

Highlights of the October Sky...

- - - 1st - - -

PM: A waning gibbous Moon is 2° to the upper right of Jupiter when they rise together in the east-northeast.

- - - 2nd - - -

PM: The Moon and Pleiades are 1½° apart when they rise above the east-northeast horizon.

- - - 6th - - -

Last Quarter Moon @ 9:48 am EDT.

- - - 7th - - -

AM: A waning crescent Moon is about 1½° to the lower right of Castor in Gemini.

- - - 8th - - -

AM: The Moon is about 3½° to the upper left of Beehive Cluster (M44) in Cancer.

- - - 9th - - -

DAWN: Venus is 2½° to the lower right of Regulus in Leo.

- - - 10th - - -

DAWN: A thin crescent Moon forms a line with Venus and Regulus.

- - - 14th - - -

New Moon @ 1:55 pm EDT

PARTIAL SOLAR ECLIPSE begins at 11:41 am EDT, reaches maximum at 1:01 pm, and ends at 2:24 pm. See page 7 to learn more.

- - - 18th - - -

DUSK: A waxing crescent Moon and Antares, in Scorpius, are less than 5° apart low in the southwest.

- - - 21st - - -

First Quarter Moon @ 11:29 pm EDT

- - - 21st → 22nd - - -

The Orionid meteor shower peaks at 6am on the 22nd. Expect an hourly rate of ~30 meteors per hour.

- - - 28th - - -

Full Moon @ 4:24 pm EDT.

PM: The Moon is just over 2½° above Jupiter.

Prime Focus

A Publication of the Kalamazoo Astronomical Society

★ ★ ★ October 2023 ★ ★ ★

This Month's KAS Events

General Meeting: Friday, October 6 @ 7:00 pm

Kalamazoo Area Math & Science Center • See Page 20 for Details

Observing Session: Saturday, October 7 @ 7:00 pm

Kalamazoo Nature Center • [Visit Observing Page for Details](#)

Eclipse Watch: Saturday, October 14 @ 11:30 am

Kiwanis Youth Conservation Area • [Visit Schedule Page for Details](#)

Astrophotography SIG: Friday, October 20 @ 8:00 pm

Held on Zoom • [Click to Register](#) • See Page 5 for Details

Observing Session: Saturday, October 21 @ 7:00 pm

Kalamazoo Nature Center • [Visit Observing Page for Details](#)

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Did you look over the list of monthly activities on the cover? We've got a lot going on in October. First up is the general meeting on October 6th. As per long-standing tradition, the theme of the meeting is "Astrophotography Night." Many of our members have become very skilled imagers, and I hope all of them are able to attend and share their best results from the past year or so. Most members may not have an interest in astrophotography, but everyone loves looking at pretty pictures! And remember, a big part of the KAS is people sharing their astronomical interests with one another. We'll also have our traditional October snack of apple cider and donuts, provided by Scott Macfarlane this year. Oh, and the October meeting will also be our first back at KAMSC since June!

We then have Public Observing Sessions at the Kalamazoo Nature Center on October 7th and 21st (weather permitting). The session on the 7th, if successful, would be our eighth in a row! It will also be the last session of the year with no pesky moon in the way. So, if the skies are clear, come out and enjoy autumn treats like the Andromeda Galaxy and Double Cluster. All of the summer showpiece objects will still be visible, along with Saturn and Jupiter.

The session on the 21st is the last scheduled of the season and will double as our contribution to [International Observe the Moon Night](#). That's why I've included six pages of Moon maps and information, starting on page 12. The first quarter

Moon will dominate the sky, which is considered by most amateurs to be the best phase to view through a telescope. People often say to me that they need to make it to at least one session this year. While many of you have, most of you have not. Two chances remain.

We'll be hosting an Eclipse Watch in conjunction with this year's Crane Fest on Saturday, October 14th. Crane Fest is held annually at the Kiwanis Youth

Conservation Area near Bellevue, MI, in Calhoun County. It's a great area to watch the partial solar eclipse, and there will be many other activities. Crane Fest features artists, vendors, nature hikes, live animals, youth activities, and, of course, thousands of Sandhill Cranes. The Eclipse Watch itself runs from 11:30 am to 2:30 pm. Mike Dupuis and Jack Price will be bringing solar telescopes, but at least two more volunteers are needed in case there's a large crowd. Two volunteers (preferably) are also needed to sell KAS Eclipse Shades. I won't be there since I'll be in New Mexico to view and image the annular eclipse. Check out my article about the eclipse, starting on page 7, and hope for clear skies on October 14th.

Lastly, the third season of the [Astrophotography Special Interest Group](#) (SIG) begins on October 20th. All meetings this season will be held on Zoom, and we've got some fantastic speakers lined up. Our very special guest this month is noted astrophotographer and author [Jerry Lodriguss](#). When he replied to my invitation, he said he's retired now and doesn't do formal presentations any more. He said he'd be happy to join us to answer questions, share stories from his 50+-year journey in shooting the night sky, and show many of his best images. My favorite is the above image of Comet Hale-Bopp (and his two sons) that he took back in 1997.

So, we have five great activities this month. The KAS has over 400 individual members. It's not asking too much for you to attend *at least* one of them, is it?



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September Meeting Minutes



The Kalamazoo Astronomical Society's general meeting for September 8, 2023, was called to order at 7:06 pm EDT by Vice President Jack Price. At least 34 members and guests attended in person within the Kalamazoo Nature Center's Cooper's Glen Auditorium, while another 28 joined us virtually on Zoom.

After Jack Price welcomed everyone to the meeting, former KAS President Mike Sinclair introduced the evening's guest speaker. Current KAS President Richard Bell presented *Two Great American Eclipses*. This was Richard's 17th full presentation for the KAS.

As his title suggests, Richard talked about the upcoming annular eclipse on October 13th and the total solar eclipse on April 8, 2024. Much of what Richard covered about eclipse safety and viewing tips for the partial or annular eclipse can be read in a special article by the speaker, starting on page 7. Everything else he talked about regarding the total eclipse will be published in a future edition of *Prime Focus*. Richard concluded his talk with a preview of the upcoming [Eclipse Series](#).

Before the meeting and during the break, many members and guests purchased KAS Eclipse Shades. Special thanks go to Anna Daly and Aaron Roman for staffing the greeting/sales table.

A short video in memory of Roger Williams was then played. Unfortunately, due to our unfamiliarity with the Nature Center's audio/visual system, we couldn't get the sound to play. The video can be viewed (and heard) on our [YouTube channel](#).

Richard gave a brief President's Report. New membership saw a decline for much of the year, but we had a surge in August. The current number of KAS memberships is 311. That puts us four away from the all-time high of 315 set last year.

Extra volunteers are needed for our annual participation in Crane Fest, held at the Kiwanis Youth Conservation Area near Bellevue, MI, in Calhoun County. Dates for this year's event are October 14th and 15th, but we're concentrating on the 14th this year. That's the date of the partial solar eclipse. At least four members with solar telescopes are needed, while two volunteers are needed to sell Eclipse Shades. We're normally on hand from 12 to 5 pm; our "Eclipse Watch" event runs from 11:30 am to 2:30 pm. Jack Price plans to stay until 5pm, so most volunteers could leave after the eclipse has ended.

And finally, we hope to have the Remote Telescope back up-and-running by October 1st, or at least sometime dur-

ing the first week of October. Jim and Tim Kurtz are heading out there to work on their house at Arizona Sky Village and will get everything back online while they're out there.

In observing reports, Aaron Roman and family enjoyed a spectacular red sunset with one large sunspot at Sleeping Bear Dunes. The extra redness is due to the smoke from raging wildfires in western Canada that we've been plagued with all summer.

Joe Comiskey recently enjoyed a view of a crescent Venus before dawn. In late August, Venus returned to the eastern sky as the morning star.

Don Stilwell took his grandson to Richland Township Park on August 30th to enjoy the rising of the "Super Blue Moon." He noted that it may have looked super, but it wasn't blue. In an additional treat, Saturn was 2° north of the Moon.

Jack Price reported that he, Mike Dupuis, and David Parks joined Dave Garten for the second-annual *Garten Getaway*, held at Dave's place in the Huron-Manistee National Forest in mid-August. They enjoyed exceptionally dark skies on two really good nights.

Mike Dupuis said the Public Observing Session on August 26th was well attended, and the sky conditions were favorable. Many attendees stayed until after midnight, when Saturn finally cleared the tree from Owl Observatory and people could view it through the 16-inch Ashby Telescope.

Karen Woodworth thanked all the members who brought solar telescopes to the Parchment Community Library on August 12th. Unfortunately, it was too cloudy and even rained at the end.

Jack Price then presented Richard Bell with the Astronomical League's 2023 Mabel Sterns Newsletter Award. See the [September 2023 issue](#) of the *Reflector* to learn more (p. 13). Richard thanked everyone who ever contributed to *Prime Focus*, which made the award possible.

After previewing upcoming events, the meeting concluded at about 9:14 pm. Thanks to Pete Mumbower for running the Zoom portion of the meeting.



Board Meeting Minutes



The officers and at-large KAS members gathered for a quarterly board meeting on Sunday, September 10, 2023, at Sunnyside Church. President Richard Bell called the meeting to order at 5:05 pm. Other board members in attendance included Anna Daly, Dave Garten, Scott Macfarlane, Jack Price, Aaron Roman, Don Stilwell, and Dave Woolf.

After approving the agenda, Don presented his treasurer's report. The latest account balance report covered the month of August. The overall total was \$38,165.36. This includes \$3,060.84 in the Owl Observatory maintenance fund and \$2,834.42 in the Remote Telescope maintenance fund.

Don also provided cash flow reports for May, June, July, and August. The notable item in the June report was the Eclipse Series grant from the Irving S. Gilmore Foundation. Eclipse Shades sales have been doing well thus far, thanks in part to orders from the WMU Physics Department and the Kalamazoo Public Library.

Finally, Don submitted register reports for the same four-month period. The largest expense in May was \$1,350 for our Astronomical League membership renewal. For June, the most notable expenses were the Eclipse Shades purchase from Rainbow Symphony. The same report included costs for 2,000 resealable bags (\$48.74) and 4" x 6" postcards (\$281.25) included with each pair of shades sold. The largest expense in August was \$4,500 for Richard Bell. This was part of the Gilmore grant and is for the 30 eclipse talks Richard will give at libraries and schools throughout southwest Michigan. It was noted that all 30 talks have been reserved.

Richard then reviewed our activities that will take place until the next board meeting in November. These include the Public Observing Sessions in September and October, general meetings for both October and November, and the first Astrophotography SIG meeting of the season in October.

We then moved on to follow-up items from the previous board meeting. Dave Woolf has been working with the staff at Coover Senior Center, the

planned location of the Winter Solstice Party on December 2nd. Dave didn't have specific rental and food costs at the time of the meeting but sent them to the board by email on September 15th. The room rental fee is \$150, with a \$75.00 deposit that was approved by the six board members that responded. The food cost per person is \$25.00.

Food selections will include garden salad with assorted dressings, Alfredo pasta, grilled herb chicken, parmesan-crusted cod, grilled asparagus, and maple-glazed carrots. Beverages include water, iced tea, and lemonade.

Our Eclipse Watch during this year's Crane Fest was then discussed. Richard noted that the eclipse begins at 11:41 am. We normally begin at 12pm. Volunteers with solar telescopes should arrive by 11am and plan to stay until just after the eclipse ends at 2:24 pm. The Kiwanis Club of Battle Creek will supply a canopy and table. That'll be used to sell Eclipse Shades. Richard also noted that the Sun doesn't clear the tree line as seen from our usual spot until just after noon. Jack said they'd make it work.

Next, Richard covered our extensive publicity plans for the Eclipse Series beginning in November. We will be mailing flyers to the entire membership (we stuffed them into envelopes after the meeting). Flyers will also be distributed at locations across the area. Emails will be sent out to over 300 astronomy clubs in the U.S. and Canada, and we will send out a public service announcement to all local media outlets. We'll also make an effort to contact surrounding colleges and universities.

In new business, Richard will be subscribing to JotForm for the duration of the membership renewal period. We normally use the free version, but that only includes ten PayPal transactions per month. The cost is \$17 a month for about five months.

Richard asked for approval to order a Telesin Auto Tracking Tripod Head to use during general meetings. This will hopefully automatically follow the guest speaker's movements and free a member from working the tripod. The cost is

\$48.99. Dave Garten made the motion to purchase the tripod head, while Anna Daly seconded. It was unanimously approved.

Another field trip to Abrams Planetarium on the campus of Michigan State University was proposed. We canceled last year's field trip since they were playing the same show we saw during our last visit in 2018. Possible dates were November 4th and 18th. Scott Macfarlane looked up the MSU football schedule, and they're having a home game on the 4th, so the field trip is tentatively planned for November 18th. This will include the traditional stop at Turkeyville for dinner.

We then reviewed the schedule for the 2023-2024 Online Viewing Sessions featuring the Remote Telescope. There are no known issues with the telescope or observatory, so we should be able to begin in November. Cloud dates will be on the following Saturday (except for November). The schedule was approved and is [now online](#).

Richard then reviewed the schedule for the returning five-part *Introduction to Amateur Astronomy* lecture series. It will begin on January 13th and continue every two weeks until March 9th. Free registration will likely begin sometime in November.

Several telescopes have recently been donated to the KAS. Anne Walters donated a Celestron 114AZ-SR (model #22410-K). After some discussion, we decided to hold a giveaway for this nice beginner's telescope during the November General Meeting.

Amy Meyer (and her daughter Laura) donated three telescopes to the KAS. These include a Celestron NexStar 8SE, a Celestron NexStar 130SLT, and a QQJOY 90mm refractor. We plan to keep the 130SLT for the loan program and sell the other two.

Molly Williams donated Roger's 4-inch Stellarvue refractor with Celestron AVX mount and Coronado MaxScope 60 with Orion Atlas mount. We hope to keep both and loan them to members.

With nothing further, the meeting concluded at 6:20 pm. The next board meeting will be on November 12th.

A Lifetime of **Astrophotography**



with **Jerry Lodriguss**



Noted author, astrophotographer, and educator [Jerry Lodriguss](#) will give an informal presentation about his 50+ years of capturing portraits of the night sky. He'll reminisce about some of his most memorable nights under the stars, share many of his best images, and answer your questions about astrophotography.

Mr. Lodriguss will also briefly touch upon the subject of his latest book, *Smartphone Astrophotography - An Introduction to Photographing the Heavens*. Join us for an evening with one of the leading astrophotographers of our time.

— About the Speaker —

Jerry Lodriguss' professional career began in 1974, when he worked part-time shooting high school sports for \$5 per picture at a small suburban weekly newspaper in New Orleans. He then worked as a staff photographer for the Times-Picayune in New Orleans and as the Louisiana Newspicture Bureau Manager for United Press International. After leaving UPI, he freelanced for Sports Illustrated, Time, Newsweek, The New York Times, Washington Post, and USA Today. From 1987 until 2009, he worked at the Philadelphia Inquirer as their staff sports photographer, where he was nominated for three Pulitzer Prizes. His astrophotographs have appeared in numerous publications, including Sky & Telescope, Astronomy Magazine, and National Geographic. His work has also been featured many times on NASA's Astronomy Picture of the Day and has been included in exhibits by the Space Telescope Science Institute Hubble Heritage Program, the Smithsonian Institution National Air and Space Museum, and the American Museum of Natural History. Jerry has also authored several popular books and educational materials, sharing his expertise and passion for astrophotography with others.

Friday, October 20th @ 8:00 pm

Held Exclusively on Zoom • [Click to Register](#)

Kalamazoo Astronomical Society's ECLIPSE SERIES

Get ready for the April 8, 2024 Great North American Eclipse!



November 3rd @ 7:00 pm ET | KAMSC & Zoom

Sun Moon Earth: Solar Eclipses from Omens to Awe

presented via Zoom by **Dr. Tyler Nordgren**



November 17th @ 8:00 pm ET | Zoom Only

Part One: How to Photograph the Eclipse

presented by **Alan Dyer**



December 15th @ 8:00 pm ET | Zoom Only

Part Two: How to Process Eclipse Images

presented by **Alan Dyer**



January 12th @ 7:00 pm ET | KAMSC & Zoom

Moonshadow Madness and Eclipse Journeys

presented by **Jay Anderson**



January 19th @ 8:00 pm ET | Zoom Only

Automated Imaging of the 2024 Eclipse

presented by **Fred Bruenjes & Xavier Jubier**



February 2nd @ 7:00 pm ET | KAMSC & Zoom

A Tour of the April 8, 2024 Total Solar Eclipse

presented by **Michael Zeiler**



March 1st @ 7:00 pm ET | KAMSC & Zoom

Experiencing Totality - The Great Eclipse of 2024

presented via Zoom by **"Mr. Eclipse" Fred Espenak**

Warm-Up ECLIPSE

October's Ring of Fire

by Richard Bell

Millions of people eagerly await the total solar eclipse on April 8, 2024. On that day, the glorious solar corona will make its magnificent appearance for nearly four and a half minutes along a path from Mexico to eastern Canada. However, there's an appetizer before the main course!

An annular solar eclipse will be visible in the United States along a narrow path from Oregon to Texas on Saturday, October 14, 2023. The apparent size of the Moon's disk will be too small to completely obscure the Sun that day, so witnesses will enjoy a "Ring of Fire" around the new Moon.

The rest of the U.S. will experience a standard partial solar eclipse (an annular itself is a partial eclipse, but of a special variety). At maximum, from Kalamazoo, 38.7% of the Sun's disk will be obscured. This is comparable to the 45% partial solar eclipse that took place on December 25, 2000. Eclipse Shade sales from that eclipse helped pay for the 12-

inch Schmidt-Cassegrain that was in Owl Observatory for 18 years.

Many KAS members may remember the annular eclipse on May 10, 1994. That was the first and only annular I've seen thus far. The weather that day was absolutely perfect, with beautiful blue skies and pleasant temperatures. The northern limit of that eclipse passed through Kalamazoo County.

Mike Sinclair and Eric Schreur organized the Northernmost Eclipse Graze Line Project to accurately determine the northern edge of the eclipse path. The whole club became part of a major observing program that included over 600 students from fifteen area high schools and amateur radio operators. In 1996, Mike and Eric were named joint winners of the Astronomical League Great Lakes Region's Hans Baldauf Award due to their work on the project.

The last annular eclipse visible from the U.S. was on May 20, 2012. The path it traced out was similar to this year's

eclipse. I missed that one because I was busy getting ready for *Our Last Transit of Venus* event at Warren Dunes State Park on June 5th. One of our former members, Alan Otterson, emailed me, saying how spectacular the eclipse was from his home in Albuquerque. I told him I wouldn't have traded the experience we had on the shore of Lake Michigan for anything.

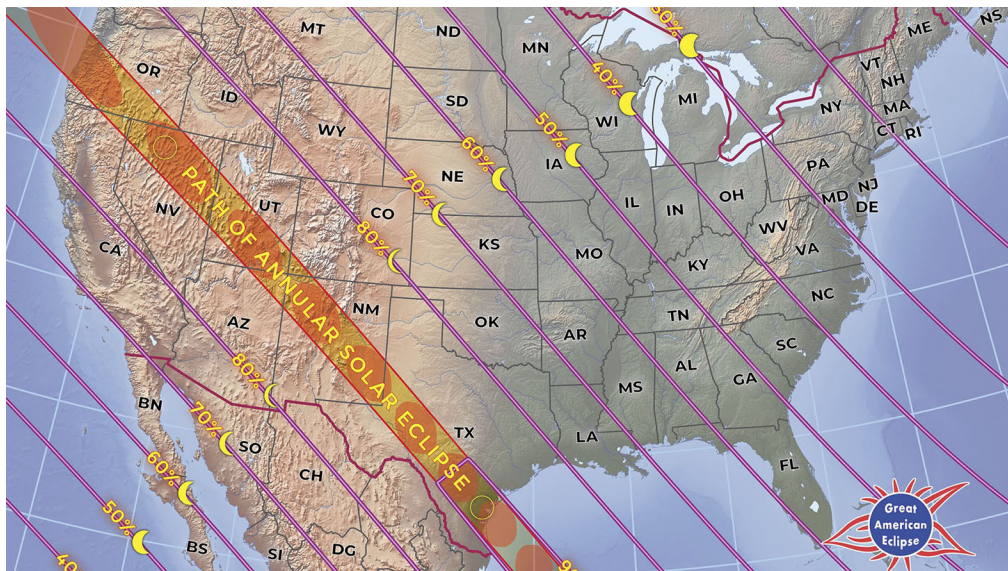
We observed that eclipse from Warren Dunes ahead of the transit. Clouds from an approaching storm spoiled most of it. The storm cleared the horizon just enough for us to see the partially eclipsed sun before it set, all while lightning bolts struck around us. It was one of the most spectacular observing experiences I ever had.

After this month's annular eclipse, another like it will not happen in the U.S. for another 25 years. Yes, we have a total solar eclipse next year, but annular eclipses, while not as spectacular, have a charm all their own. That's why I'll be traveling to New Mexico to enjoy the Ring of Fire.

Eclipse Mechanics

At first glance, it would be easy to mistake a diagram of an annular eclipse for a total solar eclipse. Both occur when the Sun, Moon, and Earth are in a straight line (and in that order), a three-body alignment known as a syzygy.

Closer inspection of the diagram (on page 8) reveals that the Moon's umbra, the inner shadow where no direct sunlight is visible, fails to reach Earth. The Moon is simply too far away from the surface for this to happen. Instead, the inverse of the umbra, or antumbra, falls onto our planet and forms a *path of annularity*. For a handful of minutes, the Moon appears within the Sun's disk. Observers along the path would witness



Path of the October 14, 2023 annular eclipse. Courtesy of Michael Zeiler, Great American Eclipse.

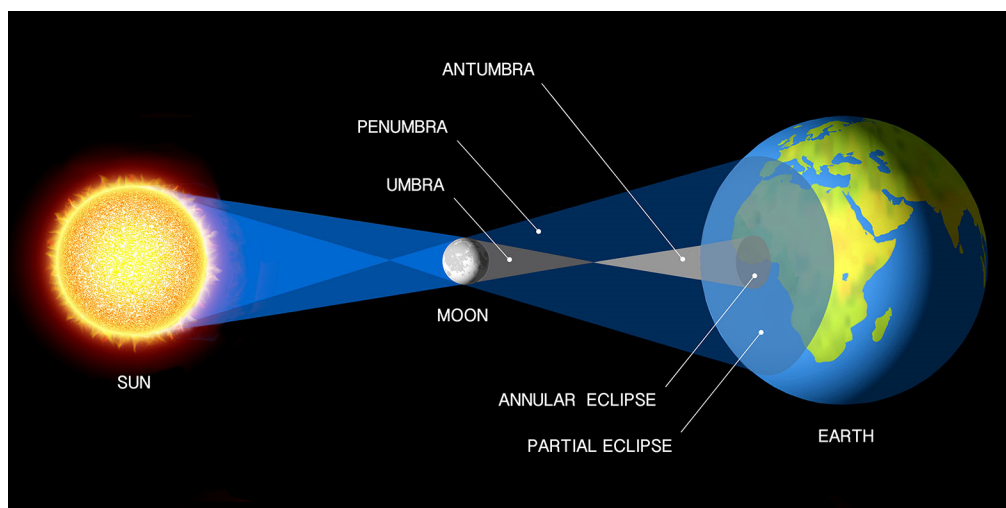


Diagram of an annular eclipse. Not to scale! The length of the antumbra is exaggerated for clarity.

a ring or annulus of sunlight around the Moon. Astronomers call this the “Ring of Fire.”

The blame for the Moon’s varying distance from Earth is Kepler’s First Law of Planetary Motion. This law states that “the orbit of a planet is an ellipse with the Sun at one of the two foci.” It’s a universal law applying to any object in orbit of another, i.e., planets around stars, moons around planets, stars around stars, and even galaxies orbiting other galaxies.

Earth’s orbit around the Sun is nearly circular. It has an eccentricity of 0.0167086, meaning it deviates from a perfect circle by 1.67086%. What all this means is that the distance of an orbiting body to its parent object is constantly changing. Earth reaches perihelion, its closest point to the Sun, in early January. The exact distance varies from year to year but never gets closer than about 91.4 million miles. Aphelion, when Earth is farthest from the Sun, occurs in July. The Sun can be as distant as 94.5 million miles. These figures average out to the familiar distance of 93 million miles from the Sun.

At perihelion, the Sun’s maximum angular diameter is 32.7 arcminutes (0.545°). Solar eclipses can occur at any time of the year, but annular eclipses tend to happen a little more often in January. The angular diameter of the Sun at aphelion is 31.6 arcminutes (0.527°), so total solar eclipses are slightly more common in July.

The Moon’s orbit around Earth is much more elliptical than Earth’s orbit around the Sun. It has an eccentricity of 0.0549, or deviates from a perfect circle by 5.49%. Its distance from Earth varies

from 225,309 miles at perigee to 251,904 miles at apogee. This causes its angular diameter to vary between 34.1 and 29.3 arcminutes, respectively.

On October 14, 2023, the Sun and Moon will meet at their inner node, the point where their paths cross, meeting the conditions for a total solar eclipse. However, the Moon is only 4.6 days past its apogee. The Moon’s angular diameter of 30 arcminutes is insufficient to completely block the 32-arcminute disk of the Sun. Observers will have to settle for an annular solar eclipse.

Martian Eclipse

Total solar eclipses do not occur anywhere else in the solar system, at least not like they do on Earth. The moons of Jupiter, for example, appear far larger than the distant Sun from its turbulent cloud tops. When they cover up the Sun,

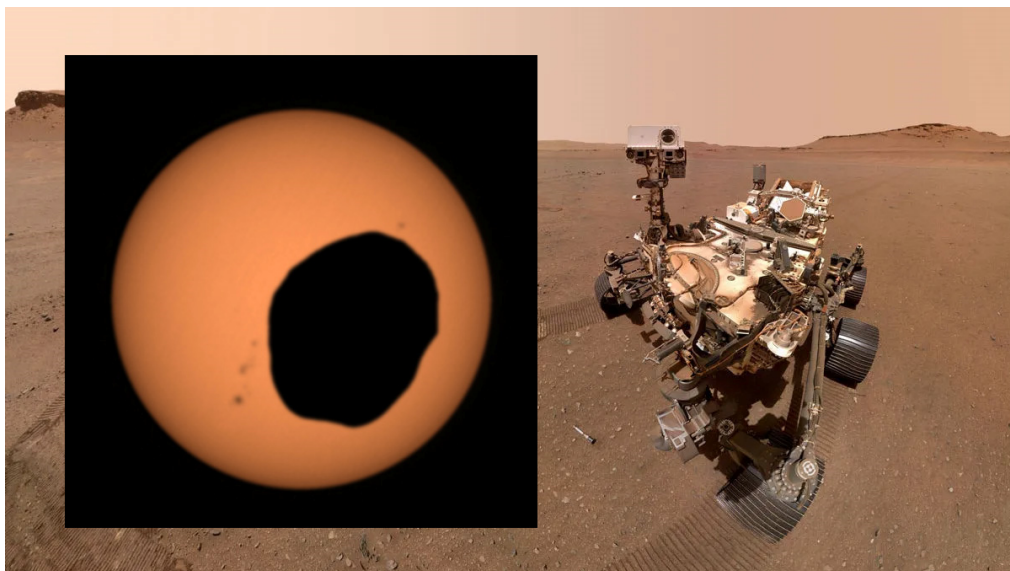
they block *everything*, corona and all, so it’s more like an occultation than an eclipse. From Earth, we get to view these solar occultations as shadow transits on Jupiter’s belts and zones.

However, annular eclipses do occur on Mars...sort of.

Mars has two moons, Phobos and Deimos. Phobos is the larger of the two and the closest to Mars. In fact, at a distance of 5,825.98 miles, no other moon in the solar system is closer to its parent planet than Phobos is to Mars. Subtract Mars’ radius from that distance, and Phobos orbits 3,700 miles above the Martian surface. Phobos completes one revolution around the Red Planet in 7 hours, 39.2 minutes. It circles the planet so fast that it rises in the west and sets in the east twice a day! Phobos’ orbit is slowly decaying. In 50 million years, it will either break up and form a temporary Martian ring or crash into the surface.

The rovers *Spirit* and *Opportunity* were the first to observe solar eclipses by Phobos from the surface of Mars. The most impressive movie of one such eclipse comes from NASA’s latest rover, *Perseverance*. Recorded on April 2, 2022, it shows lumpy Phobos crossing the face of the Sun in just over 40 seconds!

The angular diameter of the Sun from Mars is about 22 arcminutes (0.37°), while Phobos (measuring $16.7 \times 13.9 \times 11.4$ miles) has an angular diameter of 12 arcminutes (0.2°). That’s over the 50% threshold, so I believe we can comfortably call that an annular eclipse as opposed to a transit.



NASA’s Perseverance rover captured Phobos eclipsing the Sun on April 2, 2022.



Indirect methods of viewing a solar eclipse include (from left to right) the classic pinhole projection box, a Pringles can, an ordinary household colander, and trees.

I won't spend too much time discussing Deimos, which is smaller and further away from Mars than Phobos. Its passages across the Sun's face ([captured by Curiosity](#)) can definitely be labeled as transits. On the Martian surface, its angular diameter is only 2 arcminutes. That's only 1 arcminute larger than Venus when it transited the Sun (from Earth) in 2004 and 2012.

Eclipse Safety

The rules of how to safely view an annular eclipse are much simpler than those of a total solar eclipse. With a total eclipse, there's that uncertainty of when it's safe to look directly toward the Sun without protection, so you can enjoy Baily's Beads and the diamond ring effect in the moments before totality. So, when is it safe to stare directly at the Sun during an annular eclipse? NEVER!

The maximum amount of obscuration of the Sun's disk along the path of annularity in North America is about 90%. Even 1% of the photosphere (the Sun's visible surface) is too brilliant to look at safely. You must *always* use some form of direct or indirect viewing method for the entirety of an annular eclipse.

Viewing the Sun directly while wearing a pair of Eclipse Shades is the

most common method. Eclipse Shades are widely available, easy to use, and cost very little. Indeed, many libraries will be giving Eclipse Shades away for free. Many astronomy clubs, including the KAS, use the proceeds from Eclipse Shade sales to help fund their activities and facilities. After all, astronomy clubs don't receive tax dollars or endowments like museums, observatories, or planetariums do.

Magnified views of the eclipsed Sun can be had through properly filtered binoculars or telescopes. With the exception of [Herschel prisms](#) for refractors, all solar filters should securely fit over the front of binoculars and telescopes. All filters block out 99.999% of visible light and 100% of infrared and ultraviolet light.

Solar filters for binoculars and telescopes can be purchased from several dealers. Any filter using Baader Solar Material will show the Sun in its natural white light. You could easily make it yellow with a #12 planetary filter. Thousand Oaks Solarlite material gives the Sun a yellow-orange hue. Glass solar filters are getting harder to find, but they are better for astrophotography. According to a [comprehensive comparison](#) of solar filters by Alan Dyer, black polymer filters tend to give a soft image and

can be surrounded by lots of light scatter when used for astrophotography at long focal lengths.

[Lunt Solar Systems](#) sells dedicated solar binoculars and telescopes. Lunt offers 6×30 SunOculars for \$24.95. They come in blue, red, and yellow. The 8×32 pairs are sturdier and have a price range of \$119 for red and yellow and \$129 for a blue and black pair. Both sizes give an orange view of the Sun. Lunt is best known for its line of telescopes equipped with hydrogen-alpha solar filters. These filters will reveal prominences and filaments during any solar eclipse and on an ordinary day! The dedicated H-alpha telescopes range in aperture from 40 to 305 mm. Both [Coronado](#) and [DayStar](#) offer dedicated H-alpha telescopes as well.

If you're an arts and crafts kind of person and want to save a little money, you can make your own solar filter. Most of the dealers that sell pre-made solar filters offer just the material as well. Chris Cook recently [wrote a blog](#) post for Agena Astro on how to make your own solar filter for the eclipse.

There are also a variety of indirect methods that can be used to safely view a solar eclipse. The classic method is to build a pinhole viewer out of a box. A more portable pinhole viewer can be



Direct methods of viewing a solar eclipse include (from left to right) Eclipse Shades, binocular solar filters, telescope solar filters, and hydrogen-alpha filter.

made out of a Pringle's can. You could even poke holes in a flat sheet of cardboard and spell out a fun message like "Ring of Fire" or "Eclipse 2023." If you're not an arts and crafts kind of person, you could use a standard household colander.

Solar projection with binoculars or a telescope is great for large groups, so they can all view the eclipsed Sun at the same time. This method works best for binoculars and refracting telescopes. Most smaller Newtonians may also work, so long as they are of decent quality. I once tried solar projection with a plastic eyepiece that came with a cheap tabletop telescope I bought for display. Sure enough, it melted! Make sure your eyepiece is built from metal and glass.

Solar projection can also be dangerous if young kids are part of your eclipse party. They always want to peek through the eyepiece of a telescope, so you'll need to keep a watchful eye on them.

A much safer method of solar projection is to build a Sun Funnel. Don Stilwell and I first used one of these during the Venus transit in 2012. NASA's Total Solar Eclipse 2017 website has a [link to a PDF file](#) with detailed instructions on how to build one. The rear projection screen material can be purchased from [AV Outlet](#). An 8" x 8" piece costs \$16.38 plus shipping.

The Weather

Fortunately, I don't have to cover the climate history of the eight states along the annular eclipse's path. Jay Anderson and Fred Espenak do a fine job of that in an article that appears in the October 2023 issue of *Sky & Telescope* (page 34). Spoiler Alert: The best weather prospects along the path of annularity are in New Mexico. That's why I'm heading to Roswell. In fact, Jay Anderson's "[Mean October Cloud Fraction](#)" graph shows Roswell as the city with the least chance of cloud cover on Eclipse Day.

Like any good amateur astronomer or eclipse chaser, I'll be keeping a



Composite image of an annular solar eclipse with the "Ring of Fire" front and center. Image credit: Amanjot Singh and Sanchita Abro

watchful eye on the [GOES-East satellite](#) in the days and hours leading up to the eclipse. No matter where you are in the U.S. on October 14th, I hope you do the same.

Eclipse Highlights

The partial solar eclipse in Kalamazoo begins at 11:41 am EDT, when the Sun is 34° above the southeastern horizon. The Moon will begin taking a bite out of the Sun from the upper right and kind of slide along its right side as the eclipse progresses.

The Sun has been sporting sunspots every day this year, so there's a good chance you'll get to see the Moon hide some through a filtered telescope. Maximum eclipse occurs at 1:01 pm. At this time, 38.7% of the Sun will be eclipsed. The eclipse ends at 2:24 pm, at least with a white-light solar filter. You'll get at least another minute with a hydrogen-alpha telescope, since they reveal the chromosphere, the layer of the Sun above the photosphere.

If you didn't know an eclipse was happening, you'd never know it. The sky will not grow dark enough for anyone to notice. Around 90% of the Sun must be obscured for that to happen.

Those along the path will get to see more. Shadows will grow sharper when the Sun becomes a narrow crescent. If

there are trees or bushes nearby, people will see a plethora of crescent suns all over the ground. From my location near Roswell, the Moon will almost be perfectly centered within the Sun's disk at 10:41 am MDT. I was on the northern edge of the annular eclipse in 1994, so I'm really looking forward to seeing the full "Ring of Fire" in all its brilliant glory! The sky should also grow darker blue.

Many eclipse chasers travel to the northern or southern boundary of an annular eclipse on purpose. Known as the "grazing zone," it is the best place to see Bailey's Beads. It is possible to see the beads on the centerline, but only for a couple of seconds. The beads can be viewed for up to two minutes along the zone. There's more, but you can read about it [in an article](#) on Space.com.

Summary

It has been nearly 30 years since I've seen an annular eclipse. If I miss this one, like I did in 2012, I'll have to wait until June 11, 2048. To me, as a hard-core amateur astronomer, that's unforgivable. It may not be as spectacular as a total solar eclipse, but it is still a chance to watch the clockwork of the solar system in motion. Not to mention a great way to get warmed up for April 8, 2024! Clear skies to all.

ECLIPSE from KALAMAZOO, MI

Partial Eclipse: 11:41 am
Max Eclipse: 1:01 pm
Partial Ends: 2:24 pm
Obscuration: 38.7%



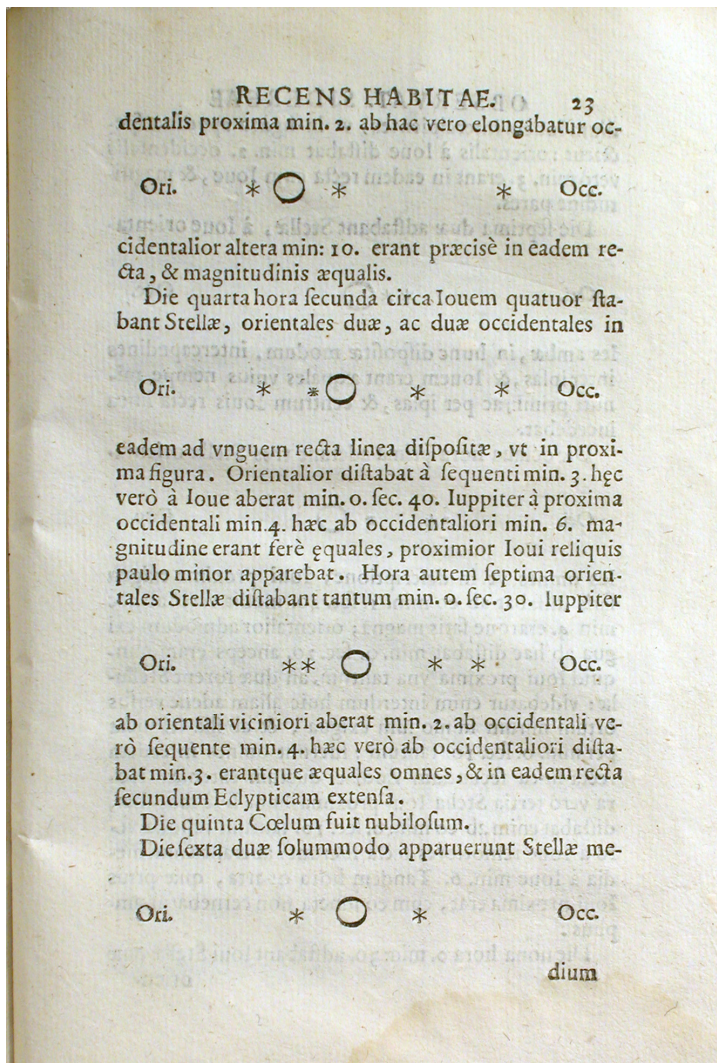


From Galileo to Clipper, Exploring Jupiter's Moons

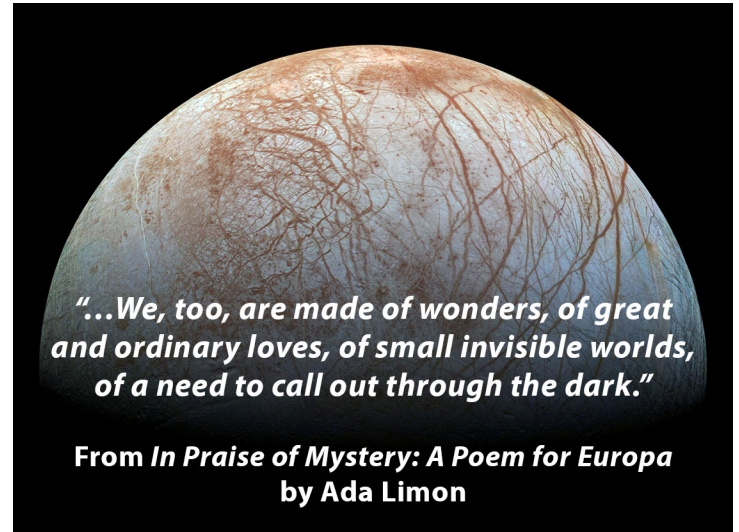
by Vivian White

As autumn begins, if you're up late, you may notice a bright point of light rising in the east. Look a bit closer, with a pair of binoculars, and you'll notice it's not a star at all. While stars look point-like no matter how big your backyard telescope, this light appears as a circle under closer examination. Even more curious, you will likely see a line of smaller dots on one or both sides. Congratulations! You've rediscovered the king of the planets - majestic Jupiter - and its four largest moons.

Galileo famously chronicled the four moving dots near Jupiter and surmised that they were orbiting the distant world. While Jupiter has well over 80 discovered moons as of September 2023, these brightest four are called the "Galilean Moons" - Io, Europa, Ganymede, and Callisto.



Galileo's drawings of Jupiter and its Medicean Stars from *Sidereus Nuncius*. Image courtesy of the History of Science Collections, University of Oklahoma Libraries.



(Great mnemonics exist to remember these in order of distance from Jupiter, such as "I Eat Green Caterpillars") You can follow these like Galileo did, using stargazing apps or [this handy graph](#). A favorite beginning observing challenge is to [track the movement](#) of the Galilean Moons over the course of many nights. Even within a few hours, you will notice them moving in relation to Jupiter, just as Galileo did.

Fast forward 414 years, and NASA will be sending a robotic mission to investigate the surface of one of these distant worlds. The [Europa Clipper Mission](#) is launching to the cold, icy moon in 2024, to begin orbiting in 2030. With its salty oceans covered by ice, Europa was chosen as an excellent location to continue the search for life outside of Earth. Clipper will be the largest spacecraft ever sent to another planet, designed to withstand Jupiter's punishing radiation. Once it arrives at Jupiter in 2030, NASA plans to do about 50 flybys of Europa, mapping almost the entire surface of this watery world.

What was once only dreamed of in the small telescope of Galileo, or in great works of fiction, NASA is turning our wildest imagination into reality. One of the celebrated quotes from the classic 2010: Odyssey Two warns, "All these worlds are yours, except Europa. Attempt no landing there." Science fiction fans can feel relieved knowing that writer Arthur C. Clarke gave his blessing for the Europa Clipper mission.

[Join the Europa Message in a Bottle Campaign](#) to send your name with the spacecraft, hear the rest of the poem by the US Poet Laureate, and learn more about the wonders of space travel with the Clipper Mission.

[Watch a wonderful Clipper webinar](#) with Dr. Cynthia Phillips, planetary geologist with the mission.



International Observe the Moon Night 2023



LUNAR MARIA (SEAS) • NORTHERN HEMISPHERE • SATURDAY, OCTOBER 21

Moon Map

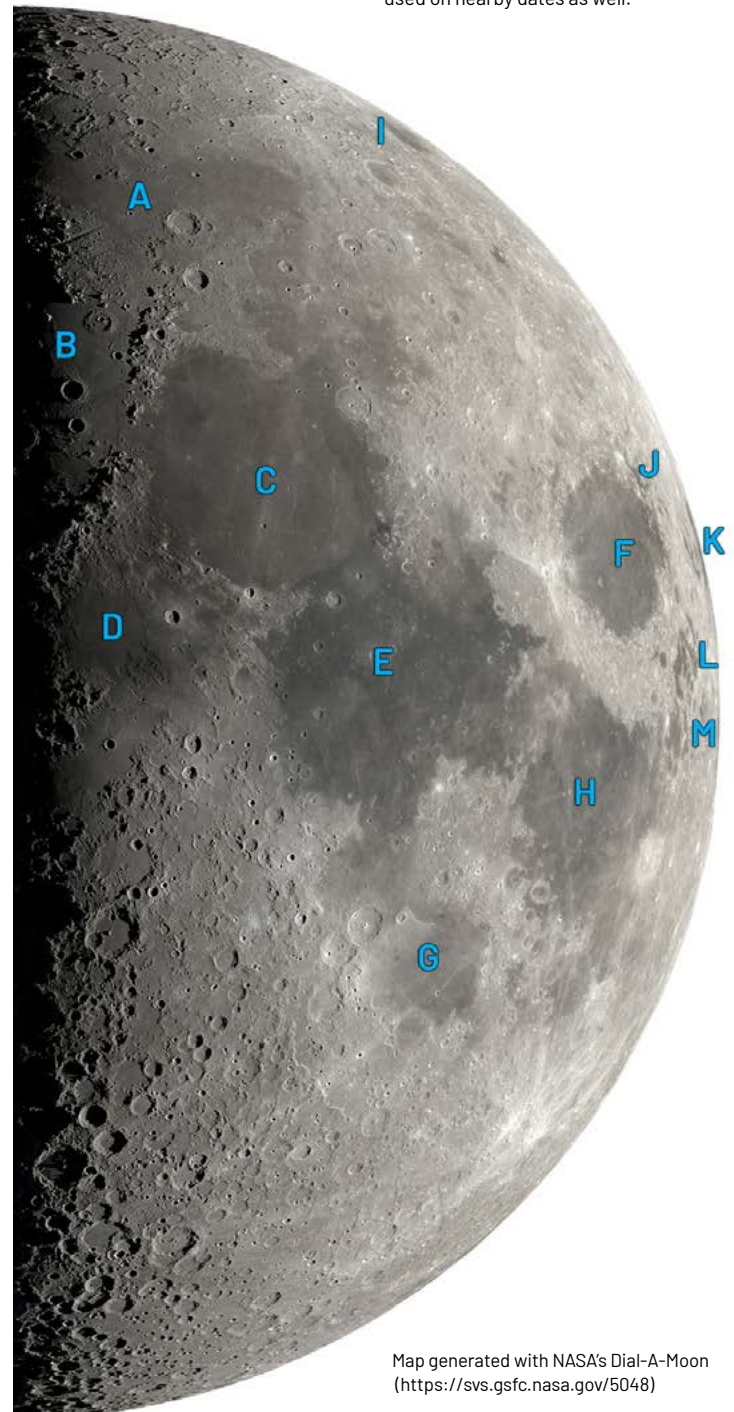
This map depicts the Moon as it will appear from the northern hemisphere on International Observe the Moon Night, October 21, 2023 (02:00 UT October 22). Many of the best views will occur along the terminator (the line between the day and night side of the Moon).

Lunar Maria (Seas)

You can see a number of maria tonight. Once thought to be seas of water, these are actually large, flat plains of solidified basaltic lava. They can be viewed in binoculars or even with the unaided eye. Some of the maria are circular, hinting at origins from giant asteroid impacts that created great basins, which were later flooded with lava. Other maria are irregular and have more mysterious origins. Tonight, you may be able to identify 13 maria on the near side of the Moon, including two maria along the eastern edge that are often hard to see. If you are up for a challenge, you can try to spot these elusive eastern seas! *Mare Humboldtianum* (I), on the Moon's northeast edge, will be the easier of the two. Observers with telescopes may just barely be able to see a very thin darkening at the far eastern limb of the Moon, marking the extreme western edge of *Mare Marginis* (K).

This map shows what the Moon will look like at 10 p.m. EDT on International Observe the Moon Night, but it can be used on nearby dates as well.

- A Mare Frigoris (Sea of Cold)
- B Mare Imbrium (Sea of Rains)
- C Mare Serenitatis (Sea of Serenity)
- D Mare Vaporum (Sea of Vapors)
- E Mare Tranquillitatis (Sea of Tranquility)
- F Mare Crisium (Sea of Crises)
- G Mare Nectaris (Sea of Nectar)
- H Mare Fecunditatis (Sea of Fertility)
- I Mare Humboldtianum (Humboldt's Sea)
- J Mare Anguis (Serpent Sea)
- K Mare Marginis (Border Sea)
- L Mare Undarum (Sea of Waves)
- M Mare Spumans (Sea of Foam)



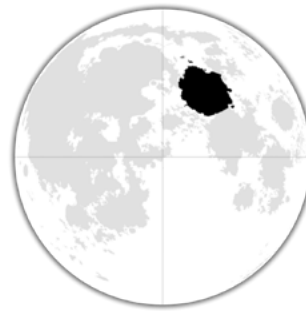
Map generated with NASA's Dial-A-Moon
(<https://svs.gsfc.nasa.gov/5048>)



A. Mare Frigoris
(Sea of Cold)



B. Mare Imbrium
(Sea of Rains)



C. Mare Serenitatis
(Sea of Serenity)



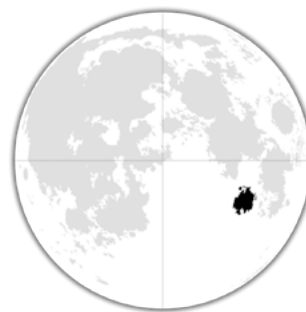
D. Mare Vaporum
(Sea of Vapors)



E. Mare Tranquillitatis
(Sea of Tranquility)



F. Mare Crisium
(Sea of Crises)



G. Mare Nectaris
(Sea of Nectar)



H. Mare Fecunditatis
(Sea of Fertility)



I. Mare Humboldtianum
(Humboldt's Sea)



J. Mare Anguis
(Serpent Sea)



K. Mare Marginis
(Border Sea)



L. Mare Undarum
(Sea of Waves)



M. Mare Spumans
(Sea of Foam)

These charts show the positions and extents of 13 lunar seas that are at least partially visible on the Moon tonight, with north up and lunar west to the left. Some of the larger seas can be found without any special equipment. Other smaller seas may be challenging to find even through binoculars. Combine these charts with the accompanying map and see how many of the Moon's maria you can track down tonight!



International Observe the Moon Night 2023



HUMAN LANDING SITES • NORTHERN HEMISPHERE • SATURDAY, OCTOBER 21

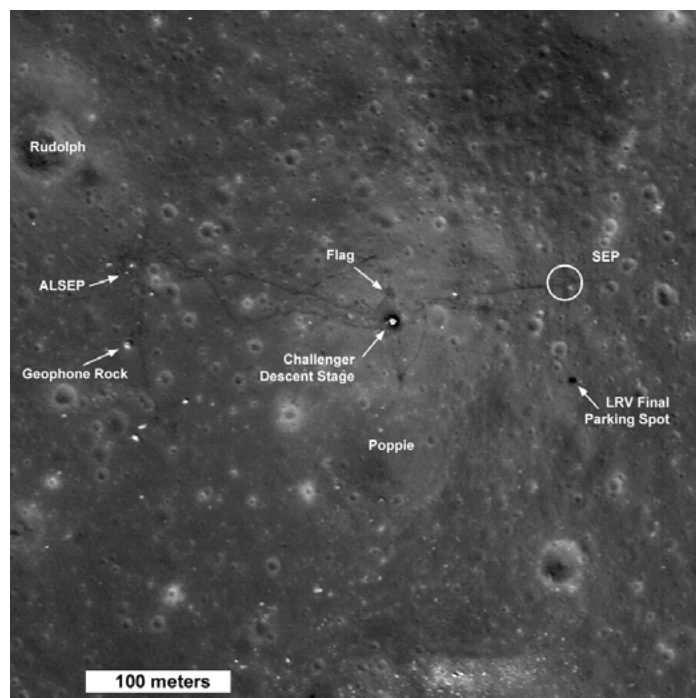
Moon Map

This map depicts the Moon as it will appear from the northern hemisphere on International Observe the Moon Night, October 21, 2023 (02:00 UT October 22). Many of the best views will occur along the terminator (the line between the day and night side of the Moon).

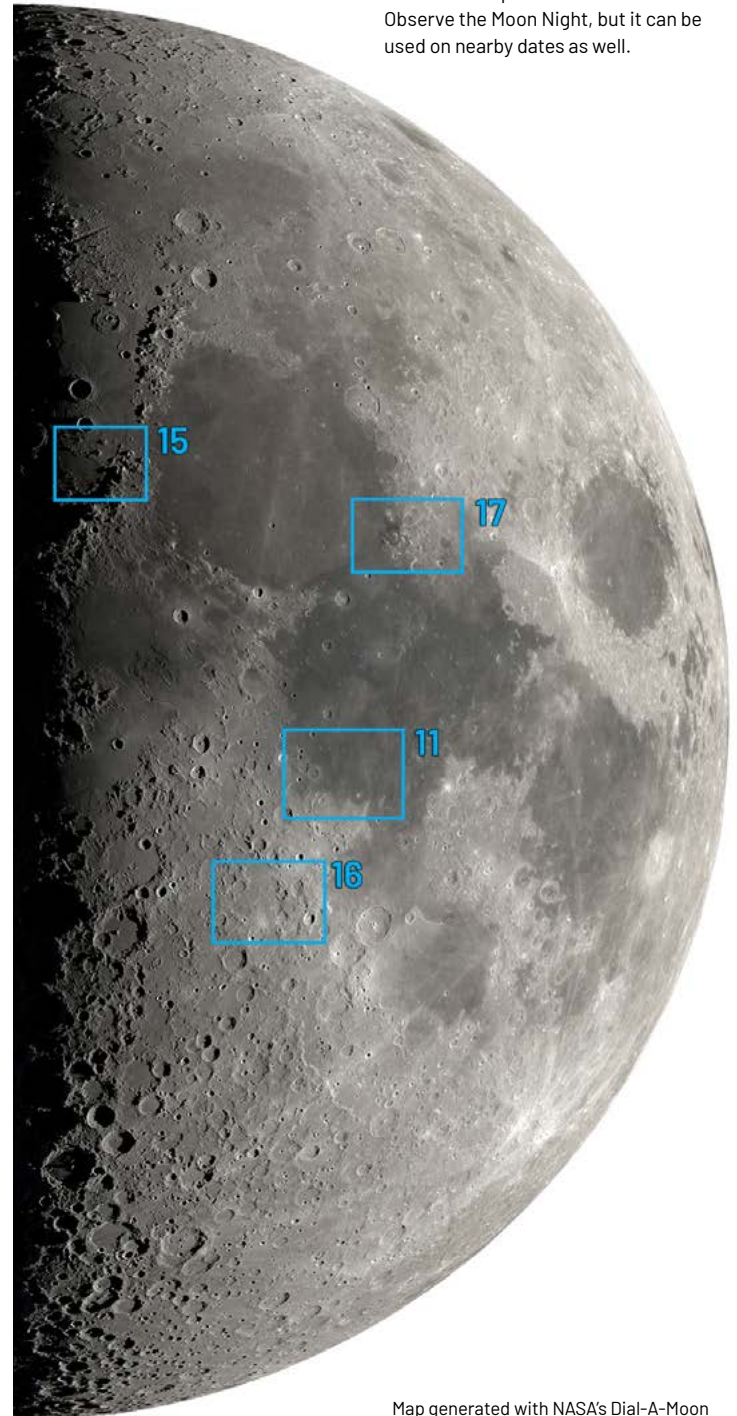
Lunar Landing Sites

Between July 1969 and December 1972 a total of 12 astronauts landed on the surface of the Moon for six of the Apollo missions. Apollo missions 11, 12, 14, 15, 16, and 17 each landed in different locations on the lunar surface. These locations, each fascinating for their own particular reasons, sampled a wide range of lunar geology and terrain, from smooth mare plains to rugged ancient highlands. Four landing sites are visible tonight. Use this map and the magnified charts on the other side of this sheet to find and observe these historic sites.

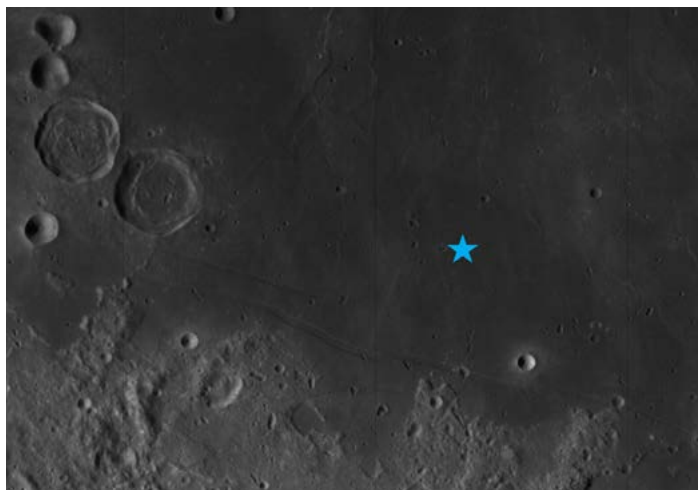
This map shows what the Moon will look like at 10 p.m. EDT on International Observe the Moon Night, but it can be used on nearby dates as well.



Detail view of Apollo 17 landing site with some features annotated. Image from the Lunar Reconnaissance Orbiter Camera.



Map generated with NASA's Dial-A-Moon (<https://svs.gsfc.nasa.gov/5048>)



Apollo 11

The first human landing site was on the smooth flat plains of the Sea of Tranquility. Despite how flat the area looks from Earth and from lunar orbit, astronauts Neil Armstrong and Edwin Aldrin had to maneuver their lander at the last minutes of their descent in order to avoid a field of giant boulders.

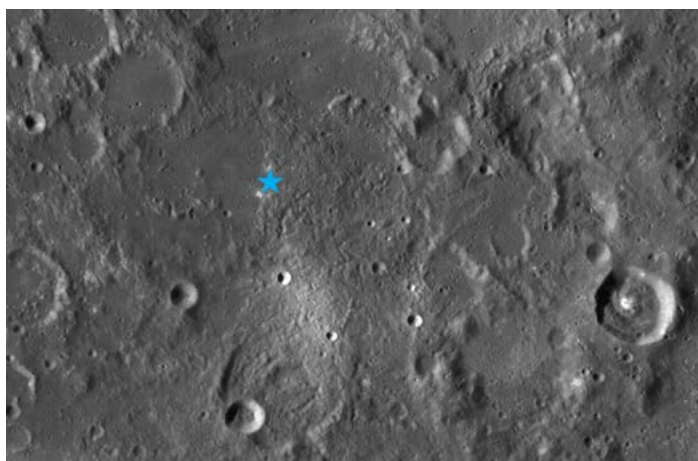
Site: **Mare Tranquillitatis** | Mission Duration: **July 16, 1969 – July 24, 1969**
 Command Module: **Columbia** | Lunar Module: **Eagle**
 Commander: **Neil Armstrong** | Lunar Module Pilot: **Edwin Aldrin Jr.**
 Command Module Pilot: **Michael Collins**



Apollo 15

In July 1971, astronauts David Scott and James Irwin landed at the edge of Mare Imbrium at the base of the towering Apennine Mountains. Driving their rover across the mare and up the lower mountain slope, they gathered samples from the dark plains and the surrounding, light-colored lunar highlands.

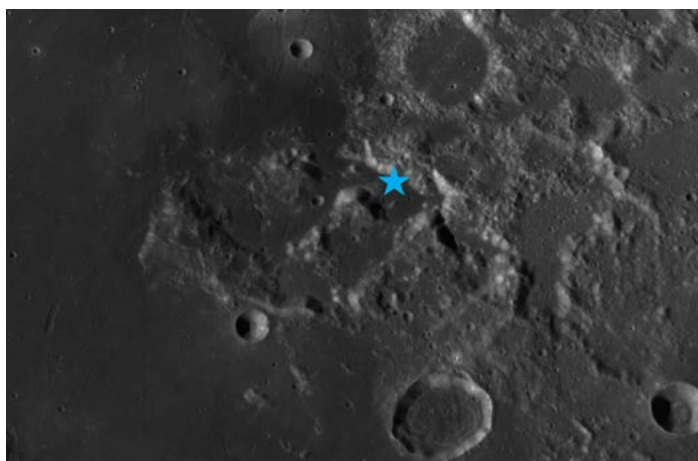
Site: **Hadley-Apennine** | Mission Duration: **July 26, 1971 – August 2, 1971**
 Command Module: **Endeavour** | Lunar Module: **Falcon**
 Commander: **David Scott** | Lunar Module Pilot: **James Irwin**
 Command Module Pilot: **Alfred Worden**



Apollo 16

This was the first and only mission to land in the rugged lunar highlands. In April 1972, astronauts John Young and Charles Duke collected rock samples more than 4 billion years old. These showed that the ancient lunar crust formed from rock that crystalized and floated to the top of a global lunar magma ocean.

Site: **Descartes Highlands** | Mission Duration: **April 16, 1972 – April 27, 1972**
 Command Module: **Casper** | Lunar Module: **Orion**
 Commander: **John Young** | Lunar Module Pilot: **Charles Duke Jr.**
 Command Module Pilot: **Thomas Mattingly II**



Apollo 17

The final Apollo mission to land on the Moon visited the spectacular Taurus-Littrow Valley, deeper than Earth's Grand Canyon. In December 1972, astronauts Eugene Cernan and Harrison Schmitt (the first professional geologist on the Moon) explored an active fault scarp, a gigantic landslide deposit, and brought back samples that included beads of volcanic glass erupted in an ancient lunar fire fountain.

Site: **Taurus-Littrow** | Mission Duration: **December 7, 1972 – December 19, 1972**
 Command Module: **America** | Lunar Module: **Challenger**
 Commander: **Eugene Cernan** | Lunar Module Pilot: **Harrison Schmitt**
 Command Module Pilot: **Ronald Evans**

Detailed images are Lunar Reconnaissance Orbiter WAC mosaics with north up and lunar west to the left.

Find more high-resolution images of the Moon at <https://trek.nasa.gov/moon>



International Observe the Moon Night 2023



SELECTED OBJECTS FOR TELESCOPIC VIEWING • NORTHERN HEMISPHERE • SATURDAY, OCTOBER 21

Moon Map

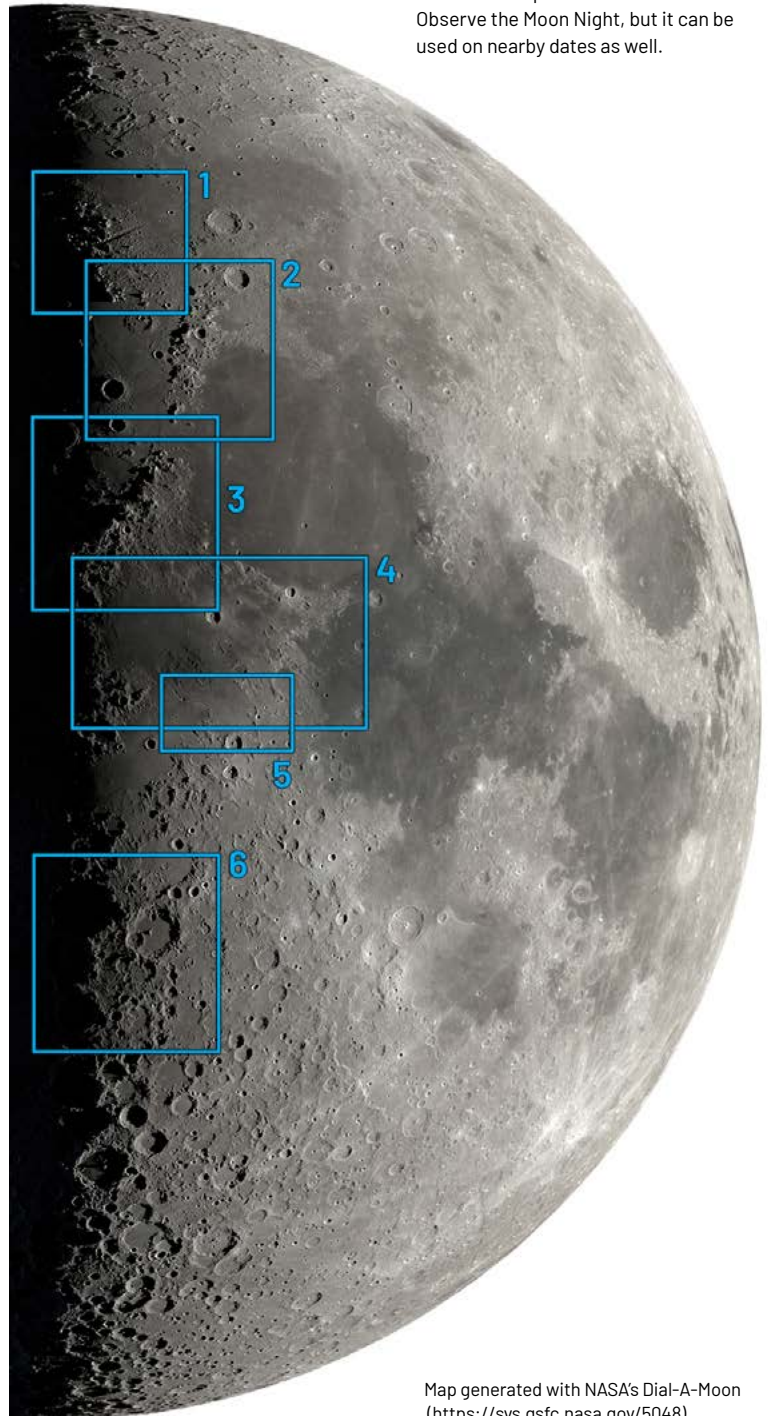
This map depicts the Moon as it will appear from the northern hemisphere on International Observe the Moon Night, October 21, 2023 (02:00 UT October 22). Many of the best views will occur along the terminator (the line between the day and night side of the Moon).

Selected Telescopic Objects

Some of the more interesting lunar landforms that have favorable lighting for viewing tonight are identified here. Details for each are on the reverse side of this map.

- 1 The lunar alps (Montes Alpes)
- 2 The Caucasus Mountains (Montes Caucasus)
- 3 Apennine Mountains (Montes Apenninus)
- 4 Imbrium Sculpture
- 5 Rima Hyginus & Rima Ariadeus
- 6 Ptolemaeus, Alphonsus, Arzachel, & Albategnius Craters

This map shows what the Moon will look like at 10 p.m. EDT on International Observe the Moon Night, but it can be used on nearby dates as well.



Map generated with NASA's Dial-A-Moon
(<https://svs.gsfc.nasa.gov/5048>)



1. The lunar alps (Montes Alpes):

This mountain range is formed by the northeast rim of the Imbrium Basin, with the plains of Mare Frigoris to the north. Cutting across the mountain range is the Alpine Valley, a graben formed by a strip of lunar crust that dropped down between two parallel faults. Peaks of the Alps rise up about 3 kilometers. The Alpine Valley is 166 km long and 10 km wide.



2. The Caucasus Mountains

(Montes Caucasus):

This mountain range rises on the eastern rim of the Imbrium Basin and the western rim of the Serenitatis Basin. Towering peaks in this rugged landscape rise to heights of about 4 kilometers. On International Observe the Moon Night 2023, the entire range will be illuminated by the early morning Sun on the Moon. This excellent lighting should provide dramatic views.



3. Apennine Mountains

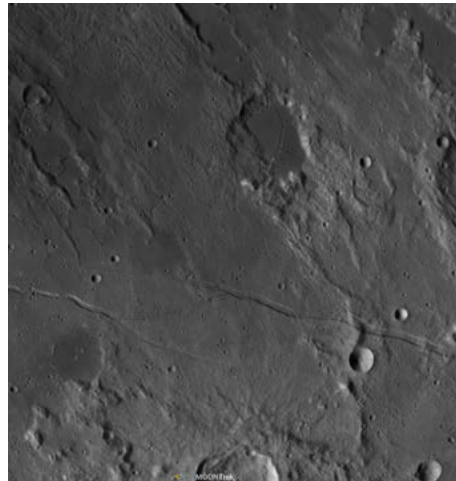
(Montes Apenninus):

The most spectacular of the Moon's mountain ranges stretches for 600 km along the southeast rim of the Imbrium Basin. Its peaks rise to heights of about 5 kilometers. Lunar sunrise will be advancing along the peaks and ridges of the range on International Observe the Moon Night, with only the northern portion illuminated.



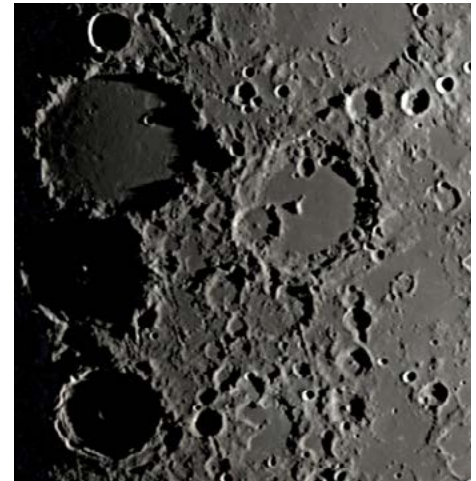
4. Imbrium Sculpture:

The Imbrium Basin formed 3.9 billion years ago in an incredibly violent impact. Evidence of this impact within the basin was buried by the flood of lava that formed Mare Imbrium. But outside the rim, dramatic evidence of the impact can still be seen. To the southeast of the basin, vast deposits of ejected debris and gigantic gouges in the Moon's surface give spectacular testimony to this event.



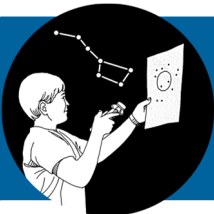
5. Rima Hyginus & Rima Ariadeus:

Amidst the chaos of the Imbrium Sculpture are two great, prominent, apparent fractures in the lunar crust. These are excellent examples of straight rilles formed by magma rising up through and widening cracks in the lunar crust. Hyginus lies to the west and Ariadeus to the east. Magma apparently reached and erupted onto the surface along Hyginus with blankets of volcanic ash around the rille and volcanic pit craters along the rille.



6. Ptolemaeus, Alphonsus, Arzachel, & Albategnius Craters:

The lunar sunrise on these large impact craters should put on a spectacular show. Watch the dark shadows of the eastern rims retreat across the crater floors and see the heights of the western rims catch the rays of the rising Sun. Look for Alphonsus' central peak to appear as a bright star as the Sun rises. Ptolemaeus, Alphonsus, Arzachel are aligned north to south and Albategnius is to the east.



October Night Sky

This star map is property of the Kalamazoo Astronomical Society. However, you may make as many copies as needed free-of-charge, so long as it is for non-profit educational purposes and full credit is given to the KAS.

www.kasonline.org

This map represents the sky at the following local standard times:

- Early September 11 pm
- Late September 10 pm
- Early October 9 pm
- Late October Dusk

NORTH

EAST

WEST

SOUTH

This Month's Moon Phases

- 6: Last Quarter
- 14: New
- 21: First Quarter
- 28: Full

Deep Sky Object Key

- Galaxy
- Open Cluster
- Globular Cluster
- Diffuse Nebula
- Planetary Nebula

A partial solar eclipse will be visible from West Michigan on October 14th. Those along a narrow path from Oregon to Texas will experience an annular eclipse.

It begins at 11:41 am EDT when the Moon touches the Sun's edge. Maximum eclipse occurs at 1:01 pm, with the Moon obscuring 38.7% of the Sun's disk. The eclipse ends at 2:24 pm.

Proper precautions must be taken to observe the Sun safely. The simplest method is to purchase Eclipse Shades from the KAS website for \$3.00 per pair.

Members will also share views of the eclipsed Sun through telescopes equipped with filters from 11:30 am to 2:30 pm during Crane Fest, held at the Kiwanis Youth Conversation Area near Bellevue, MI.

The Orionid meteor shower peaks during the early morning hours of October 22nd. The first quarter Moon sets at 12:05 am, so it will not interfere with the shower's peak hours.

The zenithal hourly rate, or the number of meteors seen during its peak hour of activity, ranges between 20 and 30. Orionids are dust-sized fragments from none other than Halley's Comet.

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Reviews · Reports · Astrophotos

Deadline for submissions is **15th of EVERY MONTH.**
The quality of this newsletter depends on **YOU!**

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Public Observing Sessions

at the *Kalamazoo Nature Center*

October 7th

Jupiter, Saturn & Galaxies of Autumn

October 21st

The Moon, Jupiter & Saturn



Gates Open: **7:00 pm** | Observing Begins: **7:30 pm**



ECLIPSE SHADES

Get ready for the **October 2023**
and **April 2024** solar eclipses!

Purchase online at kasonline.org
or at any upcoming KAS event.



A minimum contribution of \$3⁰⁰ per pair!

ECLIPSE WATCH

@ Crane Fest

Volunteers Needed:

- Solar viewing
- Eclipse Shade sales
- *Get free admission!*



Saturday, October 14th @ 11:30 am

Kiwanis Youth Conservation Area - 22300 15 Mile Rd, Bellevue, MI



ASTROPHOTOGRAPHY

Night

KAS shutterbugs show off their wares.



The tradition continues! Every October the general meeting of the Kalamazoo Astronomical Society is devoted to astrophotography, the art of photographing the night sky. Over the years, KAS shutterbugs have traveled to exotic places, ascended to dizzying heights, or just hung out at the Kalamazoo Nature Center and other locales across southwest Michigan, working the graveyard shift with their impressive array of camera gear. Now they are ready to show their artistic wares. So come on out for what always proves to be one of our most enjoyable meetings of the year!

Friday, October 6th @ 7:00 pm

Kalamazoo Area Math & Science Center

Use Dutton St. Entrance • Locked by 7:10 pm

Also held on Zoom • [Click to Register](#)