Galactic Observer

John J. McCarthy Observatory

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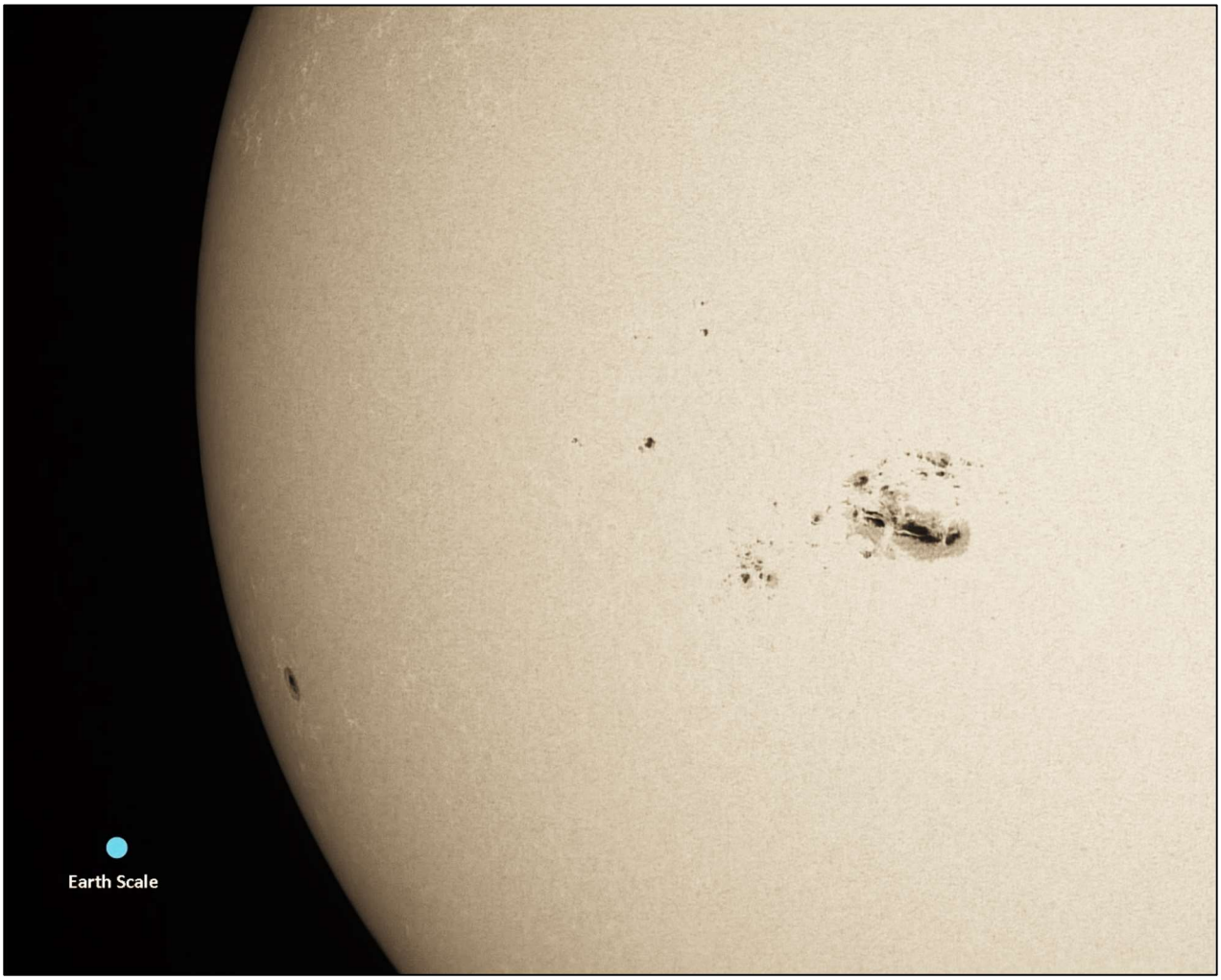
Sand ripples on the upper delta in Jezero crater photographed by NASA's Ingenuity Mars Helicopter during its 70th flight on December 22, 2023. The image was captured from an altitude of 39 feet (12 meters) and highlights the relatively featureless terrain that posed a challenge to the helicopter's navigation system, which uses a downward facing camera as a key navigation sensor to identify visually conspicuous points on the surface and track them from image to image.

Credit: NASA/JPL-Caltech

March Astronomy Calendar and Space Exploration Almanac



Sunspot AR3576

This massive sunspot, nicknamed “the Martian sunspot” as it was first spotted by NASA’s Perseverance rover from Mars, erupted on February 10th producing an M9-class solar flare. Radiation from the flare ionized the top of Earth's atmosphere; however, the accompanying coronal mass ejection (CME) appeared to have passed north of the Earth. The sunspot erupted again on the 16th with a spectacular X2.5-class solar flare but didn’t produce an Earth-directed CME.

Image captured by Bill Cloutier on February 8th with the McCarthy Observatory’s antique 4.25 inch refractor

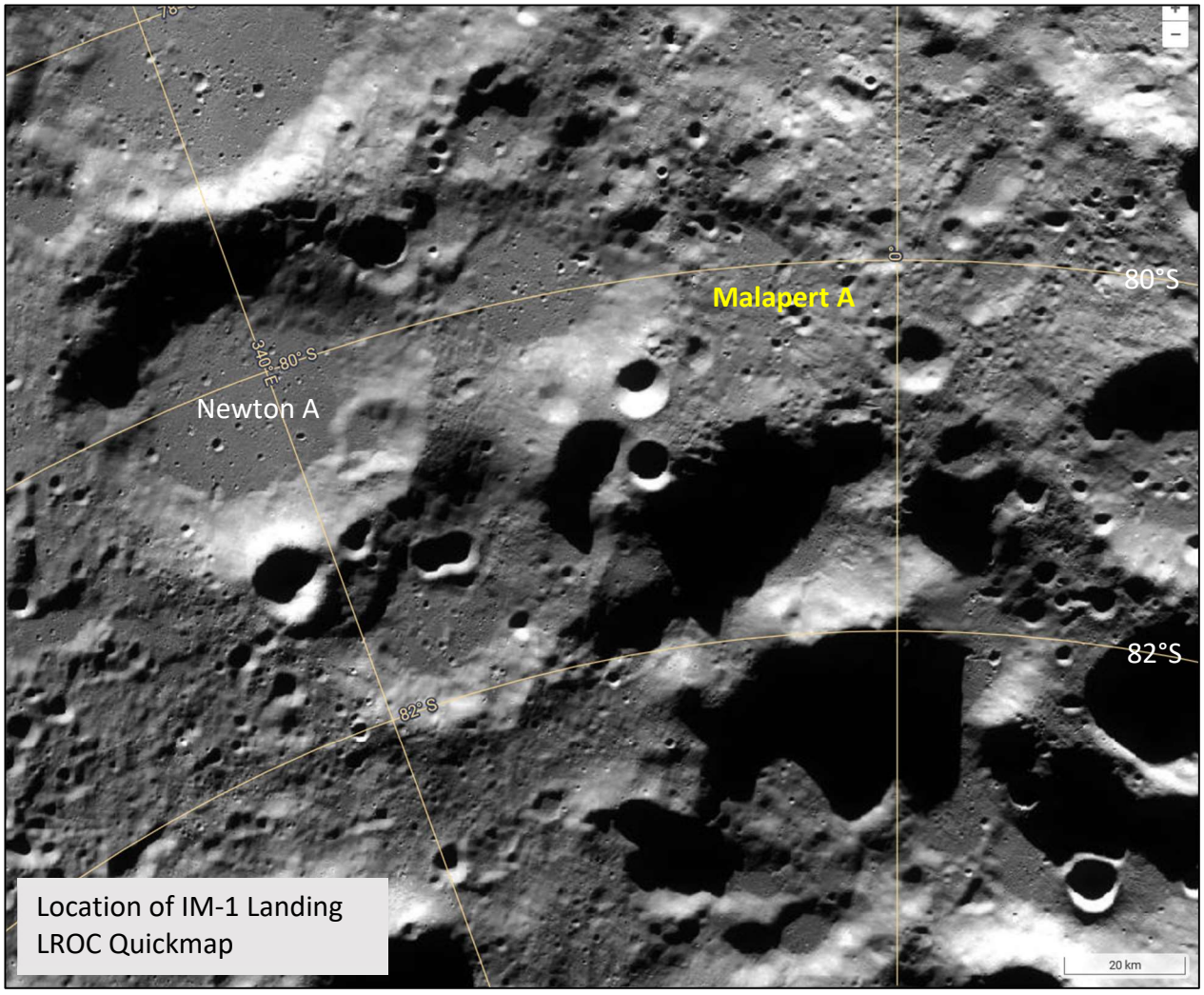
In This Issue

"Out the Window on Your Left"

It's been more than 51 years since Apollo astronaut Gene Cernan left the last boot print on the Moon's surface. 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).

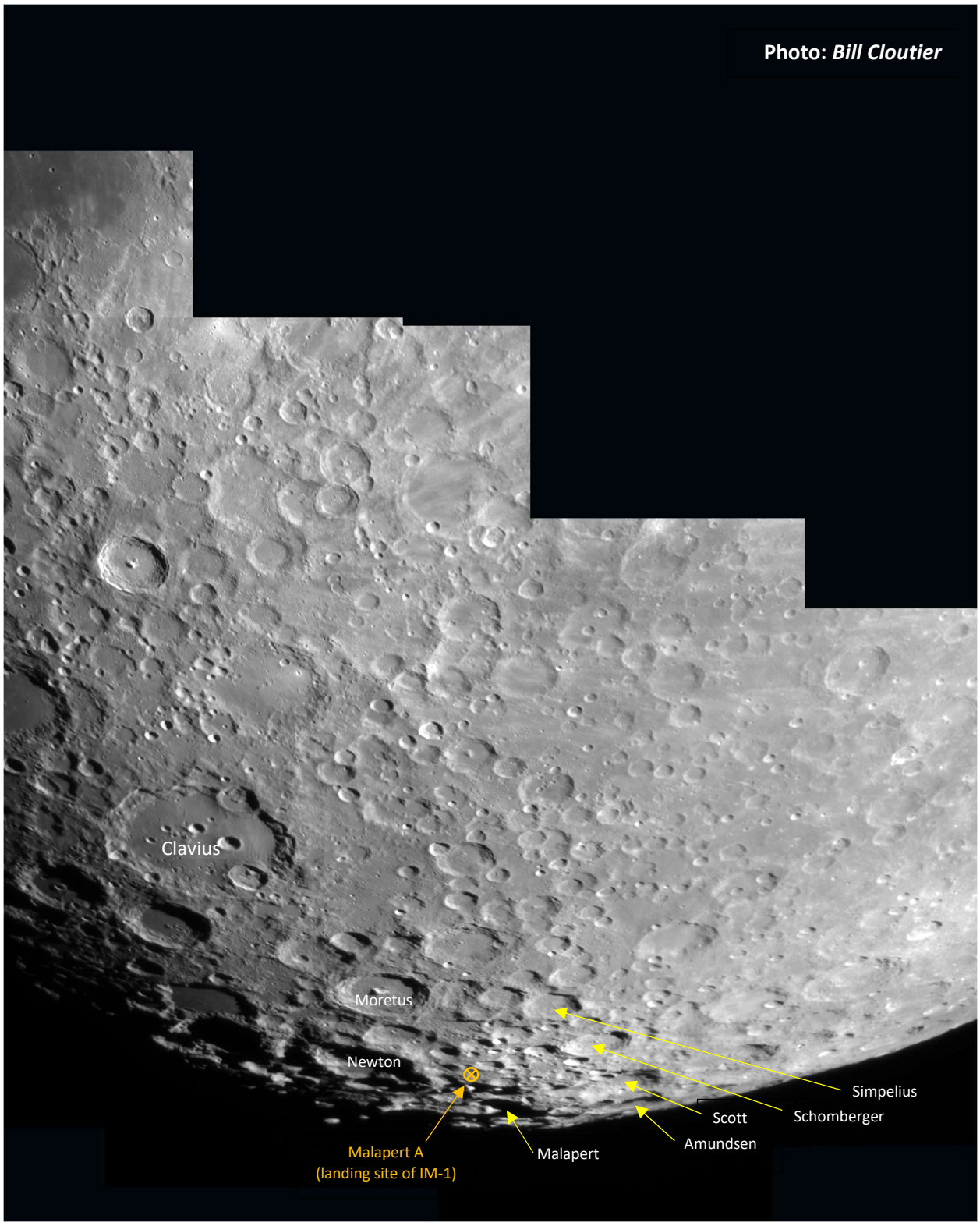
Shortly after midnight on February 13th, NASA's second Commercial Lunar Payload Services (CLPS) mission lifted off from Launch Complex 39A at the Kennedy Space Center (the first CLPS mission launched in January was not successful). Seven days later Intuitive Machines' Nova-C lander, named "Odysseus," touched down on the Moon's surface in the vicinity of Malapert A, a 43-mile-wide (69-km) crater located about 186 miles (300 km) from the Moon's south pole.

The IM-1 CLPS mission had been targeted for a site in Oceanus Procellarum (in the Moon's northwest quadrant), but was redirected to the heavily cratered southern highlands. The new location allows NASA to evaluate spacecraft communications and data transfer protocols from an extreme southern location, similar to sites being considered for future Artemis missions.

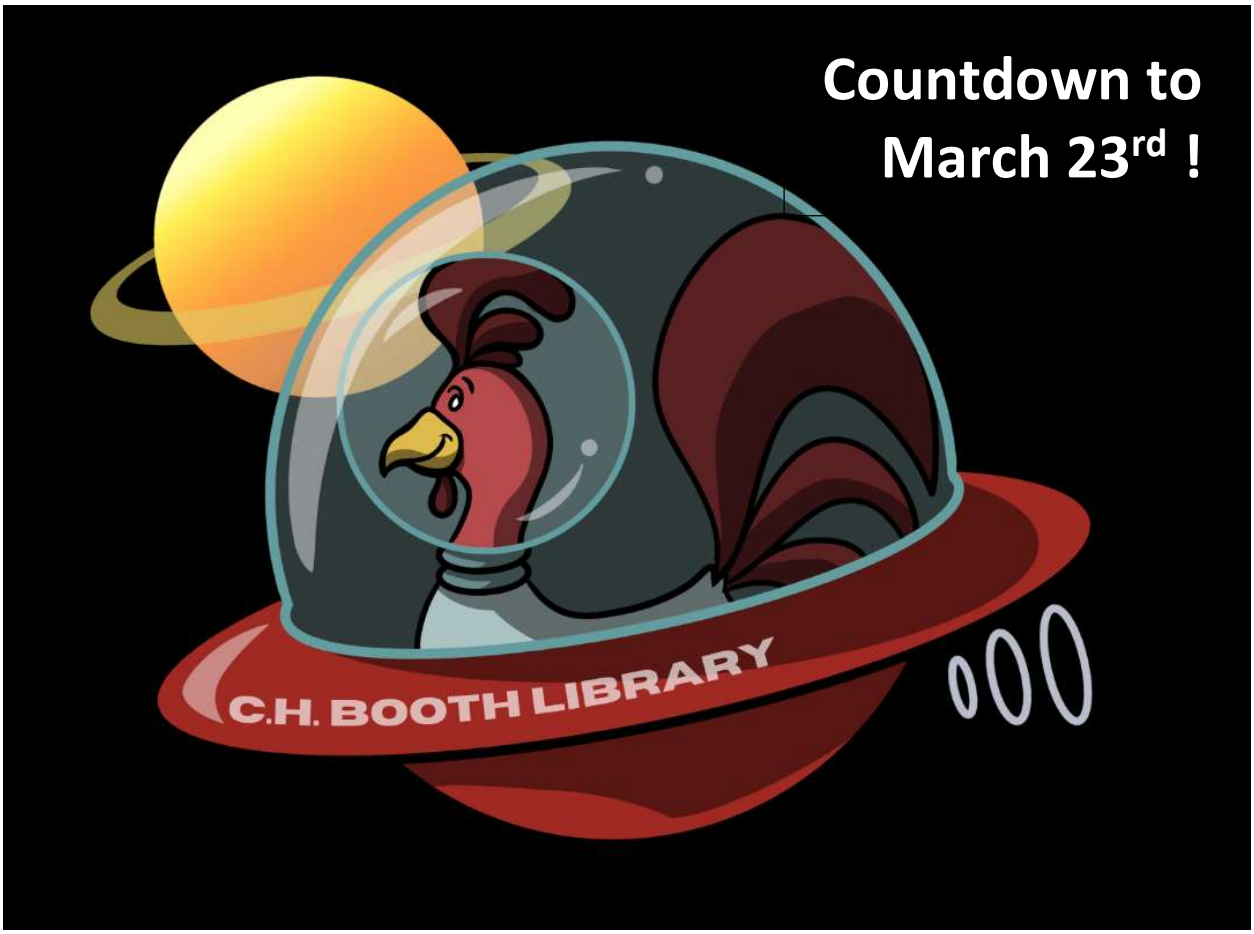


Location of IM-1 Landing
LROC Quickmap

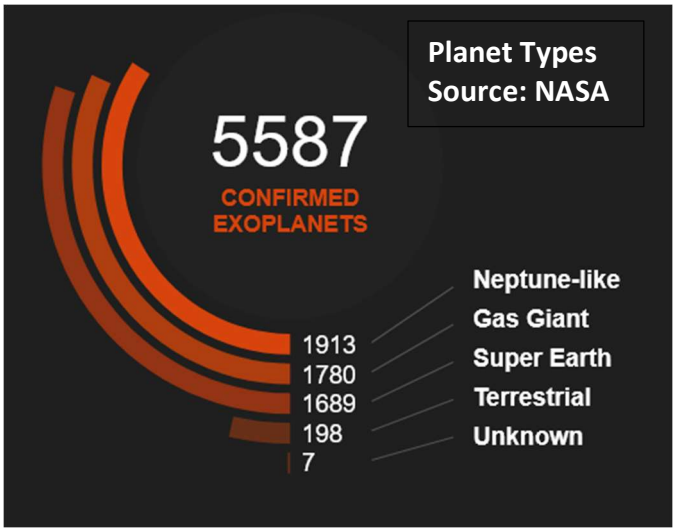
South Pole Landing Site



Local Exoplanet Exhibit



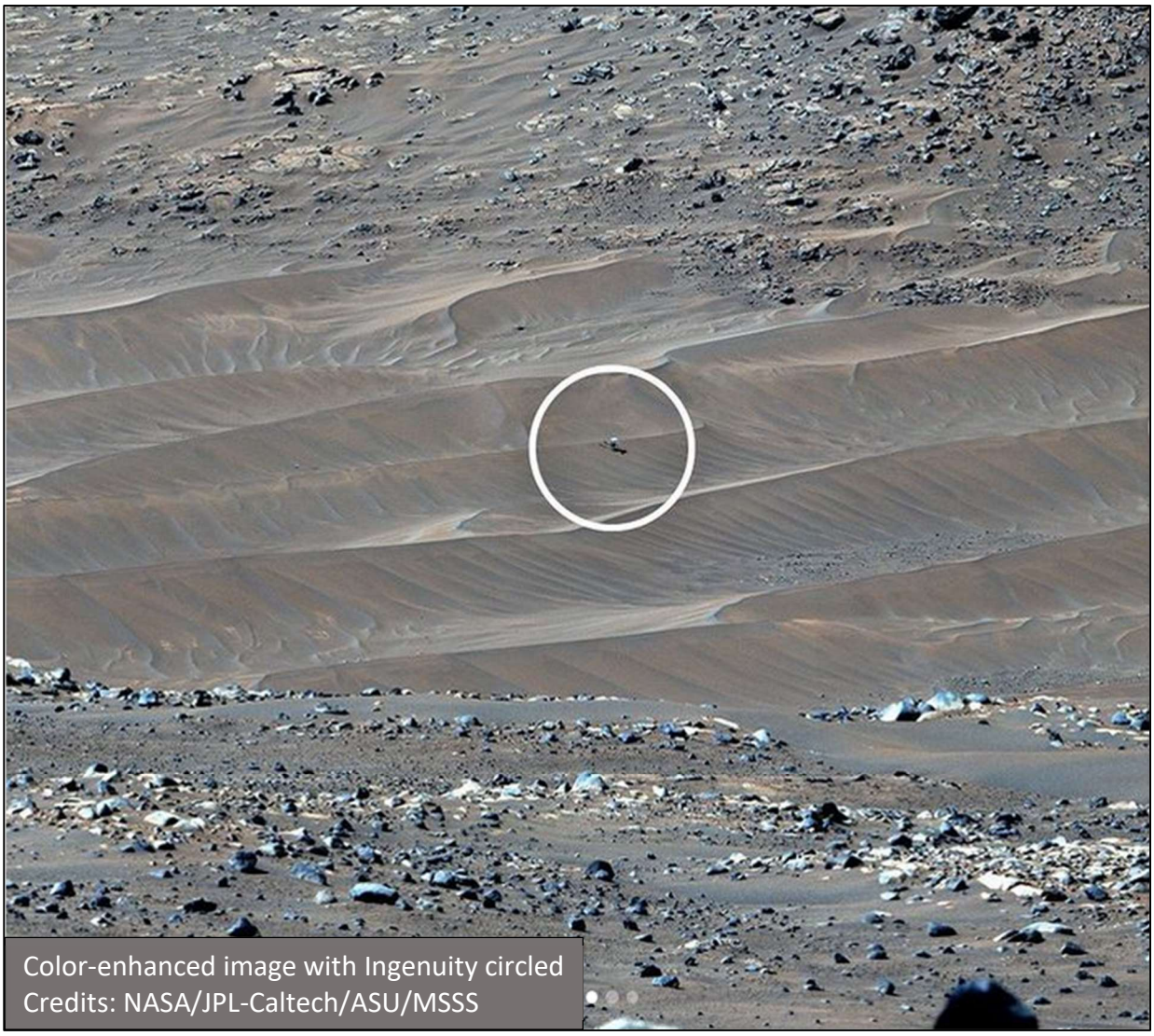
The C.H. Booth Library in Newtown will be hosting NASA's traveling exhibition *Discover Exoplanets: The Search for Alien Worlds* from late March through May. The library is one of only ten libraries in the country selected to host the exhibit and the only site in the Northeast and Tristate area.



The exhibit, in partnership with NASA's Space Science Institute, is a free, hands-on, multimedia experience that brings the excitement of exoplanets (planets outside of our solar system) to patrons and visitors to the library through a series of interactive exhibits and fun activities.

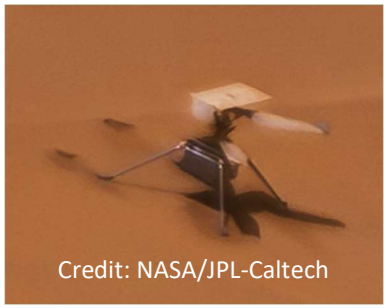
It was only 30 years ago when the first exoplanet was discovered. Since then, thanks to an exponential leap in technology, the count of confirmed exoplanets now tops 5,500, as astronomers continue to find smaller and more Earth-like worlds, including those with habitable biospheres.

Mission Complete



Color-enhanced image with Ingenuity circled
Credits: NASA/JPL-Caltech/ASU/MSSS

NASA's Perseverance Mars rover captured the final resting place of the Ingenuity helicopter among the Martian dunes. Nicknamed the "Valinor Hills" by the flight team, the spot where the helicopter completed its final flight was imaged as part of a mosaic from about 1,475 feet (450 meters) away by the rover's zoom camera.

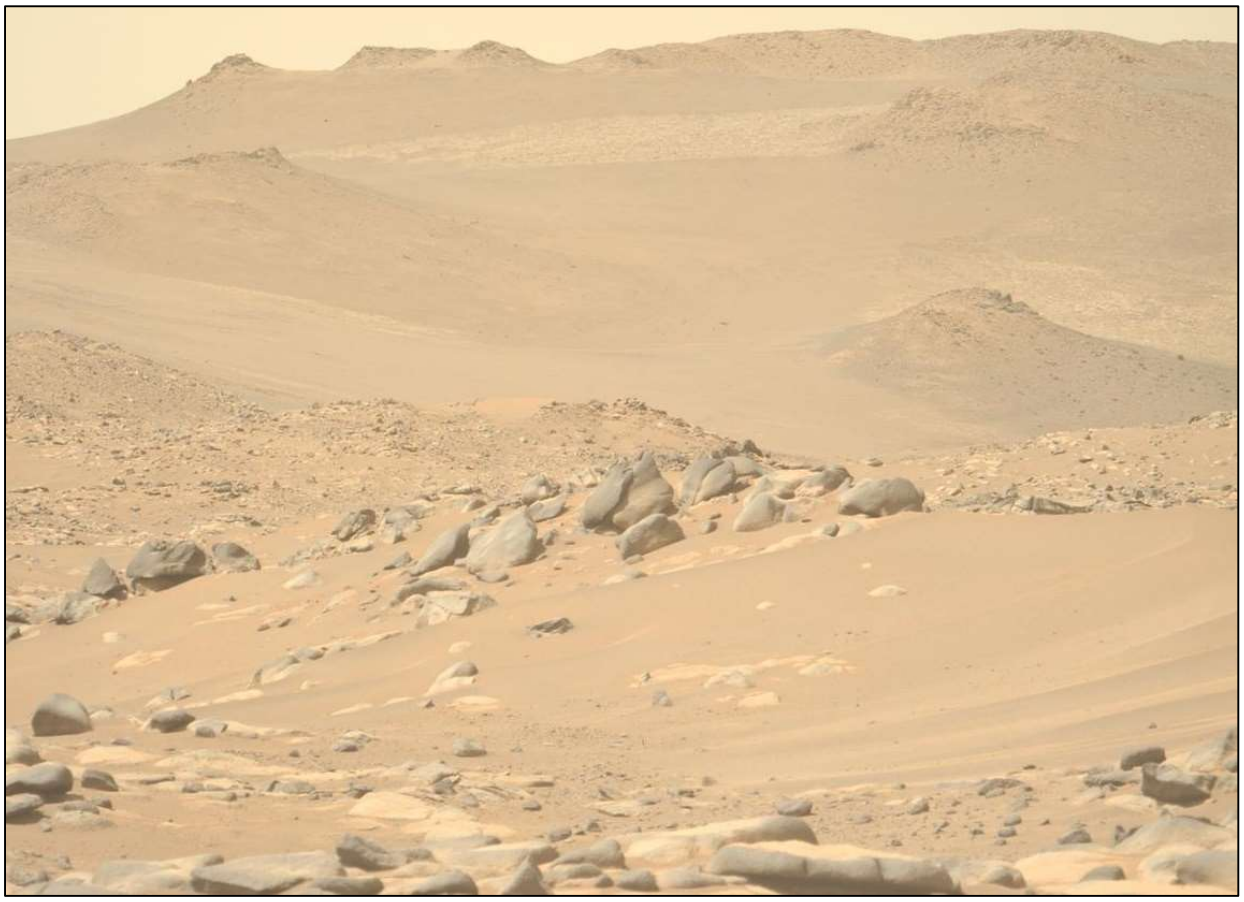


Credit: NASA/JPL-Caltech

The first aircraft to make a powered, controlled flight on another planet, Ingenuity was grounded after its 72nd flight on January 18th after several of its rotors were damaged during landing. Over almost three Earth-years, the diminutive rotorcraft flew more than 14 times farther than initially planned, while logging more than two hours of total flight time.

The relatively featureless dune fields on the Jezero Crater delta likely perplexed the helicopter's navigation system and contributed to its hard landing. While its mission is now complete, Ingenuity demonstrated the value of aerial scouts on worlds like Mars with rotorcraft expected to be an integral component in future missions of exploration and sample retrieval.

Heading for the Rim



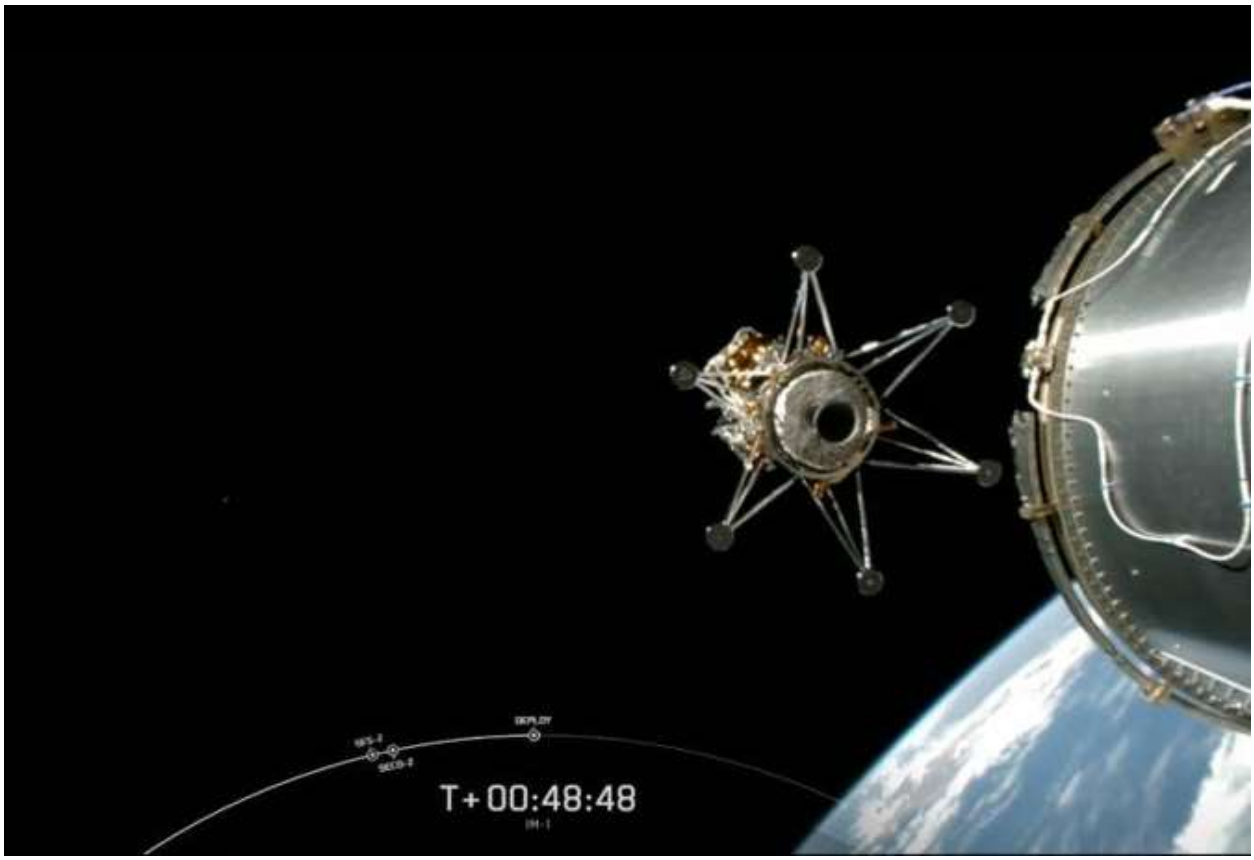
Looking toward the rim of Jezero crater approximately 2.5 miles (4 km) in the distance
Credits: NASA/JPL-Caltech/ASU

After more than 1,000 days on Mars, NASA's Perseverance rover is wrapping up its exploration of the interior of Jezero crater and the remnant of an intruding ancient river delta deposited during an eon when water flowed freely on the Red Planet's surface. The rover has driven more than 15 miles (25 km) from its landing site on the crater floor. Along the way, Perseverance found definitive evidence that the layers that comprise the sedimentary features in the crater were created by water-borne deposits. The rover has also collected 23 samples of rock and soil for future analysis on Earth, as well as established a contingency cache of ten samples at the front of the delta that could be retrieved should the rover not be available to discharge/transfer the remaining samples that it currently holds, as well as any additional samples to be collected.

Mission planners are currently guiding Perseverance into Neretva Vallis, a deep channel cut into the crater wall and through which it appears an ancient river flowed some 3.5 billion years ago. The valley likely contains material delivered by the flowing water from upstream and outside the crater. The area also features geologic outcrops that could be much older and that could provide scientists a record of the climate and environmental habitability during the earliest Noachian eon.

Moving on from the valley and the upper delta, Perseverance will make its way along natural ramps of sediment to drive to the top of the crater rim.

First Commercial Lander to Safely Land on the Moon



Separation of the Nova-C lander from SpaceX's Falcon 9 upper stage shortly after launch
Credit: SpaceX

Texas-based Intuitive Machines' (IM) first Nova-C lander soft-landed on the lunar surface on February 22nd, seven days after launching from the Kennedy Space Center, Florida. "Odysseus" arrived in lunar orbit on the previous day, settling into a 57 mile (92 km) altitude. The landing on Thursday was delayed several hours as the spacecraft's laser rangefinders were determined to be not working properly (a safety lock on the lasers had not been released prior to launch). Fortunately, the company was able to quickly upload a software patch to engage a ride-along NASA technology demonstration (a navigation doppler lidar sensor system) to support the 11-minute powered descent.

The landing was not without incident. It appears, from fuel tank data, that the spacecraft is inclined on the surface (about 30°). The unconventional orientation hasn't prevented the solar panels from completely charging and the transmission of scientific data (only one static payload is affected by the positioning). An initial analysis attributes a small lateral motion during landing as being responsible for the tip over with one or more of the six landing legs buckling or catching on the uneven surface.

Odysseus was expected to operate for about a week before the sun sets and the long lunar night begins, although spacecraft systems will be configured to power back on when the sun rises again in two weeks should the batteries survive the intense cold.

The spacecraft in orbit prior to entering its landing sequence
Photo: Intuitive Machines

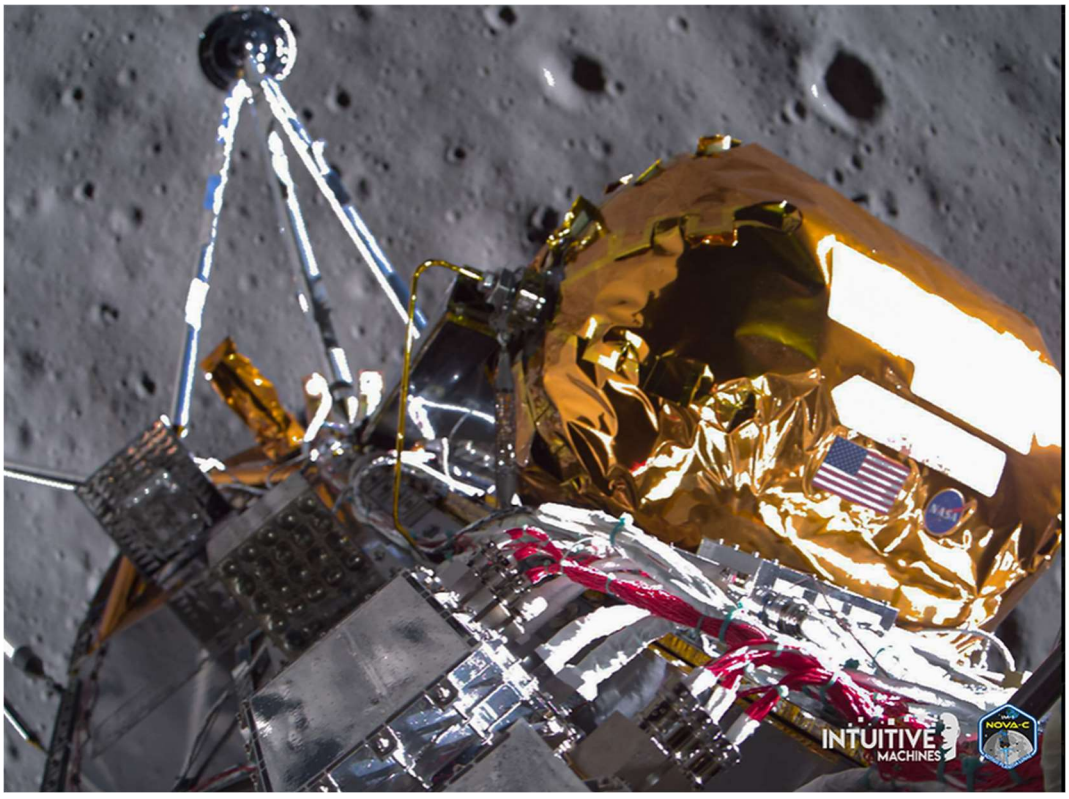
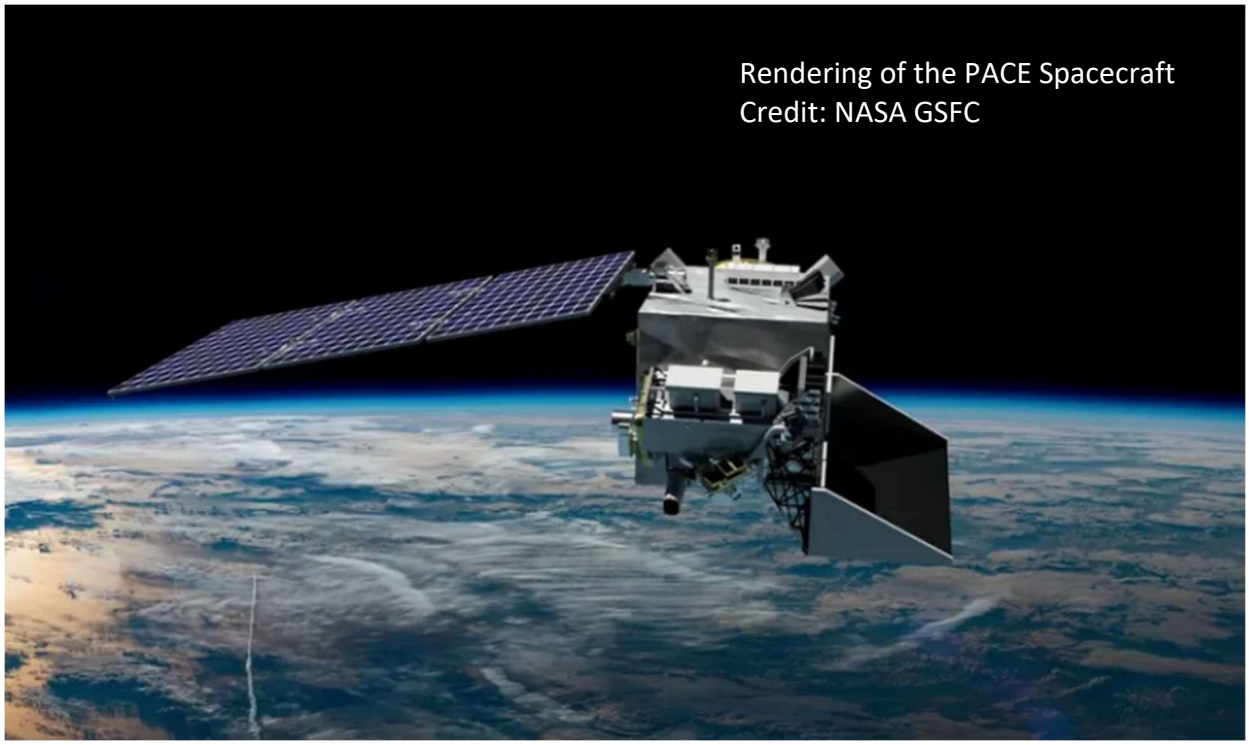


Image captured about 100 feet (30 meters) above the landing site by the camera on Odysseus
Photo: Intuitive Machines

Inclination of the lander Odysseus
Photo: Intuitive Machines

New Earth-Observation Satellite



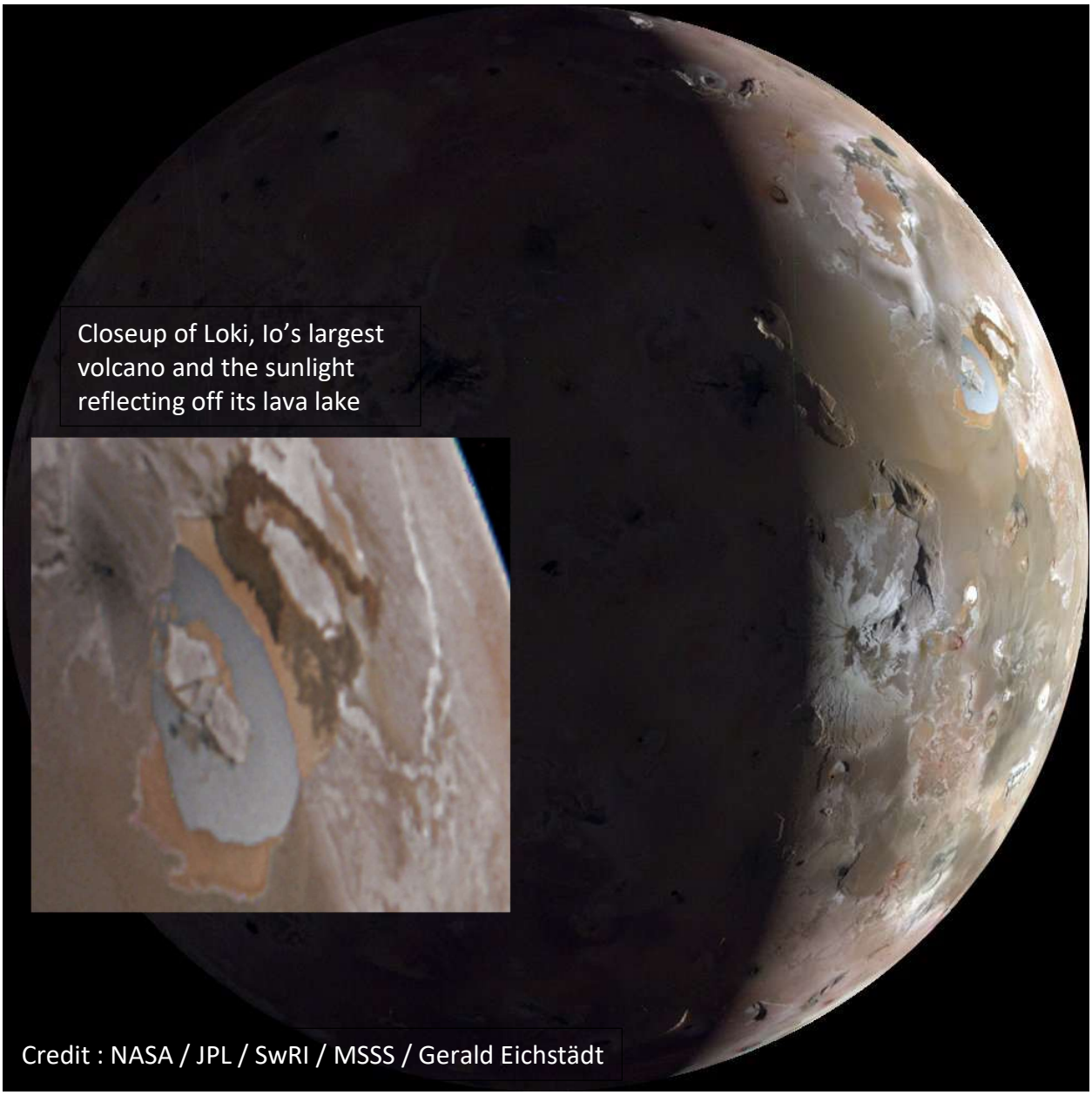
Despite being targeted by the Trump administration for cancelation (in four successive fiscal years), NASA's Plankton, Aerosol, Cloud, ocean Ecosystem (PACE) satellite took to the sky from the Cape Canaveral Space Force Station in Florida in the early morning hours of February 8th. From its orbit, hundreds of miles above the Earth, PACE will study microscopic life in the oceans and aerosols in the atmosphere, as well as investigating how these minute entities/particles affect and/or reflect changes in our planet's climate.

Researches will use the information collected by PACE to assess the health of our oceans, follow the migration of phytoplankton species, both harmful and beneficial, and track discrete aerosols in the atmosphere, such as sea spray, smoke and desert dust that can affect human health. Phytoplankton plays a role in the global carbon cycle, absorbing carbon dioxide from the atmosphere and converting it into cellular material. The abundance and type of these tiny organisms are symptomatic of the state of the environment (e.g., fisheries), habitats, and the inter-relationships of marine life.

The satellite's instruments will also provide a global view on how aerosols in the Earth's atmosphere react to sunlight, track fine particulate matter (e.g., from wildfires) and how these microscopic particles impact air quality across the globe, as well as cloud properties. The three science instruments aboard the spacecraft will also provide researchers with insights into the interaction between the ocean and the atmosphere and how these relations affect the planet's changing climate.

This newest addition to NASA's fleet of Earth-observing satellites was designed for a three-year mission, although the spacecraft has consumables on board for a decade of operations. Science data collected by PACE will be made available to the public with no delay or exclusivity period for mission scientists.

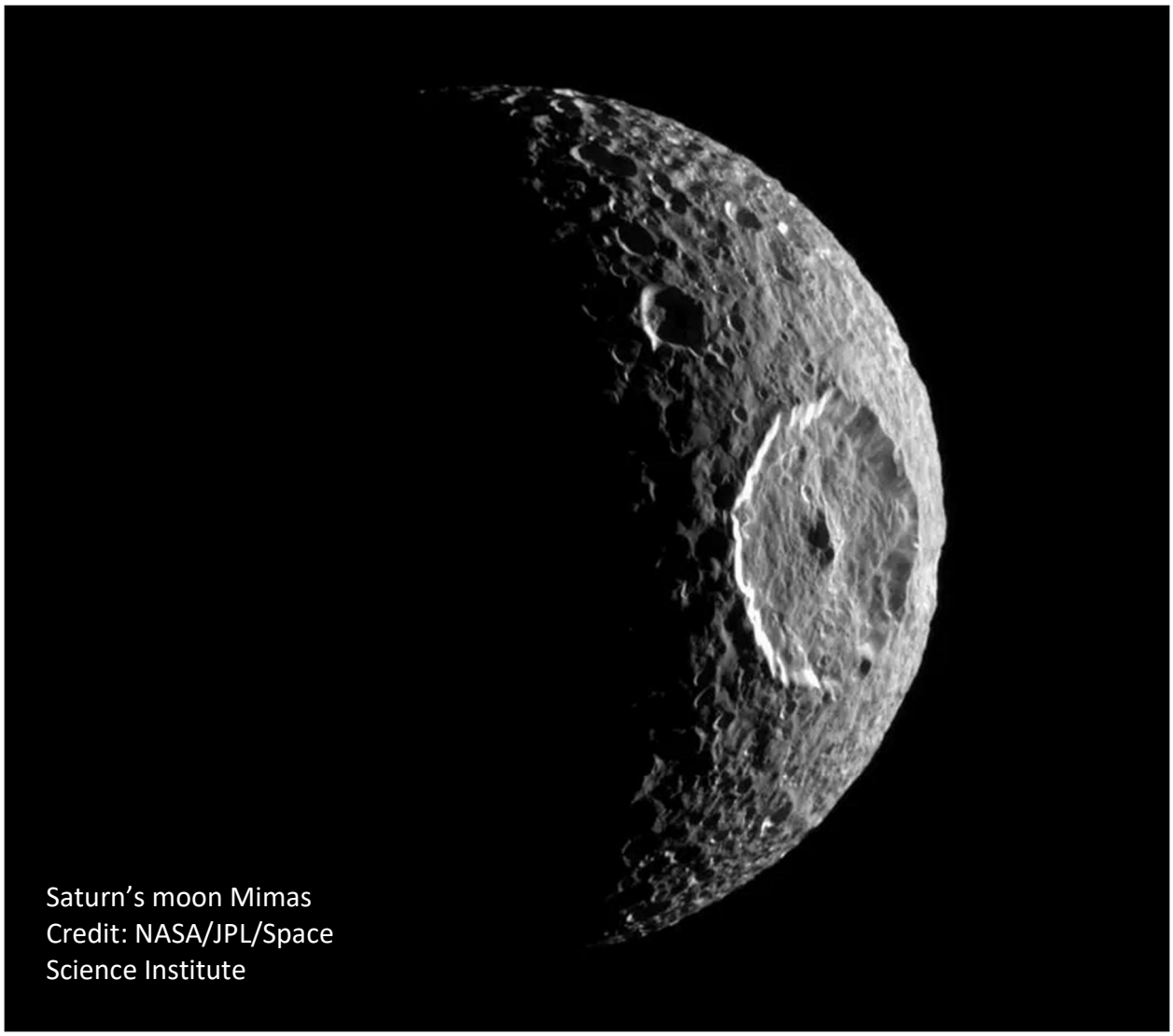
Io – One Last Look



NASA's Juno spacecraft has been orbiting Jupiter since arriving in July 2016. With its Prime Mission concluded in 2021, the space agency authorized a mission extension through September 2025, or until the spacecraft's end of life. Over the past two years, the trajectory of the planetary orbiter has been gradually modified to extend its data gathering to Jupiter's rings and four Galilean moons. During Perijove 58, after crossing over Jupiter's cloud tops on February 3rd, Juno made its second and last close flyby of Jupiter's volcanic moon Io. Similar to the previous flyby in December, this second flyby came within a distance of about 930 miles (1,500 km) of Io's surface.

Scientists expect that the close encounters will reveal more about the source of Io's volcanic activity, whether a magma ocean lurks underneath its crust, and how Jupiter's proximity, tidal forces and magnetosphere affect the tortured moon. This may be our closest look at Io for quite a while as neither ESA's JUICE mission nor NASA's Europa Clipper are targeting the moon.

Another Ocean World?

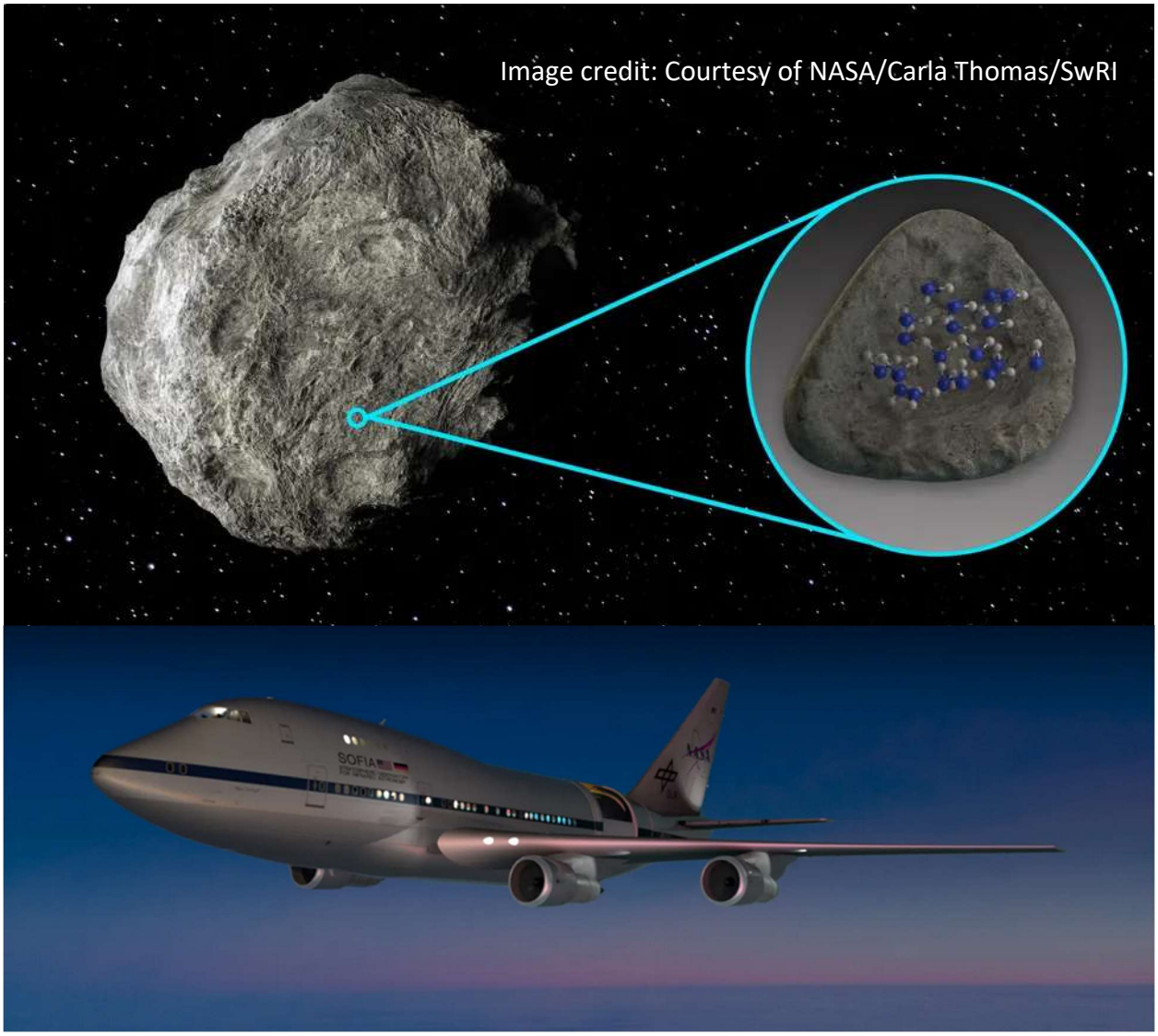


Saturn's moon Mimas
Credit: NASA/JPL/Space Science Institute

While ocean worlds like Enceladus and Europa reveal their subsurface reservoirs with active icy geysers and/or global surface modification, other candidates in the solar system are betrayed by more subtle attributes.

Mimas was discovered on September 17, 1789 by English astronomer William Herschel. To Earth-bound observers it was little more than a point of light until the Saturnian system was first visited by the Voyager spacecrafts during their 1980 flybys and then studied in more depth during the later Cassini mission. Less than 123 miles (198 km) in mean radius, the crater-covered moon is the smallest and innermost of Saturn's major moons. Its low density suggests a composition of almost entirely water ice; however, Cassini's analysis of its orbital motion suggests that the battered surface may also conceal a relatively young and still evolving global ocean. While the presence of an ocean is currently based on simulations from the spacecraft's data, the smaller craters at the moon's south pole, as compared to the rest of the surface, suggest a recent melting or resurfacing event that could be indicative of a subsurface heat source. Since the ocean on Enceladus is attributed to tidal heating, those same forces could be at work on Mimas, which is closer to Saturn.

Water Molecules Detected on Two Asteroids

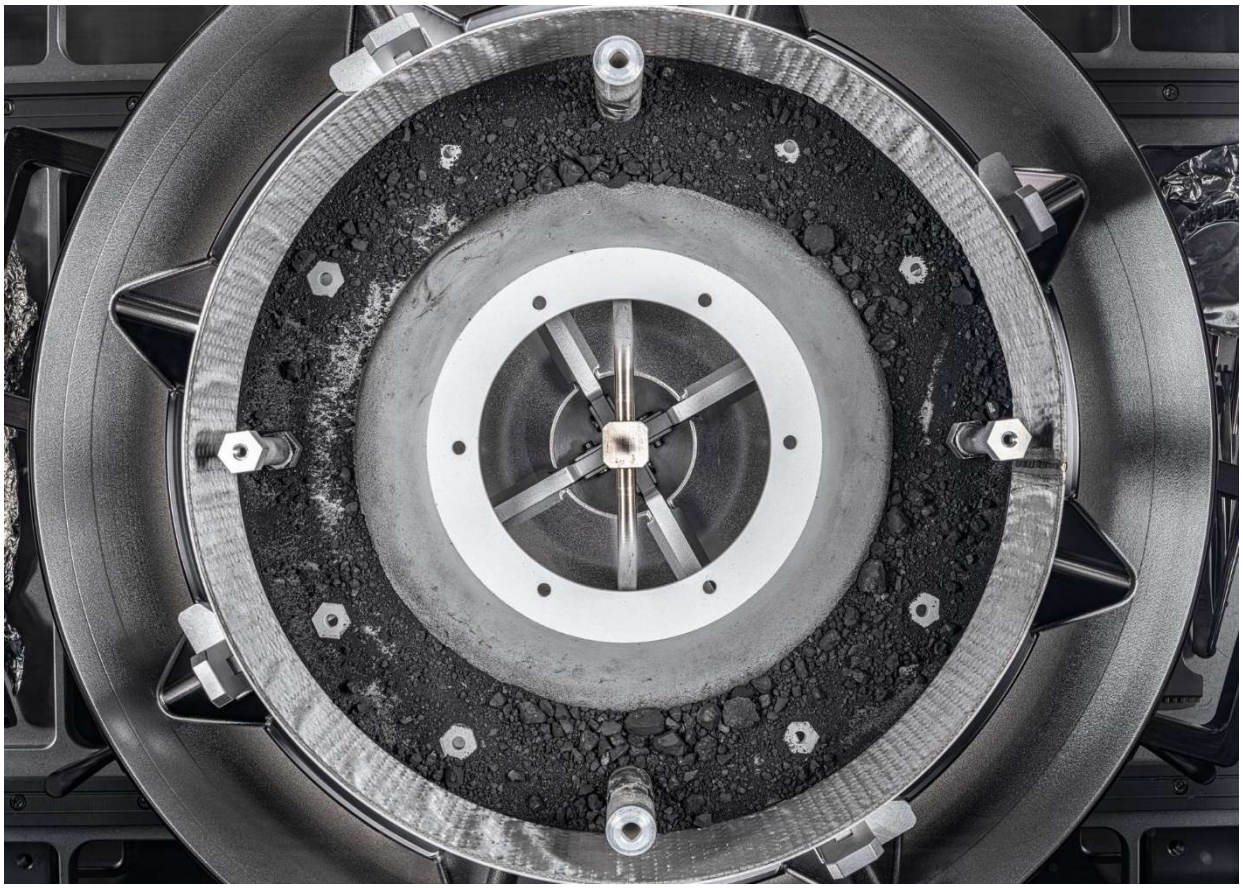


Data collected on the surface composition of asteroids by the now-retired Stratospheric Observatory for Infrared Astronomy (SOFIA), a telescope-outfitted modified Boeing 747SP
Image credit: Courtesy of NASA/Carla Thomas/SwRI

Observations by SOFIA's Faint Object InfraRed Camera (FORCAST) instrument of two silicate-rich asteroids, named Iris and Massalia, found a specific wavelength of light that indicates the presence of water molecules on their surface. SOFIA, with its 106-inch diameter telescope, was operated through a partnership between NASA and the German Space Agency. It flew at altitudes of up to 45,000 feet, above 99% of the water vapor in Earth's atmosphere, to get a clearer view of the infrared universe.

Scientists found that the abundance of water on the two asteroids was similar to that seen on the Moon. The water could be bound to minerals or adsorbed in silicates. While water molecules have been detected in asteroid samples returned to Earth, this is the first time that they have been found on the surface of an asteroid in space.

Final Accounting from 101955-Bennu

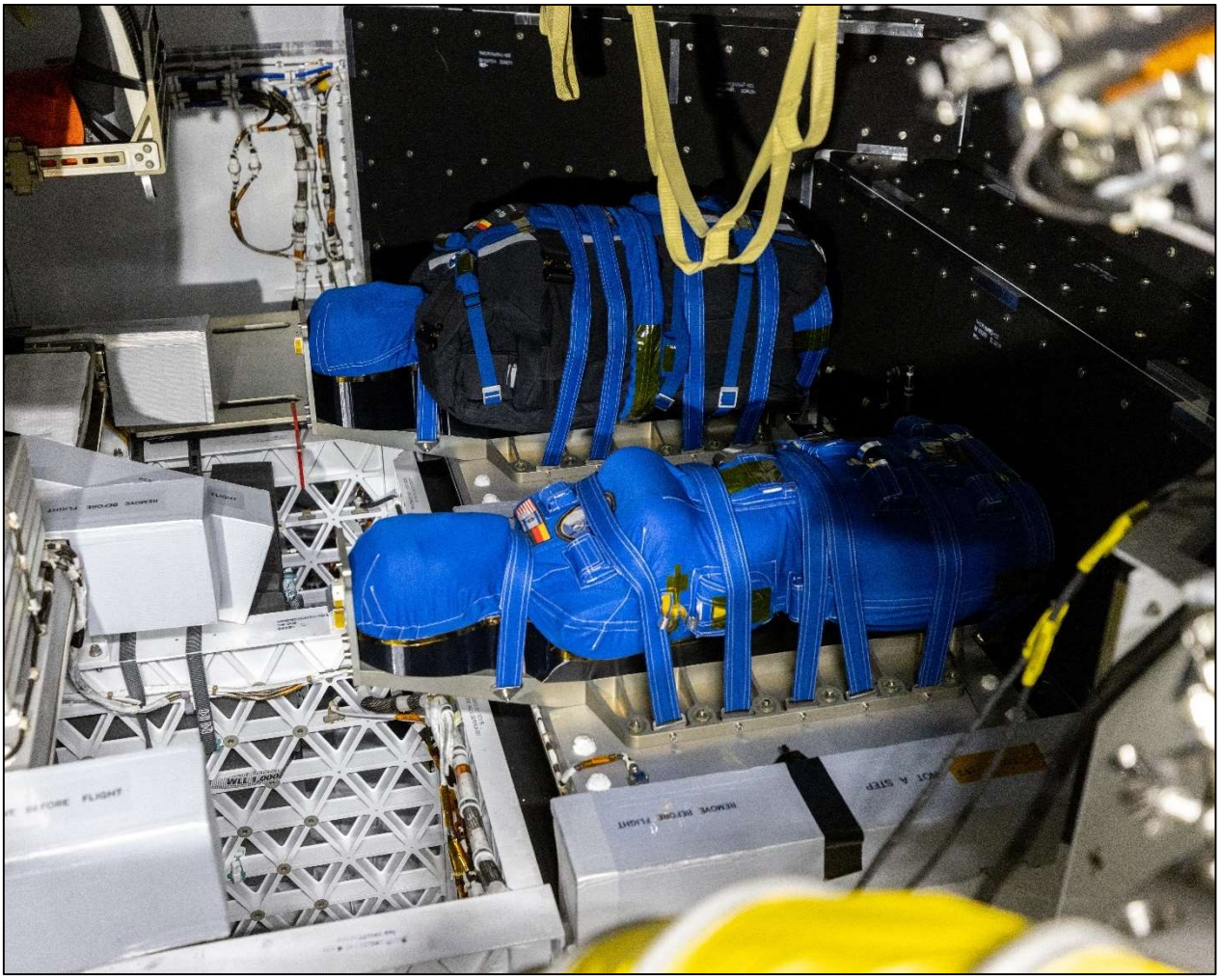


Looking down view at the opened Touch-and-Go-Sample-Acquisition-Mechanism head and at the coarse dark material collected from the asteroid Bennu
Photographers: Erika Blumenfeld & Joseph Aebersold

While NASA's OSIRIS-REx spacecraft's sample return capsule landed on the Department of Defense's Utah Test and Training Range on September 24, 2023, two (of the thirty-five) stubborn fasteners would prevent researchers from completing the retrieval process until early January. After designing, manufacturing, and testing new tools that could be used inside the sterile glovebox where the Touch-and-Go Sample Acquisition Mechanism (TAGSAM) head was being disassembled, the previously inaccessible rock and dust collected from the carbonaceous near-Earth asteroid Bennu was removed. The interior of the head assembly contained 1.81 ounces (51.2 grams) of material. Combined with the small rocks and dust from inside the large canister that housed the TAGSAM head, as well as the material removed through the TAGSAM head's mylar flap of 2.48 ounces (70.3 grams), the bulk Bennu sample mass totals 4.29 ounces (121.6 grams).

NASA had established a goal of at least 60 grams of material to meet the mission's science objectives so the final tally is about twice the mission requirement. Approximately 70% of the sample will be preserved for future study while 200 researchers at 35 institutions around the world will have access to about 25% of the Bennu material. The Canadian Space Agency will receive 4% of the sample for their contributions to the mission and the Japan Aerospace Exploration Agency (JAXA) will receive 0.5%, as part of an agreement and partnership with NASA and JAXA's Hayabusa2 asteroid sample-return mission.

Reducing Radiation Exposure During Spaceflight



DLR's mannequins Zohar (with black radiation protection vest) and Helga inside the Artemis 1 Orion spacecraft prior to launch
Credit: NASA/LM/DLR

In a joint initiative of the Israeli Space Agency, the German Space Agency (DLR), NASA, and the Orion spacecraft's prime manufacturer Lockheed Martin, two mannequins equipped with a multitude of radiation sensors rode along for the 25-day Artemis 1 mission (in addition to a NASA instrumented mannequin). The 1.4 million mile journey carried the Orion spacecraft out past the orbit of the Moon into "deep space" and back again in an uncrewed test of spacecraft systems and as a precursor to crewed expeditions.

The heavily instrumented DLR mannequins occupied two of the passenger seats in the Orion capsule and were crafted of materials that mimic the bones, soft tissues and organs of adult women (that generally have higher risk than men of developing cancer). The first mannequin, named Zohar, wore a protective vest of compressed polyethylene designed by StemRad, an Israeli-American company, while the second mannequin, Helga, served as a control experiment. While the data is still being analyzed, preliminary results are encouraging with Zohar (with the vest) absorbing 60 percent less whole-body radiation and 90 percent less in particularly sensitive areas.

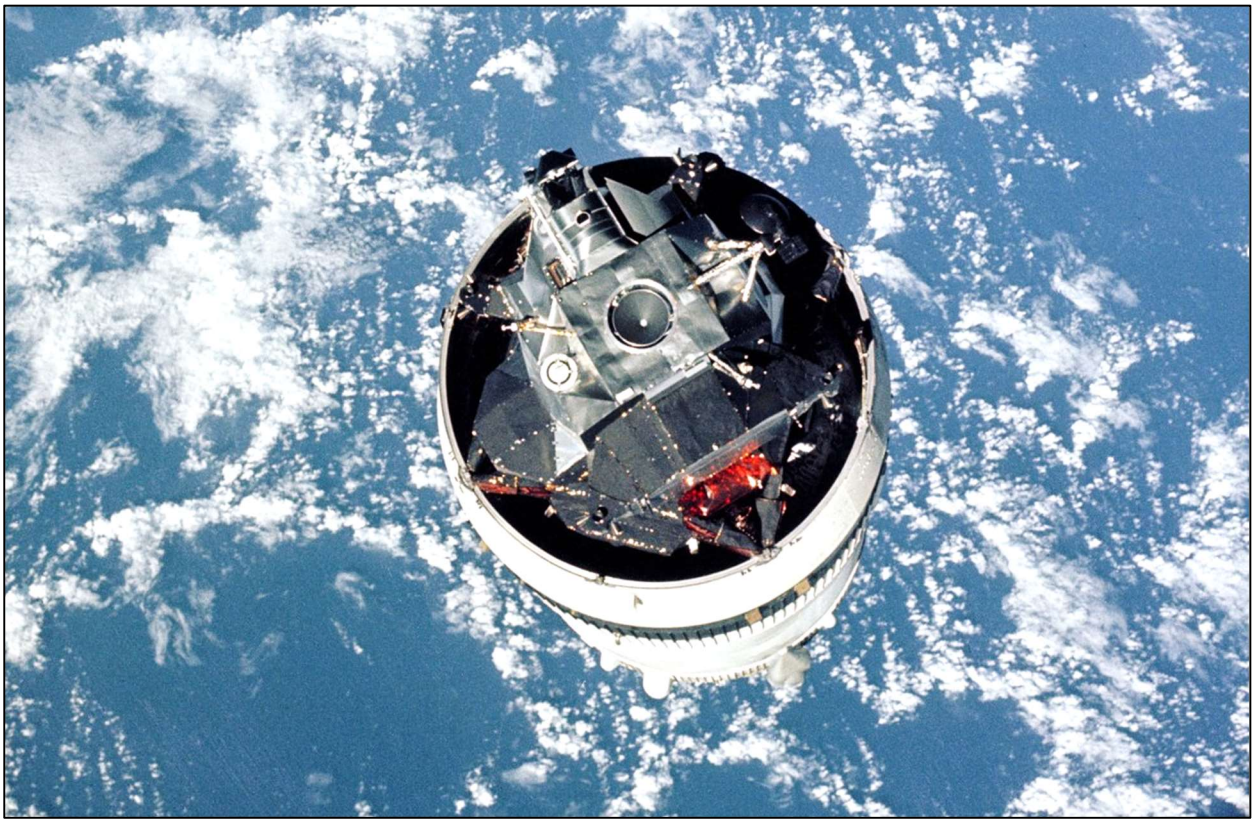
Flight of the Spider

The Apollo 9 mission was the first manned test flight of all the hardware needed for a lunar landing, including the lunar module. The Saturn V launched from the Kennedy Space Center on March 3, 1969 carried the record setting payload into low-Earth orbit. The mission was commanded by James McDivitt, with David Scott as the Command Service Module (CSM) Pilot and Russell Schweickart as the Lunar Module (LM) Pilot.

The Apollo 9 CSM taken from the window of the LM

Image: NASA

The crew would complete 152 orbits of the Earth, challenging the human physiology in ten days of weightlessness. During the first day on orbit, the CSM separated from the Saturn V's third stage. Turning around to face the rocket booster, the CSM docked with the LM nested inside. Using the CSM's thrusters, the joined pair moved a safe distance away. The third stage engine was then restarted to simulate a maneuver required for a deep space mission. It was eventually placed in a heliocentric orbit.



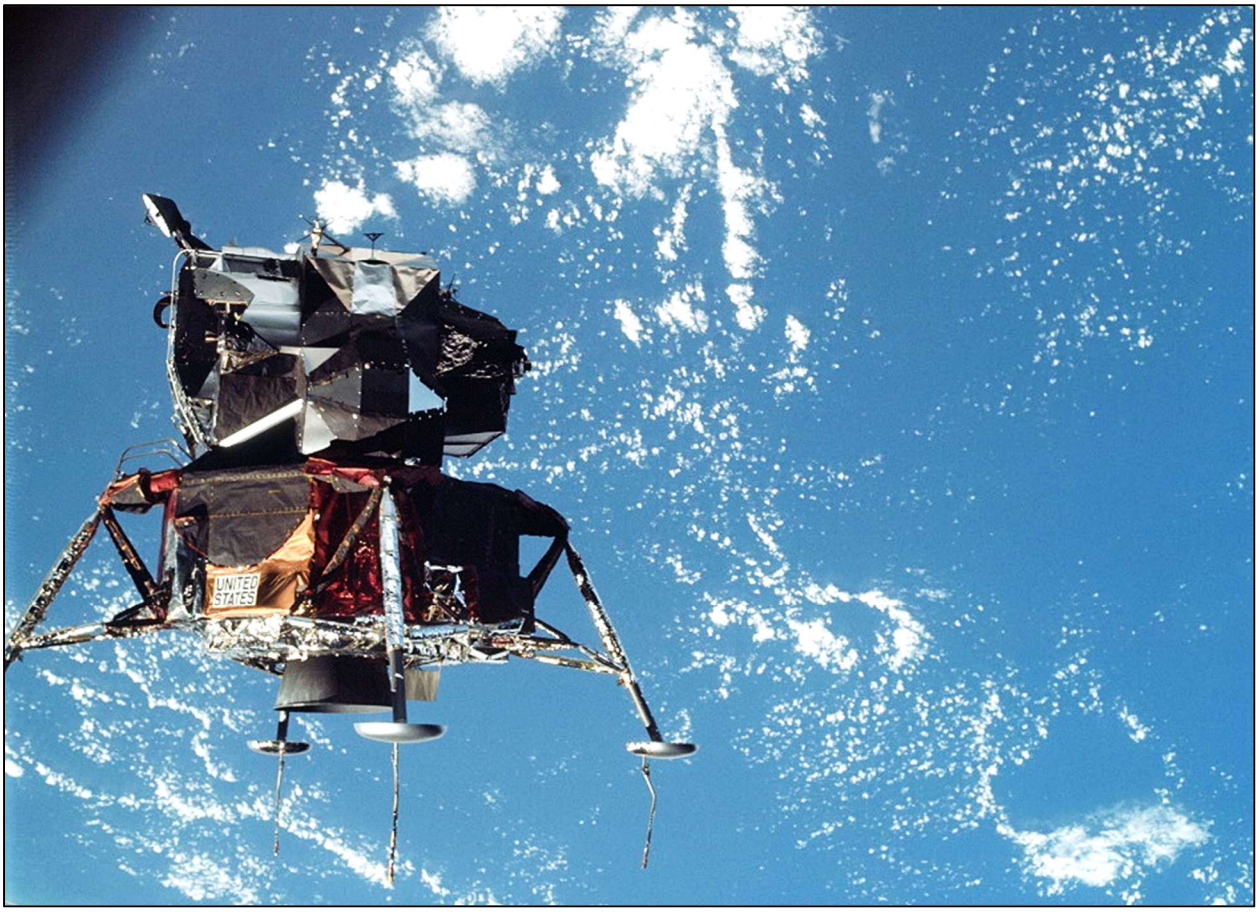
The Apollo 9 LM, nicknamed 'Spider,' shown in its launch position atop the Saturn V S-IVB third stage, its legs folded underneath. The image was taken from the CSM, nicknamed 'Gumdrop,' as it turned to face the LM. The conical drogue docking unit is visible at the top of the LM.

Image: NASA

The crew of Apollo 9 used the CSM's propulsion system to change orbit and test the structural integrity of the joined CSM and LM under load. On Flight Day 3, McDivitt and Schweickart entered the LM through a tunnel connecting the two vehicles to test fire the LM's descent engine before returning to the CSM. Schweickart's spacewalk scheduled for Flight Day 4 was cut short because of nausea. He did spend a short time outside the LM to check out the life support system backpack which the moonwalkers would use.

McDivitt and Schweickart would enter the LM again on Flight Day 5. This time the two vehicles separated, with the LM moving 113 miles away and 12 miles above the CSM. The descent stage of the LM was then jettisoned and the ascent stage engine fired for the first time. The ascent engine was used to lower the LM's altitude and rendezvous with the CSM. With docking and the transfer of McDivitt and Schweickart back into the CSM, the LM was jettisoned, its mission complete.

The crew of Apollo 9 accomplished all of the primary mission objectives, including rendezvous and docking of the two spacecraft, LM operations as a separate and independent spacecraft, transfer of the crew between the two spacecraft, a simulated rescue operation assuming a lunar landing abort, multiple restarts of the CSM's propulsion system (seven burns), and a full checkout of the CSM and LM systems. On Flight Day 10, the Command Module separated from the Service



A view of the free flying LM with its landing legs extended captured by David Scott who remained in the CSM while McDivitt and Schweickart checked out the LM. The Apollo 9 mission was the only time the LM flew in Earth orbit and would be photographed against a vibrant and colorful background rather than the stark lunar landscape.

Image: NASA

Module and reentered the Earth's atmosphere, splashing down in the Atlantic Ocean within three miles of the recovery ship, the USS Guadalcanal.

The near-Earth success of Apollo 9 would be repeated in lunar orbit by Apollo 10 in May of 1969, the precursor to the first Moon landing by the crew of Apollo 11 in July. Apollo 9 would also play a role in determining which astronaut would take that first step on Moon. McDivitt was originally selected to command Apollo 8, with the same mission objectives (full check out of the CSM and LM). However, the LM was behind schedule and wouldn't be ready, so NASA decided to send the Apollo 8 CM to the Moon without the LM.

McDivitt declined the command of Apollo 8's new mission (believing it was a publicity stunt), electing to trade places with the Apollo 9 crew, commanded by Frank Borman, in anticipation that the LM would be available for that flight. McDivitt's decision resulted in the swap of the backup crews for the two missions with Pete Conrad moving to command Apollo 12 rather than 11. Had McDivitt agreed to remain with Apollo 8, it's likely that Conrad would have taken the first step.

"The Times regrets the error"

On March 16, 1926, in Auburn, Massachusetts, Robert Goddard launched the first liquid-fueled rocket on a flight that would last only 2½ seconds. A graduate of Worcester Polytechnic Institute, despite discharging a powder rocket from the basement of the physics building, the significance of Goddard's feat is compared by space flight historians to the first aircraft flight at Kitty Hawk. Among his achievements, Goddard was first to prove that rockets would work in a vacuum and to mathematically explore the practicality of using rocket propulsion to reach high altitudes and even the Moon (1912).

Dr. Goddard with his liquid oxygen-gasoline rocket "Nell" in its launching frame on his aunt's farm in Auburn, MA NASA photo

His revolutionary ideas on spaceflight were treated harshly by the press (a New York Times 1920 editorial suggested that "he only seems to lack the knowledge ladled out daily in high schools."). As such, Goddard retreated from the public eye, eventually moving his research on rockets to the New Mexico desert (he had been banished in 1929 from the farm fields of Auburn by the local fire marshal).

Between 1926 and 1941, Goddard and his team launched 34 rockets, achieving altitudes as high as 1.6 miles (2.6 km). He developed methods to control a rocket in flight using gyroscopes and steerable thrust. His patented inventions on multi-stage rockets and a liquid-fuel rocket in 1914 (Goddard is credited with 214 inventions) and his work as a theorist and engineer are considered significant to the advancement of spaceflight and Goddard is counted one of the founding fathers of modern rocketry. Before his death in 1945, he worked for the U.S. government on rocket research. NASA's Goddard Space Flight Center was named in his honor in 1959.

The location of the first liquid-fueled rocket flight is commemorated by granite markers erected on what is now the Pakachoag Golf Course, not far from where the Massachusetts Turnpike passes by the Auburn Mall heading east.

Forty-nine years after their mocking editorial, on July 17, 1969, the day after the launch of Apollo 11, the New York Times issued a correction stating that "Further investigation and experimentation have confirmed …it is now definitely established that a rocket can function in a vacuum as well as in an atmosphere," adding "The Times regrets the error."

Zodiacal Light

The solar system is a dusty place – the source of the dust was thought to be from passing comets and collisions of asteroids. However, an accidental discovery by the Juno spacecraft on its journey to Jupiter suggests that Mars may be the source of the interplanetary dust in the orbital plane, although a clear mechanism for the dust escaping the Red Planet hasn't been identified.

Shortly before sunrise and just after sunset, sunlight can be seen reflecting off this disk of debris. Called the zodiacal light, it is best observed when the ecliptic (the apparent path of the Sun and planets) is nearly perpendicular to the horizon (on spring evenings and autumn mornings). The best time to glimpse the zodiacal light is when the Moon is absent from the evening sky (for example, during the fourth week of March and around the New Moon on the 21st).

Sunrise and Sunset (New Milford, CT)

March, the month named for the planet Mars, denotes the end of the long winter nights. The Sun crosses the celestial equator at 11:06 PM (EDT) on the 19th marking the Vernal Equinox and the beginning of the spring season in the northern hemisphere.

Sun	Sunrise	Sunset
March 1st (EST)	06:27	17:44
March 15th (EDT)	07:04	19:00
March 31st (EDT)	06:37	19:18

Astronomical and Historical Events

1st History: Launch of the space shuttle Columbia (STS-109) on an eleven-day mission to service the Hubble Space Telescope (4th servicing mission) (2002)
1st History: U.S. astronaut Scott Kelly and Russian cosmonaut Mikhail Kornienko return to Earth after a one-year stay on the International Space Station (2016)
1st History: Soviet spacecraft Venera 13 lands on Venus and records first color panoramic views of the surface (1982)
1st History: discovery of Saturn's moon *Helene* by Pierre Laques and Jean Lecacheux from the Pic du Midi Observatory in the French Pyrenees; named after Helen of Troy (1980)
1st History: Soviet spacecraft Venera 3 lands (crashes) on Venus, becoming first spacecraft to impact the surface of another planet (1966)
2nd Scheduled launch of a Crew Dragon spacecraft to the International Space Station with NASA astronauts Matthew Dominick, Michael Barratt, and Jeanette Epps along with Roscosmos cosmonaut Alexander Grebenkin from the Kennedy Space Center, Florida
2nd History: launch of an unmanned SpaceX Crew Dragon spacecraft. First American spacecraft to autonomously dock with the International Space Station (2019)
2nd History: launch of the Rosetta spacecraft (2004); rendezvoused with *Comet 67 P/Churyumov-Gerasimenko* in May 2014, sending a lander to its surface in November 2014
2nd History: launch of Pioneer 10, a Jupiter flyby mission (1972)
3rd Last Quarter Moon
3rd Close approach of Apollo class asteroid and Near-Earth Object 2019 DA1

Astronomical and Historical Events (continued)

3rd History: Chinese National Space Agency announces the Chang'e lunar exploration program (2003)
3rd History: launch of Apollo 9 with astronauts James McDivitt, David Scott and Russell Schweickart in the first manned flight test of the lunar module (1969)
3rd History: launch of the Pioneer 4 spacecraft towards the Moon; first U.S. spacecraft to escape the Earth's gravity (1959)
4th Close approach of Apollo class asteroid and Near-Earth Object 2024 CW6
4th Close approach of Aten class asteroid and Near-Earth Object 2024 CK8
4th History: discovery of Jupiter's rings by the Voyager 1 spacecraft (1979)
5th History: discovery of Jupiter moon *Thebe* by Steve Synnott (1979)
5th History: Soviet spacecraft Venera 14 lands on Venus and uses a screw drill to obtain a surface sample that was determined to be similar to oceanic basalts on Earth (1982)
5th History: flyby of Jupiter by the Voyager 1 spacecraft (1979)
6th History: Valentina Tereshkova's birthday (1937), Soviet cosmonaut became the first woman to fly to space in 1963
6th History: Dawn spacecraft enters orbit around the dwarf planet *Ceres* (2015)
6th History: launch of the Kepler telescope from Cape Canaveral Air Force Station aboard a Delta II rocket (2009); designed to survey nearby stars for Earth-size and smaller planets; to date Kepler discovered 2,778 confirmed planets with another 1,984 yet to be confirmed
6th History: flyby of Comet Halley by Vega 1, a Soviet spacecraft (1986)
7th History: John Herschel born, first astronomer to survey the southern hemisphere (1792)
8th History: maiden voyage of Europe's first unmanned cargo ship to the International Space Station; the Jules Verne was launched from Kourou, French Guiana aboard an Ariane 5 rocket; in addition to delivering supplies to the ISS, the cargo ship contained a manuscript by the 19th century French author and science fiction pioneer with computations of distances from Earth to several astronomical destinations, as well as to the center of the planet (2008)
8th History: flyby of *Comet Halley* by Susei, a Japanese spacecraft (1986)
8th History: discovery of rings around Uranus by NASA's airborne observatory (1977)
9th **Second Saturday Stars - Open House at McCarthy Observatory**
9th History: launch of Ivan Ivanovich on Sputnik 9, a mannequin used to test the Russian Vostok spacecraft in preparation for its crewed missions (1961)
9th History: Space Shuttle Discovery (STS-133) makes its final landing (2011)
9th History: flyby of *Comet Halley* by Vega 2, a Soviet spacecraft (1986)
9th History: launch of the Soviet spacecraft Sputnik 9, with dog Chernushka (1961)
9th History: Yuri Gagarin born; first person to orbit the Earth in 1961 (1934)
10th Moon at perigee (closest distance from Earth)
10th New Moon
10th Daylight Saving - Set Clock Ahead 1 Hour (United States)
10th History: Mars Reconnaissance Orbiter arrives at Mars (2006)
10th History: flyby of *Comet Halley* by Sakigake, a Japanese spacecraft (1986)
10th History: Uranus' rings discovered by astronomers James Elliot, Edward Dunham, and Jessica Mink using the Kuiper Airborne Observatory while observing a stellar occultation (1977)

Astronomical and Historical Events (continued)

11th Close approach of Apollo class asteroid and Near-Earth Object 2024 DA1
11th Close approach of Apollo class asteroid and Near-Earth Object 2015 FM34
11th History: launch of Pioneer 5 into solar orbit between the Earth and Venus; confirmed the existence of interplanetary magnetic fields (1965)
11th History: Urbain Leverrier born, mathematician and astronomer, predicted existence of Neptune (1811)
13th History: flyby of *Comet Halley* by Giotto, a European Space Agency spacecraft (1986)
13th History: discovery of Saturn's moon *Calypso* by Dan Pascu, P.K. Seidelmann, William Baum and D. Currie (1980)
13th History: Percival Lowell born, established observatory in Flagstaff, AZ to observe Schiaparelli's Martian "canali" and look for other signs of life (1855)
13th History: William Herschel discovers the planet Uranus; originally named Georgium Sidus by Herschel in honor of his patron, King George III of England (1781)
13th History: Galileo Galilei publishes "Sidereus Nuncius" (Starry Messenger), the first scientific treatise based on observations made through a telescope; it described Galileo's early observations of the Moon, the stars, and the moons of Jupiter (1610)
14th Pi Day
14th History: launch of ESA's ExoMars Trace Gas Orbiter and Schiaparelli lander aboard a Russian Proton rocket from the Baikonur Cosmodrome in Kazakhstan (2016)
14th History: Stardust passes within 112 miles (181 km) of the nucleus of *Comet Tempel 1* (2011)
14th History: John J. McCarthy Observatory issued Observatory Code Number 932 by the Minor Planet Center of the International Astronomical Union (2001)
14th History: first European launch of a liquid-fueled rocket by Johannes Winkler (1931)
14th History: Albert Einstein born, developed theories of mass to energy conversion and the curvature of space and time in large gravitational fields (1879)
14th History: Giovanni Schiaparelli born, director of the Milan Observatory and first to describe faint features on Mars as "canali" (1835)
15th Close approach of Apollo class asteroid and Near-Earth Object 2020 FU
15th Close approach of Apollo class asteroid and Near-Earth Object 2024 CJ8
15th History: dedication of the Kitt Peak National Observatory (1960)
15th History: Alan Bean born; astronaut, moonwalker and artist (1932)
16th History: third and final flyby of Mercury by the Mariner 10 spacecraft (the last of the Mariner probes); Mariner 10 was also the first spacecraft to use solar radiation pressure on its solar panels and the antenna for attitude control during flight (1975)
16th History: launch of Gemini 8 with astronauts Neil Armstrong and David Scott; first docking with another space vehicle, an unmanned Agena stage (1966)
16th History: launch of the first Titan II Intercontinental Ballistic Missile, also used as the launch vehicle for the manned Gemini spacecraft in the early 1960's (1962)
16th History: Robert Goddard launches first liquid-fuel rocket in Auburn, MA (1926)
16th History: Caroline Herschel born (1750)
17th First Quarter Moon
17th History: discovery of Asteroid 16 *Psyche* by Annibale de Gasparis (1852)
17th History: launch of the Gravity Recovery And Climate Experiment (GRACE) spacecraft (2002)
17th History: launch of Vanguard 1, 4th artificial satellite and oldest still orbiting Earth (1958)

Astronomical and Historical Events (continued)

17th History: discovery of Saturn's moon *Phoebe* by William Pickering (1899)
18th Close approach of Apollo class asteroid and Near-Earth Object 2020 FD
18th History: MESSENGER enters orbit around Mercury (2011)
18th History: New Horizons spacecraft (on its way to Pluto) crosses the orbit of Uranus (2011)
18th History: explosion during launch of a Vostok rocket carrying a military spy satellite kills 48 members of the Soviet Missile Troop; likely cause of explosion was an oxygen peroxide leak caused by the poor quality of the rocket's fuel filters (1980)
18th History: Alexei Leonov performs first spacewalk from Soviet Voskhod spacecraft (1965)
19th Vernal Equinox (beginning of the Spring season in the northern hemisphere) at 11:06 PM EDT (3:06 UT on the 20th)
19th Close approach of Apollo class asteroid and Near-Earth Object 2024 BD7
19th History: Tenham meteorite fall; fragments of a large meteor rain down on a remote area of western Queensland, Australia (1879)
19th History: Moon flyby by the Hiten spacecraft; Japan's first lunar flyby, orbiter and surface impactor (1990)
21st Scheduled launch of a Russian Soyuz spacecraft to the International Space Station with cosmonauts Oleg Novitsky and Marina Vasilevskaya, and NASA astronaut Tracy Dyson from the Baikonur Cosmodrome, Kazakhstan
21st History: launch of Ranger 9, Moon impact mission; transmitted the highest resolution imagery obtained to that date before impacting the floor of Alphonsus crater on the 24th (1965)
21st History: discovery of Saturn's moons *Tethys* and *Dione* by Giovanni Cassini (1684)
22nd History: launch of space shuttle Atlantis (STS-76), third mission to Russian space station Mir and transfer of the first American woman, Shannon Lucid, to the station (1996)
23rd Moon at apogee (furthest distance from Earth)
23rd History: launch of Gemini 3 with astronauts Virgil Grissom and John Young, first manned Gemini flight (1965)
23rd History: Wernher von Braun born, German rocket scientist and leader of the U.S. moon program (1912)
24th Close approach of Apollo class asteroid and Near-Earth Object 2019 CJ
24th History: discovery of Comet Shoemaker-Levy 9 (1993)
25th Full Moon (Full Worm Moon)
25th Close approach of Apollo class asteroid and Near-Earth Object 2021 CF6
25th History: launch of the IMAGE spacecraft, first mission dedicated to mapping the Earth's magnetosphere (2000)
25th History: close approach of Comet *Hyakutake* (0.10 AU) to Earth (1996)
25th History: launch of Soviet spacecraft Sputnik 10 with dog Zvezdochka (1961)
25th History: Christiaan Huygens discovers *Titan*, Saturn's largest moon (1655)
26th History: American astronomer J.W. Draper takes first photograph of the Moon (1840)
27th History: U.S. astronaut Scott Kelly and Russian cosmonaut Mikhail Kornienko arrive at the International Space Station for a year-long mission (2015)
27th History: launch of the Soviet atmospheric probe and lander Venera 8 to Venus (1972)
27th History: launch of Mariner 7, Mars flyby mission (1969)
27th History: President Eisenhower approves the military lunar program to be managed by the Advanced Research Projects Agency (1958)
28th History: flyby of Comet Halley by the ICE spacecraft (1986)

Astronomical and Historical Events (continued)

28th History: Heinrich Olbers discovers the asteroid 2 *Pallas* (1802)
29th Close approach of Apollo class asteroid and Near-Earth Object 2023 RO49
29th Close approach of Apollo class asteroid and Near-Earth Object 2015 MB54
29th History: First flyby of Mercury by the Mariner 10 spacecraft (1974)
29th History: Heinrich Olbers discovers the asteroid 4 *Vesta* (1807)
30th Close approach of Aten class asteroid and Near-Earth Object 2024 DQ
31st History: discovery of Dwarf Planet *Makemake* by Mike Brown, et al's (2005)
31st History: launch of Soviet spacecraft Luna 10, first man-made object to go into orbit around another planetary body; detected evidence of mass concentrations on the Moon called "mascons" (1966)

Commonly Used Terms

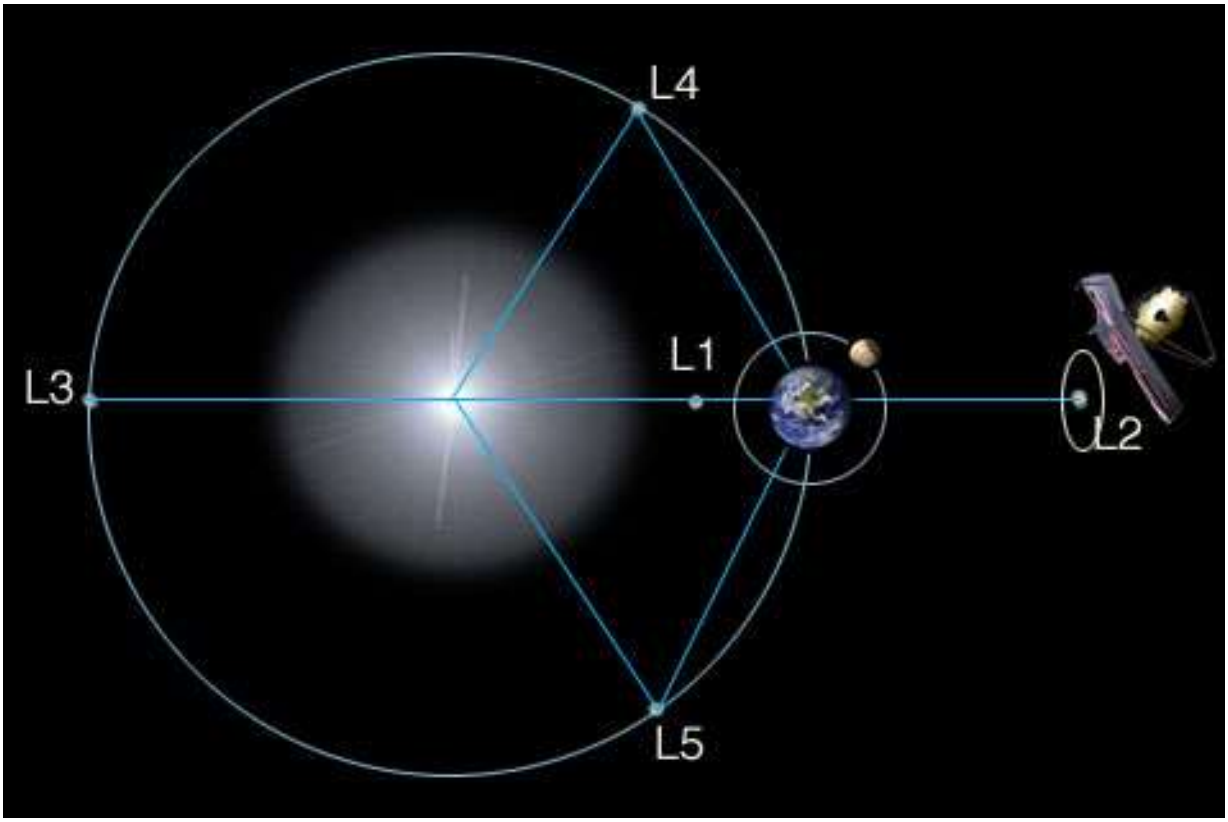
- Apollo: a group of near-Earth asteroids whose orbits also cross Earth's orbit; Apollo asteroids spend most of their time outside Earth orbit.
- Aten: a group of near-Earth asteroids whose orbits also cross Earth's orbit, but unlike Apollos, Atens spend most of their time inside Earth orbit.
- Atira: 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 (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

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 (location of the Euclide and James Webb telescope) is situated 1.5 million kilometers beyond the Earth (as viewed from the Sun).



James Webb Space Telescope

https://webb.nasa.gov/index.html

Euclid Space Telescope

https://www.esa.int/Science_Exploration/Space_Science/Euclid

International Space Station and Starlink Satellites

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

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

NASA's Global Climate Change Resource

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

Mars – Mission Websites

Mars 2020 (Perseverance rover): https://mars.nasa.gov/mars2020/

Mars Science Laboratory (Curiosity rover): https://mars.nasa.gov/msl/home/

Mars Atmosphere and Volatile EvolutioN (MAVEN): https://science.nasa.gov/mission/maven/

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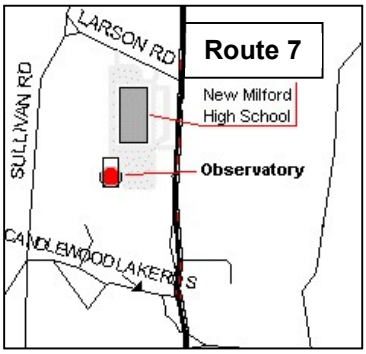

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