Education & Public Outreach
September 2025, Part 1

September Special Events: The Autumnal Equinox is on September 22, 2:19 pm EST. In Tucson, the length of the day is 12 hours and 7.6 minutes. As Don has discussed, the day is longer than 12 hours thanks to atmospheric refraction.

I want to give you notice of two upcoming events. The first is international and the second is local.

- International Observe the Moon Night is scheduled for October 4. I have included a link to the site below. You can use the site to find a local event or to register your own event. I just looked up Tucson and found two events, one is downtown, and the other is the event that I am in charge of. The one that I am hosting will be in the parking lot of the Planetary Science Institute (joint PSI and Vatican Observatory).
- The Planetary Science Institute will be having an Open House of October 23, a Thursday. I do not know the details, but I will pass information on to you when I learn more.

Some Pictures:

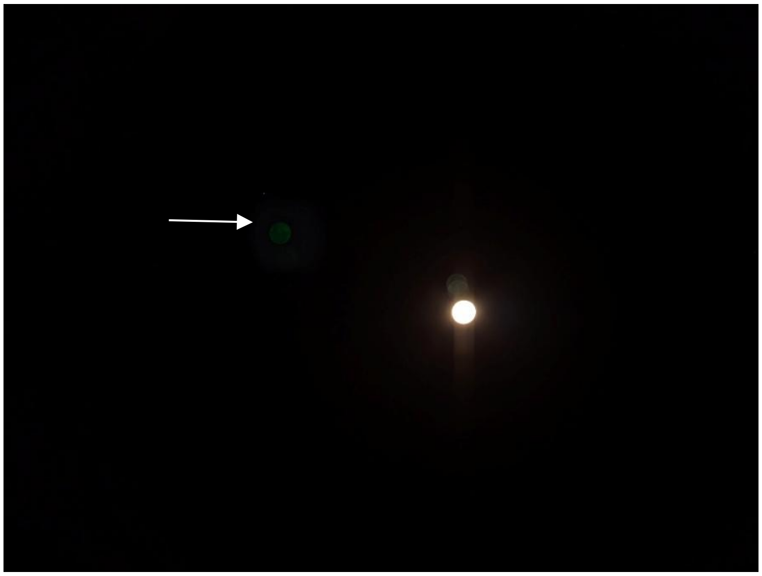
Laurie V. Ansorge provided me with a new picture, taken with her Celestron Origin telescope. Thanks! Our daughter, Miranda, took this Moon picture on Friday night (September 5). This is about as clear as it has been most of the time. On the morning of August 31 (lower right) this is a picture (4x) of Jupiter, Venus, and the beehive cluster, M44, just below and to the left of bight Venus.

Supernova in NGC7331

NGC7331
6/27/2025 1am MT
Celestron Origin; 140 sec.
37.29, -112.15; S=G; T=7/7

NGC7331 – with supernova
8/22/2025 10pm EDT
Celestron Origin; 480 sec.
39.65, -76.99; S=G; T=7/7

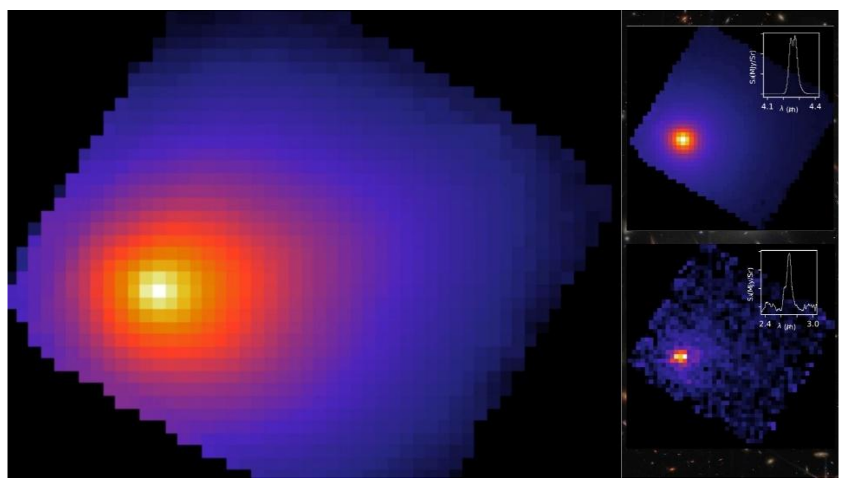
I took several more pictures on the morning of September 8, a little after 3:00. It has finally (almost cleared). These both demonstrate how much a nearly Full Moon (16 hours earlier) affects the night sky. This is about as close to Full Moon as we observe when we are on the VATT. I was limited to a 3 second exposure (a 4x) and you can barely see Saturn (the arrow). Blowing this up, I was just able to convince myself the I could see Neptune at magnitude 7.7. The right image is on the far side of the sky. The Winter Hexagon is rising earlier. In this 2-minute exposure, it is difficult to see even the brightest stars. The brightest "star" in the lower left is Jupiter and in the lower right is Sirius, the brightest star (other than the Sun) in the sky.



Astronomy in the News

NASA, ESA, and Other Missions:

JWST, 3I/ATLAS Update: 8-26-25



The interstellar invaded comet 3I/ATLAS seen by the infrared vision of the JWST. (Image credit: NASA/James Webb Space Telescope)

There is obviously a lot going on about interstellar comet 3I/ATLAS. It is being observed by large telescopes on the ground as well as several space-based telescopes. There is also "news" about the comet being an alien spacecraft, but I really do not want to get involved in that as it takes away from the important science being done. The bottom line is that this is an unusual comet. This should come as no surprise as it has been in interstellar space for perhaps billion of years and likely comes from a region of the Milky Way that is populated by stars that are as much as 3 billion years older than the Sun, which implies they are likely to be less metal-rich. Below are some of the most recent discoveries. I will note that, in most cases, the information comes from Press Releases for submitted papers, that still have to go through peer review.

- JWST has imaged the comet. The first two links below summarize the soon to be published results from NIRSpec. Astronomers have identified carbon dioxide, water, carbon monoxide, and other ices and gases. What was unexpected was that the carbon dioxide to water ratio was much higher than any previously observed comet. This could be related to the comets long exposure to cosmic rays. It is also possible that the comet formed in a carbon dioxide-rich region of its parent star. In addition the astronomers have been able to place a smaller upper limit to the diameter of the nucleus of the comet, 5.5 kilometers (3.5 miles).

- The comet has also shown high levels of nickel in the coma relative to iron. This has yet to be explained.
- Prediscovery observations by TESS have shown that the coma had an active coma farther out, at least out to 6 AU, consistent with the large amount of carbon dioxide. Additional HST observations put a slightly lower upper limit for the size of the nucleus.
- Previous observations had shown that the comet had a forward-expanding coma, implying that ices were sublimating only from the Sun-light side of the comet. More recent observations by ground-based Gemini telescope in Chile have final shown clear evidence of a more normal tail finally developing.

https://www.space.com/astronomy/james-webb-space-telescope-takes-1st-look-at-interstellar-comet-3i-atlas-with-unexpected-results

https://www.livescience.com/space/comets/james-webb-telescope-images-reveal-theres-something-strange-with-interstellar-comet-3i-atlas

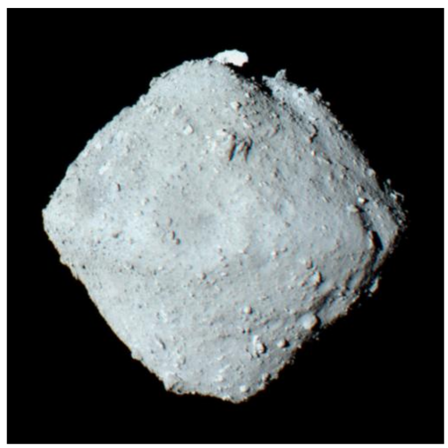
https://www.space.com/astronomy/interstellar-invader-comet-3i-atlas-could-be-investigated-by-these-spacecraft-as-it-races-past-the-sun-this-could-be-literally-a-once-in-a-lifetime-opportunity

https://www.sciencealert.com/4-powerful-telescopes-agree-interstellar-comet-3i-atlas-really-is-bizarre

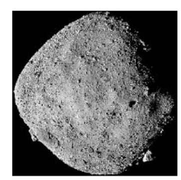
https://www.sciencealert.com/images-show-interstellar-object-3i-atlas-is-now-growing-a-tail

JWST, Bennu and Ryugu:

Meteoriticists continue to study material returned from asteroids 162173 Ryugu and 101955 Bennu. Three papers have been published which show that the parent body of 101955 Bennu has been aqueously (liquid water) altered to form clay minerals. This implies that the parent body contained ice that was mildly heated to alter the silicate minerals. However, Bennu still contains pre-solar grains, material from other stars. While not mentioned in the articles, it is thought that the collapse of the proto-Solar System nebula started to gravitational collapse after a supernova shock wave passed through the nebula. One theory is that both Ryugu and Bennu came from the parent body of what is now the Polana asteroid, family. The family is named after its largest member 142 Polana. The research reported here compares new JWST spectral measurements of Polana and compares the spectra to that of Ryugu and Bennu. They look similar, implying a possible common origin. Because the family is fairly spread out, it is thought that the impact that formed is occurred more than 2 billion years ago.



162173 Ryugu, Near-Earth Asteroid
Mean Diameter = 0.90 km
(1.00 km x 0.88 km)



101955 Bennu, Near-Earth Asteroid
Mean Diameter = 0.49 km
(0.56 km x 0.53 km x 0.51 km)

https://earthsky.org/space/asteroid-bennu-samples-reveal-dramatic-solar-system-past

https://www.livescience.com/space/james-webb-telescope-reveals-that-asteroids-bennu-and-ryugu-may-be-parts-of-the-same-gigantic-space-rock

https://www.universetoday.com/articles/its-official-asteroids-ryugu-and-bennu-are-siblings

September Night Sky

Sky Stories:

Chakana, the Andean Cross:

I thought that I had a picture of a Chakana in Peru, but I could not find one. Here is a 4,000-year-old one from Wikipedia.

By User5790 - Own work, CC0, https://commons.wikimedia.org/w/index.php?curid=140747757

My close (well she lives in Uruguay) has kindly written up the Sky Story for this Newsletter. It discusses the Chakana, the Andean Cross, which is related to the stars of what we call Crux, the Southern Cross. I wrote about the Crux in May. I hope that this will be the first in a series of articles about ancient cultures in North and South America.

During various sessions of Asteroid Lunch, convened by my dear friend Larry Lebofsky, we exchanged information and views about the observation of the skies and its representation by ancient cultures in North and South America.

I consider this a fascinating subject and hope that with all the accumulated knowledge and interest in research thereon by so many people, we could establish a sort of permanent session, incorporating ancient cultures from other continents.

There is so much to share about the ancient inhabitants of South America and their relationship with the sky, the land, and the water that it is difficult to pick a suitable start.

A great many of the legends and mythology deal with the observation of stars and forecasting of rains and floods, but since it is a wide subject connected also with the Great Flood and the Noah's Ark story in the Bible, I will leave it for my next contribution.

Let me now talk about the relationship of indigenous peoples, mainly of the Andean cultures , with the constellation of the Southern Cross so significant to the Southern Hemisphere.

The stars played a relevant role in the Andean mythology. They were considered to be deities, ancestors as divine beings, or protective spirits. Each star, constellation, and the Milky Way itself were full of symbolic and mythical meanings that were transmitted through sacred chants, histories, and ceremonies.

The ancient peoples of the Andes believed that the stars had a direct influence on the everyday life of people and that their movements and configurations affected the weather, the crops, the health, and the destiny of individuals. Thus, the agricultural practices, the thanksgiving rituals, and the various annual celebrations were closely related to the observation and understanding of the celestial bodies.

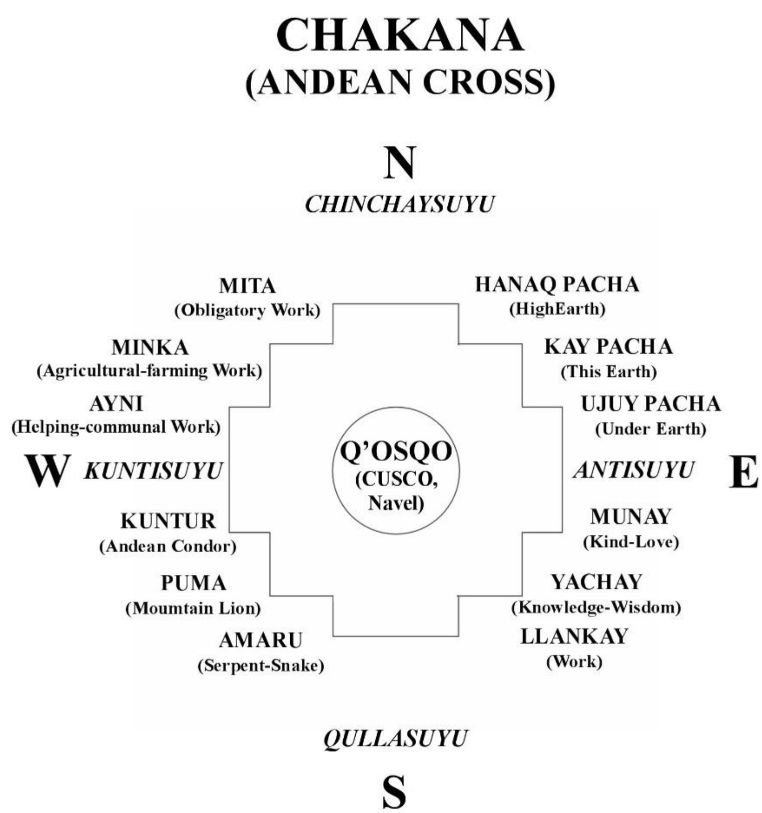
The Southern Cross, known as "Chakana" in the Andean cultures (basically Bolivia and Peru), has a deep origin and meaning in the cosmovision of the Andes. The Southern Cross, and its vicinity in the sky, represent the three regions of the Andean world: the Hanan Pacha (the upper world embodied by the Southern Cross); the Kay Pacha (the world of the Earth represented by the constellation of the Llama), and the Uku Pacha (the underworld represented by the constellation of the Snake).

The Chakana is considered to be a symbol of balance, harmony, and a connection between the different cosmic worlds.

For the Andean Cultures, the Southern Cross is considered to be a spiritual guide and a reference point for agriculture, religion, and social organization. Its presence in the night sky was essential for determining the cycles of sowing and harvesting as well as for the dating of sacred celebrations and rituals.

The importance of the Southern Cross in the Andean Cultures is reflected in their architecture, art, and traditions, being a fundamental connection between the divine and the human.

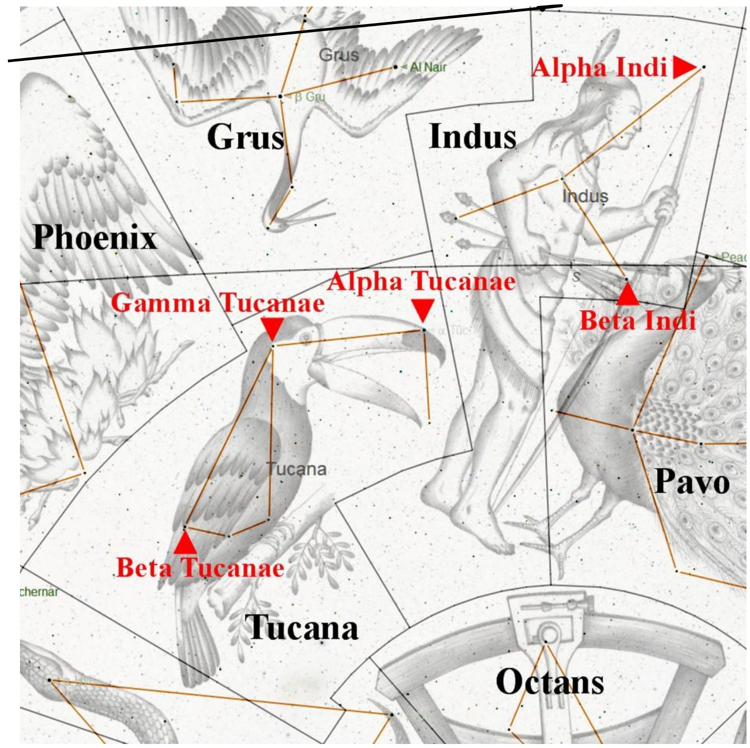
This was just an initial glimpse to be developed further, but the next article will be devoted to other traditions and legends of indigenous populations in Latin America.



Nancy bought a necklace in Cusco. Here is a picture of it. On our trip to Machu Picchu, our tour guide pointed out a Chakana and gave us copies. I have recreated the handout above, with the cardinal directions and the other steps as described in Carmen's article. I have used the original Quechua spellings, not the Spanish versions.

Featured Constellations: Indus and Tucana

Our featured constellations this month are Indus and Tucana. The Starry Night image on the right shows the usual stick figures. I have included illustrations of these constellations 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 below the word Phoenix is my true horizon. However, I am not sure how much I can see of Indus as the stars are faint. I did write briefly about Indus back in 2020, but that was before I was showing images of the constellations. As I mentioned a few months ago, Indus (the Indian) and Tucana (the Toucan) were first depicted by Petrus Plancius in 1598. Indus has two stars between magnitudes 3.0 and 3.99, and an additional five stars between magnitudes 4.00 and 4.99. Tucana has one star between magnitudes 2.00 and 2.99, one star between magnitudes 3.00 and 3.99, and an additional seven stars between magnitudes 4.00 and 4.99. Indus has 13 known (both confirmed and candidate) exoplanets orbiting 13 stars. Tucana has 25 known exoplanets orbiting 23 stars.

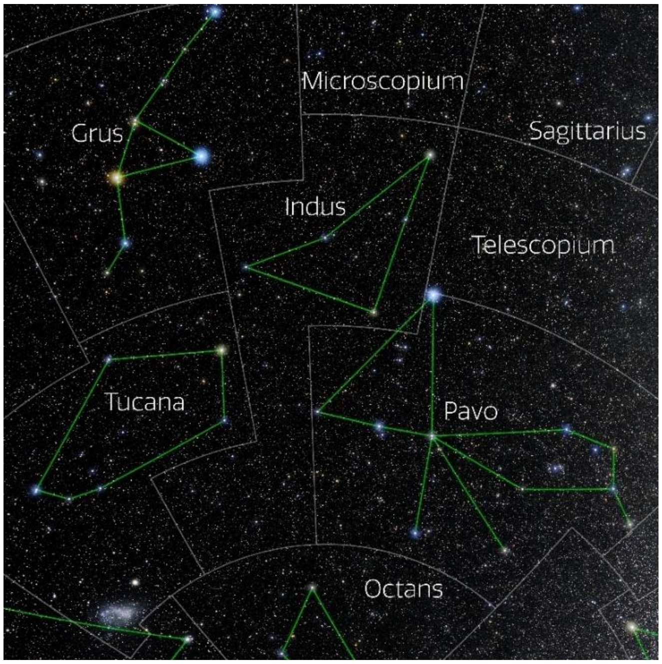


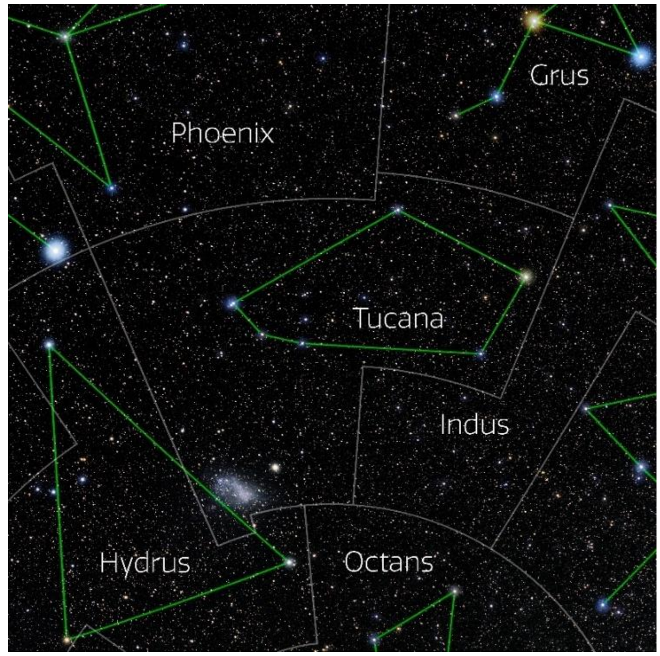
Looking South at about 11:00 p.m. (DST) on September 15 (without horizon)

The brightest star in Indus is Alpha Indi at magnitude 3.22. The brightest star in Octans is Alpha Tucanae (Lang-Exster) at magnitude 2.86. "Lang" is Malay and Indonesian meaning hornbill and "Exster" is Dutch meaning hornbill. Both names were historically used for the constellation.

Alpha Indi is a K0 III-IV (orange) "red clump" star (half-way between a subgiant and giant) that has evolved off the Main Sequence. Alpha Indi has a surface temperature (visible surface) of 4,900 K. It is about 50 times as luminous as the Sun with a mass that is about 2.2 times that of the Sun and a diameter that is about 10 times that of the Sun. Alpha Indi is about 100 light-years from us. It is estimated to be about 1.6 billion years old. Alpha Indi may have two M-type companions that are at least 1,000 AU from the primary. Lang-Exster is a K3 III (orange) giant that has evolved off the Main Sequence, having fused all the hydrogen in its core. Lang-Exster has a surface temperature (visible surface) of 4,300 K. It is about 420 times as luminous as the Sun with a mass that is about 2.5 to 3 times that of the Sun and a diameter that is about 37 times that of the Sun. Lang-Exster is about 180 light-years from us. I have not been able to find an age for Lang-Exster. Lang-Exster is a spectroscopic binary. The secondary star has an orbital period of 11.5 years.

Below: Photos of the constellations Indus and Tucana with annotations from the IAU and Sky & Telescope. Credit: E. Slawik/ NOIRLab/NSF/AURA/M. Zamani





Telescope, Binocular, and Camera Targets:
Mars is still visible in the evening sky, though it is getting fainter and setting earlier. Saturn is now an evening object, rising around 9:00 p.m. DST at the beginning of September and earlier throughout the month. With a small telescope, you will be able to see Saturn, its rings and Titan. Neptune is around 2 degrees from Saturn and is about a half magnitude brighter than Titan. If you get up before sunrise, you will get to see Saturn in the southwest. Jupiter and Venus are visible before sunrise in the west. But as Jupiter gets higher throughout the month, Venus is getting lower and lower. On the morning of September 19, Venus, the thin crescent Moon and the star Regulus are only about 1.5 degrees apart.

Moon and Planets:
First Quarter Moon was on August 30/31. September's Full Moon, the Full Corn Moon, was on September 7. Last Quarter Moon is on September 14. The next New Moon is on September 21. The First Quarter Moon is on September 29. A term that seems to be in the news a lot this month is the black moon. September 21 is a Black Moon. I went many decades (do not ask) without knowing this term. Here is what Wikipedia says: "**Black Moon** is a term first recorded in 2016. It is not a term used in astronomy. No single, universally accepted definition exists. Among the meanings ascribed to it are these: a second New Moon that appears in the same month; the third new moon in an astronomical season with four new moons [the one that is presently being used]; the absence of a New Moon in February; or the absence of a full moon in February."

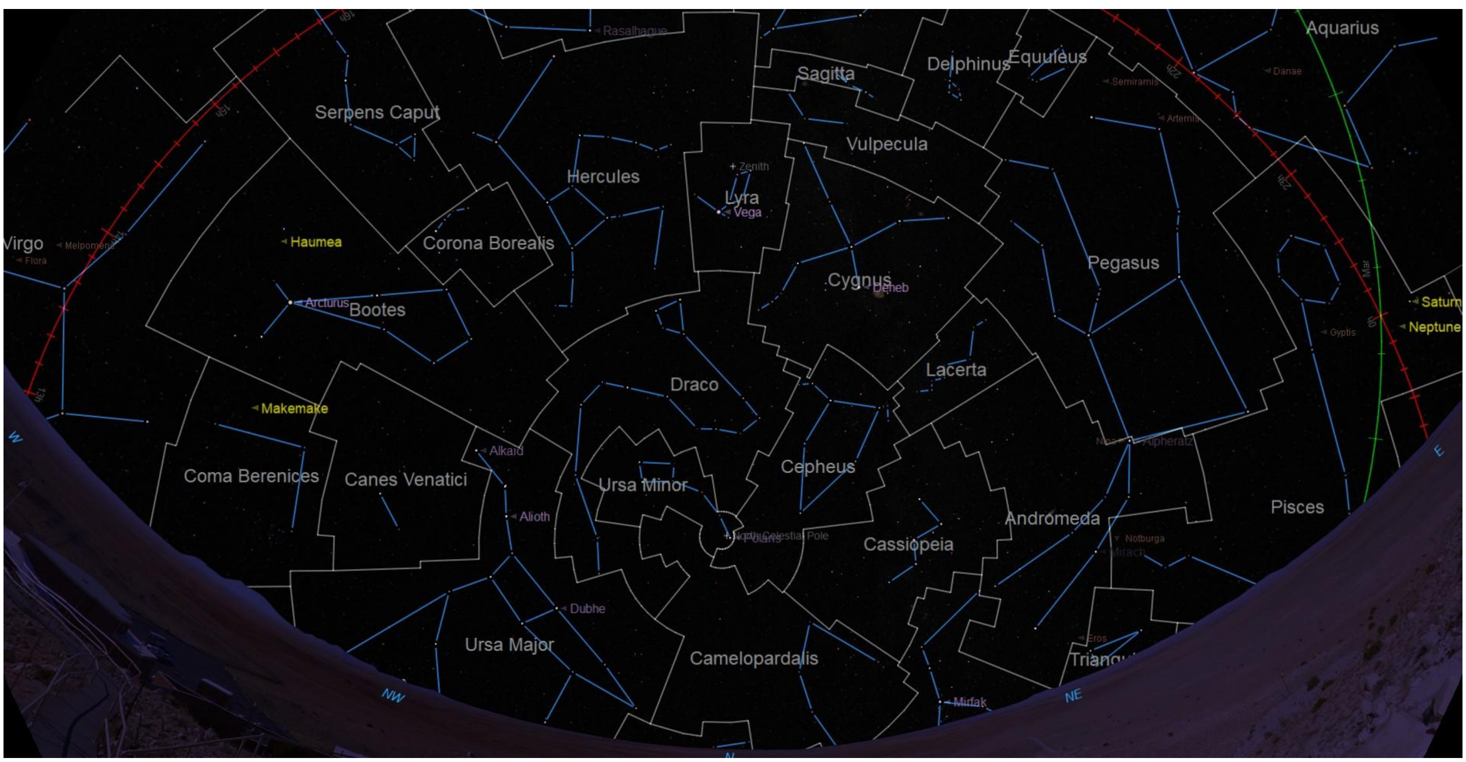
> *From Timeanddate.com:*
> "The September Full Moon can be both the Harvest Moon and the Corn Moon. Most years, the Harvest Moon is in September, but around every three years, it's in October." [The Harvest Moon is the Full Moon closest to the autumnal equinox, so October 6 is the Harvest Moon this year.]
>
> "The Full Moon in September also has **traditional names**; the most well-known one is the **Full Corn Moon**, **Green Corn Moon** or simply **Corn Moon**, from Native American tribes harvesting their corn around that time.
>
> "The Celtic and Old English names are **Wine Moon, Song Moon, and Barley Moon**."
>
> *From Space.com:*
> "This year, the September full moon is called the Corn Moon, reflecting the timing of corn harvests during this season. While the September full moon is typically referred to as the Harvest Moon, this designation shifts to the October full moon every four to five years."

The Moon is at apogee (405,548 km [252,553 miles] from the Earth) on September 26. The Moon will be at perigee (364,773 km [226,660 miles] from Earth) on September 10.

There was a lunar eclipse on September 7, visible from most of the world, except the Americas. On September 8, Saturn passes 4 degrees north of Saturn at 4:00 p.m. (EDT). Two hours later, the Moon passes 3 degrees north of Neptune (seen only with a telescope). On September 12, the Moon passes 5 degrees north of Uranus (seen only with binoculars or a telescope). On September 16, the Moon passes 5 degrees north of Jupiter at 7:00 a.m. (so observe this earlier, before dawn). On September 19, the Moon passes 0.8 degrees north of Venus at 8:00 a.m. (this is 2 days before New Moon, so the Moon will be a thin crescent; the sky will be getting light, but this should be visible before dawn). They are joined by Regulus, Alpha Leonis. On September 24, the 3-day-old Moon passes 4 degrees south of Mars at 11:00 a.m. (observe this that evening).

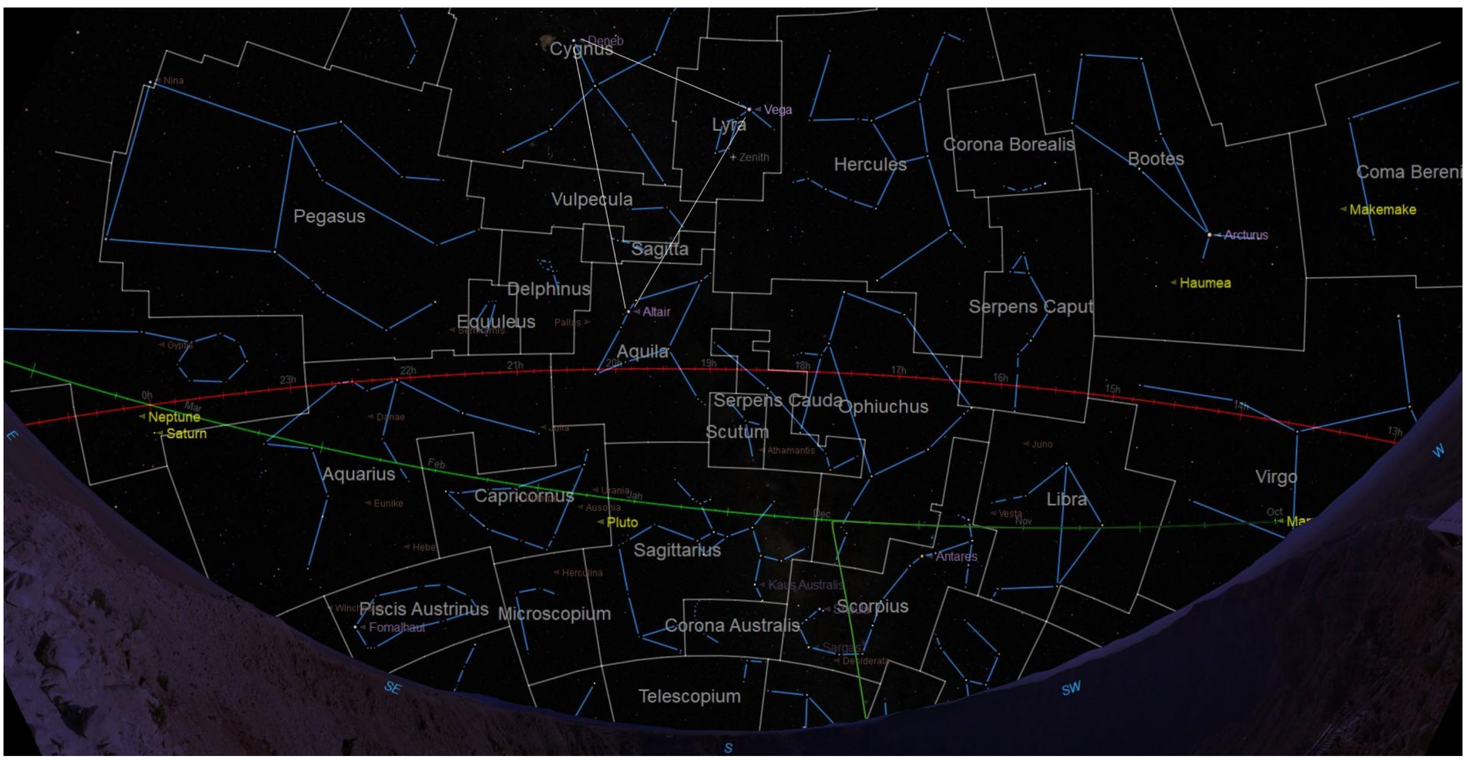
Early Evening Sky Viewing:

- **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 September 15, 2025, sunset is at 6:29 p.m. (38 minutes earlier than on August 15), Civil Twilight is at 6:53 p.m. (40 minutes earlier), Nautical Twilight is at 7:22 p.m. (42 minutes earlier), and Astronomical Twilight is at 7:51 p.m. (45 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 12 hours and 21 minutes on September 15 (58 minutes shorter than on August 15). **Times will also vary depending on where you are in your time zone and your latitude. In New York, sunset is at 7:04 p.m. on September 15 (49 minutes earlier than on August 15). The length of the day in New York is 12 hours 27 minutes on August 15 (80 minutes shorter than on August 15).**



September 15, 2025, looking North at 8:30 p.m. (DST, 7:30 MST and HST). 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.

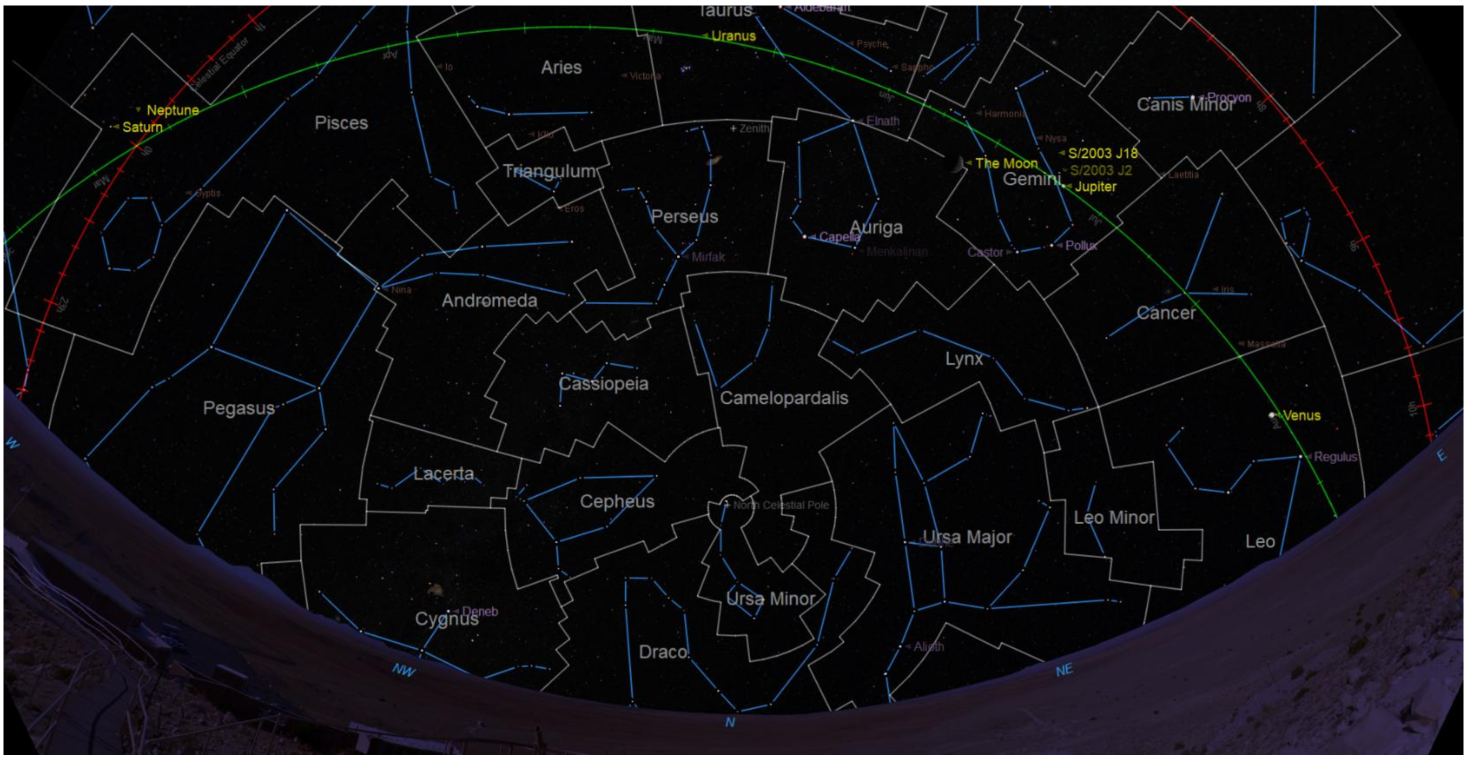
Looking North at about 8:30 p.m. (DST, 7:30 p.m. in Arizona and Hawaii) in mid-September, many of the constellations that were low in the West last month have set or are setting as the constellations and their stars rise earlier/set earlier. This is a week before the autumnal equinox. The Sun is setting earlier (and rising later), so the nights are getting longer. As I mentioned last month, since we are observing a half hour earlier, there is not much change from what we saw last month in the evening. Low in the west/northwest (setting or soon to set), Virgo (the Maiden) is setting and Mars is very low on the horizon (best seen looking south). Below Virgo are Coma Berenices (Berenice's Hair) and Canis Venatici (the Hunting Dogs). Ursa Major (the Great Bear) is in the northwest and Camelopardalis (the Giraffe) is due north of Polaris (the North Star). These are circumpolar constellations, but they are partially below our northern horizon (or almost completely below my horizon thanks to the mountains). Higher in the northwest is Boötes (the Herdsman). A little more to the right (east) of Boötes, but still in the northwest are Corona Borealis (the Northern Crown) and Hercules (the Hero). A little to the west of north and above Polaris are Draco (the Dragon), Ursa Minor (the Lessor Bear). Just east of these are Cassiopea (the Queen) and Cepheus (the King). High in the northeast are Lyra (the Lyre) and Cygnus (the Swan). Above them are Sagitta (the Arrow) and Vulpecula (the Little Fox). Along with Aquila (the Eagle), not visible looking north, is the Summer Triangle that I will show looking south. Below Cygnus and east (right) of Cepheus is Lacerta (the Lizard). Pegasus (the Flying Horse) and Andromeda (the Queen) are now well above the horizon in mid-September at 8:30. Above Pegasus are Delphinus (the Dolphin) and Equuleus (the Little Horse). Very low in the northeast, Triangulum (the Triangle is just rising (it is still a late evening or morning object). Much of Pisces (the Fishes), along with Neptune and Saturn are low in the east.



September 15, 2025, looking South at 8:30 p.m. (DST). The + marks the Zenith (overhead).

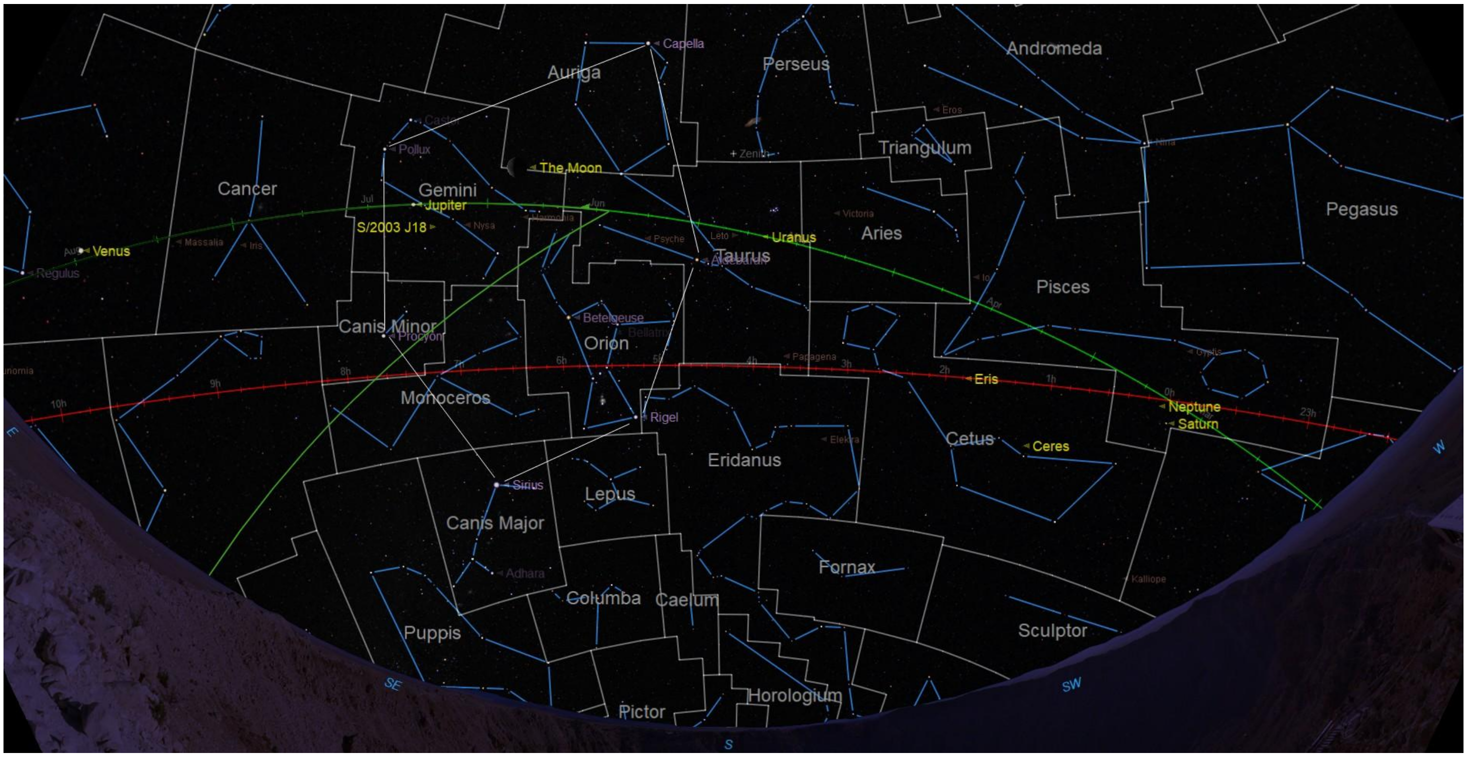
Describing constellations not discussed above, looking South, at 8:30 p.m., by mid-September, we have lost a few of the constellations that are very low in the south. Low in the southwest are Libra (the Scales) and Scorpius (the Scorpion). Due south are Sagittarius (the Archer), Corona Australis (the Southern Crown), and Telescopium (the Telescope). Above these are Scutum (the Shield), Serpens Caput (the Head of the Serpent), Ophiuchus (the Serpent Bearer), and Serpens Cauda (the Tail of the Serpent). Looking high in the south we can now see the three bright stars in the constellations of the Summer Triangle: Deneb (in Cygnus), Vega (in Lyra), and Altair (in Aquila, the Eagle). To the east of due south and east of Sagittarius are Capricornus (the Horned Goat), Microscopium (the Microscope), and Aquarius (the Water Bearer). To the east of Microscopium, just rising is Piscis Austrinus (the Southern Fish).

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 September 15, in the morning, Astronomical Twilight is at 4:45 a.m. (26 minutes later than on August 15), Nautical Twilight is at 5:14 a.m. (23 minutes later), Civil Twilight is at 5:43 a.m. (21 minutes later), and sunrise is at 5:48 a.m. (19 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 6:37 a.m. on September 15 (31 minutes later than on August 15).**



September 15, 2025, looking North at 6:00 a.m. (DST). The + marks the Zenith (overhead). This is a little before Nautical Twilight, so the sky is still fairly dark.

Looking North at 6:00 a.m. (DST, 5:00 a.m. in Arizona and Hawaii) in mid-September, 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. Cygnus (the Swan) and Pegasus (the Flying Horse) are setting in the northwest/west. East (right) of Cygnus and Pegasus are Cepheus (the King), Lacerta (the Lizard), and Andromeda (the daughter of Cassiopeia). Below Polaris are Draco (the Dragon) and Ursa Minor (the Little Bear). Between Cepheus and Andromeda is Cassiopeia (the Queen), just west of north. Above Andromeda are Pisces (the Fishes), with Saturn and Neptune, Triangulum (the Triangle), Perseus (the Hero), and Aries (the Ram). Above Ursa Minor and just east of north are Camelopardalis (the Giraffe) and Auriga (the Charioteer). To the east of Ursa Minor and very low in the northeast (especially for those of us in the south) is Ursa Major (the Great Bear) on his tail. Above Ursa Major is Lynx (the Lynx). High in the northeast are Cancer (the Crab), Gemini (the Twins), alone with Jupiter, and Canis Minor (the Lessor Dog). Just rising are Leo Minor (the Lessor Lion) and Leo (the Lion). Venus is now in Leo.



September 15 2025 looking South at 6:00 a.m. (DST). The + marks the Zenith (overhead).

Looking South in mid-September at 6:00 a.m., for the constellations that are not mentioned looking North. In the south, low on the horizon, so they may not be visible, for those in the northern US, and almost setting is Sculptor (the Sculptor). Above Sculptor in the southwest is Cetus (the Sea Monster or Whale). Southeast of Cetus are Fornax (the Furnace) and Eridanus (the River). To the east of Fornax and low in the south/southeast are Horologium (the Pendulum clock), Caelum (the Chisel), and Columba (the Dove). Very low in the southeast are Pictor (the Painter or Painter's Easel) and Puppis (the Stern). Above Columba are Lepus (the Hare) and Canis Major (the Greater Dog). Above Lepus and Canis Major are Orion (the Hunter) and Monoceros (the Unicorn). Just rising in the east is the long constellation Hydra (the Water Snake). It is 100 degrees, so it will be rising for months.

Where are the Planets?

Mercury is at superior conjunction on September 13, so it is not visible until early October, when it reappears in the evening sky, eventually meeting up with Mars.

Venus continues to be a morning object and visible in the morning sky all month. Venus starts the month at magnitude -3.95 and fades to magnitude -3.93 by the end of the month. Venus is on the far side of the Sun and moves slightly farther away from us, from 1.35 AU to 1.5 AU as the month progresses. At the same time, it goes from 84% illumination to 91% illumination. Venus starts out the month in Cancer and passes into Leo on September 10. On September 19, two days before New Moon, the Moon, Venus, and the star Regulus are within about 1.5 degrees of each other.

Mars is in our evening sky all month but is setting earlier and earlier. Mars sets less than 1.5 hours after the Sun by mid-September. Mars is in Virgo all month and is at magnitude 1.6 all month.

Jupiter is in Gemini all month. Jupiter starts out the month at magnitude -2.0 and ends the month at magnitude -2.1. The waning crescent Moon passes near Jupiter on September 16.

Saturn is transitioning into an evening object. Saturn is rising before 9:00 pm DST (8:00 Tucson and Hawaii) at the beginning of September and before 7:00 DST by the end of the month. In the morning, Saturn does not set until about 6:30 am by the end of September. Saturn is at magnitude 0.7 all month and is in Pisces all month, moving into Aquarius around October 1. The waning gibbous Moon passes by Saturn on September 8 (see above).

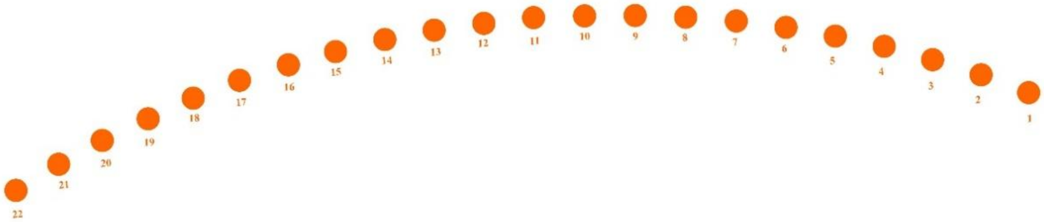
Uranus is in Taurus, about 4 degrees away from the Pleiades, all month. It brightens from magnitude 5.7 to magnitude 5.6 during the month as it gets closer to us as we both orbit around the Sun. The waning gibbous Moon passes by Uranus on September 16, but before Uranus rises

Neptune is in Pisces all month. It is close to Saturn for all of September. Neptune is at magnitude 7.7 at the beginning of September and fades to magnitude 7.8 by the end of the month. With a telescope, Saturn is a good starting point to find Neptune in the sky. At the beginning of the month, Saturn and Neptune are about 1.5 degrees apart and this distance grows to 2.5 degrees by the end of the month. The Moon passes by Neptune on August 12.

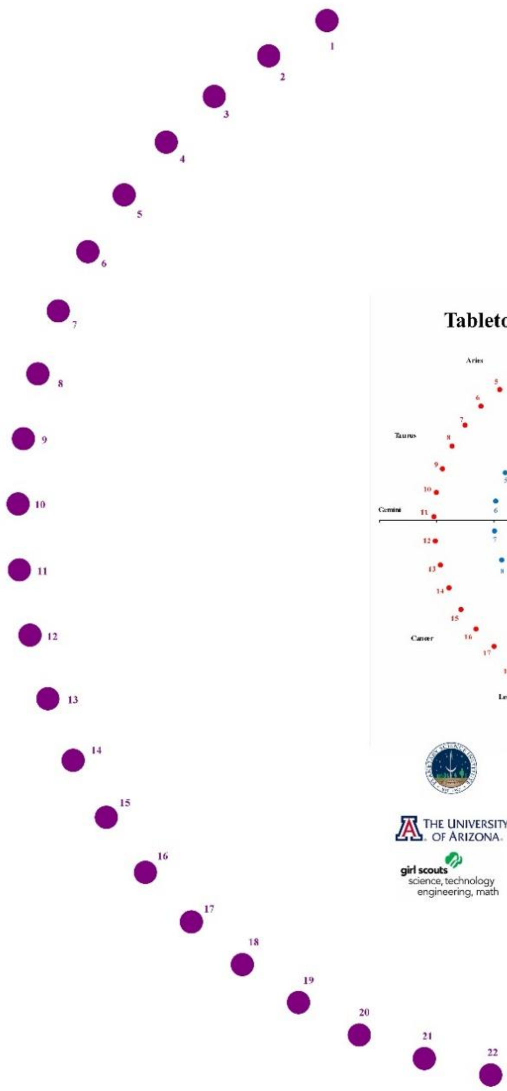
Connecting with the Human Orrery

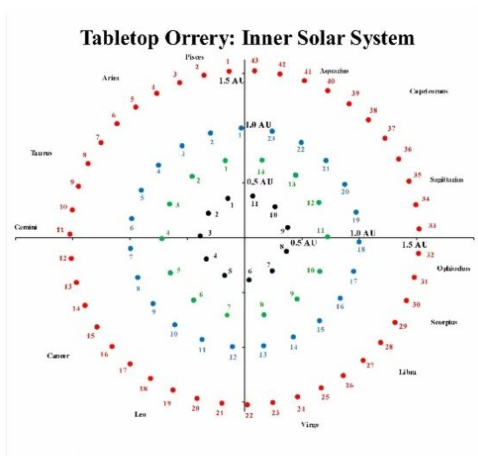
Using the Orrery, it is easy to model the positions of the planets relative to each other and to the Sun. Because the stars in the constellations are not at their true relative distances (many kilometers away in this model), the positions of the planets relative to the constellations may be "off" by 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 11inch paper (standard paper), the scale is about 1.5 cm = 1 AU, the Sun-Earth distance. The second Orrery has circles relevant for September only. I have given the relative positions for September 22, 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 the Earth rotates in a counterclockwise direction, just after the Sun sets (over your left shoulder as you stand on the Earth), on September 22, you will see **Mars** low in the west. You need to continue to rotate counterclockwise until late evening (the Sun is almost at your back). It is only then that you can see **Saturn** (rising over your left shoulder before 6:30 p.m. in Arizona and Hawaii; the Orrery does not "correct" for Daylight Saving Time). As you continue to rotate, you will see **Jupiter** and then **Venus.** Finally, you will not be able to see Mercury, as it is on the far side of the Sun. 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





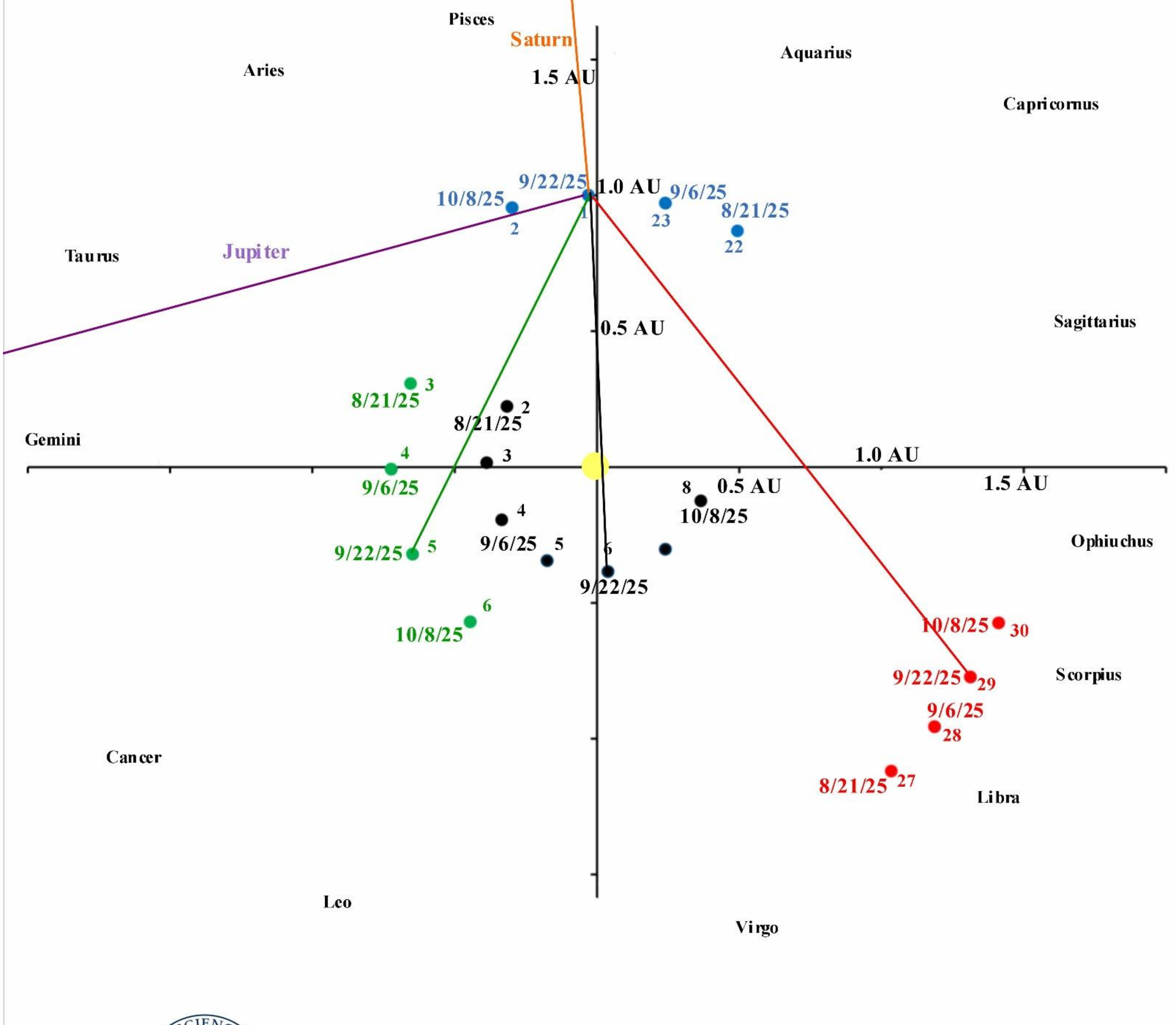
5 centimeters = 1 AU (Earth-Sun distance)
Step size: Mercury = 8 days
Venus, Earth, and Mars = 16 days
Jupiter and Saturn = 80 days

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

THE UNIVERSITY OF ARIZONA

girl scouts
science, technology
engineering, math

Tabletop Orrery: Inner Solar System



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