National Aeronautics and Space Administration

Welcome to Pluto!

After a decade-long journey through our solar system, New Horizons made its closest approach to Pluto on July 14, about 7,750 miles above the surface — roughly the distance from New York to Mumbai, India — making it the first-ever space mission to explore a world so far from Earth.

Following the closest approach, the spacecraft followed its plan to stay in data-gathering mode and not to contact flight controllers for about 21 hours, until it was beyond the Pluto system. It was a day filled with joy but tempered with a bit of anxiety as the team at the Johns Hopkins University Applied Physical Laboratory (APL) in Laurel, Maryland, waited for the call to come in. Finally, the hardy spacecraft phoned home to let the world know it had indeed accomplished the historic first-ever flyby of Pluto.

"The exploration of Pluto and its moons by New Horizons represents the capstone event to 50 years of planetary exploration by NASA and the United States," said NASA Administrator Charles Bolden. "I know today we've inspired a whole new generation of explorers with this great success, and we look forward to the discoveries yet to come. This is a historic win for science and for exploration. We've truly raised the bar of human potential."

Pluto is the first Kuiper Belt object (KBO) visited by a mission from Earth. New Horizons' flyby of the dwarf planet and its five known moons is providing an up-close introduction to the solar system's outer region populated by icy objects ranging in size from boulders to dwarf planets. KBOs such as Pluto preserve evidence about the early formation of the solar system. New Horizons will continue on its adventure deeper into the Kuiper Belt, where thousands of objects hold frozen clues as to how the solar system formed. If NASA approves an extended mission, the spacecraft may get to fly by a small KBO.

New Horizons principal investigator Alan Stern of the Southwest Research Institute (SwRI) in Boulder, Colorado, says the mission now is writing the textbook on Pluto. "The New Horizons team is proud to have accomplished the first exploration of the Pluto system," Stern said. "This mission has inspired people across the world with the excitement of exploration and what humankind can achieve." The spacecraft is collecting so much data it will take 16 months to send it all back to Earth.

One day after the flyby, the team announced several discoveries and showed some early images. Scientists learned that Pluto has one of the youngest surfaces yet seen in the solar system. Unlike the icy moons of giant planets, Pluto cannot be heated by gravitational interactions with a much larger planetary body. Some other process must be generating the mountainous landscape.

Stay tuned – there is much, much more to be revealed!

Principal Investigator Alan Stern, seated with large smile, science team members and journalists gather around a laptop with delight as they review new processed images from the New Horizons spacecraft on July 15, 2015.
Credit: NASA/Bill Ingalls

INSIDE

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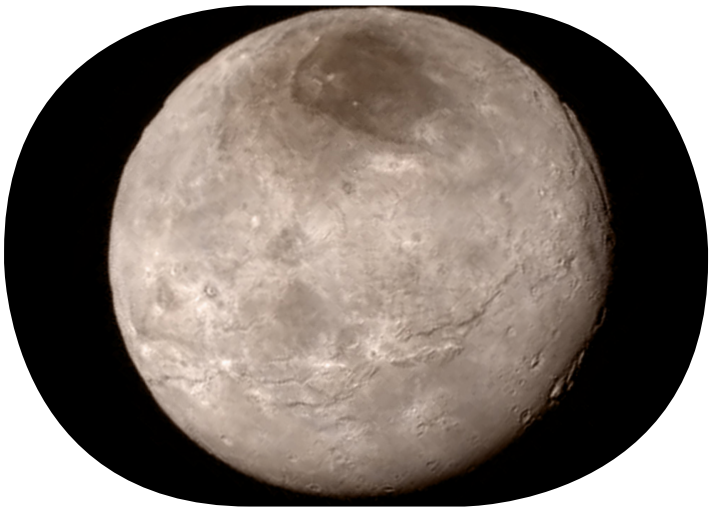
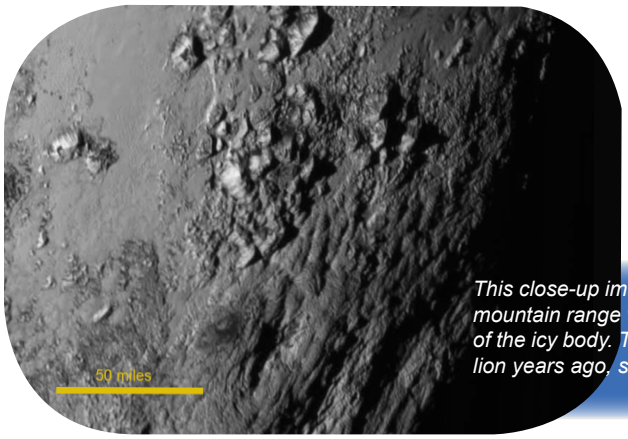
About 16 hours and 476,000 miles before closest approach, New Horizons captured this image of one of Pluto's most dominant features. The "heart" is estimated to be 1,000 miles across at its widest point, about the same distance as Denver to Chicago. Some surfaces on Pluto appear peppered with impact craters and therefore are relatively ancient, perhaps several billion years old. Other regions show no obvious craters and thus are probably younger, indicating that Pluto has experienced a long and complex geological history.
Credit: NASA/JHUAPL/SwRI



This view of Charon reveals a youthful and varied terrain. Scientists are surprised by the apparent lack of craters. A swath of cliffs and troughs stretching about 600 miles suggests widespread fracturing of Charon's crust, likely the result of internal geological processes. The image also shows a canyon estimated to be 4 to 6 miles deep.
Credit: NASA/JHUAPL/SwRI



This close-up image near the base of Pluto's heart-shaped feature shows a mountain range with peaks jutting as high as 11,000 feet above the surface of the icy body. The mountains on Pluto likely formed no more than 100 million years ago, suggesting the region may still be geologically active today.
Credit: NASA/JHUAPL/SwRI

Follow New Horizons on social media: Facebook, Youtube and Twitter.

Dawn – First Spacecraft to Orbit Two Planetary Objects

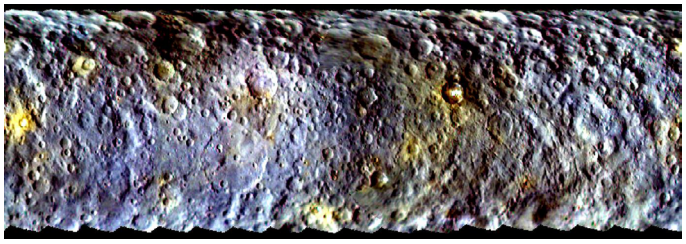
NASA's Dawn spacecraft made history when it became the first mission to orbit a dwarf planet on March 6.

"Since its discovery in 1801, Ceres was known as a planet, then an asteroid and later a dwarf planet," said Marc Rayman, Dawn chief engineer and mission director at JPL. "Now, after a journey of 3.1 billion miles and 7.5 years, Dawn calls Ceres 'home'."

Dawn also has the distinction of being the first mission to orbit two extraterrestrial targets. From 2011 to 2012, the spacecraft explored the giant asteroid Vesta, delivering new insights and thousands of images from that distant world. Ceres and Vesta are the two most massive residents of our solar system's main asteroid belt between Mars and Jupiter. While Vesta is a dry body, Ceres is believed to be 25 percent water ice by mass. By comparing Vesta and Ceres, scientists hope to gain a better understanding of the formation of the solar system.

A month after its capture by the gravity of Ceres, Dawn continued to perform flawlessly, thrusting with its ion engine into a circular orbit 26,000 miles above the surface, then descending into the first planned science orbit from April 23 – May 9 at 8,400 miles above the surface. Then Dawn began to spiral even lower to observe Ceres from a closer vantage point.

A color map of Ceres reveals the diversity of its surface. Differences in morphology and color suggest Ceres was once an active body with processes that resulted in different materials in different regions. It has a pair of very bright spots in its northern hemisphere. A new animated video of dwarf planet Ceres provides a unique perspective of this heavily cratered, mysterious world.

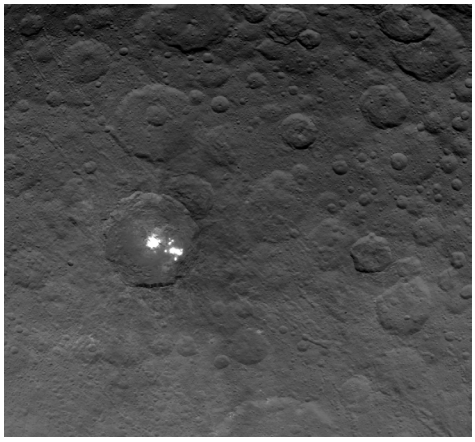


Credit: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA

Dawn entered its second mapping orbit on June 3 and spent the rest of the month observing the dwarf planet from 2,700 miles above its surface. The region with the brightest spots is in a crater about 55 miles across. The spots consist of many individual bright points of differing sizes with a central cluster. So far, scientists have found no obvious explanation for their observed locations or brightness levels. It could be ice, it might be salt. Closer views and different angles will provide more information.

Dawn is healthy and stable after experiencing an anomaly in the system that controls its orientation on June 30, triggering a safe mode. Engineers traced this anomaly to the mechanical gimbal system that swivels ion engine #3 to help control the spacecraft's orientation during ion-thrusting. Dawn has three ion engines and uses only one at a time.

The engineering team switched to ion engine #2 and conducted tests which confirmed that the spacecraft is ready to continue with the exploration of Ceres. As of July 17, Dawn is descending to its third mapping orbit at Ceres, which will take about five weeks to bring the spacecraft to an altitude of about 900 miles above the dwarf planet.



This image of Ceres' brightest spots is from June 6, 2015, at an altitude of 2,700 miles. The resolution is 1,400 feet per pixel.
Credit: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA

I C Ceres

To celebrate Dawn's arrival at Ceres, the mission hosted a Space Science Festival at Caltech in Pasadena, CA, on May 9, while 26 remote sites hosted their own events across the U.S. and in Europe, Ghana and Russia.

The Caltech event drew about 2,100 festival-goers to investigate 20 booths with hands-on activities and mission information. Inside the auditorium, presentations on small worlds and Dawn, and a panel featuring speakers from NASA Headquarters, New Horizons, OSIRIS-REx and Rosetta entertained the live crowd of nearly 500 while more than 2,000 watched the live stream.

Follow Dawn on social media: Facebook, Twitter, Google + and YouTube.

MESSENGER Mission Ends with Planned Impact on Mercury's Surface

On April 30, more than 4 years since entering into orbit about Mercury, NASA's MErcury Surface, Space ENvironment, GEochemistry, and Ranging (MESSENGER) spacecraft impacted the surface of Mercury, as predicted.

MESSENGER was launched on August 3, 2004, and began orbiting Mercury on March 18, 2011. The plan was to orbit for one year, collecting data to answer six critical questions. The spacecraft achieved its primary science objectives by March 2012. Because MESSENGER's initial discoveries raised important new questions and the payload remained healthy, the mission was extended twice, allowing the spacecraft to make observations from extraordinarily low altitudes and capture images and information about the planet in unprecedented detail. Through a series of technological innovations, MESSENGER's engineers devised a way to save fuel early on and leverage helium gas later, paving the way for a final one-month extension that enabled mission scientists to continue to acquire novel, low-altitude measurements.

In March the team embarked on a hover campaign that allowed the spacecraft to operate 3 to 22 miles above the planet's surface. The team successfully executed seven orbit-correction maneuvers (the last four of which were conducted entirely with helium pressurant after the remaining liquid hydrazine had been depleted) which kept MESSENGER aloft as long as possible. Finally, with no way to increase its altitude, MESSENGER was unable to resist the Sun's gravitational pull and slammed into Mercury's surface at around 8,750 miles per hour, creating a new crater up to 52 feet wide. A future Mercury mission might be able to identify the impact crater excavated by MESSENGER.

Near the top of the list of science accomplishments is providing compelling support for the hypothesis that Mercury harbors abundant water ice and other frozen volatile materials in polar craters.

"The water now stored in ice deposits in the permanently shadowed floors of impact craters at Mercury's poles most likely was delivered by the impacts of comets and volatile-rich asteroids," said Sean Solomon, MESSENGER's Principal Investigator and Director of Columbia University's Lamont-Doherty Earth Observatory. Mercury's polar regions suggest delivery to the inner solar system of water and

organic compounds from the outer solar system, a process that much earlier may have led to prebiotic chemical synthesis and the origin of life on Earth.

Solomon added, “Among its achievements, MESSENGER determined Mercury’s surface composition, revealed its geological history, discovered that its internal magnetic field is offset from the planet’s center, taught us about Mercury’s unusual internal structure, followed the chemical inventory of its exosphere with season and time of day, and discovered novel aspects of its extraordinarily active magnetosphere. MESSENGER surpassed all expectations and delivered a stunningly long list of discoveries that have changed our views of the entire inner solar system.”

Learn about MESSENGER’s top 10 science findings here and the top 10 technological innovations here.Videos of team members discussing the mission are available here.

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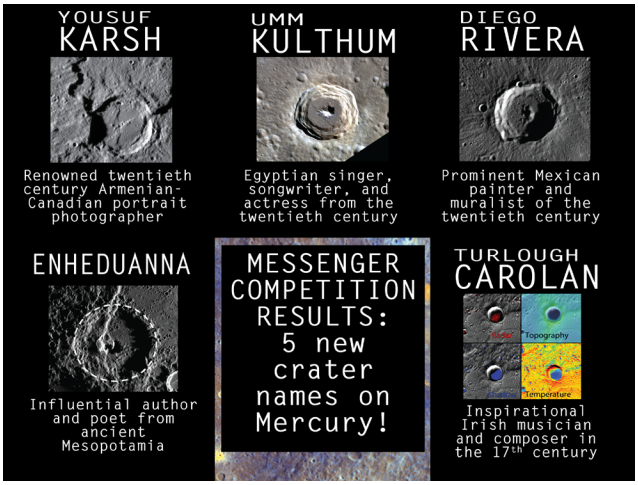


MESSENGER’s Education and Public Outreach team included the public in the final chapter of the MESSENGER story by sponsoring a “Name that Crater” competition. Thousands of submissions were received, and the five winners were announced on April 29

With One Year to Jupiter, NASA’s Juno Team Prepares for Orbit

With just one year remaining in a five-year journey to Jupiter, the Juno team is preparing for arrival at the solar system’s largest planet. Juno is scheduled to begin orbiting Jupiter on July 4, 2016. The mission aims to reveal the story of Jupiter’s formation and details of its interior structure. Data from Juno will provide insights about our solar system’s beginnings; what we learn will enrich scientists’ understanding of giant planets around other stars.

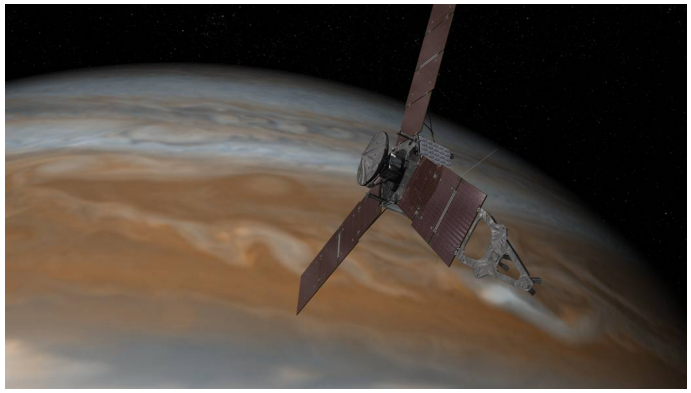
Juno is the first mission dedicated to the study of a giant planet’s interior, which it will do by mapping the planet’s magnetic and gravity fields. The mission will also map the abundance of water vapor in the planet’s atmosphere, providing the key to understanding which of several theories about the planet’s formation is likely the correct one. In addition, Juno will travel through the previously unexplored region above the planet’s poles, collecting the first images from there, along with data about electromagnetic forces and high-energy particles in the environment.

Although other spacecraft have previously visited Jupiter, the regions above the poles are full of unknowns. Following a detailed analysis by the Juno team, NASA recently approved changes to the mission’s flight plan at Jupiter. Instead of taking 11 days to orbit the planet, Juno will now complete one revolution every 14 days. The difference will be accomplished by having Juno execute a slightly shorter engine burn than originally planned. This will allow Juno to build maps of the planet’s magnetic and gravity fields in a way that will provide a global look at the planet earlier in the mission.

The original plan would have required 15 orbits to map these forces globally, with 15 more orbits filling in gaps to make the map complete. In the revised plan, Juno will get very basic mapping coverage in just eight orbits. A new level of detail will be added with each successive doubling of the number, at 16 and 32 orbits.

The revised plan lengthens Juno’s mission at Jupiter to 20 months instead of the original 15, and the spacecraft will now complete 32 orbits instead of 30. So it will take Juno a bit longer to collect the full data set the mission is after, but it will get a low-resolution version of its final products earlier in the mission than originally planned.

The slightly longer orbit also will provide a few extra days between close approaches to the planet for the team to react to unexpected conditions the spacecraft might experience in the complex environment very close to Jupiter. Juno will be immersed in a strong and variable magnetic field and hazardous radiation, and it will get closer to the planet than any previous orbiting spacecraft. The unknowns are part of what makes this mission, and space exploration, so exciting.



This artist’s rendering shows NASA’s Juno spacecraft making one of its close passes over Jupiter.
Image Credit: NASA/JPL-Caltech

Follow Juno on social media: Facebook, Twitter and YouTube.

NASA Begins Testing InSight Lander

InSight, NASA's next mission to Mars, began testing in late May to help ensure it can survive deep space travel and the harsh conditions of the Martian surface. Scheduled to launch in March 2016, the spacecraft will lift off from Vandenberg Air Force Base in California and land on Mars about six months later.

Short for Interior Exploration using Seismic Investigations, Geodesy and Heat Transport, the car-sized lander will be the first mission devoted to understanding the interior structure of the Red Planet. Its instruments will assess properties of the planet's crust, mantle and core. The interior of Mars has not been churned as much as Earth's because Mars lacks the tectonic activity that recycles Earth's crustal plates back into the mantle. Thus, Mars offers an opportunity to find clues no longer present on Earth about how rocky planets such as Earth, Mars, Venus and Mercury formed and evolved.

During the environmental testing phase, the lander will be exposed to extreme temperatures, vacuum conditions of nearly zero air pressure

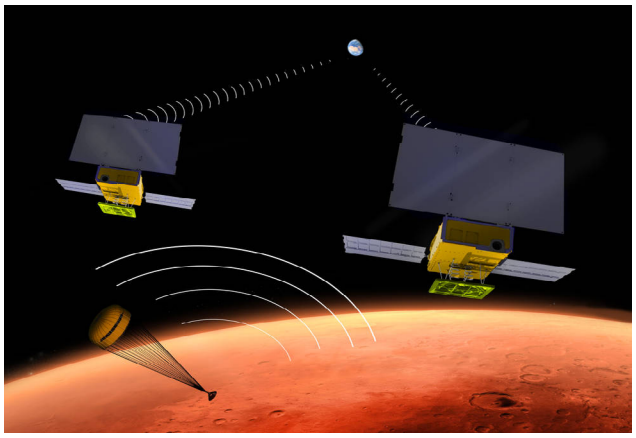
The solar arrays on NASA's InSight lander are deployed during this test which shows how the spacecraft will look on the surface of Mars.
Credit: NASA/JPL-Caltech/Lockheed Martin

simulating interplanetary space, and a battery of other tests. The regimen is designed to identify any issues with the spacecraft so they can resolved before launch. This phase takes nearly as long as assembly, but is necessary to ensure InSight will perform as expected in extreme environments.

"It's great to see the spacecraft put together in its launch configuration," said InSight Project Manager Tom Hoffman at NASA's Jet Propulsion Laboratory, Pasadena, California, "It is fantastic to get to this critical milestone."

MarCO: First Interplanetary CubeSat Mission

When NASA launches InSight, the flight will include the first two CubeSats flown in deep space. The twin communications-relay CubeSats constitute a technology demonstration called Mars Cube One (MarCO). If successful, the technology will allow NASA to quickly transmit status information about the main spacecraft after it lands.



Two small MarCO CubeSats will provide an experimental communications relay to inform Earth quickly about InSight's descent and landing.
Credits: NASA/JPL-Caltech

CubeSats are a class of spacecraft based on a standardized small size and modular use of off-the-shelf technologies. Many have been made by university students, and dozens have been launched into Earth orbit using extra payload mass available on launches of larger spacecraft. The basic CubeSat unit is a box roughly 4 inches square. Larger CubeSats are multiples of that unit. MarCO's design is a six-unit CubeSat - about the size of a briefcase.

Watch this short video to see how MarCO works. By verifying CubeSats as a viable technology for interplanetary missions and feasible on a short development timeline, this technology demonstration could lead to many other applications to explore and study our solar system.

Follow InSight on social media: Facebook and Twitter.

OSIRIS-REx Begins ATLO Phase

OSIRIS-REx, a groundbreaking mission to retrieve a sample from an asteroid, passed a critical milestone on March 30 and was officially authorized to move into the next phase – Assembly, Test, and Launch Operations or ATLO. Short for Origins Spectral Interpretation Resource Identification Security Regolith Explorer, the mission passed Key Decision Point-D (KDP-D) after completing a series of independent reviews that cover the technical health, schedule and cost of the project. Now the spacecraft bus will be completed, the instruments integrated into the spacecraft and tested, and the spacecraft shipped to NASA's Kennedy Space Center in Florida for integration with the Atlas V rocket.

"This is an exciting time for the team," said Dante Lauretta, principal investigator at the University of Arizona, Tucson. "After almost four years of intense design efforts, we are now proceeding with the start of flight system assembly."

OSIRIS-REx is scheduled for launch in late 2016 to near-Earth asteroid Bennu, arriving in 2018. The first U.S. mission to return samples from an asteroid to Earth, it will study the giant space rock's composition, topography and temperature — all key to selecting a safe sampling site. It will return about a 2 ounce sample to Earth in 2023.

The mission's five science instruments will examine the surface of Bennu, helping scientists understand the composition of the very early solar system and the source of organic materials and water that made their way to our planet. It will improve our understanding of asteroids that could impact Earth.

The OSIRIS-REx spacecraft core structure is successfully lowered and mated to the hydrazine propellant tank and boat tail assembly at Lockheed Martin, Denver.
Credit: Lockheed Martin

The team has been assembling and testing the Touch-and-Go Sample Acquisition Mechanism (TAGSAM) which consists of two major components: a sampler head and an articulated positioning arm. This video shows TAGSAM deployment, sample collection, and stowage in the Sample Return Capsule.

In June, the mission passed another key milestone by completing a Mission Operations Review (MOR) that focused specifically on operational readiness and progress to launch. The panel of experts assessed the mission's approach to data processing and analysis, commanding and planning of the spacecraft and instruments, navigation, and the verification and validation plans required before the spacecraft takes flight.

"The MOR allowed each of the team members to demonstrate how they will operate together after launch to accomplish the work of this mission," said Lauretta. "So many aspects of our mission have never been attempted before, and this review showcased the innovative approach to finding solutions that the entire OSIRIS-REx operations team brings to the mission."

Follow the mission on social media: Facebook, Twitter, YouTube and subscribe to the email newsletter.

Design of Discovery

The Discovery and New Frontiers Programs hosted our fifth annual professional development workshop for classroom and out-of-school time educators on Saturday, March 7, at four locations: NASA's Jet Propulsion Laboratory and Johnson Space Center, The Johns Hopkins University Applied Physics Laboratory in Laurel, MD, and University Corporation for Atmospheric Research in Boulder, CO.

Linked via NASA's Digital Learning Network, 180 participants at the 4 sites engaged in a variety of mission-design activities to help students understand the relationship between scientific objectives of a NASA space mission and the engineering and design process.

The day began with an overview of the current missions in the programs then moved into a guided engineering activity where participants constructed a model of the OSIRIS-REx spacecraft. After hearing from speakers representing the Dawn, New Horizons, MESSENGER, and OSIRIS-REx missions, the educators were introduced to a new MISSION-Makers activity and given the opportunity to design their own mission, based on the concepts learned throughout the day.

The new activity is still being field-tested but should be available soon.

All the presentations are available to watch on the workshop archive page.

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