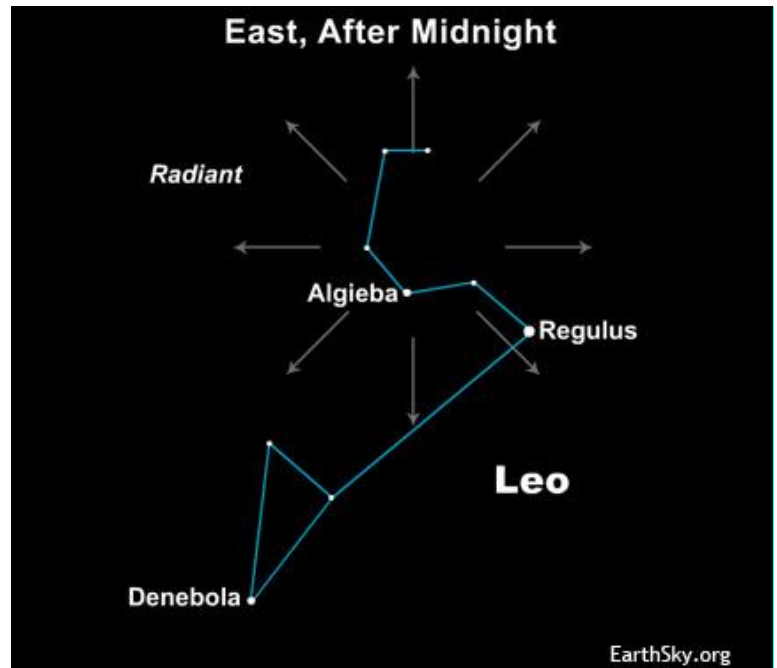


November Special Events:

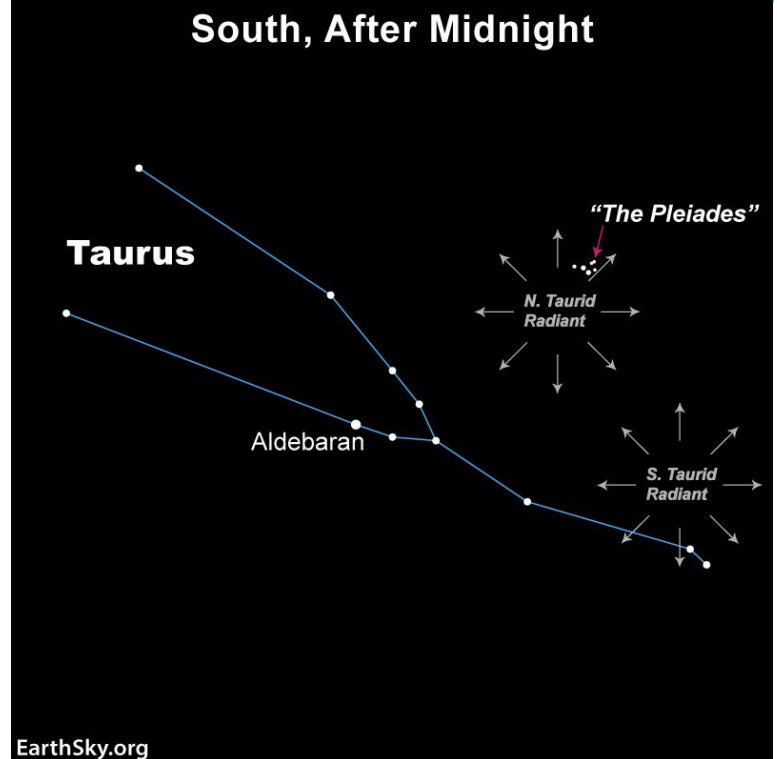
Leonid Meteor Shower:

The Leonid Meteor Shower peaks late on November 17/18. However, there are meteors from this shower from about November 6 to November 30. It peaks at only about 15 meteors per hour. The shower is related to Comet 55P/Tempel-Tuttle. Tempel-Tuttle is in a retrograde orbit, so we meet this shower head on. The illustration on the right from the EarthSky website will give you an idea from where the meteors appear to radiate. Remember not to look directly at that radiant (look left, right, or above). At around 5:00 in the morning, Leo will be in the south southeast. This year, the New Moon is on November 20, so the Moon will be thin waning crescent that does not rise until 5:30 a.m.



Taurid Meteor Showers:

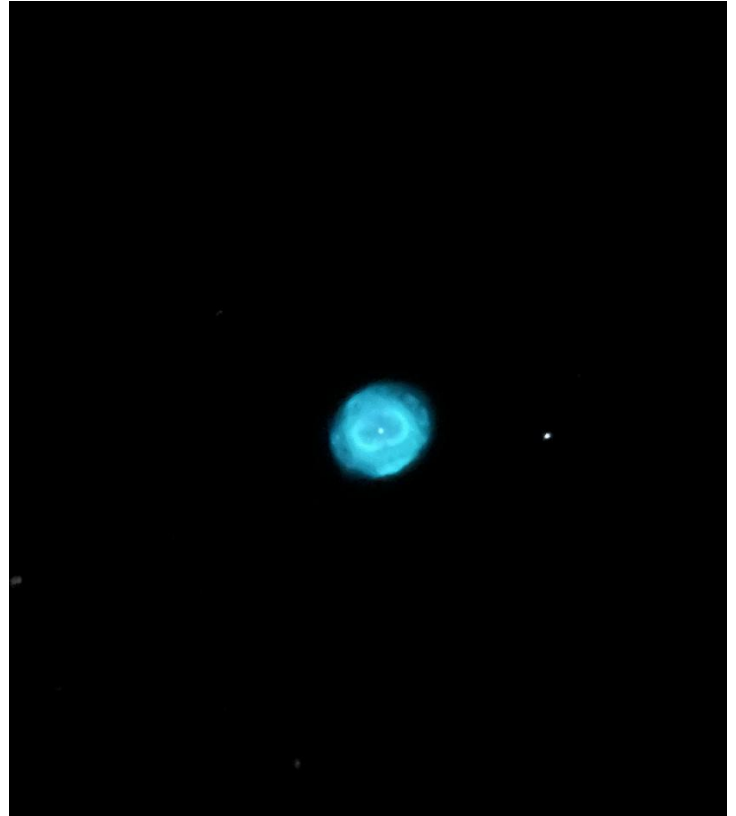
Both the North Taurid and South Taurid meteor showers are “active” in November. Neither of these are very strong, peaking at only about five meteors each at their peak. However, they usually are bright meteors. The South Taurid Shower peaks on night of November 4/5. The shower is active until about November 20. The North Taurid Meteor Shower peaks on November 11/12 (an hour earlier than South Taurids). The shower is active until early December. In both cases, now is a good time to observe them if you are up in the middle of the night and the Moon has already set. The Full Moon is on November, so will interfere with peak of the North Taurids. The source of the South Taurids is Comet 2P/Encke. For the North Taurids, the story is a little more complex. It is thought that about 20,000 years ago, a much larger comet broke up to create Comet 2P/Encke as well as up to 10 small Near-Earth Objects, including 2004 GT10 (the one whose orbital parameters most closely match the North Taurids). So, these showers are directly related to Encke and 2004 GT10 and indirectly the other asteroids as well as the original comet breakup. Please note that there have been several meteoroid impacts seen in the last few days and some astronomers are thinking that they may have derived from the Taurids.



<https://earthsky.org/astronomy-essentials/taurid-meteors-all-you-need-to-know/>

Some Pictures:

Don and I were at Astronomy Camp from October 24 to 27. We had three beautiful nights. I am hoping to get more pictures from staff and Campers and will post them in the future. Here are two images taken by staffer Meredith Stone through the 61" telescope. Upper left is M15, the Great Pegasus Cluster, a globular cluster. The upper right image is Blue Snowball Nebula, a planetary nebula. I took the bottom two images. On the evening of October 26, I was able to see (left bottom image) both Mercury, left, and Mars, right (very faint), as well as a plane. I also have a picture taken just before Camp that includes the 2.5-day-old Moon, but Mercury is even harder to see. The lower right image was may "best" image of Comet Lemmon. This was taken on the evening of October 25.



Camper Douglas Harris took the picture on the left with me holding a mirror and Don holding a piece of paper to demonstrate a pinhole image of the Sun. On the right, Campers Elida and Matthew Killian hold up the Earth-Moon scale model.



Astronomy in the News

Comet Updates:

I will eventually, I hope, show images of Comet Swan and Comet Lemmon from Mt. Lemmon. Comet 3I/ATLAS is now on the far side of the Sun. The image on the right was taken by the GOES-19 weather satellite, with the comet visible in the inset (on October 18). 3I/ATLAS brightened just before its closest distance to the Sun on October 29/30.

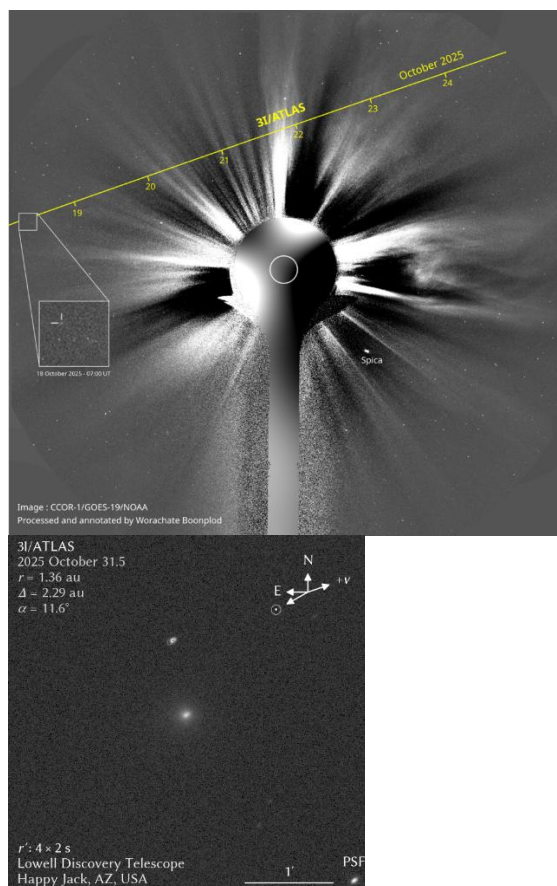
<https://www.livescience.com/space/comets/nasa-spacecraft-reveal-interstellar-comet-3i-atlas-brightened-rapidly-as-it-swooped-behind-the-sun>

<https://earthsky.org/space/new-interstellar-object-candidate-heading-toward-the-sun-a11p13z/>

<https://skyandtelescope.org/astronomy-blogs/explore-night-bob-king/all-eyes-on-interstellar-comet-3i-atlas/>

This was just published, the first image of the comet after it came out from behind the Sun. This was taken by a telescope in Flagstaff, AZ. “Comet 3I/ATLAS is the bright white dot in the center of the image, while the dot above it is a star that appears distorted because of the comet’s motion. (Image credit: Qicheng Zhang/Lowell Observatory)”

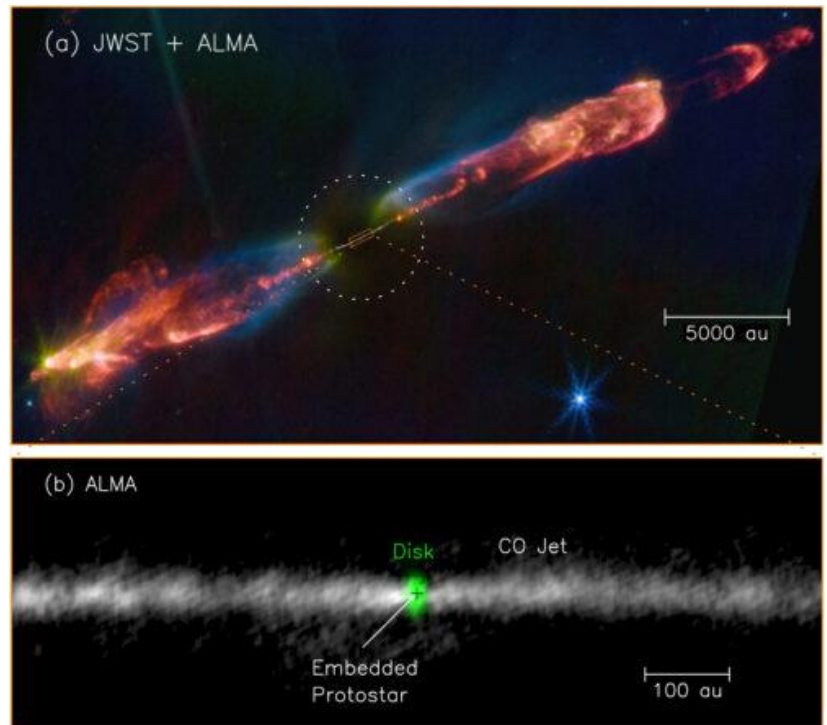
<https://www.livescience.com/space/comets/astronomer-reveals-first-look-at-comet-3i-atlas-as-it-reappears-from-behind-the-sun>



JWST, A Star is Born:

HH 211 is a protostar (about 1,000 light-years away) with a protoplanetary accretion disk with protostellar jets that are created close to the young star. For the first time, astronomers have combined ALMA millimeter observations with JWST infrared observations to be able to see close to the star where the jets originate. The astronomers conclude that the jets are formed only about 0.02 AU from the surface of the star which confirms models that predict that the jets are created by the interaction of the accretion disk with the young star's magnetic field.

<https://www.livescience.com/space/astronomy/alma-and-jwst-solve-major-star-formation-mystery-space-photo-of-the-week>



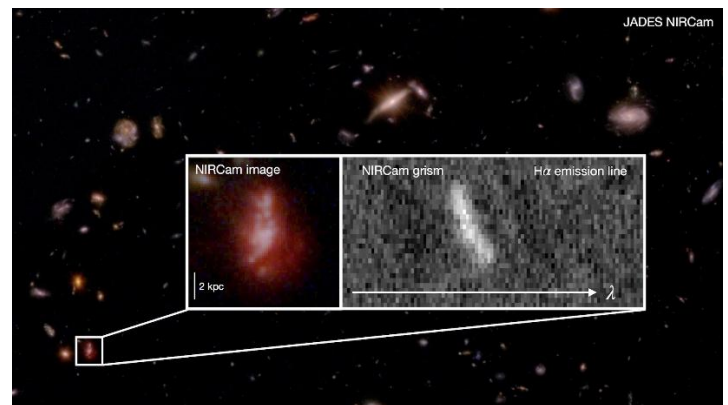
The dual JWST/ALMA image of the system (top) compared to ALMA's observations of the young protostar at the system's center (bottom). (Image credit: Lee et al.)

JWST, Early Chaotic Galaxies:

Astronomers using JWST studied 250 galaxies in the early Universe, from 800 million to 1.5 billion years after the Big Bang. They found that these galaxies were going through a turbulent phase and not like the settled down galaxy shapes that we see today. These galaxies contained a lot of gas which created rapid star formation and kept the galaxies from forming the stable shapes we see such as spiral and elliptical galaxies.

<https://www.livescience.com/space/astronomy/james-webb-telescope-finds-that-galaxies-in-the-early-universe-were-much-more-chaotic-than-we-thought>

<https://www.space.com/astronomy/galaxies/our-universes-oldest-galaxies-were-hot-messes>

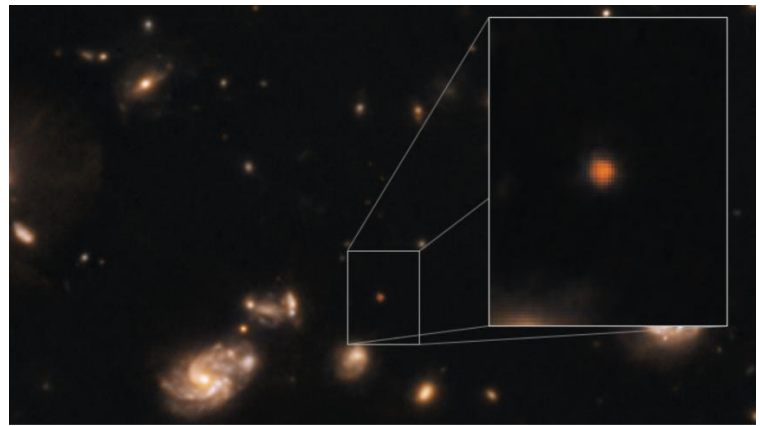


“When the James Webb Space Telescope examined young galaxies with its Near Infrared Camera (NIRCам), it uncovered the messy early stages of formation in these distant objects. (Image credit: NASA, ESA, CSA, STScI, B. Robertson (UC Santa Cruz), B. Johnson (CfA), S. Tacchella (Cambridge), P. Cargile (CfA))”

JWST, Earliest Galaxy:

I was not sure that I would post this article as the paper has not been peer reviewed and reviewers may ultimately question some of the conclusions of the paper. Astronomers used both NIRCam and NIRSpec to study what the authors have named Capotauro. The object shows up only in the longest wavelength NIRCam filters, which would imply, if it were a galaxy, that it was being observed only 100 million years after the Big Bang (200 million years older than the previous record). Unfortunately, there is an alternate explanation, a failed star, a brown dwarf, that is too cold to be seen at the shortest NIRCam wavelengths and is at a distance of at least 7,000 light-years (not 7 as stated in the linked article below). It will be interesting to see, if published, how the conclusions of the authors are modified by the manuscript reviewers.

<https://www.livescience.com/space/cosmology/puzzling-object-discovered-by-james-webb-telescope-may-be-the-earliest-known-galaxy-in-the-universe>



“Capotauro is located near the tail of the Big Dipper constellation. (Image credit: Image processing: Giuseppe Capriotti & Giovanni Gandolfi. Data: NASA / ESA / CSA / JWST / CEERS collaboration.)”

November Night Sky

Sky Stories, Faith and Astronomy—Star-Mapping Nuns:

Br. Guy Consolmagno made our Asteroid Lunch group aware of an article that had been written last year by Bob Trembly for Sacred Space Astronomy (where I occasionally write articles. My friend, Carmen, kindly wrote up a shortened version of the article. So, this is a story about space, not a space story! Larry’s comment, this is not much different than how women were treated in the book and movie, “Hidden Figures.”

Between 27 September 2011 and 13 November 2012 astronomers Richard P. Boyle and Kazimieras Cernis, working from the Vatican Advanced Technology Telescope in Mount Graham, Arizona, discovered a series of asteroids a few of which they named Panceri, Colombo, Concettafinardi, and Ponzoni.



The asteroids were named in honor of four Italian nuns, from the Sisters of the Child Mary. Between the years 1909 and 1919 they catalogued nearly half a million stars from photographic plates.

Their extraordinary contribution was made possible by an initiative launched in 1887 when 56 scientists from 19 countries met in Paris to approach a new discipline, “astrophotography”.

Their project used 22,000 photographic plates to map the entire sky (Carte du Ciel). The work was distributed among institutions from Europe and the United States, including the Vatican Observatory. One of each was assigned a particular zone of the sky to map and categorize. The Vatican Observatory took responsibility for areas in the constellations of Cassiopeia, Cepheus, Draco, and a vast area of the Milky Way.

At the time, male astronomers often relied on women to act as their “computers.” The men would lead the project, but behind the scenes women carried out the intensive processing, cataloguing, and calculating for low wages. As is well-known, Harvard Observatory director Edward Charles Pickering hired “Pickering’s harem,” a group of bright young women who did his share of the star cataloguing. Also known as “the Harvard Computers,” these women who were formidable astronomical minds in their own right, were just recently recognized for their contribution to science.

Coming back to our nuns (Sisters Emilia Ponzoni, Regina Colombo, Concetta Finardi, and Luigia Panceri), they were recruited by the Vatican to measure and map stars from the plate-glass photographs. They catalogued the brightness and location of 481,215 stars during their years of devoted work.

Although some pictures of the nuns appeared in material about the history of astronomy, neither were their names known nor their accomplishments recognized until now [last year, when the original article was written]. Father Sabino Maffeo, a Jesuit Priest at the Vatican Observatory, found their names while organizing papers for the archives.

The global endeavor they contributed to was, at the time, one of the largest scientific undertakings in history which unfortunately time forgot.

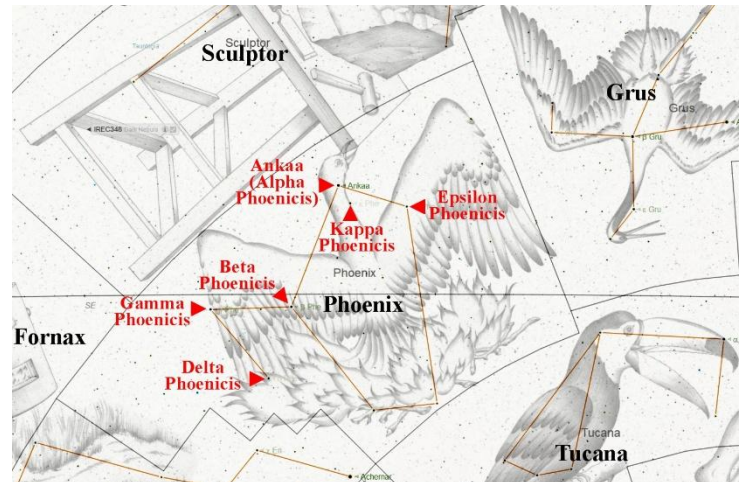
The project resulted in the *Astrographic Catalogue*, a 254-volume catalog of 4.6 million stars. The star atlas, also called *Carte du Ciel*, was only half-way finished when it was stopped in 1962. However, despite the failure of the Atlas, the catalogue turned into the basis of a system of star references still in use today. The Vatican Observatory has recently completed a project to digitize its old glass plates from the “*Carte du Ciel*” survey.

In 1889, following the Vatican Observatory joining the *Carte du Ciel* project, its authorities approached the Reverend Mother Superior of the Congregation of the Child Mary to find out the possibility of counting on some nuns to contribute to the research. At first the Reverend Mother was reluctant to this idea which would distance the sisters from their commitment to charity work. On second thought and understanding the value of the endeavor, the Superior accepted the release of the sisters, stating that in their free time from the astronomical commitment they would teach the Christian Doctrine to the girls of the community. Her sound example of faith and science allowed the nuns to make their extraordinary contribution.

Featured Constellation: Phoenix

Our featured constellation this month is Phoenix (the Phoenix). The Starry Night image on the right shows the usual stick figure. I have included illustrations of this constellation and a few surrounding ones. I have removed the horizon so that you can see the constellations that are below my horizon (and anyone farther north). The black line above the word Phoenix is my true horizon. About half the stars in Phoenix are above my horizon, if it were perfectly flat, which it is not. “Phoenix was the largest of the 12 constellations established by Petrus Plancius from the observations of Pieter Dirkszoon Keyser and Frederick de Houtman.” The first appearance of this constellation in a celestial atlas was in Johann Bayer’s *Uranometria*, published in 1603.

Phoenix has one star between magnitudes 2.0 and 2.99, six stars between magnitudes 3.0 and 3.99, and an additional eight stars between magnitudes 4.00 and 4.99. Phoenix has 36 known (both confirmed and candidate) exoplanets orbiting 31 stars.



Looking South-Southeast at about 7:30 p.m. (Standard Time) on October 15 (without horizon)

The brightest star in Phoenix is Ankaa (Alpha Phoenicis) at magnitude 2.38. The second brightest star in Phoenix is Beta Phoenicis at magnitude 3.30.

Ankaa (the Phoenix) is a K0.5 III (orange) giant star that has evolved off the Main Sequence. Ankaa has a surface temperature (visible surface) of 4,700 K. It is about 80 times as luminous as the Sun with a mass that is about 2.8 times that of the Sun and a diameter that is about 15 times that of the Sun. Beta Ankaa is about 85 light-years from us. I have not seen an estimated age for Ankaa. Ankaa is a spectroscopic binary. The secondary star orbits at an average distance of 7 AU with a period of 10.5 years.

Beta Phoenicis is a binary star system with two widely separated components about an arcsecond apart, Beta Phoenicis A and Beta Phoenicis B. They are essentially twins. A and B are G8 III (yellow) giant stars that have evolved off the Main Sequence. A and B have surface temperatures (visible surfaces) of 4,950 K. They are about 100 times as luminous as the Sun with masses that are about 2.7 to 3 times that of the Sun and diameters that are about 14 times that of the Sun. Phoenicis A and Beta Phoenicis B are about 190 light-years from us. The binary pair orbit each other at a distance of about 17 AU with a period of 170.7 years. A and B have an estimated age of about 800 million years.

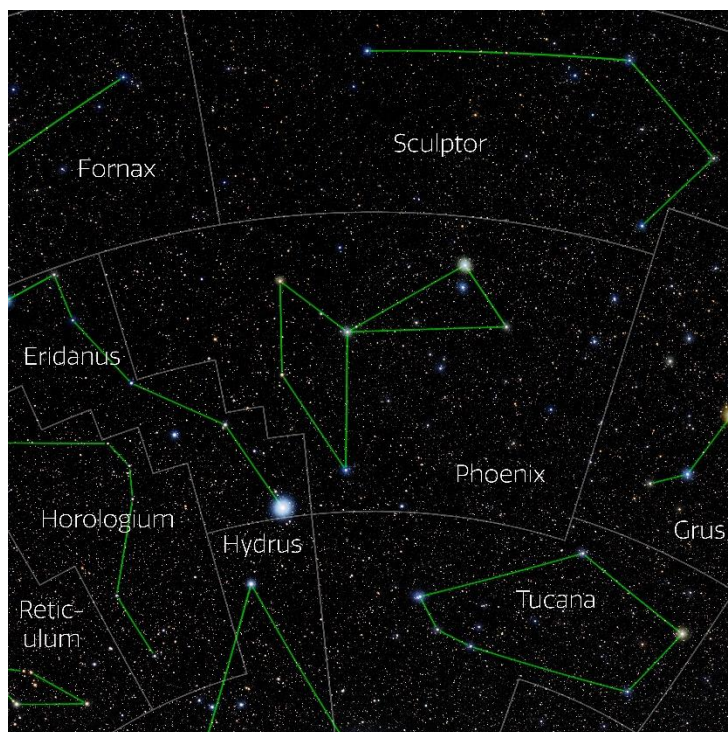


Photo of the constellation Phoenix with annotations from the IAU and Sky & Telescope. Credit: E. Slawik/NOIRLab/NSF/AURA/M. Zamani

Telescope, Binocular, and Camera Targets:

With a small telescope, you will be able to see Saturn, its rings, and Titan. Neptune is less than 4 degrees from Saturn and is about a half magnitude brighter than Titan. Saturn is visible until after midnight. Jupiter and its four Galilean moons are becoming evening objects, rising around 8:30 pm by the end of the month. However, before Jupiter rises in Gemini, you should be able to see the Pleiades, Orion, the Orion Nebula, and Sirius rising in the east. Venus is visible before sunrise in the east, but it is rising later and later (closer to sunrise).

Moon and Planets:

First Quarter Moon was on October 29. November's Full Moon, the Beaver Moon, is on November 5. Last Quarter Moon is on November 11. The next New Moon is on November 19. The First Quarter Moon is on November 27. This month's New Moon is a "Micro New Moon," and the Full Moon is a "Super Full Moon." These are actually the farthest that the Moon gets from the Earth all year as well as the closest, respectively.

From Timeanddate.com:

"The Full Moon in November is named after beavers. It can also be the **Hunter's** Moon, if it follows the Harvest Moon, or Mourning Moon, depending on the December solstice."

"Busy Beavers in the Moonlight"

According to some sources, the Full Moon for November is named after beavers because, at this time, they become particularly active in building their winter dams in preparation for the cold season. The beaver is mainly nocturnal, so they work under the light of the Full Moon.

"Native American names for the November Full Moon are Frost Moon, Freezing Moon, Trading Moon, and Snow Moon, although the latter is more common for the February Full Moon. Oak Moon can be either the Full Moon in November or December, depending on which source you use.

“Hunter’s Moon Some Years

The Hunter’s Moon follows the Harvest Moon. Every three years or so, the Harvest Moon falls in October, which makes November’s Full Moon the Hunter’s Moon.

“This happens in 2025. The closest Full Moon to the September equinox (on September 22) was on October 7: This was the Harvest Moon. The following Full Moon is November 5—this becomes the Hunter’s Moon.

“Mourning Moon

In Celtic tradition, the last Full Moon before the December solstice has also been named the Mourning Moon or the Darkest Depths Moon.

“The astronomical seasons do not match up with the lunar months. Therefore, the month of the Mourning Moon in the Northern Hemisphere varies. In some years, the Mourning Moon is in November, while in others, it is in December.”

<https://www.timeanddate.com/astronomy/moon/harvest.html>

From Space.com:

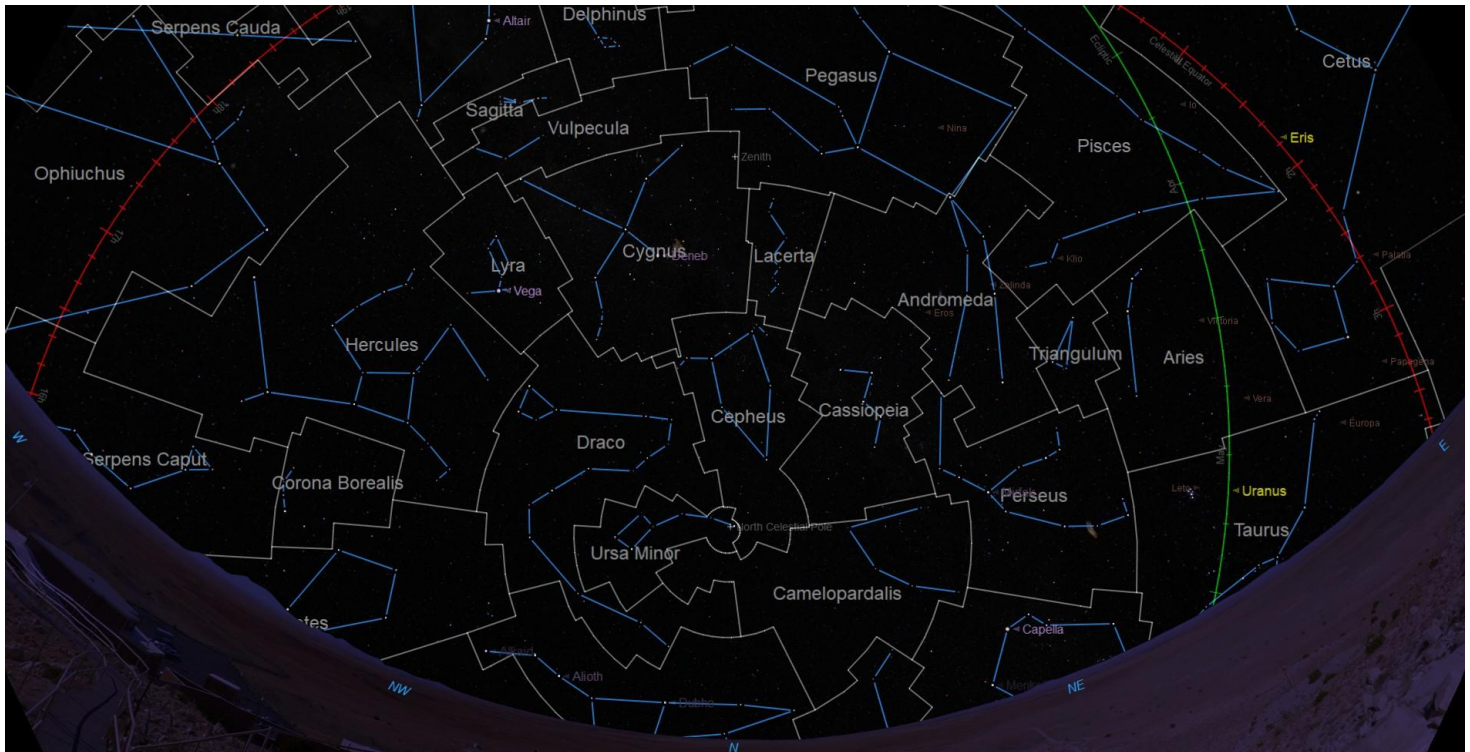
Some accounts suggest the name **Beaver Moon** came from the fact that this moon signaled it was time to set beaver traps before the swamps froze to ensure a supply of warm winter furs! Another interpretation suggests that the name Beaver Full Moon comes from the fact that the beavers are now active in their preparation for winter. Also called the Frost Moon (Cree, Assiniboine), Freezing Moon (Anishinaabe), Digging/Scratching Moon (Tlingit) according to the Farmer's Almanac.”

The Moon is at apogee (406,691 km [252,706 miles] from the Earth) on November 19. The Moon will be at perigee (356,834 km [221,726 miles] from Earth) on November 5.

On November 2, the Moon passes 4 degrees north of Saturn at 6:00 a.m. (EST). Six hours later, the Moon passes 3 degrees north of Neptune (seen only with a telescope). On November 6, the Moon passes 5 degrees north of Uranus (seen only with binoculars or a telescope) at noon. On November 10, the Moon passes 4 degrees north of Jupiter at 3:00 a.m. On November 19, the Moon passes 6 degrees south of Venus at 4:00 a.m. (this is less than a day before New Moon). On November 29, the Moon passes 4 degrees north of Saturn at 2:00 p.m. (observe that night) and 7 hours later, the Moon passes 3 degrees north of Neptune at 9:00 p.m.

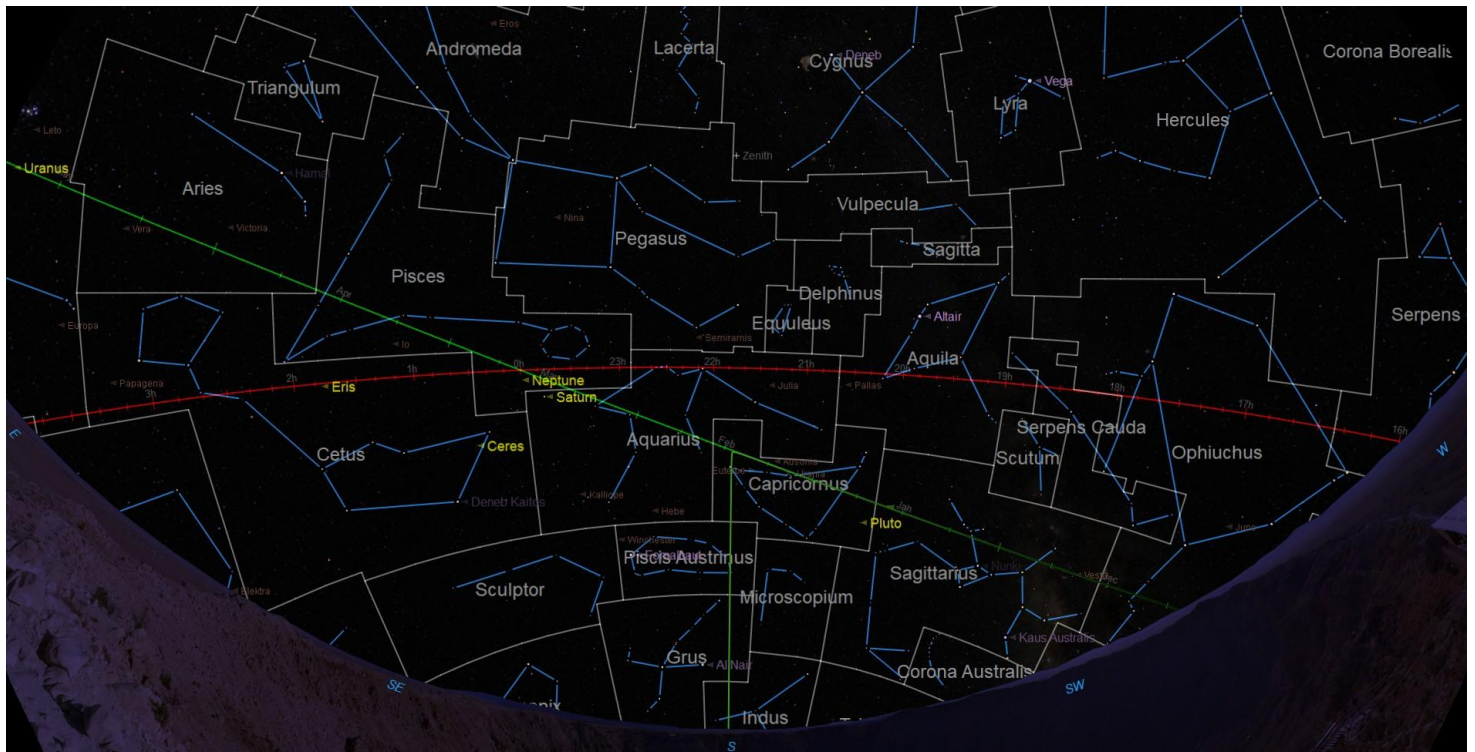
Early Evening Sky Viewing:

All times in this paragraph are for Tucson (Standard Time), so, since the rest of the country is now on Daylight Saving Time, we are now in the same zone as California. Any other differences will be related only to your latitude and location in your time zone. In Tucson, on the evening of November 15, 2025, sunset is at 5:23 p.m. (27 minutes earlier than on October 15), Civil Twilight is at 5:49 p.m. (26 minutes earlier), Nautical Twilight is at 6:18 p.m. (26 minutes earlier), and Astronomical Twilight is at 6:47 p.m. (25 minutes earlier). You may see a few of the brightest stars and planets after Civil Twilight. You start seeing fainter stars and planets by around Nautical Twilight and the sky is darkest by Astronomical Twilight. The length of the day in Tucson is 10 hours and 30 minutes on November 15 (52 minutes shorter than on October 15). **Times will also vary depending on where you are in your time zone and your latitude. In New York, sunset is at 4:37 p.m. on November 15 (106 minutes earlier than on October 15, 60 minutes of which is due to the change from Daily Saving Time to Standard Time). The length of the day in New York is 9 hours 54 minutes on November 15 (71 minutes shorter than on October 15).**



November 15, 2025, looking North at 6:30 p.m. (Standard Time). The + marks the Zenith (overhead). This is half-way between Nautical Twilight and Astronomical Twilight, so the sky is fairly dark. The red line is the celestial equator, the projection of Earth's equator onto the sky and the green line is the ecliptic, the path of the Sun through the sky.

Looking North at about 6:30 p.m. (Standard Time) in mid-November, many of the constellations that were low in the West last month have set or are setting as the constellations and their stars rise earlier/set earlier. The Sun is setting earlier (and rising later), so the nights are getting longer. You will also note that there is a 1.5-hour change in the time of the evening chart that also reflects going from DST to Standard Time. The nights, here in Tucson, are almost three hours longer than they were three months ago in mid-August. Setting in the northwest is Boötes (the Herdsman), setting in the west is Serpens Caput (the Head of the Serpent), and setting in the southwest is Ophiuchus (the Serpent Bearer). Due north is Canis Major (the Great Bear). It will be much more visible for those of you farther north than Tucson. Low in the northwest is Corona Borealis (the Northern Crown) and slightly higher in the sky is Hercules (the Hero). West of Polaris (the North Star) are Ursa Minor (the Lessor Bear) and Draco (the Dragon). Above Draco and just west of north are Lyra (the Lyre), Cygnus (the Swan), Vulpecula (the Little Fox), and Sagitta (the Arrow). East of Polaris are Camelopardalis (the Giraffe), Cepheus (the King), Lacerta (the Lizard), and Pegasus (the Flying Horse). Below Pegasus and east of Cepheus are Cassiopeia (the Queen), Andromeda (the Queen), and Perseus (the Hero). Above Perseus are Triangulum (the Triangle), Aries (the Ram), and Pisces (the Fishes). Just rising in the northeast are Lynx (the Lynx), Auriga (the Charioteer), and Taurus (the Bull), along with Uranus. Cetus (the Sea Monster or Whale) is rising in the southeast.

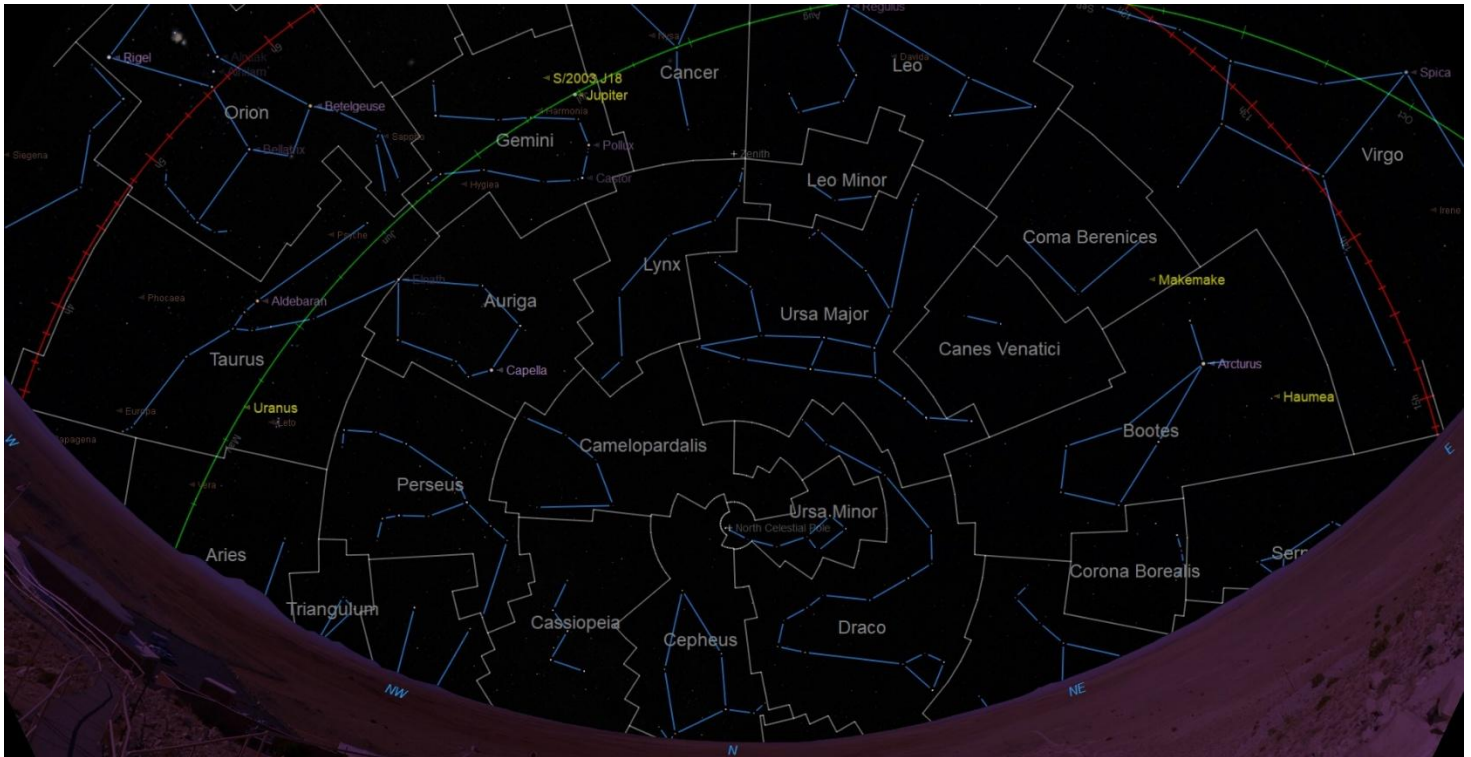


November 15, 2025, looking South at 6:30 p.m. (Standard Time). The + marks the Zenith (overhead).

Describing constellations not discussed above, looking South, at 6:30 p.m., by mid-November, we have lost a few of the constellations that were very low in the south. Low in the southwest and setting are Sagittarius (the Archer) and Corona Australis (the Southern Crown). Indus (the Indian) is setting low in the south (below the horizon for those in the northern part of the US). In the south and just west of due south are Microscopium (the Microscope) and Capricornus (the Horned Goat). High in the southwest are Scutum (the Shield), Serpens Cauda (the Serpent's Tail), and Aquila (the Eagle). Even though it is November, we can still see the Summer Triangle! East of Aquila are Equuleus (the Little Horse) and Delphinus (the Dolphin). East of due south, starting low in the south, are Grus (the Crane), Piscis Austrinus (the Southern Fish), and Aquarius (the Water Bearer). Saturn is in Aquarius, while Neptune is close by in Pisces. Low in the southeast is Sculptor (the Sculptor). Partially visible in the south-southeast, below Sculptor, is our Featured Constellation, Phoenix (the Phoenix). To the east of Phoenix, along the horizon, Eridanus (the River) is just rising.

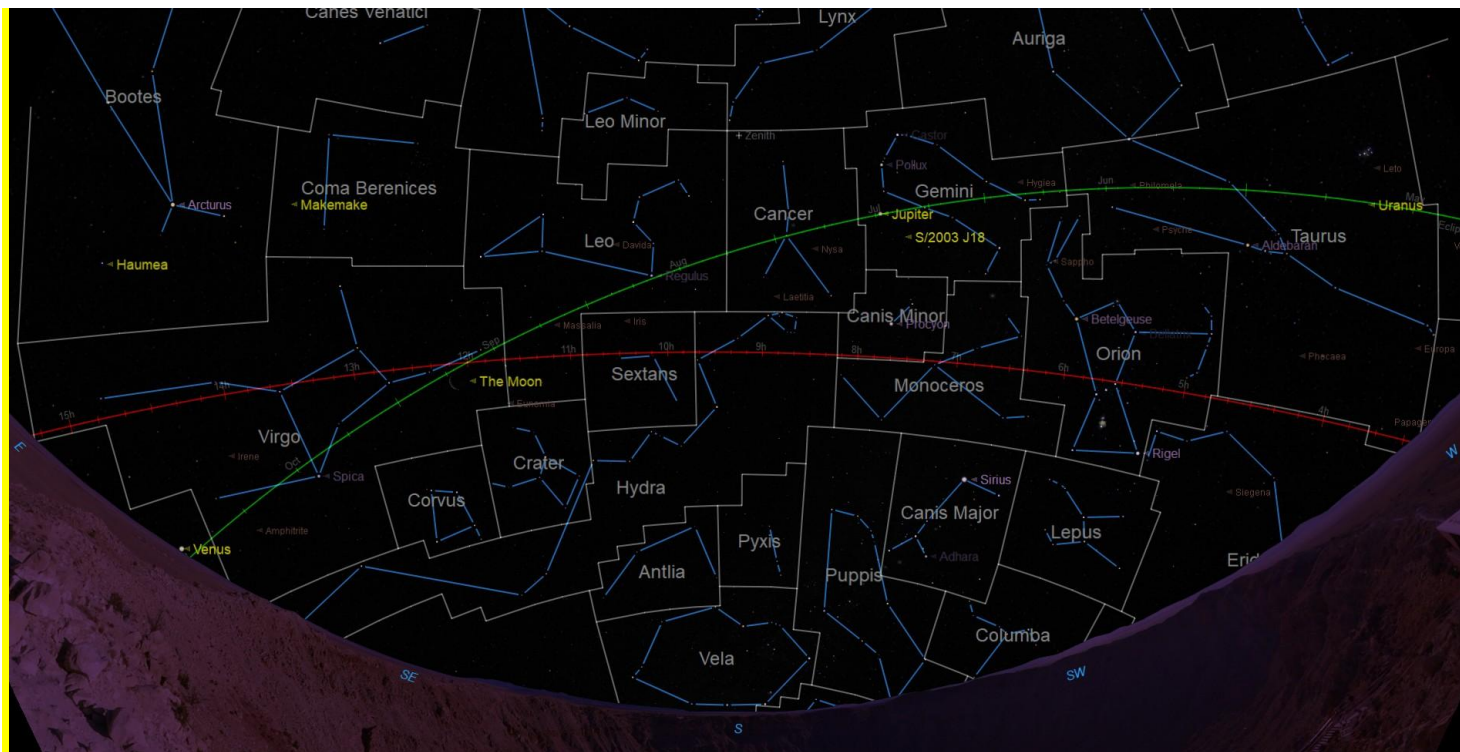
Early Morning Sky Viewing:

All times in this paragraph are for Tucson (Standard Time), so, since the rest of the country is now on Daylight Saving Time, we are now in the same zone as California. Any other differences will be related only to your latitude and location in your time zone. In Tucson, on November 15, in the morning, Astronomical Twilight is at 5:28 a.m. (22 minutes later than on October 15), Nautical Twilight is at 5:57 a.m. (23 minutes later), Civil Twilight is at 6:27 a.m. (24 minutes later), and sunrise is at 6:53 a.m. (26 minutes later). You start losing your fainter stars by around Nautical Twilight and lose all but the very brightest stars and planets before Civil Twilight. Times will also vary depending on where you are in your time zone and your latitude. Times will also vary depending on where you are in your time zone and your latitude. **Times will also vary depending on where you are in your time zone and your latitude. In New York, sunrise is at 7:08 a.m. on November 15 (25 minutes earlier than on October 15, again thanks to the change to Standard Time).**



November 15, 2025, looking North at 6:00 a.m. (Standard Time). The + marks the Zenith (overhead). This is close to Nautical Twilight, so the sky is still fairly dark.

Looking North at 6:00 a.m. (Standard Time) in mid-November, the constellations that are just rising in the evening are the ones that are setting in the west and northwest before dawn. The constellations that are in the east before dawn were evening constellations one or two months ago (if they are not circumpolar). We have “lost” (have already set at this time) a number of morning constellations as the season progresses. Setting in the northwest are Triangulum (the Triangle) and Aries (the Ram). Part of Taurus (the Bull) is low in the west and extends higher in the west, along with Uranus. Cepheus (the King) and Cassiopeia (the Queen) are low in the northwest, but are circumpolar, so may not set for observers in the north. Below Taurus and higher in the west is Auriga (the Charioteer). Below Auriga are Perseus (the Hero) and Camelopardalis (the Giraffe). Above Taurus and Auriga are Orion (the Hunter, upside down) and Gemini (the Twins), along with Jupiter. East of Auriga, but still to the west, is Lynx (the Lynx). Above Lynx, and best seen looking south, is Cancer (the Crab). East of Polaris are Ursa Minor (the Little Bear) and Draco (the Dragon). Higher up and just east of due north are Ursa Major (the Great Bear) on his back, Leo Minor (the Lessor Lion), and Leo (the Lion) on his back. East of Ursa Major are Canes Venatici (the Hunting Dogs) and Coma Berenices (Berenice's Hair). Lower in the northeast is Boötes (the Herdsman) and below Boötes is Corona Borealis (the Northern Crown). Virgo (the Maiden) is in the southeast, best seen looking south



November 15 2025 looking South at 6:00 a.m. (Standard Time). The + marks the Zenith (overhead).

Looking South in mid-November at 6:00 a.m., for the constellations that are not mentioned looking North, there are constellations that are low in the south and low on the horizon, so they may not be visible for those in the northern US. Setting low in the south and southwest are Puppis (the Stern), Columba (the Dove), and Eridanus (the River). Above these, but still low in the south and southwest are Lepus (the Hare) and Canis Major (the Greater Dog). Above Lepus, mentioned above, is Orion (the Hunter), now on his feet. Low in the west is Taurus, mentioned above. Higher in the southwest and west are Monoceros (the Unicorn), Canis Minor (the Lessor Dog), and Gemini (and Jupiter), mentioned above. East of Puppis and due south are Vela (the Sails) and Pyxis (the Mariner's Compass). East of these is Antlia (the Pump). East of these and still rising is the long constellation Hydra (the Water Snake). It is 100 degrees long, so it will be rising for months. Along the back of Hydra are Corvus (the Crow), Crater (the Crater), and Sextans (the Sextant). Below Virgo (mentioned above) in Libra (below the horizon), is Venus.

Where are the Planets?

Mercury is moving between us and the Sun while **Mars** are moving toward the far side of the Sun, so they are both low in the west just after sunset. They are about 1.3 degrees apart on November 12 (Mercury south of Mars). Mercury is at inferior conjunction (between us and the Sun) on November 20. Soon after that, it will become a morning object and will pass 1.1 degrees north of Venus on November 24.

Venus continues to be a morning object and visible in the morning sky all month. Venus is at magnitude -3.9 all month. Venus is on the far side of the Sun and moves slightly farther away from us, from 1.6 AU to 1.7 AU as the month progresses. Venus starts out the month in Virgo and passes into Libra on November 13. The waning crescent Moon passes south Venus on November 19.

Mars is still in our evening sky all month but is setting earlier and earlier. Mars sets less than 40 after the Sun by end of November. Mars starts the month in Libra at magnitude 1.5, moves into Scorpius for a few days, and moves into Ophiuchus on November 15. At the end of the month, Mars brightens to magnitude 1.3 by the end of the month. Its distance does not increase by much, but I suspect we are seeing what is called the opposition effect (I have talked about this about when discussing the brightness of the Full Moon).

Jupiter is in Gemini all month. Jupiter starts out the month at magnitude -2.3 and ends the month at magnitude -2.5. The waning crescent Moon passes near Jupiter on November 10. It is becoming an evening object, rising around 8:30 by the end of November

Saturn is an evening object. Saturn is now rising before sunset. In the morning, Saturn does not set until about 1:30 am by the end of November. Saturn starts the month at magnitude 0.9 and fades to magnitude 1.1 by the end of the month. Saturn is in Aquarius all month. The waxing gibbous Moon passes by Saturn on November 2 and again on November 29.

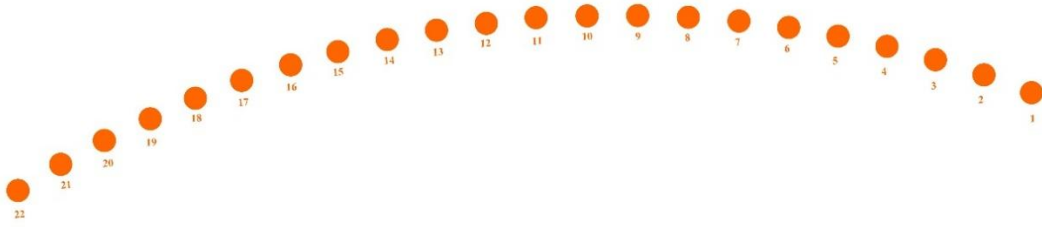
Uranus is in Taurus, about 4 degrees away from the Pleiades, all month. It is at magnitude 5.6 all month. The waning gibbous Moon passes near Uranus on November 6.

Neptune is in Pisces all month. It is still close to Saturn for all of November, less than 4 degrees apart all month. Neptune is at magnitude 7.8 all month. With a telescope, Saturn is a good starting point to find Neptune in the sky. The waxing gibbous Moon passes by Neptune on November 2 and again on November 29.

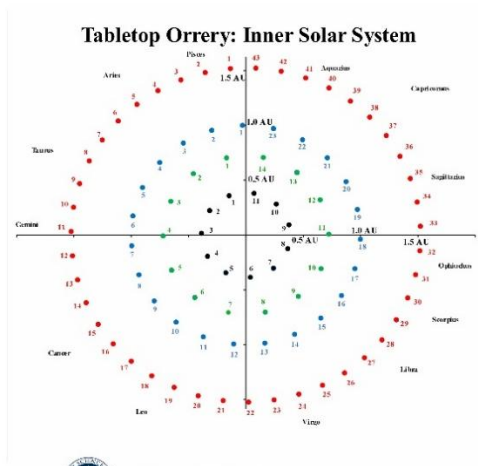
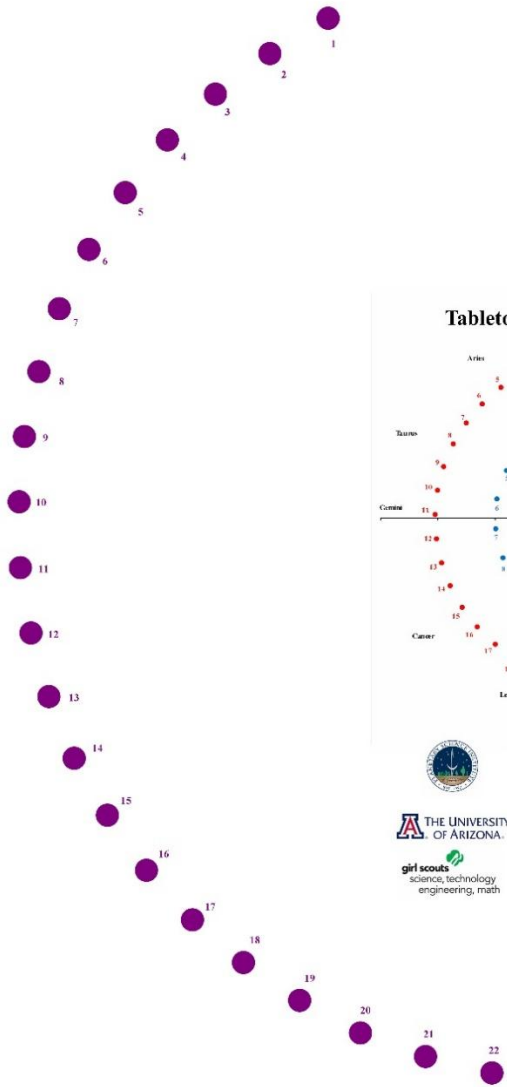
Connecting with the Human Orrery

Using the Orrery, it is easy to model the positions of the planets relative to each other and to the Sun. Because the stars in the constellations are not at their true relative distances (many kilometers away in this model), the positions of the planets relative to the constellations may be “off” by more than a constellation. The first Orrery image below shows the planets out to Saturn. Jupiter and Saturn are at their correct relative distances. When printed out on 8.5 inch by 11 inch paper (standard paper), the scale is about 1.5 cm = 1 AU, the Sun-Earth distance. The second Orrery has circles relevant for November only. I have given the relative positions for November 9, 2025 . Printed out on standard paper gives a scale of 5 cm =1 AU. On the page-sized scale, Jupiter is 26 cm from the Sun’s position and Saturn is 48 cm from the Sun’s position. Because Jupiter and Saturn are “off the page,” the lines from the Earth to Jupiter and Saturn go off the page toward their true relative positions. I should note that the Orrery is not perfect. It uses circular rather than elliptical orbits. For this reason, the relative positions of the planets may be off by a few days.

Using the Orrery, if you are on the Earth, as you (the Earth) rotate in a counterclockwise direction, just after the Sun sets (over your right shoulder as you stand on the Earth), on November 9, first, you will see both **Mercury** and **Mars** very low in the west (if you go out, Mars is lower on the horizon; you are probably seeing the limitations of the Orrery which assumes circular orbits and not the true elliptical orbits that affect the motions of the planets in their orbits around the Sun). If you now look toward your left, a little bit east of south, you can see **Saturn** in the southeast. As you continue to rotate, at midnight, the Sun is at your back and Saturn is in the southwest (toward your right shoulder). In the southeast, toward your left shoulder, you will now see **Jupiter** in the southeast. As you continue to rotate, you will eventually see **Venus** rising in the east (over your left shoulder) a little before the Sun rises This model does not include Uranus and Neptune (or Pluto).



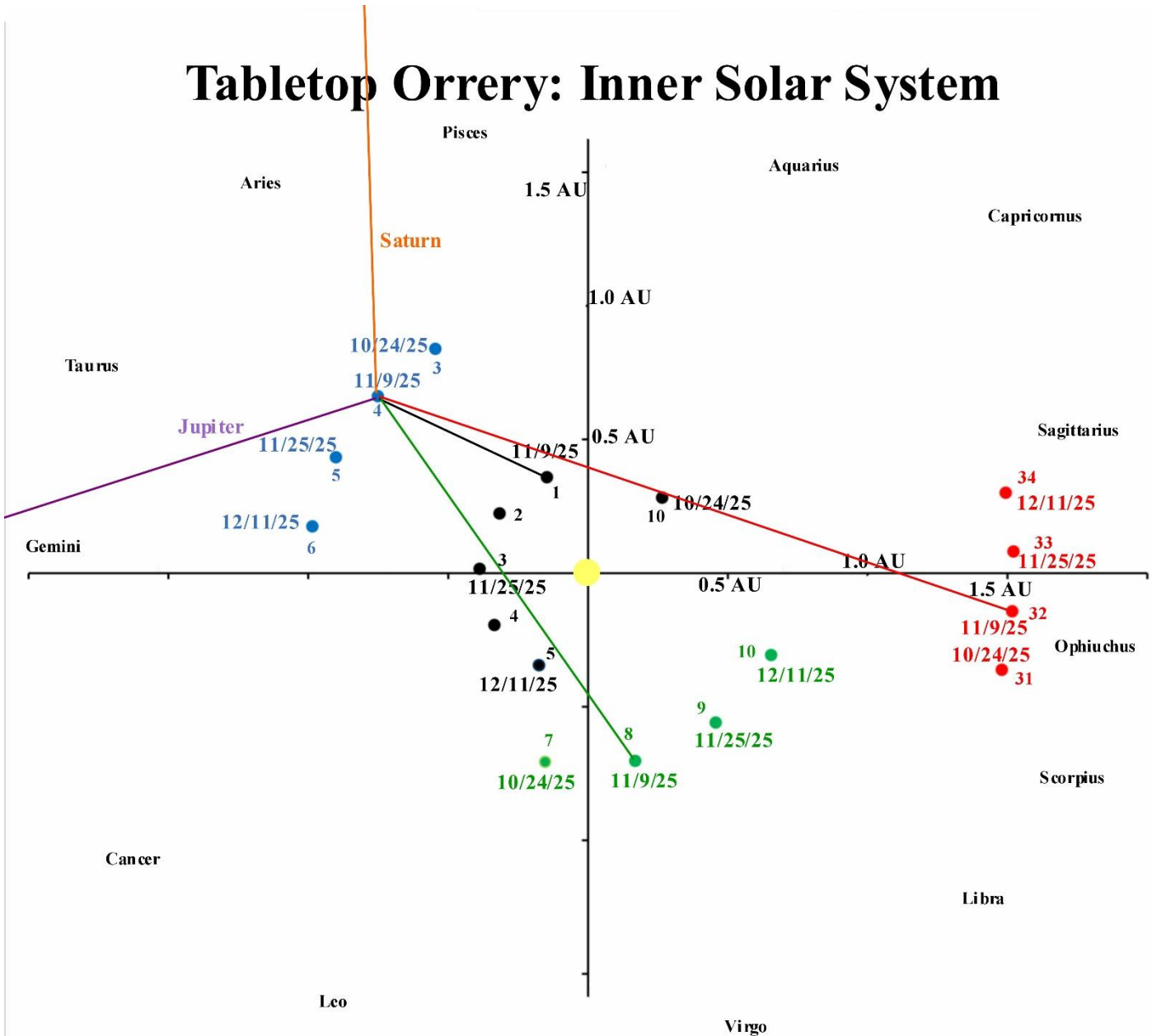
- 1 7/15/23
- 2 10/3/23
- 3 12/22/23
- 4 3/11/24
- 5 5/30/24
- 6 8/18/24
- 7 11/6/24
- 8 1/25/25
- 9 4/15/25
- 10 7/4/25
- 11 9/22/25
- 12 12/11/25
- 13 3/1/26
- 14 5/20/26
- 15 8/8/26
- 16 10/27/26
- 17 1/15/27
- 18 4/5/27
- 19 6/24/27
- 20 9/12/27
- 21 12/1/27
- 22 2/19/28



5 centimeters = 1 AU (Earth-Sun distance)
 Step size: Mercury = 8 days
 Venus, Earth, and Mars = 16 days
 Jupiter and Saturn = 50 days

Mercury: 0.39 AU, orbital period = 88.0 days, 47.4 km/s
 Venus: 0.72 AU, orbital period = 224.7 days, 35.0 km/s
 Earth: 1.00 AU, orbital period = 365.25 days, 29.8 km/s
 Mars: 1.52 AU, orbital period = 687.0 days, 24.1 km/s
 Jupiter: 5.2 AU, orbital period = 11.86 years, 13.1 km/s
 Saturn: 9.6 AU, orbital period 29.46 years, 9.7 km/s

Tabletop Orrery: Inner Solar System



5 centimeters = 1 AU (Earth-Sun distance)

Step size: Mercury = 8 days

Venus, Earth, and Mars = 16 days

Jupiter and Saturn = 80 days

Mercury: 0.39 AU, orbital period = 88.0 days, 47.4 km/s

Venus: 0.72 AU, orbital period = 224.7 days, 35.0 km/s

Earth: 1.00 AU, orbital period = 365.25 days, 29.8 km/s

Mars: 1.52 AU, orbital period = 687.0 days, 24.1 km/s

Jupiter: 5.2 AU, orbital period = 11.86 years, 13.1 km/s

Saturn: 9.6 AU, orbital period 29.46 years, 9.7 km/s

