December 2019 Astronomy Calendar by Dave Mitsky
Some information supplied and/or added by Tony Donnangelo

All times are Eastern Standard Time (-5 hrs. U.T.).

Events listed are based on a location of 40°N in the Eastern US and may not be visible in all areas.

Concerning moderate and minor meteor shower activity:
Do not have any high expectations. This general information is to account for why you might be seeing a few more than normal meteors during your observing session.

Lunar light rays may occur prior to or after the predicted time. Initial observations might have occurred after the ray’s inception or continued after the observer’s session. Rays may last a very short time or for many hours. Obtain further information; send reports (including non-occurrences and miss-calculations), photos, and observations of new rays to:

12/1 Comet C/2017 T2 (PANSTARRS) is at opposition at 1.650 A.U.
12/1 Comet 203P/Korlevic is at closest approach to Earth at 2.256 A.U.
12/1 60th anniversary (1959) of first color photo of Earth taken from space (Thor missile).
12/1 Asteroid (2) Pallas is in conjunction with the Sun at 9:00 p.m.
12/1 Comet 160P/LINEAR is at perihelion at 1.787 A.U.
12/2 Posidonius (sunrise) lunar light ray predicted to occur at 7:50:31 p.m.
12/3 Comet C/2018 F4 (PANSTARRS) is at perihelion at 3.441 A.U.
12/3 Robert G Harrington's 115th birthday (1904).
12/3 European Space Week being held through the 5th in Helsinki, Finland.
12/3 Hipparchus (sunrise) lunar light ray predicted to occur at 6:59:54 p.m.
12/4 Comet 114P/Wiseman-Skiff is at closest approach to Earth at 0.723 A.U.
12/4 60th anniversary (1959) of Little Joe 2 launch (monkey "Sam").
12/4 The earliest end of evening twilight at 40° north takes place today.
12/4 The Lunar X (Purbach or Werner Cross), an X-shaped illumination effect involving various rims and ridges between the craters La Caille, Blanchinus, and Purbach, is predicted to occur at 01:44 a.m.
12/4 First Quarter Moon occurs at 1:58 a.m.
12/4 The Moon is at apogee, subtending 29' 33" from a distance of 404,446 kilometers (251,311 miles), at 11:08 p.m.
12/5 Comet 298P/Christensen is at opposition at 1.893 A.U.
12/5 Bonpland (sunrise) lunar light ray predicted to occur at 5:12:06 p.m.
12/5 Hesiodus (sunrise) lunar light ray predicted to occur at 5:15:27 p.m.
12/6 Clyde Cowan's 100th birthday (1919).
12/7 The earliest sunset at latitude 40° north occurs today.
12/7 Comet P/2006 H1 (McNaught) is at perihelion at 2.423 A.U.
12/7 Scheiner (sunrise) lunar light ray predicted to occur at 2:05:00 a.m.
12/7 Griffith Observatory Public Star Party being held in Los Angeles.
12/7 Tempel (sunset) lunar light ray predicted to occur at 10:19:49 p.m.
12/8 Comet P/2013 EW90 (Tenagra) is at opposition at 2.938 A.U.
12/8 The Moon is 5° north of Uranus at 6:00 a.m.
12/9 Comet P/2018 L5 (Leonard) is at opposition at 2.952 A.U.
12/9 75th anniversary (1944) of Wallops Island launch site founded.
12/10 Comet P/1996 R2 (Lagerkvist) is at closest approach to Earth at 2.128 A.U.
12/10 Phocylides (sunrise) lunar light ray predicted to occur at 1:38:25 a.m.
12/10 The Moon is 7.3° south of the bright open cluster M45 (the Pleiades or Subaru) in Taurus at 2:00 p.m.
12/10 Venus is 1.8° south of Saturn at 11:00 p.m.
12/11 Venus passes 1.8 degrees from Saturn.
12/11 Comet 48P/Johnson is at closest approach to Earth at 2.734 A.U.
12/11 Comet 83D/Russell is at opposition at 3.013 A.U.
12/11 John Macklin's 80th birthday (1939).
12/11 The Moon is 2.9° north of the first-magnitude star Aldebaran (Alpha Taurii) at 6:00 a.m.
12/12 Comet 71P/Clark is at opposition at 3.660 A.U.
12/12 Comet 325P/Yang-Gao is at opposition at 4.245 A.U.
12/12 Full Moon (known as the Before Yule, Cold, Long Nights, and Oak Moon) occurs at 1:12 a.m.
12/12 Venus, Saturn, and Pluto lie within a circle with a diameter of 2.7° at 2:00 p.m.
12/12 The Moon is 1.5° south of the bright open cluster M35 in Gemini at 11:00 p.m.
12/13 Geminids Meteor Shower Peak
12/13 Royal Astronomical Society (RAS) Ordinary Meeting being held in London, United Kingdom.
12/13 Sir William McCrea's 115th birthday (1904).
12/13 The Moon is at the ascending node (longitude 98.4°) at 9:00 a.m.
12/13 Venus (magnitude -3.9) is 1.1° south of Pluto (magnitude +14.3) at 11:00 a.m.
12/13 Geminids meteor shower (major activity - 100 to 120 per hour) peaks at 2:00 p.m. on the 14th. Duration is from 6th to 19th. The Geminids are dust from asteroid (3200) Phaethon. Observing and history: http://meteorshowersonline.com/geminids.html
12/14 Endymion (sunset) lunar light ray predicted to occur at 4:04:46 a.m.
12/14 Austin Astronomical Society Star Party being held in Pedernales Falls State Park, Texas.
12/14 Dinosaur Valley State Park Star Party being held in Glen Rose, Texas.
12/14 The Moon is 5.3° south of the first-magnitude star Pollux (Beta Geminorum) at 1:00 p.m.
12/15 Comet 9P/Tempe is at opposition at 3.621 A.U.
12/15 Charles Augustus Young's 185th birthday (1834).
12/15 The Moon is 1.0° north of the bright open cluster M44 (the Beehive Cluster or Praesepe) in Cancer at 11:00 a.m.
12/15 Maskelyne P (sunset) lunar light ray predicted to occur at 10:05:32 p.m.
12/16 Comet 294P/LINEAR is at closest approach to Earth at 1.957 A.U.
12/16 Comet P/2013 EW90 (Tenagra) is at closest approach to Earth at 2.931 A.U.
12/16 Hans Suess' 110th birthday (1909).
12/16 Mercury is 5.0° N-NE of the 1st magnitude star Antares (Alpha Scorpii) at 2:00 a.m.
12/16 Maskelyne F (sunset) lunar light ray predicted to occur at 10:58:23 p.m.
12/17 Comet P/2012 O1 (McNaught) is at opposition at 2.041 A.U.
12/17 Comet C/2019 V1 (Borisov) is at opposition at 2.729 A.U.
12/17 The Moon is 3.7° north of the first-magnitude star Regulus (Alpha Leonis) at 2:00 a.m.
12/18 Comet 298P/Christensen is at closest approach to Earth at 1.870 A.U.
12/18 Gottfried Kirch's 380th birthday (1639).
12/18 Lade (sunset) lunar light ray predicted to occur at 1:28:13 a.m.
12/18 Egede (sunset) lunar light ray predicted to occur at 4:05:50 a.m.
12/18 The Moon is at perigee, subtending 33' 16" from a distance of 370,265 kilometers (230,072 miles), at 3:25 p.m.
12/18 The Sun enters the constellation of Sagittarius (ecliptic longitude 266.6°) at 3:00 p.m.
12/18 Coma Berenicids meteor shower (minor activity) peaks from 12/18 to 1/6. Duration is from 12/8 to 1/23. Observing and history: http://meteorshowersonline.com/showers/coma_berenicids.html
12/18 Last Quarter Moon occurs at 11:57 p.m.
12/19 Comet P/1996 R2 (Lagerkvist) is at opposition at 2.141 A.U.
12/19 Mercury is at the descending node today.
12/19 Ptolemaeus (sunset) lunar light ray predicted to occur at 3:24:25 a.m.
12/19 Archimedes (sunset) lunar light ray predicted to occur at 5:16:18 p.m.
12/19 Venus is at its southernmost latitude from the plane of the ecliptic (-3.4°) at 6:00 p.m.
12/20 Mt. Wilson Observatory's 115th birthday (1904).
12/20 Ames Research Center's 80th birthday (1939).
12/20 Comet 237P/LINEAR is at opposition at 4.057 A.U.
12/20 The Curtiss Cross, an X-shaped clair-obscure illumination effect located between the craters Parry and Gambart, is predicted to be visible at 4:23 a.m.
12/20 Night Sky Program being held in Florissant Fossil Beds National Monument, Colorado.
12/20 The Moon is 7.2° N-NE of the 1st magnitude star Spica (Alpha Virginis) at 11:00 p.m.
12/21 Comet 289P/Bianpain is at perihelion at 0.959 A.U.
12/21 Francis Bacon's 115th birthday (1904).
12/21 Winter Solstice is at 11.19 p.m. The Sun's longitude is 270°
12/21 The Moon is 4.0° south of Mars at 9:00 p.m.
12/21 The peak of the Ursid meteor shower (5 to 10 per hour) occurs at 10:00 p.m.
12/24 The Moon is 7.1° north-northeast of Antares at 6:00 a.m.
12/25 Gerhard Herzberg's 115th birthday (1904).
12/25 The Moon is 1.9° north-northeast of Mercury at 7:00 a.m.
12/25 The equation of time equals 0 (i.e., mean solar time equals apparent solar time) at 11:00 a.m.
12/25 An annular solar eclipse visible from Saudi Arabia, the United Arab Emirates, Oman, southern India, Sri Lanka, Sumatra, Singapore, Borneo, part of the Philippines, and Guam begins at 10:43 p.m. and ends at 2:01 a.m.
12/26 New Moon (lunation 1200) occurs at 12:13 a.m.
12/26 The Moon is 0.3° northeast of Jupiter at 3:00 a.m.
12/26 The Moon is at the descending node (longitude 278.4°) at 8:00 a.m.
12/26 The Moon is at its southernmost declination (-23.2°) for the year at 3:00 p.m.
12/27 The Moon is 1.2° south of Saturn at 12:00; the Moon is 0.6° south of Pluto, with an occultation taking place in southern Madagascar, southernmost Africa, Kerguelen Island, portions of Antarctica, South Georgia, and southern South America, at 10:00 a.m.
12/27 Jupiter is in conjunction with the Sun at 2:00 p.m.
12/28 Staunton River State Park Observing Session being held in Staunton River State Park, Scottsburg, Virginia
12/28 Star Gazing at the Marsh Event being held in Collier-Seminole State Park, Naples, Florida.
12/28 Maarten Schmidt's 90th birthday (1929).
12/28 The Moon is 1.0° south of Venus, with an occultation taking place in southernmost South America and Antarctica, at 9:00 p.m.
12/29 Comet 389P/Siding Spring is at perihelion at 1.663 A.U.
12/29 Comet P/2017 R1 (PANSTARRS) is at opposition at 3.623 A.U.
12/30 Comet 76P/West-Kohoutek-Ikemura is at closest approach to Earth at 0.950 A.U.
12/30 Comet P/2013 R3 (Catalina-PANSTARRS) is at opposition at 2.025 A.U.
12/30 Comet C/2019 V1 (Borisov) is at closest approach to Earth at 2.696 A.U.
12/30 Comet C/2014 E1 (Larson) is at opposition at 3.095 A.U.
12/30 Comet 135P/Shoemaker-Levy is at opposition at 3.458 A.U.
12/30 Mercury is at aphelion today.
12/30 The middle of the eclipse season (i.e., the Sun is at the same longitude as the Moon’s descending node, 278.3°) occurs at 3:00 a.m.
12/31 Robert Aiken's 155th birthday (1864).

Tycho Brahe, Johannes Kepler, Isaac Newton, E. E. Barnard, and Arthur Eddington were born in December.

Giovanni Cassini discovered the Saturnian satellite Rhea on December 23, 1672. Nicolas Louis de Lacaille discovered NGC 2070 (the Tarantula Nebula) on December 5, 1751. The bright spiral galaxies M81 and M82 in Ursa Major were discovered by Johann Bode on December 31, 1774. William Herschel discovered the galaxy pair NGC 3166 and NGC 3169 in Sextans on December 19, 1783. Caroline Herschel discovered Comet C/1791 X1 (Herschel) on December 15, 1791. The Jovian satellite Himalia was discovered by Charles Perrine on December 3, 1905. Audouin Dolfus discovered the Saturnian satellite Janus on December 15, 1966. The Saturnian satellite Epimetheus was discovered by Richard Walker on December 18, 1966.

The peak of Geminid meteor shower occurs on the morning of December 14th but is adversely affected by moonlight from a bright waning gibbous Moon. The Geminids, which are associated with the Palladian asteroid, or possible cometary nucleus, 3200 Phaethon, have become the most reliable meteor shower of the year. Geminid meteors appear to originate from a radiant that’s just northwest of Castor (Alpha Geminorum). That radiant lies almost at the zenith at 2:00 a.m. local time. Geminid meteors travel at a relatively slow speed of 35 kilometers per second (22 miles per second). An article on this year's Geminids can be found on pages 48 and 49 of the December 2019 issue of *Sky & Telescope*. The Ursids, a normally minor meteor shower with a maximum zenithal hourly rate of 10 per hour, peak on the morning of December 23rd and are not affected by a thin crescent Moon. A surge of up to 30 meteors per hour may occur this year. The radiant is located close to Kochab (Beta Ursae Minoris), some 15 degrees from the celestial pole. See [https://earthsky.org/space/everything-you-need-to-know-geminid-meteor-shower](https://earthsky.org/space/everything-you-need-to-know-geminid-meteor-shower) and [https://www.imo.net/resources/calendar/](https://www.imo.net/resources/calendar/) for additional information on the Geminids and [https://earthsky.org/?p=2976](https://earthsky.org/?p=2976) and [https://www.imo.net/resources/calendar/](https://www.imo.net/resources/calendar/) for more on the Ursids.

Information on Iridium satellite flares and passes of the ISS, the X-37B, the HST, and other satellites can be found at [http://www.heavens-above.com/](http://www.heavens-above.com/)

The Moon is 4.2 days old, is illuminated 19.1%, subtends 30.4 arc minutes, and is located in Virgo on December 1st at 0:00 UT. Due to the position of the ecliptic, the Moon reaches its highest point in the sky for the year in December. It attains its greatest northern declination (+23.2 degrees) for the month on December 14th and greatest southern declination (-23.2 degrees) on December 27th. Longitudinal libration is at a maximum of +5.0 degrees on December 26th. It’s at a minimum of -4.7 degrees on December 12th. Latitudinal libration is at a maximum of +6.8 degrees on December 7th and a minimum of -6.8 degrees on December 20th. New Moon occurs on December 26th. The Moon is at apogee (a distance of 63.41 Earth-radii) on December 5th and at perigee (a distance of 58.05 Earth-radii) on December 18th. The Moon occults Pluto on December 27th and Venus on December 29th from certain parts of the world. Consult [http://www.lunar-occultations.com/iota/iotandx.htm](http://www.lunar-occultations.com/iota/iotandx.htm) for more on these events. Visit [http://saberdoesthestars.wordpress.com/2011/07/05/saber-does-the-stars/](http://saberdoesthestars.wordpress.com/2011/07/05/saber-does-the-stars/) for tips on spotting extreme crescent Moons and [http://www.curtrenz.com/moon.html](http://www.curtrenz.com/moon.html) for Full Moon data. Browse [http://www.cambridge.org/features/turnleft/the_moon.htm](http://www.cambridge.org/features/turnleft/the_moon.htm) and [http://www.shallowsky.com/moon/](http://www.shallowsky.com/moon/) for information on various lunar features. Click on [https://www.calendar-12.com/moon_calendar/2019/december](https://www.calendar-12.com/moon_calendar/2019/december) for a lunar phase calendar for this month. Times and dates for the lunar crater light rays predicted to occur this month are available at [http://www.lunar-occultations.com/rlo/rays/rays.htm](http://www.lunar-occultations.com/rlo/rays/rays.htm)
The Sun is located in Ophiuchus, a non-traditional constellation of the zodiac, on December 1st. Sol enters Sagittarius on December 18th. Winter solstice for the northern hemisphere occurs when the Sun is farthest south for the year on December 21st. It is the shortest "day" of the year (9 hours and 20 minutes) at latitude 40 degrees north. An annular solar eclipse visible from western Australia, Asia, the Middle East, eastern Europe, extreme eastern Africa, the Indian Ocean, and the Pacific Ocean occurs on December 26th. It’s the 46th eclipse of 71 in Saros 132. Greatest eclipse takes place in eastern Sumatra (Indonesia) at 05:17:48 UT1 and has an annular duration of 3 minutes 39 seconds. For more on this event, consult http://www.eclipsewise.com/oh/ec2019.html#SE2019Dec26A or page 49 of the December 2019 issue of Sky & Telescope.

Brightness, apparent size, illumination, distance from the Earth in astronomical units (a.u.), and location data for the planets and Pluto on December 1st: Mercury (magnitude -0.6, 6.3", 69% illuminated, 1.07 a.u., Libra), Venus (magnitude -3.9, 11.6", 89% illuminated, 1.44 a.u., Sagittarius), Mars (magnitude +1.7, 3.9", 98% illuminated, 2.39 a.u., Virgo), Jupiter (magnitude -1.8, 32.1", 100% illuminated, 6.15 a.u., Sagittarius), Saturn (magnitude +0.6, 15.4", 100% illuminated, 10.78 a.u., Sagittarius), Uranus (magnitude +5.7, 3.7", 100% illuminated, 19.18 a.u. on December 16th, Aries), Neptune (magnitude +7.9, 2.3", 100% illuminated, 30.05 a.u. on December 16th, Aquarius), and Pluto (magnitude +14.3, 0.1", 100% illuminated, 34.80a.u. on December 16th, Sagittarius).

During the evening, Venus, Jupiter, and Saturn can be found in the southwest, Uranus in the southeast, and Neptune in the south. Uranus is in the west at midnight. In the morning, Mercury and Mars are located in the southeast.

Venus, Saturn, and Pluto are all located in Sagittarius within a circle with a diameter of 2.7 degrees on December 12th.

A bright gibbous Mercury is visible in the southeastern morning sky in early December. By December 16th, the speediest planet will be too close to the Sun to be seen. It is at the descending node on December 19th. The Moon passes less than two degrees north-northeast of Mercury on December 25th. The closest planet to the Sun is at aphelion on December 30th. Mercury shrinks in apparent size from 6.3 to 4.9 arc seconds but increases in illumination from 69 to 99% during December.

Venus climbs higher into the morning sky and Saturn sinks lower as the month unfolds. The bright globular cluster M22 lies less than one degree to the north of Venus on December 2nd. M75, another globular cluster, lies with one degree of Venus on the night of December 18th and December 19th. Venus and Saturn are five degrees apart on December 6th. The second-magnitude star Nunki (Sigma Sagittarii) is less than two degrees from Venus on that date. Venus passes less than two degrees from Saturn on December 11th. That distance increases to more than ten degrees by December 20th. Venus is at its heliocentric latitude south on December 20th. The Moon passes one degree south of the brightest planet on December 28th. Venus increases in apparent size to 13.0 arc seconds but decreases in illumination to 82% by December 31st.

A tiny Mars exits Virgo and enters Libra early in the month. It climbs higher in the morning sky and reaches an elongation of 40 degrees by the end of December. The Red Planet rises by more than three hours before the Sun as the year ends. Mars is four degrees south of the waning crescent Moon on the night of December 23rd.

Jupiter is lost in the sunset by midmonth. The largest planet is in conjunction with the Sun on December 27th.

Saturn lies very low in the southwest during December. Saturn’s disk spans 15 arc seconds and its rings 35 arc seconds on December 1st. Its rings are tilted by 24 degrees. A slender crescent Moon passes 1.2 degrees south of the Ringed Planet on December 27th.
Uranus lies in southern Aries near the border with Pisces, a region lacking in any bright stars. Uranus is five degrees north of the Moon on December 8th. The gas giant planet attains an altitude of about 60 degrees in the south around 9:30 p.m. local time early in the month and doesn’t set until a few hours after midnight. Visit http://www.bluewaterastronomy.info/resources/Maps/Charts-2019/09uranus_2019_1.pdf and http://www.nakedeyeplanets.com/uranus.htm for finder charts.

Neptune is located 1.5 degree west-southwest of the fourth-magnitude star Phi Aquarii on the first day of the month. As December ends, Neptune lies 1.1 degrees from the star. The waxing gibbous Moon passes four degrees south of Neptune on 10th. Neptune sets before midnight this month. Browse http://www.bluewaterastronomy.info/resources/Maps/Charts-2019/10neptune_2019_1.pdf and http://www.nakedeyeplanets.com/neptune.htm for finder charts.


Pluto will not be readily visible again until next year.

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

Comet C/2017 T2 (PanSTARRS) may brighten to ninth magnitude as it heads northwestward along the border of Perseus and Camelopardalis. The comet passes just north of the open cluster NGC 1528 in Perseus on December 15th and through the faint emission nebula Sharpless 2-205. Visit http://cometchasing.skyhound.com/ and http://www.aerith.net/comet/future-n.html for information on comets that are visible this month. A list of the closest approaches of comets to Earth is posted at http://www.cometography.com/nearcomet.html

Asteroid 15 Eunomia shines at tenth magnitude as it travels northeastward through Aquarius this month. It passes 0.8 degree south of the third-magnitude star Alpha Aquarii on December 17th. During the final week of December, Eunomia glides through the Water Jar asterism, which consists of Gamma, Pi, Zeta, and Eta Aquarii. Asteroid 55 Pandora (magnitude +11.1) occults the 6.5-magnitude star 18 Aurigae for up to 7 seconds from Africa, southern United States, and Mexico on the evening of December 6th. Click on http://www.asteroidoccultation.com/2019_12/1207_55_62270.htm for additional information. Asteroids brighter than magnitude +11.0 reaching opposition this month include 97 Klotho (magnitude +10.1) on December 2nd, 28 Bellona (magnitude +10.5) on December 10th, 132 Aethra (magnitude +10.5) on December 14th, and 69 Hesperia (magnitude +10.5) on December 30th. For information on this year’s bright asteroids and upcoming asteroid occultation events, consult http://www.curtrenz.com/asteroids.html and http://asteroidoccultation.com/ respectively.

A wealth of current information on solar system celestial bodies is posted at http://nineplanets.org/ and http://www.curtrenz.com/astronomy.html

Various events taking place within our solar system are discussed at https://cosmicpursuits.com/night-sky-this-month/ and 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/

The famous eclipsing variable star Algol (Beta Persei) is at a minimum, decreasing in magnitude from +2.1 to +3.4, on December 2nd, 5th, 8th, 10th, 13th, 16th, 19th, 22nd, 25th, 28th, and 30th.
Algol is at minimum brightness for approximately two hours and is well-placed for observers in N America on the nights of December 4th (centered at 10:18 p.m. EST) and December 25th (centered at 12:02 a.m. EST). Consult page 50 of the December 2019 issue of *Sky & Telescope* for the times of the eclipses. For more on Algol, see [http://stars.astro.illinois.edu/sow/Algol.html](http://stars.astro.illinois.edu/sow/Algol.html) and [http://www.solstation.com/stars2/algol3.htm](http://www.solstation.com/stars2/algol3.htm)


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

Finder charts for the Messier objects and other deep-sky objects are posted at [https://freestarcharts.com/messier](https://freestarcharts.com/messier) and [https://freestarcharts.com/ngc-ic](https://freestarcharts.com/ngc-ic) and [http://www.cambridge.org/features/tturnleft/seasonal_skies_july-september.htm](http://www.cambridge.org/features/tturnleft/seasonal_skies_july-september.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](http://www.astro-tom.com/messier/messier_fINDER_chARTS/map1.pdf) and [http://sao64.free.fr/observations/catalogues/cataloguesac.pdf](http://sao64.free.fr/observations/catalogues/cataloguesac.pdf) respectively.


Author Phil Harrington offers an excellent freeware planetarium program for binocular observers known as TUBA (Touring the Universe through Binoculars Atlas), which also includes information on purchasing binoculars, at [http://www.philharrington.net/tuba.htm](http://www.philharrington.net/tuba.htm)

Stellarium and Cartes du Ciel are useful freeware planetarium programs that are available at [http://stellarium.org/](http://stellarium.org/) and [https://www.ap-i.net/skychart/en/start](https://www.ap-i.net/skychart/en/start)


**Comet information for: July 31, 2019 11:12 p.m. (New Moon).**

<table>
<thead>
<tr>
<th>Constellation</th>
<th>Rises</th>
<th>Transits</th>
<th>Sets</th>
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<tbody>
<tr>
<td>Camelopardalis</td>
<td>circumpolar</td>
<td>9:28 p.m.</td>
<td></td>
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<tr>
<td>Pices</td>
<td>11:31 a.m.</td>
<td>6:21 p.m.</td>
<td>1:11 a.m.</td>
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<tr>
<td>Andromeda</td>
<td>8:16 a.m.</td>
<td>5:18 p.m.</td>
<td>2:19 a.m.</td>
</tr>
<tr>
<td>Aquarius</td>
<td>10:24 a.m.</td>
<td>3:46 p.m.</td>
<td>9:08 p.m.</td>
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</tbody>
</table>
For location (40°16'N 76°45'W) Hummelstown, PA, USA:

**December 1:**

<table>
<thead>
<tr>
<th>Event</th>
<th>Time</th>
<th>Altitude</th>
<th>Azimuth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum altitude:</td>
<td>23:56</td>
<td>-71.6°</td>
<td>360°</td>
</tr>
<tr>
<td>Nautical twilight begins:</td>
<td>06:06</td>
<td>-12.0°</td>
<td>109°</td>
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<tr>
<td>Civil twilight begins:</td>
<td>06:40</td>
<td>-6.0°</td>
<td>114°</td>
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<tr>
<td>Sunrise:</td>
<td>07:10</td>
<td>-0.8°</td>
<td>118°</td>
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<tr>
<td>Maximum altitude:</td>
<td>11:56</td>
<td>27.9°</td>
<td>180°</td>
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<tr>
<td>Sunset:</td>
<td>16:42</td>
<td>-0.8°</td>
<td>242°</td>
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<tr>
<td>Civil twilight ends:</td>
<td>17:12</td>
<td>-6.0°</td>
<td>246°</td>
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<tr>
<td>Nautical twilight ends:</td>
<td>17:45</td>
<td>-12.0°</td>
<td>251°</td>
</tr>
<tr>
<td>Astronomical twilight ends:</td>
<td>18:18</td>
<td>-18.0°</td>
<td>256°</td>
</tr>
</tbody>
</table>

**January 1:**

<table>
<thead>
<tr>
<th>Event</th>
<th>Time</th>
<th>Altitude</th>
<th>Azimuth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum altitude:</td>
<td>00:10</td>
<td>-72.8°</td>
<td>360°</td>
</tr>
<tr>
<td>Astronomical twilight begins:</td>
<td>05:52</td>
<td>-18.0°</td>
<td>105°</td>
</tr>
<tr>
<td>Nautical twilight begins:</td>
<td>06:25</td>
<td>-12.0°</td>
<td>110°</td>
</tr>
<tr>
<td>Civil twilight begins:</td>
<td>06:59</td>
<td>-6.0°</td>
<td>115°</td>
</tr>
<tr>
<td>Sunrise:</td>
<td>07:30</td>
<td>-0.8°</td>
<td>120°</td>
</tr>
<tr>
<td>Maximum altitude:</td>
<td>12:11</td>
<td>26.7°</td>
<td>180°</td>
</tr>
<tr>
<td>Sunset:</td>
<td>16:51</td>
<td>-0.8°</td>
<td>240°</td>
</tr>
<tr>
<td>Civil twilight ends:</td>
<td>17:22</td>
<td>-6.0°</td>
<td>245°</td>
</tr>
<tr>
<td>Nautical twilight ends:</td>
<td>17:56</td>
<td>-12.0°</td>
<td>250°</td>
</tr>
<tr>
<td>Astronomical twilight ends:</td>
<td>18:29</td>
<td>-18.0°</td>
<td>255°</td>
</tr>
</tbody>
</table>

For location (40°16'N 76°45'W) Hummelstown, PA, USA:

**December 1:**

<table>
<thead>
<tr>
<th>Event</th>
<th>Mercury Right ascension</th>
<th>Venus Right ascension</th>
<th>Mars Right ascension</th>
<th>Jupiter Right ascension</th>
<th>Saturn Right ascension</th>
<th>Uranus Right ascension</th>
<th>Neptune Right ascension</th>
<th>Pluto Right ascension</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15° 8' 42.6&quot;</td>
<td>18° 28' 24.2&quot;</td>
<td>14° 22' 18.5&quot;</td>
<td>17° 57' 33.0&quot;</td>
<td>19° 16' 54.9&quot;</td>
<td>2° 4” 2.2“</td>
<td>23° 8” 48.5“</td>
<td>19° 32” 2.8“</td>
</tr>
<tr>
<td>Declination</td>
<td>-15° 23' 53”</td>
<td>-24° 45' 17&quot;</td>
<td>-13° 29' 32&quot;</td>
<td>-23° 17' 51&quot;</td>
<td>-22° 10' 9&quot;</td>
<td>-6° 36' 48&quot;</td>
<td>-22° 22' 16”</td>
<td></td>
</tr>
<tr>
<td>Elongation from Sun</td>
<td>1.076</td>
<td>1.436</td>
<td>2.385</td>
<td>6.149</td>
<td>10.783</td>
<td>19.012</td>
<td>29.797</td>
<td>34.650</td>
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<tr>
<td>Brightness</td>
<td>-0.5</td>
<td>-3.8</td>
<td>1.7</td>
<td>-1.7</td>
<td>0.6</td>
<td>5.7</td>
<td>7.9</td>
<td>14.3</td>
</tr>
<tr>
<td>Equatorial Diameter</td>
<td>6.25&quot;</td>
<td>11.62&quot;</td>
<td>3.93&quot;</td>
<td>32.06&quot;</td>
<td>15.41&quot;</td>
<td>3.71&quot;</td>
<td>2.29&quot;</td>
<td>0.09&quot;</td>
</tr>
<tr>
<td>Phase Angle</td>
<td>66.1°</td>
<td>39.2°</td>
<td>18.2°</td>
<td>3.8°</td>
<td>3.6°</td>
<td>1.7°</td>
<td>1.9°</td>
<td>1.1°</td>
</tr>
<tr>
<td>Constellation</td>
<td>Libra</td>
<td>Sagittarius</td>
<td>Libra</td>
<td>Sagittarius</td>
<td>Sagittarius</td>
<td>Aries</td>
<td>Aquarius</td>
<td>Sagittarius</td>
</tr>
<tr>
<td>Rises</td>
<td>05:30</td>
<td>09:28</td>
<td>04:36</td>
<td>08:50</td>
<td>10:04</td>
<td>14:48</td>
<td>12:57</td>
<td>10:20</td>
</tr>
</tbody>
</table>
### January 1:

<table>
<thead>
<tr>
<th>Object</th>
<th>Right ascension</th>
<th>Declination</th>
<th>Equatorial Diameter</th>
<th>Phase Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury</td>
<td>11:47</td>
<td>11.7°</td>
<td>Sagittarius</td>
<td>11.7°</td>
</tr>
<tr>
<td>Venus</td>
<td>07:18</td>
<td>50.1°</td>
<td>Capricornus</td>
<td>13.08°</td>
</tr>
<tr>
<td>Mars</td>
<td>16:16</td>
<td>14.6°</td>
<td>Libra</td>
<td>4.29°</td>
</tr>
<tr>
<td>Jupiter</td>
<td>09:40</td>
<td>24.3°</td>
<td>Sagittarius</td>
<td>31.76°</td>
</tr>
<tr>
<td>Saturn</td>
<td>09:10</td>
<td>0.7°</td>
<td>Sagittarius</td>
<td>15.11°</td>
</tr>
<tr>
<td>Uranus</td>
<td>09:10</td>
<td>1.1°</td>
<td>Aries</td>
<td>3.63°</td>
</tr>
<tr>
<td>Neptune</td>
<td>07:18</td>
<td>10:15</td>
<td>Aquarius</td>
<td>2.25°</td>
</tr>
<tr>
<td>Pluto</td>
<td>11:47</td>
<td>12:44</td>
<td>Sagittarius</td>
<td>0.3°</td>
</tr>
</tbody>
</table>

The objects listed below are located between 2:00 and 4:00 hours of right ascension.

One hundred and five binary and multiple stars for December: Gamma Andromedae, 59 Andromedae, Struve 245 (Andromeda); Struve 362, Struve 374, Struve 384, Struve 390, Struve 396, Struve 400, Struve 419, Otto Struve 67 (Camelopardalis); Struve 191, Struve Iota Cassiopeiae, Struve 263, Otto Struve 50, Struve 283, Struve 284 (Cassiopeia); 61 Ceti, Struve 218, Omicron Ceti, Struve 274, Nu Ceti, h3511, 84 Ceti, h3524, Lambda Ceti, Struve 330 (Cetus); h3527, h3533, Theta Eridani, Rho Eridani, Struve 341, h3548, h3565, Tau-4 Eridani, Struve 408, Struve 411, h3589, h3601, 30 Eridani, 32 Eridani (Eridanus); h3478, h3504, Omega Fornacis, Eta-2 Fornacis, Alpha Fornacis, See 25, Xi-3 Fornacis, h3596 (Fornax); Struve 268, Struve 270, h1123, Otto Struve 44, h2155, Nu Persei, Struve 297, Struve 301, Struve 304, Eta Persei, Struve 314, Otto Struve 48, Tau Persei, Struve 331, Struve 336, Es588, Struve 352, Struve 360, Struve 369, Struve 382, Struve 388, Struve 392, Struve 410, Struve 413, Struve 425, Otto Struve 59, Struve 426, 40 Persei, Struve 434, Struve 448, Es277, Zeta Persei, Struve 469, Epsilon Persei, Es878 (Perseus); Struve 399, Struve 406, Struve 401, Struve 422, Struve 430, Struve 427, Struve 435, 30 Tauri (Taurus); Epsilon Trianguli, Struve 219, Iota Trianguli, Struve 232, Struve 239, Struve 246, 10 Trianguli, Struve 269, h653, 15 Trianguli, Struve 285, Struve 286, Struve 310 (Triangulum)

One hundred deep-sky objects for December: NGC 891 (Andromeda); IC 342, K6, St23, Tom 5 (Camelopardalis); Be65, IC 1848, K4, Me115, NGC 896, NGC 1027, St2, Tr3 (Cassiopeia); M77, NGC 788, NGC 835, NGC 864, NGC 908, NGC 936, NGC 955, NGC 958, NGC 1015, NGC 1016, NGC 1022, NGC 1042, NGC 1052, NGC 1055, NGC 1087, NGC 1094 (Cetus); IC 2006, NGC 1084, NGC 1140, NGC 1187, NGC 1199, NGC 1209, NGC 1232, NGC 1291, NGC 1300, NGC 1309, NGC 1332, NGC 1337, NGC 1353, NGC 1357, NGC 1395, NGC 1400, NGC 1407, NGC 1421, NGC 1426, NGC 1440, NGC 1452, NGC 1453, NGC 1461 (Eridanus); NGC 1079, NGC 1097, NGC 1201, NGC 1292, NGC 1316 (Fornax I Galaxy Cluster), NGC 1317, NGC 1326, NGC 1344, NGC 1350, NGC 1360, NGC 1365, NGC 1371, NGC 1374, NGC 1379, NGC 1380, NGC 1381, NGC 1387, NGC 1398, NGC 1404, NGC 1406, NGC 1425 (Fornax); Bas10, Cz8, IC 351, IC 2003, K5, Me1 20, M34, NGC 869, NGC 884, NGC 957, NGC 1023, NGC 1058, NGC 1161, NGC 1245, NGC 1275 (Perseus I Galaxy Cluster), NGC 1333, NGC
NGC 777, NGC 784, NGC 890, NGC 925, NGC 949, NGC 959, NGC 978A/B (Triangulum)

Top ten binocular deep-sky objects for December: M34, M45, Mel15, Mel20, NGC 869, NGC 884, NGC 1027, NGC 1232, St2, St23

Top ten deep-sky objects for December: M34, M45, M77, NGC 869, NGC 884, NGC 891, NGC 1023, NGC 1232, NGC 1332, NGC 1360

Challenge deep-sky object for December: vdB14 (Camelopardalis)