



# Ephemeris

The Official Newsletter of the Prescott Astronomy Club (PAC)  
*e-phem-er-is*: a time-based listing of future positions of solar system objects.



Original Photo: Lucas Pezeta

**General Meeting of the Prescott Astronomy Club**  
POSTPONED until Wednesday, September 6th, 2023 at 6:00 pm  
Prescott Public Library - Founders Room

**Speaker:** Dr. Moskowitz

**Topic:** Earth strikes back: NASA's first planetary defense experiment (DART follow-up)

**Background:** Late 2022 NASA's DART spacecraft deliberately crashed into an asteroid at a speed of more than 13,000 mph. Given this dramatic end, ground based telescopes, including several at Lowell Observatory, will be tasked with witnessing the aftermath. I will discuss background to the DART mission, what is expected to happen, and why smashing into things in outer space can be fun.

**Bio:** Nick Moskowitz is an astronomer at Lowell Observatory in Flagstaff, Arizona. He has degrees from the University of California at Santa Barbara (BS Physics) and the University of Hawaii (PhD Astronomy). His research is related to small bodies in the Solar System with active projects involving video observations of meteors, curation of an asteroid database ([asteroid.lowell.edu](http://asteroid.lowell.edu)), and observations of near-Earth asteroids.

**General Meeting of the Prescott Astronomy Club**  
Wednesday, April 5, 2023 6pm  
Prescott Public Library - Founder's Room

**Speaker:** Dr. Noel Richardson, Assistant Professor at Embry-Riddle Aeronautical University

**Topic:** ERAU's recent SOFIA flight

**Background:** Dr. Noel Richardson recently led students from Embry-Riddle Aeronautical University in a rare opportunity to travel abroad the world's largest flying observatory, NASA's Stratospheric Observatory for Infrared Astronomy (SOFIA) to study unusual dust-forming objects called Wolf-Rayet binary systems. They conducted hands-on research, glimpsed the aurora borealis and got front-row seats to their dream careers.

**Bio:** Dr. Richardson's research area is a broad interest in the physics of the most massive stars that end their lives in supernova explosions. Most of these stars are binary systems (two stars going around each other), and often interact with each other. He is interested in the processes in which these stars interact and affect each other's evolution, as well as how their strong winds send material into space. To study these phenomena Dr Richardson uses telescopes across the globe and in space to observe these stars from the ultraviolet to the infrared with techniques including measuring changes in stellar brightness, stellar spectroscopy, and long-baseline interferometry.

## UPCOMING SPEAKERS

May: Ernest Cisneros - Mastcam-Z/Perseverance rover MSL mission

# NASA Night Sky Notes

Original Photo: unknown

## Spot the King of Planets: Observe Jupiter

By David Prosper

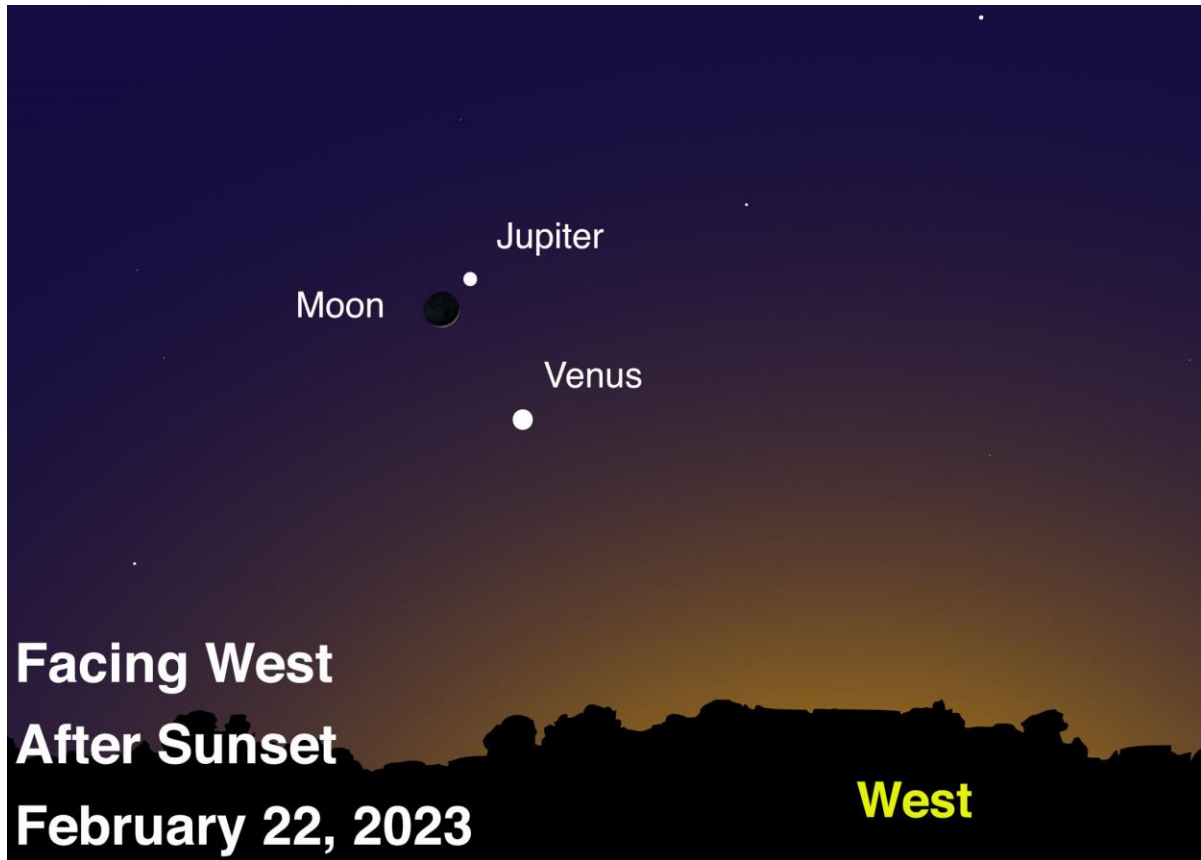
Jupiter is our solar system's undisputed king of the planets! Jupiter is bright and easy to spot from our vantage point on Earth, helped by its massive size and banded, reflective cloud tops. Jupiter even possesses moons the size of planets: Ganymede, its largest, is bigger than the planet Mercury. What's more, you can easily observe Jupiter and its moons with a modest instrument, just like Galileo did over 400 years ago. Jupiter's position as our solar system's largest planet is truly earned; you could fit 11 Earths along Jupiter's diameter, and in case you were looking to fill up Jupiter with some Earth-size marbles, you would need over 1300 Earths to fill it up – and that would still not be quite enough! However, despite its awesome size, Jupiter's true rule over the outer solar system comes from its enormous mass. If you took all of the planets in our solar system and put them together they would still only be half as massive as Jupiter all by itself. Jupiter's mighty mass has shaped the orbits of countless comets and asteroids. Its gravity can fling these tiny objects towards our inner solar system and also draw them into itself, as famously observed in 1994 when Comet Shoemaker-Levy 9, drawn towards Jupiter in previous orbits, smashed into the gas giant's atmosphere. Its multiple fragments slammed into Jupiter's cloud tops with such violence that the fireballs and dark impact spots were not only seen by NASA's orbiting Galileo probe, but also observers back on Earth!



This stunning image of Jupiter's cloud tops was taken by NASA's Juno mission and processed by Kevin M. Cill. You too can create amazing images like this, all with publicly available data from Juno. Go to [missionjuno.swri.edu/junocam](https://missionjuno.swri.edu/junocam) to begin your image procession journey – and get creative! Full Image Credit: NASA/JPL-Caltech/SwRI/MSSS; Processing: Kevin M. Cill, license: CC BY 2.0] <https://creativecommons.org/licenses/by/2.0/> Source: <https://epod.nasa.gov/epod/ap201123.html>

Jupiter is easy to observe at night with our unaided eyes, as well-documented by the ancient astronomers who carefully recorded its slow movements from night to night. It can be one of the brightest objects in our nighttime skies, bested only by the Moon, Venus, and occasionally Mars, when the red planet is at opposition. That's impressive for a planet that, at its closest to Earth, is still over 365 million miles (587 million km) away. It's even more impressive that the giant world remains very bright to Earthbound observers at its furthest distance: 600 million miles (968 million km)! While the King of Planets has a coterie of around 75 known moons, only the four large moons that Galileo originally observed in 1610 – Io, Europa, Ganymede, and Callisto – can be easily observed by Earth-based observers with very modest equipment. These are called, appropriately enough, the *Galilean moons*. Most telescopes will show the moons as faint star-like objects neatly lined up close to bright Jupiter. Most binoculars will show at least one or two moons orbiting the planet. Small telescopes will show all four of the Galilean moons if they are all visible, but sometimes they can pass behind or in front of Jupiter, or even each other. Telescopes will also show details like Jupiter's cloud bands and, if powerful enough, large storms like its famous Great Red Spot, and the shadows of the Galilean moons passing between the Sun and

Jupiter. Sketching the positions of Jupiter's moons during the course of an evening - and night to night - can be a rewarding project! You can download an activity guide from the Astronomical Society of the Pacific at [bit.ly/drawjupitermoons](https://bit.ly/drawjupitermoons)



*Look for Jupiter as it forms one of the points of a celestial triangle, along with Venus and a very thin crescent Moon, the evening of February 22, 2023. This trio consists of the brightest objects in the sky - until the Sun rises! Binoculars may help you spot Jupiter's moons as small bright star-like objects on either side of the planet. A small telescope will show them easily, along with Jupiter's famed cloud bands. How many can you count? Keep watching Jupiter and Venus as the two planets will continue to get closer together each night until they form a close conjunction the night of March 1. Image created with assistance from Stellarium.*

NASA's Juno mission currently orbits Jupiter, one of just nine spacecraft to have visited this awesome world. Juno entered Jupiter's orbit in 2016 to begin its initial mission to study this giant world's mysterious interior. The years have proven Juno's mission a success, with data from the probe revolutionizing our understanding of this gassy world's guts. Juno's mission has since been extended to include the study of its large moons, and since 2021 the plucky probe, increasingly battered by Jupiter's powerful radiation belts, has made close flybys of the icy moons Ganymede and Europa, along with volcanic Io. In 2024 NASA will launch the Europa Clipper mission to study this world and its potential to host life inside its deep subsurface oceans in much more detail. Find the latest discoveries from Juno and NASA's missions at [nasa.gov](https://nasa.gov).



Original Photo: Eberhard Grossgasteiger

The Backyard Astronomer - March 2023  
**Bullish About Astronomy**  
By Adam England, The Backyard Astronomer





Photo: Mars, Courtesy PAC member Joel Cohen, imaged from Prescott Valley, 10-02-2020.

The Red Planet shines bright this month, transiting between the horns of Taurus, the bull, and up towards Gemini, the twins, at just over one AU from Earth. One Astronomical Unit is the average distance from the Earth to the Sun, or about 93 million miles/150 million kilometers.

The horns of Taurus are peaked by the bright stars Zeta Tauri and Elnath. At apparent magnitudes 3.0 and 1.67, respectively, they should be quite easy to find by looking to the Southwestern sky after sunset. Zeta Tauri is a binary star system, with the brighter Zeta Tauri A 11 times more massive than our sun, and separated from its partner Zeta Tauri B by only 1.17 AU. Being nearly as close to each other as we are to the Sun or Mars right now, we cannot see them as separate objects with backyard telescopes, though scientists have been able to measure the Doppler shift – or change in the frequency of their light spectrum - calculating an orbital period of just 133 days.

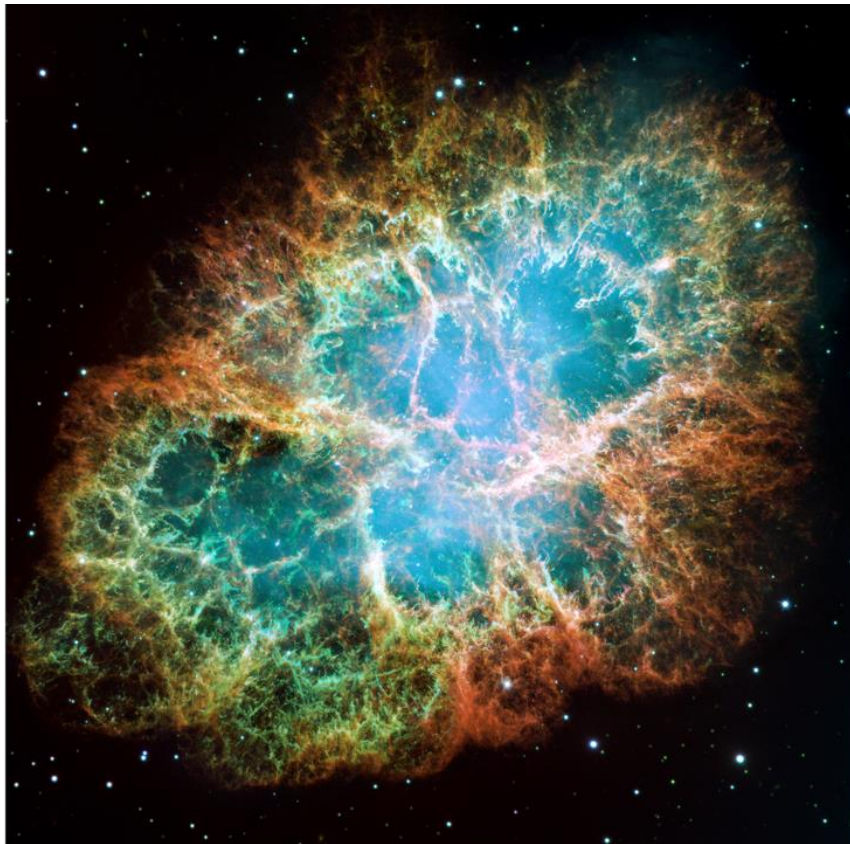


Photo: Crab Nebula, courtesy Hubble Space Telescope.

About 1 degree west of Zeta Tauri is the popular Crab Nebula. You can approximate 1 degree in the sky by the width of your finger at arm's length. The Crab Nebula bears the designation M1 or Messier 1, as it was the first object recorded by Charles Messier in 1758 during his attempts to locate the predicted return of a comet, as previously calculated by its modern namesake, Edmund Halley. This same nebula was independently discovered by multiple astronomers over the 18<sup>th</sup> century, and has since become one of the most studied and beloved objects in

the night sky. Modern observations by the Hubble Space Telescope, Chandra X Ray Observatory, and the Spitzer Infrared Telescope have continued to provide extraordinary detail into this magnitude 8.4 remnant of an ancient supernova which was recorded by Chinese astronomers in 1054.

Defining the bull's other horn, Elnath come from the Arabic meaning "the butting one". Relatively close at 130 ly distant, this giant star is 5 times the mass of our Sun, while putting out approximately 700 times more light.

While the Pleiades is the most familiar open cluster in the constellation Taurus, it is host to many other star clusters and nebulae. The Hyades cluster is nearer the bright star Aldebaran in the face of the bull, with approximately 100 total stars filling a spherical void in space with the same age and chemical composition.

Moving counterclockwise from the West around Elnath, backyard astronomers can find the Flaming Star Nebula (magnitude 6.0), Messier 38 or the Starfish Cluster (magnitude 7.4), and Messier 36 or the Pinwheel Cluster (magnitude 6.3).



Photo: Mars In Taurus, 03-15-2023 at 8PM MST, courtesy SkySafari.

Adam England is the owner of Manzanita Insurance and Accounting and moonlights as an amateur astronomer, writer, and interplanetary conquest consultant. Follow him @ Facebook.com/BackyardAstronomerAZ and Instagram.com/TheBackyardAstronomerAZ.



Original Photo: Camille Cox

**March 2023:**

This calendar is put together from several sources & shows the objects & events visible during March 2023.

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1 Close Approach of Venus & Jupiter	2 Conjunction of Mercury & Saturn Conjunction of Venus & Jupiter	3 Moon at Apogee Theta Carinae Cluster is Well-Placed	4

5	6	7 Full Moon (Crow Moon)	8	9 Moon at Aphelion Wishing Well Cluster is Well-Placed	10	11
12	13 Lunar Occultation of Delta Scorpii	14 Last Quarter Moon	15 γ-Normid Meteor Shower 2023 Neptune at Solar Conjunction	16	17 Mercury at Superior Solar Conjunction	18
19 Moon at Perigee Conjunction of Moon & Saturn Moon at Perihelion	20 March Equinox	21 New Moon 1 Ceres at Opposition	22 Conjunction of Moon & Jupiter	23	24 Conjunction of Moon & Venus Close Approach of Moon & Venus	25
26	27	28 Close Approach of Moon & Mars Conjunction of Moon & Mars First Quarter Moon	29 Comet C/2019 US (PANSTARRS) Passes Perihelion 136472 Make at Opposition	30 Conjunction of Venus & Uranus	31 Moon at Apogee Mercury at Perihelion	

# Call for Images & Ideas

Original Photo: Egil Sjøholt

## We'd Love Your Photos & Ideas for the Newsletter!

I am requesting any & all photographer members of PAC to submit astronomical &/or sky photographs to share with all the members by their inclusion in Ephemeris. Images can be sent to Hilary Legacy at [ed@prescottastronomyclub.org](mailto:ed@prescottastronomyclub.org). Please include descriptions of equipment, cameras, image capture parameters & processing, as well as what's in the image & when & where you took it. Or, for anyone who likes to photo edit or make their own images, I'd love to hear from you too. Thanks!

I'm also asking for anyone with ideas of things we could put in our newsletter to contact me. If there's something you'd like to see here, then tell me about it. Email Hilary Legacy at [ed@prescottastronomyclub.org](mailto:ed@prescottastronomyclub.org).

# Observing Lists

Original Photo: Joonas Kääriäinen

Observing lists are available in PDF format on the PAC website to provide guidance & goals for visual & astrophotography programs. This list These lists graciously provided by Past President David Viscio to assist in planning your observation activities. The lists are in PDF format and may be viewed, downloaded or printed with the permission of David Viscio.

Astroleague Lunar 100  
Bright Nebulae Dunlop 100.  
Globular Clusters  
Messier  
Planet Maps

Binocular Showpieces Caldwell  
Face-On Spiral Galaxies  
Herschel II  
Herschel 400

Royal Astronomical Society of Canada Finest NGC Saguaro Astronomy Club Best NGC S&T

## SCAVENGER HUNTS IN THE SKY Lists for Any Occasion

Need ideas for your visual or astrophotography program? We have you covered with observing lists for your personal exploration or use at a star party.

Click on the links below to open an observation list in another window to view or print it.

[Astroleague Lunar 100](#)

[Astroleague Urban](#)

[Binocular Showpieces](#)

[Bright Nebulae](#)

[Caldwell Objects](#)

[Double Stars](#)

[Dunlop 100 \(Southern Hemisphere\)](#)

[Face-On Spiral Galaxies](#)

[Globular Clusters](#)

[Herschel 400](#)

[Herschel II](#)

[Hidden Treasures](#)

[Messier Objects](#)

[Open Clusters](#)

[Planet Maps](#)

[Planetary Nebulae](#)

[RAS of Canada Finest NGC](#)

[Saguaro Astronomy Club Best NGC](#)

[Secret Deep](#)

[Space & Telescope Lunar 100](#)

[Telescope Showpieces by Month](#)

# Get to Know . . .

Original Photo: Rajesh S. Balouria

## What You Need to Know About Astronomy Apps

By Hilary Legacy

I hope last month's review of the app **Sky Tonight**. There are many astronomy apps available on both the Apple & Android platforms, but not all are created equal. Each offers different functions & information, each with a different design & style. Some focus on constellations & stars, others on the moon, yet others on education. I'll begin with the ones I myself have, one per month, & then other apps will follow in the next issue.

### Night Sky

Night Sky also gives you stars & constellations, but with this app, you have more customization of your view of them. There are four buttons vertically down the top right side of the screen (listed in order from top to bottom): Sky Window/Sky Blending allows you to choose either outdoor or indoor; then there's a Compass Alignment button; the circular arrow refreshes your screen; the button that looks like three pieces of paper in a stack allows you to select the objects & other items you see; & the button with the rainbow circle changes the light type (everything from ultraviolet to infrared to x-rays, etc.). Then, if you pull the bottom of your screen up, you get more information: on top is your location as well as the time & date; then the stargazing conditions where you are; then an option to do Sky Blending, which overlays the Night Sky map over the real sky; then there are many buttons under the PLUS header that allows for many different options (everything from Live Sky Tour to Aurora Forecasts to AR Planetary Portals); then you have News & Events tabs; then the current level of light pollution; & last is a list of articles, tutorials

(astrophotography is one of them), quizzes & other items. This doesn't have the educational articles that Star Walk 2 has, but a solid app. And getting to see things through different frequencies of light is neat!

I hope these gives you a good look at some of the astronomical apps out there!



Original Photo: Tobias Bjørkli

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**PAC Contact Information:**

**Website:** <http://www.prescottastronomyclub.org>

**Email:** [pacinfo@prescottastronomyclub.org](mailto:pacinfo@prescottastronomyclub.org)

**PAC Mentors:**

If you need advice on the purchase of astronomy equipment, setting up equipment, astrophotography, etc., contact a PAC mentor.

**Astrophotography:** Brian Blau

**General & Astrophotography:** David Viscio

**Visual Observation:** Greg Lutes





# Need to Know?

Original Photo: Jeremy Müller

## Ask a Member!

A 15-minute segment is being added to the regular general meetings where members can have their burning questions answered by other knowledgeable members. If you have an astronomy-related question you would like answered, submit it to Art Arnold-Roksandich at [p@prescottastronomyclub.org](mailto:p@prescottastronomyclub.org). You can also bring up the question at the meeting.