Snake River Skies

The Newsletter of the Magic Valley Astronomical Society

www.mvastro.org

Membership Meeting

Saturday, June 8th 2019
7:00pm at the
Herrett Center for Arts & Science
College of Southern Idaho.

Public Star Party follows at the Centennial Observatory

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Magic Valley Astronomical Society is a member of the Astronomical League

M-51 imaged by
Rick Widmer &
Ken Thomason
Herrett Telescope
Shotwell Camera

MVAS President's Message
June 2019

Colleagues,

I write this after watching the skies open up and soaked the customers leaving my local grocery store. I At another store, I heard a customer and a cashier exchange complaints about the cold weather, and what it's doing to their plans. We as astronomers understand just what they're saying. It's time for summer and the skies to clear, and we're all looking forward to it. A small MVAS star party at the Jerome Gun Club in May teased out some great targets, which means June should offer more.

There are two activities that should provide us with provide us with great opportunities to get out and take in the heart of the Milky Way. First, on June 22nd, we'll be at the Hagerman Fossil Beds National Monument for our annual summer visit there. The site has proven to be underrated, so this is an opportunity to show the public what's really out there. Please keep in touch for additional details.
The following week will be the Idaho Falls Astronomical Society's turn to get out there, as they host their annual summer star party at the Craters of the Moon National Monument on June 28th and 29th. This isn't our star party, but we are invited, and it's another great opportunity as well.

Until then, we look forward to seeing you at the June 8th meeting. William Cook, author of books on binocular astronomy, will be giving us a presentation on how to use one of astronomy's most overlooked tools.

Clear Views,

Rob Mayer

Calendar

June 2019

Sun	Mon	Tue	Wed	Thu	Fri	Sat
						1
2	3 New Moon Lunation 1193 1% Visible ↑ Age: 0.07 Days 	4	5	6	7	8 MVAS Meeting at 7:00pm at the Herrett Center Public Star Party Centennial Obs. 9:45p - 12:00a
9	10 First Quarter Moon Visible: 54% ↑ Age: 7.67 days 	11	12	13	14 Flag Day 	15
16 Father's Day 	17 Full Moon 100% Visible Age: 14.90 Days 	18	19	20	21	22
23	24	25 Last Quarter Visible 48% ↓ Age: 22.43 Days 	26	27	28	29
30						

Snake River Skies is the Newsletter of the Magic Valley Astronomical Society and is published electronically once a month.

Be Careful – Be Safe – Get Out There – Explore Your Universe

June Celestial Calendar by Dave Mitsky

All times, unless otherwise noted, are UT (subtract six hours and, when appropriate, one calendar day for MDT)

6/1 The Moon is 3.1 degrees south-southeast of Venus at 21:00
6/2 The Moon is 7.9 degrees south-southeast of the bright open cluster M45 (the Pleiades or Subaru) in Taurus at 13:00
6/3 Mercury is at its greatest heliocentric latitude north today; asteroid 2 Pallas is stationary at 2:00; the Moon is 2.3 degrees north of the first-magnitude star Aldebaran (Alpha Tauri) at 6:00; New Moon (lunation 1193) occurs at 10:02
6/4 The Moon is 3.7 degrees south of Mercury at 17:00
6/5 A double Galilean satellite shadow transit (Ganymede's shadow precedes Io's) begins at 0:29; the Moon is 1.6 degrees south of Mars at 15:00; the Moon is at the ascending node (longitude 107.9 degrees) at 23:00
6/6 Mercury is 1.2 degrees north of the bright open cluster M35 in Gemini at 1:00; the Moon is 6.2 degrees south of the first-magnitude star Pollux (Beta Geminorum) at 10:00
6/7 The Moon makes a close approach to the bright open cluster M44 (the Beehive Cluster or Praesepe) in Cancer at 8:00; the Moon is at perigee, subtending 32' 26" from a distance of 368,504 kilometers (228,978 miles), at 23:15
6/8 The Moon is 3.0 degrees north-northeast of the first-magnitude star Regulus (Alpha Leonis) at 22:00
6/9 Venus is 5.1 degrees south-southeast of the bright open cluster M45 at 5:00
6/10 The Purbach Cross or Lunar X, an X-shaped illumination effect involving various rims and ridges between the craters La Caille, Blanchinus, and Purbach, is predicted to be visible at 4:17; First Quarter Moon occurs at 5:59; Jupiter (magnitude -2.5, apparent size 46.0") is at opposition at 16:00
6/12 A double Galilean satellite shadow transit (Io's shadow precedes Ganymede's) begins at 3:33; the Moon is 7.3 degrees north-northeast of the first-magnitude star Spica (Alpha Virginis) at 18:00
6/13 The equation of time, which yields the difference between mean solar time and apparent solar time, equals 0 at 10a
6/14 The earliest sunrise of the year at latitude 40 degrees north occurs today
6/15 The Moon is 0.9 degree north of dwarf planet/asteroid 1 Ceres, with an occultation taking place in Japan, northern and eastern China, northeastern Kazakhstan, and central and eastern Russia, at 15:00
6/16 The Moon is 7.8 degrees north-northeast of the first-magnitude star Antares (Alpha Scorpii) at 5:00; the Moon is 2.0 degrees north-northeast of Jupiter at 20:00
6/17 The earliest morning twilight of the year at latitude 40 degrees north occurs today; Full Moon, known as the Rose or Strawberry Moon, occurs at 8:31; Venus is 5.0 degrees north of the first-magnitude star Aldebaran (Alpha Tauri) at 21:00
6/18 Mercury (magnitude +0.2) is 0.2 degree north of Mars (magnitude +1.8) at 14:00
6/19 The Moon is at the descending node (longitude 287.6 degrees) at 2:00; the Moon is 0.4 degree south of Saturn, with an occultation taking place in southern Africa, the Antarctic Peninsula, southern South America, and Easter Island, at 4:00; the Moon is 0.1 degree south of Pluto, with an occultation taking place in western South America, Central America, southern Polynesia, southern Micronesia, northeastern Australia, and Melanesia, at 11:00; Mercury is 5.4 degrees south-southwest of Pollux at 14:00
6/21 Mars is 5.5 degrees south of Pollux at 8:00; the Sun reaches an ecliptic longitude of 90 degrees and the northern hemisphere summer solstice occurs at 15:56
6/22 The Sun enters Gemini, at longitude 90.43 degrees on the ecliptic, at 3:00; Neptune is stationary at 4:00
6/23 The Moon is at apogee, subtending 29' 32" from a distance of 404,548 kilometers (251,375 miles), at 7:50; Mercury is at greatest eastern elongation (25 degrees) at 23:00
6/24 The latest evening twilight of the year at latitude 40 degrees north occurs today; the Moon is 3.6 degrees south-southeast of Neptune at 4:00
6/25 Last Quarter Moon occurs at 9:47
6/26 Mercury is at the descending node today; the Curtiss Cross, an X-shaped illumination effect located between the craters Parry and Gambart, is predicted to be visible at 6:33
6/27 The latest sunset of the year at latitude 40 degrees north occurs today
6/28 The Moon is 4.5 degrees south-southeast of Uranus at 2:00
6/29 The Moon is 7.9 degrees south-southeast of the bright open cluster M45 at 23:00
6/30 The Moon is 2.3 degrees north of Aldebaran at 15:00

Giovanni Cassini (1625-1712), John Dollond (1706-1761), Charles Messier (1730-1817), William Lassell (1799-1880), George Ellery Hale (1868-1938), and Carolyn Shoemaker (1929) were born this month.

The Sun, the Moon, & the Planets

The Moon is 26.9 days old, is illuminated 7.6%, subtends 30.3 arc minutes, and is located in Cetus on June 1st at 0:00 UT. The June lunar month is 29 days 09 hours 14 minutes in length. The Moon is at its greatest northern declination of +22.2 degrees on June 6th and at its greatest southern declination of -22.3 degrees on June 19th. Longitudinal libration is at a maximum of +5.1 degrees on June 16th and a minimum of -5.2 degrees on June 2nd and -6.1 degrees on June 29th. Latitudinal libration is at a maximum of +6.8 degrees on June 27th and a minimum of -6.7 degrees on June 12th. New Moon occurs on June 3rd. On June 7th, the Moon passes very near the bright open cluster M44. The Moon is at perigee on June 7th (distance 57.78 Earth-radii) and at apogee on June 23rd (distance 63.43 Earth-radii). The Moon occults 1 Ceres on June 15th and Saturn and Pluto on June 19th from certain parts of the world. See http://www.lunar-occultations.com/iota/iotandx.htm for information on lunar occultations taking place this month. Visit http://saberdoesthestars.wordpress.com/2011/07/05/saber-does-the-stars/ for tips on spotting extreme crescent Moons. Click on http://www.calendar-12.com/moon_calendar/2019/june for a lunar phase calendar. Times and dates for the lunar light rays predicted to occur this month are available at http://www.lunar-occultations.com/rlo/rays/rays.htm

The Sun is located in Taurus on June 1st. It enters Gemini on June 22nd. The Sun reaches its farthest position north for the year on June 21st. There are 15 hours and one minute of daylight at latitude 40 degrees north on June 21st, the day of the summer solstice. At latitude 40 degrees north, the earliest sunrise occurs on June 14th and the latest sunset on June 27th. For an explanation of why this occurs, click on https://earthsky.org/?p=4027

Brightness, apparent size, illumination, distance from the Earth in astronomical units, and location data for the planets and Pluto on June 1st: Mercury (-1.1, 5.5", 87% illuminated, 1.23 a.u., Taurus), Venus (magnitude -3.8, 10.5", 94% illuminated, 1.59 a.u., Aries), Mars (magnitude +1.8, 3.9", 98% illuminated, 2.43 a.u., Gemini), Jupiter (magnitude -2.6, 45.8", 100% illuminated, 4.30 a.u., Ophiuchus), Saturn (magnitude +0.3, 18.0", 100% illuminated, 9.25 a.u., Sagittarius), Uranus on June 16th (magnitude +5.9, 3.4", 100% illuminated, 20.49 a.u., Aries), Neptune on June 16th (magnitude +7.9, 2.3", 100% illuminated, 29.82 a.u., Aquarius), and Pluto on June 16th (magnitude +14.2, 0.1", 100% illuminated, 32.93 a.u., Sagittarius).

Mercury and Mars are in the northwest and Jupiter is in the southeast in the evening sky. At midnight, Jupiter lies in the south and Saturn lies in the southeast. Venus in the northeast, Jupiter and Saturn can be found in the southwest, Uranus in the east, and Neptune in the southeast at dawn.

Mercury grows in apparent size from 5.5 to 9.2 arc seconds but decreases in magnitude from -1.1 to +0.9. Mercury reaches its highest heliocentric latitude on June 3rd. On June 4th, a very thin two-day-old waxing crescent Moon passes four degrees south of the planet at sunset. Mercury is located 1.2 degrees north of the bright open cluster M35 on June 8th. Mercury and Mars are separated by 28 arc minutes on June 17th and just 18 arc minutes during their closest conjunction in 13 years on June 18th. Mercury shines at magnitude +0.2, which is five times brighter than the Red Planet, and subtends 7.4 arc seconds, which is twice the apparent size of Mars at the time. As June progress, Mercury climbs higher into the sky and Mars loses altitude. The speediest planet reaches its greatest eastern elongation on June 23rd, when it is located at an altitude of 11 degrees 30 minutes after sunset.

Brilliant **Venus** and the waning crescent Moon lie six degrees apart and six degrees above the horizon 30 minutes before sunrise on June 1st. The planet is at an elongation of 20 degrees at the time. Aldebaran is approximately five degrees to the lower right of Venus on the morning of June 18th. Venus is just three degrees above the horizon one half-hour before the Sun rises on June 30th.

During June, **Mars** shines faintly at magnitude +1.8 and shrinks to 3.7 arc seconds, just three arc seconds larger than Uranus. The waxing crescent Moon passes 1.6 degrees south of Mars on June 5th. Mars and Mercury undergo a very close conjunction on June 18th.

Jupiter reaches opposition on June 10th. At that time, it shines at magnitude -2.5, subtends 46.0 arc seconds, has a declination of -22 degrees, and is 36 light minutes from the Earth. The waxing gibbous Moon passes two degrees north of Jupiter on June 16th. An article on observing Jupiter appears on pages 52 and 53 of the May 2019 issue of Sky & Telescope. Browse http://www.skyandtelescope.com/observing/interactive-sky-watching-tools/ or http://www.projectpluto.com/jeve_grs.htm in order to determine transit times of Jupiter's central meridian by the Great Red Spot. GRS transit times are also available on page 50 of the June 2019 issue of Sky & Telescope. Javascript Jupiter at http://www.shallowsky.com/jupiter/ shows Galilean satellite events. Data on the Galilean satellite events can also be found on page 51 of the June 2019 issue of Sky & Telescope and at https://www.projectpluto.com/jevent.htm#jun and http://www.skyandtelescope.com/observing/interactive-sky-watching-tools/

Saturn rises at about 11:00 p.m. local daylight time on June 1st. The planet shines at magnitude +0.2 and subtends 18.2 arc seconds at its equator, while its rings span 41 arc seconds and are inclined 24 degrees. The waxing gibbous Moon passes less than one degree south of Saturn, with an occultation occurring in some parts of the world, on June 19th. Eighth-magnitude Titan passes north of Saturn on the mornings of June 13th and June 29th and south of the planet on the mornings of June 5th and June 21st. For information on Saturn's satellites, browse http://www.skyandtelescope.com/observing/interactive-sky-watching-tools/

By the end of the month, **Uranus** rises at about 2:00 a.m. local daylight time. The ice giant is situated in southern Aries, some ten degrees south of the first-magnitude star Hamal (Alpha Arietis) and 2.4 degrees south of the sixth-magnitude star 19 Arietis. The waxing gibbous Moon passes five degrees north of Uranus on June 27th. Visit http://www.bluewaterastronomy.info/resources/Maps/Charts-2019/09uranus_2019_1.pdf and http://www.nakedeyeplanets.com/uranus.htm#finderchart for finder charts.

Neptune rises shortly after 1:00 a.m. local daylight time by mid-June. The eighth planet lies 1.2 degree east-northeast of the fourth-magnitude star Phi Aquarii on June 1st. Neptune reaches its first stationary point on June 22nd, when it will be less than 1.5 degrees northeast of Phi Aquarii and less than 0.5 degree south of the sixth-magnitude star 96 Aquarii. The waning gibbous Moon passes four degrees south of Neptune on June 24. Browse https://s22380.pcdn.co/wp-content/uploads/UrNep-2019-2020.pdf and http://www.nakedeyeplanets.com/neptune.htm#finderchart for finder charts.

Finder charts for Uranus and Neptune are available at https://s22380.pcdn.co/wp-content/uploads/UrNep-2019-2020.pdf

Pluto resides in northeastern Sagittarius. The waxing gibbous Moon passes 0.1 degree south of Pluto, with an occultation occurring in some parts of the world, on June 19th. Finder charts can be found at http://www.bluewaterastronomy.info/resources/Maps/Charts-2019/Pluto2019.jpg and on pages 48 and 49 of the July 2019 issue of Sky & Telescope and page 243 of the RASC Observer's Handbook 2019.

For more on the planets and how to locate them, browse http://www.nakedeyeplanets.com/

Asteroids

Shining at ninth magnitude, asteroid 2 Pallas glides southeastward through eastern Coma Berenices this month. It lies about two degrees to the west of the sixth-magnitude star 2 Boötes on June 21st. The main belt asteroid passes very close to similarly bright stars on June 12th and June 26th. Asteroids brighter than magnitude +11.0 that reach opposition this month include 410 Chloris (magnitude +10.3) on June 14th, 22 Kalliope (magnitude +10.8) on June 15th, and 914 Palisana (magnitude +10.8) on June 28th. Information on asteroid occultations taking place this month is available at http://www.asteroidoccultation.com/2019_06_si.htm

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Carbon Star

Notable carbon star for June: V Coronae Borealis Right Ascension: $15^{h}\ 49^{m}\ 31.31093^{s}$ Declination: +39° 34′ 17.9111″

Comets

Comet C/2018 N2 (ASASSN) travels northeastward through northeastward through northeastern Cetus during June. The faint comet lies about 1.5 degrees to the east of the fourth-magnitude star Xi Ceti on June 30th. Visit http://cometchasing.skyhound.com/ and http://www.aerith.net/comet/future-n.html for information on comets visible this month.

Meteors

The minor Boötid meteor shower (5 per hour) peaks on the morning of June 27th. The source of Boötid meteors is the periodic comet 7P/Pons-Winnecke. The radiant lies in northern Boötes at right ascension 14 hours 56 minutes, declination 48 degrees. Browse http://www.spaceweather.com/meteors/junebootids.html for additional information.

Orbiting Earth

Information on Iridium flares and passes of the ISS, the Tiangong-2, the USAF's X-37B, the HST, and other satellites can be found at http://www.heavens-above.com/. Satellite information with ISS Live HD streaming https://www.n2yo.com

Information on the celestial events transpiring each week can be found at http://astronomy.com/skythisweek and http://www.skyandtel...ky-at-a-glance/

The Deep Sky

Fifty deep-sky objects for June: NGC 5466, NGC 5676, NGC 5689 (Bootes); M102 (NGC 5866), NGC 5678, NGC 5879, NGC 5905, NGC 5907, NGC 5908, NGC 5949, NGC 5963, NGC 5965, NGC 5982, NGC 5985, NGC 6015 (Draco); NGC 5694 (Hydra); NGC 5728, NGC 5791, NGC 5796, NGC 5812, NGC 5861, NGC 5878, NGC 5897 (Libra); M5, NGC 5921, NGC 5957, NGC 5962, NGC 5970, NGC 5984 (Serpens Caput); M101, NGC 5473, NGC 5474, NGC 5485, NGC 5585, NGC 5631 (Ursa Major); NGC 5566, NGC 5634, NGC 5701, NGC 5713, NGC 5746, NGC 5750, NGC 5775, NGC 5806, NGC 5813, NGC 5831, NGC 5838, NGC 5846, NGC 5850, NGC 5854, NGC 5864 (Virgo)

Top ten deep-sky objects for June: M5, M101, M102, NGC 5566, NGC 5585, NGC 5689, NGC 5746, NGC 5813, NGC 5838, NGC 5907

Top five deep-sky binocular objects for June: M5, M101, M102, NGC 5466, NGC 5907

Challenge deep-sky object for June: Abell 2065 Right Ascension: $15^{h}\ 22^{m}\ 31.8^{s}$ Declination: $+27°\ 42'\ 04''$

The objects listed above are located between 14:00 and 16:00 hours of right ascension.

A wealth of current information on solar system celestial bodies is posted at http://www.curtrenz.com/astronomy.html and http://nineplanets.org/ | Various events taking place within our solar system are discussed at http://www.bluewaterastronomy.info/styled-4/index.html

Information on the celestial events transpiring each week can be found at http://astronomy.com/skythisweek and http://www.skyandtelescope.com/observing/sky-at-a-glance/

Free star maps for March can be downloaded at http://www.skymaps.com/downloads.html and http://www.telescope.com/content.jsp?pageName=Monthly-Star-Chart

The famous eclipsing variable star Algol (Beta Persei) is at a minimum, decreasing in magnitude from 2.1 to 3.4, on April 2nd, 5th, 8th, 11th, 14th, 16th, 19th, 22nd, 25th, and 28th. A favorable date for observing Algol at mid-eclipse from the eastern United States is on April 10th at 11:49 p.m. EDT or 3:49 UT on April 11th. For more on Algol, see http://stars.astro.i.../sow/Algol.html and http://www.solstatio...rs2/algol3.htm

Data on current supernovae can be found at http://www.rochesterastronomy.org/snimages/

It is possible to observe all 109 (or 110) Messier objects during a single night around the time of the vernal equinox, if the Moon phase and local latitude are favorable. For information on running a so-called Messier Marathon, browse http://messier.seds.org/xtra/marathon/marathon.html and http://www.richardbell.net/marathon.html

Information on observing some of the more prominent Messier galaxies is available at http://www.cloudynights.com/topic/358295-how-to-locate-some-of-the-major-messier-galaxies-and-helpful-advice-for-novice-amateur-astronomers/

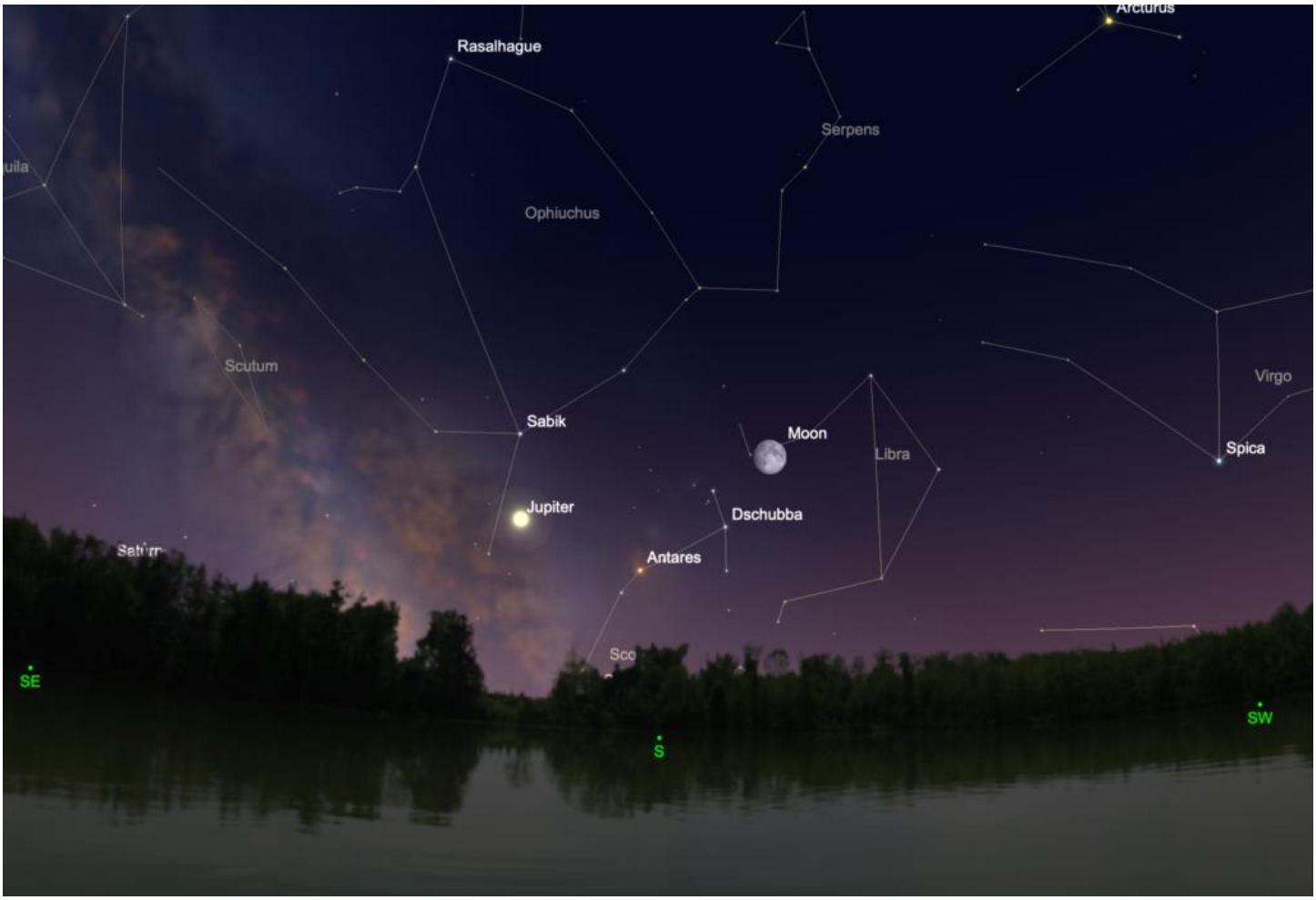
Finder charts for the Messier objects and other deep-sky objects are posted at https://freestarcharts.com/messier and https://freestarcharts.com/ngc-ic and http://www.cambridge.org/features/turnleft/seasonal_skies_january-march.htm

Telrad finder charts for the Messier Catalog and the SAC's 110 Best of the NGC are posted at http://www.astro-tom.com/messier/messier_finder_charts/map1.pdf and http://www.saguaroastro.org/content/db/Book110BestNGC.pdf respectively.

Deep-sky object list generators can be found at https://dso-browser.com/ and http://www.virtualcolony.com/sac/ and http://tonightssky.com/MainPage.php

Free sky atlases can be downloaded at http://www.deepskywatch.com/files/deepsky-atlas/Deep-Sky-Hunter-atlas-full.pdf and https://www.cloudynights.com/articles/cat/articles/observing-skills/free-mag-7-star-charts-r1021 and https://allans-stuff.com/triatlas/

The Moon, Mercury, and Mars line up in the west-northwestern evening sky after sunset on June 5, 2019.



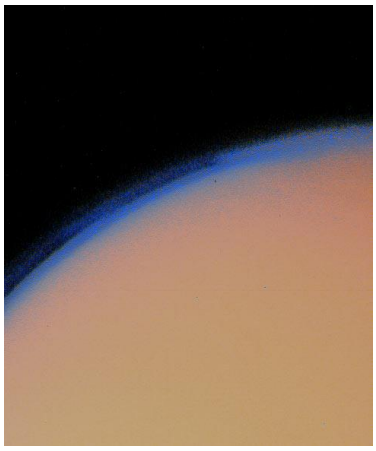
The Moon, Jupiter, and the star Antares form a tight triangle in the southeastern sky around midnight on June 15, 2019.

The British astronomer Edmund Halley discovered M13 on June 1, 1714. The French astronomer Nicolas Louis de Lacaille discovered the globular cluster M55 on June 16, 1752. A transit of the Sun by Venus was observed by Austrian, British, and French astronomers from various parts of the world on June 6, 1761. The French astronomer Charles Messier discovered the globular cluster M14 on June 1st, 1764, the emission and reflection nebula M20 (the Trifid Nebula) on June 5, 1764, and the open cluster M23 on June 20, 1764. The globular cluster M62 was discovered by Charles Messier on June 7, 1771. The French astronomer Pierre Méchain discovered his first deep-sky object, the spiral galaxy M63 (the Sunflower Galaxy), on June 14, 1779. The German/English astronomer William Herschel discovered the globular cluster NGC 6288 on June 24, 1784. Neptune was independently discovered by the British astronomer John Couch Adams on June 5, 1846. The Italian astronomer Giovanni Battista Donati discovered Comet C/1858 L1 (Donati), the first comet to be photographed, on June 2, 1858. A large storm on Saturn was observed by the American astronomer E. E. Barnard. The Tunguska event occurred on June 30, 1908. The largest known solar flare was recorded on June 27, 1984. The Georgian astronomer Givi Kimeridze discovered a Type Ia supernova in the spiral galaxy M58 on June 28, 1989. Namaka, a satellite of the dwarf planet Haumea, was discovered on June 30, 2005. Kerberos, Pluto's fourth satellite, was discovered by the Hubble Space Telescope team on June 28, 2011.

The *Voyager* Odyssey
Chapter 3: The Saturn flyby & the planet-moon Titan
by Loretta J Cannon

"We were looking at the shadow of Saturn on the rings, and it was clearly from this wild, crazy angle. Wow, holy cow, we're on the other side of Saturn."
- Rich Terrile, Imaging Science Team
quoted in documentary *The Farthest Voyager in Space* (2017)

The Voyager spacecrafts made their closest approaches to Saturn almost 40 years ago, in November 1980 for *Voyager 1* and August 1981 for *Voyager 2*. These flybys were no less fascinating and eye-opening than the Jupiter flybys. Among the mission goals at Saturn were: examine the moon Titan, examine the ring system up close, examine Saturn's atmosphere.


Titan's hazy atmosphere credit: NASA/JPL

Titan was identified by Huygens in 1655, the first of Saturn's moons to be discovered. By 1944, astronomers had observed an atmosphere on this planet-sized moon. [For *Star Wars* fans, think of the Rebel base on the 4th moon of the gas giant planet Yavin, only the Rebel moon had green plants and breathable air.] *Pioneer 11* data in 1979 indicated a thick atmosphere composed of organic compounds, e.g., methane etc. It was theorized that this small world may just be a model for the early earth, before oxygen-producing life existed. Thus, it was a very high priority for the *Voyagers*, so high that **if** *Voyager 1* had failed to gather data at Titan, then *Voyager 2* would have been re-directed to encounter Titan and we would have lost the ability to go on to Uranus and Neptune. Remember from Chapter 2, the graphic showing the trajectories of the two spacecraft out of the solar system. In order to get close enough to study Titan, *Voyager 1*'s path would take it 'up' out of the solar system's plane, with no hope of going to the outer planets.

The good news is that *Voyager 1* was successful at Titan! We were able to measure the moon's size and mass and learned that it's a world of both ice and rock, with a frigid surface temperature of -300 F. In addition to methane, the atmosphere is composed of nitrogen, ethane, ethylene, acetylene and hydrogen cyanide. Compounds that could be liquid, gas or solid at the temperatures and pressures on this planet-moon.

The mission engineers programmed *Voyager 2* to examine Saturn's atmosphere while flying very close to the planet, skimming close to a ring, and moving around behind the planet. During this maneuver, *Voyager* would observe sunlight passing through the atmosphere, and *Voyager*'s radio signals would pass through the atmosphere to be observed-analyzed on earth. This is a useful phenomena known as occultation. One body passes in front of another body and blocks a light source from reaching the second body; the detectable halo or outline of light around the second body, for planetary studies, provides valuable information. For the *Voyager* mission, this would be a great opportunity to observe: close-ups of the moons Tethys and Enceladus, the rings edge-on, Saturn's southern hemisphere, and analyze the molecular makeup of the atmosphere.


Saturn w/Tethys & Dione credit: NASA/JPL

It's important to note here that *Voyager* was flying close to 10 miles per second as it moved behind the planet, and it was expected to accelerate close to 15 miles per second coming out the curve. The scan platform on which the cameras and some of the instruments are housed has small motors to re-position said cameras and instruments. Further, while moving behind the planet (in relation to earth & the sun), temperatures will be much colder. As such, the engineers had to program the cameras and instruments to move quite rapidly to get the needed pictures (in focus) and required data in a very short time. And while all this amazing data was being acquired, *Voyager 2* would be out of contact with Earth for almost two hours.

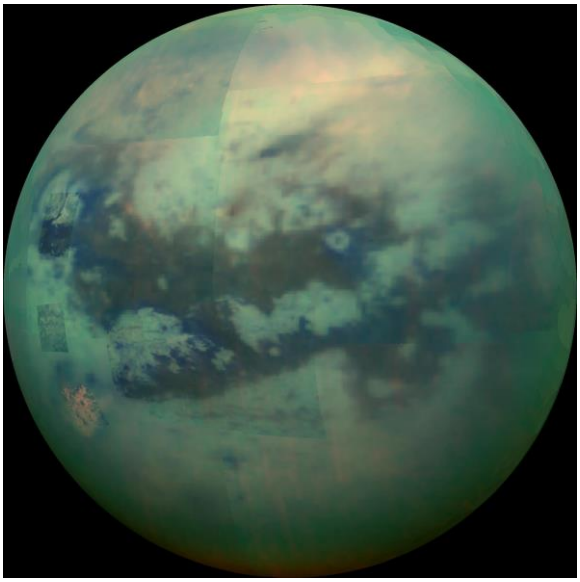
As *Voyager 2* began transmitting data again, the jubilation that the spacecraft was still 'alive' was short-lived. The images coming through were black. Something was seriously wrong. The biggest concern was that the spacecraft was hit by something during the ring crossing. The plasma wave subsystem scientist reported extremely high energy levels during ring crossing, suspected to have been caused by impacts from thousands of very small dust grains. This author searched for a copy of this recording on the NASA website to no avail. Here's a file claiming to be a Voyager recording of the sounds of Saturn's rings: https://www.youtube.com/watch?v=eVfkW9oxhIk . It is faint so you'll want to listen in a quiet room with the speakers turned up; authenticity unknown.

Eventually, the most likely scenario was that the scan platform froze up due to the fast and complicated machinations it was asked to do while going behind Saturn. Instructions were sent that had the platform making small, slow movements back and forth which seemed to get the gears moving normally. Yay, the cameras and instruments were fine and the scan platform was functioning again. Other than a disappointing loss of data, the mission could continue.

From both *Voyagers*, we learned that Saturn's atmosphere is only 7% helium as compared to Jupiter's 11%. It was thought that the helium may be sinking through the atmospheric hydrogen, which process may be involved in the heat radiated by Saturn (more than what's received from the Sun). As at Jupiter, winds move at high speeds, up to 1100 miles per hour; further, some winds may be moving north to south deep within the planet while surface winds are moving mostly eastwards. Auroras and auroral activity were imaged both at mid-latitudes and near the poles.

The most interesting fun fact identified was this: unlike all other planets in our solar system, Saturn is less dense than water. If a ginormous bowl of water could be imagined, the planet would float on the surface.

Our exploration of Saturn and Jupiter continued long after the *Voyager* mission left the planets. In the Jan 18, 2019 issue of *Science* (vol 363, issue 6424, pp. 214-5), there's a brief report on the results of the *Cassini* probe that explored Saturn and the *Juno* probe that explored Jupiter. *Cassini* found that Saturn's core may have a mass 15-18 times bigger than the Earth. In addition, the probe "was tugged by something deep within Saturn that could not be explained by the winds", something that was not experienced by *Juno* at Jupiter! But that's not the really interesting discovery. (Now remember, *Voyager* found that Saturn is not as dense as water.) *Cassini* found that Saturn vibrates, the whole planet! And these vibrations affect the rings "like the trace on a seismograph" and are being used to study and explain forces deep within the planet.



Titan as viewed by Cassini probe credit: NASA/JPL/Univ of AZ/Univ of ID

This amazing image of Titan was compiled by data from the *Cassini* probe, which looked beneath the thick haze with radar and spectrometers. The dark areas are believed to be lakes of liquid methane and ethane.

The *Voyager* mission laid a good foundation for planetary science. Imagine, in 1977 when the spacecraft were launched, we knew so little about Saturn, and neither professional nor amateur astronomers had seen much detail beyond a striated gas giant with three rings and ten moons. To date, not only have we identified seven ring groups but over 50 moons.

For the next chapter, we'll explore the early days of the *Voyager* mission. How an assignment given to a graduate student in aerodynamics at Caltech in the mid-1960s, regarding a maybe-someday exploration of the outer planets, became *The* mission in astrophysics in the 1980s.

[NOTE - Information Found: *Voyager 1*, which left the plane of the solar system first, is headed for the constellation Camelopardalis, to pass by star AC+79-3888. Perhaps you all could point a telescope in that direction at an upcoming star party and take a picture to share in an upcoming newsletter?]

bout the Author: Loretta J Cannon is a 3rd generation Idahoan. She earned both of her Bachelor degrees om Boise State University and her Masters from Arizona State University. After almost20 years working for cal banks, non-profits and the Federal government, she is somewhat retired and devotes her time to cience writing & editing and real estate. She can be reached at LorettaJCannon@gmail.com.

Phil Harrington's Cosmic Challenge

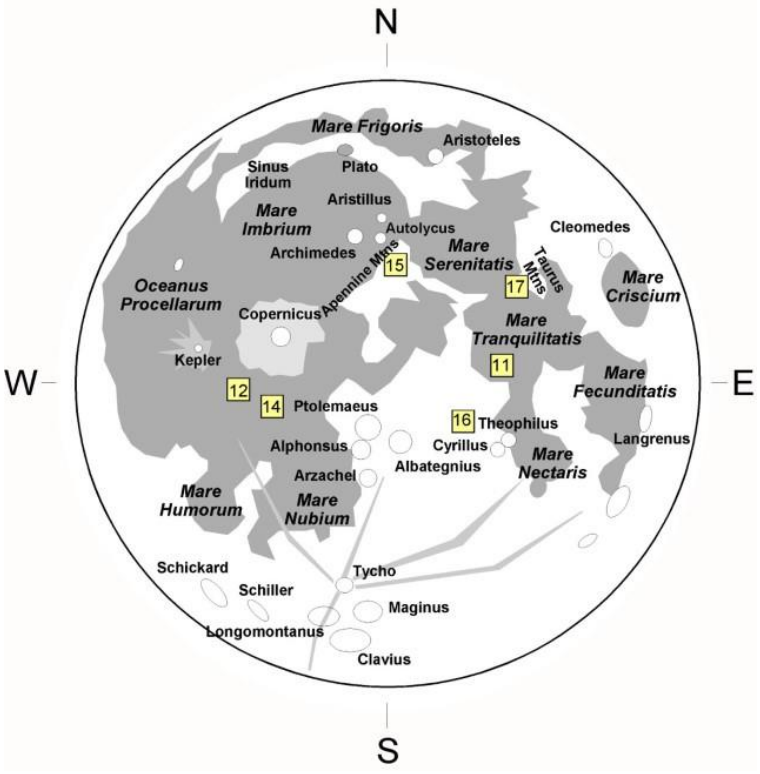
Cosmic Challenge: Apollo Landing Sites

	2-inch (5 cm) to 5-inch (13 cm) Telescopes

Target	Type	RA	DEC	Constellation	Magnitude	Size
Apollo landing sites	Lunar	n/a	n/a	n/a	n/a	n/a

Between July 1969 and December 1972, six teams of United States astronauts ventured across the gap between Earth and Moon to land and walk on that distant world. Have you ever visited their landing sites? If not, let's do so now.

Above: The Apollo space program logo. Source: NASA



Above: Finder chart for this month's Cosmic Challenge.
Click on the chart to open a printable PDF version in a new window.
Image reduced to fit newsletter format - Editor

We begin with **Apollo 11**, "Tranquility Base." The dark gray outline of Mare Tranquilitatis (the Sea of Tranquility) looks almost perfectly round from our earthly vantage point. The best time to view Mare Tranquilitatis is during the waxing crescent phases, about 5.5 to 6 days after New Moon. This month, that will be (at least here in North America) on the evening of June 9. Apollo 11 touched down near the southwestern shore, east-southeast of the craters Ritter and Sabine, fifty years ago next month, on July 20, 1969. "The Eagle [nickname of the mission's Lunar Module] has landed!"

Of course, the primary mission objective of Apollo 11 is obvious; in the words of the late President John F. Kennedy: to "land a man on the Moon and return him safely to the Earth." But there were also science goals, as well. Clearly, the first goal was to collect samples of the lunar surface. Astronauts Neil Armstrong and Edwin Aldrin collected 49 pounds (22 kg) of rock and soil samples during their single 2.5-hour moonwalk, or EVA (Extra-Vehicular Activity), as well as deployed Apollo Lunar Surface Experiments Package (ALSEP) instruments to check the composition of the solar wind, measure seismic activity, and determine the exact distance to the Moon. The latter, called the Laser Ranging Retroreflector, is still in use today, as are similar packages left by Apollo's 14 and 15. During the exploration, the astronauts also extensively photographed the lunar terrain.

Apollo 12 landed on Oceanus Procellarum (the Ocean of Storms) in November 1969. Dominating the waxing gibbous phases, the Ocean of Storms covers more than one million square miles of lunar terrain. The mission's exact landing site lies southeast of the crater Lansberg, which in turn is south-southwest of the prominent crater Copernicus. The area sees sunrise two nights after First Quarter. This month, that's on June 12. Watch as sunlight first bathes Copernicus' sharply defined walls, catching the strong central mountain peak before sliding down to the crater floor. Mark your calendar to come back in a few nights when the brilliant ray system of Copernicus explodes into view against the darker background of the mare. Its starburst pattern is unmistakable through even the most modest binoculars.

While Apollo 11's touchdown point was about four miles downrange from the predicted site, Apollo 12's landing crew, Pete Conrad and Alan Bean, really hit the mark. They landed the Lunar Module, "Intrepid," just 53 feet away from the Surveyor 3 unmanned spacecraft that the United States sent 2.5 years earlier. Beyond collecting more lunar samples, one key mission objective was to bring back components of that spacecraft. This enabled engineers and materials scientists to study the effect that the harsh lunar environment had on those parts. Incidentally, there's a long-lived urban legend that researchers examining Surveyor 3's camera, which was one component returned for study, discovered evidence of microorganisms inside the camera that had apparently stowed away before the 1966 launch. Even though that "fake news" persists on-line, it turns out that the microorganisms, Streptococcus Mitis, contaminated the camera after its return to Earth by Apollo 12, as this archived study reports. (Click on the "++ -- Description Continues" to read a capsule summary, where it states "may be the result of accidental contamination of the material after it was returned to Earth.")

After the nearly catastrophic mission of Apollo 13 in April 1970, we returned to the Moon 10 months later with the mission of **Apollo 14**. Its landing site was the hilly region known as Fra Mauro. Fra Mauro is found near the southeastern shore of the Ocean of Storms, to the east of Apollo 12. Fra Mauro experiences sunrise a night earlier, on June 11.

That location was chosen because it is believed to have been formed from debris left over from the impact that formed Mare Imbrium. The samples returned by Apollo 14 showed that Mare Imbrium is no more than about 4.25 billion years old. Apollo 14 featured the return to space by America's first astronaut, Alan B. Shepard Jr. Shephard had piloted the first Mercury mission, a suborbital flight known as Freedom 7, almost exactly a decade earlier. Serving as Apollo 14 commander, Shepard and Lunar Module pilot Edgar Mitchell, landed on February 5, 1971. While on the surface, Shepard famously hit a golf ball using a makeshift club made from a Wilson Staff 6-iron head attached to the "contingency return sample collector" he was to use on the Moon.

July 30, 1971 saw **Apollo 15** astronauts David Scott and James Irwin touch down next to Hadley Rille and the Apennine Mountains. The lunar Apennines mark the southeastern edge of Mare Imbrium (the Sea of Rains), just south of the prominent triangle of craters formed by Aristillus, Autolycus, and Archimedes. All three craters lie near the Moon's terminator, or sunrise line, on the night after First Quarter. Take a look on June 10, or a night or two later if it's cloudy.

Apollo 15 used a second-generation Lunar Module to bring along the first Lunar Rover. During their three EVAs, Scott and Irwin drove the Rover a total of 17.5 miles. In the process, they gathered over 170 pounds of lunar samples, including a core sample from about 10 feet beneath the lunar surface, and set up their mission's ALSEP instruments. One of the rocks returned became known as the Genesis Rock, one of the oldest samples returned at an estimated age of 4.1 billion years.

Piloted by Commander John Young and Lunar Module Pilot Charles Duke, **Apollo 16** landed just north of the crater Descartes in the highlands south of Mare Tranquilitatis on April 20, 1972. The craters Theophilus and Cyrillus are to the east of the landing site, while Albategnius is roughly an equal distance to its west. June 9, the night before First Quarter is perfect for viewing this area. Just west of Albategnius, three more striking craters that almost touch each other's borders – Ptolemaeus, Alphonsus, and Arzachel – see sunrise the following evening.

Apollo 16's landing site in the lunar highlands was chosen so that the astronauts could gather geologically older lunar material than in the lunar Maria landing sites of Apollo's 11, 12, and 15. Young and Duke drove the second Lunar Rover 16.6 miles (26.7 km) during their three EVAs. Along the way, they gathered 211 pounds (95.8 kg) of lunar samples for return to Earth. Those samples proved that the area was not volcanic in origin, as had been previously believed.

Apollo 17's landing on December 1972 signaled an end to the Apollo era. We find its site near the Taurus Mountains, which form the eastern rim of Mare Serenitatis (the Sea of Serenity). The best time to view this area is during the waxing crescent phases on June 7 and for a few nights thereafter. The mission's Taurus-Littrow landing site was selected because it offered the best of both worlds, a combination of mountainous highlands and valley lowlands.

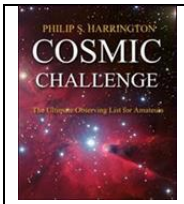
Mission Commander Eugene Cernan and Harrison Schmitt explored the region with the third Lunar Rover, covering 22.3 miles (35.9 km) in three EVAs. In the process, they gathered a record 243.7 pounds (110.5 kg) of samples. Schmitt knew especially what to look for, as he was the only trained geologist ever to walk on the lunar surface.

Cernan became the last man to walk on the Moon when he left its surface on December 14, 1972. Before climbing the ladder back into the Lunar Module, his last words from the surface were "…as I take man's last step from the surface, back home for some time to come - but we believe not too long into the future - I'd like to just [say] what I believe history will record. That America's challenge of today has forged man's destiny of tomorrow. And, as we leave the Moon at Taurus-Littrow, we leave as we came and, God willing, as we shall return, with peace and hope for all mankind. Godspeed the crew of Apollo 17."

I find it very sad that Eugene Cernan is still the last man on the Moon nearly half a century later. When will we return to the Moon? Who will be the next visitor on the surface to walk in the shadows of our Apollo heroes? Only time will tell. But even as we remain confined to our planet for the foreseeable future, we can relive the magic of the historic Apollo program this month as we get ready to commemorate the half-century anniversary of Apollo 11 in July. Visit each of the landing sites from your own yard this month. And then get ready, because next month, we return to explore in greater detail the Apollo 11 landing site and three commemoratively named craters that lie nearby.

Until next month, remember that half of the fun is the thrill of the chase. Game on!

First step on the Moon by Astronaut Neil A. Armstrong
Added to the article by the Editor



About the Author: Phil Harrington writes the monthly *Binocular Universe* column in Astronomy magazine and is the author of 9 books on astronomy. Visit his web site at www.philharrington.net to learn more.

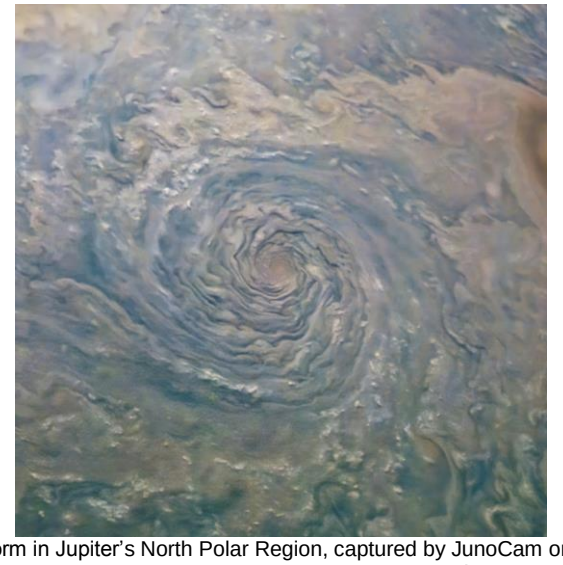
This article is distributed by NASA Night Sky Network
The Night Sky Network program supports astronomy clubs across the USA dedicated to astronomy outreach. Visit nightsky.jpl.nasa.org to find local clubs, events, and more!

Jupiter Shines in June

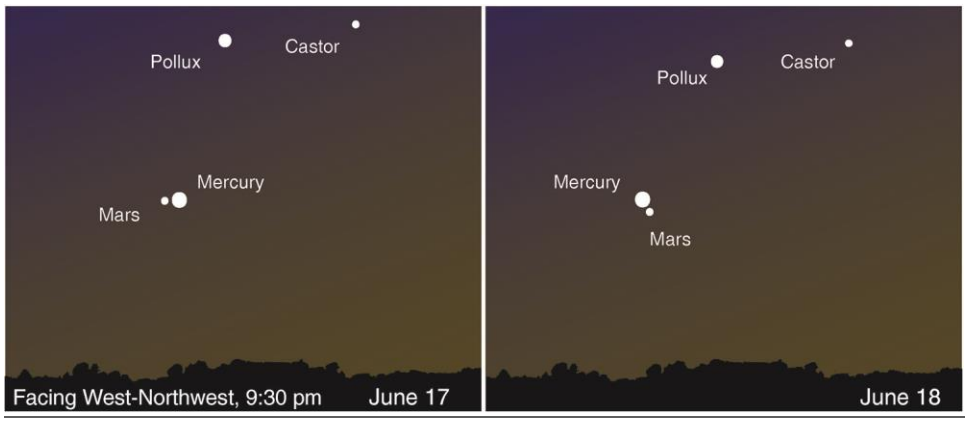
By David Prosper

Jupiter stakes its claim as the king of the planets in June, shining bright all night. Jupiter is visible almost the entire evening this month. Earth will be between Jupiter and the Sun on June 10, meaning Jupiter is at **opposition**. On that date, Jupiter rises in the east as the Sun sets in the west, remaining visible the entire night. Jupiter will be one of the brightest objects in the night sky, shining at magnitude -2.6. Its four largest moons and cloud bands are easily spotted with even a small telescope.

What if your sky is cloudy or you don't have a telescope? See far more of Jupiter than we can observe from Earth with NASA's **Juno** mission! Juno has been orbiting Jupiter since 2016, swooping mere thousands of miles above its cloud tops in its extremely elliptical polar orbits, which take the probe over 5 million miles away at its furthest point! These extreme orbits minimize Juno's exposure to Jupiter's powerful radiation as it studies the gas giant's internal structure, especially its intense magnetic fields. Juno's hardy JunoCam instrument takes incredible photos of Jupiter's raging storms during its flybys. All of the images are available to the public, and citizen scientists are doing amazing things with them. You can too! Find out more at bit.ly/JunoCam. Discover more about NASA's current and future missions at nasa.gov.



Caption: A giant storm in Jupiter's North Polar Region, captured by JunoCam on February 4, 2019.
Image processing performed by citizen scientists Gerald Eichstädt and Seán Doran.Source: bit.ly/JupiterSpiral



Caption: Mars and Mercury after sunset the evenings of June 17-18, 2019. Image created with assistance from Stellarium.

Observatory and Planetarium

CSI Centennial Observatory / Faulkner Planetarium Herrett Center

Event	Place	Date	Time	Admission
Summer Solar Session #2	Centennial Observatory	Wednesday, June 5th, 2019	1:30 to 3:30 PM	FREE
Monthly Free Star Party	Centennial Observatory	Saturday, June 8th, 2019	9:45 PM to midnight	FREE
Summer Solar Session #3	Centennial Observatory	Wednesday, June 12th, 2019	1:30 to 3:30 PM	FREE
Summer Solar Session #4	Centennial Observatory	Wednesday, June 19th, 2019	1:30 to 3:30 PM	FREE
Hagerman Star Party (6th annual)	Hagerman Fossil Beds National Monument	Saturday, June 22nd, 2019	2:00 PM to 12:00 AM	FREE
Summer Solar Session #5	Centennial Observatory	Wednesday, June 26th, 2019	1:30 to 3:30 PM	FREE

College of Southern Idaho Campus Twin Falls, ID
Faulkner Planetarium / Show Times
http://herrett.csi.edu/astronomy/planetarium/showtimes.asp

Now Showing

About the Magic Valley Astronomical Society

Magic Valley Astronomical Society
550 Sparks St.
Twin Falls, ID

The Magic Valley Astronomical Society (MVAS) was founded in 1976. The Society is a non-profit [501(c) 3] educational and scientific organization dedicated to bringing together people with an interest in astronomy.

In partnership with the Centennial Observatory, Herrett Center, College of Southern Idaho - Twin Falls; we hold regularly scheduled monthly meetings and observation sessions, at which we share information on current astronomical events, tools and techniques for observation, astrophotography, astronomical computer software, and other topics concerning general astronomy. Members enthusiastically share their telescopes and knowledge of the night sky with all who are interested. In addition to our monthly public star parties we hold members only star parties at various locations throughout the Magic Valley.

MVAS promotes the education of astronomy and the exploration of the night sky along with safe solar observing through our public outreach programs. We provide two types of outreach; public star parties and events open to anyone interested in astronomy, and outreach programs for individual groups and organizations (e.g. schools, churches, scout troops, company events, etc.), setting up at your location. All of our outreach programs are provided by MVAS volunteers at no cost. However, MVAS will gladly accept donations. Donations enable us to continue and improve our public outreach programs.

Membership is not just about personal benefits. Your membership dues support the work that the Magic Valley Astronomical Society does in the community to promote the enjoyment and science of astronomy.
Speakers, public star parties, classes and support for astronomy in schoolrooms, and outreach programs just to name a few of the programs that your membership dues support.

Annual Membership dues will be:
$20.00 for individuals, families, and $10.00 for students.
Contact Treasurer Jim Tubbs for dues information via e-mail: jtubbs015@msn.com

Donations to our club are always welcome and are even tax deductible. Please contact a board member for details.

Membership Benefits:
Lending Telescopes: The society currently has three telescopes for loan and would gladly accept others please contact President Robert Mayer, for more information on these and other benefits.

Telescopes are an individual thing and not practical for public use. However, everyone should have the experience of a good look at the moon for at least 5 minutes in their life time. It is a dimension and feeling that is unexplainable. Pictures or TV can't give this feeling, awareness, or experience of true dimension. A person will not forget seeing our closest neighbor, the moon. Norman Herrett in a letter to Dr. J. L. Taylor, president of the College of Southern Idaho, Twin Falls, ID, USA.