# What's Up?

Highlighting the Near and Deep Sky

June 2024

### Moon Phases

New Moon June 6 8:40am





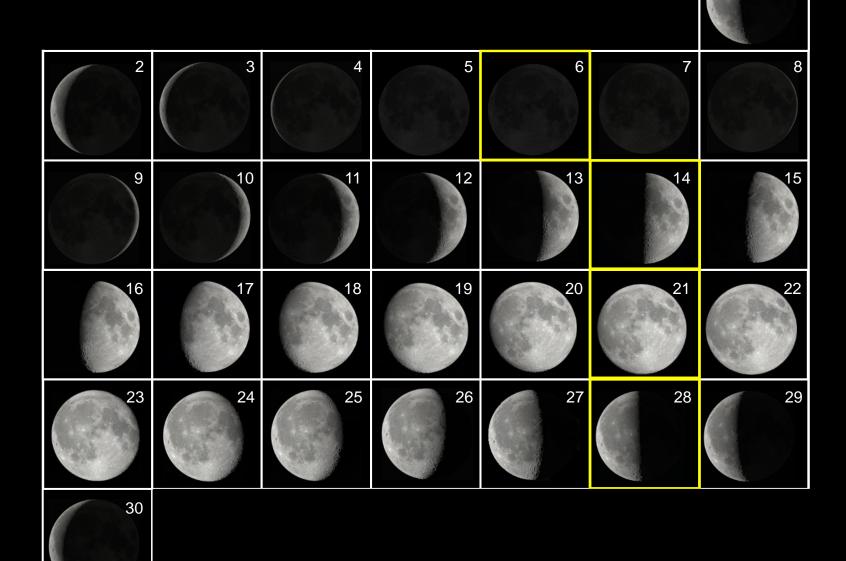
Full Moon June 21 9:10pm





Last Quarter

June 28

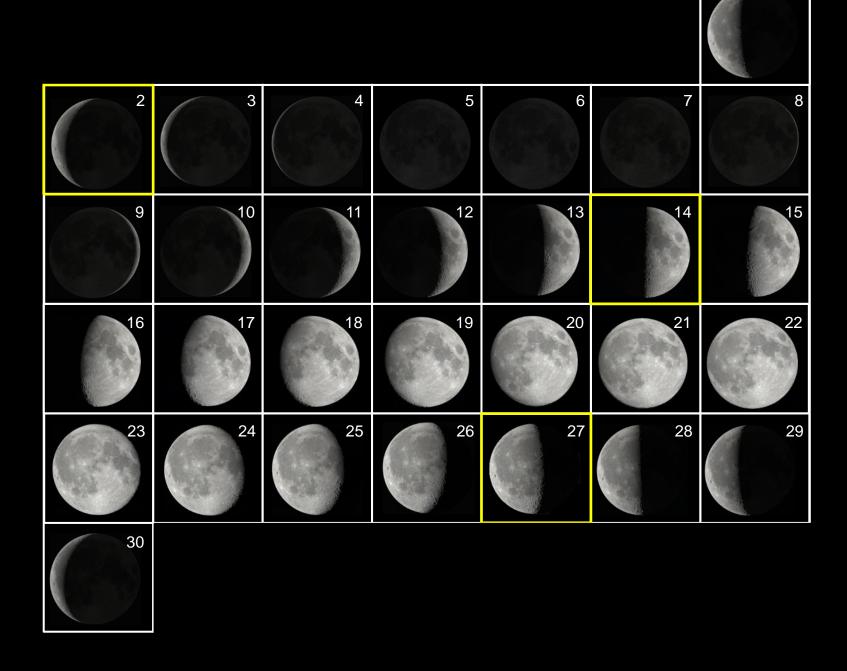


### Moon Apsides

Perigee June 2, 3:16am 228,728 miles (368,102 km)

Apogee June 14, 9:35am 251,082 miles (404,077 km)

Perigee June 27, 7:30am 229,464 miles (369,286 km)



## (Some) Forces on the Moon

### **Evection**

- Formerly called the Moon's second anomaly, and Latin for "carrying away."
- Short version: The gravitational pull by the Sun changes throughout the Moon's already-elliptical orbit as distance changes, sometimes aided and sometimes impeded by the gravitational pull of the Earth.

### **Variation**

 That gravitational pull of the Earth is stronger at perigee and weaker at apogee, and each of these can occur at varying places in the Moon's orbit (sometimes during syzygy alignment, sometimes during quadrature, most of the time in between).

These forces result in a 205.89 day cycle of perihelion/aphelion distances, mostly from evection with a small contribution from variation.

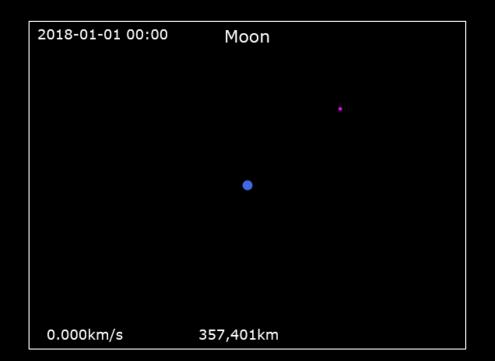
Evection.

69. The next term +  $\frac{1}{2}me \sin\{(2-2m-c) \ pt-2\beta+\alpha\}$ in the value of  $\theta$  has been named the *Evection*. We shall consider its effect in two different ways. Firstly, by itself, as forming a correction on pt.  $\theta = pt + \frac{1}{2}me\sin\left\{\left(2 - 2m - c\right)pt - 2\beta + a\right\}.$ = moon's mean longitude at time t, Let ) = $\odot = mpt + \beta = sun's$  .....  $\alpha' = (1-c) pt + \alpha = mean longitude of apse \dots,$ then  $\theta = pt + \frac{1}{2}me \sin[2 \{pt - (mpt + \beta)\} - \{pt - (1 - c) pt + \alpha\}]$  $= pt + \frac{1}{2}me \sin \{2(\mathbf{p} - \mathbf{o}) - (\mathbf{p} - \alpha')\}.$ The effect of this term will therefore be as follows: In syzygies  $\theta = pt - \frac{1}{2}me \sin(1) - \alpha';$ or the true place of the moon will be before or behind the mean, according as the moon, at the same time, is between apogee and perigee or between perigee and apogee. In quadratures  $\theta = pt + \frac{1}{2} me \sin(1) - \alpha'),$ and the circumstances will be exactly reversed. In both cases, the correction will vanish when the apse happens to be in syzygy or quadrature at the same time as the moon. In intermediate positions, the nature of the correction is more complex, but it will always vanish when the sun is at the middle point between the moon and the apse, or when distant 90° or 180° from it; for if  $\odot = \frac{1+\alpha'}{2} - r.90^\circ$ , where  $r = 0, \pm 1$ , or 2,  $\sin[2(\mathfrak{d} - \mathfrak{d}) - (\mathfrak{d} - \alpha')] = \sin(\mathfrak{d} + \alpha' - 2\mathfrak{d})$  $=\sin r.180^{\circ}$ 

### Lunar Precession

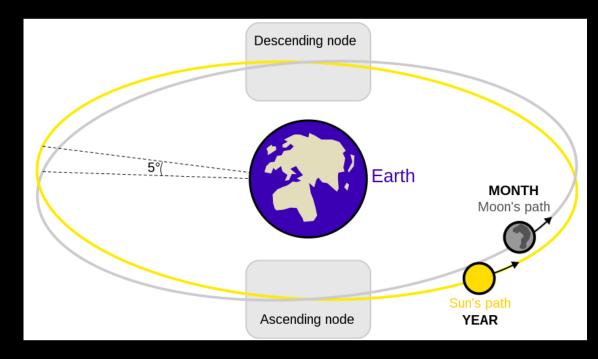
### **Apsidal Precession**

 The major axis of the Moon's orbit (from perihelion to aphelion) makes a full rotation to the east every 8.85 years.

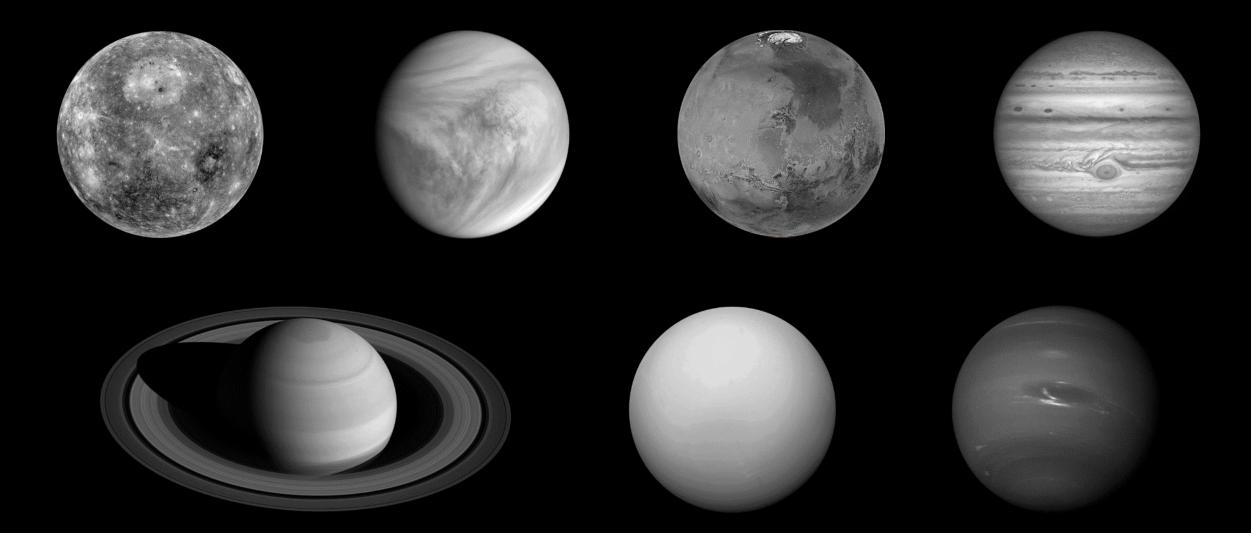


### **Nodal Precession**

 The ascending node of the Moon's orbit (lunar orbit rising above solar) makes a full rotation to the west every 18.6 years.

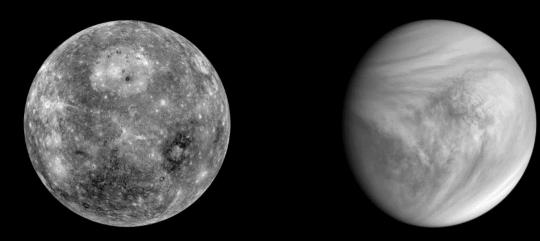


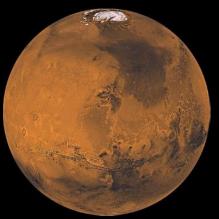
## **Evening Planets?**



# How About Morning Planets? (all times for June 15)

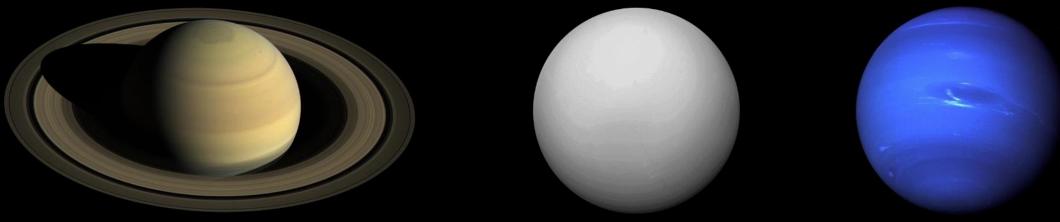
Rising at 03:11





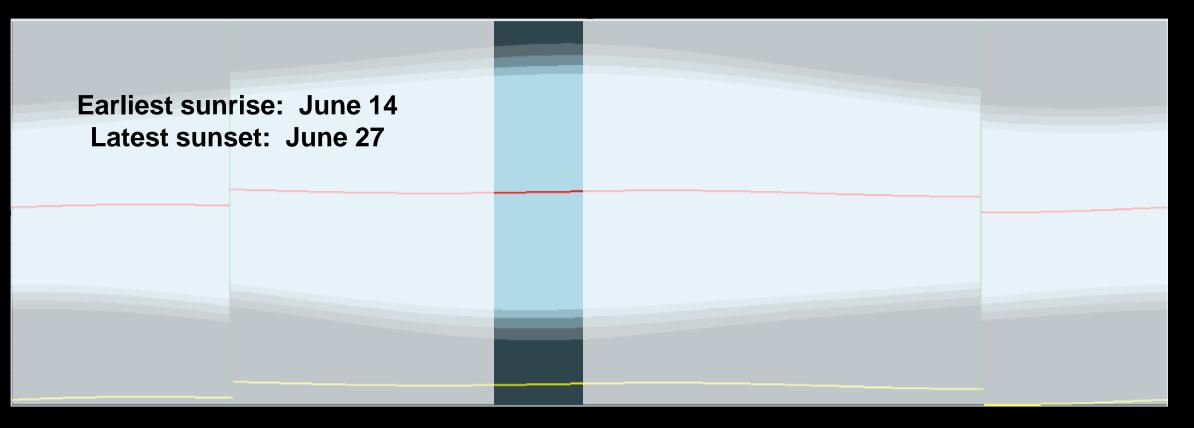
Rising at 04:43



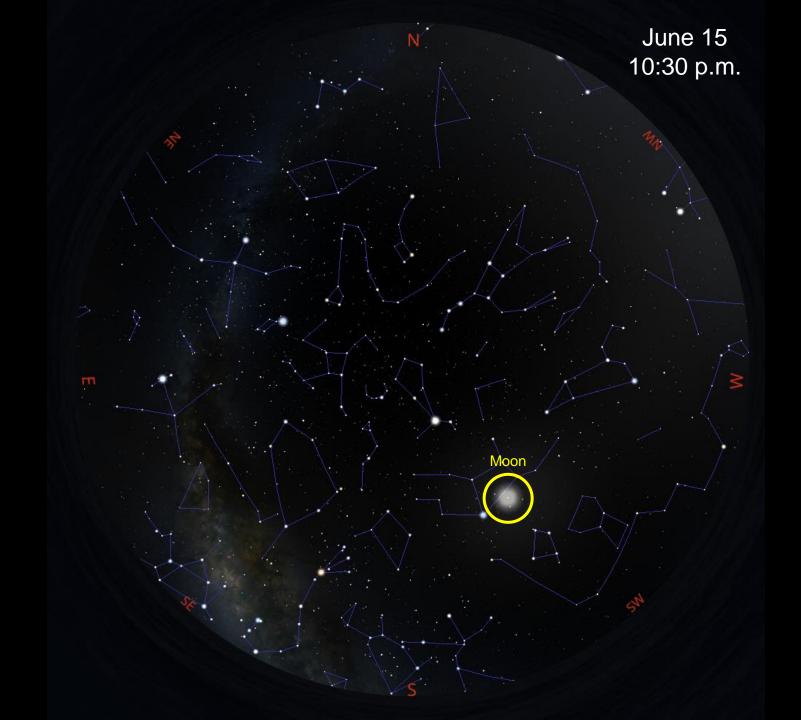


Rising at 01:21

Rising at 01:44



	End of Night	End of Astronomical Twilight	End of Nautical Twilight	Sunrise	Sunset	Beginning of Nautical Twilight	Beginning of Astronomical Twilight	Beginning of Night
June 1	4:10am	4:52am	5:30am	6:00am	8:34pm	9:05pm	9:43pm	10:25pm
June 10	4:06am	4:49am	5:28am	5:58am	8:40pm	9:10pm	9:49pm	10:32pm
June 20	4:06am	4:49am	5:28am	5:59am	8:43pm	9:14pm	9:53pm	10:37pm
June 30	4:10am	4:53am	5:31am	6:02am	8:44pm	9:15pm	9:53pm	10:36pm



### Celestial Event #1

Friday, June 7 "Daytime Arietids" meteor shower peak

The most active daytime meteor shower (60-200/hour)



Mars

Kitchener 75 Rochester Rome<sup>®</sup> Utica Madison Hamilton Milwaukee Syracuse -London 401 Grand Rapids 69 NEW YORK Lansing Janesville The second 75 00 390 Dubuque Waterloo Ithaca 😈 Detroit Ann Arbor Rockford 86 380 ..... Erie Binghamto Elmira Elgin 275 Cedar Rapids Chicago 180 Naperville 39 **E**khart Iowa City Toledo 80 South Bendo Cleveland Davenport Joliet Scranton 90 480 80 380 Akron 75 Fort Wayne Ottumwa 76 0 Galesburg Youngstow 75 Mansfield Wooster Canton Burlington PENNSYLVANIA Peoria 99 Allento 55 Bloomington Pittsburgh Lafayette Harrisburg Kirksville OHIO Muncie ILLINOIS Champaign INDIANA Wheeling 70 Lancaster 70 72 Columbus 76 Springfield 76 Spring Decatur Indianapolis York 70 Dayton ancaste Morgantow Terre Haute 70 Greenwood MARYLAND Hamilton Mason Baltimore 55 Cincinnati Washington Columbia O'Fallon Alton 70 65 St. Louis 81 Jefferson City WEST Ū T Harrisonburg 64 WRGINIA Fredericksburg Louisville MISSOURI Frankfort Lexington Staunton Charlottesville Evansville Rolla 64 Owenshord Carbondale Richmond Elizabethtown Richmond 44 165 Lynchburg KENTUCKY 75 Blacksburg Cape Paducal Girardeau U Bowling Gree 55 National Forest Norfolk Poplar Bluff Clarksville Kingspor 55 Nashville Paragould Winston-Saler Durhan Knoxville 40 Mour 40 Franklino Murfreesbord Pigeon Forge Nags Head Raleigh 15 NORTH TENNESSEE Hickory Jackson Asheville 40 Mooresville 75 Charlotte Memphis 0 Chattanooga Fayetteville Collierville Rock Hill Southaven Jacksonville Huntsville ARKANSAS 22 Decatur Morehead C rancis Marion 📆 National Forest 59 & Sumte Tupelo Pine Bluff Wilmington Florence Alpharetta US Athens Carolina Beach Columbiao SOUTH Atlanta CAROLINA 59 Myrtle Beac 20 Birmingham Augusta MISSISSIPPI Starkville 459 26 Tuscaloosa Summerville Macon ALABAMA Charlestor 95 185 Auburr GEORGIA Ruston Monro Statesboro Meridia Ū Jackson Vicksburge 20 Brandor Savannah 59 55 75 Laurel

Alban

MISSISSauda

DELAWARE **Celestial Event #2** Ocean City Saturday, June 15, 1:15:21.5am **Occultation of star** TYC 7404-03568-1 Virginia Beach by asteroid 623 Chimaera RA 18:16:13.8114 DEC -37°24'57.828"

NEW

HAMPSHIRE

MASSACHUSETTS salem

Worcester

Springfie

Hartford

CONNECTICUT

New Haven

Concord Portsmo

Boston

**QFall River** 

495

RHODE

ISLAND

Providence

Saratoga

Albany

22

New York Long Island

476

Philadelphia

**NEW JERSEY** 

Atlantic City

Spring

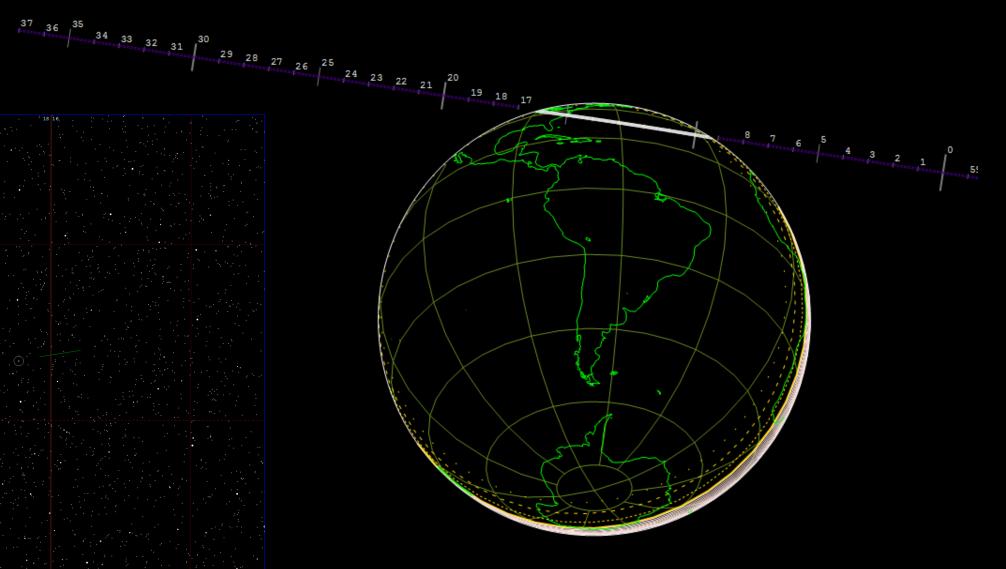
### 623 Chimaera occults TYC 7404-03568-1 on 2024 Jun 15 from 5h 9m to 5h 16m UT

Star: (Dia < 0.1 mas) Mv 11.7; Mb 11.9; Mr 11.5 RA = 18 16 13.8114 (astrometric) Dec = -37 24 57.828 ... [of Date: 18 17 55, -37 24 28] Prediction of 2023 Jul 14.4 Reliable 1.1 (good),

Durations: Max = 3.5 secs 1km = 0.081 secs, 1mas = 0.10 secs Mag Drop: 3.1 [94%]v, 2.8 [92%]r Sun : Dist = 163° Moon: Dist = 88°, illum = 59% 10 Err: ±(15.0 x 3.7) mas in PA 79°

Asteroid: (in DAMIT) Mag = 14.6 Dia = 44 ±3km, 35 mas Parallax = 5.070" Hourly dRA =-2.950s dDec = 5.42" JPL#932023Apr24, Known errors

### 2024 Jun 15, 623 Chimaera @ 6hr steps Plot 42' x 42', to Mag 15.0



UCAC4 vis Occult 4.2024.1.26

### Celestial Event #3

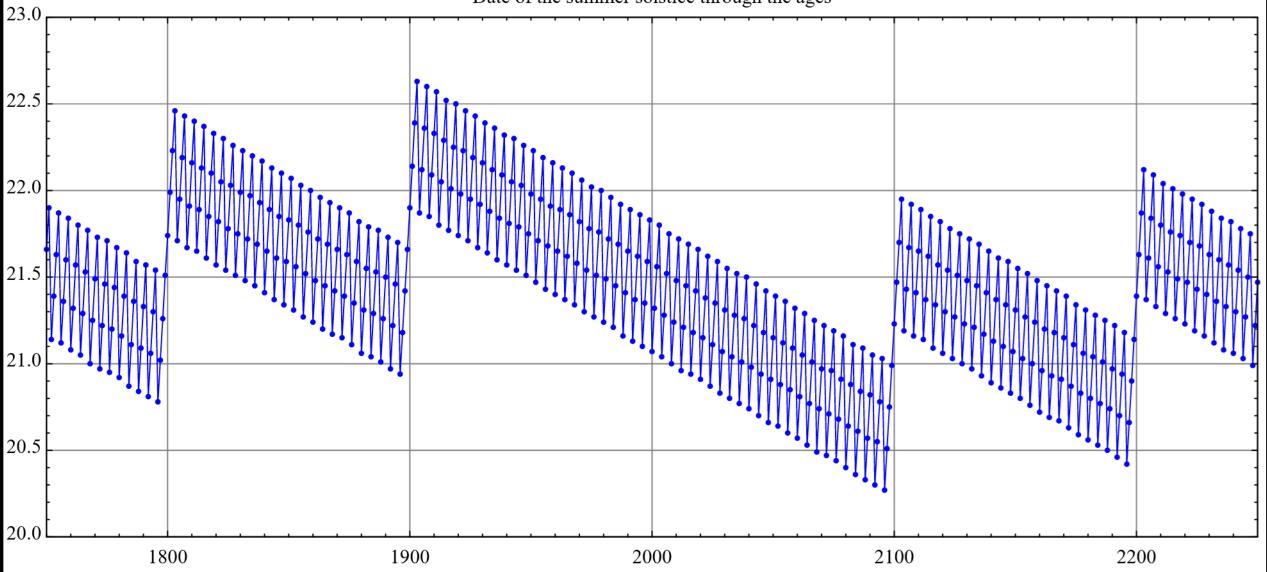
- Thursday, June 20: Solstice (4:51pm)
  - Earliest solstice since 1896
  - The next solstice earlier than 2024 will be in 2028, then 2032, etc.
- 2020: 5:43pm 2036: 2:31pm
- 2024: 4:51pm
- 1896: 4:28pm
- 2028: 4:02pm
- 2032: 3:09pm

- 2040: 1:46pm
- 2044: 12:50pm
- 2048: 11:54am
- 2052: 11:16am

- 2020: 5:43pm
- 2021: 11:32pm 2
- 2022: 5:14am\*
- 2023: 10:58am\*
- 2024: 4:51pm

- 2025: 10:42pm
- 2026: 4:25am\*
- 2027: 10:11am\*
- 2028: 4:02pm
- 2029: 9:48pm

Leap shifting of the gregorian calender Date of the summer solstice through the ages



<u>Celestial Event #4</u> Thursday, June 27 June Boötid meteor shower peak

Usually 1-2 meteors/hour, but outbursts up to ~100/hour have happened (last in 1998)

Antihelion

Earth, Roanoke, 296 m

June Bootids

Arcturus







<u>Celestial Event #5</u> Thursday, June 27, 9:00am Try to spot Saturn during the day!

Earth, Roanoke, 296 m

### Astronomical League Lunar Program

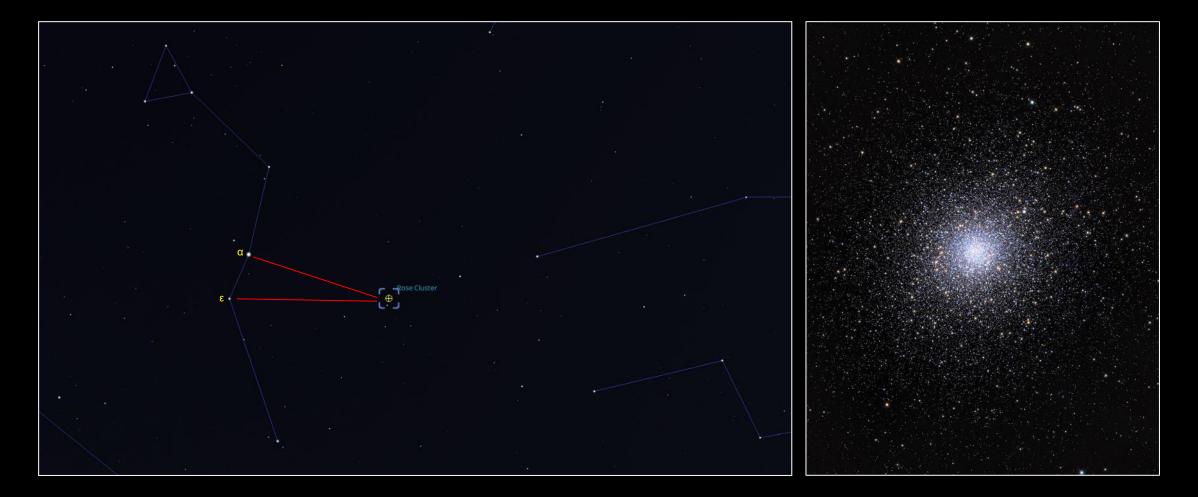
- Objects to observe with naked eye (18), binoculars (46), and telescopes (36)
  - Certificate available for completing only the naked eye and binocular portion
- 100 observations required
  - 100 "standard" items on the list, plus 10 "optional activities" that each count as two observations (6 naked eye, 2 binocular, 2 telescope)
- Both visual and imaging permitted
- Some observations must be completed only at certain lunar phases
- 2" minimum telescope recommendation
- Manual observations only, no remote telescopes or GoTo systems permitted



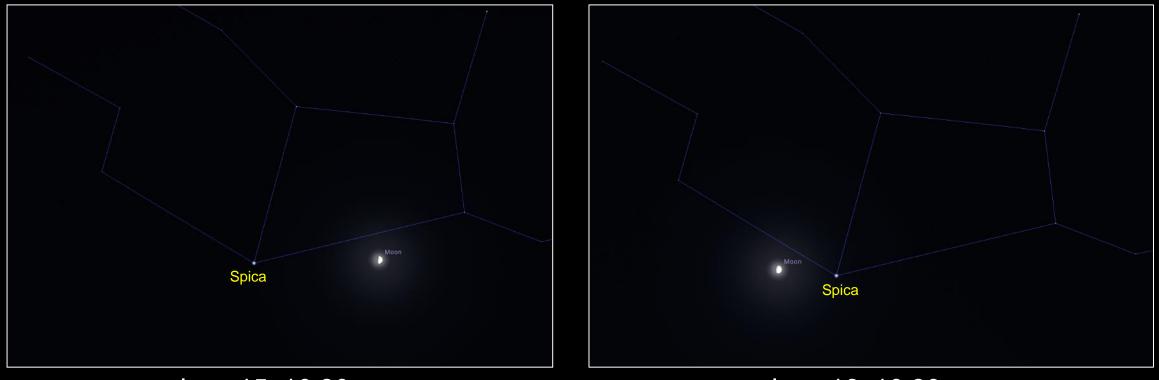
# Monthly Telescope Target: IC 4592 (Blue Horsehead Nebula)



# Monthly Binocular Target: M5 (Rose Cluster)



# Monthly Naked Eye Target: Watch the Moon Switch Sides of Spica



June 15, 10:30pm

June 16, 10:30pm

## Image Credits

- Lunar phases: Screenshots from Stellarium
- Evection text: H. Godfray: *Elementary Treatise on the Lunar Theory*, 1859. Hosted on the Internet archive: <u>https://archive.org/details/anelementarytre02godfgoog/page/n82/mode/2up</u>
- Apsidal precession: Wikipedia user Phoenix7777, using data from the HORIZONS system / JPL / NASA
- Nodal precession: Wikipedia user SuperManu, modifying an older image from Tom Ruen
- Original planet images:
  - Mercury: NASA / JHUAPL / Carnegie Institution of Washington
  - Venus: Kevin M. Gill / DARTS / ISAS / JAXA
  - Mars: NASA / JPL
  - Jupiter: NASA / ESA / A. Simon (GSFC) / M.H. Wong (UC Berkeley)
  - Saturn: NASA / JPL-Caltech / SSI
  - Uranus: NASA (modified by Wikipedia user Jcpag2012)
  - Neptune: NASA / JPL-Caltech

- Sun rise/set bar: timeanddate.com
- All-sky view, Arietid radiant, Bootid radiant, and Moon-Saturn conjunction: Screenshots from Stellarium
- 623 Chimaera occultation visualizations and path generated by <u>https://www.poyntsource.com/</u>
- Leap shifting of the Gregorian calendar: Wikipedia user Baszoetekouw, using data generated by Astrolabe (astrolabe.sourceforge.net)
- Moon rising over forest art: NASA
- Monthly sky target charts: Screenshots from Stellarium
- IC4592 image: Giuseppe Donatiello
- M5 image: Adam Block / Mount Lemmon SkyCenter / University of Arizona

# Questions ???