



Taking  
education  
to new heights.

2007 NASA Education Highlights





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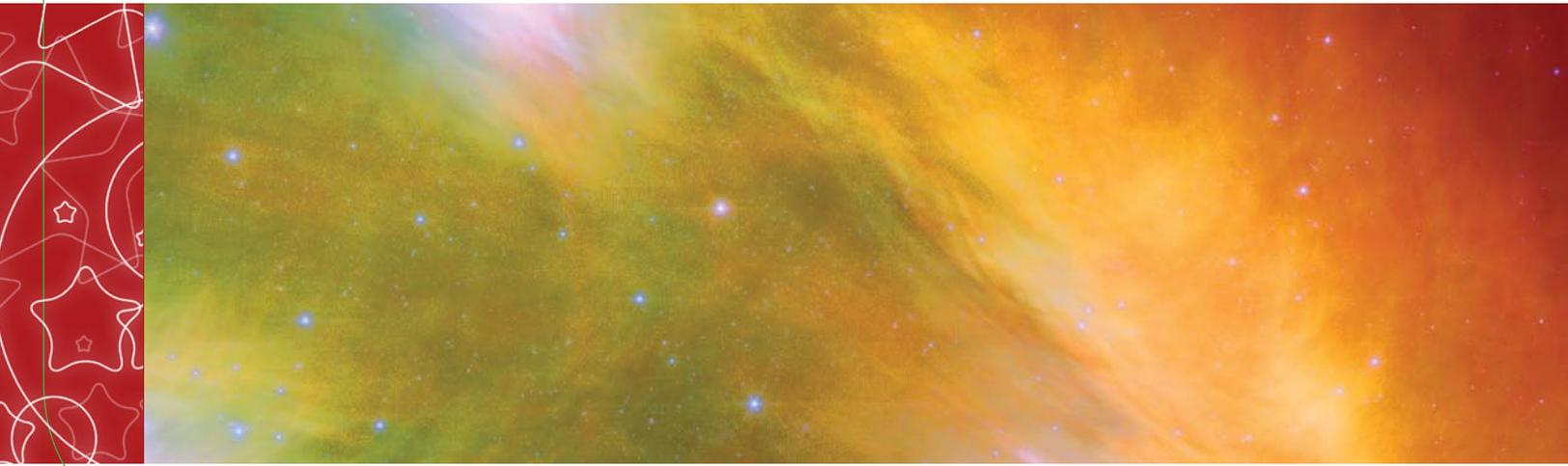


NASA has a tradition of investing in programs and activities that inspire and engage students, educators, families, and communities at large in the excitement and discovery of exploration.

Read about the innovative ways NASA is creating new activities that spark the interest and imagination of people from all segments of society.

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NASA Education:  
revolutionizing learning,  
one mind at a time.



November 2007

## A Message from the Assistant Administrator for Education



Next year, NASA will celebrate 50 years of exploration and discovery that have led to a better understanding of the universe, a multitude of technological breakthroughs, enhancements in air travel safety and security, and a broadened frontier of scientific research.

Accordingly, with great anticipation, NASA's Office of Education is creating a pathway to help future generations prepare to continue the journey.

To inspire, engage, educate, and employ these "explorers and innovators of the next millennium," NASA has designed its educational investments to strengthen NASA's and the Nation's future workforce; attract and retain students in science, technology, engineering, and mathematics (STEM) disciplines through a progression of educational opportunities for students, teachers, and faculty; and engage Americans in NASA's mission.

Experience has shown that exciting and compelling NASA missions can truly inspire the next generation. The launch of Space Shuttle Endeavour in August 2007 embodied the Agency's efforts to sustain future exploration and share the excitement of innovation and discovery.

Mission specialist Barbara Morgan engaged students and educators worldwide from her position aboard the International Space Station (ISS), 240 miles above Earth. She was a member of the seven-person crew of STS-118, an assembly mission to the ISS and the first space flight of an Educator Astronaut. The historic STS-118 mission set the stage for NASA to deliver a national, yearlong campaign that leveraged the excitement of the flight, showcased our education resources, and celebrated the education community. Although NASA has a vital partnership with educators, it also is spreading the word to many other key audiences. Through NASA's Office of Strategic Communications, the Agency is establishing active communications with NASA's various stakeholders and engaging them NASA's mission as well as education activities and goals.

The breadth of our educational investments and the implementation of programs at a national level serve as evidence of NASA's ability to ignite the desire to learn in a unique and powerful way. Illustrations from this year include the following:

- NASA's four Mission Directorates provided opportunities for students to engage in NASA mission-related experiences.
- NASA and the National Science Foundation (NSF) signed a historic agreement to work together and coordinate efforts to expand opportunities for promoting STEM education and to broaden the participation of the underrepresented.
- The National Space Grant College and Fellowship Program continued to provide fellowships and scholarships to students across the country.
- NASA and the Federal Aviation Administration (FAA) signed a Memorandum of Understanding (MOU) to foster the development of students' skills in STEM.
- The Ash Institute for Democratic Governance and Innovation at Harvard University's John F. Kennedy School of Government announced that NASA's Science, Engineering, Mathematics, and Aerospace Academy was among the top 18 programs in the 2007 Innovations in the American Government Awards competition.
- Strategic alliances with nongovernmental organizations such as the National Institute of Aerospace, the National Science Teachers Association, AOL's Kids On-Line, the Girl Scouts of the USA, Imaginary Lines, and Reader's Digest provided an immediate springboard as unfunded collaborators to produce, market, and distribute educational information about NASA's projects and programs.

This year was an extraordinary one for education across the Agency; its momentum will propel us into a promising 2008 and beyond. We invite you to join us for the journey.

Cordially,  
Dr. Joyce L. Winterton  
NASA Assistant Administrator for Education

# NASA Education Programs Overview

The comprehensive strategic education plan that NASA has recently developed defines a portfolio of investments that NASA will use to contribute to the development of the science, technology, engineering, and mathematics (STEM) workforce in those disciplines that are needed to achieve the Agency's strategic goals. This portfolio includes the following five program areas:

**Higher Education** focuses on supporting institutions at this education level by strengthening their research capabilities as well as providing opportunities that attract and prepare increasing numbers of students for NASA-related careers. The research conducted by these institutions will contribute to the research needs of NASA's Mission Directorates. The student projects serve as a major link in the pipeline for addressing NASA's Human Capital Strategies and the President's Management Agenda. The projects help to "build, sustain, and effectively deploy the skilled, knowledgeable, diverse, and high-performing workforce needed to meet the current and emerging needs of government and its citizens."



**Minority University Research and Education** engages underrepresented populations through a wide variety of initiatives. Multiyear grants are awarded to assist minority institutions, faculty, and students in research pertinent to NASA missions. The program focuses on recruiting and retaining underrepresented and underserved students in STEM disciplines through completion of undergraduate or graduate degrees in support of their entry into the scientific and technical workforce.



**Elementary and Secondary Education** provides K–12 educators with tools, experiences, and opportunities to further their education. Students participate in unique NASA learning experiences that enhance their knowledge of STEM and inspire pursuit of STEM careers. The program supports the role of educational institutions, providing the framework to bring together students, families, and educators for educational improvement.



**Informal Education** intends to increase learning by educating students, educators, and the general public on specific STEM content areas, resulting in the expansion of the Nation’s future STEM workforce. Projects within the program produce supplemental education materials and handouts that are standards-based; that support staff and facilitators trained or qualified in the STEM education fields by actively working with participants to further enhance their understanding; and that develop content based on educational standards and/or learning objectives in order to supplement and enrich an experience, visual, or activity.



**Education Technology and Products** sustains the research and development of technology applications, products, and services. In addition, this program area supports the implementation of technology-enriched infrastructure, thereby facilitating the appropriate and effective technology-based applications that enhance the educational process for formal and informal education. Education Technology and Products identifies projects that will meet the President’s Management Agenda of providing citizen-centric services related to NASA Education efforts.



*For more information on NASA Education strategy and outcomes, please see Appendix B.*



## NASA Ignites the Flame of Knowledge with STS-118

NASA's education quest was taken to new heights in 2007 as mission specialist and Educator Astronaut Barbara Morgan made her first flight into space. The following stories showcase exciting NASA STS-118 activities designed to engage educators and inspire the Nation's future workforce before, during, and after the first space flight of an Educator Astronaut.

### NASA Education Launches the Countdown

Officially, the countdown clock for the STS-118 Space Shuttle mission began in August 2007, about 3 days before launch. However, the STS-118 countdown clock for teachers nationwide began on November 14, 2006, with an event that marked the formal beginning of NASA's education support for the mission.

The Agency worked with the U.S. Department of Education to launch its STS-118 efforts during International Education Week. The event was Webcast and broadcast on NASA TV, allowing teachers and students around the world to watch. For students from three DC-area high schools, the highlight of the event was a downlink talk with the Expedition 14 crew aboard the International Space Station. The event truly lived up to the occasion's name as the students asked NASA astronaut Michael Lopez-Alegria, Russian cosmonaut Mikhail Tyurin, and European Space Agency astronaut Thomas Reiter questions in five languages.

In addition, Ray Simon, the U.S. Deputy Secretary of Education, spoke about International Education Week. Barbara Morgan and NASA Assistant Administrator for Education Joyce Winterton

talked about the importance of education, provided an STS-118 preview, and discussed the Agency's Engineering Design Challenge.

### Meet an Astronaut Day

Mission specialist and Educator Astronaut Barbara Morgan and mission specialist Dave Williams met with more than 100 Texas elementary and middle school students during Space Center Houston's "Meet an Astronaut Day" on January 19.

During this prelaunch event, Morgan and Williams talked about the upcoming STS-118. STS-118 would continue the assembly of the International Space Station by delivering a third starboard truss segment. On her first flight, Morgan would operate the Shuttle's and Space Station's robotic arms. Williams, of the Canadian Space Agency, would make his second trip into space and conduct several spacewalks. As the first Educator Astronaut to fly in space, Morgan emphasized the importance of teaching as a profession and the important role teachers play in their students' lives.

The mission's lead Shuttle flight director, Matt Abbott, and lead ISS flight director, Joel Montalbano, first greeted the students, introducing them to a flight director's responsibility in leading the mission and emphasizing the value of teamwork at NASA and in the classroom.

### NASA Teams Up with Sally Ride Science

In 2001, Dr. Sally Ride, best known as America's first woman in space, founded an innovative science content company dedicated to supporting girls' and boys' interests in science, math, and technology. Sally Ride Science, which creates quality programs and products that educate, entertain, engage, and inspire, partnered with NASA to conduct a series of Northrop



Grumman-sponsored workshops for teachers. Educators from coast to coast had the opportunity to get a behind-the-scenes look at STS-118 (the first space flight of an Educator Astronaut) and learn how they could engage their students in STEM using the excitement of space flight. Participants learned about the STS-118 mission objectives and experienced education activities that they could take back to their classrooms.

During one session, the educators were asked, “How would you grow seeds on the Moon?” To find the answer, teachers participated in a demonstration of the hands-on Engineering Design Challenge, in which teachers and students build and test plant growth chambers. Participants also learned how they could get space-exposed seeds flown on STS-118 to help their students assess their designs. One teacher who was excited about the workshop proclaimed that it was “fantastic” and that she wished all of her colleagues could experience it.

### Students Train Like Astronauts with NASA’s Fit Explorer

Developed in cooperation with NASA scientists and fitness professionals working directly with astronauts, the Fit Explorer Project is a physical and inquiry-based approach to human health and fitness on Earth and in space. It was launched in summer 2007 on the NASA STS-118 Web site, and it aims to inspire the Nation’s future explorers by joining NASA and the President’s Council on Physical Fitness and Sports in a variety of exciting physical and hands-on activities.

Students in grades 3 through 5 can participate in physical activities modeled after the real-life physical requirements of humans traveling in space. Future space explorers can experience a simulated walk to their “base station,” learn how astronauts coordinate muscle movement for a spacewalk, and practice postmission activities to improve balance. Students will record their personal progress in their mission journals and earn points in the Fit Explorer Challenge while working with their crewmembers to progress through the levels.

### STS-118 Prelaunch Education Conference: “Innovative Strategies for Cultivating the STEM Workforce”

NASA hosted a 2-day education conference in Orlando, FL, on August 5–6. Over 400 members of the education community from all over the country were in attendance and participated in engaging sessions and briefings. The event was hosted by the NASA Assistant Administrator for Education, Dr. Joyce L. Winterton, and featured NASA Associate Administrator for Space Operations William Gerstenmaier, NASA Kennedy Space Center Deputy Director Janet Petro, and NASA Chief of Strategic Communications Robert Hopkins.

Attendees included kindergarten through 12th-grade educators, university faculty and students, informal education leaders (from science centers, the Girl Scouts, and others), and industry representatives from companies such as Microsoft and Google. The conference focused on discussing innovative programs at all education levels to attract and retain more students in STEM disciplines to help build the technical workforce of the future.

Participants were also treated to an in-depth tour of Kennedy Space Center, a reception at the Apollo Saturn-V Center, and VIP viewing of the launch of STS-118 from the Banana Creek Viewing Site, with a direct view of pad 39A.

### NASA Hosts Teacher in Space Ambassadors and Network of Educator Astronaut Teachers for Historic Launch

For decades, teachers from around the country had waited for this one special space flight. Many of the 114 state finalists from the ’80s-era Teacher in Space Project, from which Christa McAuliffe and Barbara Morgan were selected, gathered in Cocoa Beach, FL, for the launch of STS-118. Also journeying to the Cape were members of the Network of Educator Astronaut Teachers, top-tier applicants of the Educator Astronaut Project that led to the 2004 selection of three mission specialists/Educator Astronauts (Dottie Metcalf-Lindenberger, Ricky Arnold, and Joe Acaba). Individuals from these two dynamic groups were reunited and viewed the picture-perfect launch of STS-118 as truly distinguished guests of the Office of Education.



## Student-Designed Pennant Launches into Space

NASA and AOL's online kids' service, KOL, recently teamed up to sponsor the NASA Space Pennant Design Challenge. Thousands of entries showcasing students' ideas about space were received. In addition to developing a creative design, students were required to research the STS-118 Shuttle mission and future NASA exploration to gather information that would form the basis for both their design and the 100-word essay that they wrote to accompany it.

The winning pennant was submitted by Tapasya Das of Mount Laurel, NJ. The winning pennant (above), entitled "Education 4 Exploration," flew on Space Shuttle Endeavour's STS-118 mission in August 2007. The grand prize also included the opportunity for the Tapasya and her family to view the launch.

Tapasya's description of the winning entry reads: "The pennant shows Earth pictured in a book, and STS-118 is going out to space. The space missions signified by the space craft carry space exploration out of theory into practice. The first teacher who is fully trained as an astronaut is going to space in the STS-118. The teacher is taking the visions of an educator, to look at space research with a new perspective. Also, education from now will approach space missions with a more practical approach, and not just theory in textbooks. Hence, futuristically, it will forever be education for exploration."

## Long-Distance Calls from Space

What better way to engage and inspire students than to give them a chance to talk to astronauts in space? This summer, a few inquisitive students were given the chance to chat with STS-118 and Expedition 15 crewmembers about living and working

in space. After a nationwide call for proposals, three education organizations were selected to join live in-flight education downlinks with the STS-118 crew.

The first downlink occurred with the Discovery Center of Idaho, which provides informal educational programs that serve 30,000 students throughout mission specialist and Educator Astronaut Barbara Morgan's home state. The second host organization, the Challenger Center for Space Science Education (CCSSE), is a nonprofit organization founded by the families of astronauts lost during the Space Shuttle Challenger accident in 1986.

"We are absolutely thrilled to be talking with you," Morgan said during the second downlink to the assembled students in Virginia, as well as countless others participating via NASA TV and the Internet. "Good morning from ISS."

Students from across the country asked a variety of questions that ranged from "How do you brush your teeth in space?" to "Can you see constellations in space?" to "How will the experiments on the ISS help continue and further the mission to Mars?" In addition to answering the students' questions, crewmembers also performed demonstrations in the microgravity environment.

Robert L. Ford K-8 NASA Explorer School in Lynn, MA, was selected to host the third and final downlink, which was canceled due to an early Shuttle return date. Utilizing NASA's Digital Learning Network, the students were able to ask their questions of NASA astronauts Bill McArthur and Joe Acaba via a videoconference from NASA Johnson Space Center. The event was attended by NASA Assistant Administrator for Education Dr. Joyce Winterton; Grace Corrigan, Christa McAuliffe's mother; local government and community leaders; and various media.



## STS-118 Provides Space Harvest for Classrooms

NASA flew two education payloads aboard Space Shuttle Endeavour on mission STS-118 as part of NASA and ITEA's Engineering Design Challenge for students. As part of the challenge, students in grades K–12 will plan, design, and build their version of a lunar plant growth chamber. They will then validate their chambers using space-exposed seeds and Earth-based control seeds.

The first payload consisted of two small, collapsible plant growth chambers and the associated hardware to conduct a 20-day plant germination investigation. During the investigation, crewmembers maintained the plants and captured images of plant growth.

Approximately 10 million basil seeds made up the second payload. The seeds flew into space in SPACEHAB, a pressurized, mixed-cargo carrier that supports various quantities, sizes, and locations of experiment hardware; remained throughout the mission; and returned to Earth, having stayed on the Shuttle during the entire mission. After the mission, the seeds will be distributed to students and educators as part of the Engineering Design Challenge.

Working under the supervision of their teachers, students design, build, test, redesign, and rebuild models that meet specified design criteria. As they improve their designs, students employ the same analytical skills as engineers. The design challenge culminates in the classroom, with each student team preparing a poster that describes the process and results of their work.

## Other NASA Education Highlights

### NASA Education's Royal Experience

As part of a visit to commemorate the 400th anniversary of the Jamestown settlement in Virginia, Queen Elizabeth II and the Duke of Edinburgh toured NASA Goddard Space Flight Center's Visitor Center in Greenbelt, MD, on Tuesday, May 8. The Queen and Prince Philip received a warm welcome at the Earth Science Gallery from NASA Assistant Administrator for Education Dr. Joyce Winterton, along with NASA Administrator Dr. Michael Griffin and Goddard Space Flight Center Director Dr. Edward Weiler. Students were

also present, participating in an education workshop designed to spark curiosity similar to that which led to the discovery of the New World. The activities focused on the role of light in exploration and featured representatives from the Hubble Institute.

Dr. Winterton introduced the Queen at each of three learning stations to engage in dialog with local students about their interests, studies, and future plans. Her Majesty had the opportunity to interact directly with students ranging from middle school to undergraduate level. The students expressed enthusiasm about the opportunity to meet the Queen, celebrate Jamestown, and learn about becoming future explorers. The tour of Goddard occurred near the end of the Queen's historic visit to the United States.

### One Giant Leap for STEM Education

NASA and the National Science Foundation (NSF) signed a historic agreement to work together and coordinate efforts to expand opportunities for promoting science, technology, engineering, and mathematics (STEM) education and to broaden the participation of underrepresented students in those areas. The signing occurred on February 22, 2007, at the Joint NASA/NSF Higher Education Research and Education Opportunities Conference for Principal Investigators, Faculty, and Partners.

The Memorandum of Understanding (MOU) lays out the rationale and terms under which the two agencies seek to create a partnership that "advances the scientific and technical capabilities of the nation." Joyce Winterton, NASA's Assistant Administrator for Education, and Cora Marrett, NSF's Assistant Director of Education, signed the agreement of behalf of their agencies.

"This really is a tremendous step forward, and it is something that has been needed for a very long time," Winterton said. "This conference and this agreement are just the start of what we think will be a new way of operating."

A critical area of focus in the agreement will be sharing knowledge and expertise on pending legislation and legislative initiatives to assess their impact on programs and to respond jointly. The agencies also that sharing program announcements and reports will assist them in identifying common issues and strategies to maximize resource allocation and assure that common goals are met.

# Higher Education Overview



## Meeting Future Workforce Needs

The Office of Education is strengthening involvement with institutions of higher education to ensure that NASA can meet future workforce needs in the STEM fields. Participation in NASA programs and research stimulates students to continue their studies at all levels of the higher education continuum and earn advanced degrees in these critical fields.

Through a portfolio of project types, the NASA Higher Education activities seek to increase the overall capacity at all levels of universities and colleges to better address STEM disciplines related to NASA.

## Higher Education Strategy

Specifically, projects are in place to:

- Build connections, through partnerships and consortium awards, that provide institutions of higher education and other educational entities better bridges for students;
- Provide fellowship and scholarship opportunities to attract “the best and the brightest” students to NASA disciplines;
- Catalyze institutional development to improve the ability of colleges and universities to compete for NASA research awards;
- Increase the candidate pool of qualified faculty who can compete for NASA research awards; and
- Facilitate improved coordination between NASA-sponsored university research activities and teacher preparation projects to expose teachers-in-training to NASA research and discoveries, thus furthering their understanding of STEM disciplines.



### Examples of Higher Education Projects

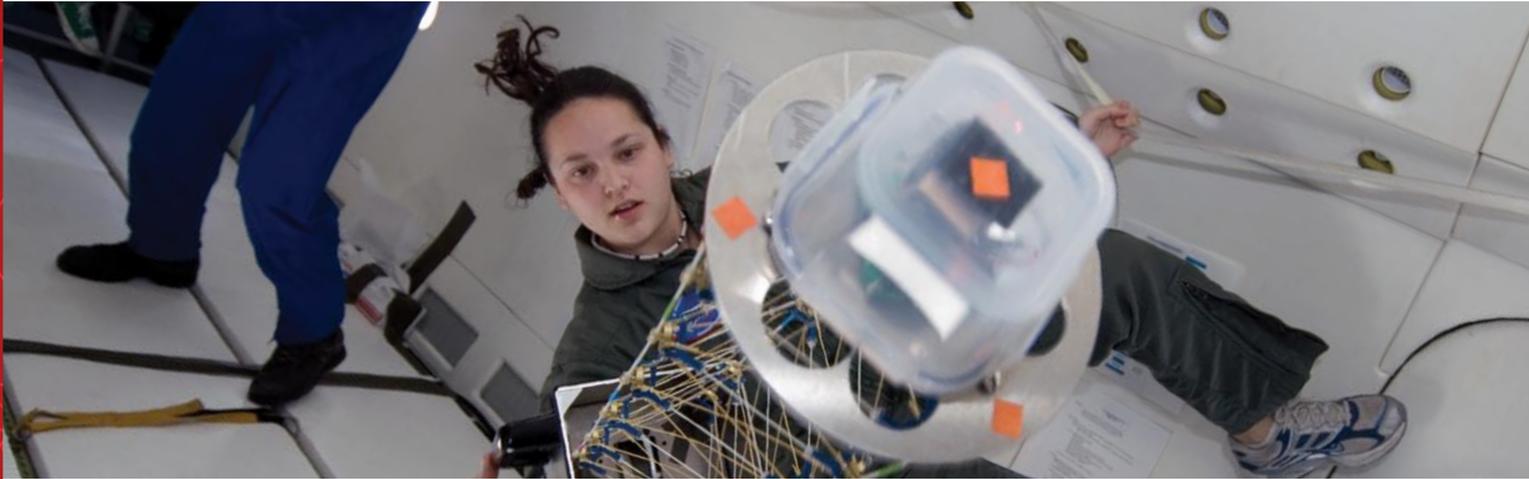
NASA's Higher Education Program supports institutions of higher education as they strengthen their research capabilities, thereby providing opportunities that attract and prepare increasing numbers of students for NASA-related careers. The research conducted by these institutions will contribute to the research needs of NASA's Mission Directorates. The student projects serve as a major link in the pipeline for addressing NASA's Human Capital Strategies and the President's Management Agenda by helping to "build, sustain, and effectively deploy the skilled, knowledgeable, diverse, and high-performing workforce needed to meet the current and emerging needs of government and its citizens."

**The Experimental Program To Stimulate Competitive Research** develops academic research enterprises that are long-term, self-sustaining, and nationally competitive by supporting states with modest research infrastructure to become more competitive in attracting research funding. Funding is awarded to lead academic institutions, fostering a STEM relationship with industries for research and development opportunities.

**The Graduate Student Researchers Project** cultivates research ties to the academic community to help meet the continuing needs of the Nation's aeronautics and space effort. This project seeks to increase the number of highly trained scientists and engineers in aeronautics and space-related disciplines and to broaden the base of students pursuing advanced degrees in science, mathematics, and engineering. Fellowships are awarded for graduate study leading to master's or doctoral degrees in the fields of science, mathematics, and engineering related to NASA research and development.

**The National Space Grant College and Fellowship Program** is a national network of colleges and universities that works to expand opportunities for Americans to understand and participate in NASA's aeronautics and space programs by supporting and enhancing science and engineering education, research, and public outreach programs.

**The Undergraduate Student Research Project (USRP)** offers summer and academic-year internships at NASA Field Centers to students seeking careers in NASA-related fields.



## NASA Announces Education Research Program Award Recipients

NASA has awarded more than \$17 million to institutions nationwide to help make significant contributions to the research and technology priorities of the Agency.

The selections are part of NASA's Experimental Program to Stimulate Competitive Research (EPSCoR). The EPSCoR program is designed to assist states in establishing an academic research enterprise directed toward a long-term, self-sustaining, competitive capability that will contribute to the states' economic viability and development. EPSCoR enables continuing education, training, and workshops important to NASA's mission. The program assists in developing partnerships between NASA research assets, academic institutions, and industry.

In all, 23 proposals were selected for funding in Puerto Rico and the following states: Alabama, Alaska, Arkansas, Idaho, Kentucky, Louisiana, Maine, Montana, Nebraska, New Hampshire, New Mexico, Nevada, Oklahoma, South Carolina, South Dakota, Vermont, and West Virginia. Winning proposals were selected through a merit-based, peer-reviewed competition.

## Dr. Patricia McDaniel Navigated the NASA Education Pipeline

Dr. Patricia McDaniel, a NASA Graduate Student Researchers Project (GSRP) participant, was the keynote speaker at the 2007 GSRP Orientation and Workshop in July 2007. McDaniel discussed overcoming the technology challenges of the 21st century and how to prepare for future opportunities in space exploration. Orientation objectives were to familiarize new recipients of GSRP fellowships with Langley Research Center's facilities and provide all GSRP students with the opportunity to meet and conduct technical discussions with their NASA advisers and other assigned scientists.

Dr. McDaniel was a Langley National Research Council Resident Research Associate from 1997 to 1999 and a Langley High-Performance Polymers, Nanotechnology and Composites senior research scientist from 1999 to 2000.

The goals of NASA's GSRP are to cultivate research ties to the academic community; to help meet the continuing needs of the Nation's aeronautics and space requirements by increasing the number of highly trained scientists and engineers in aerospace-related disciplines; and to broaden the base of students pursuing advanced degrees in science, mathematics, and engineering. Dr. McDaniel currently manages Aerospace Adhesive Research and Development at Cytec Engineered Materials in Maryland and southern California.



## NASA Pre-Service Teacher Institutes Help Educators See Learning in a Whole New Light

Marshall Space Flight Center hosted its 6th Annual Pre-Service Teacher Institute (PSTI) in June, with participants from Alabama A&M University, Oakwood College, Miles College, Tuskegee University, Bethune-Cookman University, and the University of Central Florida. The 2-week residential institute immersed elementary education majors in inquiry-based methods of teaching mathematics and science and in the effective use of technology in teaching and learning.

One highlight of the institute was a shared learning experience with NASA Explorer Schools (NES) teachers, in which the NES teachers shared science and math learning activities with the PSTI participants. A series of hands-on workshops was presented by NASA education specialists, area college professors, and public school teachers. Participants visited the U.S. Space & Rocket Center and area science museums. They also practiced their new skills by teaching lessons on rocketry to day campers at Oakwood College. The students were delighted with the variety of NASA teaching resources and felt that the PSTI was one of their most valuable learning experiences.

On Monday, July 16, 2007, 24 Pre-Service Teacher Institute participants began a hands-on and intensive 2-week experience at NASA Langley Research Center to help them develop a deeper conceptual understanding of mathematics and science. Aerospace Education Specialist Rudo Kashiri opened the Institute by identifying the significance of STS-118 and the part Educator Astronaut Barbara Morgan would play in the mission. The preservice teachers developed skills and knowledge enriched with the application of technology; these will help them to become more competent and confident in teaching mathematics and science.

## Students “Defy” Gravity for Experiments

The Reduced Gravity Student Flight Opportunities Program allows teams of undergraduate science and engineering students nationwide to propose, design, and fly a reduced-gravity experiment.

In 2007, for the first time, the program provided flights dedicated to lunar gravity to give the next generation of scientists and engineers an opportunity to experience what it may be like to prepare for a future lunar expedition. Teams from Lamar University, Michigan Technological University, and the University of Missouri-Rolla researched topics in electric welding and lunar dust behavior and removal.

Microgravity flights included teams from the University of New Mexico, Smith College, Cornell University, Fairfield University, the University of Southern California, Wichita State University, the University of Michigan, the University of Cincinnati, and Purdue University. Teams are investigating the effect of microgravity on the human body, fluids, inflatable structures, metals, and lasers. To date, student teams from 46 states have flown. These include more than 2,200 undergraduate students from 150 universities, 81 students from 9 community colleges, and 446 high school students from 73 schools.

## The Great Moonbuggy Race

Marshall Space Flight Center held its 14th annual Great Moonbuggy Race on April 13 and 14, 2007, at the U.S. Space & Rocket Center. It was a wild and wonderful ride for 44 competing high school and university/college teams representing 19 states, Canada, Germany, and Puerto Rico in the 2-day event.

The moonbuggy race is an applied, hands-on engineering challenge for high school and university/college students that relates to the NASA's exploration mission while inspiring students to pursue careers in science, technology, engineering, and mathematics. Students work in classrooms, garages, and shops all across the country trying to figure out the best way to design, build, and race a human-powered buggy capable of traveling around a half-mile track on Earth. Prizes are awarded not only for the fastest vehicles, but also to the team whose design represents the best technical approach to solving the engineering problem of navigating a simulated lunar surface.



## Diversity in Higher Education

The Office of Education is strengthening involvement with higher education institutions to ensure that NASA can meet future workforce needs in STEM fields. Participation in NASA projects and research stimulates increasing numbers of students to continue their studies at all levels of the higher education continuum and earn advanced degrees in these critical fields.

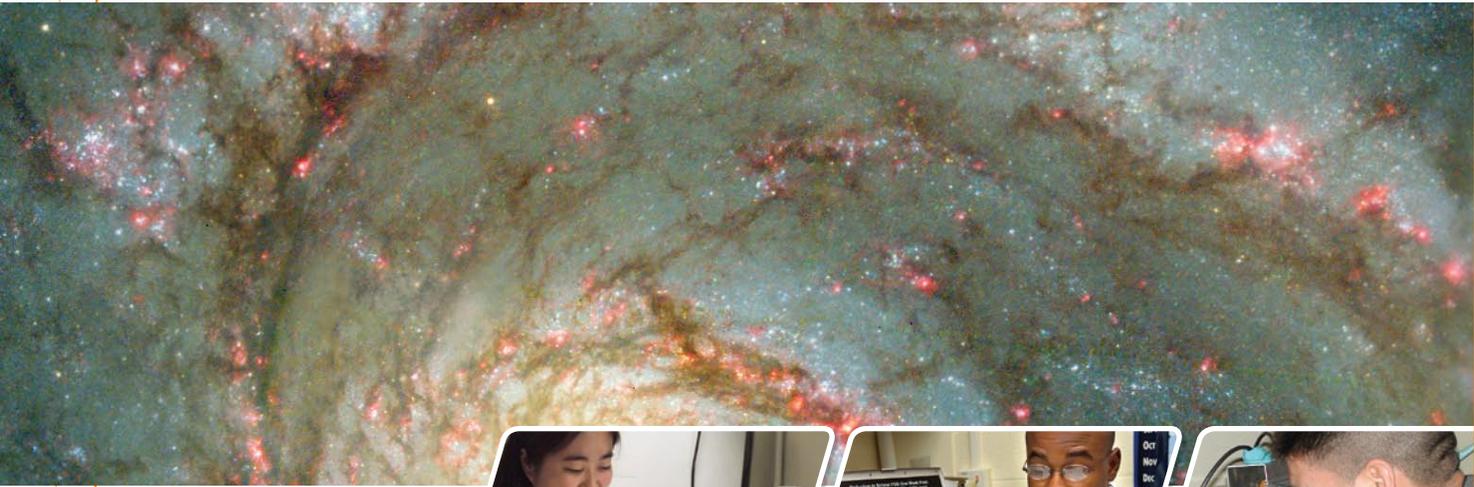
The Office of Education strives to ensure that underrepresented and underserved students participate in NASA education and research projects to assist more of these students in their pursuit of STEM careers. The Higher Education Program will continue to focus on the Minority University Research and Education Program (MUREP), thereby enhancing the capabilities of Historically Black Colleges and Universities' (HBCUs'), Hispanic Serving Institutions' (HSIs'), and Tribal Colleges and Universities' (TCUs') contributions to the research needs of science and technology enterprises. In addition, the Office of Education encourages these institutions to collaborate with teacher preparation programs that improve the quality and diversity of STEM teachers.

## Examples of Minority University Research and Education Projects

Minority University Research and Education activities engage underrepresented populations through a wide variety of initiatives. Multiyear grants are awarded to assist minority institutions (MIs), faculty, and students in research pertinent to NASA missions.

**The Curriculum Improvement Partnership Award**, a 3- year undergraduate curriculum improvement program for HBCUs, HSIs, TCUs, and other MIs, emphasizes improvements that are directly related to the NASA mission by infusing the curriculum with innovative STEM learning experiences.

**Faculty Awards for Research** provide faculty at MIs with opportunities early in their academic careers to integrate their research and education components with the unique mission requirements of a specific NASA Center. By involving MI faculty and students, the Agency strives to increase the interest and participation of traditionally underrepresented students in NASA research programs.



**The Harriett G. Jenkins Predoctoral Fellowship Project** provides support for underrepresented and underserved students in STEM disciplines, including women, minorities, and those with disabilities, who seek advanced degrees and opportunities for NASA-related research. The ultimate goal is to facilitate the development of a more inclusive, multicultural, and sustainable STEM workforce.

**MUREP Small Projects** support a variety of opportunities for students, teachers, faculty, and researchers from underrepresented and underserved communities in NASA-related STEM fields.

The NASA Administrator's Fellowship Project seeks to increase the ability of MIs to respond to NASA's overall research and development mission. To that goal, NASA employees spend a year visiting faculty and administrators at MIs, and members of MI STEM faculty spend a year conducting research at a NASA Field Center.

**The Research Academy** provides leading-edge research opportunities for faculty and students from MIs that complement NASA's research programs and make original contributions to NASA in astrobiology, biotechnology, information technology, and nanotechnology. Faculty and students from MIs collaborate on research with the scientists at NASA Ames Research Center, industry, academia, and nonprofit organizations in order to help prepare the next generation of explorers for NASA missions.

**The Tribal College and University Project** responds to Executive Order 13270, which directs Federal agencies to provide support to Tribal College faculty and students. NASA partners with TCUs to increase student and faculty involvement in the excitement of space exploration and cutting-edge technology. The partnership enhances the capacity of TCUs to compete for Federal grants and other resources and provides high-quality educational opportunities to Native American students and faculty.

**University Research Centers** provide a broad-based, competitive, NASA-related research capability among the Nation's MIs that fosters new aerospace science and technology concepts; expands the Nation's base for aerospace research and development; develops mechanisms for increased participation by faculty and students of MIs in mainstream research; and increases the prevalence of U.S. citizens who have historically been underrepresented in NASA-related research and in obtaining advanced degrees in STEM disciplines.

**Motivating Undergraduates in Science and Technology (MUST)** provides partial scholarships to undergraduate students to support tuition and fees.



### Inspiring Future Leaders from Tribal Colleges and Universities

The Tribal Colleges and Universities Project (TCUP) provides high-quality scientific and technical research and educational opportunities through NASA to Native American students and faculty from Tribal Colleges and Universities (TCUs). Each summer, most NASA Centers host TCU faculty and students, with joint collaboration on research projects ranging from standards for Shuttle orbiter landing gear to lunar soils to water quality to climate change to robotics.

In order to prepare tribal college students for the scientific and engineering workforce of the future in technical and STEM fields, NASA has developed a partnership with students, faculty, and scientists from the Nation's 35 TCUs through TCUP. Seven of the NASA Centers hosted students and faculty from the TCUs through the NASA-AIHEC (American Indian Higher Education Consortium) Summer Research Experience Program this year. During these research experiences, students and faculty worked on an exciting variety of projects involving landing gear environmental seals of orbiters; 3-D models of advanced manufacturing; robotics; high-temperature microbes; and remote sensing studies of issues relevant to their own tribal lands, including climate change, air and water quality, arctic grazing lands, forest fires, bald eagle migration routes, and land cover changes.

Two students from TCU Navajo Technical College were participants in a summer internship project at NASA Marshall Space Flight Center (MSFC). Valerie Benally and Nickolette Begay are working in the National Center for Advanced Manufacturing at MSFC, creating 3-D models for the Ares 1 upper stage. Valerie and Nickolette are both computer-aided design majors. Their work includes conducting simulations to validate the manufacturing and assembly process involved in the upper stage portion of Ares 1. They are using state-of-the-art digital manufacturing software to assist NASA in visually communicating the manufacturing processes that will need to take place. Navajo Tech faculty adviser Harold Halliday is also working on the project.

### First Motivating Undergraduates in Science and Technology Project Scholars Selected

The Motivating Undergraduates in Science and Technology (MUST) Project awards scholarships and internships to undergraduates pursuing degrees in STEM fields. The MUST Project is open to all students and is particularly focused on encouraging students from underserved and underrepresented groups to enter STEM fields. Applicants must be rising college freshmen, sophomores, or juniors; be U.S. citizens; have a minimum cumulative grade point average of 3.0 on a 4.0 scale; and be pursuing an undergraduate degree in a STEM discipline as a full-time student at an accredited institution of higher education.



MUST will support approximately 100 undergraduate students with a 1-year competitive scholarship of up to one-half of tuition, not to exceed \$10,000. Students who maintain the required minimum grade point average will be eligible for a paid internship relevant to their chosen field at a NASA Center. Additionally, students will benefit year-round from tutoring, lecture series, and mentoring from STEM faculty and peers. The scholarships and internships will be renewable for up to 3 years provided the students continue to meet the academic requirements.

During the 2007 fiscal year, the first cohort of MUST scholars was selected from 68 colleges and universities, of which 10 Historically Black Colleges and Universities (HBCUs) and 14 Hispanic-Serving Institutions (HSIs) were represented. Ninety-six scholars participated in research assignments Agency-wide, and 66 of the current scholars are eligible to renew their scholarships.

### Undergraduate Student Research Project Gets a “Spacelift”

The Undergraduate Student Research Project (USRP) completed its seventh year in 2007; it provided 139 students—from 99 different academic institutions representing 38 states and Puerto Rico—with valuable real-world experience at all the major NASA Field Centers, Wallops Island and White Sands Test Facility, and Los Alamos National Laboratory. This accomplishment brings the total number of students participating in USRP internships to 845 since 2001. In 2008, NASA plans to increase significantly the number of funded internships by means of the inclusion of rising sophomores, the addition of a spring internship session, and a more consistent distribution of opportunities across the calendar year (approximately 50 percent in the summer and 50 percent in the fall or spring). Two things, however, will not change: the high quality of research experiences NASA offers to USRP students and the outstanding talent the USRP students bring to NASA. USRP has built a strong reputation among researchers, mentors, universities, and student participants—and that reputation will be maintained as the project continues to grow.

### The Face of NASA 2020

The Career Exploration Project (CEP), offered for four decades at NASA Johnson Space Center (JSC) in Houston, TX, is a successful activity that has recently reached new heights. In the CEP, students learn about NASA and about science, technology, engineering, and math career fields through behind-the-scenes tours, an extensive mentoring network, and hands-on administrative or technical work. The project experience transforms the knowledge, skills, and attitude of participants by improving their overall understanding and awareness of space science and education.

The NASA student pipeline is a series of opportunities, progressing from elementary school activities to college, graduate, and postgraduate projects, whose ultimate goal is to equip the participants with the background, skills, and knowledge required to embark upon a career with NASA. Student employment programs like CEP help develop the capable and committed workforce needed to achieve NASA’s future exploration goals. CEP provides opportunities to high school and college students and creates a mechanism to help students progress through NASA’s pipeline into other NASA student programs and eventually gain entry into the NASA workforce.

During the 2006–07 program year, CEP students garnered over \$535,000 in scholarships. Since 1996, 69 high school students have successfully traveled the pipeline into the college programs and 65 have transitioned from the pipeline into the NASA workforce. Additionally, JSC has provided internship opportunities to over 1,200 high school students.

# Elementary and Secondary Education Overview



## Preparing the Next Generation

NASA is taking bold steps at the K–12 grade levels to prepare the next generation of explorers. Building on previous accomplishments, NASA has established a series of innovative programs designed to stimulate student interest in order to motivate higher levels of study in STEM subjects. These activities provide unique learning experiences for students, teachers, administrators, and families. NASA strives to ensure that underrepresented and underserved students participate in education programs, thereby encouraging more of these students to pursue STEM careers. NASA is also working to develop new digital media methods that will make NASA's exciting discoveries and missions available to K–12 students and educators.

## Examples of Elementary and Secondary Education Projects

NASA Elementary and Secondary Education projects provide K–12 educators with tools, experiences, and opportunities to further their education. By participating in unique NASA learning experiences, they enhance their knowledge of STEM, which increases their ability to inspire students to pursue STEM careers. These activities support the role of educational institutions, providing the framework to bring together students, families, and educators for educational improvement.

**The Aerospace Education Services Project** serves the elementary and secondary education community by providing classroom demonstrations, faculty workshops, parent training, and inservice training for teachers, as well as the identification of appropriate classroom resources. NASA utilizes former teachers who are well-trained and well-equipped in STEM content.



**Education Flight Projects** provide opportunities for K–12 students to gain hands-on experience as payload investigators using NASA flight platforms such as the Space Shuttle, the International Space Station, sounding rockets, and scientific balloons.

**The Educator Astronaut Project** selects outstanding educators to become permanent members of the Astronaut Corps. It then uses the visibility and educational opportunities created by the activities of the Educator Astronauts to inspire greater K–12 STEM achievement, promote STEM careers, and elevate public esteem for the teaching profession. The program has also trained the top tier of Educator Astronaut applicants, called the Network of Educator Astronaut Teachers, to perform as NASA Education advocates by engaging their schools and communities in NASA education activities and informing them of NASA resources.

**The Interdisciplinary National Science Project Incorporating Research and Education Experience (INSPIRE)** replaces NASA's Summer High School Apprenticeship Program. INSPIRE will maximize student participation and involvement in STEM, enhancing the STEM pipeline from high school (grades 9–12) into the undergraduate level. A solicitation for this concept was initiated in FY 2007 and will be awarded in FY 2008.

**NASA Explorer Schools (NES)** offers a 3-year partnership between NASA and teams consisting of teachers and education administrators from diverse communities across the country. Focusing on underserved populations, the program is designed for education communities at the 4–9 grade levels to help middle schools improve teaching and learning in STEM education through significant structural (e.g., professional development, stipends, grants) and curricular support based on NASA's resources.

**The Science Engineering Mathematics and Aerospace Academy (SEMAA)** reaches K–12 minority students who are traditionally underrepresented in STEM careers. Students meet during school, after school, on Saturday mornings, or during the summer to engage in hands-on, interactive learning sessions that are specifically designed for each grade level.



### Harvard Recognizes the Science Engineering Mathematics and Aerospace Academy as a Top Government Innovator

NASA's Science Engineering Mathematics and Aerospace Academy (SEMAA) Project was named one of 18 finalists for the 2007 Innovations in American Government Awards. The competition, held annually, is sponsored by the Ash Institute at Harvard University's John F. Kennedy School of Government and seeks to recognize the best and brightest innovations from local, state, and Federal Government. SEMAA was the only education initiative to be selected as a finalist.

SEMAA's selection as one of the finalists places the project in the top 2 percent of the original pool of over 1,000 applicants from all over the country. It also marks the first time that a NASA-sponsored project has been recognized at this level of the competition. As a finalist, the SEMAA Project is eligible to receive a \$10,000 grant to disseminate and replicate its innovations and best practices throughout the 2008 fiscal year.

### Research Course Inspires Future Scientists

The Earth System Science Research (ESSR) course, a partnership between NASA Goddard Space Flight Center and one Maryland county public school system, uses Earth system science-based research projects to increase student interest in scientific fields.

Frederick County's Catoclin High School in Thurmont, MD, has offered the ESSR course since 2002. Since then, the small school boasts that at least seven students from the program have gone on to careers in the fields of science, technology, engineering, math, and geography.

In the 2006–07 school year, two Catoclin students, Stamatina Hunter and Margaret Glancey, took first-place honors in their projects' categories at the Frederick County Science Fair. Working with teacher Lisa Bruck, Hunter and Glancey each completed an independent-study project that utilized data from NASA-inspired research subjects. Hunter will attend Pennsylvania State University to study meteorology, and Glancey will begin pre-med coursework at Villanova University. Two others who completed the course have been named on published scientific papers. Their research in high school helped them to develop the skills and the inspiration to pursue these science research opportunities.



## Collaborative Learning with the Department of Education

The U.S. Department of Education's Teacher-To-Teacher Initiative workshops are based on the idea that teachers are the best resource for each other in bringing new ideas into the classroom. The workshops' host locations can add to the unique and exciting experience for participants. The initiative's first gathering was held at NASA Johnson Space Center in Houston, TX, and kicked off the 2007 series of nationwide workshops.

The event provided sessions with information about NASA topics including the STS-118 mission and ideas on utilizing NASA's unique content to inspire students about STEM fields. As a surprise bonus, teachers spoke with Expedition 15 Flight Engineer Suni Williams aboard the International Space Station via an amateur radio link. NASA's participation in the workshop initiative supported the Agency's goal of attracting and retaining students in the technical disciplines.

## Texas Aerospace Scholars Earn Extra Credit

Designing a mission to Mars with JSC engineers and co-ops, High School Aerospace Scholars (HAS) are receiving formal recognition for their extracurricular work in the form of a 1-year science elective credit toward their respective high school diplomas. Through space exploration-themed opportunities, the Texas Aerospace Scholars (TAS) project continues both to inspire Texas youth to pursue STEM degrees and careers and to equip educators with STEM teaching tools, thus strengthening the future workforce of the state and Nation. To date, more than 5,600 Texans have participated in TAS. Additionally, HAS has expanded to the state of Washington through a partnership with NASA JSC and the Museum of Flight. As a result, during summer 2007, 95 students became Washington Aerospace Scholars.

## NASA Engineers of Today and Tomorrow Build Robots

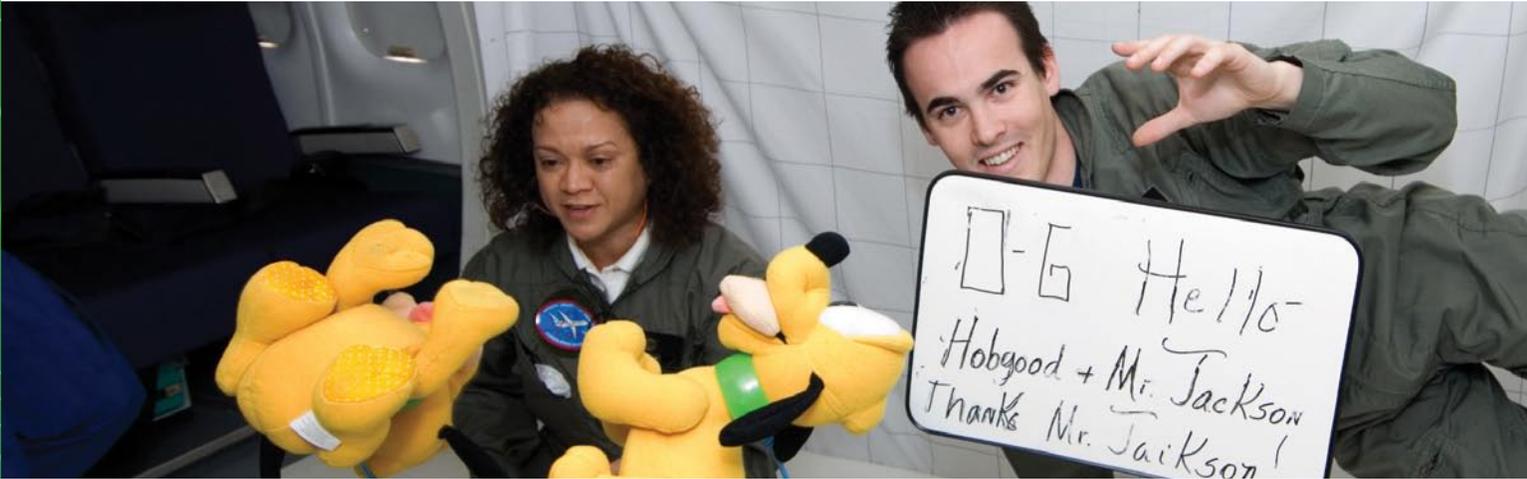
Robotics is an integral part of future space exploration and the future workforce. Johnson Space Center addresses this need through the Automation, Robotics, and Simulation Division. For over 11 years, students in the greater Houston, TX, area have worked with JSC engineers to design, build, and operate robots to compete in school-coordinated robotics programs. Students

are provided with opportunities in construction, engineering, computer programming, electronics, and leadership through hands-on robotics programs beginning as early as third grade and culminating with For Inspiration and Recognition of Science and Technology (FIRST) in high schools.

NASA as a whole is heavily involved in FIRST and is the largest sponsor of the annual FIRST competition, which combines the exhilaration of sports with engineering challenges. The Agency also sponsors teams and regional competitions across the country. Aimed at inspiring students in the pursuit of engineering and technology careers, each year's FIRST Robotics challenge game is unique. The 2007 student teams each spent 6 weeks building and preparing their robots to compete in a game called Rack 'N Roll. The game involved scoring points by using robots to pick up inflatable rings and hang them on a rack in the center of the playing field as well as block opponents from scoring.

Fifty-eight teams of high school students from six U.S. states, Puerto Rico, and Canada flocked to Cleveland for the FIRST Buckeye Regional Robotics Competition, which is cosponsored by NASA Glenn Research Center. In this fast-paced competition, unexpected mechanical problems could eliminate a team. Fortunately, the NASA machine shop volunteers were well equipped to help the students keep their robots in peak condition. Armed with a drill press, welder, circular saw, mill, and lathe, the staff made and repaired more than 300 robot parts.

NASA Stennis Space Center sponsored the first-ever regional FIRST robotics competition in New Orleans. School grants and other contributions to the regional competition totaled more than \$500,000. NASA supports FIRST by providing team mentors, as well as competition event judges, referees, and audiovisual and other volunteer staff personnel. Ten high school teams from Mississippi and 17 from Louisiana competed in the event. They pitted their skills and robot creations against teams from across the country.



### College Bound Workshop Introduces Students to Engineering

College Bound (CB) is an intensive 2-week summer academic workshop designed to introduce minority and female students to the profession of engineering. College Bound will introduce students to the engineering profession and encourage them to prepare academically to make high school graduation, college attendance, and STEM careers a reality. CB is held in the College of Engineering, Technology and Computer Science on the campus of Tennessee State University (TSU) in Nashville, TN. College Bound is sponsored by NASA Glenn Research Center in Cleveland, OH, and TSU.

### NASA Educator Resource Center Workshops Enhance STEM Education

NASA Educator Resource Centers (ERCs) help teachers learn about and use NASA's educational resources. Personnel at ERCs located throughout the United States work with teachers to find out what they need and to share NASA's expertise. The ERCs provide educators with demonstrations of educational technologies such as NASA educational Web sites and NASA Television. ERCs also provide inservice and preservice training utilizing NASA instructional products.

The Educator Resource Center at NASA Stennis Space Center (SSC) is helping educators meet the ever-demanding requirements for recertification. Approximately 500 teachers participate annually in more than 50 long- and short-term educator workshops at SSC. The ERC also provides about 200 student presentations and activities yearly to more than 10,000 teachers and students. Technology workshops include podcasting, digital photography and movie-making, and content workshops that focus on geography, propulsion, math, and science. All workshops use NASA materials and content.

A highlight of this ERC's 2007 summer program was the Mississippi State University (MSU) Industry Education Partnerships, which sponsored preservice and inservice teachers, administrators, and faculty to partner with NASA education for improving learning skills that are needed to succeed in today's workforce. The program also inspired educators to be leaders in providing students with STEM knowledge and skills. NASA resources will be used to enhance MSU planned workshops. Along with presentations and workshops, participants receive grade-appropriate educator materials, as well as a NASA resource presentation.



## A School To Watch

Conyers Middle School, 30 miles east of Atlanta, GA, was under the watchful eye of the U.S. Department of Education. Students' standardized test scores were low, and the school was labeled a "School in Need of Improvement." The school's leaders began to seek programs to strengthen their school.

In 2006, the school applied to be a NASA Explorer School (NES). Since its involvement with NASA Explorer Schools, Conyers focused on staff development and a NASA technologies plan for the school designed by a NASA Aerospace Education Specialist.

Conyers is using NASA support to continue to bolster its science and mathematics curriculum. A team of Conyers eighth-graders built an experiment that flew aboard NASA's reduced-gravity flights in February 2007. In 2006, Conyers students competed for the first time in a contest in which teams from across the country constructed robots to complete an assigned task. The Conyers team's robot qualified for the 2006 state finals, and the next year, one of three teams qualified for the state-level contest.

The school was named a Title I School of Distinction for the 2006–07 school year, as part of the No Child Left Behind Act recognition program. NASA resources have greatly contributed to the school, which now receiving recognition for its recent successes.

## NES Teachers Take Flight

NASA selected a new record of 20 experiments developed by NASA Explorer Schools throughout the Nation to fly aboard the Agency's reduced-gravity aircraft, the "Weightless Wonder," a modified McDonnell Douglas DC9.

Teachers and students from each of the 20 schools designed and built the components of their proposed project to get it ready for flight. Once the projects were completed, the teachers traveled to NASA's aircraft facility at Ellington Field and Johnson Space Center in Houston to prepare for their flight. Following their flight, the teachers shared their experiences and immediate findings with their students back at their schools via videoconferencing technology through NASA's Digital Learning Network.

# Informal Education Overview



## Education Beyond the Classroom

In our fast-changing world, people of all ages continue to seek knowledge and enrich their lives beyond the formal education environment of the classroom. NASA seeks to enhance the capabilities of the informal education community by providing access to NASA staff, research, technology, information, and/or facilities; with professional development opportunities for informal science educators; and by facilitating the formation of collaborative partnerships between the informal and formal education communities. The informal education community includes amateur astronomy groups, after-school programs, libraries, museums, science centers, planetaria, zoos, aquaria, and community youth groups.

Informal Science Education provides stimulating experiences for STEM learning outside of formal classroom environments through media, exhibits, and community-based programming. The Informal Education program area goals are to:

- Increase interest in and understanding of STEM disciplines by inspiring and engaging individuals of all ages;
- Establish linkages between informal and formal education; and
- Stimulate parents and others to support children's STEM learning endeavors by becoming informed proponents for high-quality, universally available STEM education.



## Examples of Informal Education Projects

NASA's Office of Education, Office of Public Affairs, Mission Directorates, and Field Centers all work together to develop partnerships and activities that enhance the capabilities of the informal education community to inspire the next generation of explorers by providing access to NASA staff, research, technology, information, and facilities. The following are some examples of current activities and resources available through NASA.

**NASA Explorer Institutes** are designed to engage the informal education community, provide instructional materials and resources for use at their home institutions, and serve as professional development opportunities for informal education professionals across the Nation.

**NASA Museum Alliances** are best practices forums for the informal education community and NASA professionals to collaborate, evolve, and develop dynamic and creative educational applications of Earth and space science data, expertise, and emerging technology.

**The Museum and Science Center Reduced Gravity Program** encourages museums or science centers to propose an experiment to fly on NASA's C-9 reduced-gravity aircraft. Up to 10 teams per year are competitively selected to fly their experiments.



### Establishing a Virtual Space Community

Space Center Houston (SCH), the official Visitors Center of NASA Johnson Space Center, in coordination with NASA, the Imaginarium, and the Louisville Science Center, led a new partnership to develop the Virtual Space Community. This Web-based community provides science centers nationwide with a forum to share ideas and work toward the common goal of educating the next generation of explorers. The Web site offers space-themed curricula; links to NASA resources; “webisodes”; discussion blogs; and ways for partners, teachers, and students to interact.

SCH has also designed space-themed distance-learning programming using state-of-the-art videoconferencing technology to share SCH- and NASA-unique resources with new student audiences, including larger international audiences. For more information, visit <http://www.virtualspacecommunity.org/>.

### Exploring the Moon and Mars with Girl Scouts

In support of the Agency-wide Memorandum of Understanding between NASA and Girl Scouts of the USA (GSUSA), an initiative was launched to bring the excitement of the newest dimension of NASA’s robotic exploration of the Moon and Mars to Girl Scouts. Twenty-six adult volunteer NASA-GSUSA core trainers from across the country participated in a weeklong robotic exploration workshop at JSC. They experienced elements of what it takes to design, build, and utilize robotic technology missions in observing, traveling to, and exploring our nearest planetary neighbors, as well as the future for robot-assisted human exploration. The trainers participated in fun and engaging hands-on activities designed to tell the NASA Exploration Systems Mission Directorate (ESMD) story of robotic exploration; they also planned related events in their local councils. These Girl Scout events are designed to encourage girls’ interest in STEM and raise their awareness of the skill sets and experience needed to choose a career in space-related engineering.

The trainers have received over 100 hours of previous instruction in other NASA topics and over 5 years’ experience in developing and delivering Girl Scout events in their councils. They typically hold over 100 events that directly reach over 10,000 girls and adults annually.



## Alabama's Place in Space Day

The November 2006 Alabama's Place In Space Day Event, held at the U.S. Space & Rocket Center museum in Huntsville, AL, was designed to inspire Alabama Girl Scouts to explore science-, technology-, engineering-, and mathematics-related careers. Girl Scouts from around the state were engaged in activities that covered various engineering topics by tackling problems related to water filtration, thermal protection, and rocket building. Older Scouts were also invited to interview female scientific professionals from NASA Marshall Space Flight Center. All Scouts were given the opportunity to spend a night at the U.S. Space & Rocket Center Habitat, which added to the overall space-themed experience.

## NASA Astro Camp Introduces Thousands to NASA and STEM

NASA Stennis Space Center's popular Astro Camp introduces thousands of children to NASA, space flight, and STEM each year. The project offers Saturday camps and weeklong summer camps for children ages 7–15. A traveling Astro Camp provides stimulating educational activities to thousands of people at events across the United States. Astro Camp students learn principles of propulsion and space flight through exciting hands-on projects, including rocket launches, egg drops, neutral-buoyancy exercises, and much more. Astro Camp Plus, a special activity for 13–15-year-olds, emphasizes technology. Campers build their own small robot, participate in a simulated Mars mission, and learn to develop a podcast.

As NASA prepares to send humans back to the Moon and on to Mars, campers join in the excitement by learning about the different goals and assignments it takes to make the space program a success. Counselors work with campers on team projects and games that teach science and math principles as they inspire future scientists, engineers, and astronauts to follow their dreams.

## NASA Exhibits Science Resources for After-School Programs

Research has found strong parallels between NASA's goals and purposes and those of the after-school programs and youth-serving communities. Working closely with after-school program providers, NASA can engage a new generation of young people and provide them with the skills, knowledge, opportunities, and resources they need to join the STEM workforce.

In 2007, NASA had a significant presence at the National AfterSchool Association's (NAA) annual conference in Phoenix, AZ. The NAA is the only national professional association for the after-school field and has over 9,000 members. The NAA focuses on professional development, program quality, public policy, and issues affecting children and youth in their out-of-school time.

NASA's Science Mission Directorate sponsored a dedicated workshop room at the conference, offering 12 hands-on science activity demonstration sessions. Geared for students of all ages, workshops explored topics such as ice, health in space, and careers, along with solar system missions including Cassini, Dawn, and Stardust.

The Mars Education Program offered a "Bus Trip to Mars," in which participants visited Arizona State University's Mars Space Flight Facility, talked with scientists, viewed spacecraft models, and received training in presenting various hands-on activities.

The NASA team staffed a large exhibit booth at the conference and distributed thousands of curricular activities and fun math and science products to enthusiastic after-school educators.

# Education Technology and Products Overview



## Leveraging Technology for Engagement

Technology plays an important role in providing a delivery mechanism to reach the next generation of explorers to inspire, inform, and involve them in NASA research activities and encourage them to pursue STEM fields. NASA is committed to distributing educational information through instructional and outreach products. In the future, powerful technologies will enable new learning environments to be developed that use simulations, visualizations, immersive environments, game-playing, and learner networking. These tools will create rich and compelling learning opportunities, thereby meeting the needs of learners while empowering educators and other adults to unlock the potential of a student's mind. Learning will be on demand, meaning that students, educators, and the general public will have access to exactly what they need when they need it. NASA is moving toward this education future by developing new methods for making its exciting discoveries and valuable resources available to students, educators, and the public.

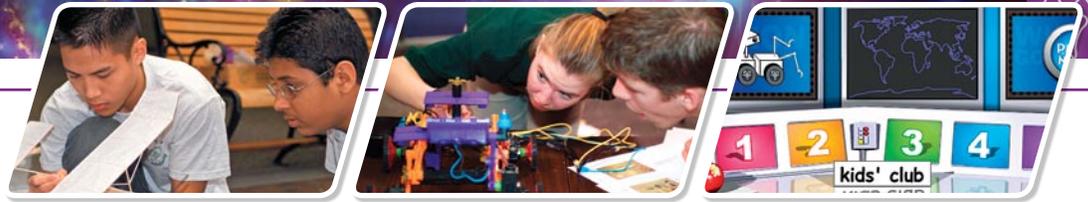
The intent of NASA e-Education is to develop an infrastructure and deploy research-based technology applications, products, and services that enhance the educational process for formal and informal education. NASA e-Education actively pursues the development of common procedures, capabilities, and tools to ensure that education projects and products from across the Agency might be captured and shared with NASA Education's constituencies. NASA e-Education partners with Mission

Directorates and other NASA organizations to create rich, effective learning experiences for a range of audiences. The e-Education portfolio includes the Digital Learning Network, Learning Technologies Projects, NASA-sponsored Classroom of the Future, Education File on Digital NASA TV, Web services, a suite of video and Web-based instructional materials, and an electronic- and site-based dissemination network.

## Examples of NASA Education Technology and Products

### NASA Education Web Site

Visitors to NASA's Web site are transported to a multimedia environment where they can experience the vision, emotion, and imagination of NASA. Education sections of the NASA Web site include multimedia resources, instructional materials, professional development opportunities, student opportunities, the NASA Education TV schedule, an express mailing list for educators, homework help for students, kids' games and activities, and education-related NASA news. See <http://www.nasa.gov/education>.



### NASA Educational Materials

NASA Education products are produced in multiple formats to best meet the needs of NASA's educational audiences. Types of products include CD-ROMs, DVDs, videos, educational topics and briefs, educational wallsheets (posters with educational material on the back), educator guides, education programs and services brochures, and lithographs.

There are four ways to receive NASA educational materials:

**www.NASA.gov**—The NASA Home Page serves as the gateway for information regarding content, programs, and services offered by NASA. Educators have access to curriculum support materials that may be downloaded and printed from the following Web site: <http://www.nasa.gov/education/materials>.

**OfficeMax**—NASA and OfficeMax have partnered to provide educators an additional venue to acquire NASA curriculum support materials. Using the Internet, educators can search an online database of NASA materials, preview these materials, and order copies through their nearest OfficeMax for a nominal charge. For more information, go to <http://www.nasa.gov/education/officemax>.

**Educator Resource Center Network (ERCN)**—The purpose of a NASA Educator Resource Center (ERC) is to help teachers gain access to NASA's educational resources. Members of the ERCN work with educators within their state to provide curriculum support and inservice and preservice training to demonstrate and facilitate educational technologies and to partner with local, state, and regional organizations. For more information, please visit <http://www.nasa.gov/education/ercn>.

**Central Operation of Resources for Educators (CORE)**—CORE serves as the worldwide distribution center for NASA-produced multimedia materials. For a minimal charge, CORE provides materials to educators who are not able to visit an ERC. Through its online catalog, educators can use the mail-order service to purchase items such as subject area classroom modules; DVDs; and CD-ROMs, including closed- and descriptive-captioned videos and guides. Go to <http://www.nasa.gov/education/core>.



### NASA Accessible Math Tool Wins Major Award

The Learning Technologies Team from Johnson Space Center has been recognized as one of 25 laureates of “The Tech Museum Awards,” an international awards program that “honors innovators from around the world who are applying technology to benefit humanity” (for more information, visit <http://www.techawards.org/about/>). Five laureates will receive a cash award of \$50,000 to further their work. The award recognizes MathTrax, a tool for accessible graphical math and science, and the Math Description Engine Software Development Kit (MDE/SDK) that underlies the application. MathTrax provides alternative access to graphical mathematics through text descriptions and sonification. The software uses rule- and computation-based machine intelligence to synthesize natural-language descriptions of curves generated from equations, data, or simulations. Originally intended as an “equalizer” for students with blindness or low vision, MathTrax has been a huge success in mainstream classes by providing alternate access to challenging graphical concepts. MathTrax and the MDE/SDK were the 2006 runner-up for NASA Software of the Year.

### NASA Beams into the Classroom

Throughout the year, over a quarter of the population across the Nation visits an educational institution. Annually, the NASA Johnson Space Center Digital Learning Network (JSC DLN) connects to over 751 of those institutions to educate students from grade school to graduate school about NASA’s missions and future goals using videoconferencing technology. To encourage the study of geography and STEM subjects needed to prepare students to enter the future workforce, the network allows students to interact live with NASA experts and education specialists. Educators also gain tools that aid NASA in inspiring the next generation of space explorers.

Along with regular modules, the JSC DLN also hosts special events such as the Extreme Environment series (including NASA Extreme Environment Mission Operations [NEEMO], Desert Research and Technology Studies [RATS], and studies in Antarctica), in which subject-matter experts interact with students and educators live from the field. In the first-ever NASA-wide DLN Relay Rally event, JSC hosted a 2-day, multipoint connection between each of the 10 NASA Centers and students across the country. NASA scientists and engineers, along with mission specialist and Educator Astronaut Joe Acaba, talked about the Agency’s education focus on the first spaceflight of mission specialist and Educator Astronaut Barbara Morgan. They discussed the STS-118 mission and related educational activities, and they fielded questions from students about exploration and NASA research.



## NASA Podcast Connects Students with Learning Opportunities

The NASA Student Opportunities podcast is a dynamic initiative that debuted in 2007. This weekly audio podcast informs high school and college students about NASA internships, fellowships, scholarships, and other learning opportunities. The radio-style shows feature interviews with students who have participated in NASA learning opportunities and allow potential participants to hear firsthand what it is like to be a student member of a NASA team. Student interns share their NASA experiences and offer tips and suggestions for other students. The free podcast also provides up-to-date information on approaching application deadlines.

NASA Education taps into this trendy technology to connect with students because podcasting is popular and is used widely on college campuses as a learning tool. A podcast is a media file that is distributed by subscription over the Internet for playback on personal computers or portable devices, such as an MP3 player or cell phone. Once a Web user subscribes to a podcast, new episodes are automatically delivered to his or her computer for playback at any time. For more information, visit <http://www.nasa.gov/nso>.

## Virtual Lab Offers Use of \$500,000 Microscopes Free of Charge

Virtual Lab, funded by NASA's Learning Technologies Project, was developed to answer educator requests for access to NASA's high-tech hardware. Educators felt that access to these instruments would greatly increase students' abilities while helping them to become proficient in technology- and science-related areas. The current suite of microscopes includes a scanning electron microscope, a light microscope, an atomic force microscope, and an energy dispersive spectrometer, with interactive spectrographs. Although the simulation is high-tech, the software interface is extremely user-friendly and very easy to learn. The teacher tools provided online make it easy to incorporate Virtual Lab into your classroom while still meeting national education standards. NASA is also collaborating with Microsoft, which is porting Virtual Lab for use within their new suite of educational tools, codenamed Grava. Visit <http://www.nasa-inspired.org/cogs> for more information.

## NASA Creates Virtual Worlds Education Research Roadmap

NASA's long history of using simulations for astronaut training make the Agency a natural choice to push the limits of the virtual world's research envelope. Massive multiplayer online gaming and synthetic environments, initially popularized in the entertainment world, are now finding growing interest in education and training environments. There is increasing recognition that these immersive environments can serve as powerful "hands-on" tools for teaching a range of complex subjects. Virtual worlds with scientifically accurate simulations can help learners grasp complex concepts and apply this understanding to real-world problems. For example, simulations can allow users to manipulate chemical reactions in living cells, practice operating and repairing expensive equipment, and experience microgravity.

To foster the necessary research to support the appropriate use of gaming and synthetic-environment technologies for education, the NASA Learning Technologies Project collaborated with the Federation of American Scientists in the development of a research roadmap. The *NASA eEducation Roadmap: Research Challenges in the Design of Persistent Immersive Synthetic Environments for Education & Training* outlines major research areas and issues. More than 20 experts on synthetic environments and learning were consulted during the development of the roadmap, and dozens of collaborators from universities, Federal agencies, and industry participated in its review process. Since being released in April 2007, this roadmap has received wide attention and is being used by government agencies and universities as a guide for their own efforts in synthetic-environment research.



NASA's Aeronautics Research Mission Directorate (ARMD) conducts long-term, cutting-edge research in the core aeronautics disciplines across all flight regimes (subsonic, supersonic, and hypersonic flight) that will lead to the development of revolutionary ideas, concepts, approaches, technologies, and capabilities that have broad applicability to the aeronautics community. New investments in undergraduate and graduate education will focus on developing technical excellence in future NASA and aerospace industry researchers and engineers. Over the next several years, ARMD will continue to adjust its education portfolio, consistent with the NASA Education Strategic Framework, to emphasize high-payoff efforts in support of the undergraduate and graduate communities. Some examples of ARMD educational activities are listed below.

## Higher Education

ARMD is committed to the development of the future aerospace workforce. A robust workforce of sufficient quality and quantity is required to support the Nation's future aerospace endeavors. As a result, ARMD is focusing its educational efforts on students at the higher education levels in order to encourage an expanded pipeline of talent entering aerospace careers.

Curriculum will be developed through partnerships with outside groups to fill in subject matter gaps and to expand current programs to meet future aerospace workforce needs. This development will include Web-based, supplemental materials related to undergraduate and continuing educational activities in the aeronautics field, as well as design competitions for university students using capabilities unique to NASA. All of this will be accomplished through collaboration with aerospace professional societies.

Scholarships and fellowships are currently being offered by ARMD at the graduate level to support master's degree-level students performing aeronautics-related research and to provide real-world experience at NASA Centers through summer internships. These scholarship programs are being expanded in FY 2007 to include the undergraduate level. The undergraduate scholarships will provide both monetary support for the students and opportunities to perform actual research at NASA Centers during the summer. The NASA Postdoctoral Program will also support a number of postdoctoral students performing research on topics of interest to ARMD.

## Elementary and Secondary Education

While ARMD develops new programs and products for the higher education levels, it also continues to offer an extensive portfolio of electronic and print resources for K–12 educators and students. In FY 2007, ARMD is releasing “Pushing the Envelope,” an educator guide on jet engines that supports physical science standards for grades 9 through 12 (in print and for downloading).

## Informal Education

A traveling aerospace design exhibit highlights the design of aerospace vehicles through wind tunnel models and flight hardware.

## ARMD Education Highlights

### **NASA and FAA Team To Ignite Students' Interest in Aerospace Careers**

NASA and the Federal Aviation Administration (FAA) have formed a partnership to encourage and foster the development of science, technology, engineering, and math skills among students. This partnership unites the strengths of both agencies to provide the best of aviation-related educational products and experiences to the widest possible population of students and educators.

The agencies' initial focus is on a NASA curriculum called Smart Skies for students in grades 5 through 9. Smart Skies includes an online air traffic control simulator and accompanying workbooks, through which students learn math and problem-solving skills central to air traffic control. Smart Skies provides a hands-on and exciting way for students to learn math while being exposed to high-technology careers related to aviation.

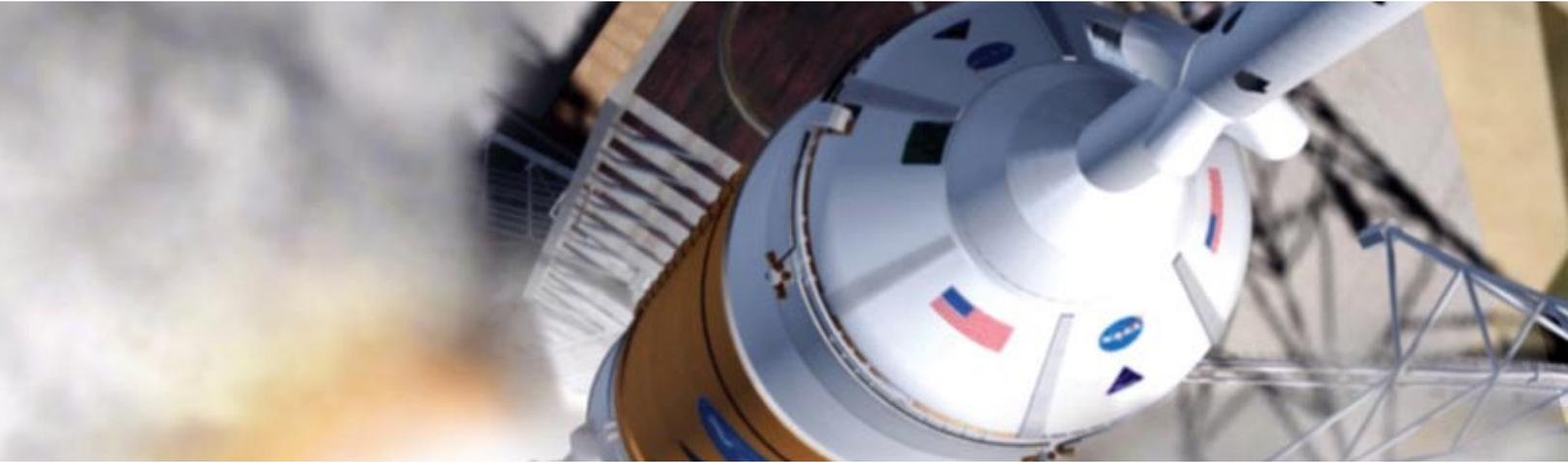
Such joint outreach efforts under this partnership will contribute to meeting the NASA and FAA goals for a diverse, qualified aviation and space workforce for the future.

### **Pushing the Envelope**

The Aeronautics Research Mission Directorate has created the Pushing the Envelope Educators Guide, designed for grades 9 to 12, to aid in teaching math, physics, and chemistry concepts from the viewpoint of propulsion and aeronautics. It contains information to help educators explain Newton's Laws of Motion utilizing aircraft engine technology. Each problem is based on real-world applications to provide practice relating to the concepts, and the guide is designed to allow for sections to be completed independently and in any order. A teacher section included in the back of the guide provides worked-out solutions to problems, as well as a glossary and definitions of the units of measure used throughout the guide. The guide is aligned to the national mathematics and science standards.

### **NASA's Guide to Hypersonics**

NASA's Guide to Hypersonics Web site has been developed for the NASA Aeronautics Fundamentals Research Program. The Guide contains several interactive computer programs that demonstrate the high-speed, high-temperature physics of hypersonic flight and includes content pages that provide the science and math background for the computer programs. Material at the Web site targeted for advanced high school or undergraduate students provides the fundamental math and science principles that are used in the study of hypersonic flows, including shock waves, boundary layers, and heat transfer. The Web site includes several interactive computer programs that demonstrate the high-velocity, high-temperature physics of this speed regime. An existing, interactive Turbine Based Combined Cycle (TBCC) simulator was made available at the site for use in higher education senior design projects. The program computes the inlet, nozzle, ram burner, and turbine engine performance. A rocket-based combine cycle (RBCC) and scramjet propulsion simulation have also been included.



NASA's Exploration Systems Mission Directorate (ESMD) is developing the next generation of spacecraft, including capabilities and technologies that enable sustained and affordable human and robotic exploration of space as outlined in the Vision for Space Exploration.

ESMD research also ensures the health and performance of crews during long-duration missions. The ESMD education portfolio supports the broad Agency education goals and is specifically tailored to meet NASA's long-term workforce requirements.

## Higher Education

The ESMD Higher Education program focuses on increasing the future workforce for ESMD, specifically in the areas of systems engineering; mechanical, electrical, and aerospace engineering; and applied physical and life sciences research. Emphasis is placed on providing authentic research and engineering experiences to faculty and undergraduate, graduate, and postdoctoral students.

Each year, ESMD supports the Agency-sponsored Graduate Student Researchers Project (GSRP) and the NASA Postdoctoral Program (NPP) by providing funding for additional participants.

Center-managed efforts, such as the "Building Bi-Generational ESMD R&D Teams" and "Spaceward Bound" projects, sponsor faculty and/or undergraduate teams to participate in hands-on research in ESMD mission activities. To engage undergraduates further in the engineering fields, ESMD is funding internships within the aerospace industry and is providing funds to encourage the use of ESMD-themed activities for senior design courses.

## Elementary and Secondary Education

The ESMD Elementary and Secondary Education program reflects the Agency goal of providing STEM-focused educational materials and training to K-12 students and educators. ESMD supports Agency-managed elementary and secondary activities, including the NASA Explorer Schools.

Many new K-12 projects are in development and are managed at NASA Centers. Types of investments include educator professional development workshops (e.g., "Fundamentals of Lunar Exploration"), lesson plans, and guides (such as "21st Century Explorer"). Activities represent ESMD themes of robotic and lunar exploration, physical and life sciences, mathematics, engineering and technology development, and health and human performance. ESMD is currently in partnerships with the International Technology Education Association (ITEA) to provide ESMD-themed transportation modules for K-12 students.

## Informal Education

The ESMD Informal Education Program partners with informal education providers to offer STEM learning opportunities in venues outside the classroom. Through partnerships with museums, science centers, after-school programs, libraries, and community-based organizations with an emphasis on education, these projects help students find applications and relevance for the STEM concepts they learn during the school day.

The theme of lunar exploration is being emphasized in current collaborations with the Girl Scouts of the USA, the American Museum of Natural History, and other partners.

## ESMD Education Highlights

### Today's Knowledge for Tomorrow's Explorers!

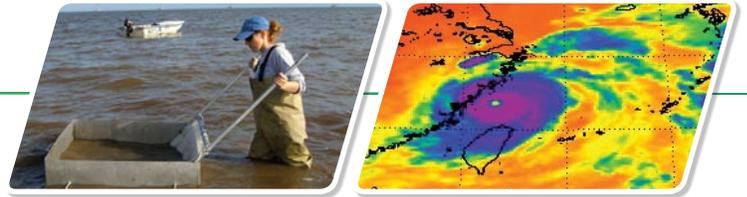
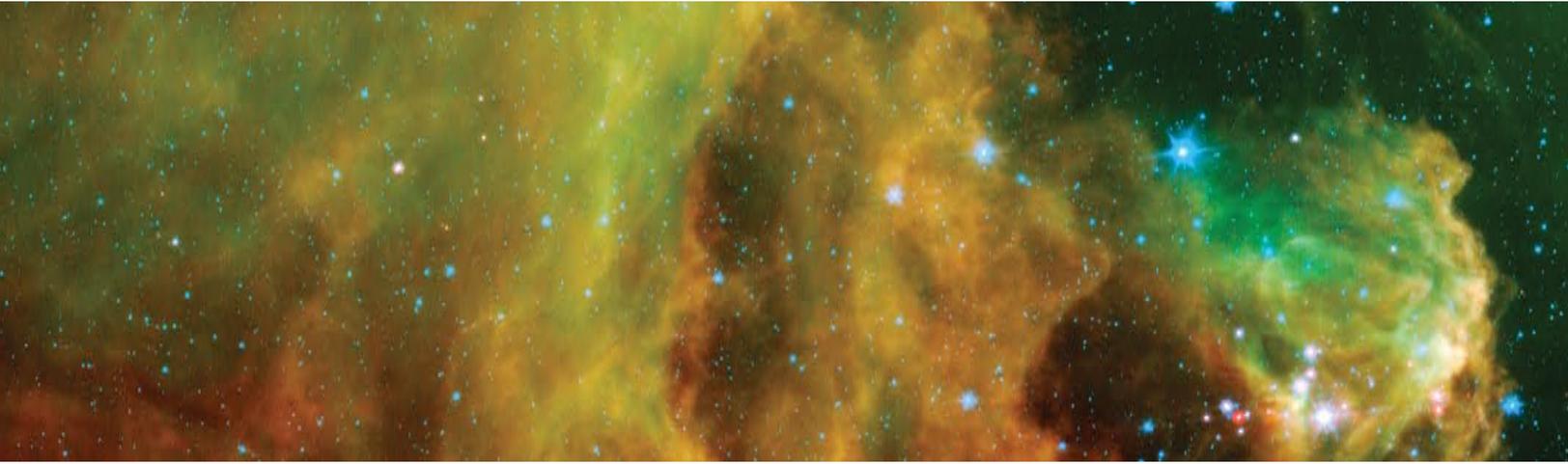
Exploration expands our horizons on Earth and expands them even further into space. The 21st Century Explorer Project uses exploration to inspire students, through the use of innovative educational materials, to discover the wonders of science, technology, engineering, and mathematics. While targeting underrepresented students in the third through fifth grades, 21st Century Explorer builds upon the grassroots philosophy of involving the community in NASA's missions and space exploration goals.

The 21st Century Explorer materials are delivered via a NASA Web site and contain 12 educational packages covering NASA exploration topics. All classroom-ready materials are presented in English and Spanish and have been evaluated using after-school settings in New Mexico and Texas, reaching over 500 students and 35 educators from 20 elementary schools.

Family-based 21st Century Explorer events have encouraged participants to go beyond classroom learning and into hands-on exploration. This project has supported an adult literacy program, has been recognized during a Houston Dynamo soccer game, and is the recipient of a Congressional Certificate of Merit.

### Growing Engineers in Support of Future NASA Exploration

The ESMD Space Grant Project offers the Nation's undergraduate and graduate students opportunities to contribute to NASA's future exploration through spacecraft, propulsion, lunar, and planetary surface systems, as well as ground operations work. This year, 1,200 students engaged in ESMD-relevant objectives through internships offered at NASA Centers and in industry, senior engineering design courses that incorporated ESMD-related projects relevant to NASA engineers and scientists, and participation in national competitions. Eight of the 60 funded challenge teams provided NASA with systems engineering papers of their work to compete for cash scholarships and an invitation to a Space Shuttle launch. The high caliber of the students' work impressed NASA judges, one of whom commented, "The papers were as good as what I've seen from NASA engineering." Through participation in the ESMD Community of Practice (CoP), all alumni get support and continue their lifelong learning through interactions with peers, mentors, and potential employers. Funding has been competitively awarded to 48 out of the 52 Space Grant Consortia to continue internship and senior design project opportunities. Through this and other ESMD projects, NASA is growing the next generation of engineers, thus enabling the return to the Moon as well as future exploration of Mars and beyond. For more information, visit <http://education.ksc.nasa.gov/ESMDspacegrant/>.



NASA's Science Mission Directorate (SMD) invests in the continued development of a workforce able to pursue Earth and space science research from space; partners with institutions and professional societies in increasing the public's understanding of science and technology; and informs the teaching and learning of STEM subjects in the classroom. Education and Public Outreach (E/PO) is built into all aspects of the NASA Science Mission Directorate program.

## Higher Education

These programs provide research support to outstanding students pursuing degrees in all disciplines engaged in Earth and space sciences. Such investments ensure the continued supply of highly trained and qualified individuals to continue the scientific exploration of space.

The Science Mission Directorate collaborates with the Office of Education on the Graduate Student Researchers Project (GSRP) and Undergraduate Student Research Project (USRP) and enhances them with additional support such as the NASA Earth and Space Science Fellowship Program. SMD also focuses on strengthening the instructional capacity at colleges and universities that are not routinely exposed to new scientific research, including improvement of academic programs in Earth

and space science, providing mentoring and undergraduate research for underrepresented groups of students, and so on.

## Elementary and Secondary Education

These activities primarily aim to improve formal education by (1) the use of SMD missions/programs to support local, state, regional, and national mathematics, science, engineering, and technology education change efforts through collaboration with internal and external stakeholders; (2) the use of SMD missions, facilities, human resources, and programs to provide exposure and experiences to teachers and faculty to support the enhancement of knowledge and skills and to provide access to NASA information in science and mathematics; (3) the development, utilization, and dissemination of science, mathematics, geography, and technology instructional materials based on SMD missions and results; and (4) the use of SMD missions, facilities, human resources, and programs to provide information, experiences, and research opportunities for students in order to support the enhancement of knowledge and skills in the STEM areas.

## Informal Education

Informal education and public outreach activities inspire and engage learners of all ages through partnerships with community-based groups like museums and planetariums, the Girl Scouts, and amateur astronomers/citizen scientists. Examples are planetarium shows developed or produced with

direct SMD mission/program involvement, exhibits developed with direct SMD mission/program involvement and installed in a science center or museum, and materials or content supplied by SMD missions/programs for use as components of planetarium shows or museum exhibits.

## Early-Career Programs

These activities provide competitive research support to scientists and engineers who have recent Ph.D. degrees and are pursuing academic and/or research careers in Earth system science, heliophysics, planetary studies, or astrophysics. Examples include the New Investigator Program in Earth science, the Early Career Fellowship Program in planetary science, and the Chandra and Hubble Fellow programs in astrophysics.

## SMD Education Highlights

### After Katrina, a Story of Survival and Science

Lake Pontchartrain may be best known as the source of floodwaters that devastated much of New Orleans in the wake of Hurricane Katrina. For University of New Orleans graduate student Lissa Lyncker, the lake is both the culprit responsible for destroying the homes of many of her family and friends and the laboratory in which she conducts scientific research in pursuit of a master's degree in biological sciences. Funded in part by NASA's GSRP, Lyncker tracks water circulation in the lake using images from the Moderate-resolution Imaging Spectroradiometer (MODIS), an instrument on board NASA's Terra and Aqua satellites. Using MODIS data, combined with information gathered as she traverses Pontchartrain by boat, Lyncker learns how and why blue crabs end up where they do. Blue crabs are a valuable resource not only to Louisiana's ecology, but also to its economy; they contribute significantly to the state's commercial and recreational fisheries industry. For more information, visit <http://fellowships.hq.nasa.gov/gsrp/>.

### Tuning In to the Sounds of Space

Ocean waves breaking up on a beach. Pebbles landing on a tin roof. A quiet hiss. As far as we know, sandy beaches, tin roofs, and hissing snakes don't exist in space. But with the right equipment, these are the kinds of noises derived from radio signals emitted by the Sun, Jupiter, and the Milky Way galaxy in general. NASA's Radio JOVE kit contains all the parts needed to build a radio telescope that allows observers to listen to celestial objects that are millions of miles away. Many astronomers both look at and listen to data, because the human ear can recognize patterns the eye might miss. But for those without sight, listening to data is even more important. That's why these sounds from space are music to the ears of Wanda Diaz, a graduate student who is blind. Radio JOVE has played

an important role in her ability to conduct research and teach astronomy to younger students. Data collected can be used for various projects, including the study of radio storms and changes in the ionosphere. For more information, visit <http://radiojove.gsfc.nasa.gov/>.

### Solar System Ambassadors

While about 175 diplomatic ambassadors represent the United States in countries around the world, nearly 500 "solar system ambassadors" are spreading knowledge of the solar system to communities across the Nation. These volunteers are part of the Solar System Ambassadors Program, a public outreach effort of NASA's Jet Propulsion Laboratory to communicate the excitement of space exploration. Solar system ambassadors are space enthusiasts who volunteer to organize or attend community events where they talk about recent discoveries and upcoming milestones in space science, as well as future NASA missions. Featured topics include Jupiter, Saturn, Mars, Earth, asteroids, comets, the Sun, and the universe. Some ambassadors also write articles for local newspapers and are interviewed by local TV and radio stations. During training sessions, ambassadors interact with NASA scientists and engineers as they learn about various NASA missions. NASA supplies ambassadors with education and outreach materials such as videos, CDs, booklets, posters, lithographs, and online resources. For more information, visit <http://www2.jpl.nasa.gov/ambassador/>.

### Classrooms Go Pro with Spitzer

Professional scientists are not the only ones using NASA's Spitzer Space Telescope to learn about brown dwarfs, iron stars, and other deep space objects. Teachers and students, mainly from high schools across the country, produce their own advanced research based on Spitzer data. Participants in the Spitzer Space Telescope Research Program for Teachers and Students are teamed with scientists from the Spitzer Science Center in Pasadena, CA, and the National Optical Astronomy Observatory in Tucson, AZ. Together, they investigate everything from star formation to the characteristics of black holes. Working closely with real data and advanced technology provides a window into what it is really like to be a scientist and how science does not always yield clear-cut answers. As part of the overall program, teachers have presented their work at conferences and workshops for educators and scientists. They also incorporate Spitzer data and images into their classroom activities and conduct workshops that show other teachers how to do the same. For more information, visit [http://coolcosmos.ipac.caltech.edu/cosmic\\_classroom/teacher\\_research/](http://coolcosmos.ipac.caltech.edu/cosmic_classroom/teacher_research/).



NASA's Space Operations Mission Directorate (SOMD) seeks to provide educational projects, products, and activities to inspire the next generation of explorers to take the next steps in the Vision for Space Exploration. Additionally, SOMD strives to support educators who prepare students to meet national education standards in STEM for grades K through 12. The Mission Directorate engages learners in hands-on experiences related to space operations. Below are some examples of SOMD educational activities.

## Higher Education

Reduced-gravity student flight opportunities encourage undergraduate students to propose, design, fabricate, fly, and evaluate a reduced-gravity experiment over 6 months.

The Great Moonbuggy Race challenges undergraduate and high school students to compete in teams, applying engineering skills to design a collapsible vehicle powered by one male and one female and ride it through a simulated lunar terrain obstacle course.

Pre-Service Teacher Institutes train preservice teachers in how to use NASA educational materials with hands-on science pedagogy in these workshops.

NASA Means Business challenges science, communications, and fine arts students to produce public service announcements on a NASA message and conduct educational outreach with their product in this competition.

The NASA Postdoctoral Program allows postdoctoral students to conduct research for the Space Operations Mission Directorate at participating NASA Centers.

## Elementary and Secondary Education

The NASA Educational Exploration Team Educator Resource Center provides educational materials and multimedia resources for all visiting classes and educators from around the country at Kennedy Space Center.

The NASA Educational Exploration Team: Exploration Station trains visiting educators and classes at Kennedy Space Center's unique facilities.

The Digital Learning Network provides K-16 educators and students, along with science museum audiences, with a chance to talk to scientists and see NASA-unique facilities via two-way video and Webcast.

The Kennedy Launch Academy Simulation System offers software that converts a computer lab into a launch simulation room. Teachers can select scenarios for different science content areas and different grade levels.

The Student Launch Initiative challenges high school students with a competition to design, build, and test reusable rockets with scientific payloads.

## Informal Education

NASA Brain Bites produces Emmy award-winning broadcast TV products, 30 and 60 seconds in length, that share high-interest concepts and answer frequently asked questions. Used by teachers, museums, exhibits, broadcast TV, and NASA TV and radio.

Astro Camp provides a variety of 1-day to 1-week camp experiences, tailored to middle school students, at Stennis Space Center, schools, exhibits, and other venues that use exciting, hands-on activities about propulsion.

## Minority Outreach

Diversity Education Grants offer grant awards to three higher education institutions to serve underrepresented and underserved K–12 educators and students and to help them pursue STEM careers.

Minorities in Science and Engineering serves as a work-study program for scholars and provides faculty mentoring, peer tutoring, and ongoing research for African-American high school students to encourage college enrollment in science and engineering.

Exploration Infusion delivers NASA content, training, workshops, coaching, and activities to the Gulf Coast Education Initiative Consortium and the Mississippi Band of Choctaw Indians; it serves 21 districts, 252 schools, and 128,000 students and teachers.

## SOMD Education Highlights

### **Bring a Launch Countdown to Your Classroom!**

The Kennedy Launch Academy Simulation System (KLASS) is a launch countdown software package that simulates a firing room. KLASS is intended to run in a school computer lab or on any group of networked computers. The students will monitor and respond to launch countdown problems that the teacher has selected. The objective is to solve issues and problems appropriately in order to launch the Shuttle successfully. This program can be run one time or expanded to a yearlong curriculum or more. Background materials, including lesson plans and countdown log sheets that are tied to national standards, are included in the package. This project was funded by the NASA Space Operations Mission Directorate as a hands-on activity to inspire young students to explore STEM careers. While this software is currently available for beta testing, it is anticipated to be publicly released in late 2007.

### **“Harmonious” Name for ISS Node 2**

The NASA International Space Station (ISS) Node 2 Naming Student Competition was held in 2006–07 for U.S. K–12 students. The NASA Exploring Space Challenges (ESC) program hosted this nationwide competition as the “Name The ISS Node 2 Challenge.” Students were required to learn about the ISS and its functions, build a scale model of Node 2, and write an essay explaining their justification for the name that they proposed. Registered schools represented 36 states and one U.S. Department of Defense school in Japan. The 62 completed entries involved more than 3,100 students across all grade levels. Six different schools submitted the name Harmony. A panel of NASA educators, engineers, scientists, and senior Agency management selected Harmony because the name symbolizes the spirit of international cooperation embodied by the Space Station, as well as the module’s specific role in connecting the international partner modules.

Students from the winning six schools received a surprise memento and certificate from the ISS Program Manager, and they were all congratulated by an astronaut during a joint interactive video conference via the NASA Digital Learning Network on April 23, 2007.

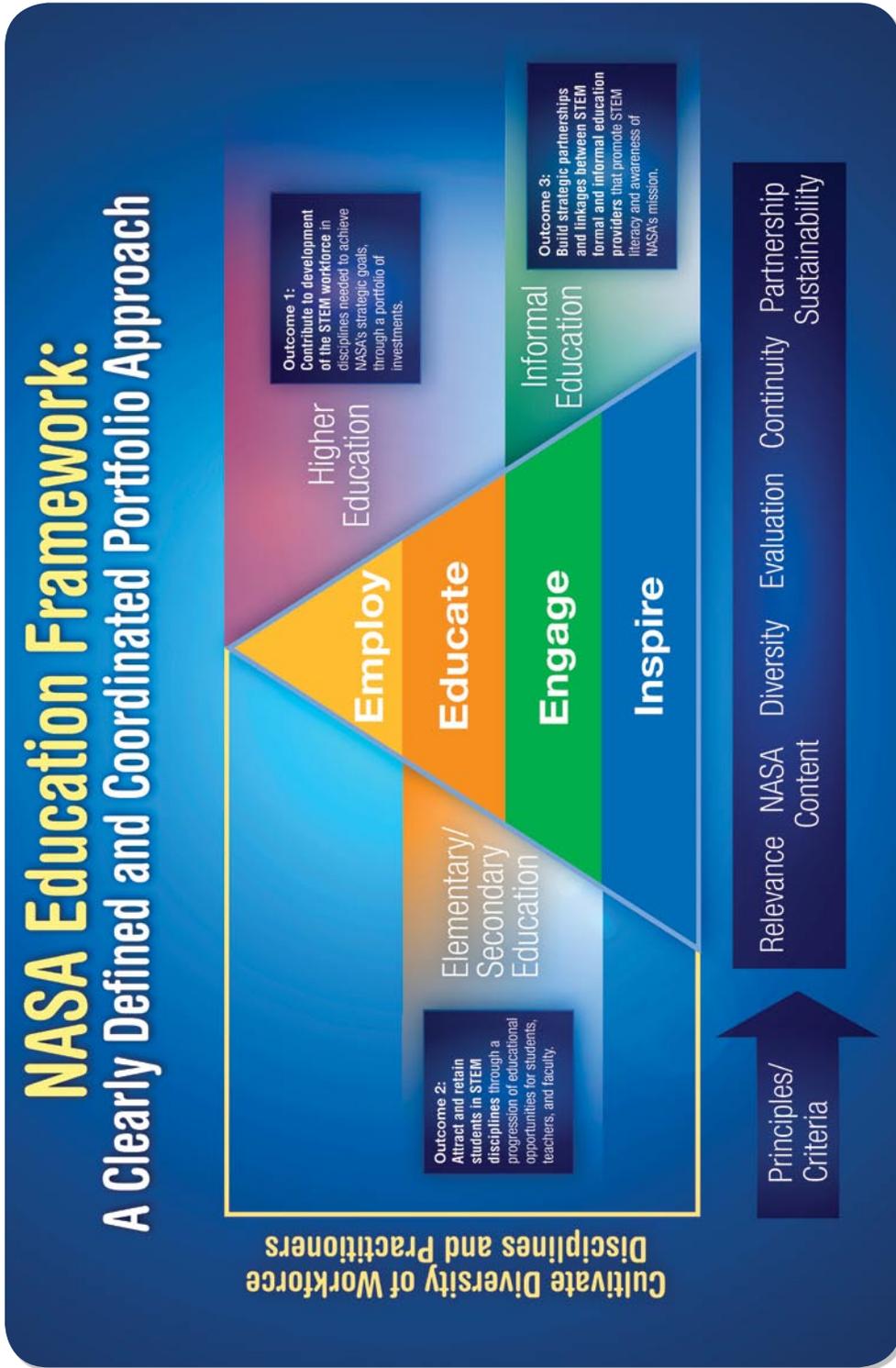
Harmony joins three other named U.S. modules on the Station: the Destiny laboratory, the Quest airlock and the Unity node. This is the first U.S. piece of the Space Station named by people outside of NASA.

### **Award-Winning NEET Continues To Inspire, Educate, and Engage**

The NASA Education Exploration Team (NEET) at Kennedy Space Center (KSC) uses the Exploration Station, the Educators Resources Library, and escorted educational tours to provide workshops for preservice, current, and out-of-service teachers incorporating STEM topics and NASA careers.

Highlighting SOMD’s focus on human space flight, launch vehicles, low-Earth orbit vehicles, and satellites, the professional staff develops unique workshops for educators. The result is a professional development workshop that is hands-on, presented at the teaching level of the teacher, correlated to national standards, and, most importantly, easily reproduced in the classroom, with opportunities to interact with NASA employees at their work site. In fiscal year (FY) 2006, NEET worked with 8,132 educators. During times when workshops were not being presented, educators brought 16,800 students for hands-on activities and 8,000 members of the general public visited the Exploration Station.

# NASA Education Framework Chart



# NASA Education Framework, Outcomes, and Involvement

NASA delivers a comprehensive Agency education portfolio implemented by the Office of Education, the Mission Directorates, and the NASA Field Centers. Through the portfolio, NASA contributes to our Nation's efforts in achieving excellence in STEM education.

## The Guiding Education Strategic Framework

The Education Strategic Framework depicted in Appendix A provides a conceptual basis for examining, guiding, and coordinating the NASA education portfolio. It is a strategic management tool that allows the Agency to monitor participant movement through education activities, with each category leading to the next. Education programs and projects draw from the category below them as a key source for participants, and they connect participants to the category above them, providing a more experienced and focused group and creating a measurable pipeline.

### Three Outcomes Serve To Align All Agency Education Activities:



#### Outcome 1

Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals through a portfolio of investments.



#### Outcome 2

Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty.



#### Outcome 3

Build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA's mission.

## Four Categories of Involvement

### Inspire

Activities focused on promoting awareness of NASA's mission among the public, primarily through informal education and outreach activities. This category is heavily supported by the outreach activities of other NASA organizations, such as the Office of Public Affairs. Inspire-level efforts are broad, with the goal of reaching a large number of people. This category forms the base of an education structure that becomes more focused at progressively higher levels of the framework pyramid.

### Engage

Education activities that in some manner incorporate participant interaction with NASA content for the purpose of developing a deeper understanding. Participants are strategically identified and targeted.

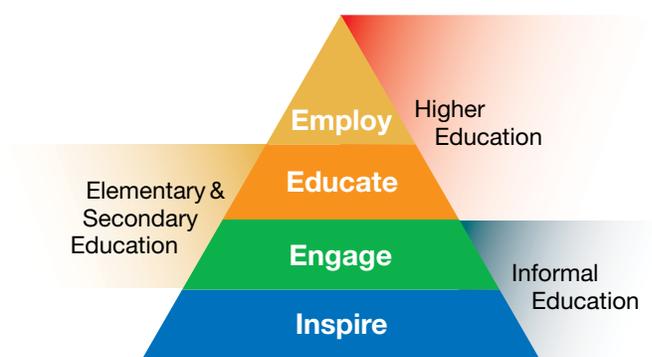
### Educate

Focused education support that promotes learning among targeted populations. Education activities focus on student learners or pre- and inservice educators and are designed to develop and/or enhance specific STEM knowledge and skills using NASA resources. These activities promote new knowledge acquisition and strengthen an individual's skills. NASA's elementary and secondary education efforts are supplementary to formal classroom instruction. NASA's higher education efforts may include development of specific university curricula in support of the NASA mission and student-built instruments.

### Employ

Targeted development of individuals who prepare for employment in disciplines needed to achieve NASA's mission and strategic goals. Through internships, fellowships, and other professional training, individuals become participants in the Vision for Space Exploration and NASA science and aeronautics research. At the apex, they have acquired sufficient mastery of knowledge for employment with NASA, academia, industry, or within STEM fields of teaching.

A detailed visualization of the NASA Education Framework can be found in Appendix A. Information about the full strategy document can be found at <http://education.nasa.gov/about/strategy/index.html>.



## Meeting Our Goals

The Office of Education has established the Education Coordinating Committee (ECC) to support the management and review of the education portfolio for NASA. Education investments are required to document their intended outcomes and use metrics to demonstrate progress toward and achievement of these outcomes and annual performance goals. Evaluation methodology is based on reputable models and techniques appropriate to the content and scale of the targeted activity, project, or program.

## Monitoring and Control

NASA's success in implementing its education portfolio is determined by the Agency's ability to achieve its desired outcomes. NASA uses objective and verifiable performance metrics, regular review processes, and defined tools to assess its performance at all levels—portfolio; outcome; and the individual program, project, product, or activity. Individual program evaluations are consolidated by outcome across the Agency, and then the three outcomes are bundled for assessment by the ECC as a complete portfolio. Performance measures are vigilantly and circumspectly chosen and applied in accordance with accepted norms. Regular performance evaluation at each level becomes one of our most important means of identifying problem areas and opportunities for better management, leading to greater organizational effectiveness and guiding investment strategies.

All implementing organizations (NASA Field Centers and NASA's external partners) conduct program-/project-/activity-level evaluations and support the Office of Education and the Mission Directorates in conducting outcome-level and portfolio assessments. Effectual consultation, coordination, and cognizance among all entities are critical to the optimal fulfillment of NASA's education investment.

## Evaluation

NASA's education portfolio depends on the management of programs and projects for ultimate implementation and specific outcomes. Through programs, projects, products, and activities, the outcomes are translated into specific objectives and measurable outputs. Management of education programs and projects complies with current NASA directives on program and project management, processes, and requirements. Education program, project, product, and activity evaluations are based on a common set of criteria, including performance alignment with the Education Overarching Philosophy and Operating Principles (see Sections 2.3.1 and 2.3.2 of the Education Strategic Framework). Evaluation plans will measure intended impact and be scaled appropriately to the size of the investment—"one size does not fit all." Mission Directorates, Field Centers, and the Office of Education regularly monitor and evaluate the programs, projects, products, and activities they fund and report the results of those evaluations to their funding organizations and the Office of Education for review by the ECC.

## For More Information

For more information, please visit [www.nasa.gov](http://www.nasa.gov).

The NASA Portal is the single point of entry to NASA public content and the most popular government site on the Web. It serves as the gateway for information regarding content, programs, and services offered by NASA for the general public and, specifically, for the education community.

Visit [www.nasa.gov](http://www.nasa.gov) to find out more information about NASA's mission, research, and activities; NASA Education strategy and programs; and NASA Mission Directorates and Field Centers.





“The greatest contribution that NASA makes in educating the next generation of Americans is by providing worthy endeavors for which students will be inspired to study difficult subjects like math, science, and engineering, because they too share the dream of exploring the cosmos.”

—NASA Administrator Michael Griffin

<http://www.nasa.gov/education>





inspire engage educate employ...

the next generation  
of explorers and innovators.