minutes.

The next lunar eclipse occurs on September 7th when the Moon puts on a similar show, but for the opposite side of the planet.***