National Aeronautics and Space Administration

NASA 101

From Vision to Reality

In 1958, the United States Congress passed the National Aeronautics and Space Act to provide for research into the problems of flight within and outside Earth's atmosphere and to ensure that our nation conducts activities in space devoted to peaceful purposes for the benefit of humankind. Since the enactment of that landmark legislation, NASA has extended our reach throughout the solar system, conducted groundbreaking aeronautics and scientific research, and created new technological capabilities that have improved the lives of people everywhere.

Today, under the direction of the president and Congress, NASA continues to pursue a bold agenda that commits our nation to developing the next-generation spacecraft to return astronauts to the moon and eventually to Mars and beyond. As we do so, NASA will maintain a balanced aeronautics research portfolio and conduct science missions to gain a better understanding about our Earth, solar system, and the stars, planets and galaxies beyond.

NASA is a unique agency, and this publication, "NASA 101: From Vision to Reality," is designed to provide a summary of NASA's many programs and projects. For additional information, please visit us on the web at www.nasa.gov.

Sincerely,

Michael Griffin
NASA Administrator

Vision for Space Exploration

From Vision to Reality

››› Announced in 2004, the Vision for Space Exploration communicates the United States' and NASA's commitment to a long-term robotic and human program to explore the solar system, starting with a return to the moon that will ultimately enable the future exploration of Mars and other destinations.

The Vision affirms our commitment to human space exploration and gives NASA a new focus and clear objectives. It is affordable and sustainable and maintains the highest levels of safety. It has been endorsed by bipartisan majorities of the U.S. Congress.

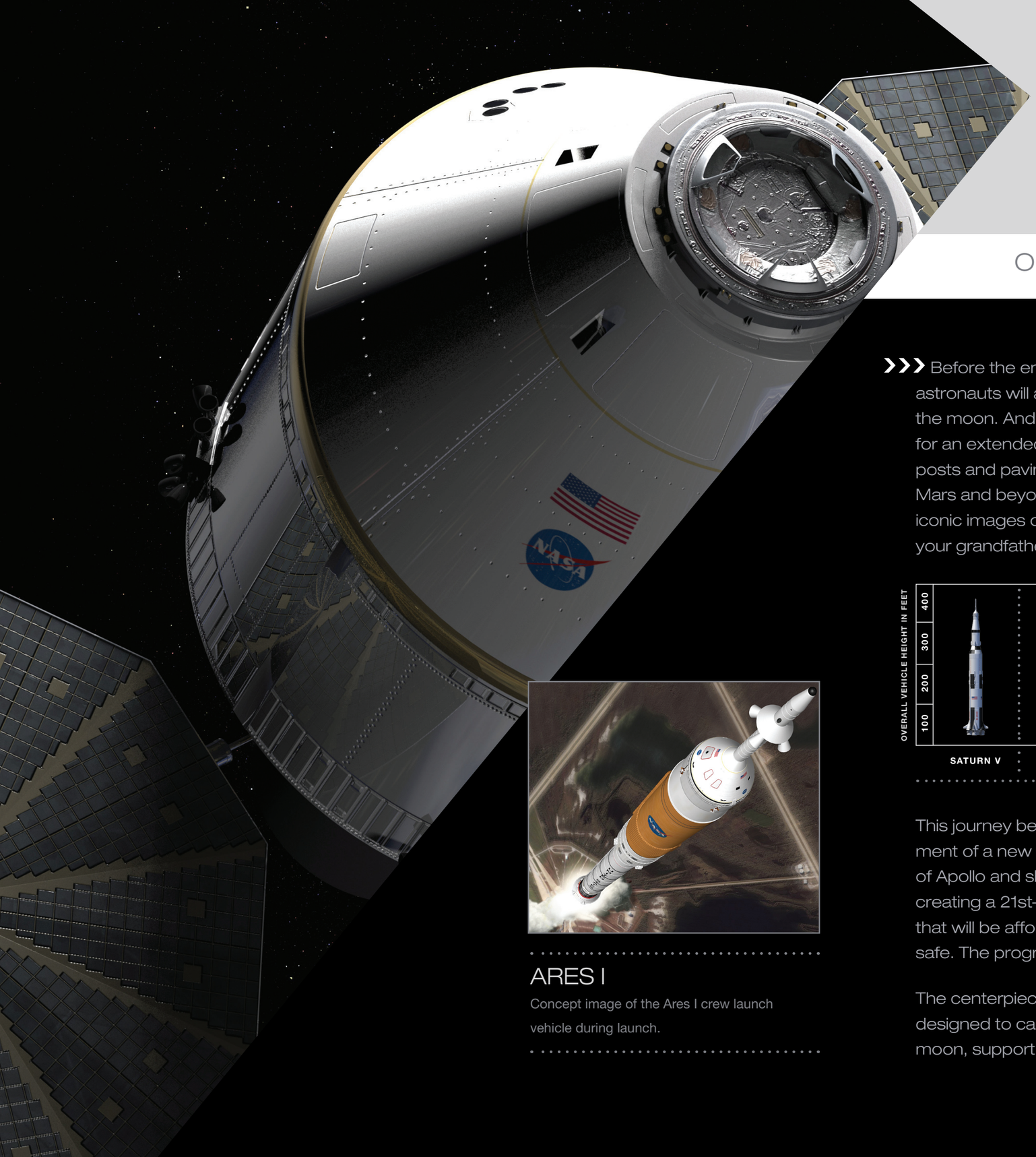
The Vision for Space Exploration is based on the following strategic goals:

- Fly the space shuttle as safely as possible until its retirement, no later than 2010.
- Complete the International Space Station in a manner consistent with NASA's commitments to international partners and to the needs of human exploration.
- Develop a balanced overall program of science, exploration and aeronautics consistent with the redirection of the human space flight program to focus on exploration.
- Bring Orion, the new crew exploration vehicle, into service as soon as possible after the shuttle's retirement.
- Encourage the pursuit of partnerships with the emerging commercial space sector.
- Establish a lunar return program having the maximum possible utility for missions to Mars and other destinations.

The Vision for Space Exploration does not require large budget increases. In fact, NASA's total budget accounts for less than 0.7 percent of the total federal budget.

Constellation

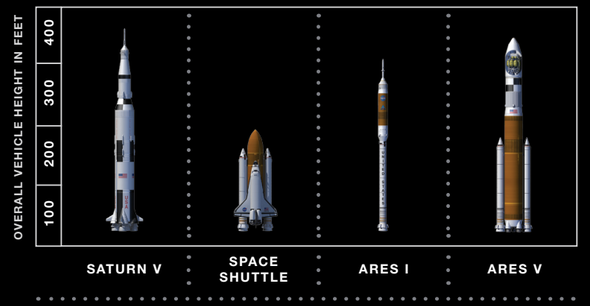
Orion Crew Vehicle and Ares Launch Vehicles



ARES I

Concept image of the Ares I crew launch vehicle during launch.

Before the end of the next decade, NASA astronauts will again explore the surface of the moon. And this time, we're going to stay for an extended period of time, building outposts and paving the way for journeys to Mars and beyond. There are echoes of the iconic images of the past, but it won't be your grandfather's moon shot.



This journey begins soon, with the development of a new spaceship. Building on the best of Apollo and shuttle technology, NASA is creating a 21st–century exploration system that will be affordable, reliable, versatile and safe. The program is called Constellation.

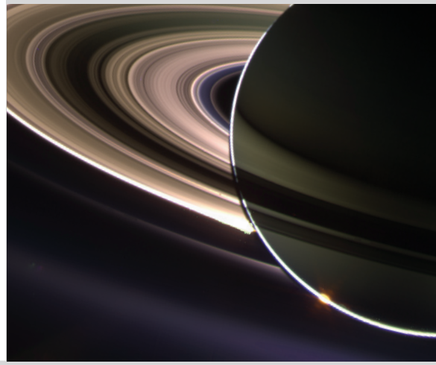
The centerpiece of this system, Orion, is designed to carry four astronauts to the moon, support up to six crewmembers on future missions to Mars, and deliver crew and supplies to the International Space Station. The Ares I rocket will carry Orion and its crew into low-Earth orbit, while the Ares V rocket, the "heavy lifter" of America's next-generation space fleet, will carry the cargo.

Orion is targeted for operations to the International Space Station no later than 2014. Plans call for as many as five trips a year to the station. In the meantime, robotic missions will lay the groundwork for lunar exploration. Plans call for returning humans to the moon by 2020.

Once a lunar outpost is established, crews would be able to live on the lunar surface for up to six months. With a minimum of two lunar missions per year, momentum could build quickly toward an extended presence. Crews could stay longer and learn to utilize the moon's resources while landers make one-way trips to deliver cargo. Eventually, the new system could rotate crews to and from a lunar outpost every six months.

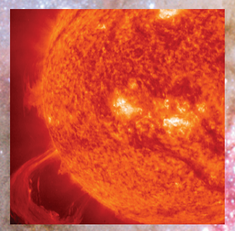
SCIENCE

The Science Mission Directorate (SMD) projects humankind's vantage point into space with Earth-orbit and deep space observatories; spacecraft that visit other planetary bodies; and robotic landers, rovers, and sample return missions. SMD organizes its work to achieve the goals in the NASA Strategic Plan through Earth science, heliophysics, planetary science and astrophysics.



Cassini-Huygens at Saturn

Cassini's view of Saturn eclipsing the sun reveals the wispy outermost "E" ring that is created by geysers on Saturn's moon Enceladus.



Mars Exploration Rover

NASA scientists exploring Mars via the robotic geologists Spirit and Opportunity have discovered evidence of an ancient wet environment that may have been suitable for life.

Earth Science: The Science Mission Directorate works to develop a scientific understanding of the Earth system and how it responds to changes from both natural and human sources. NASA's view from space brings science to bear on national priorities like improved predictions of climate, weather and natural hazards.

Heliophysics: Through studying the sun and its effects on Earth and the solar system, SMD seeks to understand space weather, the heliosphere (space dominated by the sun) and planetary environments as a single system. Doing so will help reduce the vulnerability of human activities to dangerous space weather events like solar flares and protect human and robotic explorers as they travel the solar system.

Planetary Science: SMD advances scientific knowledge of the solar system's origin and history, the potential for life elsewhere, and the hazards and resources present as humans explore space. This includes exploring the wide variety of planets, moons, asteroids and comets in our solar system, as well as the potential habitability of Mars and other bodies.

Astrophysics: SMD seeks to discover the origin, structure, evolution and destiny of the universe and to search for Earth-like planets. Using space-based observatories, SMD exploits the entire spectrum of light in search of answers to fundamental questions: How did the big bang unfold? How were galaxies and stars created? What are dark matter and dark energy? Does life exist elsewhere in the cosmos?

SMD manages a diverse constellation of more than 60 spacecraft and is a world leader working in concert with the science community and NASA's international partners. SMD has missions in all phases of development, as well as grant-based research programs designed to derive new scientific discoveries from their data, imagery and samples. These missions help fulfill NASA's science mission by providing information as practical as next week's weather and as profound as clues to the nature of the universe. Scientific exploration both enables and is enabled by the human exploration of space.

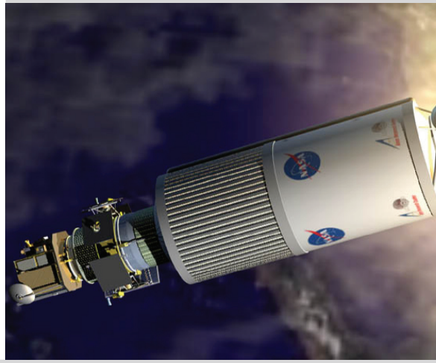
For more information on the Science Mission Directorate, go to *http://science.hq.nasa.gov.*

EXPLORATION

The Exploration Systems Mission Directorate (ESMD) develops the launch systems, vehicles and other capabilities that will carry humans into space and, ultimately, enable exploration of the moon and Mars, beginning with the servicing of the International Space Station following the retirement of the space shuttle in 2010.

LRO/LCROSS

In preparation for NASA's return to the moon, the agency is working toward the 2008 launch of the Lunar Reconnaissance Orbiter and the Lunar Crater Observation and Sensing Satellite.



Orion Crew Exploration Vehicle

Orion, NASA's new spacecraft, will succeed the space shuttle as NASA's primary vehicle for human space exploration.

The Exploration Systems Mission Directorate's priorities include the following:

- Developing the Orion crew exploration vehicle and the Ares I crew launch vehicle to minimize the gap between the space shuttle's retirement and the new U.S. human launch system. The first human operational flight to the ISS should occur no later than 2014. Larger equipment bound for the moon and beyond will ride into space atop the Ares V heavy launch vehicle.
- Enabling the Vision for Space Exploration by actively working to achieve a sustained robotic and human presence on the moon to prepare for human missions to Mars and beyond.
- Supporting the Advanced Capabilities program, which focuses on producing the systems and technologies that will support space travelers. These include advanced spacesuits, human medical and support technologies, and power-generation systems.

ESMD is exploring ways to collaborate in lunar exploration with international and commercial partners. NASA met with representatives of 13 of the world's space agencies, non-governmental organizations and commercial interests to answer these questions: Why return to the moon? What will we do when we get there? From those discussions, NASA identified six overarching themes that demonstrate the value of returning humans to the moon:

- Exploration Preparation: To test technologies, systems, flight operations and exploration techniques to prepare for future missions to Mars and beyond.
- Scientific Knowledge: To pursue scientific activities addressing fundamental questions about Earth, the solar system, the universe and our place in them.
- Human Civilization: To extend human presence to the moon.
- Economic Expansion: To expand Earth's economic sphere to encompass the moon and to pursue lunar activities with direct benefits to life on Earth.
- Global Partnership: To provide a challenging, shared, peaceful activity that unites nations in the pursuit of common objectives.
- Public Engagement: To use a vibrant space exploration program to engage the public, encourage students, and help develop the high-tech workforce of tomorrow.

For more information on the Exploration Systems Mission Directorate, go to *http://exploration.nasa.gov.*

Space OPERATIONS

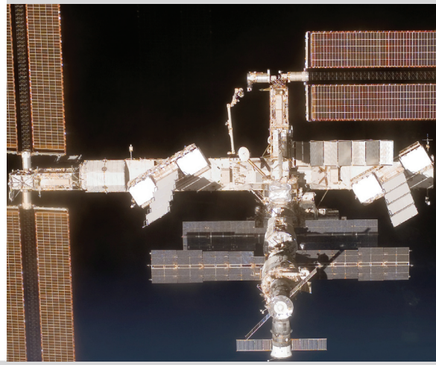
The Space Operations Mission Directorate (SOMD) manages the Space Shuttle and International Space Station (ISS) programs, as well as space communications and launch services. This paves the way for extended-duration human exploration in space.

NASA Space Shuttle

The space shuttle is the most complex machine ever built.

International Space Station

The International Space Station will help human crews to endure longer missions and venture farther from Earth in their exploration of space.



International Space Station (ISS)

Scheduled for completion in 2010, the ISS serves as the largest scientific and technical cooperative program in history, drawing on the resources and scientific expertise of 16 nations. When assembled, the ISS will support exploration goals, with an emphasis on understanding how the space environment affects astronaut health and capabilities. It will serve as a technology testing ground for future long-duration space missions.

Space Shuttle

The world's first reusable spacecraft to carry large payloads to and from orbit, the shuttle launches like a rocket, maneuvers in Earth orbit like a spacecraft, and lands like an airplane. Until NASA retires its three orbiters — Discovery, Atlantis and Endeavour — in 2010, shuttle missions will focus on assembling the ISS. SOMD and ESMD are working to transition from the shuttles to the new Constellation vehicles, starting with the Orion crew exploration vehicle and the Ares I crew launch vehicle.

Launch Services

SOMD oversees agency launch requirements, including launches on commercial expendable launch vehicles (ELVs). Unpiloted ELVs have carried into space some of NASA's most famous missions, ranging from those observing Earth, such as Landsat, to interplanetary missions like the Mars exploration rovers, Spirit and Opportunity.

Space Communications

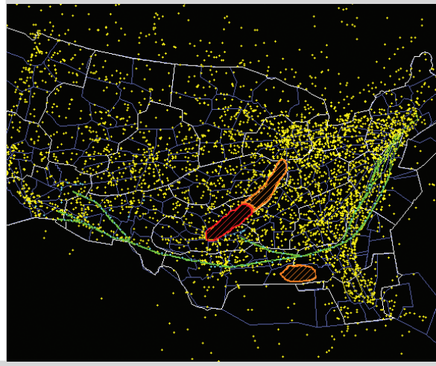
In order to track and acquire data for the agency's space flight missions, NASA operates space communications networks such as the Ground Network, the Space Network, the Deep Space Network, and the NASA Integrated Services Network. Other functions associated with space communications include agency spectrum management, technology development and architecture planning. Space communications support both launch vehicles and satellites reaching the limits of the solar system. In addition, SOMD is planning for future communications and navigation systems to help fulfill the Vision for Space Exploration.

For more information on the Space Operations Mission Directorate, go to *http://www.hq.nasa.gov/osf.*

The Aeronautics Research Mission Directorate (ARMD) generates the revolutionary concepts, technologies and capabilities needed to advance aircraft and airspace systems. ARMD's programs facilitate safer, more efficient and more environmentally friendly air transportation systems. In addition, ARMD's research will continue to play a vital role in supporting NASA's human and robotic space activities.

FACET

The display of simulated aircraft flows over the U.S. using the Future ATM (Air Traffic Management) Concepts Evaluation Tool (FACET) allows air traffic managers to utilize constrained airspace more effectively.



AERONAUTICS Research

X-48B or Blended Wing Body

Potential benefits of this aircraft configuration include an increase in aircraft performance, noise reduction and improvements in structural efficiency.

The Fundamental Aeronautics Program conducts cutting-edge research to enable the design of vehicles that fly through any atmosphere at any speed. Long-term program goals include significantly advancing the state of the art in fundamental technologies critical to reducing noise, emissions and fuel consumption, as well as enhancing the performance of future vehicles. The program also supports the broader goals of the agency by conducting fundamental research to enable the safe and accurate entry, descent and landing phases of vehicles re-entering the atmosphere from space.

The Aviation Safety Program focuses on developing cutting-edge tools, methods and technologies to improve the intrinsic safety attributes of current and future aircraft that will operate in the Next Generation Air Transportation System (NGATS). The research conducted in this program will also have applicability to space exploration activities, such as enabling the self-reliant and intelligent systems necessary for long-duration travel by future space vehicles.

The Airspace System Program develops innovative research and development solutions envisioned to enable the NGATS. In partnership with the Joint Planning and Development Office, the program will develop concepts, capabilities and technologies required to meet the nation's anticipated growth in airspace operations, both in the air and on the ground, for decades to come.

The Aeronautics Test Program ensures that NASA's aeronautical test facilities are available to meet its own research requirements and those of national partners. Strategic utilization, operations, maintenance and investment decisions are made for facilities at Ames Research Center in Moffett Field, Calif.; Glenn Research Center in Cleveland, Ohio; and Langley Research Center in Hampton, Va., as well as for the Western Aeronautical Test Range, support aircraft and test bed aircraft at Dryden Flight Research Center in Edwards, Calif.

For more information on the Aeronautics Research Mission, go to *http://www.aerospace.nasa.gov.*

EDUCATION

NASA education activities are designed to reach the nation's students with a balanced and diverse portfolio that includes the Elementary and Secondary Education, Higher Education, e-Education, Informal Education, and Minority University Research and Education Programs.

Hands-On Experiences

NASA encourages college students to interact with their local centers to gain insight into various NASA programs. This college student is learning about the dexterity of the astronaut glove.

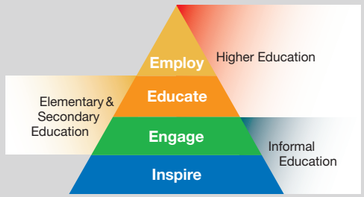
Our Partners

NASA's Office of Education helps provide opportunities for children to explore and develop their full learning potential. NASA will continue to support the nation's elementary and secondary schools, universities, colleges and community colleges by providing exciting research and internship opportunities that will light the fire and fuel the passion for a new culture of learning and achievement in science, technology, engineering and mathematics (STEM) education. Additionally, to strengthen STEM education, NASA will sustain professional development and research opportunities for pre-service and in-service teachers and university professors.

Federal Agencies	Business and Industry	Federal, State and Local Entities	International Partners
National/State/Local Associations and Organizations Serving the Underserved and Underrepresented			
Network of Informal Education Organizations			
Schools, Colleges and Universities			
Educators	Students	Parents	Communities

NASA's planned investments in education:

- Contribute to the development of the science, technology, engineering and mathematics (STEM) workforce in disciplines needed to achieve NASA's strategic goals, through a portfolio of programs.
- Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers and faculty.
- Build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA's mission.



NASA's Office Education continues its efforts to motivate students to pursue careers in STEM. The efforts are accomplished through collaborative efforts within NASA's Office of Education, mission directorates and centers; with other federal agencies engaged in education activities; and with NASA's various public and private partners.

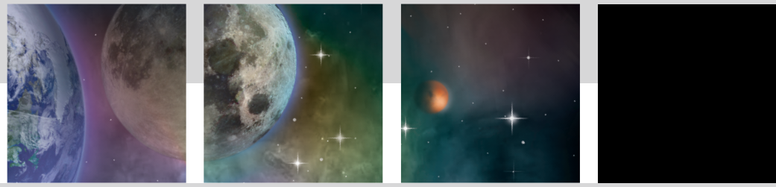
As America builds upon the accomplishments of the first century of flight, NASA is paving the way for the next generation of explorers with great anticipation. These explorers of the new millennium will reflect the nation's vibrant and rich diversity. The Office of Education will fully engage the underrepresented and underserved communities of students, educators and researchers.

Student Collaboration

The Venetia Burney Student Dust Counter from the University of Colorado is the first science instrument on a planetary mission that was designed and managed by students. It was launched in January 2006 on the New Horizons mission to Pluto and is detecting dust grains on the long journey. It is an example of how NASA has worked and will continue to work with the formal and informal education communities to inspire, engage, educate and employ the next generation of the STEM workforce in NASA missions.

For more information on the Office of Education, go to *http://education.nasa.gov.*

NASA'S TOP STORIES OF 2006



NASA moved forward in 2006 to extend humanity's exploration of the solar system and learn more about the universe and our home planet. While the space shuttle resumed building the International Space Station, the agency began developing the next generation of spacecraft and outlined plans for returning to the moon as a steppingstone to Mars. Space science missions found new evidence of water on Mars, sent the first-ever probe toward Pluto, brought back dust from a comet and launched new instruments to study the sun and the weather on Earth.

NEXT STOP: THE MOON

The long-term plan for sending humans to Mars and beyond moved ahead in August with the selection of Lockheed Martin Corporation as the prime contractor to build the Orion crew exploration vehicle, to be operational as early as 2014. The Ares I successfully completed its systems requirement review during the fall of 2006. In December, NASA unveiled elements of a Global Exploration Strategy and lunar architecture to explain the rationale for returning to the moon for further exploration and to help prepare for later journeys to Mars and other destinations.

SHUTTLE AND STATION BACK TO BUSINESS

During the space shuttle's 25th-anniversary year, three missions resumed construction work on the International Space Station. Astronauts aboard Space Shuttle Discovery's STS-121 mission in July proved new engineering designs and safety techniques and demonstrated that if needed, the shuttle's robotic arm could serve as a platform for emergency repairs. Discovery also delivered a new crewmember, increasing the station's crew size to three for the first time since May 2003. NASA followed up that flight with the launches of STS-115 in September and STS-116 in December. The shuttles delivered and attached a critical piece of the station's girder-like backbone and reconfigured the station's power and thermal control systems. Astronauts also installed a new station component, giving crewmembers more room to live and work in orbit. The stage is now set for an active 2007 that will see the station's size and research capabilities dramatically grow.

HUBBLE SERVICING MISSION A "GO"

In late October, NASA announced plans for a fifth space shuttle servicing mission to the Hubble Space Telescope to extend and improve the observatory's capabilities through 2013. During 2006, the Hubble continued to make unprecedented observations that included an image of the dimmest stars ever seen in any globular cluster and the discovery of 16 extrasolar planet candidates.

A WET RED PLANET?

New NASA images from the Mars Global Surveyor revealed bright new deposits seen in two gullies on Mars. The images suggest that water carried sediment through the gullies sometime during the past seven years. These observations give the strongest evidence to date that water still flows occasionally on the surface of the red planet. The new findings heighten intrigue about the potential for microbial life on Mars.

DEEP SPACE DISCOVERIES

The launch of the New Horizons spacecraft to Pluto in January began an extraordinary year of deep space activities. Scheduled to arrive at Pluto in 2015, the spacecraft will encounter Jupiter in 2007. NASA's Stardust mission completed a 2.88-billion-mile round-trip odyssey to capture and return comet and interstellar dust particles to Earth. Scientists believe that these rare samples may provide answers to fundamental questions about the origins of the solar system. The Cassini spacecraft may have found evidence of liquid water reservoirs that erupt in Yellowstone-like geysers on Saturn's moon Enceladus. Cassini also discovered two new rings around Saturn, confirmed the presence of two others and photographed something never before seen on another planet — a hurricanelike storm at Saturn's south pole.

WEATHER AND CLIMATE STUDIES

NASA's Earth research provided new discoveries during 2006 about our home planet and its climate. The agency launched the first satellite to provide three-dimensional images of clouds, along with a weather satellite to provide timely environmental information to meteorologists and the public. NASA also completed its "A-train" of six satellites flying in close proximity around Earth to gain a better understanding of key factors related to climate change. Research activities included a comprehensive hurricane study on how winds and dust from Africa influence the life of tropical cyclones in the Atlantic Ocean. Researchers also examined the effects of pollution moving around the world, improved wildfire and hurricane tracking, and studied the changing landscape of global ice and snow.

A NEW DIRECTION FOR AERONAUTICS

NASA's Aeronautics Research Mission Directorate restructured its research portfolio in 2006 to return to long-term, cutting-edge, fundamental research. This change will ensure that the Directorate will conduct the high-quality, innovative research required to facilitate the next-generation air transportation system and will support the nation's Vision for Space Exploration.

HERE COMES THE SUN

NASA research on Earth's nearest star provided many firsts in 2006. Researchers developed a computer simulation to create a model of the sun's outer atmosphere. Scientists predicted the next solar activity cycle to be 30 to 50 percent stronger than the previous one. In March, NASA and Libyan scientists conducted joint activities to observe and study a total solar eclipse. This complemented the launch of NASA's twin Solar Terrestrial Relations Observatories (STEREO) mission spacecraft, which will help researchers construct the first-ever three-dimensional views of the sun. These research activities may provide information to help mitigate the effects of solar storms, which can disrupt satellite orbits and electronics, interfere with radio communication and threaten astronaut safety.

NASA'S NOBEL LAUREATE

On Dec. 10, John C. Mather, senior astrophysicist and senior project scientist at NASA's Goddard Space Flight Center in Greenbelt, Md., received the 2006 Nobel Prize in physics in Stockholm. Mather is the first NASA civil servant employee to win the Nobel Prize. Mather and George Smoot of the University of California at Berkeley were recognized for "their discovery of the black body form and anisotropy of the cosmic microwave background radiation" based on research using NASA's Cosmic Background Explorer (COBE) satellite.

NASA Field Centers and Facilities

Ames Research Center, California
Ames provides products, technologies and services that enable NASA missions and expand human knowledge. Ames's prime location in California's Silicon Valley affords outstanding opportunities for innovative partnerships with the nation's technological, academic and entrepreneurial leaders that will make the Vision a reality.

Dryden Flight Research Center, California
Dryden performs flight research and technology integration to revolutionize aviation and pioneer aerospace technology. The center validates space exploration concepts, conducts airborne remote sensing and science observations, and supports operations of the space shuttle and the International Space Station.

Glenn Research Center, Ohio
Glenn develops critical space flight systems and technologies to advance the exploration of space while maintaining leadership in aviation propulsion research. Glenn leads the development of the service module and spacecraft adapter for the nation's crew exploration vehicle.

Goddard Institute for Space Studies, New York
The Goddard Institute for Space Studies, which studies global climate change, is a laboratory of the Earth Sciences Division at Goddard Space Flight Center and a unit of the Columbia University Earth Institute.

Goddard Space Flight Center, Maryland
Goddard is home to the nation's largest organization of scientists and engineers dedicated to learning and sharing their knowledge of Earth, the sun, the solar system and the universe. It was established in 1959 as NASA's first space flight center.

Jet Propulsion Laboratory, California
JPL, which is managed by the California Institute of Technology, is NASA's lead for robotic exploration of the solar system.

Johnson Space Center, Texas
Johnson is the home of NASA Mission Control and the Astronaut Corps; it is NASA's premier center for human space flight and related scientific and medical research efforts. The center also manages the development, testing, training, production and delivery of all U.S. human spacecraft, as well as the program offices for the space shuttle, the International Space Station and Constellation.

Kennedy Space Center, Florida
Kennedy is America's Gateway to the Universe — leading the world in preparing and launching missions around Earth and beyond.

Langley Research Center, Virginia
Langley is NASA's original research and technology center, recognized worldwide for its contributions to space exploration, aeronautics and science. The center is a key contributor to NASA's mission via its systems analysis capabilities.

Marshall Space Flight Center, Alabama
Marshall develops key space transportation and propulsion technologies, including the Ares I crew exploration and Ares V cargo launch vehicles; manages space shuttle propulsion elements and science aboard the International Space Station; and pursues scientific research in space that will improve life on Earth.

Michoud Assembly Facility, Louisiana
Michoud is one of the largest manufacturing plants in the world and is responsible for the assembly of the space shuttle external fuel tanks.

NASA Headquarters, Washington, D.C.

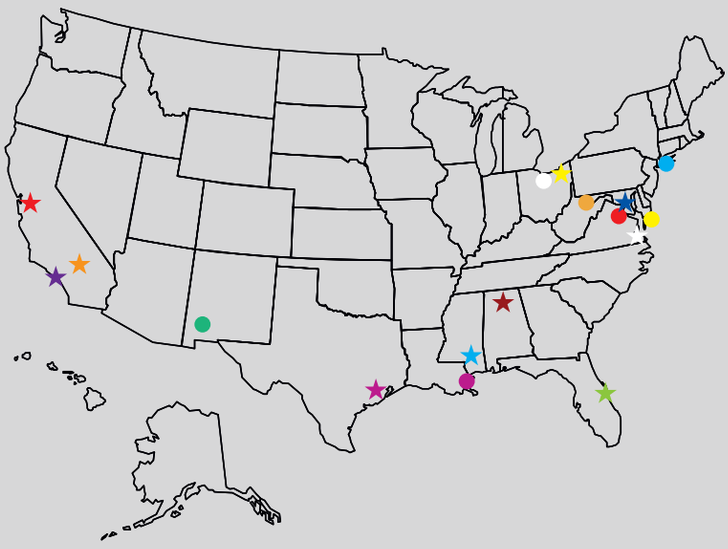
Plum Brook Station, Ohio

Software Independent Verification and Validation (IV&V) Facility, West Virginia
IV&V provides safety and cost-effectiveness for mission-critical software.

Stennis Space Center, Mississippi
Stennis is home to America's largest rocket engine test complex, where every space shuttle main engine is tested and where future engines and stages will be tested for returning astronauts to the moon, with eventual journeys to Mars and beyond. Stennis also helps partner agencies make more informed decisions through science research results, remote sensing and other capabilities.

Wallops Flight Facility, Virginia
Wallops is NASA's principal facility for the management and implementation of suborbital research programs and is managed by Goddard Space Flight Center.

White Sands Test Facility, New Mexico
White Sands is a pre-eminent resource for testing and evaluating potentially hazardous materials, space flight components and rocket propulsion systems.



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NP-2007-02-457-HQ