

Galactic Observer

John J. McCarthy Observatory

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Space Launch System (SLS)

The core stage of NASA's SLS rocket arrived at the Kennedy Space Center's Vehicle Assembly Building in Florida on April 29, 2021. The liquid-fueled core will be mated with its solid rocket boosters ahead of the Artemis I launch. Photo credit: NASA/Jamie Peer and Mike Downs

June Astronomy Calendar and Space Exploration Almanac



The innermost planet, Mercury, joined a waxing crescent moon (two days old) shortly after sunset on May 13 for one of the best evening apparitions of the year. Mercury reached greatest western elongation on the 17th (separation from the Sun) when it reached an altitude of 19° as the Sun set. Soon after, Mercury plunged toward the Sun (in our sky) as it passed between the Earth and Sun – disappearing into the Sun’s glare.

Apparitions of Mercury occur every 3–4 months, alternating between the early morning and evening skies. The planet will reach its next elongation (western) on July 4 when it will reach an altitude of 15° in the eastern sky before sunrise.

Photo: Bill Cloutier

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“Out the Window on Your Left”

It’s been almost 52 years since Neil Armstrong first stepped onto the moon’s surface and more than 48 years since Gene Cernan left the last footprint. As a nation founded on exploration and the conquest of new frontiers, today’s commitment to return to the moon has been as fleeting as the funding. 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 provide some thoughts to ponder when planning your visit (if only in your imagination).

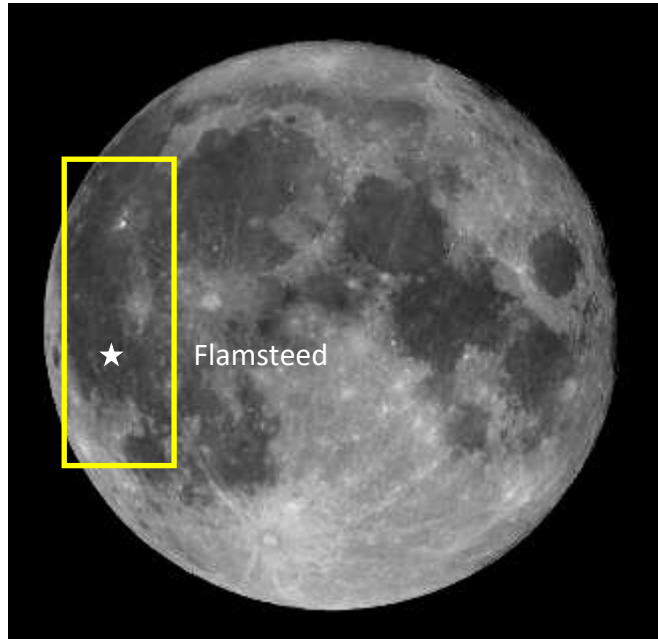
Exploration of the Moon by the Apollo astronauts was preceded by a number of robotic explorers – the Ranger and Surveyor missions. The projects were managed by NASA’s Jet Propulsion Laboratory in Pasadena, California, and involved two spacecraft with very different objectives.

The Ranger spacecrafts were designed to transmit photographs and other data on approach, and all the way down to the surface of the Moon before impacting. Nine spacecraft were launched between 1961 and 1965 (two into low-Earth orbit), with only Rangers 7, 8 and 9 being successful. The last three Rangers transmitted over 17,000 images, in total, resolving objects on the surface as small as 16 inches (50 centimeters).

The Surveyor spacecrafts were designed to soft-land, with seven launched towards the Moon between 1966 and 1968. Five were successful, including the first, with three surviving at least one lunar night. Surveyor 1 landed on the lunar surface on June 2, 1966, about 64 hours after launch from Cape Canaveral, Florida. It landed inside a 70-mile (112 km) diameter flooded, walled plain, north of Flamsteed Crater, in southwest Oceanus Procellarum (Ocean of Storms). The first images transmitted by Surveyor 1 settled the debate on whether the lunar regolith could bear the weight of a lunar lander and its astronauts, returning details on the granular surface - resolving objects as small as $\frac{1}{12}$ inch (2 millimeters).

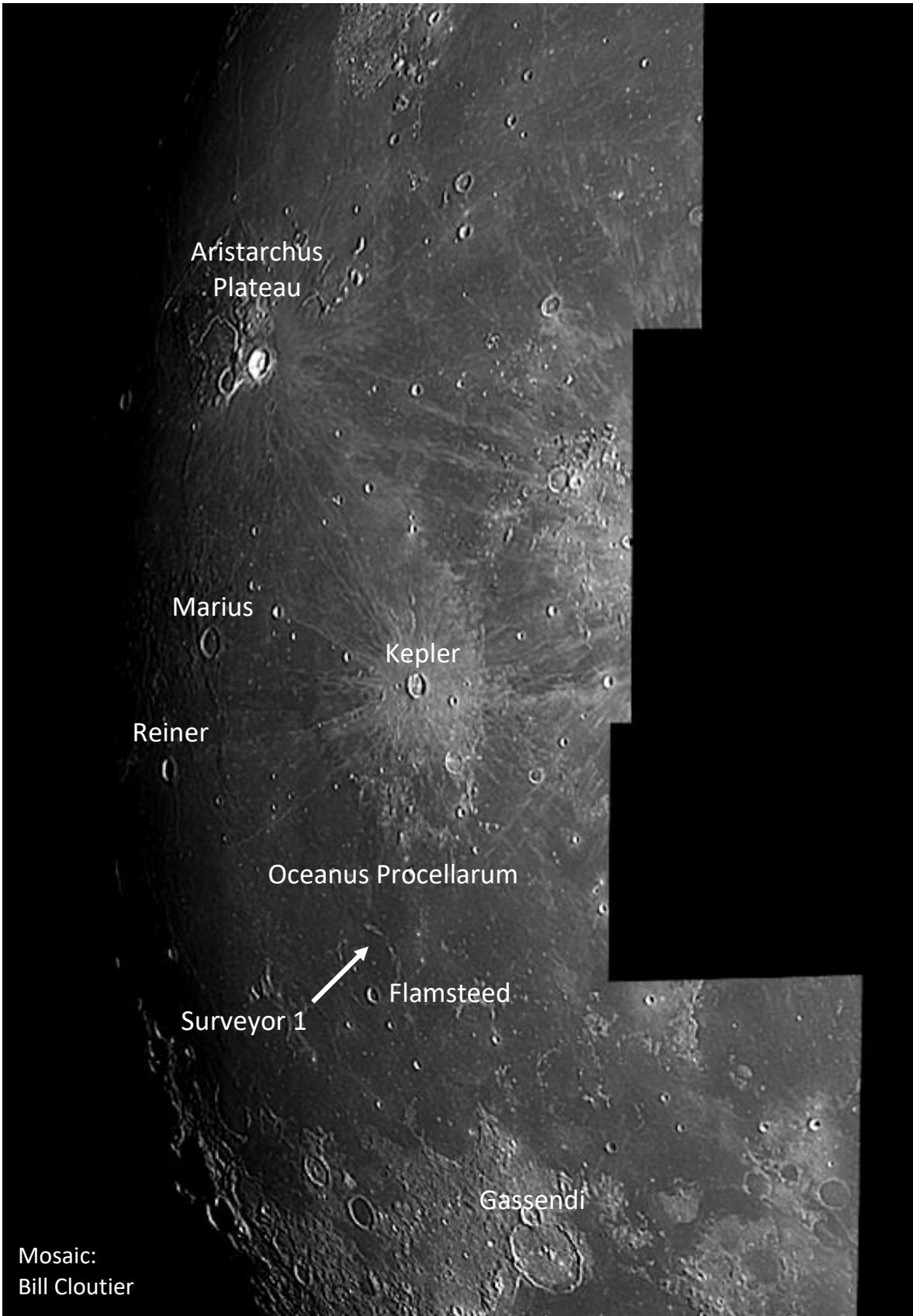
Surveyor 1 was the first US spacecraft to successfully land on another world. It would transmit over 11,000 images, most during the first lunar day. NASA maintained contact with the 649-Earth pound (294.3 kg) lander until January 1967.

A successful Surveyor 3 mission, following the crash of Surveyor 2, played a role in the Apollo program – becoming a destination for the Apollo 12 astronauts. In November 1969, the astronauts visited the landing site, removing and bringing back several parts of the vehicle to Earth where they were studied for their 2½-year exposure to the lunar environment. Surveyor 3’s camera eventually went on display at Smithsonian’s National Air and Space Museum.



Location of Flamsteed crater and Surveyor 1 in Oceanus Procellarum

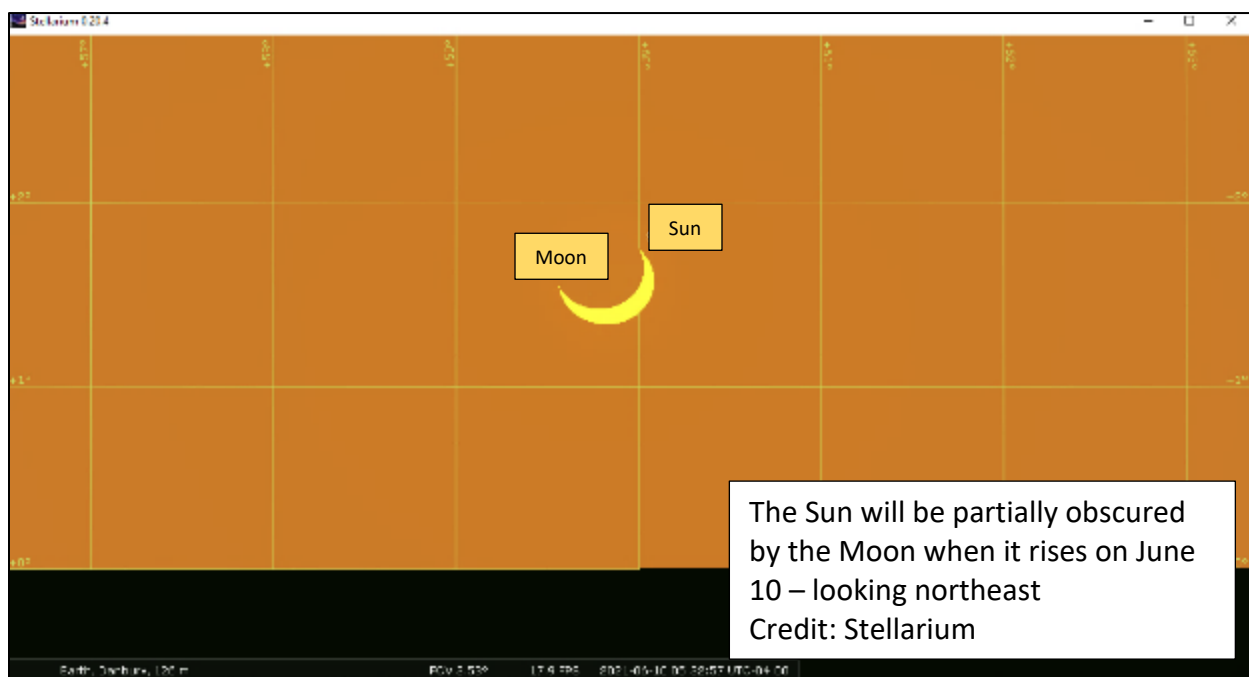
Surveyor 1 and the Ocean of Storms



Solar Eclipses

On June 10, an annular solar eclipse will be visible from parts of Russia, Greenland, and northern Canada. Residents in northern Asia, Europe, and the United States will see a partial eclipse.

During a solar eclipse, the Moon obscures the solar disk as it moves between the Earth and Sun. If the eclipse is “total,” the solar disk is completely covered, with only the Sun’s outer atmosphere (corona) visible in a darkened sky. The spectacle is possible because, at this time, while the Moon is about 400 times smaller than the Sun, it is also about 400 times closer to the Earth than the Sun – meaning that the two appear to be roughly the same size in the sky. However, since the Moon’s orbit is elliptical (varying by about 30,000 miles or 50,000 km), not all eclipses are equal. When the Moon is furthest from the Earth in its orbit (apogee), the lunar disk appears smaller than the solar disk and a ring of sunlight will surround the Moon. This configuration is known as an annular solar eclipse. In June, lunar apogee occurs on the night June 7, less than three days before the eclipse.



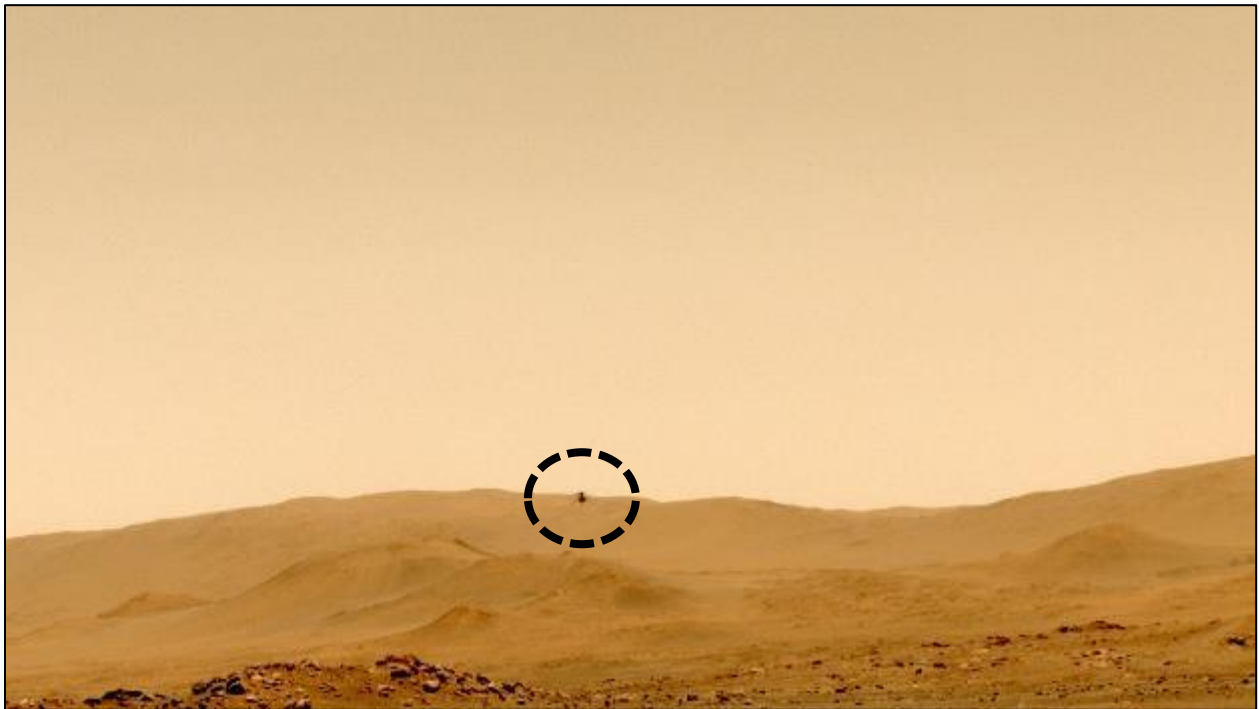
On the morning of June 10, the Sun will rise around 5:20 am in western Connecticut. A partial eclipse will have started when the Sun was below the horizon, about 40 minutes earlier. Looking towards the northeast (**YOU WILL NEED TO WEAR YOUR ECLIPSE GLASSES OR USE ANOTHER APPROVED FILTER TO SAFELY VIEW THE ECLIPSE AND PREVENT DAMAGE TO THE EYES!**), a crescent Sun will be low on the horizon (the tips of the crescent will appear first). Maximum eclipse will occur around 5:33 am, and less than 2 degrees above the horizon, when the Moon is closest to the center of the Sun. At this time, the lunar disk will obscure about 73% of the solar disk, from our location.

The eclipse will end around 6:32 am, when the Moon leaves the edge of the Sun. The next solar eclipse, visible from the United States, will be on October 14, 2023 when an annular eclipse will be visible along a narrow path from Oregon through Texas. The annular eclipse will set the stage for the next “Great American Eclipse” on April 8, 2024, when a totally eclipsed Sun will be visible in the sky along a corridor that extends across the United States from Texas to Maine.

New Mission for Ingenuity

On May 7, the Mars helicopter Ingenuity lifted off from Wright Brothers Field for its fifth flight. Unlike the previous four excursions, the helicopter did not return to base. Instead, Ingenuity headed south, landing about 423 feet (129 meters) from its point of departure. The flight concluded the helicopter's 30-Sol demonstration program and, in the original mission plan, would have had Ingenuity deactivated and abandoned, as the Perseverance rover moved on towards the ancient river delta in Jezero crater and its mission to look for signs of ancient life.

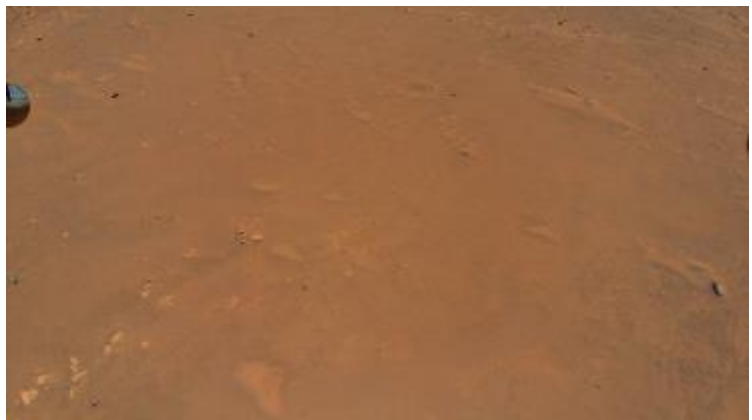
However, the four-Earth-pound rotorcraft proved to be so robust and capable, that NASA elected to extend and change Ingenuity's mission from a technology demonstration to one of field support. This decision was made possible when the rover mission team decided to explore the local area first, before heading off to the delta (the rover carries the helicopter's communications base station). In this next phase, NASA will evaluate Ingenuity's ability to identify potential targets to explore and possible routes for the rover, observe inaccessible areas, and conduct detailed stereo imaging from a higher vantage point than possible with the rover.



Above: Ingenuity is captured by one of the rover's navigation cameras during its fifth flight on May 7.

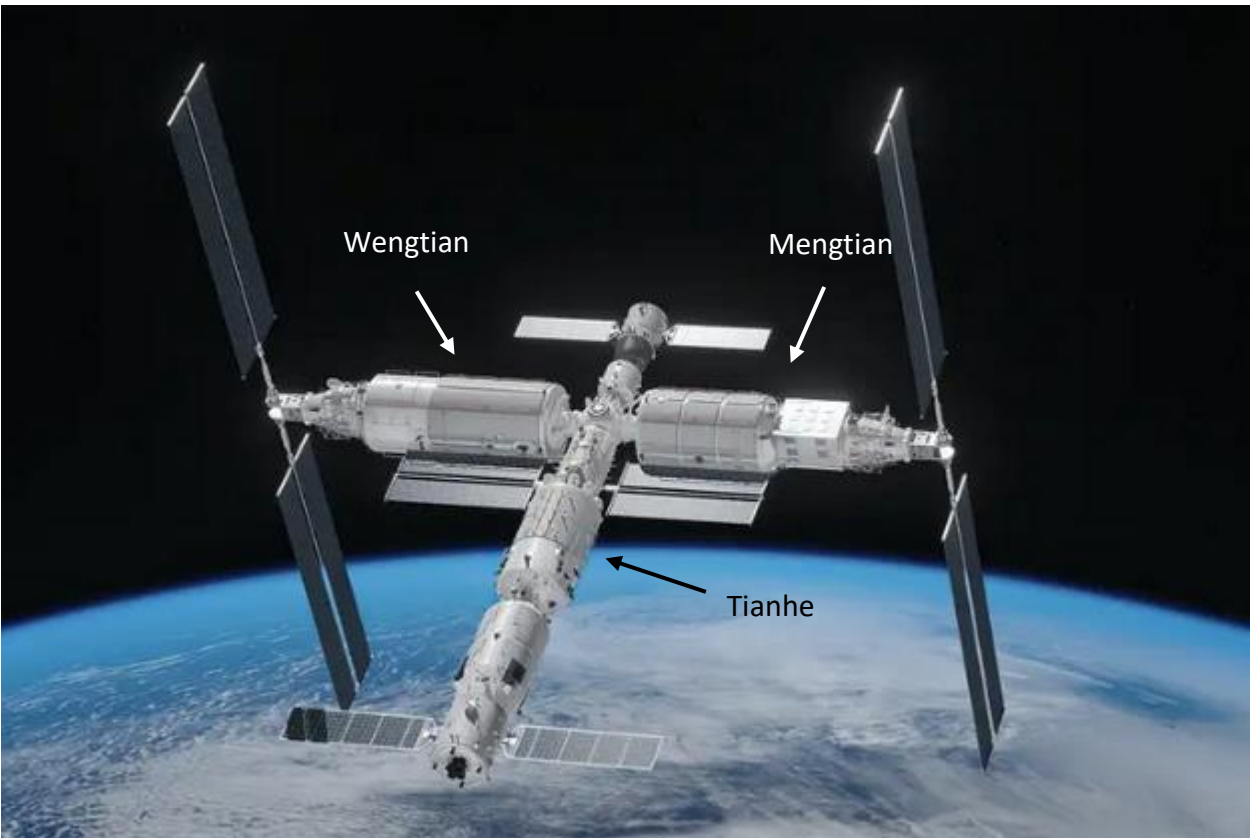
Right: image of the surface of Jezero crater from Ingenuity's color camera from an altitude of 33 feet (10 meters) during that flight.

Credits: NASA/JPL-Caltech



“Heavenly Palace” Under Construction

China launched the first of three core elements of its new Tiangong space station on April 29, 2021 with a Long-March 5B rocket from its Wenchang launch center. The Tianhe module (54.4 feet or 16.6 meters long and 13.8 feet or 4.2 meters wide) is the station’s control center, containing power and propulsion units, docking ports for cargo and visiting crewed spacecraft, as well as living space for up to three taikonauts. Fully fueled, the module was reported to weigh 49,600 pounds (22.5 metric tons) at launch.



Artist concept of the completed Tiangong space station
Source: Xinhua news agency

Tiangong is China’s third space station – the first two being much smaller in size. When completed

next year, it will be about a third the size of the International Space Station and slightly larger than the Soviet Mir station, which was deorbited in 2001.

Another ten or more launches will be required to complete and outfit the station. Tiangong will orbit Earth at an altitude of 210-280 miles (340 to 450 km) and is expected to operate for at least 10 years.

Similar in size and launch weight to Tianhe, two other modules (“Wengtian” and “Mengtian”) will be added to the complex and designated for scientific research in microgravity.

The Tianhe module is expected to be visited by China’s taikonauts in June aboard a Shenzhou 12 spacecraft. A Tianzhou 2 spacecraft, loaded with fuel, parts, equipment and life supplies, is expected to be headed to the station in anticipation of the visit.

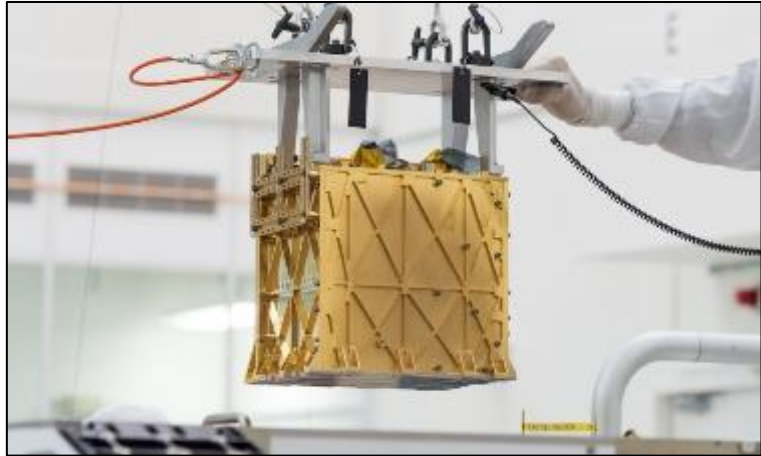
MOXIE Delivers

Among the scientific instruments on NASA's Perseverance rover is a technology demonstration - MOXIE (for Mars Oxygen In-situ Resource Utilization Experiment). The MIT-designed instrument was devised to evaluate the feasibility of extracting oxygen from the thin Martian atmosphere, comprised of 95% carbon dioxide.

On Tuesday, April 20 (Sol 60 in Jezero crater), MOXIE was powered up for the first time (on Mars). After a two-hour warm-up period, the instrument started to produce oxygen – a first on another planet. MOXIE works by drawing the Martian air inside the rover, filtering it to remove any contaminants, compressing the carbon dioxide, and then heating it to approximately 1,470°F (800°C) to separate the gas into oxygen and carbon monoxide. The oxygen ions are further processed – emerging from the unit as O₂. Since MOXIE does not have the ability to store the oxygen it produces, it is discharged back into the atmosphere along with the carbon monoxide.

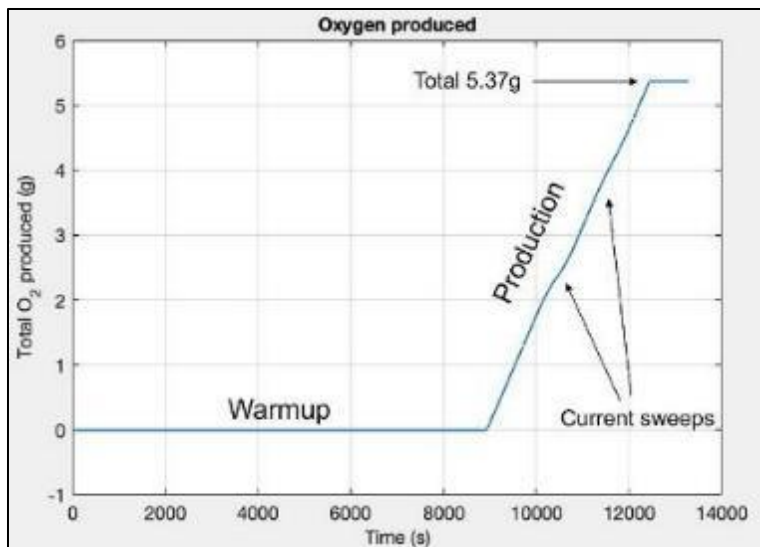
In its first run, MOXIE produced about 5.4 grams of oxygen in an hour - enough to provide one person with breathable air for about 10 minutes, according to NASA. At full power, the unit can produce twice that amount for each hour of operation.

The proof of concept has major implications for future human exploration of the Red Planet. A scaled-up MOXIE plant could provide pure oxygen for use as propellant, breathable air, or, combined with hydrogen for water. More important, these products wouldn't have to be carried with the explorers when they left Earth – saving mass and the fuel to deliver that mass.



Technicians at NASA's Jet Propulsion Laboratory install MOXIE into the rover's chassis prior to launch in July 2020

Credit: NASA/JPL-Caltech

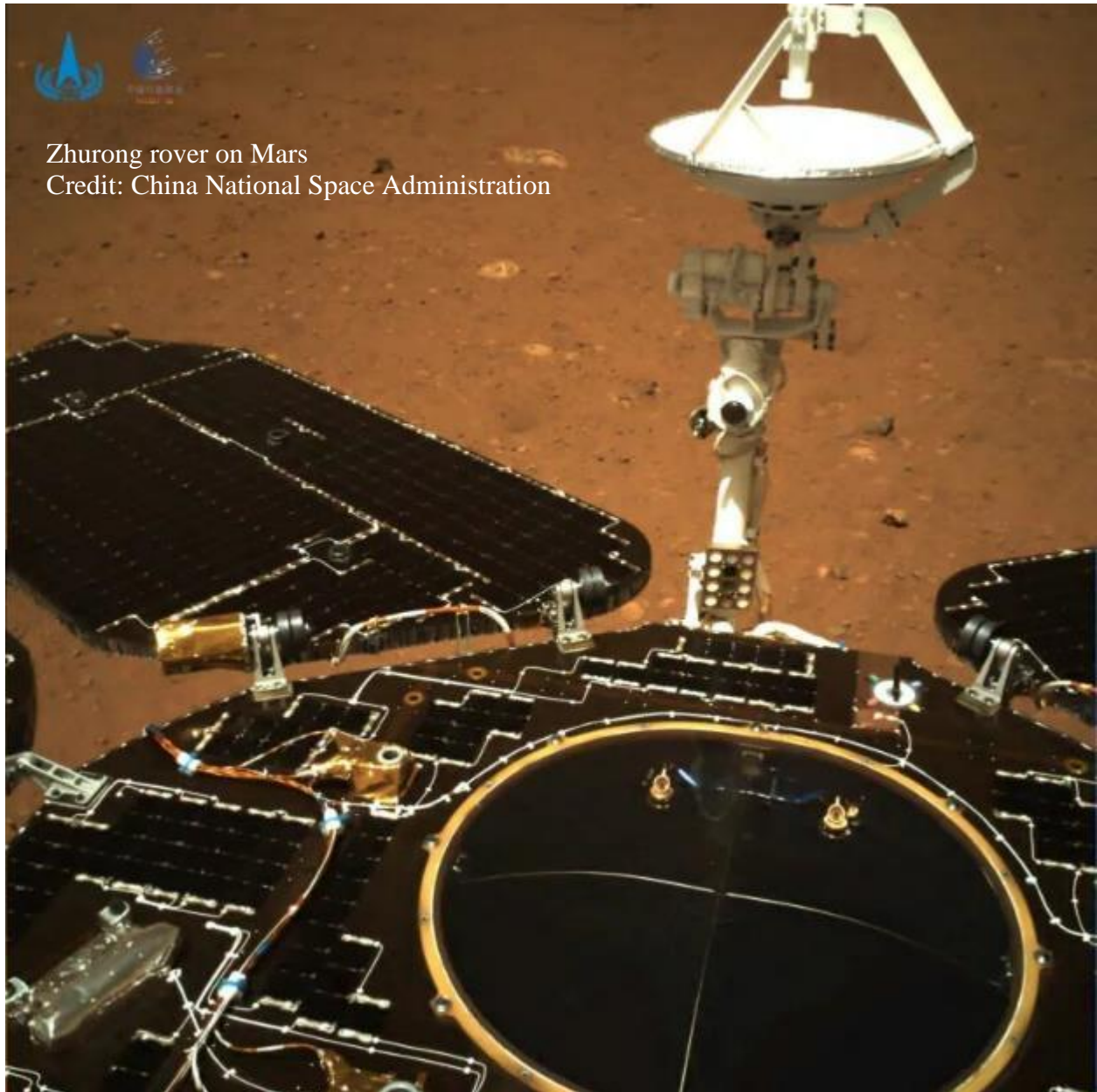


Graphical results of MOXIE's first run and production of oxygen

Credit: NASA/JPL-Caltech/MIT Haystack Observatory

Roving Mars

China's Mars mission achieved another milestone on May 14 when it delivered a rover to the planet's surface (only the second country to successfully do so). The rover, named Zhurong, had been carried to Mars on the Tianwen-1 spacecraft, which arrived in February. Since that time, the orbiter's instruments have been evaluating possible landing sites. The site ultimately chosen is in the planet's northern hemisphere (Utopia Planitia) where the U.S. Viking 2 lander set down in 1976. The rover is expected to spend about three months exploring the local geology and searching for subsurface water-ice with its ground penetrating radar.



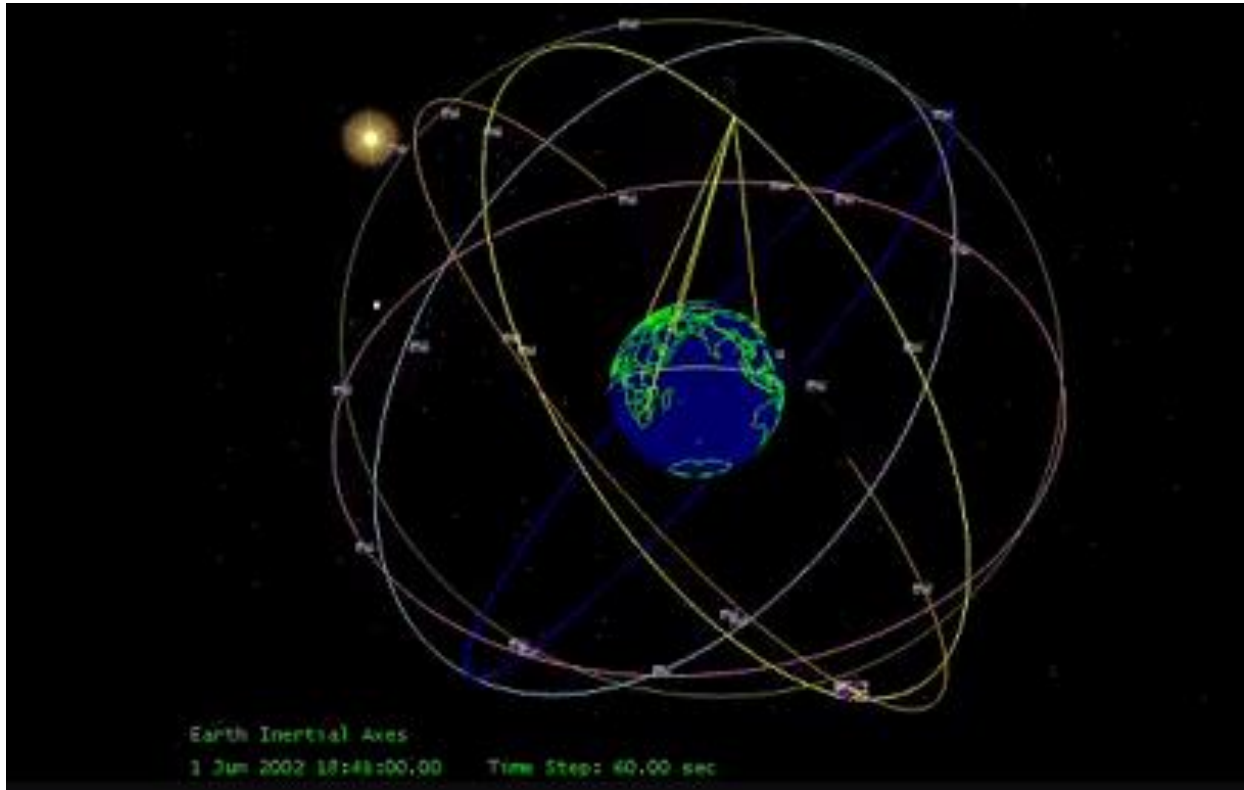
The first images beamed back from Zhurong show a ramp by which the rover has accessed the surface and the rover's fully deployed solar panels (above). Zhurong joins NASA's rovers Curiosity (Gale Crater) and Perseverance (Jezero Crater) in the exploration of the Red Planet and the search for signs of ancient life and/or environmental conditions to support life.

Back to the Stars

The Global Positioning System (GPS) is a satellite-based radionavigation system owned by the United States government and operated by the U.S. Space Force. It consists of a constellation of 32 satellites in total, with 24 being active at any one time, that orbit the Earth twice a day at an altitude of 12,550 miles (20,200 km) and transmit the satellites' position and time. The service that GPS provides is available to both civilian and military users. It has become an essential element in everyday life and integral to the nation's business infrastructure and security. Unfortunately, an advanced technology such as GPS can be hacked and spoofed (where radio transmitters are used to interfere with a legitimate GPS signal).

The vulnerabilities of GPS technology are such that the U.S. military is actively pursuing more robust alternatives. The Naval Academy reinstated celestial navigation in 2011 for ship navigators (since you can't hack the stars). The Navy is also developing an Automated Celestial Navigation System that could continuously fix a ship's position, day and night (stars are visible in infrared wavelengths during the daytime), with the goal of GPS-level precision.

Private industry has also been looking to the stars for a solution. Draper Laboratory in Cambridge, Massachusetts (known for developing the Apollo Guidance Computer) is touting its Skymark™ technology. The system provides a location fix using the known positions of stars and satellites and a combination of advanced optics, sensors and algorithms for triangulation.



Skymark™ triangulation technology

Source: Draper Air Warfare & Intelligence, Surveillance, and Reconnaissance Programs

From a Galaxy Far, Far Away

In addition to the plethora of historic planes and spacecraft on exhibit at the Smithsonian National Air and Space Museum's Steven F. Udvar-Hazy Center, located in Chantilly, Virginia, near Washington Dulles International Airport, visitors can gain an appreciation for the work that goes into preserving vintage aircraft. Large windows on the museum's upper level look down on the working floor of Mary Baker Engen Restoration Hanger and aircraft in various stages of disassembly, refurbishment and conservation.



Star Wars Starfighter on view in the Restoration Hanger
Courtesy of the Smithsonian National Air and Space Museum

The hanger's newest resident, a X-wing Starfighter, only flew in the movies (in the Star Wars franchise).

The Smithsonian's interest in a fictional vehicle is all about promoting a public interest in space and adventure. Margaret Weitekamp, space history chair at the museum, believes that "All air and space milestones begin with inspiration, and science fiction so often provides that spark—the iconic X-wing displayed amid our other spacecraft celebrates the journey from imagination to achievement."

The first X-wing Starfighter appeared in "Star Wars: A New Hope" in 1977 and took its name from the distinctive profile of the wings in the attack position. It was created by the artists at Industrial Light & Magic. The full-scale Starfighter, undergoing conservation, has a wingspan of 37 feet and appeared in the movie "Star Wars: The Rise of Skywalker."

On long-term loan from Lucasfilm, the Starfighter will be displayed outside the Albert Einstein Planetarium in the newly renovated Air & Space building on the National Mall starting late next year.

Starship Sticks the Landing

The fifth time was the charm. After the flights of four SpaceX Starship prototypes ended with catastrophic results, Starship, serial number SN15, returned to a landing pad about 1,000 feet (360 meters) from where it took off at Starbase, in Boca Chica, Texas, about eight minutes earlier. SN15 successfully executed its high-altitude flight test, reaching an apogee of about 6 miles (10 km), before a controlled “fall” back to Earth using active aerodynamic control (with its four flaps), and reigniting its engines for an upright landing.



The Starship prototypes are equipped with three methane-burning Raptor engines. During flight one or more of the engines are shutdown, and later restarted, according to the test profile and vehicle performance requirements.

Starship in flight (above) with a view from the engine compartment (left) showing two of the Raptor methane-fueled engines under power.
Credit: SpaceX

Summertime Sights

The constellation Sagittarius (the Archer) graces the southern summer evening sky. The center of our Milky Way galaxy lies in the direction of Sagittarius. Surrounding the galaxy's core is a halo of older stars and many compact, spherical groupings of stars, called globular clusters. One of the most centrally concentrated globular clusters is Messier 75 (designated such as it was catalogued by Charles Messier in 1780). The cluster is 67,000 light years from the Earth and contains approximately 400,000 stars. The stars in the cluster are believed to be 13 billion years old and are mostly low-mass red stars and intermediate-mass yellow stars.



Messier 75 as captured by the NASA/ESA Hubble Space Telescope's Advanced Camera for Surveys

Credit: ESA/Hubble & NASA, F. Ferraro et al.

The cluster is located in the western part of Sagittarius. With a dense core, it is an easy object to locate for binoculars and small telescopes at magnitude 8.6, however, a larger telescope is needed to resolve individual stars. The best month to observe the cluster is in August.

Charles Messier catalogued 29 globular clusters (there are 150 known clusters in the Milky Way Galaxy). Brighter ones, like Messier 13 in the constellation Hercules (northern hemisphere) and Omega Centauri in Centaurus (southern hemisphere), can be seen on a dark night without any optical aid.

Summer Solstice

On the morning of June 21, the Sun will rise over a prehistoric structure on the Salisbury Plain in southern England as it has for the last 4,000 years. For those individuals standing within the 100-foot diameter circle of 30 sandstone or sarsen-stones (weighing up to 50 tons each), the Sun will appear over a large naturally shaped stone (Heel Stone) located outside and to the northeast of the circle. The alignment signals the start of the longest day, midsummer, or the summer solstice.

The photo shows the current state of the stone circle. Many of the original stones are missing or damaged. Over time, they were taken to build houses and roads, chipped away by visitors and taken as souvenirs. What remains represents the last in a progressive sequence of monuments erected at the site between 3,000 and 1,600 B.C. The Heel Stone is adjacent to the access road to the site. The ancient people who constructed this monument left no written record of their accomplishments or the intended use of the stone circle. Its purpose has been widely debated and many groups have



attempted to claim ownership. However, archeologists have clearly shown that the construction of Stonehenge predates the appearance of most modern cultures in Britain.

In the 1960s, Gerald Hawkins, an astronomer at the Smithsonian Astrophysical Observatory, found that each significant stone aligns with at least one other to point to an extreme position of the sun or moon (“Stonehenge Decoded,” Doubleday & Company). That Stonehenge is an astronomical observatory or celestial calendar is intriguing, as the precision and architectural refinement by which it was constructed certainly suggests a significant purpose for this megalithic monument.

June History

Women in Space

On June 16, 1963, Valentina Tereshkova became the first woman in space. Shortly after Yuri Gagarin’s flight, the Soviets began a search for suitable female candidates for spaceflight. With few female pilots, the majority of the candidates were women parachutists (Valentina had joined an amateur parachuting club at the age of 18). Control of the Vostok spacecraft was completely automatic, so piloting experience was not required. However, since the Vostok was not designed to return its occupant safely to Earth, the cosmonaut was required to eject from the spacecraft after re-entry and parachute to the landing site.

The selection of Valentina Tereshkova for the flight was made by Premier Khrushchev. In addition to experience and fitness, qualifications included being an ideal Soviet citizen and model Communist Party member. On June 16, Valentina rode Vostok 6 into orbit with the call sign “Chaika” (Seagull). The mission was not without incident and included space-sickness, leg cramps and other discomforts from being strapped into the capsule for three days. More importantly, the capsule ended up in the wrong orientation and, had it not been corrected, would not have allowed her to return to Earth.



Valentina’s three days in space was more flight time than all the American astronauts combined (at that time). After fulfilling her duties to her country, Tereshkova retired to a small house on the outskirts of Star City. The house is topped with a seagull weathervane, the call sign of her flight.

Twenty years later on June 18, Sally Ride became the first American woman in space. Launched aboard the space shuttle Challenger, Sally served as the mission specialist on the five-person crew.

An Extraordinary Feat

If you have ever seen a Gemini space capsule (there is one on display at the Air and Space Museum in Washington, D.C.) it is difficult to comprehend how two people could have spent any length of time inside its cramped interior (Frank Borman and Jim Lovell spent 14 days orbiting the Earth in Gemini 7). The reentry module, where the two astronauts sat, is approximately 11 feet long with a maximum diameter of 7½ feet and filled with instrumentation, life support systems and controls.



On June 3, 1965, Gemini 4 lifted off on a four-day mission. The highlight of the mission was to be a spacewalk by Ed White. NASA was very concerned with “putting guys in vacuums with nothing between them but that little old lady from Worcester, Massachusetts [the seamstress at the David Clark Company], and her glue pot and that suit.” However, the Soviets had challenged the United States with a spacewalk by Cosmonaut Alexei Leonov in March during a Voskhod II mission, and the United States did not want to appear to be falling behind its adversary.

After struggling with a faulty hatch, Ed White finally exited the spacecraft as it passed over the Pacific Ocean. Using a gun powered by compressed oxygen, he was able to maneuver outside the capsule, just avoiding the flaming thrusters of the Gemini capsule. After a 23-minute spacewalk, Jim McDivitt struggled to get the six-foot-tall Ed White back inside the capsule and close the balky door.

Sadly, after making history as the first American to walk in space, Ed White died during a launch pad test of the Apollo 1 spacecraft when the pure oxygen atmosphere exploded, killing all three astronauts inside.

Sunrise and Sunset (from New Milford, CT)

<u>Sun</u>	<u>Sunrise</u>	<u>Sunset</u>
June 1 st (EDT)	05:22	20:17
June 15 th	05:19	20:26
June 30 th	05:24	20:28

Summer Nights

For the more adventurous and sleep deprived individuals, the summer sky sparkles as twilight deepens and the summer Milky Way rises. The Milky Way is heralded by the three stars of the summer triangle Vega, Deneb and Altair. Appearing like a gossamer stream of stars, it flows across the night sky, emptying into the constellation Sagittarius. In our light-polluted skies, it may be easier to see on nights when the Moon is absent (in the week preceding and following the New Moon on the 10th).

High in the June sky is the constellation Hercules. Shaped like a keystone or trapezoid, Hercules is home to one of the finest globular star clusters in the northern hemisphere. The Great Hercules Cluster (M13) is a collection of several hundred thousand suns located near the galactic core of the Milky Way Galaxy at a distance of approximately 25,000 light years. Hercules rises in the evening after the constellation Boötes with its bright star Arcturus and before the constellation Lyra with its bright star Vega. The cluster can be found on the side of the keystone asterism facing Boötes.

Astronomical and Historical Events

- 1st Aten Asteroid 2018 LB near-Earth flyby (0.007 AU)
- 1st Kuiper Belt Object 2010 JO179 at Opposition (58.655 AU)
- 1st History: final landing of Space Shuttle Endeavour (STS-134) (2011)
- 1st History: launch of the ROSAT (Röntgen) X-ray observatory; cooperative program between Germany, the United States, and United Kingdom; among its many discoveries was the detection of X-ray emissions from Comet Hyakutake (1990)
- 1st History: Founding of the Caltech Rocket Research Group (precursor to the Jet Propulsion Laboratory) (1936),
- 2nd Last Quarter Moon
- 2nd History: founding of the Baikonur Cosmodrome, Kazakhstan (Soviet and Russian launch complex) (1955)

Astronomical and Historical Events (continued)

- 2nd History: launch of the Mars Express spacecraft and ill-fated Beagle 2 lander (2003)
- 2nd History: launch of the Space Shuttle Discovery (STS-91); ninth and final Mir docking (1998)
- 2nd History: launch of Soviet Venus orbiter Venera 15; side-looking radar provided high resolution mapping of surface in tandem with Venera 16 (1983)
- 2nd History: Surveyor 1 lands on the Moon (1966)
- 2nd History: Gemini 5, Gemini 11, Apollo 12 and Skylab 2 astronaut Pete Conrad born (1930)
- 2nd History: discovery of Comet Donati by Italian astronomer Giovanni Battista Donati; brightest comet of the 19th century and first comet to be photographed (1858)
- 3rd Plutino 470308 (2007 JH43) at Opposition (39.538 AU)
- 3rd Scheduled launch of a SpaceX Dragon 2 spacecraft from the Kennedy Space Center, Florida, with cargo for the International Space Station
- 3rd History: discovery of two rings around the centaur asteroid 10199 *Chariklo*, the smallest known object to have rings (2013)
- 3rd History: discovery of Jupiter impact event by Anthony Wesley (2010)
- 3rd History: launch of Gemini 9 with astronauts Thomas Stafford and Eugene Cernan (1966)
- 3rd History: launch of Gemini 4; Ed White becomes first American to walk in space (1965)
- 3rd History: dedication of the 200-inch Hale Telescope at Palomar Mountain (1948)
- 4th History: maiden flight of SpaceX's Falcon 9 rocket; launched from Cape Canaveral, Florida (2010)
- 4th History: discovery of Classical Kuiper Belt Object 50000 *Quaoar* by Mike Brown and Chad Trujillo from images acquired at the Samuel Oschin Telescope at Palomar Observatory (2002)
- 5th Plutino 38628 *Huya* at Opposition (27.822 AU)
- 6th History: launch of Soviet Venus orbiter Venera 16; side-looking radar provided high resolution mapping of surface in tandem with Venera 15 (1983)
- 7th Moon at apogee (furthest distance from Earth)
- 8th Kuiper Belt Object 278361 (2007 JJ43) at Opposition (39.793 AU)
- 8th History: New Horizons spacecraft, on its way to Pluto, crosses the orbit of Saturn (2008)
- 8th History: discovery of Nova Aquila; a supernova explosion from the collapse of a white dwarf (1918)
- 8th History: launch of Soviet Venus orbiter/lander Venera 9; transmitted the first black and white images of the surface of Venus (1975)
- 8th History: Giovanni Cassini born, observer of Mars, Jupiter and Saturn (1625)
- 9th History: dedication of the Kathleen Fischer Sundial at the McCarthy Observatory (2012)
- 10th New Moon
- 10th Partial Solar Eclipse at Sunrise
- 10th Asteroid 3 *Juno* closest approach to Earth (2.316 AU)
- 10th Scheduled launch of a Chinese Shenzhou 12 spacecraft from Jiuquan, China, with a crew to the new Chinese space station
- 10th History: launch of Mars Exploration Rover A (Spirit) in 2003
- 10th History: launch of Explorer 49, Moon orbiter and radio astronomy explorer (1973)
- 11th Amor Asteroid 433 *Eros* closest approach to Earth (0.682 AU)
- 11th Kuiper Belt Object 2010 KZ39 at Opposition (44.888 AU)

Astronomical and Historical Events (continued)

- 11th History: flyby of Venus by Soviet spacecraft Vega 1 on its way to Comet Halley; dropped off lander and a balloon to study middle cloud layers (1985)
- 12th History: launch of Venera 4, Soviet Venus lander; first to enter atmosphere of another planet (1967)
- 13th Atira Asteroid 2019 AQ3 closest approach to Earth (0.615 AU)
- 13th Apollo Asteroid 4197 *Morpheus* closest approach to Earth (0.764 AU)
- 13th History: return of the sample capsule from the Hayabusa (MUSES-C) spacecraft (2010)
- 14th Aten Asteroid 2014 OL339 closest approach to Earth (0.305 AU)
- 14th History: launch of a V-2 rocket carrying a rhesus monkey (Albert II) – monkey survived flight and successfully transmitted biomedical data, but died on impact when parachutes failed to open (1949)
- 14th History: first radar astrometry for an asteroid from Goldstone and Haystack antennae observations of the asteroid 1566 *Icarus* (1968)
- 14th History: launch of Mariner 5; Venus flyby mission (1967)
- 14th History: launch of Venera 10; Soviet Venus orbiter/lander (1975)
- 15th Kuiper Belt Object 174567 *Varda* at Opposition (45.371 AU)
- 15th History: flyby of Venus by Soviet spacecraft Vega 2 on its way to Comet Halley; dropped off lander and a balloon to study middle cloud layers (1985)
- 16th History: Liu Yang becomes the first Chinese woman in space aboard a Shenzhou-9 spacecraft, joining two other crew members on a thirteen-day mission to the orbiting Tiangong 1 laboratory module (2012)
- 16th History: Valentina Tereshkova; first woman in space aboard Soviet Vostok 6 (1963)
- 17th First Quarter Moon
- 18th History: launch of the Lunar Reconnaissance Orbiter (LRO) and Lunar CRater Observation and Sensing Satellite (LCROSS) to the Moon (2009)
- 18th History: Sally Ride becomes the first American woman in space aboard the Space Shuttle Challenger (1983)
- 19th Amor Asteroid 3757 *Anagolay* closest approach to Earth (1.633 AU)
- 19th History: discovery of the potentially hazardous asteroid (PHA) 99942 *Apophis* – on April 13, 2029, the asteroid will pass within 19,000 miles (31,000 km) of the Earth (2004)
- 19th History: flyby of Earth by the ill-fated Nozomi spacecraft on its way to Mars (2003)
- 20th Summer Solstice at 11:32 p.m. EDT (3:32 UT on June 21st)
- 20th History: successful landing of the Viking 1 spacecraft on Mars' Chryse Planitia (Plains of Gold) (1976)
- 20th History: discovery of Nova 1670 in Vulpeculae (1670)
- 21st History: SpaceShipOne makes first privately funded human spaceflight (2004)
- 22nd Vaira Asteroid 2020 AV2 closest approach to Earth (0.536 AU)
- 22nd Plutino 28978 *Ixion* at Opposition (37.715 AU)
- 22nd History: launch of Soviet space station Salyut 5 (1976)
- 22nd History: founding of the Royal Greenwich Observatory (1675)
- 22nd History: discovery of Pluto's largest moon *Charon* by Jim Christy (1978)
- 23rd Moon at perigee (closest distance from Earth)
- 24th Full Moon (Strawberry Moon and Supermoon)
- 24th History: launch of the Salyut 3 Soviet space station (1974)
- 24th History: Fred Hoyle born; British astronomer and proponent of nucleosynthesis (1915)
- 24th History: Sir William Huggins makes first photographic spectrum of a comet (1881)

Astronomical and Historical Events (continued)

- 25th Apollo Asteroid 441987 (2010 NY65) near-Earth flyby (0.040 AU)
- 25th Aten Asteroid 136818 *Selqet* closest approach to Earth (1.514 AU)
- 25th History: Rupert Wildt born, German-American astronomer and first to hypothesize that the CO₂ in the Venusian atmosphere was responsible for the trapped heat (1905)
- 25th History: Hermann Oberth born, father of modern rocketry and space travel (1894)
- 26th Centaur Object 5145 *Pholus* at Opposition (28.067 AU)
- 26th History: Discovery of Saturn's moons Surtur, Jarnsaxa, Greip and Loge (2006)
- 26th History: Charles Messier born, famed comet hunter (1730)
- 27th Kuiper Belt Object 50000 *Quaoar* at Opposition (41.779 AU)
- 27th History: discovery of the Mars meteorite SAU 060, a small 42.28 g partially crusted grey-greenish stone found near Sayh al Uhaymir in Oman (2001)
- 27th History: flyby of the asteroid *Mathilde* by the NEAR spacecraft (1997)
- 27th History: Space Shuttle Atlantis (STS-71) first docking with the Russian space station Mir (1995)
- 27th History: launch of SEASAT, the first Earth-orbiting satellite designed for remote sensing of the Earth's oceans (1978)
- 27th History: Alexis Bouvard born, French astronomer, director of Paris Observatory, postulated existence of eighth planet from discrepancies in his astronomical tables for Saturn and Uranus. Neptune was subsequently discovered by John Couch Adams and Urbain Le Verrier after his death where he had predicted (1767)
- 28th Asteroid 4279 *De Gasparis* closest approach to Earth (1.765 AU)
- 28th History: discovery of Pluto's moon *Kerberos* by Mark Showalter, et al., using the Hubble Space Telescope (2011)
- 28th History: Nakhla meteorite fall in Egypt (Mars meteorite), a piece of which was claimed to have vaporized a dog; first direct evidence of aqueous processes on Mars (1911)
- 29th Atira Asteroid 2015 ME131 closest approach to Earth (1.094 AU)
- 29th History: George Ellery Hale born, founding father of the Mt. Wilson Observatory (1868)
- 29th Scheduled launch of a Russian Progress cargo-carrying spacecraft from the Baikonur Cosmodrome, Kazakhstan, to the International Space Station
- 30th Aten Asteroid 398188 *Agni* closest approach to Earth (0.980 AU)
- 30th Apollo Asteroid 306367 *Nut* closest approach to Earth (2.397 AU)
- 30th History: the Cassini-Huygens spacecraft enters orbit around Saturn (2004)
- 30th History: discovery of *Haumea*'s moon *Namaka*, the smaller, inner moon of the dwarf planet, by Mike Brown, Chad Trujillo, David Rabinowitz, et al. (2005)
- 30th History: crew of Soyuz 11 dies upon return from the Salyut space station when capsule depressurizes (1971)
- 30th History: Tunguska Explosion Event (1908)

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

References on Distances

- the apparent width of the Moon (and Sun) is approximately one-half a degree ($\frac{1}{2}^\circ$), 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

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 Artificial Satellites

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

NASA's Global Climate Change Resource

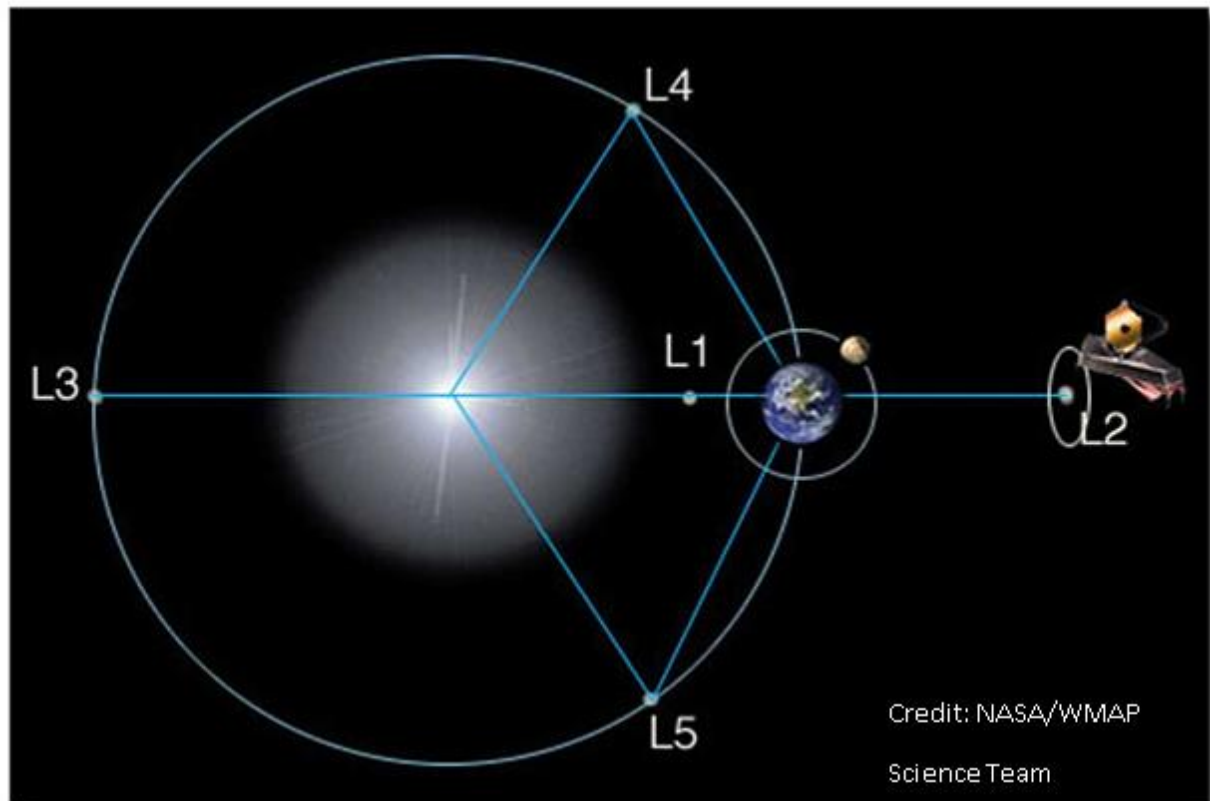
Vital Signs of the Planet: <https://climate.nasa.gov/>

Mars 2020 Mission

The latest information on the Perseverance rover and the Ingenuity helicopter can be found at <https://mars.nasa.gov/mars2020/> and <https://mars.nasa.gov/technology/helicopter/>

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).



Contact Information

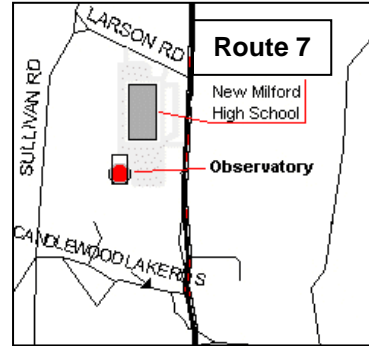
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