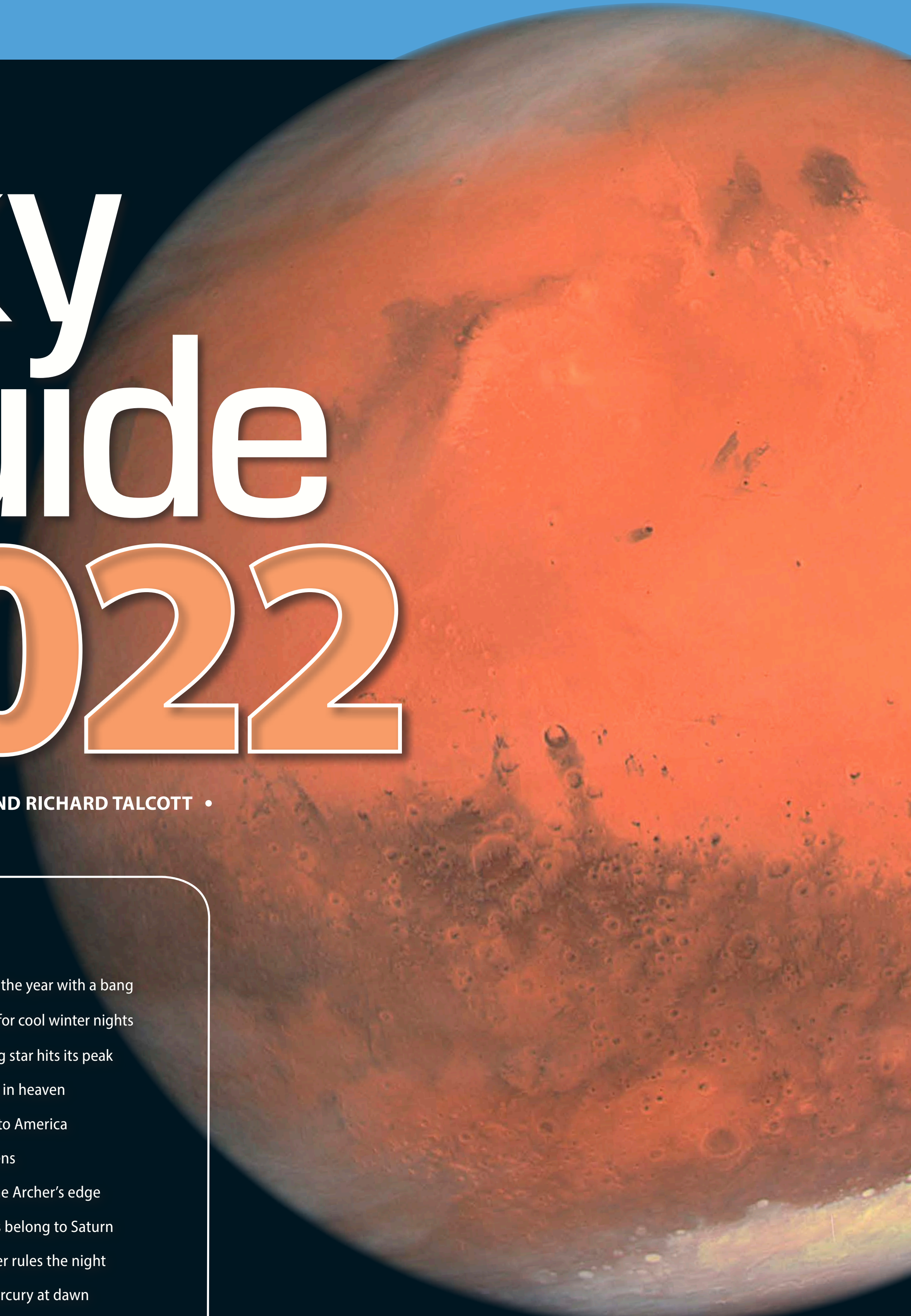
Astronomy magazine

Sky Guide 2022

• BY MARTIN RATCLIFFE AND RICHARD TALCOTT •



Mars returns to brilliance in late 2022 and climbs nearly overhead for lucky Northern Hemisphere observers. ESA & MPS FOR OSIRIS TEAM

contents

Martin Ratcliffe *is a planetarium professional with Evans & Sutherland and enjoys observing from Wichita, Kansas.* **Richard Talcott** *is a contributing editor of* **Astronomy.**

A supplement to *Astronomy* magazine

2022 Jan

S	M	T	W	T	F	S
						1
	3	4	5	6	7	8
	10	11	12	13	14	15
16		18	19	20	21	22
23	24		26	27	28	29
30	31					

3 Quadrantid meteor shower peaks

The Moon passes 3° south of Mercury, 8 P.M. EST

4 The Moon passes 4° south of Saturn, noon EST

5 The Moon passes 4° south of Jupiter, 7 P.M. EST

7 The Moon passes 4° south of Neptune, 5 A.M. EST

Mercury is at greatest eastern elongation (19°), 6 A.M. EST

8 Venus is in inferior conjunction, 8 P.M. EST

11 The Moon passes 1.5° south of Uranus, 6 A.M. EST

Asteroid Juno is in conjunction with the Sun, 5 P.M. EST

16 Pluto is in conjunction with the Sun, 10 A.M. EST

23 Mercury is in inferior conjunction, 5 A.M. EST

29 The Moon passes 2° south of Mars, 10 A.M. EST

The Moon passes 10° south of Venus, 9 P.M. EST

30 The Moon passes 8° south of Mercury, 7 P.M. EST

Meteors launch the year with a bang

The New Year gets off to a great start when a prolific meteor shower peaks just one day after New Moon. The Quadrantids reach their maximum Jan. 3, when up to 120 meteors per hour can rain down before dawn under ideal conditions. Of course, January often brings cold temperatures and cloudy skies. But if the weather cooperates, observers should be in for a treat.

The Quadrantids derive from an extinct comet that astronomers now classify as asteroid 2003 EH_1. During countless trips around the Sun, the comet's ices turned to gas and liberated tons of dust particles that now occupy the current asteroid's orbit. Earth encounters these cosmic bread crumbs the first week of every year. As our planet sweeps up the dust motes, friction with air molecules incinerates them and creates the flashes of light we call meteors.

The Quadrantid shower is relatively young, and the particles have not had enough time to spread into a broad stream. So, even though the shower remains active from Dec. 28 through Jan. 12, it has a sharp peak. This pinnacle should arrive around 21h UT on the 3rd, which favors viewers in Europe and Asia. Still, those in North America should have a good show the mornings of both Jan. 3 and 4.

The meteors appear to radiate from a point in northern Boötes the Herdsman. Until a century ago, this region belonged to the now-defunct constellation Quadrans Muralis, for which the shower is named. When the International Astronomical Union officially defined the constellation boundaries in the 1920s, it incorporated the stars of Quadrans Muralis into Boötes and Draco the Dragon.

A Quadrantid fireball blazed above a moonlit landscape in Parsonsfield, Maine, on Jan. 3, 2021. Fortunately, dark skies will prevail for the peak of this year's shower. ABHIJIT PATIL

Viewing conditions for the Quadrantids stand head and shoulders above those for the other two big annual meteor showers. The Perseid shower's peak Aug. 12 coincides with a Full Moon, which will wipe out faint meteors and render bright ones less impressive. December's Geminids don't fare much better because a waning gibbous Moon shares the sky after 10 P.M. local time. This shower produces lots of bright meteors, however, and could deliver a decent show.

Of the other major showers, the Eta Aquariids offer the best prospects. They peak May 6 under a waxing crescent Moon that sets before the prime predawn hours. Sadly, a waning crescent Moon interferes with both October's Orionids and November's Leonids. The thinner crescent at the Orionids' peak makes conditions for that shower a bit better.

Meteor showers in 2022

Name	Peak date	Moon's phase	Prospects
Quadrantids	Jan. 3	New Moon	Excellent
Lyrids	April 22	Last Quarter Moon	Fair
Eta Aquariids	May 6	Waxing crescent	Excellent
Perseids	Aug. 12	Full Moon	Poor
Orionids	Oct. 21	Waning crescent	Good
Leonids	Nov. 17	Waning crescent	Fair
Geminids	Dec. 14	Waning gibbous	Poor

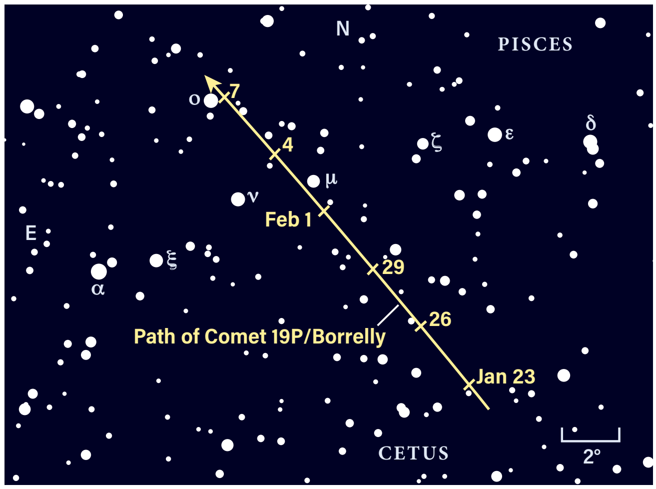
A bright comet for cool winter nights

In many years, the brightest comet visible in our skies is a first-time visitor from the distant solar system. Such comets typically arrive with little warning, so observers need to keep abreast of the latest comet news by checking Sky This Month in *Astronomy* magazine or the Astronomy.com website.

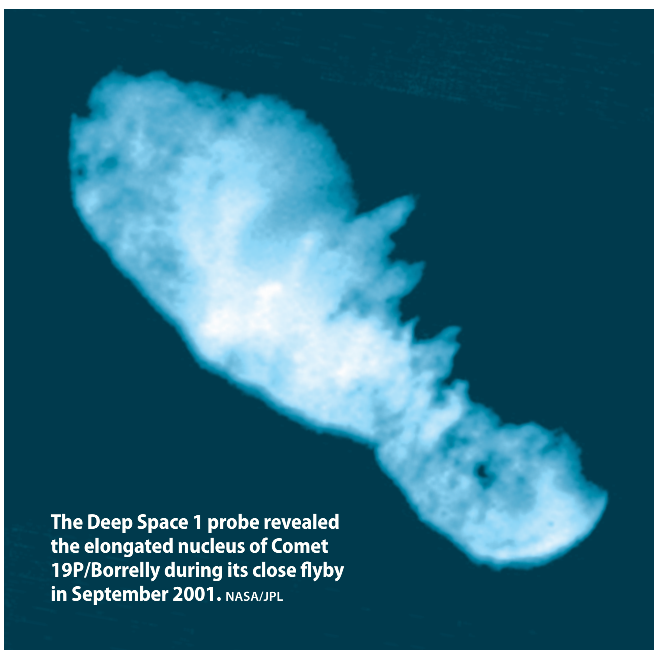
Periodic comets tend to be more predictable. And 2022 offers the return of a favorite that hasn't visited Earth's vicinity since 2015. Comet 19P/Borrelly should reach 8th magnitude when it peaks in late January and early February. Although that's too faint to see with the naked eye, it should be bright enough to see well with binoculars and to put on a nice show through most telescopes.

Borrelly reaches perihelion — its closest approach to the Sun during its 6.85-year orbit — Feb. 1 at a distance of 121 million miles. Perihelion coincides with a New Moon, which makes the last week of January and first week of February the prime viewing window. The comet should display a compact head and a short tail that flows to the east.

Borrelly moves from Cetus into Pisces during this period. This area lies high in the southwest once twilight fades to darkness and doesn't set until around 11 P.M. local time. Fortunately, early February provides some bright guide stars to help you find the comet. Borrelly passes 0.4° east of magnitude 4.8 Mu (μ) Piscium on the 2nd and the same distance west of magnitude 4.3 Omicron (ο) Psc on the 7th.



Comet Borrelly should peak at 8th magnitude as it slides through Pisces the Fish in early February. ALL ILLUSTRATIONS: *ASTRONOMY*: ROEN KELLY



The Deep Space 1 probe revealed the elongated nucleus of Comet 19P/Borrelly during its close flyby in September 2001. NASA/JPL

French astronomer Alphonse Borrelly discovered this comet from Marseille Observatory on Dec. 28, 1904. If 19P/Borrelly sounds familiar, it should. NASA sent its Deep Space 1 spacecraft — which successfully tested the space agency's then-new ion-propulsion technology — within 1,349 miles of this comet in September 2001. The probe delivered the sharpest views of any comet's nucleus to that date, revealing a variety of terrains across its 5-mile-long body.

Feb 2022

S	M	T	W	T	F	S
		○	2	3	4	5
6	7	◑	9	10	11	12
13	14	15	●	17	18	19
20	21	22	◐	24	25	26
27	28					

- **2** The Moon passes 4° south of Jupiter, 4 P.M. EST
- **3** The Moon passes 4° south of Neptune, 4 P.M. EST
- **7** The Moon passes 1.2° south of Uranus, 3 P.M. EST
- **12** Venus is at greatest brilliancy, 1 P.M. EST
- Venus passes 7° north of Mars, 8 P.M. EST
- **16** Mercury is at greatest western elongation (26°), 4 P.M. EST
- **27** The Moon passes 9° south of Venus, 1 A.M. EST
- The Moon passes 4° south of Mars, 4 A.M. EST
- **28** The Moon passes 4° south of Mercury, 3 P.M. EST
- The Moon passes 4° south of Saturn, 7 P.M. EST

Moon Phases

- ◑ **First Quarter**
- ● **Full Moon**
- ◐ **Last Quarter**
- ○ **New Moon**

Events that can be viewed with **the naked eye**

Events that can be viewed with **binoculars**

Events that can be viewed with a **telescope**

2022 March

S	M	T	W	T	F	S
		1	○	3	4	5
6	7	8	9	◑	11	12
13	14	15	16	17	●	19
20	21	22	23	24	◐	26
27	28	29	30	31		

2 Mercury passes 0.7° south of Saturn, 8 A.M. EST

5 Jupiter is in conjunction with the Sun, 9 A.M. EST

7 The Moon passes 0.8° south of Uranus, 1 A.M. EST

12 Venus passes 4° north of Mars, 9 A.M. EST

13 Neptune is in conjunction with the Sun, 8 A.M. EDT

20 Venus is at greatest western elongation (47°), 5 A.M. EDT

Equinox (northern spring/southern autumn begins), noon EDT

Mercury passes 1.3° south of Jupiter, 6 P.M. EDT

27 The Moon passes 4° south of Mars, 11 P.M. EDT

28 The Moon passes 7° south of Venus, 6 A.M. EDT

The Moon passes 4° south of Saturn, 8 A.M. EDT

29 Venus passes 2° north of Saturn, 9 A.M. EDT

30 The Moon passes 4° south of Jupiter, 11 A.M. EDT

The Moon passes 4° south of Neptune, 3 P.M. EDT

The morning star hits its peak

Venus dominates the morning sky from January to September. It reaches its peak at greatest elongation March 20, when it lies 47° west of the Sun and appears 11° high in the southeast an hour before sunrise. The inner planet then shines at magnitude –4.5 against the background stars of Capricornus. Venus shares the Sea Goat's abode with two other planets: Mars appears 4° to Venus' lower right while Saturn lies 8° to Venus' lower left. The inner planet shines more than 100 times brighter than either of its neighbors.

Although March 20 marks Venus' peak separation from the Sun, the planet achieves other significant milestones during this morning apparition. It dazzles at magnitude –4.9 Feb. 12, its maximum brightness for the year. It then stands 15° above the southeastern horizon an hour before sunup.

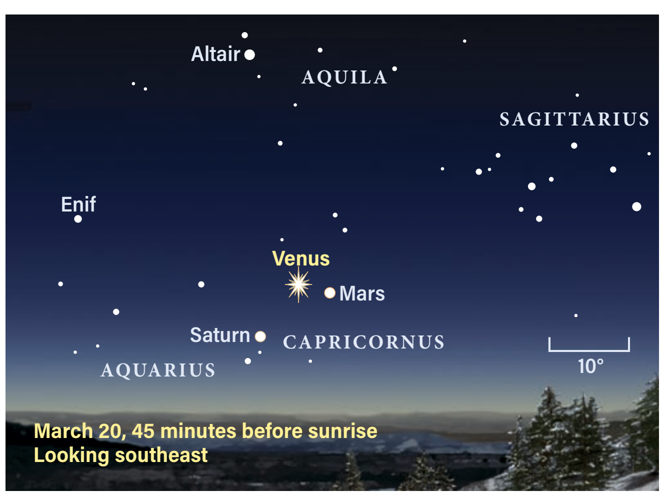
An abandoned house served as a spooky foreground for brilliant Venus during its exceptional evening appearance in April 2020. BARRY BURGESS

Why does Venus appear higher in February than when it's farther from the Sun a month later? Solar system geometry is more complicated than you might suspect. Blame the orientation of the ecliptic — the apparent path of the Sun across our sky that the planets follow closely. It makes a shallow angle to the eastern horizon at dawn in early spring, so Venus' large distance from the Sun in March translates more into distance along the horizon than into elevation.

February and March are also great times to view Venus through a telescope because it appears large and shows a beautiful crescent phase. On Feb. 1, the inner world appears 49" across and just 15 percent lit. At greatest brilliancy, the disk spans 41" and the Sun illuminates 26 percent of its Earth-facing hemisphere.

When March rolls around, Venus displays a 32"-diameter disk that's 38 percent lit. And at greatest elongation, the planet shows a disk that measures 25" across and appears half-lit.

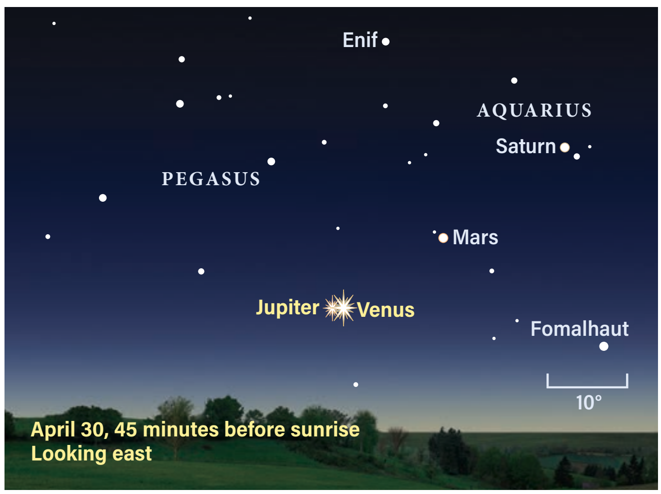
Venus also participates in several pretty conjunctions this year. The inner world passes 7° north of Mars on Feb. 12 and 4° north of the Red Planet on March 12. Venus catches up to Saturn on March 29, sliding 2° north of the ringed world. But the best event comes April 30, when Venus passes 0.2° south of Jupiter. We'll have more on this stunning conjunction next month.



Venus dominates the early morning sky as it reaches its peak in March near its sister planets Mars and Saturn.

A match made in heaven

Venus (the brightest object at left) paired with Jupiter in evening twilight above the waters of Lake Namtso in Tibet on July 15, 2015. JEFF DAI



Venus passes within 0.2° of Jupiter before dawn April 30. The two brightest planets haven't appeared this close since August 2016.

All the planets orbit the Sun in nearly the same plane, called the ecliptic, and they all move at different rates. So it shouldn't come as a surprise that these solar system worlds frequently pass close to one another from our perspective. April 30 brings a particularly spectacular event when Venus skims just 0.2° south of Jupiter. The two brightest planets haven't appeared this close in more than five years.

But the final week of April offers a second, even closer conjunction for those seeking a challenge. Let's pick up the action in the predawn sky on the 27th. Find an observing site with an unobstructed eastern horizon and wait for Venus to rise about 100 minutes before the Sun. Then train your binoculars or a telescope on the brilliant planet and look for the slightly bluish glow of 8th-magnitude Neptune to the beacon's east-northeast.

From the central U.S., the two appear 25' apart. (They'll be a little closer for those on the West Coast and slightly farther apart from the East Coast.) The planets come closest — less than 1' from each other — at around 19h UT, placing Australian and Japanese observers in prime viewing locations. Although Venus and Neptune climb higher as twilight brightens, Neptune's faint glow quickly fades from view. But don't go inside just yet. A slender waning crescent Moon joins the scene about a half-hour after Venus rises.

That same morning, you can't miss Jupiter's presence. It rises less than 10 minutes after Venus and appears 3.2° to the inner planet's lower left. The gas giant shines at magnitude –2.1, two full magnitudes fainter than Venus. The next morning finds them 2.3° apart and the 29th brings them within 1.4° of each other.

All this sets the stage for April 30's spectacular conjunction. The two planets rise together with Jupiter 29' — the apparent diameter of a Full Moon — to Venus' left. (Again, this is the separation from the central U.S.; the gap closes slightly the farther west you are.) Australia and Japan are once again favored for seeing the closest approach of 15'. If the weather doesn't cooperate on the 30th, try again the morning of May 1. U.S. observers will then see Jupiter 33' to Venus' upper right.

These two planets haven't been this close since Aug. 27, 2016, and that conjunction was much harder to view because the planets set less than an hour after the Sun. To find a more favorable meeting of these worlds, you have to go back to Aug. 18, 2014.

2022 April

S	M	T	W	T	F	S
					○	2
3	4	5	6	7	8	◑
10	11	12	13	14	15	●
17	18	19	20	21	22	◐
24	25	26	27	28	29	○

2 Mercury is in superior conjunction, 7 P.M. EDT

3 The Moon passes 0.6° south of Uranus, 1 P.M. EDT

4 Mars passes 0.3° south of Saturn, 6 P.M. EDT

11 Asteroid Pallas is in conjunction with the Sun, 11 P.M. EDT

12 Jupiter passes 0.1° north of Neptune, 4 P.M. EDT

22 Lyrid meteor shower peaks

24 The Moon passes 5° south of Saturn, 5 P.M. EDT

25 The Moon passes 4° south of Mars, 6 P.M. EDT

26 The Moon passes 4° south of Venus, 10 P.M. EDT

The Moon passes 4° south of Neptune, 11 P.M. EDT

27 The Moon passes 4° south of Jupiter, 4 A.M. EDT

Venus passes 0.007° south of Neptune, 3 P.M. EDT

29 Mercury is at greatest eastern elongation (21°), 4 A.M. EDT

30 Venus passes 0.2° south of Jupiter, 3 P.M. EDT

Partial solar eclipse, 4 P.M. EDT

May 2022

S	M	T	W	T	F	S
1	2	3	4	5	6	7
◑	9	10	11	12	13	14
15	●	17	18	19	20	21
◐	23	24	25	26	27	28
29	○	31				

- **2** The Moon passes 1.8° south of Mercury, 10 A.M. EDT
- **5** Uranus is in conjunction with the Sun, 3 A.M. EDT
- **6** Eta Aquariid meteor shower peaks
- **15** Total lunar eclipse, midnight EDT
- **17** Mars passes 0.6° south of Neptune, 7 P.M. EDT
- **21** Mercury is in inferior conjunction, 3 P.M. EDT
- **22** The Moon passes 4° south of Saturn, 1 A.M. EDT
- **24** The Moon passes 4° south of Neptune, 6 A.M. EDT
- The Moon passes 3° south of Mars, 3 P.M. EDT
- The Moon passes 3° south of Jupiter, 8 P.M. EDT
- **26** The Moon passes 0.2° south of Venus, 11 P.M. EDT
- **28** The Moon passes 0.3° south of Uranus, 10 A.M. EDT
- Mars passes 0.6° south of Jupiter, 8 P.M. EDT

Totality comes to America

The Moon turned stunning shades of orange and red when it passed through Earth's umbral shadow the night of Jan. 20/21, 2019.
RATHIJIT BANERJEE

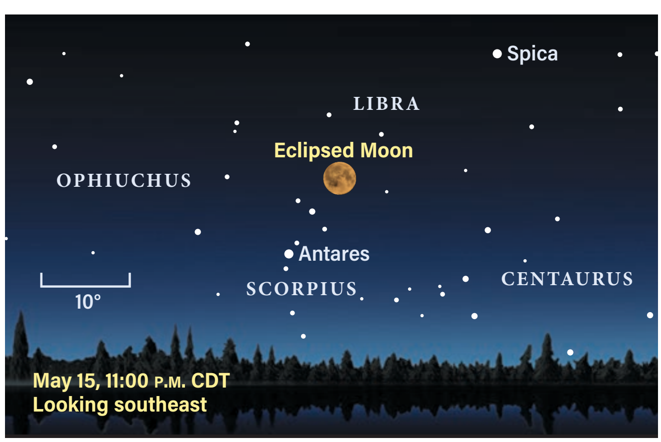
Observers across North America get to witness two spectacular total eclipses of the Moon during 2022. The first occurs the night of May 15/16 and the second the morning of Nov. 8. In a coincidence of cosmic proportions, both of these eclipses feature 85 minutes of totality.

The first event begins the evening of May 15. What you see depends on where you live. Viewers on the East Coast can catch the entire eclipse in a dark sky. From the Midwest, the initial penumbral stages start during twilight, enhancing the appearance of this normally subtle shadow. Observers in the Rocky Mountain states witness the early partial phases in twilight. And from the West Coast, totality begins during twilight while the eclipse's latter stages take place in a dark sky.

The eclipse commences when the Full Moon first touches Earth's outer penumbral shadow at 9:32 P.M. EDT (all eclipse times are in EDT). This occurs on the Moon's western limb, which appears closest to the horizon as it rises. You should start noticing a dusky shading by 10 P.M. or so.

The Moon reaches the outer edge of Earth's dark umbral shadow at 10:28 P.M. This shadow appears a deep gray at first, but as more of Luna slides into the umbra, it takes on a distinctly orange hue. This coloring shows up best through a telescope.

Totality begins at 11:29 P.M., when the Moon's trailing edge enters the umbra. Although Earth blocks most of the Sun's light from reaching the Moon at this stage, our atmosphere in not opaque. Air molecules scatter out blue light while letting some red through to journey the additional quarter of a million miles to the Moon, artistically bathing it in an ethereal orange glow.

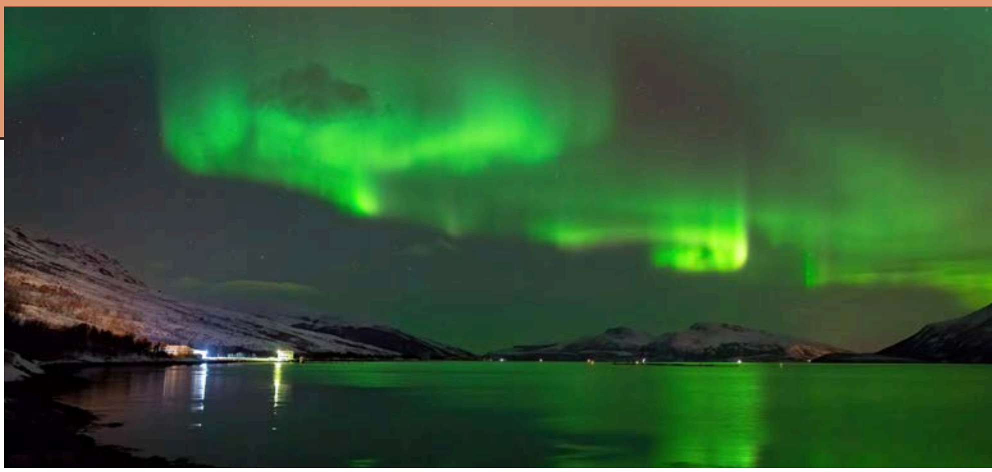


A total lunar eclipse graces the skies above North America the night of May 15/16. During totality, the Moon resides in Libra.

The Moon resides in Libra with the 1st-magnitude red supergiant star Antares in Scorpius hanging 15° below it. If you live in the country, you'll enjoy a spectacular view of the ruddy Moon set in a star-studded dome with the summer Milky Way rising in the east. The scene looks particularly breathtaking once your eyes become dark adapted, typically between mideclipse (12:12 A.M.) and the end of totality (12:54 A.M.). The partial phases wrap up at 1:55 A.M. as the Moon exits the umbra, and the penumbral stages end at 2:51 A.M.

Try capturing some wide-field views of the eclipse with your camera. Set the camera on a sturdy tripod and try to position some photogenic objects in the foreground for an artistic effect. You can expose for up to 30 seconds using a 50mm or wider-angle lens before star trails become apparent. You can freeze the sky's motion with a longer lens if you use shorter exposures and higher ISO settings.

The Sun awakens



The northern lights played above an icy landscape near Tromsø in northern Norway on Dec. 5, 2015. Aurorae should be on the increase in 2022 as the Sun grows more active. JAMIE COOPER

When most people think of observing, they think of dark nights under the stars. But that ignores half the day when a single star dominates the sky. Viewing the Sun can be just as rewarding as nighttime observations, as long as you take proper precautions. Don't risk your eyesight — make sure you use only an approved solar filter.

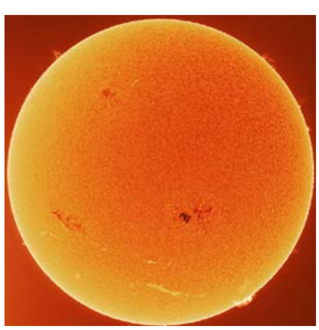
Now's a great time to start observing the Sun because solar activity is on the rise. Solar Cycle 25 began in December 2019 and the 11-year cycle has been building ever since. The big questions are when will solar maximum occur, and how high will it be?

Every decade, a group of scientists gathers to predict the next cycle. After comparing five dozen models of the Sun, they announced in 2020 that Cycle 25 should peak in July 2025 with a sunspot number of 115. That would match Cycle 24, which was the weakest cycle in a century.

By mid-2021, observations showed a faster-than-expected rise in sunspot numbers, warranting some to say the peak could occur in late 2024. The overall picture should be clearer by this summer.

Sunspot numbers have been recorded the same way since Swiss astronomer Rudolf Wolff devised the system in 1848. It combines the number of individual sunspots with the number of sunspot groups while also taking into account the observer's instrument and viewing conditions.

We've seen quick rises in sunspot numbers before, however. In 2011, the count leapt to 140, only to fall back to 50 the following year. It then hovered in the range of 85 for most of 2012 before a final burst in early 2014. This gave Cycle 24 an odd double peak. You never know what you're going to see when you target the Sun, which is a big part of the enjoyment.



Dark sunspots and bright filaments scarred the Sun's face while glowing prominences arced high above the solar limb April 24, 2021. ARTURO BUENROSTRO

Of course, sunspots are only one aspect of solar activity. Prominences, filaments, and solar flares also ramp up as the number of sunspots increases. Hydrogen-alpha filters, which let through only a narrow band of solar wavelengths, enhance the view of these features.

Oddly enough, solar activity isn't just for daytime observers. Powerful solar flares and coronal mass ejections occasionally send streams of charged particles toward Earth. When these particles reach our planet, Earth's magnetic field channels them toward the magnetic poles, where they can energize atoms and molecules and cause them to glow. These aurorae, or northern lights, are among nature's most beautiful sights. As solar activity increases, aurorae will grow more common and more often reach lower latitudes, increasing your chances of seeing them. Just don't wait until June — the short nights leave only a brief window for aurora viewing.

2022 June

S	M	T	W	T	F	S
			1	2	3	4
5	6	◑	8	9	10	11
12	13	●	15	16	17	18
19	◐	21	22	23	24	25
26	27	○	29	30		

11 Venus passes 1.6° south of Uranus, 9 A.M. EDT

16 Mercury is at greatest western elongation (23°), 11 A.M. EDT

18 The Moon passes 4° south of Saturn, 8 A.M. EDT

20 The Moon passes 4° south of Neptune, 1 P.M. EDT

21 Solstice (northern summer/southern winter begins), 5 A.M. EDT

The Moon passes 3° south of Jupiter, 10 A.M. EDT

22 The Moon passes 0.9° south of Mars, 2 P.M. EDT

23 Mercury passes 3° north of Aldebaran, 10 A.M. EDT

24 The Moon passes 0.05° south of Uranus, 6 P.M. EDT

26 The Moon passes 3° north of Venus, 4 A.M. EDT

27 The Moon passes 4° north of Mercury, 4 A.M. EDT

July 2022

S	M	T	W	T	F	S
					1	2
3	4	5	◑	7	8	9
10	11	12	●	14	15	16
17	18	19	◐	21	22	23
24	25	26	27	○	29	30
31						

1 Venus passes 4° north of Aldebaran, 8 P.M. EDT

15 The Moon passes 4° south of Saturn, 4 P.M. EDT

16 Mercury is in superior conjunction, 4 P.M. EDT

17 The Moon passes 3° south of Neptune, 9 P.M. EDT

18 The Moon passes 2° south of Jupiter, 9 P.M. EDT

19 Pluto is at opposition, 10 P.M. EDT

21 The Moon passes 1.1° north of Mars, 1 P.M. EDT

Dwarf planet Ceres is in conjunction with the Sun, 9 P.M. EDT

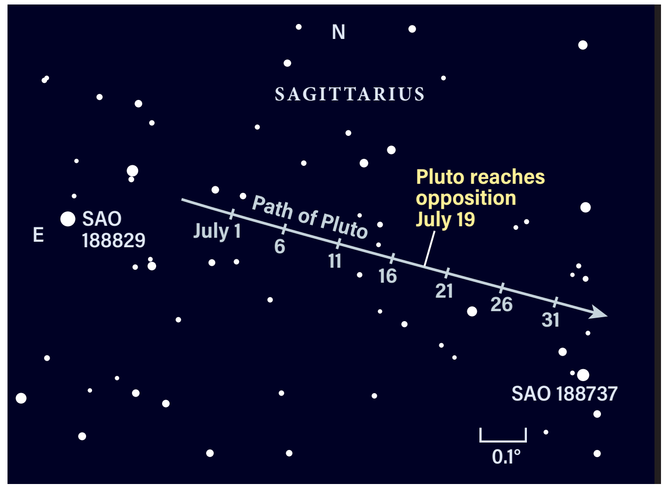
22 The Moon passes 0.2° north of Uranus, 2 A.M. EDT

26 The Moon passes 4° north of Venus, 10 A.M. EDT

Pluto reaches the Archer's edge

A remarkably dynamic little world lurks in the outer reaches of our solar system. Pluto boasts moving glaciers of frozen nitrogen, massive mountains built from water ice, and even a tenuous nitrogen atmosphere. NASA's New Horizons spacecraft revealed this exceptional dwarf planet during its historic flyby in July 2015. Seven years later, the time is right to track down Pluto as it reaches opposition in July and remains visible all night.

Finding Pluto isn't easy, however. The planet spans just 1,477 miles and lies more than 3.1 billion miles from Earth, rendering it as a dim, 15th-magnitude dot in our sky. But two factors make the challenge slightly less daunting this year. First, Pluto's leisurely orbital motion has carried it to the eastern edge of Sagittarius and away from the rich background of the Milky Way it's been mired in for the past two decades. Second, the distant world lies near the deep-sky landmark M75, a globular cluster that makes finding the correct field fairly simple.



Everyone's favorite dwarf planet comes to opposition in July, when it lies among the background stars of eastern Sagittarius.

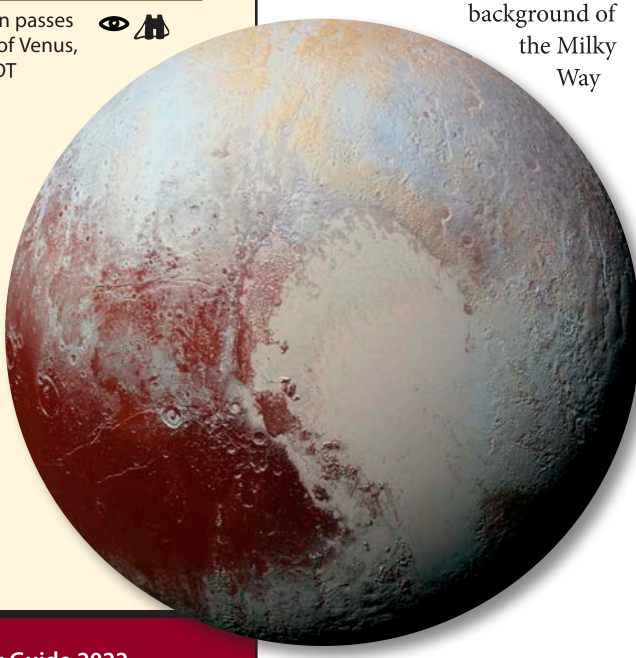
M75 glows at magnitude 8.5 from its perch in Sagittarius on that constellation's border with Capricornus. Look for it 8° south-southwest of 3rd-magnitude Beta (β) Capricorni. Pluto lies within 3° of M75 all summer. Get used to exploiting this globular cluster as a signpost to Pluto — the two objects remain within 3° of each other until 2025.

Once you've found M75, aim your telescope 1.4° southwest to the magnitude 6.0 star SAO 188829. This is the brightest star in the vicinity and should be easy to pick out. Pluto passes 7' due north of this star the evening of June 13. The planet's westward motion carries it to a point 21' due west of SAO 188829 by July 1.

At opposition on the 19th, 46' separate the planet and star. By that point, you may want to add magnitude 7.6 SAO 188737 to your guide-star list. Pluto lies 24' northeast of this star at opposition and pulls within 10' of it by July 31.

To see Pluto in the eyepiece, you'll need at least a 6-inch telescope, and bigger is better. You'll likely find plenty of large scopes at a summer star party or a local astronomy club, and many people willing to target the planet for you.

If you're a solitary observer, try sketching Pluto's field of view one night and returning to the same area a night or two later. The "star" that changes position between your two observations is Pluto. You can also image the field every couple of days over a period of several weeks and create a time-lapse recording of the planet's westward motion.



Pluto's spectacularly diverse landscape surprised scientists when NASA's New Horizons spacecraft zoomed past in July 2015. NASA/JHUAPL/SWRI

Summer nights belong to Saturn

2022 Aug

S	M	T	W	T	F	S
	1	2	3	4	◑	6
7	8	9	10	●	12	13
14	15	16	17	18	◐	20
21	22	23	24	25	26	○
28	29	30	31			

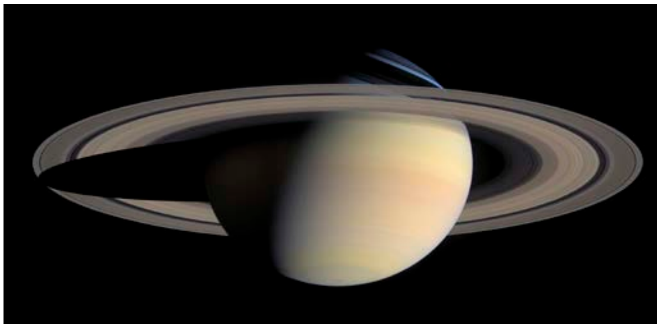
Saturn reaches opposition and peak visibility Aug. 14. It then rises at sunset, climbs highest in the south around midnight local time (1 A.M. daylight time), and sets at sunrise. The ringed planet also lies closest to Earth at opposition, so it shines brightest and looms largest when viewed through a telescope.

Don't limit yourself to viewing Saturn on only one night, however. The planet's year starts in March when it becomes visible low in the southeast before dawn. Watch Venus pass 2° due north of Saturn on March 29, then see Mars slide 0.3° south of the ringed world April 4.

The planets soon go their separate ways. Saturn rises earlier each day as it heads eastward relative to the starry backdrop of Capricornus. This motion stops 2° shy of this constellation's border with Aquarius in early June. The planet then begins moving westward, passing 1.5° north of Capricornus' brightest star, magnitude 2.8 Delta (δ) Capricorni, on July 8. Saturn shines at magnitude 0.2 at opposition, some 10 times brighter than Delta.

Few sights in the night sky compare with a telescopic view of Saturn. In mid-August, the world shows a slightly oval disk measuring 19" across the equator, surrounded by a spectacular ring system that spans 43" and tilts 14° to our line of sight.

Study Saturn's golden-hued globe looking for subtle atmospheric belts. And keep an eye open for erupting storms.



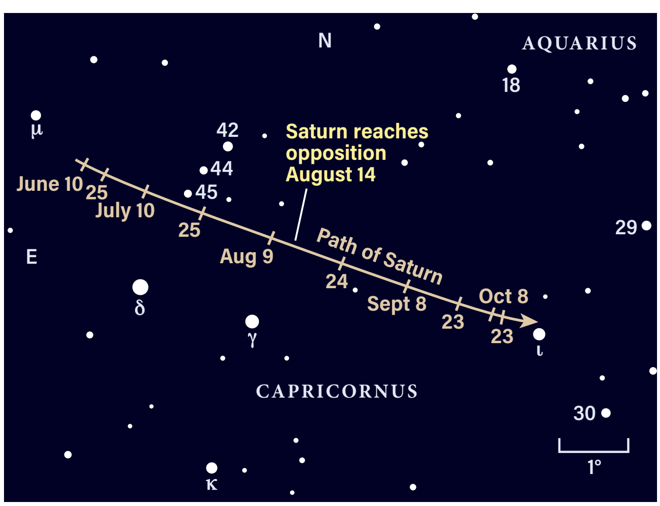
The Cassini orbiter captured Saturn in all its glory in October 2004. The spacecraft took 126 images over two hours to create this mosaic. NASA/JPL/SSI

Although these tempests are rare, they can grow to planetwide features.

The rings offer their own structure. Look for the broad Cassini Division that separates the outer A ring from the brighter B ring. Under excellent viewing conditions, the dusky C ring shows up closer to the planet.

Also look for the brightest members of Saturn's vast collection of moons. Any scope reveals 8th-magnitude Titan, while 4- to 6-inch instruments bring in four more. Tethys, Dione, and Rhea all glow steadily at 10th magnitude. Two-toned Iapetus poses more of a challenge. This moon shines at 10th magnitude when farthest west of the planet, but fades to 12th magnitude when farthest east. It reaches greatest western elongation at the end of August's first week.

After opposition, Saturn continues moving westward until late October, when it stops 0.6° from magnitude 4.3 Iota (ι) Cap. By December, the ringed planet is strictly an evening object, standing 25° high in the southwest as twilight fades to darkness.



The ringed planet resides in Capricornus the Sea Goat throughout 2022, peaking at magnitude 0.2 at its August opposition.

1 Mars passes 1.4° south of Uranus, 5 A.M. EDT

4 Mercury passes 0.7° north of Regulus, 1 A.M. EDT

7 Venus passes 7° south of Pollux, 6 A.M. EDT

11 The Moon passes 4° south of Saturn, midnight EDT

12 Perseid meteor shower peaks

14 The Moon passes 3° south of Neptune, 6 A.M. EDT

Saturn is at opposition, 1 P.M. EDT

15 The Moon passes 1.9° south of Jupiter, 6 A.M. EDT

18 The Moon passes 0.6° north of Uranus, 11 A.M. EDT

19 The Moon passes 3° north of Mars, 8 A.M. EDT

22 Asteroid Vesta is at opposition, 3 P.M. EDT

25 The Moon passes 4° north of Venus, 5 P.M. EDT

27 Mercury is at greatest eastern elongation (27°), noon EDT

29 The Moon passes 7° north of Mercury, 7 A.M. EDT

2022
Sept

S	M	T	W	T	F	S
				1	2	◑
4	5	6	7	8	9	●
11	12	13	14	15	16	◐
18	19	20	21	22	23	24
○	26	27	28	29	30	

4 Venus passes 0.8° north of Regulus, 9 P.M. EDT

7 Asteroid Juno is at opposition, 1 P.M. EDT

8 The Moon passes 4° south of Saturn, 7 A.M. EDT

Mars passes 4° north of Aldebaran, 9 P.M. EDT

10 The Moon passes 3° south of Neptune, 3 P.M. EDT

11 The Moon passes 1.8° south of Jupiter, 11 A.M. EDT

14 The Moon passes 0.8° north of Uranus, 7 P.M. EDT

16 Neptune is at opposition, 6 P.M. EDT

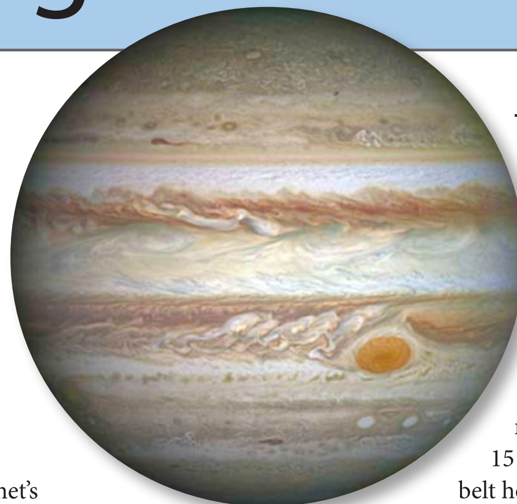
The Moon passes 4° north of Mars, 10 P.M. EDT

22 Equinox (northern autumn/southern spring begins), 9 P.M. EDT

23 Mercury is in inferior conjunction, 3 A.M. EDT

26 Jupiter is at opposition, 4 P.M. EDT

Brilliant Jupiter rules the night



Jupiter's atmospheric bands and the Great Red Spot stand out in this Hubble image, though amateur telescopes can reveal many of these features. NASA/ESA/A. SIMON (GSFC)

Jupiter's brilliance stands out even more than usual this year. At opposition Sept. 26, it shines at magnitude –2.94 — the brightest it's been in 12 years. That's because opposition occurs less than four months prior to the planet's perihelion, or closest approach to the Sun. Also consider that the giant world resides in the dim constellation Pisces, and that it climbs higher in the Northern Hemisphere sky than it has in six years.

Jupiter first becomes prominent in the morning sky in April, when it has a spectacular conjunction with Venus on the 30th (see April for details). A month later, on May 29, Jupiter appears just 0.6° north of ruddy Mars. The giant planet makes a rare sojourn into the non-zodiacal constellation Cetus the Whale from late June to early September before returning to Pisces the Fish for the rest of the year.

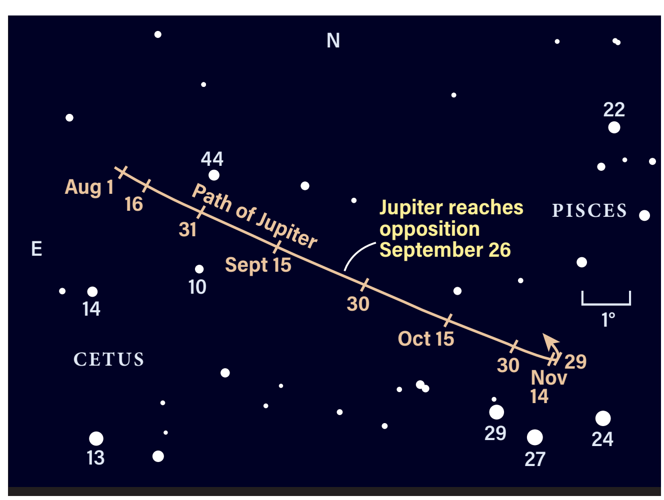
The view through a telescope should be stunning most of this year, but never more so than from early September to mid-October. Jupiter shines at magnitude –2.9 throughout this period and shows a disk that spans more than 48". And it reaches an impressive maximum altitude of about 50° from mid-northern latitudes.

But the absolute peak comes at opposition. On Sept. 26, the giant planet measures 49.9" across the equator and 46.7" through the poles — a difference that's obvious once you know to look for it. Look for two dark equatorial belts, one on either side of a brighter zone that coincides with the planet's equator, running parallel to each other. A whole series of alternating belts and zones shows up during moments of good seeing.

The two equatorial belts often resolve into finer details. Look for streamers, white ovals, and barge-shaped dark spots. Because the planet rotates in less than 10 hours, attentive observers can see these features move in as little as 15 minutes. The southern belt hosts the Great Red Spot, which typically rotates on to Jupiter's Earth-facing hemisphere every other night.

Also check out the planet's four bright Galilean moons: Io, Europa, Ganymede, and Callisto. They provide an ever-changing display as they orbit the planet in periods ranging from two to 17 days.

Jupiter continues to dominate the evening sky through the end of the year. Even in late December, the planet stands 45° high in the southwest two hours after sunset and gleams at magnitude –2.4, second only to Venus.



The giant planet shines at magnitude –2.9 in September, crossing from Cetus the Whale into Pisces the Fish on the 1st.

Spot elusive Mercury at dawn

No bright planet is harder to see than Mercury because the inner planet orbits close to the Sun and thus never strays far from its bright light. Even at its best, Mercury rarely appears outside of twilight for Northern Hemisphere observers.

The planet's best morning appearance of 2022 arrives in October. You might glimpse Mercury on the 1st, when it stands 4° above the eastern horizon 45 minutes before the Sun rises. It then glows at magnitude 1.3 and should show up through binoculars. The planet grows brighter and climbs higher each day if you view at the same time relative to sunrise. (We'll use 45 minutes for consistency.)

Mercury should be easy to see with the naked eye by Oct. 5, when it glows at magnitude 0.1 and appears 7° high. A telescope shows the planet's 7.9"-diameter disk and 34-percent-lit phase.

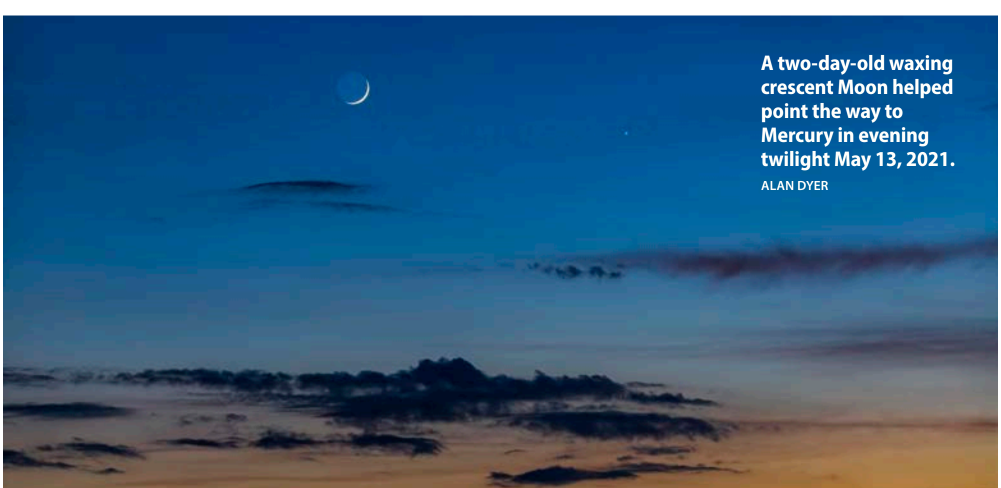
The inner world reaches its peak at greatest elongation on the 8th, when it lies 18° west of the Sun and climbs 8° high. It also shines noticeably brighter, at magnitude –0.5. If you have trouble finding it, zero in on the 1st-magnitude star Regulus 30° high in the east. Then drop toward the horizon and a bit to the left to find Mercury. The planet appears 7.0" across and 52 percent illuminated through a telescope.

Mercury continues to brighten as it falls back toward the Sun following greatest elongation. It reaches magnitude –1.0 on the 18th, when it stands 5° high. A scope reveals a 5.6"-diameter disk that is 84 percent lit.

This is one of seven Mercury apparitions this year, though it is easily the best for morning observers. It climbs only about half as high at the Feb. 16 and June 16 greatest elongations.

The evening sky offers four Mercury appearances in 2022. By far the best occurs April 29, when Mercury climbs 11° high 45 minutes after sunset. The planet maxes out at altitudes of 7° and 6° at the Jan. 7 and Dec. 21 greatest elongations, respectively. Alas, Mercury's late August appearance sees it climb just 1° high at its best.

The innermost planet climbs well above the eastern horizon during morning twilight around its Oct. 8 peak.



A two-day-old waxing crescent Moon helped point the way to Mercury in evening twilight May 13, 2021. ALAN DYER

Oct 2022

S	M	T	W	T	F	S
						1
◑	3	4	5	6	7	8
●	10	11	12	13	14	15
16	◐	18	19	20	21	22
23	24	○	26	27	28	29
30	31					

5 The Moon passes 4° south of Saturn, noon EDT

7 The Moon passes 3° south of Neptune, 11 P.M. EDT

8 The Moon passes 2° south of Jupiter, 2 P.M. EDT

Mercury is at greatest western elongation (18°), 5 P.M. EDT

12 The Moon passes 0.8° north of Uranus, 3 A.M. EDT

15 The Moon passes 4° north of Mars, 1 A.M. EDT

21 Orionid meteor shower peaks

22 Venus is in superior conjunction, 5 P.M. EDT

25 Partial solar eclipse, 7 A.M. EDT

2022
Nov

S	M	T	W	T	F	S
				3	4	5
6	7		9	10	11	12
13	14	15		17	18	19
20	21	22		24	25	26
27	28	29				

1 The Moon passes 4° south of Saturn, 5 P.M. EDT

4 The Moon passes 3° south of Neptune, 4 A.M. EDT

The Moon passes 2° south of Jupiter, 4 P.M. EDT

8 Total lunar eclipse, 6 A.M. EST

The Moon passes 0.7° north of Uranus, 8 A.M. EST

Mercury is in superior conjunction, noon EST

9 Uranus is at opposition, 3 A.M. EST

11 The Moon passes 2° north of Mars, 9 A.M. EST

17 Leonid meteor shower peaks

28 The Moon passes 4° south of Saturn, midnight EST

Luna's double dip into Earth's shadow

Slightly less than six months after our satellite plunged through Earth's shadow, bringing a total lunar eclipse to North America the night of May 15/16, the Full Moon takes another journey into darkness. On the morning of Nov. 8, Luna spends 85 minutes inside Earth's dark umbra, matching May's duration of totality. This time around, however, viewers in western North America see the whole show with the Moon higher in the sky while those in the east witness only the early stages.

The subtle penumbral phase begins at 3:02 A.M. EST, with the obvious partial stages getting started at 4:09 A.M. EST. The shadow eats away at the Full Moon from top to bottom.

It takes more than an hour for the umbral shadow to completely swallow Luna. Totality arrives at 5:17 A.M. EST. Earth's shadow then bathes the Moon in a beautiful orange color — the light from all our planet's sunrises and sunsets — an effect that grows more pronounced as mideclipse approaches at 5:59 A.M. EST.

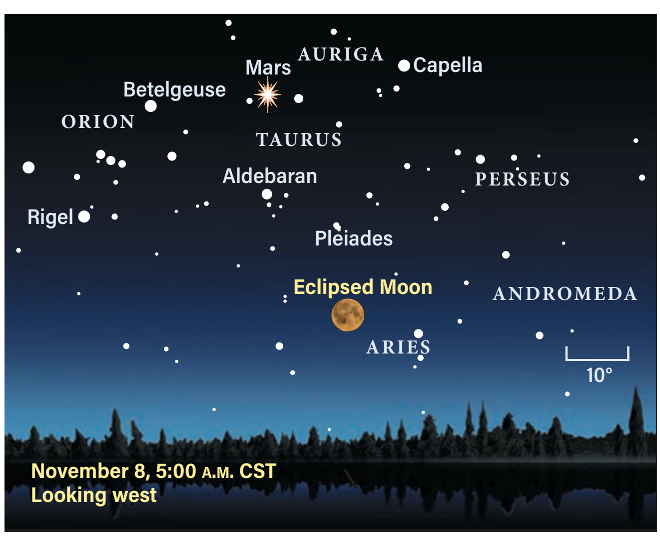
A ruddy Moon hung above the Santa Rita Mountains of south-central Arizona during the total lunar eclipse of Jan. 20/21, 2019. BURLEY PACKWOOD

The eclipsed Moon hangs low in the west while the Pleiades star cluster (M45) sparkles above it and Orion the Hunter stands higher in the southwest.

The total phase wraps up at 6:42 A.M. EST, just as the Moon sets along the East Coast. Midwesterners get to see the final partial stages, which conclude in gradually brightening twilight at 6:49 A.M. CST. Those in western North America can watch until the bloody end, when the Moon exits the penumbral shadow at 5:56 A.M. PST.

Luna spends the eclipse within the borders of Aries the Ram. Dedicated observers will recognize this constellation as the current home of Uranus. In fact, the magnitude 5.7 planet sits 1.9° east of the Moon's western limb as totality begins, and the gap shrinks as Luna progresses through the shadow. Binoculars will deliver a wonderful view of the two objects along with several stars in the same field. (Just don't confuse Uranus with a magnitude 6.3 star that lies closer to the lunar limb.)

Seasoned skywatchers know that eclipses usually come in pairs — one solar and one lunar — separated by two weeks. Oct. 25 brings a partial eclipse of the Sun to viewers in most of Europe, western Asia, and northeastern Africa. Greatest eclipse occurs in central Russia, where the Moon obscures 82 percent of the Sun's disk at sunset. From London, Luna covers 15 percent of our star at 9h59m UT with the Sun 22° above the horizon.



The bright stars of late autumn and early winter arch above the eclipsed Moon during totality the morning of Nov. 8.

The Red Planet climbs high in the sky

2022 Dec

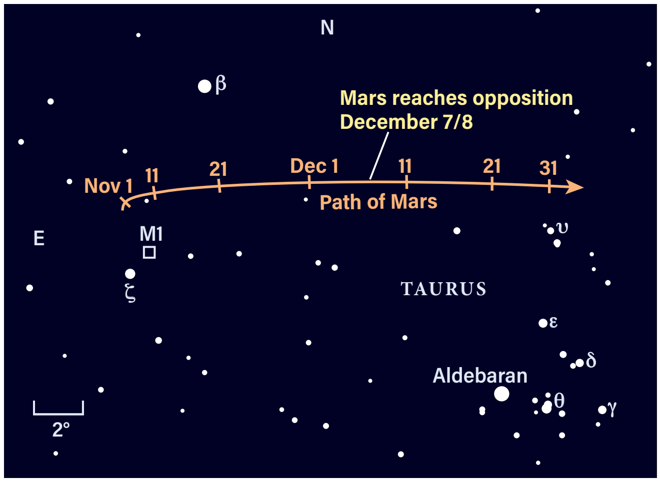
S	M	T	W	T	F	S
				1	2	3
4	5	6	●	8	9	10
11	12	13	14	15	◐	17
18	19	20	21	22	○	24
25	26	27	28	◑	30	31

The closing months of 2022 bring great views of Mars to Northern Hemisphere observers. The Red Planet reaches opposition the night of Dec. 7/8, when it lies high in the sky among the background stars of Taurus the Bull. Experienced observers know that viewing Mars is not a one-night operation, however. The ruddy world delivers great views starting when its apparent diameter reaches 10" in early September. Conveniently, it then rises a little before midnight local daylight time.

The planet passes 4° north of Taurus' brightest star, 1st-magnitude Aldebaran, on Sept. 8. It then shines at magnitude –0.3, three times brighter than its southern neighbor. Mars' eastern trek carries it 1.2° north of the Crab Nebula (M1) on Oct. 17, when it glows at magnitude –0.9 and appears 14" across when viewed through a telescope.

The planet's eastward motion relative to the starry backdrop halts Oct. 30. As it embarks on its retrograde (westward) path, it once again passes the Crab, appearing 2.3° north of it Nov. 11. Mars now shines at magnitude –1.5 and spans 16" in the eyepiece.

Less than a month later, on Dec. 7/8, the Red Planet reaches opposition and is visible all night. From its perch in northern Taurus,



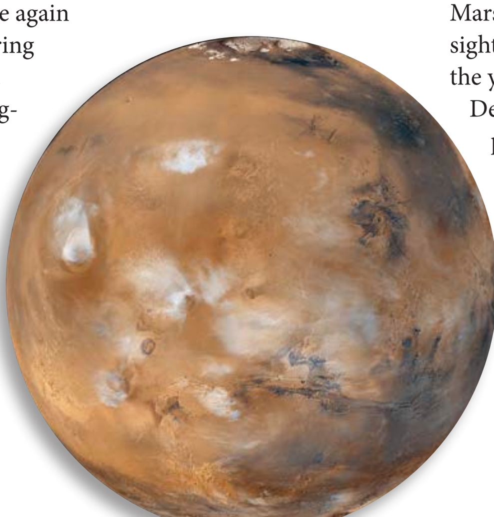
The Red Planet traverses northern Taurus the Bull when it reaches a spectacular peak in early December.

Mars climbs 75° above the southern horizon when it peaks around midnight local time. At magnitude –1.9, it outshines all the other nighttime stars and planets except for Jupiter. And it spans an impressive 17" when viewed through a telescope. Although this is 5" smaller than at its October 2020 opposition, the high altitude partly makes up for this shortcoming.

Seeing surface details on Mars typically requires a 6-inch or larger telescope. The easiest structure to see is Syrtis Major, a dark, wedge-shaped feature near the equator. The bright, deep desert basin known as Hellas lies immediately to its south. Major dust storms occasionally erupt from Hellas and blot out other features.

If you're observing Mars early the night of its opposition, you can't fail to see the Full Moon nearby — very nearby. Luna passes directly in front of the Red Planet for viewers across much of the U.S. and Canada. Viewers will want to be sure to mark their calendars for this rare event.

Following opposition, Mars remains a magnificent sight through the end of the year and into 2023. On Dec. 31, the magnitude –1.2 planet displays a 15"-diameter disk through a telescope.



The Mars Global Surveyor spacecraft captured bright clouds of water ice hanging above the massive Tharsis volcanoes in this mosaic taken in April 1999. NASA/JPL/MSSS

1 The Moon passes 3° south of Neptune, 8 A.M. EST

The Moon passes 3° south of Jupiter, 8 P.M. EST

5 The Moon passes 0.7° north of Uranus, 1 P.M. EST

7 The Moon passes 0.5° north of Mars, 11 P.M. EST

8 Mars is at opposition, 1 A.M. EST

14 Geminid meteor shower peaks

21 Mercury is at greatest eastern elongation (20°), 10 A.M. EST

Solstice (northern winter/southern summer begins), 5 P.M. EST

Mars passes 8° north of Aldebaran, 11 P.M. EST

24 The Moon passes 3° south of Venus, 6 A.M. EST

The Moon passes 4° south of Mercury, 2 P.M. EST

26 The Moon passes 4° south of Saturn, 11 A.M. EST

28 The Moon passes 3° south of Neptune, 3 P.M. EST

29 Mercury passes 1.4° north of Venus, 4 A.M. EST

The Moon passes 2° south of Jupiter, 6 A.M. EST

Venus climbs high in a dark evening sky in spring 2023, passing near the Pleiades star cluster in April. ALAN DYER

2023 Preview

Looking ahead to next year . . .

THE SUN, THE MOON, AND EARTH lined up four times in 2022, bringing two total lunar eclipses and two partial solar eclipses. Next year also delivers four eclipses, but the circumstances are nearly reversed. On the lunar side, neither the May 5 penumbral eclipse nor the slight partial eclipse Oct. 28 will be visible from North America.

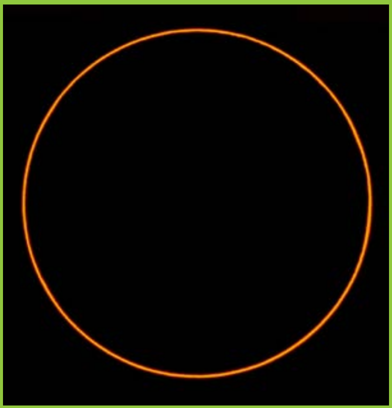
But the solar eclipses make up for any disappointment. On April 20, the Moon passes directly in front of the Sun. Observers at the ends of the central path in the Southern Ocean and southeast of the Marshall Islands will see an annular eclipse. But those in between will witness totality. Maximum eclipse occurs just south of the island of Timor and provides 1 minute 16 seconds under the corona's light. The path of totality also touches Western Australia and some of Indonesia's islands.

The Oct. 14 annular eclipse hits even closer to home. The center line crosses Oregon, Nevada, Utah, Arizona, New Mexico, and Texas before reaching Mexico, Central America, and northern South America. The solar ring of fire will last more than four minutes everywhere on the center line in the U.S.

Several planets put on exceptional shows in 2023 as well. Mars and Jupiter remain brilliant early in the year, and Jupiter returns for an encore at opposition in early November. Although not as bright as the other planets, Saturn looks spectacular through a telescope around its late August opposition. But perhaps Venus will steal the show. It makes a great evening appearance in spring and puts on an equally stunning predawn performance in autumn.

Happily, fortunes for 2023's preeminent meteor showers are reversed from 2022. Although the Quadrantids in January will be a dud because they peak just two days before a Full Moon, August's Perseid shower and December's Geminid shower peak within three days of a New Moon, providing dark skies for the year's best meteors.

A hybrid solar eclipse occurs Aug. 20, 2023. More than a minute of totality awaits viewers on the center line in western Australia, New Guinea, and the islands in between. JOE LLAMA



Observers along a narrow path crossing the western and southern U.S., Mexico, Central America, and northern South America will witness a ring of fire eclipse Oct. 14, 2023.
GUILLERMO ABRAMSON