InSight Will Take First Look Deep Inside Mars

InSight, an investigation into the interior of Mars, is NASA's choice for the 12th Discovery Program mission. The new exploration, set to launch in 2016, seeks to answer one of science's most fundamental questions: How did the terrestrial planets form?

InSight, short for Interior Exploration using Seismic Investigations, Geodesy and Heat Transport, is a terrestrial planet explorer that will address a key issue of planetary and solar system science — understanding the processes that shaped the rocky planets of the inner solar system more than four billion years ago. InSight will be the first to go below the surface of the Red Planet to find clues about why it evolved so differently from Earth.

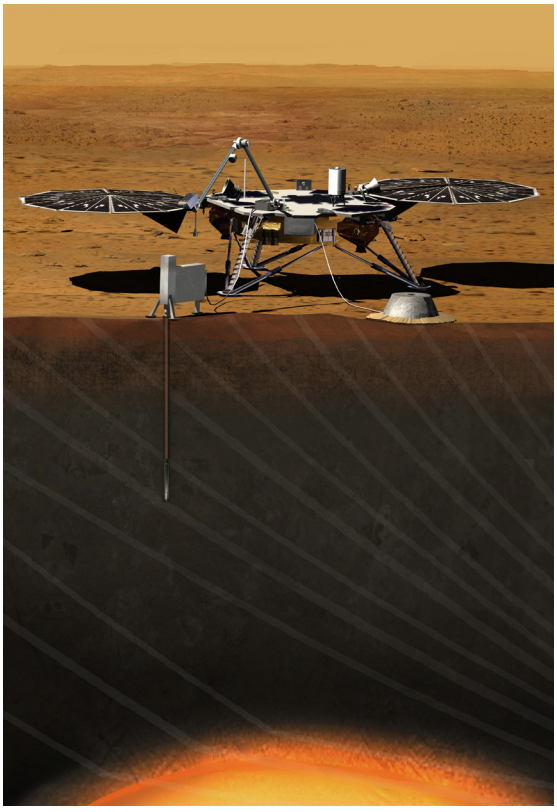
To do this, InSight will place a single geophysical lander on Mars. Three instruments will delve deep beneath the surface, shedding new light on the processes of terrestrial planet formation, as well as measuring the planet's "vital signs": "pulse" (seismology), "temperature" (heat flow probe), and "reflexes" (precision tracking).

InSight will carry two cameras. One will capture black-and-white images of the instruments on the lander's deck and a 3-D view of the ground where the seismometer and heat flow probe will be placed. These images will help engineers and scientists guide the deployment of the instruments to the ground. With a 45-degree field of view, the camera will also provide a panoramic view of the terrain surrounding the landing site. The second camera will provide a complementary view of the instrument deployment area.

InSight will investigate whether the core of Mars is solid or liquid like Earth's and why Mars' crust is not divided into tectonic plates that drift like those on Earth. Detailed knowledge of the interior of Mars in comparison to Earth will help scientists understand better how terrestrial planets form and evolve.

"The exploration of Mars is a top priority for NASA, and the selection of InSight ensures we will continue to unlock the mysteries of the Red Planet and lay the groundwork for a future human mission there," said NASA Administrator Charles Bolden.

InSight will be led by W. Bruce Banerdt at NASA's Jet Propulsion Laboratory in Pasadena, CA. InSight's science team includes U.S. and international co-investigators from universities, industry, and government agencies. The French space agency Centre National d'Etudes Spatiales, or CNES, and the German Aerospace Center are contributing instruments to InSight, which is scheduled to land on Mars in September 2016 to begin its two-year scientific mission.



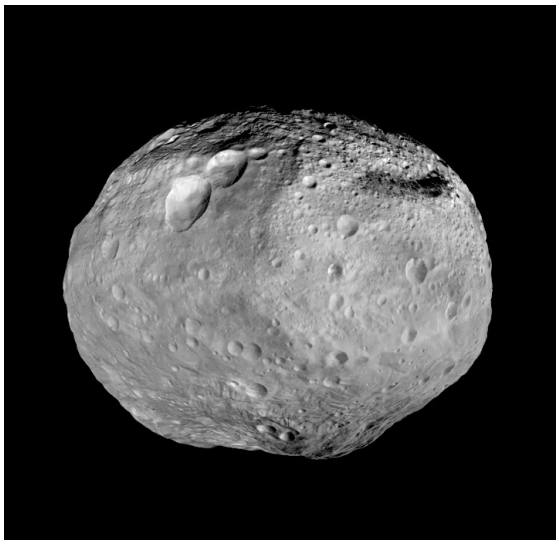
Artist's rendition of the InSight lander. Credit: JPL/NASA

INSIDE

September 2012 • Volume 13 Number 2

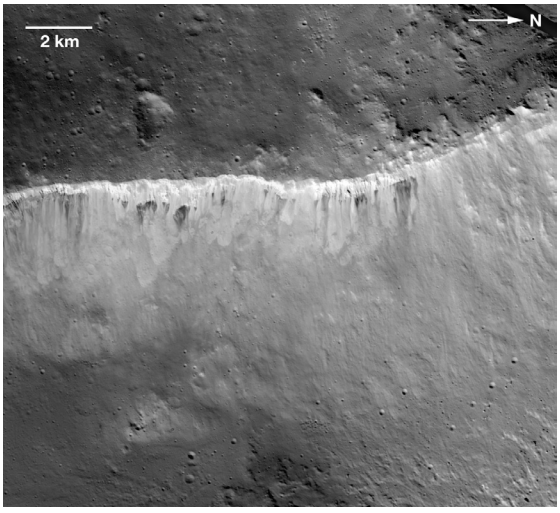
Transforming Asteroid Understanding — Dawn's Awesome Year at Vesta

Images of Vesta revealed by the Dawn spacecraft during its incredible year in orbit have shed enormous light on this large, mysterious space rock in the main asteroid belt. After a very successful science campaign in which the original mission goals were exceeded, Dawn "left the building" on September 5, departing from Vesta and beginning its journey to dwarf planet Ceres. Dawn will spend the majority of the next two and one-half years thrusting with the ion propulsion system, speeding to Ceres for an equally compelling rendezvous in early 2015.



This mosaic synthesizes some of Dawn's best views of Vesta. The mountain visible at the bottom is more than twice the height of Mount Everest. The three craters known as the "snowman" are at the top left. Credit: NASA/JPL-Caltech/UCAL/MPS/DLR/IDA

"As we respectfully say goodbye to Vesta and reflect on the amazing discoveries over the past year, we eagerly look forward to the next phase of our adventure at Ceres, where even more exciting discoveries await," said Robert Mase, Dawn project manager at the Jet Propulsion Laboratory. Over the past year, Dawn has comprehensively mapped this previously uncharted world, detecting unusual geologic features not seen previously on asteroids. The findings are helping scientists unlock some of the secrets of how the solar system, including our own Earth, was formed.



The interplay of bright and dark material at the rim of Marcia crater on Vesta is visible in this mosaic taken by Dawn. The scientific significance has several possible interpretations. Credit: NASA/JPL-Caltech/UCLA/ MPS/DLR/IDA/ LPI/ASU

A stunning animation of Vesta was made from framing camera images taken September–October 2011 at different viewing angles to help determine the topography. Other images were taken through special infrared and visible light filters in the camera. The colors highlight the minerals on Vesta's surface. Green indicates iron, but scientists have not yet determined the composition represented by the other colors. It is clear from the wide range of colors that Vesta is one of the most diversely colored asteroids that has been imaged.

Another great video celebrating Dawn's "greatest hits" at Vesta is available here. Made from images captured during the summer of 2012, it highlights the top accomplishments and identifies some of the amazing features.

Vesta is one of the brightest objects in our solar system and the only asteroid visible to the naked eye from Earth. Some areas are twice as bright as others, revealing clues about the asteroid's history. Analysis shows this bright material, most predominant in and around craters, has undergone little change since Vesta's formation over four billion years ago. The team is eager to learn more about what minerals make up this material and how the current surface came to be. Rocks crashing into the surface may have mixed the bright material with darker surface material. Learn more at the Dawn website.

Education and Public Outreach Highlights

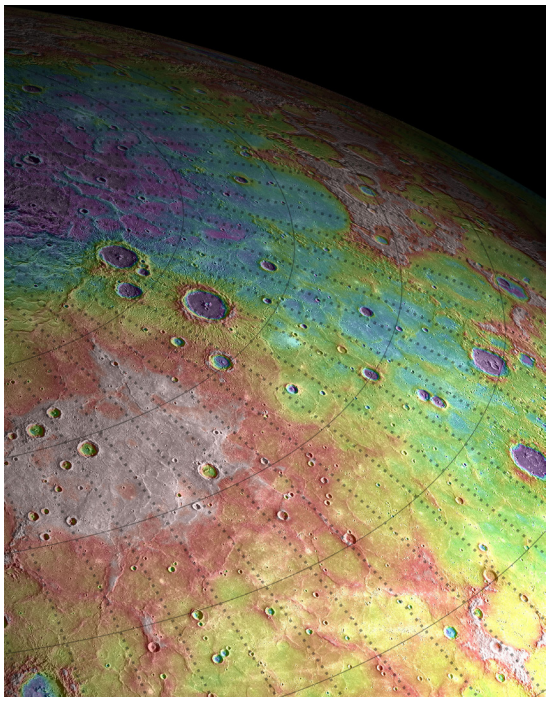
Dawn and CosmoQuest have partnered to launch Asteroid Mappers, a new citizen science project where everyone can access high-resolution images of Vesta and assist scientists in identifying craters, boulders, and other features. Register now and join in this scientific adventure to help figure out Vesta's surface history and geology, how and when these features formed. Detectives are needed to reveal the clues hidden in this ancient object!

Dawn said "Hasta la vista, Baby" to its favorite giant asteroid on September 8, 2012, with 38 "Hasta La Vesta" celebrations nationwide. Dawn hosted its first Google+ Hangout, with science and engineering team members from JPL, APL, the Planetary Institute, University of Texas–Austin, and Max Planck Center for Solar System Research sharing images, videos, and stories and answering questions submitted via social media. Watch the archived program here. The Hangout was attended by an average of 100 Google+ participants. It was also streamed live on the Dawn website, with 728 views, as well as YouTube and Google On Air.

MESSENGER: Eight Years and Going Strong

On August 3, the MESSENGER team marked the eighth anniversary since launch. Its remarkable 6.5-year, 4.9-billion mile journey to become the first spacecraft to orbit Mercury included 15 trips around the Sun, a flyby of Earth, two flybys of Venus, and three flybys of Mercury.

MESSENGER thrilled scientists when it finally entered into orbit about Mercury on March 17, 2011. During its year-long orbital campaign, MESSENGER acquired 88,746 images and extensive other data sets as it successfully performed the first global reconnaissance of the geochemistry, geophysics, geologic history, atmosphere, magnetosphere, and plasma environment of Mercury. March 18, 2012, marked the official start of an extended mission phase designed to build upon those discoveries.



This colorized image shows the immense volcanic plains that span Mercury's northern latitudes. The purple colors are the lowest and white is the highest. Credit: NASA/JHUAPL/CIW/ Brown University

MESSENGER completed its 1,000th orbit of the planet closest to the Sun on June 22. It took a little more than 15 months to reach this mark, but with two orbit correction maneuvers in April that shortened the orbital period from just under 12 hours to 8 hours, it will take only 11 months to complete the next 1,000 orbits.

Six months into the extended mission, the team has already made substantial progress on its new objectives. At the 27th Science Team Meeting in Salem, Massachusetts, in August, team members discussed the new findings and the possibilities for a second extended mission. A special section of the *Journal of Geophysical Research* is being planned and will contain the first comprehensive set of papers reporting orbital observations of Mercury by the MESSENGER spacecraft.

IAU Approves Names for Nine Mercury Craters

The International Astronomical Union (IAU) recently approved a proposal from the MESSENGER Science Team to assign names to nine impact craters on Mercury. The IAU is the arbiter of planetary and satellite nomenclature. Craters on Mercury are named after famous deceased artists, musicians, authors, or other contributors to the humanities. All of the newly designated features are in the north polar region, an area of high scientific interest because of shadowed craters with bright deposits that may consist of water ice.

Naming the major craters is important for two reasons. It makes communicating scientific findings about specific regions and features easier, and the designations recognize contributions to the arts by the most creative individuals from many cultures and eras. Their names are now forever linked to the innermost planet.

Congratulations to Sean Solomon and Larry Nittler

In July, MESSENGER Principal Investigator Sean Solomon became the director of Columbia University's Lamont-Doherty Earth Observatory. Solomon, who has led the mission since its inception, formerly was a research scientist and director emeritus at Carnegie Institution of Washington (CIW).

At the mission's science team meeting in May, Solomon announced that Larry Nittler, a staff scientist in the Department of Terrestrial Magnetism at CIW and mission science team member, will become MESSENGER's deputy principal investigator. Nittler has worked on three previous Discovery missions. His analysis of NEAR measurements at asteroid Eros helped provide the first chemical analyses of a minor planet. He also led investigations of the samples returned by Stardust and Genesis to identify the materials involved.

Education and Public Outreach Highlights

MESSENGER staffed a display at the National Air and Space Museum's family day on April 21 with activities relating to tectonics on Mercury and the MESSENGER Mosaic Post Card puzzle. Mission buttons, stickers, and posters were distributed to 900 visitors.

Fourteen mission team members representing science, engineering, operations, and education staffed a table at the USA Science and Engineering Festival in Washington, D.C., April 25–27. MESSENGER was part of a larger NASA presence at the event, which attracted 180,000 attendees. The team displayed elements of the spacecraft, including sunshade fabric, solar panels, and a model, and led hands-on activities.

MESSENGER education staff participated in four Family Science Night events at the National Air and Space Museum during the 2011–12 academic year, with a total of 16 schools and 1,431 students, teachers, and family members attending. The events feature time in the museum, presentations on planetary science, and an IMAX film chosen by the participating schools.

MESSENGER at the USA Science and Engineering Festival.

Synchronized Flying with Ebb and Flow

If synchronized flying were an Olympic sport, the GRAIL mission's twin high-speed spacecraft would deserve the gold. Flying in formation around the Moon at 3,600 mph, Ebb and Flow have worked together in the most exacting way imaginable to get the science data that is key to their success.

To measure the gravity of the Moon with the utmost precision, the two probes must make precise measurements. As they fly over areas of greater and lesser gravity, surface features such as mountains and craters and masses hidden beneath the lunar surface can influence the distance between the two spacecraft ever so slightly. Would you believe they can detect a change in their positions down to one-tenth of a micron, which is about one-half the thickness of a human hair? Noting these sometimes miniscule changes is what will allow mission scientists to generate an incredibly high-resolution map of the Moon's gravitation field. From that, they will gain a new understanding of what goes on below the lunar surface. This information will then increase our knowledge of how Earth and its rocky neighbors in the inner solar system developed into the diverse worlds we see today.

Principal investigator Maria Zuber with MoonKam students.

So how did GRAIL perform during its prime mission, from March through May? Flawlessly, by all accounts. GRAIL's data are providing unprecedented detail about the internal structure and evolution of the Moon. Operating around the clock for 89 days in a polar orbit, Ebb and Flow collected data covering the entire surface three times. According to principal investigator Maria Zuber, many of the measurement objectives were achieved from analysis of only half the primary mission data. While there is still a lot of work to be done to achieve the full mission science, the data are in hand.

What's the plan for the extended science mission? When data collection resumes on September 30, the goal is to take an even closer look at the Moon's gravity field. The spacecraft will be guided to the lowest operating altitude that can be safely maintained, which is expected to be about 14 miles above the surface. This will clear some of the Moon's higher mountains by about 5 miles.

How about GRAIL's MoonKAM, the cameras taking images directed by students? Yes, MoonKAM is extended also. Teachers can still register their classes to participate in the extended mission. To date, more than 80,000 student images have been snapped. View some of the MoonKAM team's favorites.

Education and Public Outreach Highlights

Middle-school students and their teachers gathered in Washington, D.C., on June 1 to demonstrate science lessons and highlight images they took from lunar orbit using GRAIL's MoonKAM system. Along with demonstrating their knowledge of the Moon and science, the students listened to presentations from Maria Zuber, NASA deputy administrator Lori Garver, President Obama's science advisor John Holdren, and Sally Ride, who spoke to the students remotely.

Zuber said she was blown away with the student demonstrations and their grasp of lunar science, noting that the GRAIL mission and MoonKAM are making a difference in young student's lives one image at a time.

Salute to Sally Ride

Sally Ride, who died on July 23, will forever be remembered, first and foremost, as America's first woman in space. When she soared off the launch pad on the space shuttle Challenger on June 18, 1983, at age 32, it was a game changer for women and girls of all ages throughout the world. She was a brilliant scientist with a Ph.D. in physics from Stanford University, she was young, attractive, and gutsy, and she rocketed into space right along with the guys. She did her job extremely well, and she changed the face of America's space program. Plus she had such a cool name!

Sally flew on a second shuttle mission a year later, then she was appointed to the commission that investigated the 1986 Challenger explosion. She worked at NASA Headquarters before retiring from the space agency in 1987 to become a science fellow at the Center for International Security and Arms Control at Stanford University. In 1989, Sally joined the faculty at the University of California San Diego as a professor of physics and director of the California Space Institute.

In 2001 she founded her own company, Sally Ride Science, to provide exciting science programs, events, and publications for upper elementary and middle school students and their parents and teachers. Thousands of girls have attended Sally Ride Science festivals since 2001, one way she fulfilled her long-time passion for encouraging young girls to study science and math.

Sally also initiated and directed NASA-funded education projects designed to fuel middle school students' fascination with science. EarthKAM allows middle school students to take pictures of Earth from a digital camera on board the International Space Station.

GRAIL MoonKAM, the education and public outreach component of the Discovery Program's GRAIL mission, gives middle school students the opportunity to snap their own photos of the lunar surface using cameras on board the spacecraft that is in orbit around the Moon.

Photo of the GRAIL Education and Public Outreach Plan peer review team that met at UC San Diego in October 2009, including Sally Ride, former astronaut Kathryn Sullivan, and GRAIL principal investigator Maria Zuber (3rd, 4th, and 5th from left).

"The fact that I was going to be the first American woman to go into space carried huge expectations along with it," Ride recalled in an interview for the 25th anniversary of her flight in 2008. "On launch day, there was so much excitement and so much happening around us in crew quarters, even on the way to the launch pad," Ride said. "I didn't really think about it that much at the time . . . but I came to appreciate what an honor it was to be selected to be the first to get a chance to go into space."

Sally lived her life to the fullest, with boundless energy, curiosity, intelligence, passion, joy, and love. She had the rare ability to understand the essence of things and to inspire those around her to join her pursuits. She is gone far too soon, but the legacy she leaves behind will continue to make a difference in the lives of young girls and boys for decades to come.

New Horizons Team Continues Planning for Big Event

From late January through April, the New Horizons spacecraft zoomed toward Pluto as it made like a bear and hibernated, while its human team on Earth never stopped their efforts on Pluto encounter planning. The spacecraft was awakened on April 30, when the mission operations team began Annual Checkout 6 — an intensive, two-month-long series of activities including thorough checkouts of every prime and backup system on the spacecraft plus all seven scientific instruments, calibrations of the entire scientific payload, two major flight-software updates, and a rehearsal of the most intensive day of the Pluto encounter. Whew! After all that activity, New Horizons was tucked away to once again hibernate from July 6 until early January 2013.

This hibernation won't be quite as restful. Three instruments are collecting heliospheric science data as the spacecraft cruises through deep space beyond the orbit of Saturn — the Student Dust Counter, Solar Wind Around Pluto (SWAP), and Pluto Energetic Particle Spectrometer Science Investigation (PEPSSI). Learn more about what these observations can tell us.

On May 29–30, the New Horizons team carried out their first onboard encounter simulation, setting their imaginary clocks to July 14, 2015, to test the code that will send commands to the spacecraft's computers to guide the 22-hour encounter period.

In July, a team of astronomers using NASA's Hubble Space Telescope reported the discovery of a fifth moon orbiting the icy dwarf planet Pluto. The moon is estimated to be irregular in shape and 6 to 15 miles across. The new discovery provides additional clues for unraveling how the Pluto system formed and evolved. It will also help scientists navigate New Horizons through the Pluto system, along with ground and flight observation campaigns that are underway to support hazard assessment.

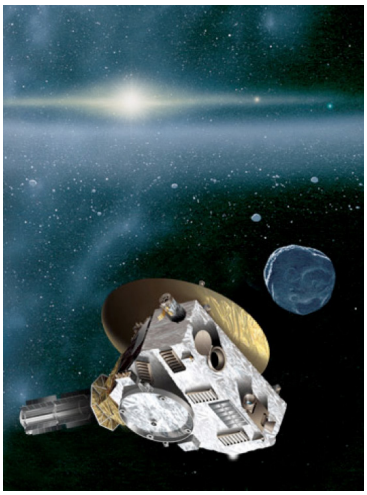
After the month-long Pluto encounter in 2015, it will take about a year to get all of the data back to Earth. This is due to both the large quantity of data to be collected and the tremendous distance to send it back to Earth.

If NASA approves an extended mission to carry out further explorations after Pluto, New Horizons will explore one or two ancient Kuiper Belt Objects (KBOs). In anticipation of this, the mission team has been searching for suitable KBOs. This is a big challenge with two main issues: 1) post-Pluto fuel supply, which is expected to be about 34 kilograms (40 percent what it carried at launch); and 2) the difficulty of finding small KBOs, which requires the largest telescopes and most sensitive astronomical cameras on Earth to detect. The spacecraft trajectory points to the heart of the Milky Way's densest star fields, making these very distant, faint, slow moving objects extremely hard to find.

While the potential KBO flybys won't be as extensive as the multi-month Pluto-system exploration in 2015, New Horizons will be able to map their surfaces, surface compositions and surface temperatures, explore their moons or rings, measure their masses, and search for any atmosphere they may have. With no other Kuiper Belt missions currently being planned, the data will provide extremely valuable additions to the body of knowledge about our solar system.

Education and Public Outreach Highlights

While the KBO searchers will continue their hunt for good targets over the next few years, citizen scientists can participate through Ice Investigators. With the potential first KBO flyby likely to occur in 2018 or 2019, New Horizons has the power and technical capabilities to fly late into the 2020s or even into the 2030s if its health remains good. All of the scientific instruments and the onboard spacecraft system were designed to work even at the far edge of the main Kuiper Belt, which it will reach in about 2021.



Artist's concept of New Horizons making a KBO flyby near the far edge of the Kuiper Belt in the late 2010s. Credit: Dan Durda

Juno Performs Two Deep Space Maneuvers

Juno continues its journey through the solar system, bound for Jupiter but on course for a flyby of Earth in 2013, to get a gravity assist to boost its speed, saving time, propellant and money.

In preparation for the Earth flyby, the mission team carried out two Deep Space Maneuvers (DSM) to alter the spacecraft's velocity. An Operations Readiness Test for the maneuver was completed in July with no issues. An event Readiness Review took place in August, as did a science planning working group meeting and a command process workshop to facilitate communication between the spacecraft and instrument operations teams.

The level of detail that goes into every aspect of a spacecraft's successful operations is like an exquisite symphony played by a well-rehearsed orchestra. Many people with different areas of expertise have unique roles among the various mission teams, just as the brass, string, woodwind, and percussion sections all play distinct parts. When they perform together as one fully integrated unit, be it a spacecraft or an orchestra, it's a thing of precision and beauty.

Juno's navigators and mission controllers accomplished their successful first main engine burn on August 30. The Leros-1b main engine was fired for 29 minutes, 39 seconds, changing the spacecraft's velocity by about 770 mph while consuming about 829 pounds of fuel.

According to project manager Rick Nybakken at the Jet Propulsion Laboratory, "We started detailed preparations for this maneuver earlier this year, and over the last five months we've been characterizing and configuring the spacecraft. Over the last two weeks, we have carried out planned events almost every day. There is a lot that goes into a main engine burn."

A second deep space maneuver, with similar duration and fuel consumption, took place on September 14, changing the velocity by 867 mph. Together, the two maneuvers place Juno on course for its Earth flyby, which will occur as the spacecraft is completing one elliptical orbit around the Sun. The Earth flyby will boost Juno's velocity by 16,330 mph, placing the spacecraft on its final flight path for Jupiter. The closest approach to Earth, on October 9, 2013, will occur when Juno is at an altitude of about 310 miles. Juno will arrive at Jupiter on July 4, 2016.

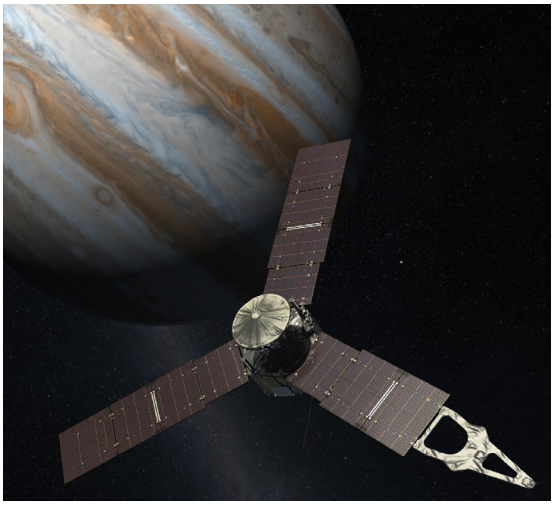
Currently Juno is about 300 million miles from Earth. "We still have the Earth flyby and another 1.4 billion miles and four years to go to get to Jupiter," said Scott Bolton, Juno's principal investigator from the Southwest Research Institute in San Antonio. "The team will be busy during that whole time, collecting science on the way and getting ready for our prime mission at Jupiter, which is focused on learning the history of how our solar system was formed. Jupiter developed by grabbing most of the material left over from the Sun's formation. Earth and the other planets are really made from the leftovers of the leftovers, so if we want to learn about the history of the elements that made Earth and life, we need to first understand what happened when Jupiter formed."

Juno was launched on August 5, 2011. Once in orbit, the spacecraft will circle Jupiter 33 times, from pole-to-pole, and use its collection of eight science instruments to probe beneath the gas giant's obscuring cloud cover. Juno's science team will learn about Jupiter's origins, structure, atmosphere and magnetosphere, and look for a potential solid planetary core.

Education and Public Outreach

Juno's main informal education product, Explore! Jupiter's Family Secrets, is now available. The module is a collection of hands-on activities for children ages 8–13, with an additional selection of deeper investigations for ages 11 to 13. It showcases how the Juno mission will unveil clues about how our solar system formed and Jupiter's unique traits. It is designed for use in summer camps, after-school programs, festivals, science days, family events, and more.

A new set of engineering and technology-focused activities called "Designing Juno" was tested with middle-school students in a summer program at Morgan State University in Baltimore July 6–21. The evaluator reported the pilot testing went very well, with genuine excitement from participating students.



Artist's rendering of Juno at Jupiter. Credit: NASA/JPL-Caltech

NASA Brings Science Fun and Inspiration to Military Educators and Students

Thousands of young American students living in Europe with military families may be viewing science in a whole new way during this school year, thanks to a week-long training of 58 classroom teachers and afterschool educators coordinated by Shari Asplund, education and public outreach manager for NASA's Discovery and New Frontiers Programs.

Six NASA scientists and education specialists brought an exciting educator workshop to Ansbach, Germany, May 14–18: the Bavaria Youth Technology Lab Training Extravaganza, or NASA-BYTE. With funding generously provided by the U.S. Army, NASA personnel traveled to Bavaria to engage, inspire and teach educators from the Department of Defense Dependent Schools (DoDDS) and staff from Child, Youth and School Services (CYSS).

The BYTE workshop was a special experience for everyone involved. Thousands of military families with children are stationed outside of the U.S., and the teachers at overseas locations do not have easy access to the hands-on training and content accessible to U.S. educators. "This curriculum will bring a fun and exciting new era of learning to our children and youth," said Col. Kelly J. Lawler, U.S. Army Garrison (USAG) Ansbach's commander, in his welcoming remarks. "It is a great professional development opportunity for staff and teachers across Europe."

NASA trainers and Ansbach garrison contact, from left: Carlton Allen, Jaclyn Allen, Shari Asplund, Wil Robertson, Shelley Hopper (standing), Whitney Cobb, Lou Mayo.

Performing Space School Musical's "Big Bang."

Twelve of the 15 Army garrisons in Europe sent representatives to the workshop, three to four from each garrison. One member of each team was designated to train others at their garrison when they return. With two school-age specialists working with grades K–6 and 7–12 and a technology specialist from each garrison, the workshop had the potential to reach nearly 36,000 students!

Shelley Hopper, Functional Technology Specialist with CYSS at USAG Ansbach, is the person who worked extremely hard on the Army side to make the event happen. Hopper and Asplund met at an afterschool conference a few years ago and exchanged contact information in hopes of finding ways to bring more NASA content to military educators in Europe.

The Army's goals were for NASA personnel to provide Army staff with hands-on activities in space and astronomy content. The DoDDS educators and CYSS staff, who work with students before school, after school and in summer programs, received training and materials on a wide range of NASA-related content that concentrated on planetary science and heliophysics.

All the garrisons that have telescopes brought theirs to the training and learned how to assemble and use them. The evening event culminated in a star party that left a lasting impact. One trainee wrote on the NASA-BYTE Facebook page the following week: "First clear night…the sky doesn't look the same to me anymore. #NASA-BYTEROCKS!"

Learning to use garrison telescopes and night sky viewing — all were thrilled to see Saturn!

Learning to use telescopes during the day for solar views.

To offer a variety of topics and expertise, Asplund put together a multi-talented team of NASA education and science experts: astronomer Lou Mayo from Goddard Space Flight Center; aerospace education specialist Wil Robertson from Marshall Space Flight Center; Jaclyn Allen, science education specialist from Johnson Space Center; and Whitney Cobb, lead consultant at McREL, a partner on many NASA planetary missions. A bonus team member was Jaclyn's husband Carl, the astromaterials curator at JSC.

The week-long extravaganza included topics such as Exploring Scale in the Universe, Asteroids and Comets, Rocketry, Space Weather, Robotics, Astrobiology, Design a Future Discovery Mission, Art and the Cosmic Connection, Space School Musical, lunar and meteorite disk certification, and more. The educators left the workshop with new attitudes, new ideas for engaging their students, and confident that they don't have to be Albert Einstein to teach science outside the classroom.

Art and the Cosmic Connection: Learning to look, looking to learn.

Teachers learn about heavy-lifting rockets by using balloons.

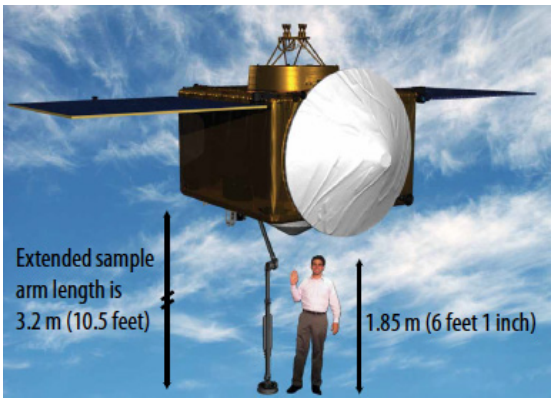
OSIRIS-REx Announces Earlier Rendezvous Date and Asteroid Naming Contest

OSIRIS-REx, the first American mission designed to return samples from an asteroid, will launch in 2016 and travel to near-Earth asteroid (101955) 1999 RQ36, study it in detail, and bring back samples of asteroid dirt to Earth.

The spacecraft will map the asteroid's global properties and measure non-gravitational forces. It will also provide observations for comparison with data obtained by previous telescope observations from Earth that indicate 1999 RQ36 is made of primitive materials. In 2023, OSIRIS-REx will return to Earth with about two ounces of samples from the asteroid.

OSIRIS-REx will reveal details about the asteroid's composition and structure, offering new insights into the nature of the early solar system, its evolution, and the building blocks that led to life on Earth. It will also tell us much more about the orbits of near-Earth objects and their impact risks.

In May, OSIRIS-REx conducted a Mission Definition Review at Lockheed Martin in Denver that covered many topics. The conclusion of the Goddard System Review Team was that the mission is ready to proceed toward the Preliminary Design Review in March 2013.



Comparison showing the size of the spacecraft and the sampling arm next to a 6' tall man.

Many other studies, meetings and reviews are ongoing and a number of procurements are in process, including launch services. An Atlas 411 rocket has been selected as the launch vehicle. Mission staff met with Launch Services Program (LSP) team members to discuss roles and responsibilities and tour the LSP facilities.

On August 17, principal investigator Dante Lauretta announced a new date for rendezvous with 1999 RQ36 to provide additional operations time at the asteroid. The launch period, asteroid departure date, and Earth return date remain the same as previously scheduled, but the flight dynamics team is now planning an October 15, 2018, rendezvous date at the asteroid instead of December 16, 2019. The first attempt to capture a sample has been moved up to July 17, 2019.

Ron Mink, Deputy Systems Engineer, said, "The additional margin of time will provide the OSIRIS-REx team the opportunity to deal with any unexpected surprises that 1999 RQ36 may have in store, such as small moons, gas and dust plumes, or a surface so rough that a good sampling site is hard to find. The early arrival also places the asteroid and spacecraft much closer to the Earth during the mission, permitting a more rapid return of science and engineering data and less time to get commands up to the spacecraft."

Education and Public Outreach Highlights

A citizen science project called "Target Asteroids!" is supporting the mission by enlisting the help of amateur astronomers to better characterize the population of Near-Earth Objects (NEOs), including their position, motion, rotation, and changes in the intensity of light they emit. Professional astronomers will use this information to refine theoretical models of asteroids, improving their understanding about asteroids similar to the one OSIRIS-REx will encounter in 2018.

Target Asteroids! data will be useful for comparisons with actual mission data. Find instructions and registration information here. The project team plans to expand participation to students and teachers in 2014.

Amateur astronomers long have provided NEO tracking observations in support of NASA's NEO Observation Program. A better understanding of NEOs is a critically important precursor in the selection and targeting of future asteroid missions.

Asteroid Naming Contest for Students

On September 4, NASA announced a contest for students to come up with a better name for (101955) 1999 RQ36. Name That Asteroid! is a contest open to kids worldwide under the age of 18. Rules govern the naming of objects in the solar system, so guidelines need to be followed. To enter, parents or teachers must fill out an online entry form with the proposed name and a short explanation of why it's a good one.

Enter by December 2, 2012 for a chance to name a piece of the solar system. The student who names the asteroid could be one of the scientists who studies the samples when they return to Earth in 2023!

Strofio Delivers Proto-Flight Model

Strofio is a unique mass spectrometer that is part of the SERENA (Search for Exospheric Refilling and Emitted Natural Abundances) suite of instruments that will fly on board the European Space Agency's BepiColombo/Mercury Planetary Orbiter (MPO) spacecraft. Strofio will determine the chemical composition of Mercury's surface, providing a powerful tool to study the planet's geological history. Strofio is a NASA-funded Discovery Mission of Opportunity.

The Strofio team continued testing of the instrument components. The project conducted the Strofio Proto-Flight Model (PFM) pre-ship review, part 1, on August 23 at Southwest Research in San Antonio. The PFM and the Ground Support Equipment were shipped to the University of Bern on August 27. They were subsequently installed in the calibration chamber. Over the next few months, integration, testing and calibration will continue.

Delivery of Strofio to SERENA is currently planned for February 2013. SERENA will be delivered to ESA in April 2013. Launch of BepiColombo is scheduled for August 2015, with arrival at Mercury in 2022.

Artist's concept of the two BepiColombo orbiters at Mercury.

Winner of a 2011 Society for Technical Communication International Summit Award of Excellence

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Written and edited by:

Shari Asplund

Discovery & New Frontiers Program
Education and Public Outreach Manager