Galactic Observer
John J. McCarthy Observatory
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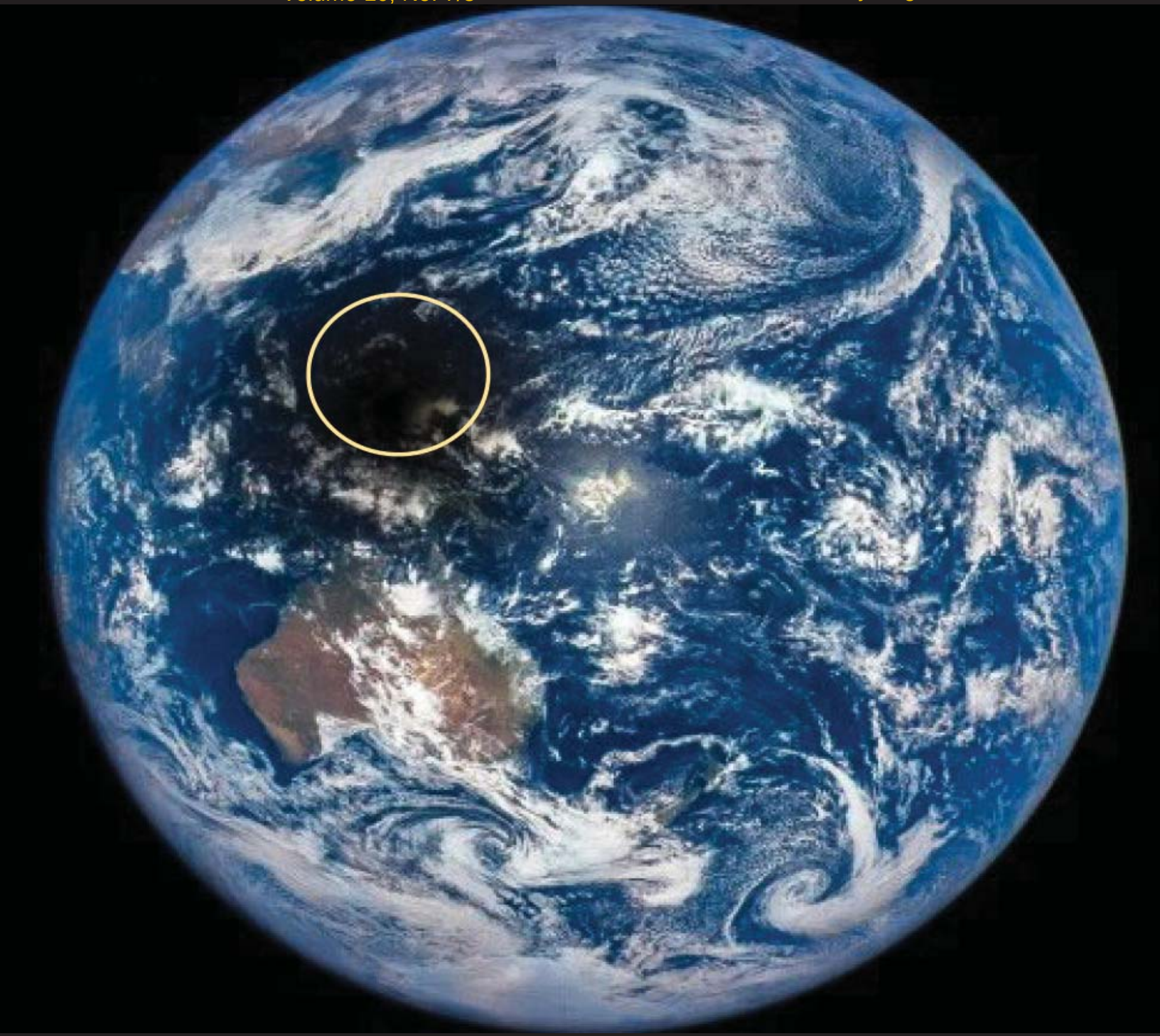

Image by the Deep Space Climate Observatory's (DSCOVR) EPIC camera of a total solar eclipse on March 9, 2016. The eclipse was only visible from the South Pacific and, in this image, the Moon's shadow is moving toward the east, north of Australia. DSCOVR is located at the Sun-Earth first Lagrange point, approximately 1 million miles from Earth. The spacecraft's instruments provide real-time monitoring of the Sun's solar wind. On August 21, 2017, DSCOVR will be position to watch the Moon's shadow race across the continental United States.

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It is through their efforts that the McCarthy Observatory has established itself as a significant educational and recreational resource within the western Connecticut community.

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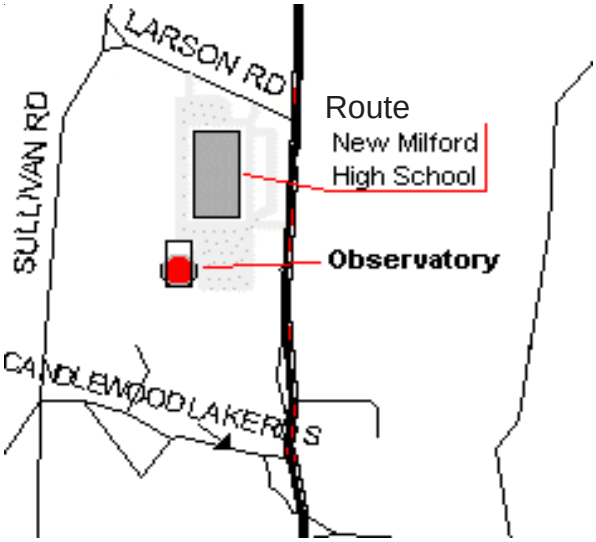
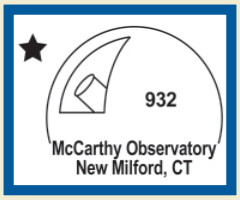
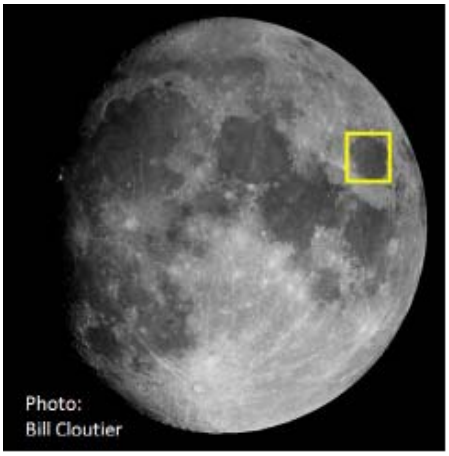


In This Issue



"Out the Window on Your Left"

IT'S BEEN ALMOST 45 years since we left the last footprint on the dusty lunar surface. Sadly, as a nation founded on exploration and the conquest of new frontiers, we appear to have lost our will to lead as a space-faring nation. But, what if the average citizen had the means to visit our only natural satellite; what would they see out the window of their spacecraft as they entered orbit around the Moon? This column may



Lunar seas of actually expansive low-lying plains formed by ancient lava flows

provide some thoughts to ponder when planning your visit (if only in your imagination).

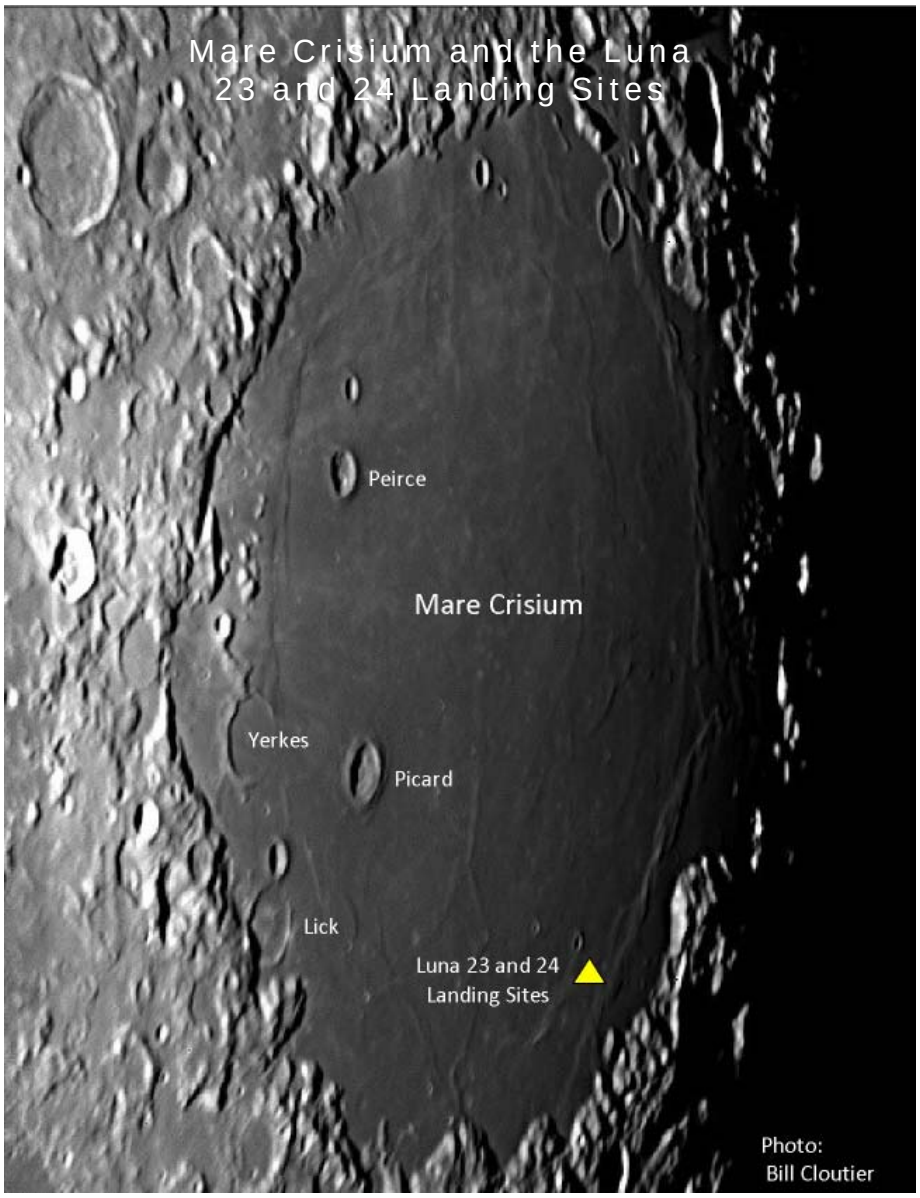
The Soviet Union's final mission to the Moon was launched on August 9, 1976. Luna 24 was the 11th (and third successful) attempt to collect and return a sample of lunar rock to the Earth with a robotic probe.

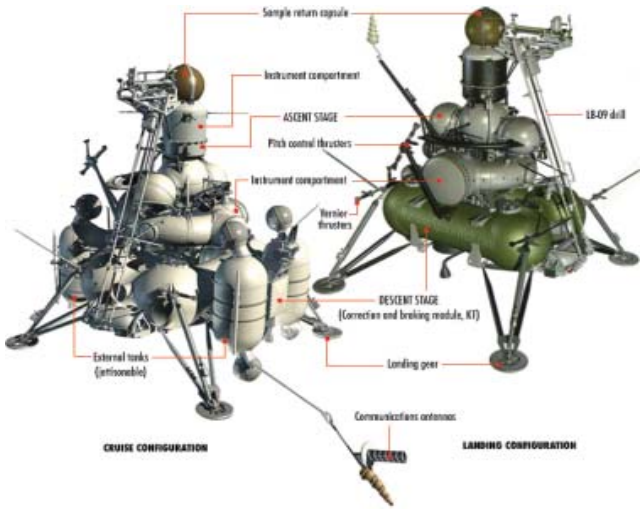
The E8-5M spacecraft was launched from the Baikonur site in Kazakhstan aboard a Proton rocket. Nine days later, the spacecraft's main engine on the descent stage performed a braking maneuver, successfully touching down in the south-eastern region of Mare Crisium (Sea of Crises), approximately 25 miles (40 km) from the shore and the impact basin's mountainous rim. Luna 24's landing site was not far from that of the failed Luna 23 spacecraft. Images by NASA's Lunar Reconnaissance Orbiter (LRO) found Luna 24 perched near the rim of a 200 foot (60 meter) diameter crater.

Luna 24 was equipped with a re-designed drill. The rotary percussion drill had several new features including the ability to adjust its drilling power with the density of the regolith and rock. The angled drill penetrated a little more than seven feet (2.25 meters) into the surrounding regolith, collecting 6 ounces (170.1 grams) of rock fragments and dust (three times the amount collected by the two previous successful missions).

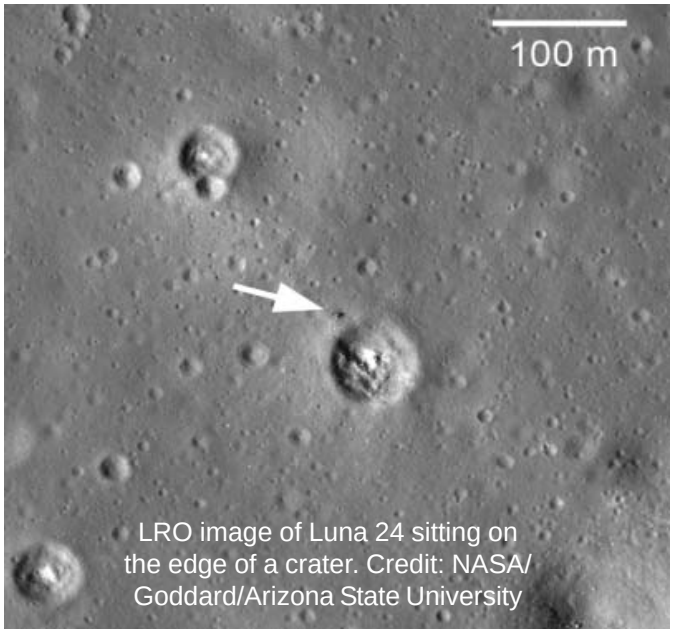
After less than 24 hours on the Moon, the ascent stage, containing the lunar sample, lifted off from the surface. Four days later, the sample returned to Earth, landing in western Siberia under parachute. The age of the material collected by Luna 24 was determined to be around 300 million years. Russian scientists would later exchange a small portion of the material (3 grams) with material collected by Apollo astronauts.

Luna 24 was launched just six months after the Soviet Union cancelled their manned Moon program after four unsuccessful launches of their N1 heavy-lift, five stage booster.





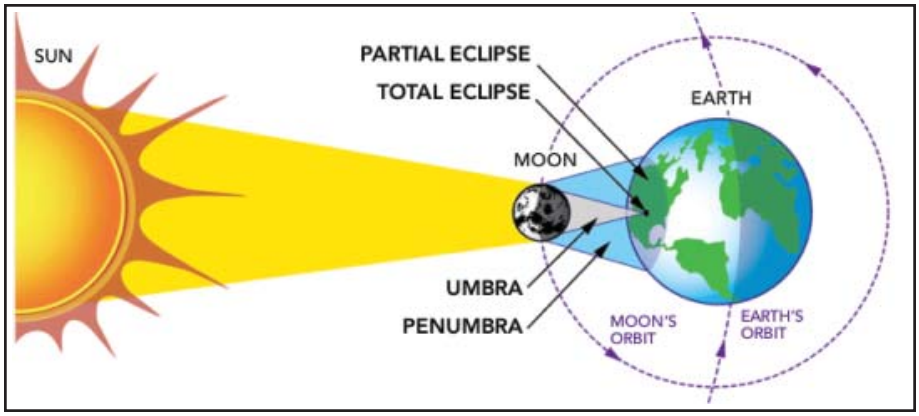
Luna 24 spacecraft - Credit: NPO Lavochkin



LRO image of Luna 24 sitting on the edge of a crater. Credit: NASA/ Goddard/Arizona State University

The All-American Solar Eclipse

On August 21, residents of North America will be treated to a total solar eclipse as the Moon passes directly between the Sun and the Earth. Within a narrow path (approximately 70 miles wide from the Oregon to South Carolina), the Moon will completely cover the Sun for up to 2½ minutes (a phase called "Totality"). Outside that path, the Moon will only cover a portion of the Sun (Partial Eclipse) – how much will depend upon how far you are away from the path's centerline. If you are planning to travel to view Totality, NASA's Eclipse Page has maps for each state along the path at *https:/ eclipse2017.nasa.gov/*. It is only when the Sun is completely covered by the Moon that its ghostly atmosphere, the corona, is visible to Earth-bound observers.



Solar eclipses occur when the New Moon passes in front of the Sun in its orbit around the Earth. Eclipses only occur every six months or so, as the Moon's orbit is inclined about 5° from the plane of the Earth's orbit around the Sun. With the inclination, the New Moon passes either above or below the Sun in Earth's sky during most monthly orbits.

Since a fully eclipsed Sun is only visible along a narrow path, it may be a hundred years or more before such an occurrence is visible from the exact same location again. On April 8, 2024, another Total Solar Eclipse with cross the continental United States, this time from Texas to Maine.

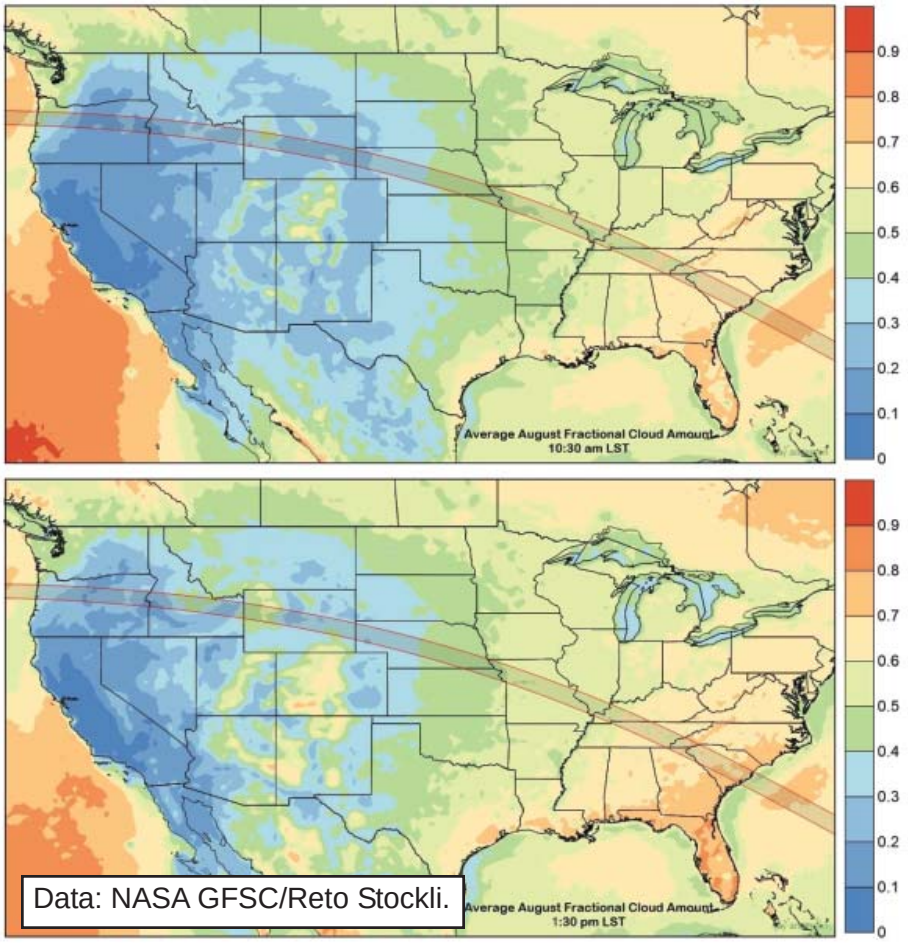
If you are staying in the New Milford area, the McCarthy Observatory will be open and have special-purpose solar filters (eclipse glasses) available for safely watching the eclipse (do not look directly at the Sun without the appropriate eye protection). From Connecticut approximately 69% of the Moon will be covered at mid-eclipse. The Observatory will post additional information on the event on its website *www.mccarthyobservatory.org* as the date approaches.

Start of the Partial Eclipse at the McCarthy Observatory(EDT):	**1:24 pm**
Maximum Eclipse (68.5% Obscuration):	**2:44 pm**
End of Partial Eclipse at the McCarthy Observatory:	**3:59 pm**

Weather Outlook for August 21st

Viewing totality (those two plus minutes when the Moon completely covers the Sun) will require the observer to be in the right location and a bit of luck with the weather. Totality begins on the west coast of Oregon at 10:16 a.m. PDT. The eclipse track will cross through Oregon, Idaho, Wyoming, Montana, Nebraska, Iowa, Kansas, Missouri, Illinois, Kentucky, Tennessee, Georgia, and North Carolina before ending in South Carolina at 2:48 p.m. EDT.

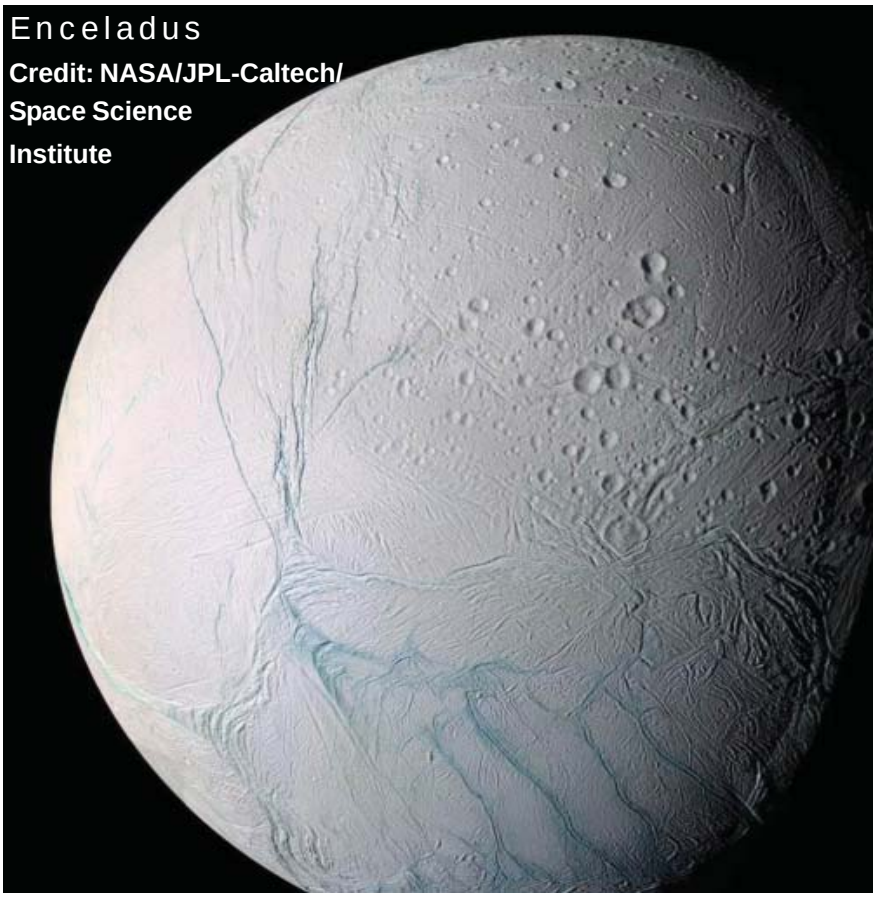
The maps (below) show the average morning (top) and early afternoon (bottom) cloudiness in August based upon 17 years of satellite data. Statistically, there is a greater chance of cloudy skies for the eastern half of the United States, with the best weather prospects in the west.



Enceladus Revisited

Cassini researchers have found evidence that the spin axis of Saturn's ocean world Enceladus may have tipped over (as much as 55°) in the distant past, likely from a of collision with another body. This would have placed the active south polar region (with its distinctive blue-green tiger stripes) closer to the equator prior to the collision, possibly explaining the present-day difference in the appearance of the moon's polar regions.

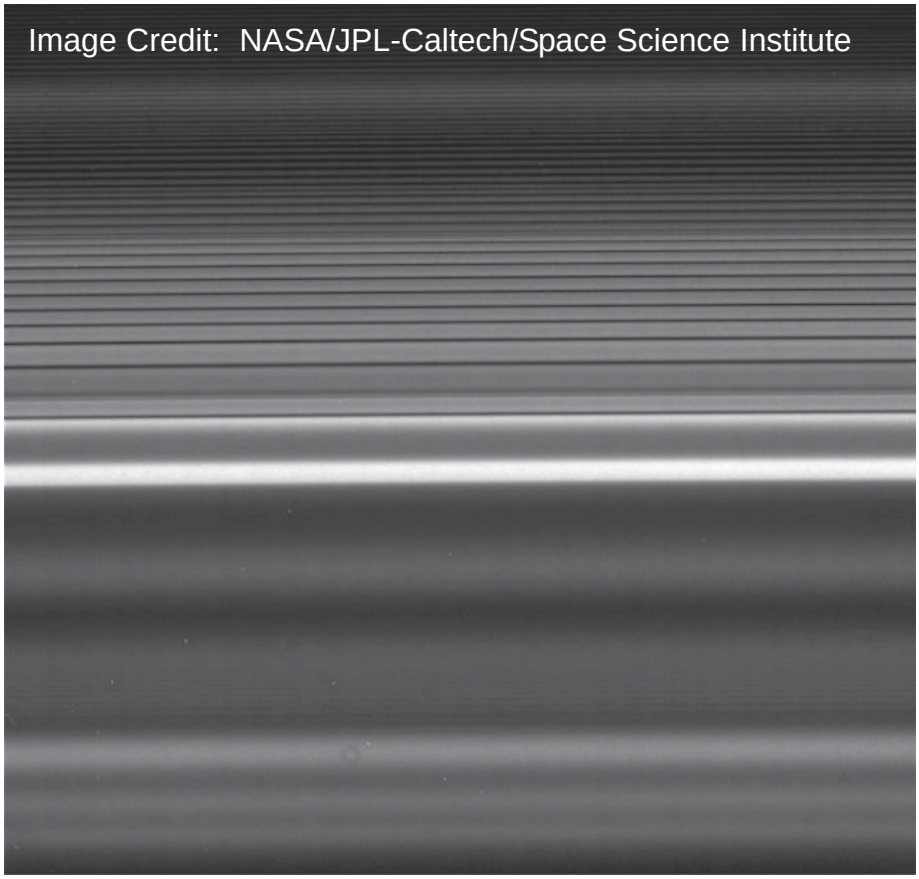
The premise is based upon a series of low-lying basins that may be indicative of previous polar areas and an equator as well, as other evidence that the moon's spin axis had shifted over time.



Endless Rings

On May 28th, during a gap dive between the planet and its rings, the Cassini spacecraft captured a unique perspective of the seemingly endless number of individual rings orbiting the planet and comprised of billions of icy particles and a smattering of dust. The uncalibrated image (below) shows the fainter D-Ring in the foreground, and looks out over the C-Ring to the largest, brightest and most massive B-ring (the rings were unlit in this image).

Twenty-two weekly transits through the 1,200-mile (2,000 km) wide gap have been planned. On September 15th, the spacecraft will complete its mission and enter Saturn's atmosphere. The final signal from the spacecraft is expected to be transmitted at 3:45 am PDT and received on Earth approximately 1 hour and 23 minutes later.



Journey to the Sun

In the summer of 2018, NASA plans to launch a probe into the

Sun's atmosphere. The Solar Probe Plus spacecraft (recently renamed the Parker Solar Probe, in honor of astrophysicist Eugene Parker), will fly within 3.7 million miles of the Sun's surface.

The objective of the mission is to better understand the Sun's outer atmosphere (corona) and the origin of the solar wind. Its four instruments will be equipped to study our star's magnetic field, plasma and energetic particles, and image the solar wind. The spacecraft will use the gravity of Venus to shape its orbit during seven flybys of the Sun over seven years.

The spacecraft will be traveling at speeds approaching 430,000 mph (700,000 kph) at closest approach. Its carbon-composite shield will need to protect the spacecraft's instruments from temperatures of 2,500 °F (1,377 °C).

Close Encounter with the Great Red Spot

NASA's Juno spacecraft arrived at Jupiter on July 4, 2016. In a polar orbit that minimizes the time the spacecraft is exposed to the planet's intense magnetic field and radiation belts, Juno makes a high-speed pass (2 hours from pole to pole) once every 53 days, passing within several thousand miles of the gas giant's cloud tops.

The spacecraft will fly over the Great Red Spot on July 11th, giving scientists their first look deep into the planet-sized cyclone.

Cassini Jupiter mosaic.Credit: NASA/JPL/Space Science Institute

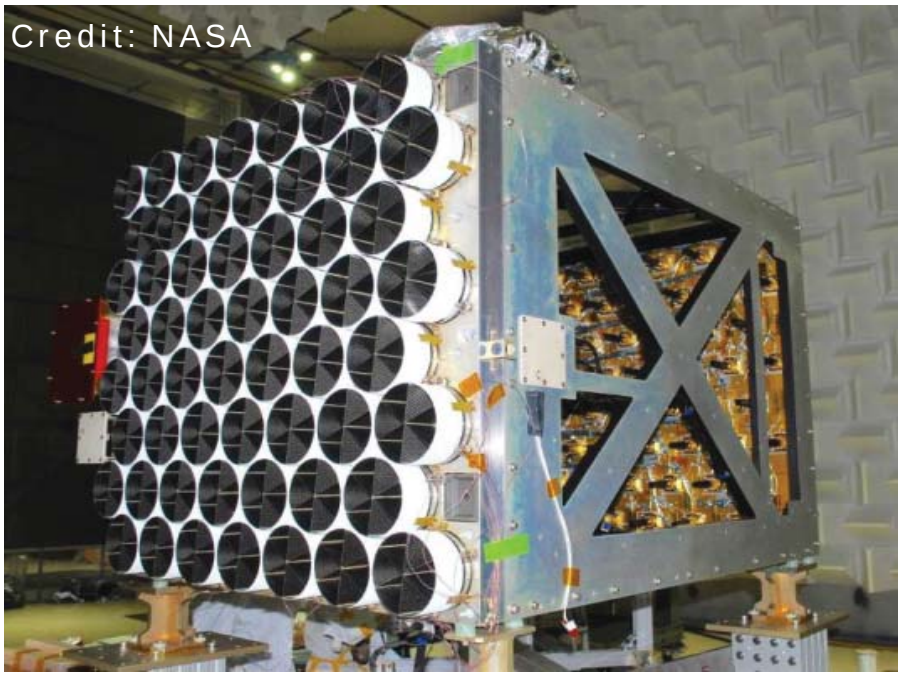
Deep Space Lighthouses

When the SpaceX Dragon spacecraft arrived at the International Space Station (ISS) on June 5th, it delivered nearly 6,000 pounds (about 2,700 kg) of equipment, food and other necessities to the crew of the space station. Tucked inside the unpressurized section of the spacecraft were three payloads that included the Neutron-star Interior Composition Explorer (NICER).

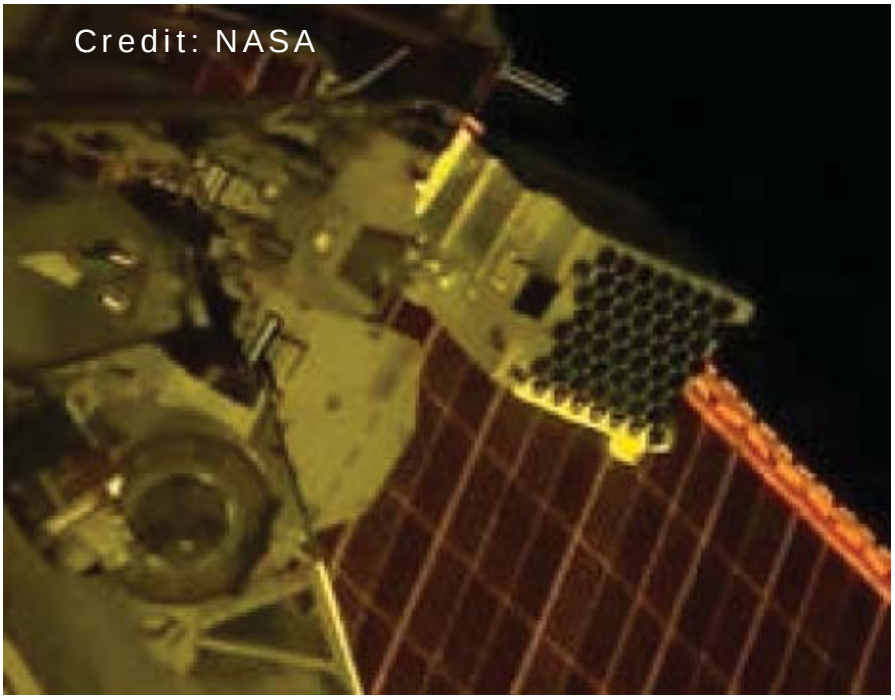
NICER was extracted from the Dragon trunk on June 12th, installed on the ISS Express Logistics Carrier 2 Site 7 and powered up two days later. By the end of June, NICER's commissioning was underway, with alignment of the Star Tracker and X-ray Timing Instrument completed. Several celestial targets have been observed, primarily for instrument calibration.

NICER's array of 56 detectors is designed to collect x-rays from hot spots on neutron stars and produced by the star's strong magnetic field. X-rays are collected using grazing-incidence, gold-coated aluminum foil optics. Each detector consists of 24 nested foils, shaped to form parabolic surfaces of a common focal length.

During the 18-month primary mission, NICER will collect data that scientists will use to study the interior of the ultra-dense neutron star. Scientists will also explore the use of pulsars (rapidly rotating neutron stars that radiate energy beams from the poles) as deep-space navigation beacons.



NICER and its array of 56 detectors or telescopes on a test bed prior to launch.



Video frame from the range of motion tests on the ISS

Space Bread

Alexander Gerst, a European Space Agency astronaut, is scheduled to join the crew of the International Space Station next spring (2018). During his stay, Gerst is scheduled to take part in a technology demonstration to bake a crumb-free, fresh bread in orbit.

The company, "Bake In Space," is working with the German Aerospace Center and other researchers to develop a dough mixture and baking process that will yield a crumb-free bread in microgravity. The company hopes to produce a typical weekend German bread roll that, in concept, could revolutionize the menu available to space travelers.

While the dough recipe has been under development, baking technology is an area that will also

need innovation, particularly, with the power constraints on the ISS (a convection oven must work on just 250 watts) and restrictions on the exterior surface temperature of any oven. Vacuum baking is also a technology being investigated as a means of using lower temperatures and pressure to bake the bread.

Bread has been excluded from spaceflight since the Gemini 3 spaceflight in 1965 when a corned beef sandwich from Wolfie's Restaurant and Sandwich Shop was smuggled on board (by John Young), producing crumbs that floated throughout the spacecraft, posing a risk to the occupants as well as to the equipment (e.g., the electrical panels).

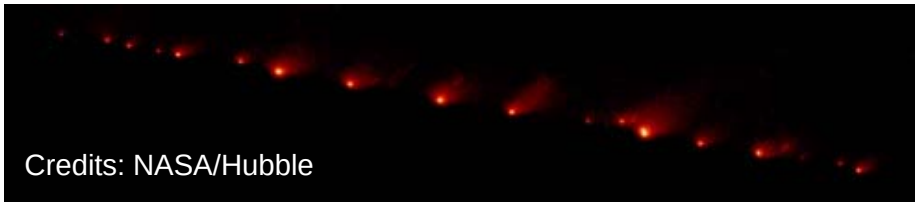
Bake In Space aims to make crumb-free German rolls on board the International Space Station in 2018. (*NASA/Wikipedia/collectSPACE*)

New Jovian Impact

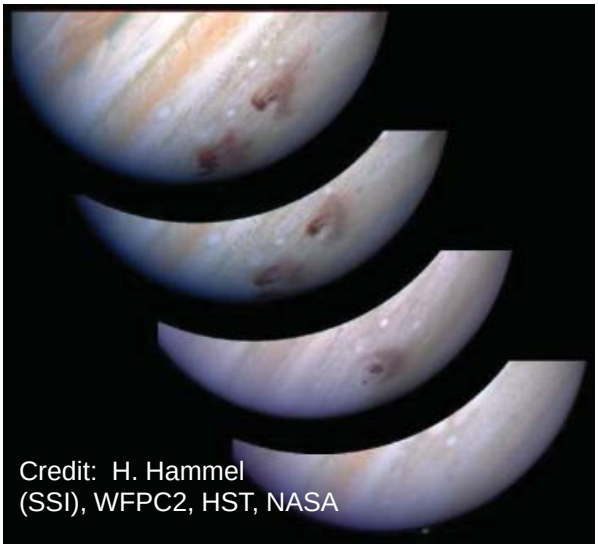
On May 26th of this year, Sauveur Pedranghelu, a French amateur astronomer, recorded a flash of light on the cloud tops of Jupiter from a meteoroid impact in the north polar region (latitude 51° north). It was the sixth recorded impact of the gas giant. The impact was confirmed by a second observer, Thomas Riessler of Dettenhausen, Germany. Both observers recorded the brief flash (less than a second in duration) on video. No trace of the explosion was detected in subsequent observing campaigns.

The first confirmed impact of Jupiter occurred in July 1994, when fragments of Comet Shoemaker-Levy 9 left dark blemishes along the multiple impact sites. Subsequent impacts (or the after effects) were recorded by amateur astronomers on July 19, 2009, June 3, 2010, August 20, 2010, and on March 17, 2016.

The image (bottom right) shows the scars from two fragments of the Comet Shoemaker Levy 9 impacts in 1994.



The 21 fragments of Comet Shoemaker-Levy 9 on a collision course with Jupiter are seen in this panoramic image captured by the Hubble Space Telescope's Wide Field Planetary Camera 2 on May 17, 1994.

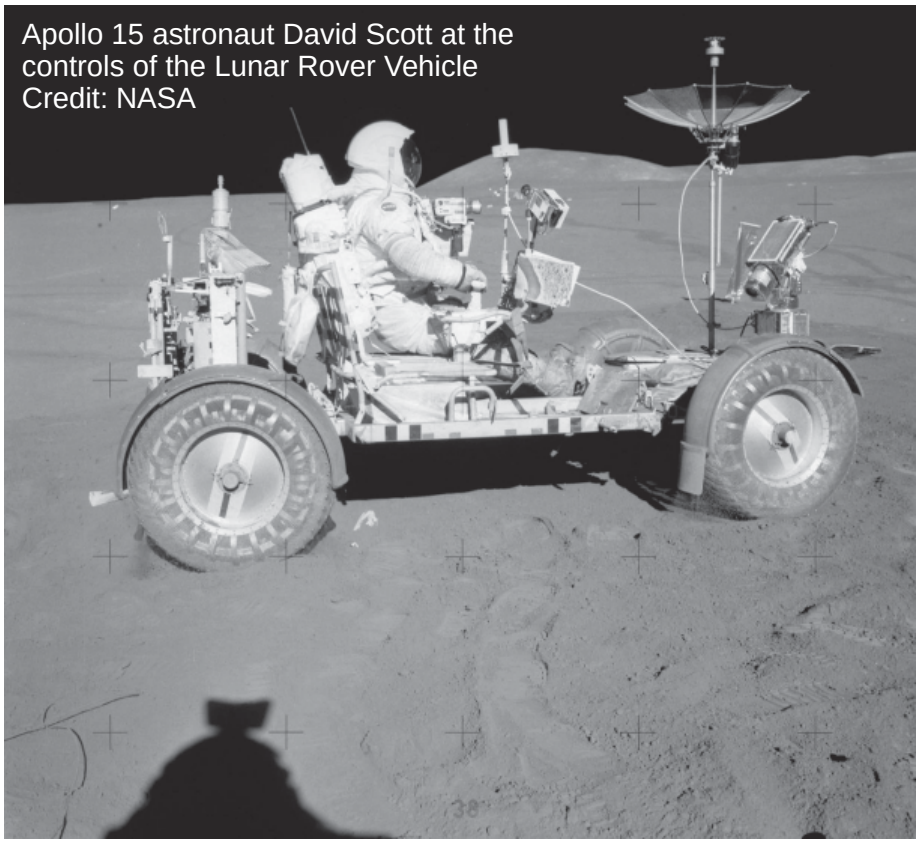


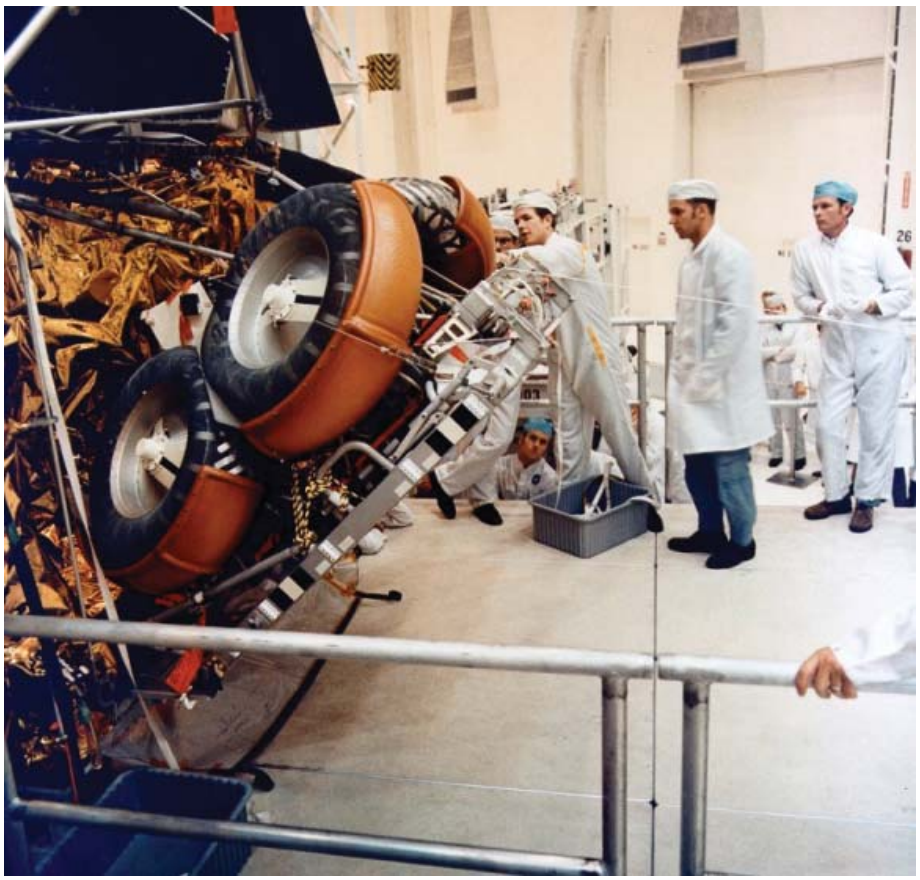
First Wheeled Vehicle on Moon

Forty-six years ago, astronaut David Scott became the first person to drive a vehicle on the Moon. The Commander of the Apollo 15 mission used an electric powered vehicle that had been specifically designed and built (by Boeing and Delco) to operate in lunar conditions (lower gravity, vacuum, and on loose, fragmented regolith). The Apollo 15 Lunar Roving Vehicle (LRV) was the first of three rovers driven on the Moon. It covered a total of 17 miles (27.9 km) in three separate excursions, carrying the astronauts up to 3 miles (5 km) from the landing site.

The LRV's chassis was constructed from aluminum alloy tubing and was hinged so that it could be folded for storage on the outside of the Lunar Module. Its four wire wheels were constructed of woven steel strands and titanium chevrons for traction. Each wheel was equipped with its own electric motor for a top speed of approximately 8 miles per hour (13 km/hr).

The LRV was designed to carry the two astronauts and their life support systems, communications and scientific equipment, photographic gear and up to 60 pounds (27 kg) of lunar samples as they explored their surroundings. However, NASA restricted the rover's range to the distance the astronauts could walk back to the Lunar Module in the event of an emergency.


Apollo 15 astronaut David Scott at the controls of the Lunar Rover Vehicle
Credit: NASA



Astronaut David Scott (center) watches as technicians fit check the folded Lunar Rover Vehicle in an exterior bay of the Lunar Module. The rover was deployed by the astronauts once on the Moon's surface using a system of pulleys, ropes and cloth tape. Photo Credit: NASA

Space Shuttle Legacy

The dramatic success of the Apollo program was also responsible for its demise. Once Kennedy's challenge had been met and the Soviet Union bested, Congress quickly lost interest in funding NASA's ambitious and expansive exploration programs, including an expedition to Mars, development of a nuclear rocket, construction of a space station and deep space bases, and a space shuttle to service orbiting facilities.

Less than six months after Neil Armstrong had stepped onto the Moon, NASA began to cancel future missions due to draconian budget cuts. Apollo 20 was cancelled in January 1970, followed by two additional cancelations by the following September. One by one, cancelation of the other programs followed.

If not for the political support of the Air Force, the shuttle would have met the same fate. The Air Force, after having several of its own space programs canceled in the 1960s, including Dyna-Soar and the Manned Orbiting Laboratory, was interested in a low-cost means of launching reconnaissance satellites and military hardware. Air Force support on Capitol Hill, however, did not come without a cost. The price of their support was the redesign of the shuttle from a straight wing to a delta wing for greater cross-range capability (for example, to execute a one-orbit mission from Vandenberg Air Force Base, polar orbit and short-duration capture missions (capturing Soviet satellites in flight)). The change in flight profile and wing configuration would significantly increase the reentry temperature - and therefore the demands on the shuttle's thermal protection system - which would one day have disastrous consequences.

The space shuttle that flew was a compromise, designed to meet Air Force requirements and the Office of Management and Budget's constraints. It was likely a much different (and more expensive) vehicle than if NASA had been allowed to pursue its fully reusable, potential hot-metal, straight-wing, initial design.

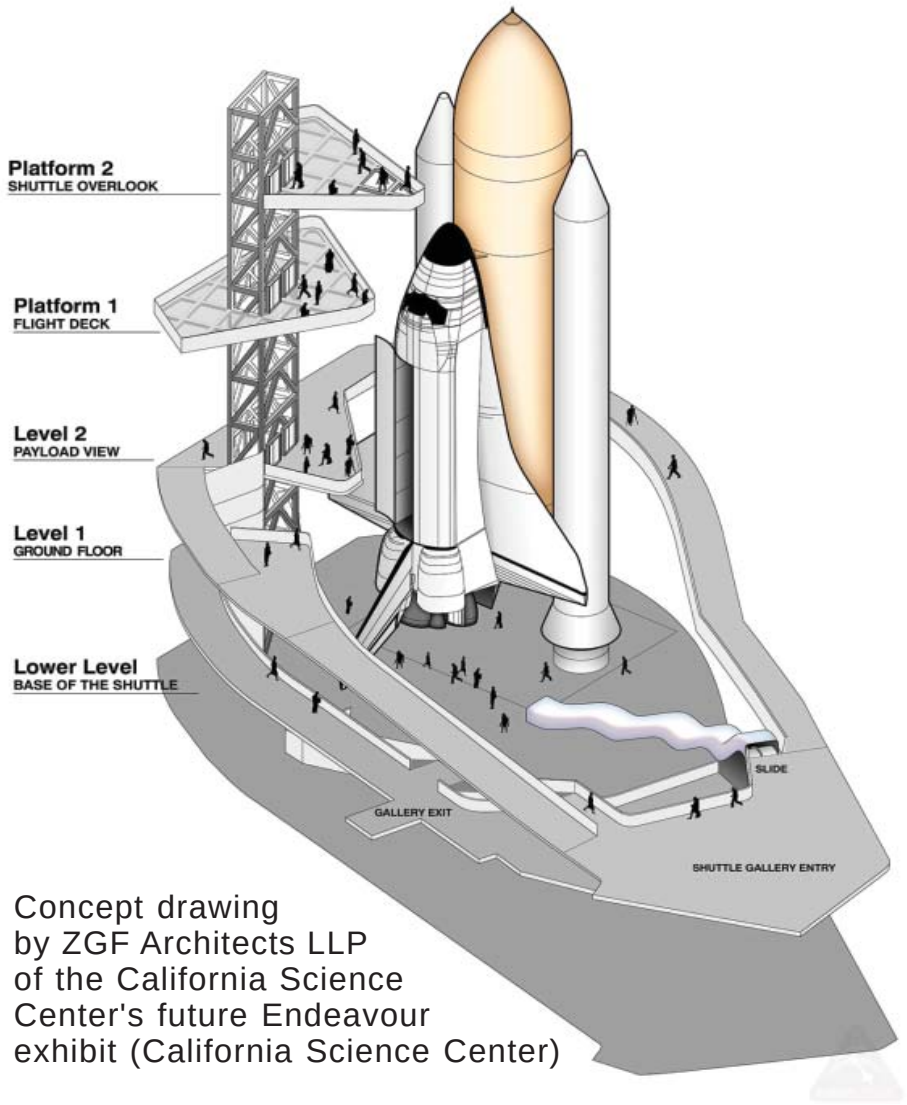
Photo: Bill Cloutier

The space shuttle (or orbiter) is only one component of the Space Transportation System (STS). The three main engines of the reusable orbiter, carrying crew and cargo into orbit, are powered by 143,000 gallons of liquid oxygen and 385,000 gallons of liquid hydrogen contained within an expendable external tank during the first 8½ minutes of flight. Two solid rocket boosters (recoverable) provide an additional 2.6 million pounds of thrust during the first two minutes of flight. The solid rockets return to Earth (ocean) by parachute. The orbiter returns in an unpowered glide to a runway landing.

Six orbiters were built at Rockwell International's facility in Palmdale, California. The first, Enterprise, was used for atmospheric testing, the other five for travel to, and for long-duration stays in, low-Earth orbit. Between April 12, 1981 and July 21, 2011, the five spaceworthy orbiters (Columbia, Challenger, Discovery, Atlantis and Endeavour) completed a total of 135 missions, carried 355 men and women, flew over 500 million miles, and spent more than 1,300 days in orbit.

The orbiters rendezvoused with Russia's Mir space station nine times, the International Space Station more than 35 times, and the Hubble Space Telescope five times. They carried to orbit satellites, space station components, space telescopes, laboratories and laboratory experiments, and spacecraft to explore the solar system.

Unfortunately, the STS never delivered as a low-cost transportation system. The greater concern, however, was the loss of two shuttles and crew. The loss of the Columbia upon reentry on February 1, 2003 prompted a comprehensive reevaluation of the program. The Columbia Accident Invstigation Board concluded that: "*Because of the risks inherent in the original design of the Space Shuttle, because that design was based in many aspects on now-obsolete technologies, and because the Shuttle is now an aging system but still developmental in character, it is in the nation's interest to replace the Shuttle as soon as possible as the primary means for transporting humans to and from Earth orbit*." Shortly after the release of the Board's findings, President Bush announced the remaining space shuttle fleet would be retired once the construction of the International Space Station was complete.



Concept drawing by ZGF Architects LLP of the California Science Center's future Endeavour exhibit (California Science Center)

The landing of Atlantis on July 21, 2011 signaled the end of the shuttle program and the beginning of the effort to prepare the orbiters for a new life on public display. Toxic fuels were drained, hazardous materials and toxic chemicals neutralized, pyrotechnics disarmed, the main engines removed and preserved for future use and the shuttle's control systems placed in a safe configuration.

The Smithsonian requested the Discovery as the oldest and most traveled orbiter for display at its National Air and Space Museum, Udvar-Hazy Center in Virginia. The Enterprise, which had been on display at the Udyar-Hazy Center, was moved to the Intrepid Sea, Air & Space Museum in New York City.

NASA awarded Endeavour to the California Science Museum in Los Angeles, close to the Palmdale facility where it was built. Atlantis stayed close to home and put on display at the Kennedy Space Center.

Enterprise

The Enterprise, designated Orbital Vehicle (OV)-101, was a test vehicle. It was not intended for spaceflight but provided critical test data on the orbiter's handling within the atmosphere, needed for a successful return from flight. It flew several captured flights (attached to the top of a Boeing 747) and five free flights at the Edwards Air Force Base. The orbiter was originally to be named Constitution; however, a write-in campaign by viewers of the Star Trek television show persuaded the administration to christen OV-101: Enterprise.

Once the Smithsonian acquired Discovery, the Enterprise was transported by barge to the Intrepid Sea, Air & Space museum where it went on display on July 19, 2012.

Discovery

Discovery was NASA's third orbiter (OV-103) and flew more missions than any of the other orbiters - 39 flights between 1984 and 2011. It was the workhorse of the fleet and the orbiter that flew the "return-to-flight" missions after the Challenger and Columbia accidents. Discovery delivered the Hubble Space Telescope to orbit and flew two of the follow-on servicing missions in 1997 and 1999. The orbiter made two flights to the Russian space station Mir and 13 flights to the International Space Station. The name Discovery was chosen to honor historic sailing ships of the past.

Discovery was delivered to the Smithsonian Air and Space Museum (near Dulles Airport) in April 2012 mounted atop NASA's Shuttle Carrier Aircraft, a modified Boeing 747 jumbo jet. It is displayed in a landing configuration with its gear deployed.

Endeavour

Endeavour (OV-105) was the last orbiter to join the fleet, built to replace the Challenger. Its maiden flight was on May 7, 1992 - the first of 25 missions. Endeavor carried the "corrective optics" in the first servicing mission to the Hubble Space Telescope. The orbiter also delivered the first U.S. component, the Unity Module, to the International Space Station. The orbiter is named after the British HMS Endeavour, the ship commanded by Captain James Cook on his first expedition to Australia and New Zealand between 1769 and 1771.

The California Science Center was selected to display the Endeavour, based, in part, on its proximity to Palmdale. The orbiter was delivered to the Los Angeles International

Enterprise

Discovery

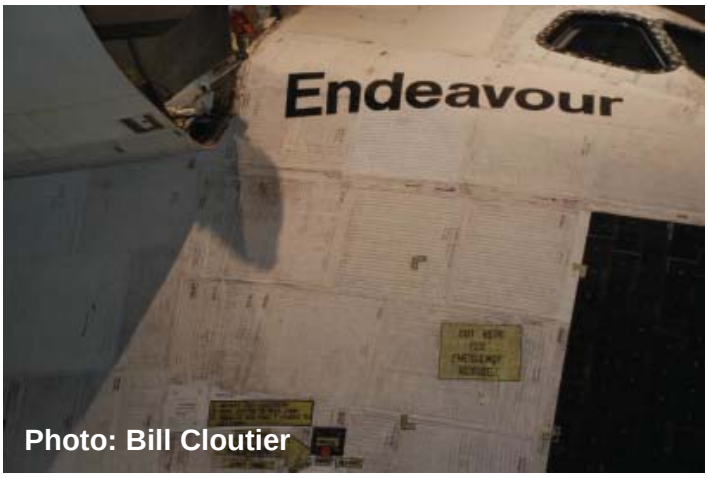


Photo: Bill Cloutier

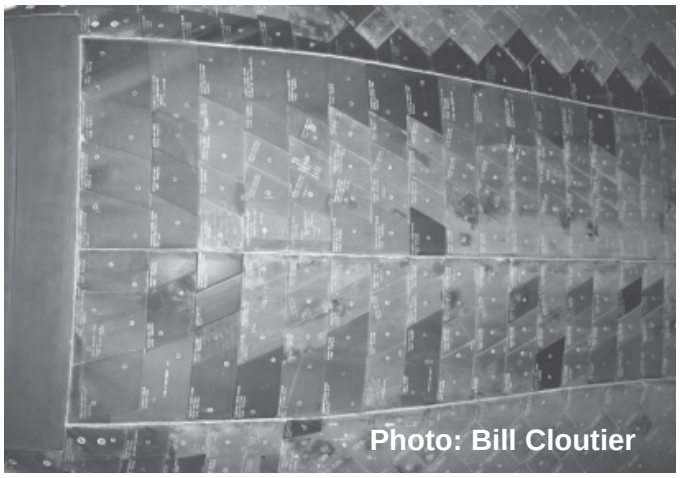


Photo: Bill Cloutier

Airport by the Shuttle Carrier Aircraft on September 21, 2012. Three weeks later, the orbiter was towed 12 miles through the streets of Los Angeles to the museum. Endeavor is on temporary display until a permanent home can be constructed. It is currently mounted in an elevated horizontal position, allowing visitors to walk beneath the orbiter. The orbiter will eventually be displayed in a vertical, launch configuration.

The California Science Center also acquired two solid rocket boosters from the Kennedy Space Center in 2012 (currently in storage at NASA's Armstrong Flight Research Center). The museum had planned to use a replica for the external tank, since the tanks used for flight were not recovered. However, by happenstance, one tank was never used (it was too heavy to be used for ISS construction). Instead, the tank became a test article and even considered for future use on the Space Launch System. Ultimately, it was recently decided not to repurpose the tank, making it available to the California Science Center. The tank was transported from NASA's Michoud Assembly Facility in Louisiana by barge, through the Panama Canal to Los Angeles, arriving on May 18, 2016. Once the new 188,000 square foot addition to the California Science Center is complete (the Samuel Oschin Air and Space Center), the tank will be joined to the orbiter and solid rocket boosters and lifted into place. The exhibit is scheduled to open in 2019.

Atlantis

Atlantis was NASA's fourth orbiter (OV-104), named after the two-masted boat that served as the primary research vessel for the Woods Hole Oceanographic Institute from 1930 to 1966. It benefited from the lessons learned in the construction of its predecessors, being completed in half the hours spent on Columbia and weighing in at 3.5 tons lighter (allowing it to carry more payload).

Atlantis was the first orbiter to dock with the Russian Mir space station. It carried to orbit planetary probes that would explore Venus (Magellan) and Jupiter (Galileo) and the Compton Gamma Ray Observatory. Atlantis delivered the U.S. laboratory module Destiny and the Joint Airlock Quest to the International Space Station, as well as sections of the Integrated Truss Structure (the structural backbone of the ISS).

Atlantis is on display at the Kennedy Space Center's Visitor Center. It is displayed as in flight, with payload doors open and its Canadarm (robotic arm) extended.

Photo: Bill Cloutier

Photo: Bill Cloutier

Lost Orbiters

Columbia

Columbia (OV-102) was NASA's first space-worthy orbiter. It lifted off on its maiden voyage on April 12, 1981, piloted by mission commander (and former Gemini and Apollo astronaut) John Young and pilot Robert Crippen. The orbiter was named for the first American ship to circumnavigate the globe in 1790 as well as the Apollo 11 command module. Among its many accomplishments, Columbia carried the Chandra X-ray Observatory into orbit in July 1999.

The orbiter and crew were lost during reentry on February 1, 2003 when hot gases entered a hole in the orbiter's left wing. The hole had been created by a small piece of foam shed by the external tank on takeoff. The hot gases melted the airframe, causing the vehicle to break up in the atmosphere.

Challenger

Challenger (OV-099) was originally built as a test vehicle. In 1979, Rockwell International received a contract to convert the orbiter for space flight (NASA believed Challenger to be a less complex conversion than Enterprise). Challenger arrived at the Kennedy Space Center in 1982, joining the Columbia.

The orbiter was named after the British Naval research vessel HMS Challenger that sailed the Atlantic and Pacific oceans during the 1870s.

Challenger made her maiden voyage on April 4, 1983. That mission included the first spacewalk from an orbiter, as well as the deployment of the first satellite in the Tracking and Data Relay Satellite System (TDRSS) constellation. Several spacelabs were carried into orbit in Challenger's payload bay. Sally Ride, the first American woman in space, rode to orbit aboard the Challenger.

Challenger was the first orbiter to be launched at night and the first to land at the Kennedy Space Center (prior missions had landed at either the Edwards Air Force Base in California or at White Sands, New Mexico).

The orbiter and crew (including high school teacher Sharon Christa McAuliffe) were lost when a seal failed in the right rocket booster. The open joint allowed burning fuel to escape from the rocket booster and breech the external tank. Seventy-three seconds after liftoff, the orbiter was destroyed in an explosion from the failure of the hydrogen and oxygen fuel inner tanks.

Space Shuttle Memorial

In June 2015, a permanent memorial, "Forever Remembered," opened at the Kennedy Space Center Visitor Complex. The memorial honors the crews lost on the Challenger (1986) and Columbia (2003) space shuttles. Personal items from the crew members are included, as well as debris from both orbiters never before displayed in public.

Planning Your Visit

Space Shuttle	Enterprise	Discovery	Endeavour	Atlantis
Location	Intrepid Sea, Air & Space Museum, NYC	Smithsonian Udvar-Hazy Center, Chantilly, Virginia	California Science Center,[1] Los Angeles	Kennedy Space Center, Florida
General Admission[2]				
Adult	$33.00	Free	Free [3]	$50.00
Seniors	$31.00	Free	Free [3]	$46.00
College Students	$31.00	Free	Free [3]	-
Child	$24.00	Free	Free [3]	$40.00
Child (under 5)	Free	Free	Free [3]	-
Retired Military	Free	Free	Free [3]	-
Active Duty	Free	Free	Free [3]	$46.00
Museum Members	Free	Free	Free [3]	-
Parking	-	$15.00	$12.00	$10.00
Summer Hours (M-F)	10:00 am - 5:00 pm	10:00 am - 6:30 pm	10:00 am - 5:00 pm	9:00 am - 6:00 pm
Summer Hours (Weekends)	10:00 am - 6:00 pm	10:00 am - 6:30 pm	10:00 am - 5:00 pm	9:00 am - 6:00 pm

[1] Endeavour is on temporary display while its permanent home is under construction

[2] Best available information and subject to change. Does not include special attractions, tours or access to traveling exhibits

[3] $2 timed reservation is required on weekends, holidays, and the high attendance periods

Reference Websites for Additional Information:

Enterprise http://www.intrepidmuseum.org/
/Discovery https://airandspace.si.edu/visit/udvar-hazy-center/
Endeavour http://californiasciencecenter.org/
Atlantis https://www.kennedyspacecenter.com

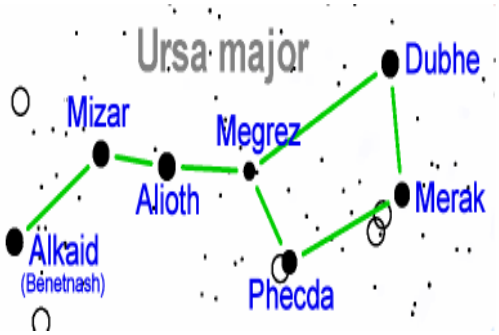
Summer Activities

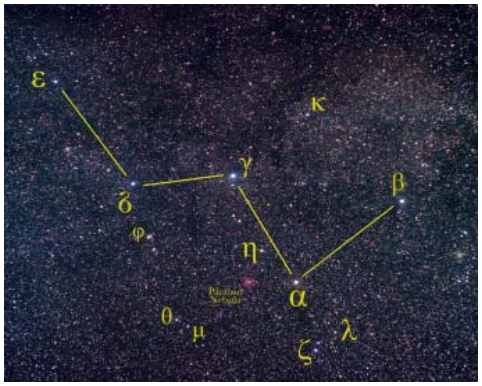
Summer is a great time to enjoy the night sky. Some suggestions for tthe season:

1. Attend a star party. Star parties are gatherings of amateur astronomers where the general public is invited to share the wonders of the night skies with skilled observers and through telescopes of every size and shape. A calendar of dates and locations across the United States is available at *www.skyandtelescope.com.* Closer to home, the McCarthy Observatory hosts a star party on the second Saturday of each month. Please join us on July 8th and August 12th with your family and friends for a memorable evening under the stars.

2. **Take in a meteor shower**. With no telescope required, this naked-eye activity can be enjoyed in a lawn chair and a warm blanket. While an occasional meteor can be spotted at anytime, August 12th is the night to catch the Perseids meteor shower. A meteor shower occurs when the Earth passes through a cloud of debris usually left behind by a comet. Comet Swift-Tuttle is the source of the small grains of dust that create the Perseid shower. As one of the most famous showers, the Perseids meteor shower usually delivers an impressive display. Expect dark skies as moonlight will not be a problem this year.

3. **Locate the Summer Milky Way**. Our solar system resides in one of the outer arms of a very large, rotating pinwheel of 200-300 billion stars called the Milky Way Galaxy. During the summer, we can see the inner arms of the pinwheel in the direction of the galactic core. Unfortunately, a dark sky is required, as excessive lighting is ruining the natural inky black of the celestial sphere. However, it can be seen from parts of New Milford, late at night and once the moon has set.



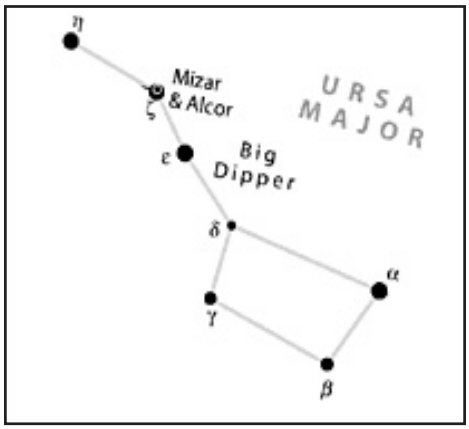


If you have never seen the Milky Way:

• Locate the Big Dipper (the most prominent asterism in the northern sky). The last two stars in the bowl of the Dipper point to the North Star.

• Imagine a line extended from the two Dipper stars, through the North Star and an equal distance beyond. You should now be between the constellations Cepheus and Cassiopeia. Cassiopeia is shaped like a W or Ó and is the starting point for our journey down the Milky Way.

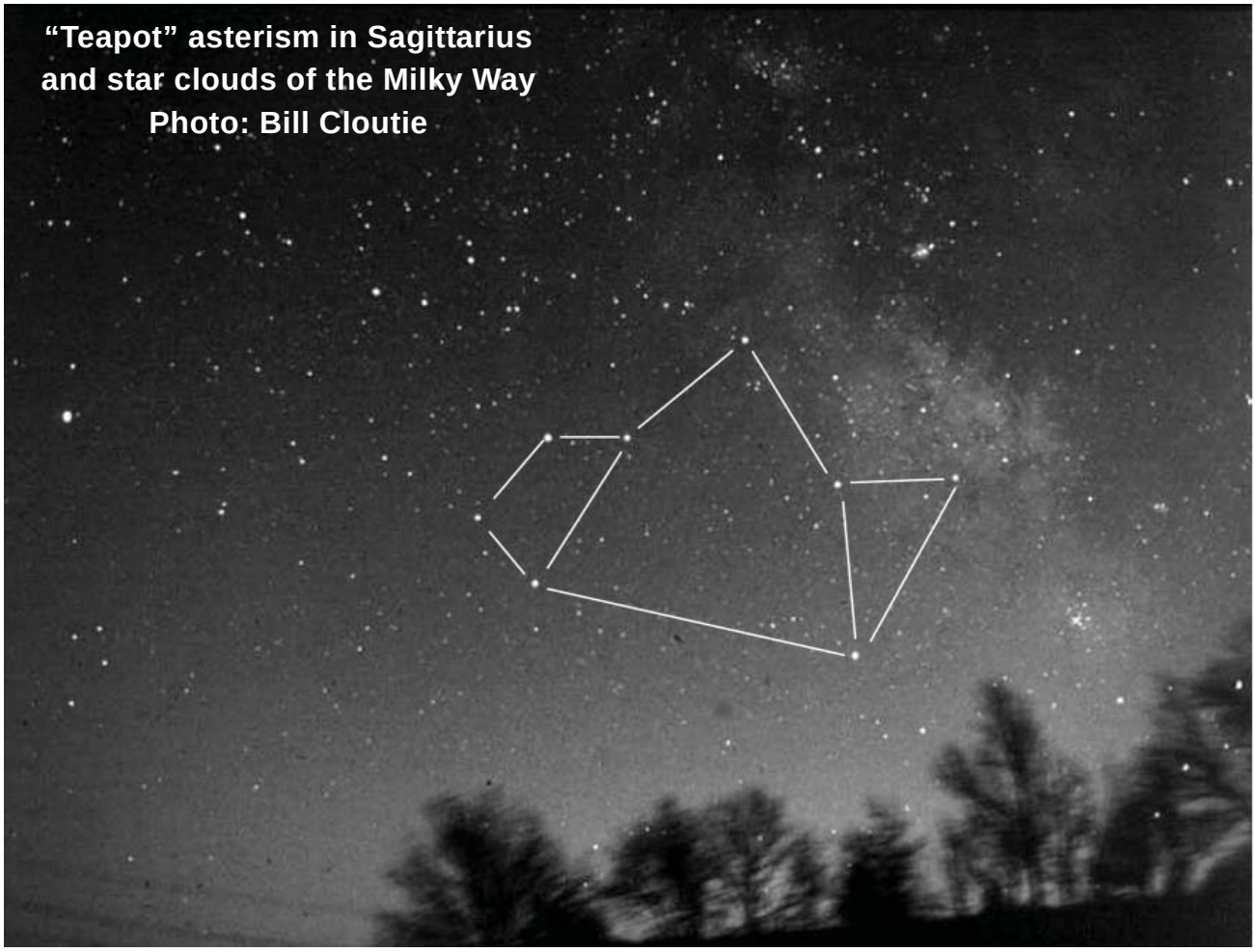
• The Milky Way flows from Cassiopeia south to Cygnus (the Swan or Northern Cross). Cygnus can be recognized by its brightest star Deneb (at the tail) and the three bright stars that form the wing.



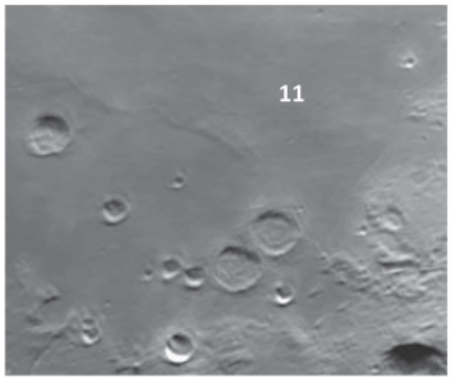
• Continuing south, the bright star Altair provides the next navigation aid, directing us to Sagittarius, an asterism shaped like a teapot. On a dark night, the star clouds of the Milky Way appear like steam from the spout of the teapot. The spout is also in the general direction of the center of our galaxy (26,000 light years away).

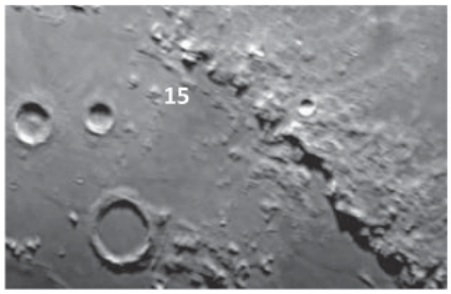
From a good observing site, you should see a band of cloudiness through this area of the sky. Through binoculars, the "clouds" can be resolved into bright areas populated by stars and darker areas with few or no stars. The darker patches are regions of gas and dust that obscure our view of the galactic center.

4. Find the Apollo landing sites. July marks the anniversaries of two moon landings. Apollo 11 landed on the southwestern shore of the Sea of Tranquility on July 20, 1969. Apollo 15 landed in the foothills of Apennine Mountains on July 30, 1971. The southwestern shore of the Sea of Tranquility is visible 5 days after a New Moon. The Sun rises on the Apennine Mountains around the First Quarter Moon.



Sea of Tranquility and
Apollo 11 landing site





Apennines Mountains and
Apollo 15 landing site

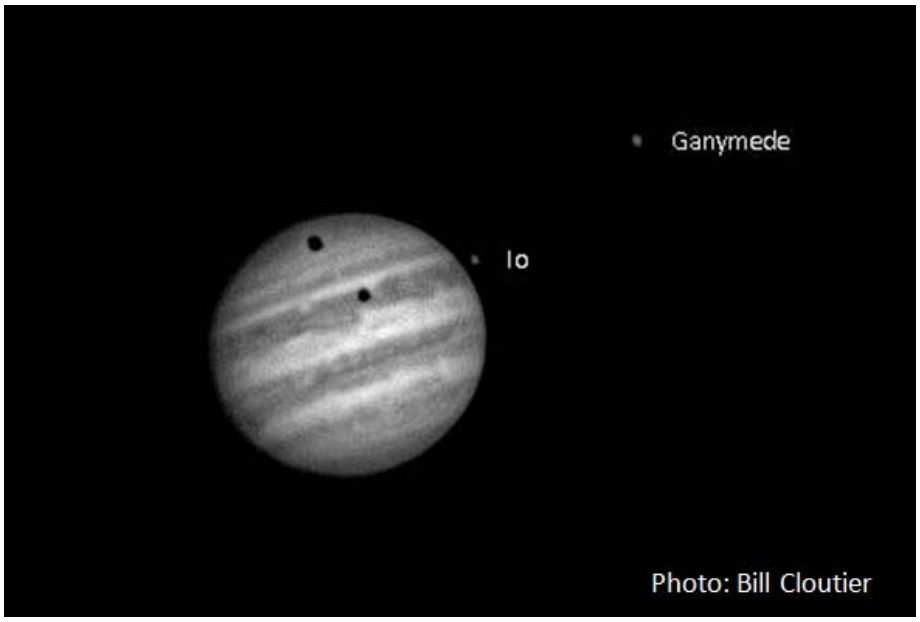
Jupiter reached Opposition and its closest approach to Earth in early April. During the month of July, Jupiter is still well placed in early evening sky after sunset. Jupiter won't set until almost 1 am on July 1st but almost two hours earlier by month's end. By the end of August Jupiter will be lost in deepening twilight approximately 90 minutes after sunset. As the Earth moves ahead of Jupiter on its inside orbit, Jupiter will diminish slightly in brightness and apparent size. As one of the brightest star-like objects in the night sky, Jupiter can be found in the constellation Virgo.

One of the more interesting and easier events to observe through a telescope is the projection of a shadow from one of Jupiter's moons on the Jovian disk as the moon passes in front of (or transits) the planet. On nights of good visibility the following events should be visible through a moderately-sized telescope. In June, we had two double transits (occurrences when the shadows of two moons are visible on the planet's cloud tops). The image (right) was captured during the double transit on June 3rd, just as Io had completed its passage in front of the gas giant.

Jovian Moon Transits

The Red Spot is a large cyclone in the upper Jovian atmosphere. The rapid rotation of this gas giant (10 hours) may be responsible for the longevity of this storm, which has been observed for over 300 years. The Red Spot will cross the center line of the planetary disk on the following evenings during the hours between 8 pm to midnight local time.

Jupiter and its Moons



Jovian Moon Transits

Date	Moon	Transit Begins	Transit Ends
July 12th	Io	8:41 pm	10:51 pm
July 14th	Europa	7:16 pm	9:38 pm
July 16th	Ganymede	10:17 pm	12:27 am (17th)
July 19th	Io	10:36 pm	12:45 am (20th)
July 21st	Europa	9:53 pm	12:15 am (22nd)
July 28th	Io	6:59 pm	9:09 pm

Red Spot Transits

Date	Transit Time	Date	Transit Time
June 30th	10:20 pm	17th	9:27 pm
July 5th	9:29 pm	22nd	8:37 pm
July 10th	8:39 pm	24th	10:16 pm
July 12th	10:18 pm	29th	9:26 pm

Sunrise and Sunset

Sun	Sunrise	Sunset
July 1st (EDT)	05:23	20:32
July 15th	05:33	20:26
July 31st	05:47	20:12
August 1st	05:48	20:11
August 15th	06:03	19:53
August 31st	06:19	19:28

Saturn - Jewel of the Summer Sky

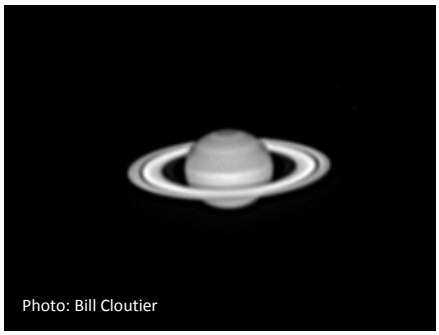


Photo: Bill Cloutier

The Earth and Saturn were closest on June 15th when only 840.6 million miles (1.35 billion km) separated the two worlds. Saturn can be found in the non-zodiacal constellation of Ophiuchus, the serpent holder, where it will remain until the planet crosses back into the constellation Sagittarius in November.

Saturn is relatively bright this year, with an apparent magnitude of +0.0 (as compared to Jupiter at magnitude -1.7). Saturn's axial tilt is almost 27° (as compared to Earth's 23.5° or Jupiter's 3°). The axial tilt produces seasons which last more than 7 years, since it takes Saturn almost 29½ years to complete an orbit around the Sun. It was summer in the southern hemisphere when the Cassini spacecraft arrived in 2004 with the planet's north pole in perpetual darkness. Saturn's Vernal equinox occurred in August 2009 with both hemispheres experiencing equal amounts of sunlight (at equinox, the rings appear almost edge on). Since that time, our view of the rings has improved. With the northern summer solstice in May, the rings are wide open with the planet's north pole sunlit and tipped towards Earth. This year the ring tilt is one of the best at 26.6°.

Astronomical and Historical Events

July

1st Apollo Asteroid 306367 *Nut* closest approach to Earth (2.456 AU)
1st Centaur Object 55576 *Amycus* at Opposition (19.290 AU)
1st History: opening of the Smithsonian National Air & Space Museum (1976)
1st History: NASA officially activates the Launch Operations Center on Merritt Island, Florida; later renamed the Kennedy Space Center (1962)
1st History: 100 inch diameter mirror for the Hooker Telescope arrives on Mt. Wilson (1917)
1st History: discovery of asteroid *6 Hebe* by Karl Hencke (1847)
2nd Apollo Asteroid 4034 *Vishnu* closest approach to Earth (1.584 AU)
2nd Kuiper Belt Object 307261 (2002 MS4) at Opposition (45.759 AU)
2nd History: launch of European Space Agency's Giotto spacecraft to Comet Halley (1985)
3rd Earth at Aphelion, furthest distance from the Sun (1.017 AU or 94.5 million miles)
3rd Centaur Object 10199 *Chariklo* at Opposition (14.651 AU)
3rd History: launch of the ill-fated Nozomi spacecraft to Mars by Japan (1998)
3rd History: launch of the Solar Anomalous and Magnetospheric Particle Explorer (SAMPEX) by a Scout rocket (1992)
4th History: Juno enters orbit around Jupiter (2016)
4th History: impact of Comet Tempel 1 by Deep Impact's impactor (2005)
4th History: Pathfinder spacecraft, with rover Sojourner, lands on Mars (1997)
4th History: Chinese astronomers record a "guest star" (supernova) in the constellation Taurus; visible for 23 days and 653 nights (1054); the remnant (Crab Nebula) later catalogued by Charles Messier as Messier 1 or M1
5th Apollo Asteroid 2017 BM31 near-Earth flyby (0.072 AU)
5th Asteroid 1221 *Amor* closest approach to Earth (1.227 AU)
5th Binary Apollo Asteroid 69230 *Hermes* closest approach to Earth (1.529 AU)
5th History: Isaac Newton's "Mathematical Principles of Natural Philosophy" published, describing the laws of motion (1687)
6th Moon at Apogee (furthest distance from Earth)
6th Distant flyby of Saturn's moons *Daphnis* and *Pan* by the Cassini spacecraft
6th Kuiper Belt Object 2014 PN70 at Opposition (42.980 AU)
6th History: discovery of Jupiter's moon *Lysithea* by Seth Nicholson (1938)
7th Kuiper Belt Object 2014 MU69 at Opposition (42.275 AU); target for a flyby by the New Horizons spacecraft on 1 January 2019
7th History: launch of the Mars Exploration Rover B (Opportunity) (2003)
8th Second Saturday Stars – Open House at the McCarthy Observatory
8th Apollo Asteroid 1566 *Icarus* closest approach to Earth (1.005 AU)
8th History: launch of the Space Shuttle Atlantis (STS-135) to the International Space Station; final space shuttle flight to low-Earth orbit (2011)
9th Full Moon (sometimes called the Full Buck, Thunder or Hay Moon)

Astronomical and Historical Events for July (continued)

9th Apollo Asteroid 2008 HU4 closest approach to Earth (0.641 AU)
9th Apollo Asteroid 37655 *Illapa* closest approach to Earth (1.447 AU)
9th History: closest pass of Jupiter's cloud tops by the Voyager 2 spacecraft (1979)
10th Distant flyby of Saturn's largest moon *Titan* by the Cassini spacecraft
10th Dwarf Planet 134340 Pluto at Opposition (32.347 AU), rising with the setting Sun and highest in the sky at midnight (only visible with a telescope)
10th History: flyby of Comet Grigg-Skjellerup by the European Space Agency's Giotto spacecraft following its close encounter of Halley's Comet (1992)
10th History: flyby of asteroid *21 Lutetia* by the European Space Agency's Rosetta spacecraft (2010).
10th History: launch of Telstar 1, prototype communication satellite designed and built by Bell Telephone Laboratories (1962)
10th History: Alvan Graham Clark born, optician and telescope maker (1832)
11th Flyby of Jupiter by the Juno spacecraft
11th History: launch of the Soviet Gamma Observatory (1990)
11th History: Skylab re-enters into the Earth's atmosphere (1979)
12th Aten Asteroid 136818 *Selqet* closest approach to Earth (0.273 AU)
12th Apollo Asteroid 5011 *Ptah* closest approach to Earth (1.812 AU)
12th History: launch of the High Engery Astronomical Observatory (HEAO-1), designed to survey the entire sky for x-ray emissions (1977)
12th History: launch of Soviet Mars orbiter Phobos 2 (1988)
13th Distant flyby of Saturn's moons *Ephimetheus*, *Pandora*, *Atlas* and *Prometheus* by the Cassini spacecraft
13th History: Soviet Union launches Luna 15, a lunar lander and sample return mission, in an attempt to upstage Apollo 11; crashed during landing (1969)
13th History: Langley Research Center's birthday (1917)
14th History: flyby of the dwarf plant Pluto by the New Horizons spacecraft dwarf planet and its largest moon Charon (2015)
14th Apollo Asteroid 2014 UV115 near-Earth flyby (0.096 AU)
14th History: flyby and first close-up view of Mars by the Mariner 4 spacecraft (1965)
15th Apollo Asteroid 2017 BS6 near-Earth flyby (0.055 AU)
15th Apollo Asteroid 2015 XZ378 near-Earth flyby (0.080 AU)
15th Amor Asteroid 153591 (2001 SN263) (2 moons) closest approach to Earth (1.768 AU)
15th History: the Dawn spacecraft enters orbit around the asteroid 4 *Vesta* (2011)
15th History: Pioneer 10 becomes the first spacecraft to enter the main asteroid belt (1972)
16th Last Quarter Moon
16th Amor Asteroid 1915 *Quetzalcoatl* closest approach to Earth (1.984 AU)
16th Apollo Asteroid 5731 *Zeus* closest approach to Earth (2.453 AU)
16th History: over twenty fragments of comet Shoemaker-Levy 9, with diameters estimated at up to 2 kilometers, collide with Jupiter between July 16th and the 22nd (1994); the comet had been discovered a year earlier by astronomers Carolyn and Eugene Shoemaker and David Levy
16th History: launch of Badr-A, first Pakistan satellite (1990)
16th History: launch of Apollo 11, with astronauts Neil Armstrong, Edwin "Buzz" Aldrin and Michael Collins, first manned lunar landing (1969)
16th History: first launch of a Proton rocket by the Soviet Union (1965)
16th History: first photo of a star other than our Sun (Vega) taken at the Harvard College Observatory (1850)
17th History: docking (and crew handshake) of an Apollo spacecraft with astronauts Thomas Stafford, Vance Brand, and "Deke" Stayton with a Soyuz spacecraft with cosmonauts Alexei Leonov and Valeri Kubasov (the Apollo-Soyuz Test Project (ASTP)) (1975)
17th History: William Bond and John Adams Whipple take the first photograph of a star (Vega) at the Harvard College Observatory (1850)
18th Atira Asteroid 2015 DR215 closest approach to Earth (0.580 AU)
18th History: John Glenn born, first American to orbit the Earth in 1962 (1921)
18th History: launch of Rohini 1, India's first satellite (1980)
18th History: launch of Gemini X, with astronauts John Young and Michael Collins (1966)
18th History: launch of Soviet Zond 3 spacecraft; first successful flyby of Moon; transmitted photographs that included the far side (1965)
18th History: Allan Sandage born, astronomer specializing in observational cosmology (1926)
19th Distant flyby of Saturn's moons *Atlas* and *Janus* by the Cassini spacecraft

Astronomical and Historical Events for July (continued)

19th History: launch of the Explorer 35 spacecraft into an elliptical lunar orbit; designed to study interplanetary plasma, magnetic field, energetic particles, and solar X-rays (1967)
20th Atira Asteroid 2010 XB11 closest approach to Earth (0.735 AU)
20th History: discovery of Jupiter's moon *Callirrhoe* (2000)
20th History: Gus Grissom's Mercury capsule (Liberty Bell 7) retrieved from the Atlantic Ocean floor at a depth of 15,000 feet, 38 years after it had sunk after splashdown (1999)
20th History: Viking 1 lands on Mars (1976)
20th History: Apollo 11 lands on Moon at 4:17 pm EDT; first step onto the lunar surface at 10:56 pm (1969)
21st Moon at Perigee (closest distance to Earth)
21st 82nd Convention of Amateur Telescope Makers (Stellafane), Springfield, Vermont (through the 25th), see https://stellafane.org/convention/2017/index.html
21st History: launch of the Soviet Mars mission Mars 4 (1973)
21st History: launch of Mercury-Redstone 4 with astronaut Virgil (Gus) Grissom; second suborbital flight by the United States (1961)
21st History: discovery of Jupiter's moon *Sinope* by Seth Nicholson (1914)
22nd History: first dogs (Dezik and Tsygan) to make a suborbital flight aboard a Soviet R-1 rocket (wore pressure suits and acrylic glass bubble helmets) (1951)
22nd History: landing of Soviet spacecraft Venera 8 on Venus (1972)
23rd New Moon
23rd Apollo Asteroid 2017 BS5 near-Earth flyby (0.008 AU)
23rd Atira Asteroid 418265 (2008 EA32) closest approach to Earth (0.593 AU)
23rd Apollo Asteroid 7092 *Cadmus* closest approach to Earth (2.854 AU)
23rd History: launch of Space Shuttle Columbia (STS-93) and the Chandra X-ray Observatory (1999); first mission commanded by a woman, Eileen Collins
23rd History: discovery of Comet Hale-Bopp by Alan Hale and Tom Bopp (1995)
23rd History: discovery of Neptune's rings (1984)
23rd History: launch of Landsat 1 into a near-polar orbit to obtain information on Earth's resources, environmental pollution, and meteorological phenomena (1972)
24th History: launch of the Geotail spacecraft, a joint JAXA/NASA mission to study the magnetic environs of Earth (1992)
24th History: first rocket launch from Cape Canaveral (Bumper/V-2 rocket) in 1950
25th Distant flyby of Saturn's largest moon Titan and second-innermost moon Pan by the Cassini spacecraft
25th Apollo Asteroid 2014 WW202 near-Earth flyby (0.052 AU)
25th Apollo Asteroid 480858 (2001 PT9) near-Earth flyby (0.069 AU)
25th History: Svetlana Savitskaya becomes the first woman to walk in space (1984)
25th History: launch of Soviet Mars orbiter Mars 5 (1973)
26th Apollo Asteroid 4660 *Nereus* closest approach to Earth (0.996 AU)
26th Apollo Asteroid 2135 *Aristaeus* closest approach to Earth (1.771 AU)
26th History: launch of the Space Shuttle Discovery (STS-114) "Return to Flight," 907 days after the loss of Space Shuttle Columbia (2005)
26th History: launch of Apollo 15 with astronauts David Scott, James Irwin and Alfred Worden; fourth lunar landing (1971)
26th History: launch of Syncom 2, first geosynchronous satellite (1963)
27th Distant flyby of Saturn's largest moon *Titan* by the Cassini spacecraft
28th Scheduled launch of a Russian Soyuz spacecraft carrying members of the next expedition crew to the International Space Station from the Baikonur Cosmodrome, Kazakhstan
28th History: launch of Skylab-3 astronauts Alan Bean, Jack Lousma and Owen Garriott (1973)
28th History: launch of Ranger 7; Moon impact mission (1964)
29th South Delta-Aquarids Meteor Shower peak
29th Centaur Object 83982 *Crantor* at Opposition (17.417)
29th Apollo Asteroid 2017 FQ64 near-Earth flyby (0.073 AU)
29th History: deorbit and destruction of the Salyut 6 space station; first of the Soviet's second-generation space station design (1982)
29th History: Deep Space 1 flyby of asteroid *Braille* (1999)
30th First Quarter Moon
30th Mercury at its greatest western elongation – apparent separation from the Sun in the early evening sky (27°)
30th History: discovery of the asteroid 951 *Gaspra* by Grigory Neujmin (1916); the Galileo spacecraft passed within 1,000 miles (1,600 km) of Gaspra on October 29, 1991 on its way to Jupiter

Astronomical and Historical Events for July (continued)

30th History: the Cassini spacecraft arrives at Saturn after a seven year journey (2004)
30th History: launch of the Wilkinson Microwave Anisotropy Probe (WMAP); mapped the Cosmic Microwave Background radiation and determined the age of the universe to be 13.73 billion years old to within one percent (2001)
30th History: Apollo 15 lands on Moon at 6:16 pm EDT (1971)
30th History: discovery of Jupiter's moon *Carme* by Seth Nicholson (1938)
30th History: Galileo observes Saturn's rings (1610)
31st History: impact of the Lunar Prospector (1999)
31st History: flyby of Mars by Mariner 6 (1969)

August

1st Distant flyby of Saturn's moons *Prometheus*, *Pandora* and *Pan* by the Cassini spacecraft
1st Apollo Asteroid 2017 KV4 near-Earth flyby (0.082 AU)
1st Kuiper Belt Object 2013 AT183 at Opposition (63.416 AU)
1st Peak of the Alpha Capricornids meteor shower
1st History: discovery of Martian meteorite (shergottite class) SAU 051 in Oman (2000)
1st History: launch of Lunar Orbiter 5, last of the Lunar Orbiter series; photographed potential Apollo and Surveyor landing sites and captured the first image of a nearly full Earth from space (1967)
1st History: Maria Mitchell born, first woman to be elected as an astronomer to the American Academy of Arts and Sciences (1818)
2nd Moon at Apogee (furthest distance from Earth)
3rd Centaur Object 52872 *Okyrhoe* at Opposition (9.587 AU)
3rd History: launch of the MESSENGER spacecraft to Mercury (2004)
4th History: launch of the Phoenix polar lander spacecraft to Mars (2007)
5th Kuiper Belt Object 2008 OG19 at Opposition (37.654 AU)
5th History: launch of the Juno spacecraft to Jupiter (2011); scheduled to arrive on July 4, 2016
5th History: flyby of Mars by the Mariner 7 spacecraft (1969)
5th History: astronaut Neil Armstrong born (1930); Commander of Apollo 11 and first person to step out on the lunar surface
6th Southern Iota Aquarids meteor shower peak
6th History: the Rosetta spacecraft and her robotic lander companion Philae arrive in orbit around Comet 67P/Churyumov–Gerasimenko after a 10-year journey (2014)
6th History: landing of the Mars Science Laboratory (MSL or Curiosity) at the base of Mount Sharp inside Gale Crater (2012)
6th History: launch of Vostok 2 and cosmonaut Gherman Titov; second man in Space (1961)
6th History: Chinese astronomers first observe supernova in Cassiopeia; remained visible for more than 6 months (1181)
7th Full Moon (sometimes called Sturgeon, Green Corn or Grain Moon)
7th Distant flyby of Saturn's moons *Janus*, *Atlas* and *Epimetheus*
7th Apollo Asteroid 1991 VG near-Earth flyby (0.057 AU)
7th Apollo Asteroid 2007 PS9 near-Earth flyby (0.077 AU)
7th Apollo Asteroid 2016 YR near-Earth flyby (0.095 AU)
7th History: Brett Gladman, et al's discovery of Saturn moons *Ymir*, *Paaliaq* and *Kiviuq* (2000)
7th History: announcement of possible microfossils found in Martian meteorite ALH84001 (1996)
7th History: Viking 2 arrives at Mars (1976)
8th Apollo Asteroid 2003 OT13 near-Earth flyby (0.093 AU)
8th Aten Asteroid 153415 (2001 QP153) near-Earth flyby (0.095 AU)
8th History: launch of Genesis spacecraft, solar particle sample return mission (2001)
8th History: launch of Pioneer Venus 2 (1978)
8th History: launch of the Soviet Zond 7 Moon probe (1969)
9th History: launch of the Soviet Luna 24 spacecraft, third attempt (and only successful attempt) to recover a sample from Mare Crisium (1976)
9th History: Henry Draper obtains the first spectrum photograph of a star (Vega) to show distinct lines (1872)
10th Scheduled launch of a SpaceX Dragon cargo-carrying spacecraft to the International Space Station from Cape Canaveral Air Force Station, Florida
10th Apollo Asteroid 2015 XO128 near-Earth flyby (0.095 AU)
10th History: launch of TOPEX/Poseidon Earth-monitoring satellite, joint venture between CNES and NASA that measured ocean surface topography to an accuracy of 4.2 cm (1992)
10th History: launch of Mars Reconnaissance Orbiter to Mars (2005)

Astronomical and Historical Events for July (continued)

10th History: launch of Kitsat A, first South Korean satellite (1992)
10th History: the Magellan spacecraft enters orbit around Venus; radar mapped 98% of the planet over the following two years (1990)
10th History: launch of the Lunar Orbiter 1 spacecraft; photographed smooth areas of the lunar surface for assessing future landing sites and captured iconic image of the Earth rising above the lunar surface (1966)
11th Distant flyby of Saturn's largest moon *Titan*
11th History: Asaph Hall discovers Martian moon *Deimos* (1877)
12th Second Saturday Stars – Open House at the McCarthy Observatory
12th Peak of the Perseids meteor shower (into the morning of the 13th)
12th History: launch of the High Energy Astronomical Observatory (HEAO-1) to monitor x-ray sources (1977)
12th History: Soviet spacecraft Vostok 4 launched one day after Vostok 3 - first time multiple manned spacecraft in orbit, although they did not rendezvous (1962)
12th History: launch of Echo 1, the first experimental communications satellite (1960)
13th Apollo Asteroid 2014 OA339 near-Earth flyby (0.032 AU)
13th Apollo Asteroid 2003 MJ4 near-Earth flyby (0.098 AU)
13th Aten Asteroid 2013 ND15 (Venus Trojan) closest approach to Earth (1.160 AU)
13th Apollo Asteroid 5143 *Heracles* closest approach to Earth (1.634 AU)
13th History: discovery of Mars' south polar cap by Christiaan Huygens (1642)
13th History: discovery of long-period variable star Mira, (Omicron Ceti) by David Fabricius (1596)
14th Last Quarter Moon
14th Distant flyby of Saturn's moons *Atlas* and *Prometheus*
15th Apollo Asteroid 414990 (2011 EM51) near-Earth flyby (0.078 AU)
15th Apollo Asteroid 1566 *Icarus* closest approach to Earth (1.109 AU)
16th History: launch of Explorer 12 spacecraft, measured cosmic-ray particles, solar wind protons, and magnetospheric and interplanetary magnetic fields (1961)
17th Apollo Asteroid 2002 CY58 near-Earth flyby (0.068 AU)
17th Apollo Asteroid 2016 CD137 near-Earth flyby (0.099 AU)
17th Atira Asteroid 2015 ME131 closest approach to Earth (0.415 AU)
17th History: launch of Venera 7; Soviet Venus lander (1970)
17th History: launch of Pioneer 7 (1966)
17th History: Asaph Hall discovers Martian moon *Phobos* (1877)
18th Moon at Perigee (closest distance to Earth)
18th Apollo Asteroid 2012 BD14 near-Earth flyby (0.067 AU)
18th History: launch of Suisei; Japan's Comet Halley mission (1985)
19th History: launch of first Philippine communications satellite Agila 2 (also known as Mabuhay 1 or ABS 5) (1997)
19th History: launch of Soviet Sputnik 5 spacecraft with dogs Belka and Strelka (1960)
19th History: discovery of S Andromedae (SN 1885A), supernova in the Andromeda Galaxy and the first discovered outside the Milky Way Galaxy; discovered by Irish amateur astronomer Isaac Ward in Belfast on the 19th and independently the following day by Ernst Hartwig at Dorpat (Tartu) Observatory in Estonia (1885)
19th History: Orville Wright born (1871)
19th History: John Flamsteed born; English astronomer known for his accurate astronomical observations and first Astronomer Royal (1646)
20th Distant flyby of Saturn's moons *Pandora*, *Pan* and *Daphnis*
20th History: launch of Voyager 2 to the outer planets (1977)
20th History: launch of Mars orbiter/lander Viking 1 (1975)
20th History: Ernst Hartwig's discovery of S Andromedae Supernova (1885)
21st New Moon
21st Total Solar Eclipse (visible from the continental United States)
21st History: launch of the Orbiting Astronomical Observatory-3, Copernicus, with a UV telescope and X-ray detector (1972)
21st History: launch of Gemini V with astronauts Gordon Cooper and Charles Conrad (1965)
23rd Apollo Asteroid 54509 YORP closest approach to Earth (0.652 AU)
23rd History: Lunar Orbiter 1 takes first photo of the Earth from the Moon (1966)
24th History: Pluto reclassified as a Dwarf Planet (2006)
24th History: launch of the Soviet Luna 11 spacecraft to analyze the Moon's chemical composition, study gravitational anomalies and measure radiation levels (1966)

Astronomical and Historical Events (continued)

25th Northern Iota Aquarids Meteor Shower Peak
25th Apollo Asteroid 2005 QQ87 near-Earth flyby (0.087 AU)
25th History: flyby of Neptune by the Voyager 2 spacecraft (1989)
25th History: launch of the Spitzer Space Telescope (2003)
25th History: launch of the Advanced Composition Explorer spacecraft to study energetic particles from the solar wind, the interplanetary medium, and other sources (1997)
26th Distant flyby of Saturn's largest moon *Titan*
26th History: flyby of the planet Saturn by the Voyager 2 spacecraft (1981)
27th Distant flyby of Saturn's moon *Janus*, *Daphnis*, *Prometheus*, *Epimetheus*, *Pandora* and *Pan*
27th Amor Asteroid 2202 Pele closest approach to Earth (0.670 AU)
27th Kuiper Belt Object 225088 (2007 OR10) at Opposition (86.829 AU)
27th History: launch of the Mariner 2 spacecraft to Venus; first successful planetary encounter (1962)
28th Distant flyby of Saturn's largest moon *Titan*
28th Amor Asteroid 2015 RQ35 near-Earth flyby (0.098 AU)
28th Apollo Asteroid 3752 *Camillo* closest approach to Earth (0.558 AU)
28th Kuiper Belt Object 408706 (2004 NT33) at Opposition (38.173 AU)
28th History: flyby of the asteroids *Ida* and *Dactyl* by the Galileo spacecraft (1993)
28th History: discovery of Saturn's moon *Enceladus* by William Herschel (1789)
29th First Quarter Moon
29th Centaur Object 7066 *Nessus* at Opposition (26.750 AU)
29th Kuiper Belt Object 307982 (2004 PG115) at Opposition (37.184 AU)
29th History: discovery of a bright nova in the constellation Cygnus (Nova Cygni 1975); visible to the unaided eye for about a week (1975)
30th Moon at Apogee (furthest distance from Earth)
30th Aten Asteroid 2100 *Ra-Shalom* closest approach to Earth (1.211 AU)
30th History: discovery of first Kuiper Belt Object (1992 QB1) by David Jewitt and Jane Luu
30th History: launch of Japanese satellite Yohkoh (Sunbeam) to observe phenomena taking place on the Sun (1991)
30th History: launch of STS-8 and astronaut Guy Bluford; first African-American in space and first night launch and landing by a shuttle (1983)
31st Centaur Object 944 *Hidalgo* at Opposition (3.287 AU)
31st Kuiper Belt Object 2003 QX113 at Opposition (59.043 AU)
31st History: President Kennedy signs the Communications Satellite which created the Communications Satellite Corporation (COMSAT) and committed the U.S. to building a global communications system (1962)
31st History: first photo showing Moon's shadow on the Earth during Solar Eclipse taken by stratospheric balloonist Captain Albert Stevens (1932)

Commonly Used Terms

Apollo: A group of near-Earth asteroids whose orbits also cross Earth's orbit; Apollo asteroids spend most of their time outside Earth orbit.

Aten: A group of near-Earth asteroids whose orbits also cross Earth's orbit, but unlike Apollos, Atens spend most of their time inside Earth orbit.

Atira: A group of near-Earth asteroids whose orbits are entirely within Earth's orbit

Centaur: Icy planetesimals with characteristics of both asteroids and comets

Kuiper Belt: Region of the solar system beyond the orbit of Neptune (30 AUs to 50 AUs) with a vast population of small bodies orbiting the Sun

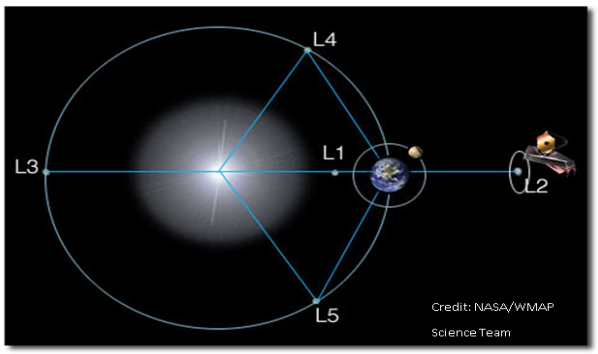
Opposition: Celestial bodies on opposite sides of the sky, typically as viewed from Earth

Plutino: An asteroid-sized body that orbits the Sun in a 2:3 resonance with Neptune

Trojan: asteroids orbiting in the 4th and 5th Lagrange points (leading and trailing) of major planets in the Solar System

Lagrange Points

Five locations discovered by mathematician Joseph Lagrange where the gravitational forces of the Sun and Earth (or other large body) and the orbital motion of the spacecraft are balanced, allowing the spacecraft to hover or orbit around the point with minimal expenditure of energy. The L2 point (and future location of the James Webb telescope) is located 1.5 million kilometers beyond the Earth (as viewed from the Sun).



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Solar Activity

For the latest on what's happening on the Sun and the current forecast for flares and aurora, check out *www.spaceweather.com.*

International Space Station and Iridium Satellites

Visit www.heavens-above.com for the times of visibility and detailed star charts for viewing the International Space Station and the bright flares from Iridium satellites.

References on Distances

- The apparent width of the Moon (and Sun) is approximately one-half a degree (½°), less than the width of your little finger at arm's length which covers approximately one degree (1°); three fingers span approximately five degrees (5°)
- 1 astronomical unit (AU) is the distance from the Sun to the Earth or approximately 93 million miles

Astronomy:

Past, Present & Future

A ***Free of Charge*** Summer Program for Young Scientists Grades 5 – 8

July 31 – August 5, 2017

7:00PM – 8:30PM

Eagle Nebula image by Marc Polansky

Course Outline

- ★ **Day 1**: The Origin of Astronomy
- ★ **Day 2**: Astronomy in the Renaissance
- ★ **Day 3**: Einstein and Newton
- ★ **Day 4**: Hubble, Galaxies, and the Astounding Expanding Universe
- ★ **Day 5**: The Big Bang Theory
- ★ **Day 6**: Observation Night – Parents welcome! Students will observe objects they've studied during the week and show off what they've learned.

Each day includes a fun, hands-on activity involving the day's topic.

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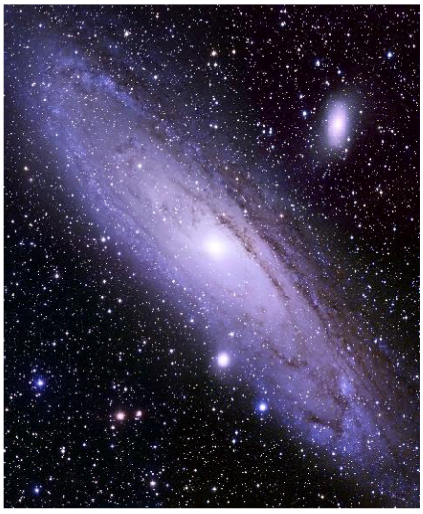

Class takes place at the JJ McCarthy Observatory, on the New Milford High School campus: 388 Danbury Road, New Milford, CT 06776

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July 8th

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The *Beginnings of the Universe*

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Family Entertainment
Handicapped Accessible
ASL Interpretation Available with Prior Notice
Rain or Shine

Map

July 2017

Celestial Calendar

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
						1 Smithsonian Air & Space Museum birthday (1976)  100-inch mirror for Hooker telescope arrives at Mt Wilson (1917)   NASA officially activates the Launch Operations Center on Merritt Island, Florida; later renamed the Kennedy Space Center (1962)
2 Moon at Perigee  Launch of European Space Agency' Giotto spacecraft to Comet Halley (1985)	3  Launch of ill-fated Japanese Nozomi spacecraft to Mars (1998)  Launch of the Solar Anomalous and Magnetospheric Particle Explorer (SAMPEX) by a Scout rocket (1992)	4  Crab nebula viewed by Chinese astronomers (1054) Mars Pathfinder landing (1997)   Henrietta Leavitt born; measured distances to far galaxies (1868)	5  A. E. (Andrew Ellicott) Douglass ,an American astronomer who discovered a correlation between tree rings and the sunspot cycle. (1867)	Moon at apogee (farthest from Earth) 6   Isaac Newton's *Principia* published (1687) Discovery of Jupiter's moon Lysithea by Seth Nicholson (1938) 	7  Launch of Mars Exploration Rover B *Opportunity* (2003)	8 Launch of the Space Shuttle Atlantis (STS-135) to the International Space Station; final space shuttle flight to low Earth orbit (2011)   2nd Saturday Stars Open House McCarthy Observatory
9 Alvan Graham Clark born, telescope maker (1832)  Flyby of Asteroid 21 Lutetia by European Space Agency's Rosetta spacecaft (2010)   launch of Telstar 1, prototype communication satellite designed and built by Bell Telephone Laboratories (1962)	Probe of comet Tempel 1 by Deep Impact impactor (2005) 10   Launch of Soviet Gamma Observatory (1990) Skylab re-enters into the Earth's atmosphere (1979) 	11  Soviet Mars orbiter Phobos 2 launched (1988)	12  Langley Research Center Birthday (1917) Soviet spacecraft Luna 15 launched, lander to crash on Moon (1969) 	13  First close-up view of Mars by Mariner 4 Spacecraft (1965)	14 Launch of Apoll0 18 and Soyuz 19 in joint U.S./ Soviet mission (1975)   The Dawn spacecraft enters orbit around the asteroid 4 Vesta (2011)	15  Close pass of Jupiter's cloud tops by Voyager 2 spacecraft (1979)
16 Apollo 11 Moon mission Armstrong, Aldrin, Collins (1969)  Schoemaker/ Levy Comet fragments impact Jupiter (July 16-22, 1994)   first photo of a star other than our Sun (Vega) by Harvard University (1850)	17 Monsignor Georges Lemaître born; Belgian priest and astronomer was first to propose expanding universe and Big Bang theory (1894)   Docking and handshakes of Apollo 18 and Soyuz 19 crews (1975)	18 Launch of Zond 5, 1st successful Moon flyby 1965)   Allan Standage born, cosmologist (1976) Rohini I, India's 1st satellite, failed at launch (1980)   Gemini X with John Young and Michael Collins (1966)	19  Launch of Explorer 35 spacecraft into an elliptical lunar orbit, to study interplanetary plasma, magnetic field, energetic particles, and solar X-rays (1967)  Edward Charles Pickering born - Harvard astronomer and physicist who discovered the first spectroscopic binary stars, later used to measure cosmic distances. (1846)	20 Apollo 11 lands on Moon (1969) Viking I lands on Mars (1976) Gus Grissom's capsule Liberty Bell raised after 30 years on ocean floor (1999)	21 Moon at perigee (closest to Earth) Launch of Soviet Mars 4 mission (1973) Virgil (Gus) Grissom, 2nd U.S. suborbital flight (1961)	22 Landing of Soviet spacecraft Venera 8 on Venus (1972)
23 Alan Hale and Tom Bopp announce discovery of comet Hale- Bopp (1995) Launch of Shuttle Columbia and Chandra X-ray Observatory; first mission commanded by a woman, Eileen Collins (1999) Launch of Landsat 1 into a near-polar orbit to study Earth's resources and meteorological phenomena (1972)	24 Bumper V-2, first rocket launch from Cape Canaveral (1950) 78th Convention of Amateur Telescope Makers (Stellafane), Springfield, Vt (through the 27th),	25 Svetlana Savitskaya becomes first woman to walk in space (1984) Launch of Soviet orbiter Mars 5 (1973)	Shuttle Discovery (STS-114) "return to flight" (2005) 26 Launch of Syncom 2, first geosynchronous satellite (1963) launch of Apollo 15, fourth lunar landing (1971)	27 Sir George Biddell Airy born - an English mathematician and Astronomer Royal who worked on planetary orbits, measuring the mean density of the Earth, and establishing Greenwich as the prime meridian (1801)	28 Launch of Ranger 7, Moon impact mission (1964) Launch of Skylab 3 (Bean, Pogue, Garriott) (1973)	29 South Delta-Aquarids meteor shower peak Deep Space I encounter with asteroid Braille (1999) President Eisenhower signs Public Law 85-568, creating the National Aeronautics and Space Administration (1958)
Moon at apogee (farthest from Earth) 30 Impact of the Lunar Prospector (1999) Launch of the Wilkinson Microwave Anisotropy Probe WMAP); mapped the Cosmic Microwave background radiation and determined the age of the universe 2001)	31 Impact of the Lunar Prospector (1999) Mariner 6 Mars flyby (1969)					

Phases of the Moon

July 9 July 16 July 23 July 30

Phases of the Moon

Aug 7 Aug 14 Aug 21 Aug 29

August 2017

Celestial Calendar

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Jul 2017 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31		**1** Peak of the Alpha Capricornids meteor shower Launch of Lunar Orbiter 5, the last of the Lunar Orbiter series (1967) Maria Mitchell born, first woman elected as an astronomer to the American Academy of Arts and Sciences (1818)	**2** Valery Fyodorovich Bykovsky born: Soviet cosmonaut flew three manned space mission space flights, spending five days in orbit aboard Vostok 5 in 1963 - a record for a solo flight. (1934)	**3** Launch of MESSENGER spacecraft to Mercury (2004)	**4** Launch of Phoenix Spacecraft to Mars (2007)	**5** Astronaut Neil Armstrong born (1930) Launch of the Juno spacecraft to Jupiter (2011) Flyby of Mars by the Mariner 7 spacecraft (1969)
6 Gherman Titov, 2nd man in space (1961) Cassiopeia Supernova observed by Chinese (1181) Landing of Mars Science Lab (MSL or Curiosity) inside Gale Crater (2012)	**7** Viking 2 on Mars (1976) Martian meteorite found to contain possible life (1996)	**8** Launch of Genesis Spacraft (2001) Launch of Pioneer Venus 2 (1978) Launch of Soviet Zond 7 moon probe (1969)	**9** Launch of Soviet Luna 24 spacecraft, third (and only successful attempt) to recover a sample from Mare Crisium (1976)	**10** Launch of Mars Reconnaissance Orbiter (2005) Magellan spacecraft orbits Venus (1990)	**11** Asaph Hall discovers Martian Moon Deimos(1877)	**12** Perseid meteor showers at peak Launch of the High Energy Astronomical Observatory (HEAO-1) to monitor x-ray sources (1977) Launch of Echo 1A, communications satellite in 2ND attempt (1960) **2nd Saturday Stars Open House McCarthy Observatory**
13 Discovery of long-period variable star Mira, Omicron Ceti by David Fabricius (1596) Discovery of Mars' south polar cap by Christiaan Huygens (1642)	**14** Educator astronaut Barbara Morgan leads a Q&A session with children in Boise, Idaho from the space shuttle Endeavour, fulfilling legacy of Christa McAuliffe, who died in the 1986 Challenger disaster (2007)	**15** President Reagan announced his support for the construction of an orbiter to replace Challenger (1986)	**16** Launch of Explorer 12 spacecraft, measured cosmic-ray particles, solar wind protons, and magnetospheric and interplanetary magnetic fields (1961)	**17** launch of Venera 7; Soviet Venus lander (1970) Asaph Hall discovers Martian Moon Phobos (1877) Launch of Pioneer 7 (1966)	**18** Moon at perigee (closest distance to Earth) Launch of Suisei, Japan's Comet Halley mission (1985)	**19** Launch of Sputnik 5, with dogs Belka and Strejka (1960) Birth of Orville Wright (1871) Sir John Flamsteed born, English astronomer (1646) Dmitri Ivanovich Mendeleev rises to 11,500 feet (3.5 km) to observe an eclipse in Russia (1887)
20 Launch of Mars orbiter/ lander Viking 1 (1975) Launch of Voyager 2 to outer planets (1977)	**21** Launch of Gemini V with astronauts Gordon Cooper and Charles Conrad (1965) Launch of the Orbiting Astronomical Observatory-3, Copernicus, with a UV telescope and X-ray detector (1972)	**22** Neptune was found to have a continuous ring system by the Voyager 2 spacecraf (1989)	**23** Lunar Orbiter 1 takes first photograph of Earth from Moon (1966)	**24** Pluto reclassified as a dwarf planet (2006) Launch of the Soviet Luna 11 spacecraft to analyze the Moon's chemistry, gravitation and radiation levels (1966)	**25** flyby of Neptune by the Voyager 2 spacecraft (1989) Meteor shower (Northern Iota Aquarids peak)	**26** Flyby of Saturn by Voyager 2 spacecraft (1981)
27 launch of the Mariner 2 spacecraft to Venus; first successful planetary encounter (1962)	**28** Discovery of Nova Cygni in the constellation Cygnus (1975)	**29** Discovery of Saturn's moon Enceladus by William Herschel (1789) Flyby of asteroids Ida and Dactyl by the Galileo spacecraft (1993)	**30** Moon at apogee (farthest from Earth) Discovery of first Kuiper Belt object, 1992 QB1, by David Jewet and Jane Luu Launch of STS-8 and astronaut Guy Bluford, 1st African-American in space (1983) First recorded occurrence - comet Howard Koomen-Michels impacts sun (energy of 1 million hydrogen bombs) (1979)	**31** US Naval Observatory authorized by an act of Congress (1842)	Sep 2017 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	