

The NASA Education Enterprise: Inspiring the Next Generation of Explorers

NASA's challenging and exciting missions provide unique opportunities for engaging and educating the public. Air travel, space flight, the exploration of the unknown, and the discovery of new, mysterious, and beautiful things are all endeavors that hold an intrinsic fascination for people around the world. And the benefits—to NASA, the Nation, and the world—of engaging students and the public in our scientific and engineering adventures cannot be overstated. By stimulating people's imaginations and creativity and by meaningfully communicating the significance of our discoveries and developments to them, we can help to improve the scientific and technological literacy of our society and draw new students into careers in science and engineering.

—NASA 2003 Strategic Plan

Preface

Inspiring our next generation of explorers, inventors, discoverers, technologists, scientists, mathematicians, and engineers is the cornerstone of the new Education Enterprise.

For nearly 50 years, the men and women of NASA have broken barriers to open new horizons of opportunity. Our journeys in air, space, and laboratories have enabled new understanding of our universe, safer and faster air travel, breakthroughs in health care and scientific research, and inspired humanity to reach for new heights. While these achievements and the people behind them are unique, at their foundation they are linked by a common denominator: education. None of the accomplishments we herald in our Nation's history, our daily lives, or in our laboratories and research centers would have been possible without quality education and the people who help open the minds of those who dare to explore and dream.

Educators create horizons of opportunity in classrooms every day. They prepare, inspire, excite, encourage, and nurture the exploration for answers and new questions. Educators are the adventurers in our midst and without them our journeys would not succeed. As we move into our second century of flight, we must work with all who touch the future to help prepare a new generation of Americans to meet the growing challenges in science, technology, engineering, and mathematics.

To meet this challenge, NASA has established the Education Enterprise. Working collaboratively with NASA's scientific and technical enterprises, the Education Enterprise will ensure that education is an integral component of every major NASA research and development mission. This enterprise will provide unique teaching and learning experiences, as only NASA can, through the Agency's research and flight capabilities. Students and educators will work with NASA and university researchers and scientists to use real-time data to study the Earth, explore the universe, and conduct scientific investigations in the fields of aerospace and space-based research.

NASA's Education Enterprise will provide opportunities for students and educators to work with the Agency's scientists and engineers to learn what it takes to develop the new technology required to understand our home planet, explore the universe, and to live and work in space.

As we celebrate the accomplishments of the Nation's first 100 years of flight, we look forward with great

anticipation to the next century of flight. The next generation of explorers—the Explorers of the New Millennium—must represent fully this Nation's vibrant and rich diversity. NASA's Education Enterprise will strive to ensure that all children can explore their full potential as Americans. We will fully engage the underrepresented and underserved communities of students, educators, and researchers. Furthermore, we will support our Nation's universities, colleges, and community colleges by providing exciting research and internship opportunities that “light the fire” and “fuel the passion” of young people, thereby creating a culture of learning and achievement in science, technology, engineering, and mathematics.

Welcome to NASA's Education Enterprise. Working together, we can “see learning in a whole new light.”



A handwritten signature in black ink that reads "Adena Williams Loston". The signature is written in a cursive, flowing style.

Dr. Adena Williams Loston
Associate Administrator for Education
National Aeronautics and Space Administration

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“Today, America has a serious shortage of young people entering the fields of mathematics and science. This critical part of NASA’s mission is to inspire the next generation of explorers so that our work can go on. This educational mandate is an imperative.”

On April 12, 2002, NASA Administrator Sean O’Keefe opened a new window to the future of space exploration with these words in his “Pioneering the Future” address. Thus began the conceptual framework for structuring the new Education Enterprise.

The Agency’s mission is to understand and protect our home planet; to explore the universe in search for life; and to inspire the next generation of explorers ... as only NASA can. In adopting this mission, education became a core element and is now a vital part of every major NASA research and development mission.

NASA’s call to “inspire the next generation of explorers” is now resounding throughout the NASA community and schools of all levels all around the country. The goal is to capture student interest, nurture their natural curiosities, and intrigue their minds with new and exciting scientific research; as well as to provide educators with the creative tools they need to improve America’s scientific literacy. The future of NASA begins with America’s youngest scholars. According to Administrator O’Keefe’s address, if NASA does not motivate the youngest generation now, “there is little prospect this generation will choose to pursue scientific disciplines later.”

Since embracing Administrator O’Keefe’s educational mandate over a year ago, NASA has been fully devoted to broadening its roadmap to motivation. The efforts have generated a whole new showcase of thought-provoking and fun learning opportunities, through printed material, Web sites and Webcasts, robotics, rocketry, aerospace design contests, and various other resources ... as only NASA can.

Administrator O’Keefe selected a highly experienced educator and education administrator, Dr. Adena Williams Loston, in the fall of 2002, to lead the charge for NASA’s Education Enterprise. Dr. Loston’s mandate from Administrator O’Keefe is to stimulate interest among students in science, technology, engineering, and mathematics study and careers by raising public awareness among educators, students, and parents about the vast array of NASA education programs and resources available. The mandate also calls for the engagement of these individuals in interactive educational activities that highlight the discoveries and missions of NASA’s Offices

of Space Flight, Space Science, Aerospace Technology, Earth Science, and Biological and Physical Research.

In 2002 alone, NASA reached well over half a million educators, nearly two million students in grades K through 12, and almost 70,000 higher education students through direct, on-site activities and programs. In addition to those served by broad-based NASA Education programs, the Agency also directly reached over 17,000 minority students through its minority-targeted academies, scholarships, and initiatives.

Whirlybirds, Pigeons, and Bats, Oh My!

In one particular endeavor to inspire the Nation’s youth, NASA decided in 2002 to build on children’s fascination with flying vehicles. “Robin Whirlybird on Her Rotorcraft Adventures,” an online, interactive children’s book, is introducing kindergarteners through fourth graders to the history, concepts, and research behind aeronautics and rotorcraft. Designed to have the look and feel of a children’s book, the story revolves around a young girl named Robin who visits a NASA research center where her mother works as an engineer. During her visit, Robin explores the concepts of aeronautical design, the physics of flight, and the practical application of rotorcraft, also known as helicopters or runway-independent aircraft. The book incorporates interactive elements on every page, a menu bar with various exploration buttons, and lesson plans aimed at strengthening language arts and vocabulary skills, making it a unique classroom tool.

In a similar effort also launched last year, NASA’s “The Adventures of Amelia the Pigeon” project is teaching children how scientists use satellite imagery to better



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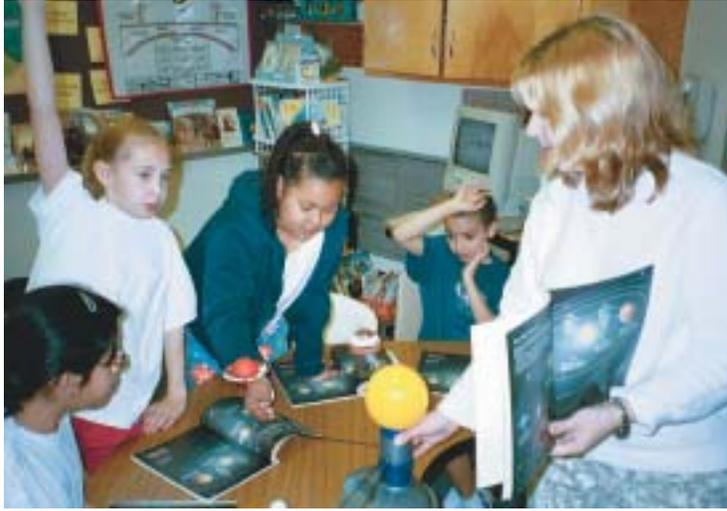
understand the Earth's environmental changes. The Web site acquaints young students (grades K through four) with Earth science concepts, beginning with classifying objects by shape, color, and texture, building a foundation for interpretation and understanding of remote sensing. The pigeon adventure—based in New York City, because of its size, diversity, and visibility of prominent features in satellite imagery—encourages the development of children's inquiry skills, via online explorations, sequential storytelling, and hands-on investigations. The story also features supplemental classroom materials associated with National Science Education Standards. "Amelia the Pigeon" is a result of Goddard Space Flight Center's Interactive Multimedia Adventures for Grade School Education Using Remote Sensing (IMAGERS) collaboration with the Department of Interior's United States Geological Survey, and follows on the success of the "Echo the Bat" program, which teaches children to understand light and the electromagnetic spectrum, as they apply to remote sensing.

New Series of Science Books

In March of this year, NASA and Pearson Scott Foresman, the leading pre-K through sixth grade education publisher, formally agreed to collaborate on elementary and middle school science curricula. Under the terms of the partnership, Pearson Scott Foresman editors and authors will draw upon NASA's rich archival material and extensive research in biological, physical, Earth, and space sciences to create the Scott Foresman Science series of books. NASA experts will review the content, and Pearson Scott Foresman will ensure the curricula reflect National Science Education Standards, as well as other specific targeted standards. Before the new series is published, specific lessons will be developed for students and teachers, following the steps that Barbara Morgan, NASA's first Educator Astronaut and a second and third grade teacher, is taking in preparation for flight into space.

Astronomy

Further helping students to reach for the stars, a new NASA astronomy program is bringing together existing Internet technology and other tools to open the universe to those who would otherwise be denied the experience due to their physical or cognitive disabilities. The effort, funded by NASA through the Space Telescope Science Institute (STScI) of Baltimore, involves the participation of the elementary school system in Howard County,



Students in the fourth grade at Longfellow Elementary School, Columbia, Maryland, answer questions about the solar system, using a planetary model called an "orrery" that they painted after viewing Hubble Space Telescope pictures.

Maryland. Dr. Carol Grady, a National Optical Astronomy Observatory researcher stationed at Goddard Space Flight Center, is the science lead for the program. She became involved after her son, who has special needs, expressed an interest in her work with the Hubble Space Telescope on planet formation and stellar evolution. "The advances in astronomy over the last hundred years are one of humanity's greatest cultural achievements, and I did not want kids like my son to get the message that activities like this are not open to them," said Grady. The team chose to target elementary-age students so that it can deliver assistive technology to them before frustration leads them to give up attempting to learn.

The wonders of the universe are also being brought to the fingertips of visually impaired students in a new book titled "Touch the Universe: A NASA Braille Book of Astronomy." The 64-page book presents color images of planets, nebulae, stars, and galaxies. Each image is embossed with lines, bumps, and other textures. The raised patterns translate colors, shapes, and other intricate details of the cosmic objects, allowing the visually impaired to feel what they cannot see. The book incorporates Braille and large-print descriptions for each of its 14 photographs to make it accessible to readers of most visual acuities. "Touch the Universe" takes the reader on a cosmic journey. It begins with an image of the Hubble Space Telescope orbiting Earth, and then travels outward into the universe, showing objects such as Jupiter, the Ring Nebula, and the Hubble Deep Star Field North. The author, Noreen Grice, teamed with

Bernhard Beck-Winchatz, an astronomer at DePaul University in Chicago, to develop the book with a \$10,000 Hubble Space Telescope grant for educational outreach. Students at the Colorado School for the Deaf and Blind in Colorado Springs evaluated the early prototype images for clarity and provided suggestions for improvement prior to publication.

Space Day 2003

Students of all ages gathered at various sites around the world on May 1 to pay tribute to aerospace exploration and to celebrate the “Future of Flight.” Administrator O’Keefe and Senator John Glenn kicked off the celebration with an opening ceremony at the Smithsonian’s National Air and Space Museum in Washington, DC. During the ceremony, student teams and teachers around the country were recognized for their “stellar” future spacecraft designs. The “Young Ohio Engineers” from Grace Home School in Westerville, Ohio, was the team awarded with the best overall “Fly to the Future” design among fourth and fifth graders. This five-student lineup designed a multi-functional X-76 Independence aircraft that could be used for various tasks, including commercial transport and military use. The X-76 Independence contains many interchangeable parts (based on its mission), is powered by a combination of turbo jet and scram jet engines that change modes based on altitude and speed, and has a vertical takeoff and landing system that enables it to be used almost anywhere.

In the “Planetary Explorers” challenge, “Team Jupiter” from the Franklin Magnet Middle School in Champaign, Illinois, took home the best overall award among sixth through eighth graders for their creation. Team Jupiter decided to go to Europa, one of the moons of Jupiter, and conduct scientific experiments. Their



“CSSC-BAM V” vehicle featured a blended-wing body design made from titanium alloy. It would use jet engines when flying on Earth or to near-Earth orbit, and plasma engines in space. A team of snakebots—machines that can crawl, coil, climb, and grasp, just like serpents—each with its own unique task, manned the plane to explore the surface of Europa upon arrival.

The celebration continued around the globe. In Morris Plains, New Jersey, first graders at Mountview Road School attempted to simulate dockings, manipulate tools under water, and eat food as if they were in a weightless environment. In Crawfordville, Florida, students viewed space videos, built small LEGO machines using NASA glove boxes they made, read space exploration books, and ate moon pies. At the Museum of Science in Boston, Massachusetts, Jet Propulsion Laboratory Solar System Ambassador Charlie Haffey spoke about the exploration of Mars, Jupiter, and Saturn, which prompted students to construct scale models of the planets. Internationally, students from Arecibo, Puerto Rico, toured the world’s largest radio telescope that searches for life in distant galaxies. In Pukekohe, South Auckland, New Zealand, students were treated to space awareness workshops featuring hands-on activities.

Over 500 schools worldwide participated in the “Student Signatures in Space” program to sign posters that will be digitized and eventually flown on a Space Shuttle mission. Established in 1997, Space Day is dedicated to the extraordinary achievements, benefits, and opportunities in the exploration and use of space. NASA is one of more than 75 organizations that support the award-winning educational initiative.

SEMMA: A Decade of Devotion to Learning

Over the last 10 years, an innovative program managed by the Office of Educational Programs at NASA’s Glenn Research Center has been inspiring a diverse student population in grades K through 12 to pursue careers in the fields of science, engineering, mathematics, and technology. The 10th anniversary celebration of the

Administrator Sean O’Keefe visits with students at Space Day 2003—Celebrating the Future of Flight. Space Day, the annual tribute to aerospace exploration, invited young students to honor the previous 100 years of aviation accomplishments at the Smithsonian’s National Air and Space Museum on May 1.

Photo credit NASA/Renee Bouchard

Science, Engineering, Mathematics, and Aerospace Academy (SEMMA) coincided with the annual National SEMMA Conference held in June in Cleveland, Ohio. Educators, students, parents, and administrators from all 19 SEMMA sites across the country attended. The focus of the conference was to develop additional ways to create awareness and access to programs with similar purposes and to develop partnerships. SEMMA was born in 1993 of then U.S. Congressman Louis Stokes' concern about the low level of academic achievement of the young students in his district and his urging for the creation of a unique program that would focus on mathematics and science.

NASA Explorer Schools

A new NASA education initiative has been designed to provide customized, extended professional development for educators and unique NASA science and technology learning experiences for students. The 3-year NASA Explorer School (NES) program will align participating schools with NASA personnel and other partners to develop and implement action plans for teachers and administrators. The action plans will promote and support the use of NASA materials and programs that address local needs in mathematics, science, and technology. Fifty NES teams will be chosen from around the country. Each team will consist of three or four science, mathematics, or technology educators, an administrator, and a state supervisor, and will participate in an expense-paid week of intensive training at one of NASA's 10 centers. Each team will also receive a \$10,000 grant, intended to assist with the purchase of science and technology tools to support implementation plans and bring cutting-edge technology to the classroom. The 2003 pilot year focus is for grades five through eight.

Emmy Award-Winning Television Programs

In an effort to continue promotion of higher learning through educational television programming, NASA is joining forces with South Carolina Educational Television (SCETV) to video-stream three educational television series to classrooms throughout South Carolina and across all other states. Developed by Langley Research Center's Office of Education, the Emmy Award-winning shows "NASA Science Files" and "NASA Connect" are aimed at students ranging from grades 3 through 12; the third show, "NASA's Destination Tomorrow," is also an Emmy Award recipient, but is designed for educators, parents, and life-long learners. NASA is using SCETV facilities to broadcast the three series nationwide. Approximately 18,000 South Carolina educators, representing about 500,000 students, are registered users of the programs.

Webcasts

NASA Webcasts are also becoming more prevalent in America's schools. Ames Research Center's "NASA Quest" Web site, a rich resource for educators, children, and space enthusiasts interested in meeting and learning about the people who work for the Space Program, features a full calendar of audio/video Webcasts and live, interactive events. On any given day, students and others can log on and learn why a deep-sea submersible laboratory stationed in the Florida Keys is helping NASA astronauts to prepare for long-term space travel; why NASA is studying the Northern Lights phenomena to improve satellite operations and space communications; and how a catalytic carburetor designed by NASA will help to reduce air pollution. NASA Quest also connects schools with NASA staff through Web chats, forums, e-mail, informative biographies and journals, curriculum resources, and more.

In March, students from grades 5 through 12 explored the frozen landscapes of Colorado's Rocky Mountains—from their desks. As virtual participants in two live Webcasts, students nationwide joined scientists from NASA, the National Oceanic and Atmospheric Administration (NOAA), other Federal agencies, and many universities as they studied the role of snow-cover on the Earth's water and climate. Using skis, snowmobiles, aircraft, and satellites, scientists participating in the 2003 NASA-NOAA Cold Land Processes Experiment studied snowpack from the ground, air, and space across the winter and spring of this year to improve forecasts of springtime water supply and snowmelt floods. Through interaction, students gained an understanding of how remote sensing is used in Earth science research and how



The NASA Connect team visited students at Andoya High School in Andenes, Norway, to tape an instructional video as part of its annual series of free standards-based learning programs.

scientists verify data from airborne platforms and satellites hundreds of miles above the planet.

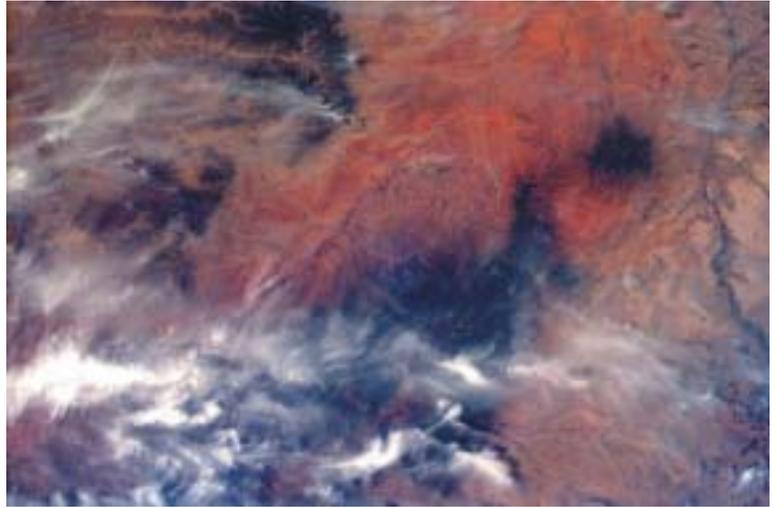
Frozen ice was also the topic of a series of live Webcasts in April. Secondary and college classrooms were invited to participate in the Internet broadcasts to explore the frozen ice sheets of the North Pole and learn how they play a role in warming the Earth. The actual research was carried out by NASA scientists and Native American students from the Bay Mills Community College in Brimley, Michigan. Together, the scientists and college students gathered data about the nature and thickness of sea ice in the Arctic and measured the concentration of aerosols and their specific properties, such as size and absorption of sunlight (the amount of sunlight that aerosols absorb is important in helping scientists better understand how they contribute to trapping heat in the atmosphere and warming the Earth). The purpose of involving the Bay Mills students was to inspire Native American students to seek out careers in technology and science. Students watching the Webcasts from their classrooms had the opportunity to dialogue with the scientists and the students in the field.

In May, an interactive Webcast gave students an early look at NASA's plans to land two twin robotic geologists on Mars in January 2004. The hour-long "Countdown to Mars" program, hosted by "Bill Nye the Science Guy," invited 250 students to conduct science and engineering experiments based on those of the actual Mars Exploration Rover mission. Viewers throughout North America were able to interact via e-mail as the students carried out the experiments on camera. Jet Propulsion Laboratory's Dr. Joy Crisp, the rovers' project scientist, joined the program as one of its guests.

Another Webcast that took place in May offered eighth graders from economically disadvantaged Chicago-area schools the opportunity to see science in action and be inspired by the International Space Station crew. The event, hosted by Chicago's Adler Planetarium and Astronomy Museum, "connected" the students with Expedition Seven astronaut Ed Lu and cosmonaut Yuri Malenchenko. The Space Station Webcast was just one of many enabled by NASA's Teaching in Space Program, managed by Johnson Space Center.

Snapshots From Space

In a case of long-distance learning, middle school students from McNair Magnet School in Cocoa, Florida, were the latest participants in a NASA project that allows youngsters to take pictures of the Earth using a camera



An aerial image of Arizona and Utah, taken from the International Space Station by middle school students, via Internet connections.

on the International Space Station (ISS). The ISS EarthKAM (Earth Knowledge Acquired by Middle school students) project, created in 1994 by Dr. Sally Ride—America's first woman astronaut, is helping scientists from Goddard Space Flight Center study the planet's changing surface. From April 29 to May 2, the McNair Magnet students controlled the high-resolution digital camera operating on the Space Station's Destiny science module, via Internet connections. The students profited by being involved in the process of real scientific research and through their interaction with scientists as they worked together on the analysis of research images. The next picture-taking mission is scheduled for November 2003, followed by four more in 2004.

Contests to Challenge the Mind

The two twin robotic geologists being sent to Mars now bear the names "Spirit" and "Opportunity," thanks to a 9-year-old explorer-to-be. Sofi Collis, a third grader from Scottsdale, Arizona, wrote the winning essay in a contest to name the rovers. Collis' essay was selected from nearly 10,000 entries in the contest, sponsored by NASA and Denmark-based toymaker LEGO, Co., with collaboration from the Planetary Society of Pasadena, California. Collis, who was born in Siberia and brought to the United States through adoption, read her essay at the name-unveiling ceremony in June at Kennedy Space Center: "I used to live in an orphanage. It was dark and cold and lonely. At night, I looked up at the sparkly sky and felt better. I dreamed I could fly there. In America, I can make all my dreams come true. Thank you for the 'Spirit' and the 'Opportunity.'"



Explorer-to-be Sofi Collis with a Mars Exploration Rover model.

Nobel laureate physicist Luis Alvarez and his coworkers proposed in 1980 a theory that an asteroid collided with the Earth about 65 million years ago, causing the extinction of the dinosaurs. The Earth has experienced catastrophic changes in its history that have changed the course of biological evolution many times. Should disaster strike the Earth, a large space colony civilization can insure life's survival and, if possible, succor Earth, according to NASA scientists. The idea of space colonies is also a natural curiosity, because living things want to grow and expand, like weeds that grow through cracks in sidewalks, and living creatures that crawl out of the oceans and colonize land. NASA notes that the key advantage of space settlements is the ability to build new land, rather than take it from someone else. This allows, but does not guarantee, a huge expansion of humanity without war or destruction of Earth's biosphere.

NASA hosts an annual Space Settlement Contest, sponsored by the Fundamental Space Biology Program



Image courtesy of The LEGO Company

at Ames Research Center, to encourage students to develop the ideas and skills necessary to make orbital colonies a possibility. The contest challenges students in grades 6 through 12 to investigate and then develop designs for a permanent, relatively self-sufficient home that cannot be based on a planet or a moon. The Fundamental Space Biology Program created a Web site that provides students access to a wealth of electronic resources to help in developing designs. The 2003 grand prize winners were two middle school students from Romania. Horia Mihail Teodorescu and Lucian Gabriel Bahrin submitted the design for an orbital colony called "Teba 1." The winning design was chosen by a panel of NASA scientists from a field of 89 designs submitted by 307 students from the United States, Austria, India, Japan, and Romania. The grand prize winners, along with the first-, second-, and third-place winners in the individual and small group categories, were invited to Ames to present their designs, talk to NASA scientists, and tour the Fundamental Space Biology laboratories.

More creative problem-solving took place during the 26th annual "Odyssey of the Mind World Finals," held at Iowa State University in May. Sponsored by NASA's Earth Science Enterprise, the Odyssey contest tested the abilities of students of all ages from around the world to design, construct, and run three small vehicles to transport items from an orbit area to an assembly station in "space." The NASA problem opened with a three-dimensional representation of an Earth scene as viewed from space. Items affecting the problem, both real and imaginary, were added to the scenario, effecting a scene change. The vehicles were powered in different ways: one carried its energy source, and two traveled on the momentum created by different sources. This problem was one of five long-term challenges presented at the contest. During the year, students were separated into four divisions, based on age, and formed teams to solve one of the challenges. After developing their solutions, teams competed at state and regional levels, before moving on to the World Finals.

Students are also receiving an educational "boost" through a variety of rocketry challenges. More than 1,000 students from 100 high schools throughout the United States gathered in Virginia to compete in the inaugural Team America Rocketry Challenge, considered the world's largest model rocket contest. The event, held in conjunction with the national yearlong

A LEGO 1:1 scale model of the Mars Exploration Rover, shown on display at the World Space Congress in Houston, Texas, in October 2002. The rover model weighs 130 kilograms (290 pounds), is made from approximately 90,000 LEGO elements, and took 650 man-hours to build.



Space Settlement Contest: Design submitted by students from Kadena Middle School in Okinawa, Japan (2002).

Centennial of Flight Celebration, offered student teams awards worth \$59,000. Boonsboro High School of Boonsboro, Maryland, placed first in the contest. The top 10 teams became eligible to submit proposals to participate in the 2004 Student Launch Initiative at Marshall Space Flight Center, where students build reusable launch vehicles carrying a science experiment payload up to an altitude of 1 mile.

Elementary and high school students from five states worked feverishly for 9 months across 2002 and 2003 to prepare their experiments for launch aboard a NASA rocket to the upper limits of the Earth's atmosphere. In June, they saw their hard work pay off with the launch of the 20-foot-tall NASA sounding rocket from the Wallops Flight Facility in Virginia. The high school students' experiments focused on satellite communications, spectral imaging and analysis, and materials and fluids in a

high-stress environment, while the elementary students' experiments focused on static electricity. The flight, part of the NASA Student Involvement Program, exposed the experiments to stresses 15 times Earth's gravity.

In the realm of robotics, hundreds of students from the United States and Canada converged on Cleveland, Ohio, in March for the Buckeye Regional For Inspiration and Recognition of Science and Technology (FIRST) Robotics Competition. Working side-by-side with professional engineers and technicians, the students took a hands-on approach to discover what real-world engineering is all about. The students were divided into teams for a game called "Stack Attack," in which they maneuvered robots they built to detect and attack opposing robots' stacks of plastic containers. Participating robots were required to operate autonomously using onboard sensors to seek out the containers. The students would then take control, commanding their robots to position as many containers as they could on their side of the playing field and also stack them as high as possible. Although each team started out with the same parts kit to build its robot back in January, 64 unique robotic creations were represented at the competition.

In another region, students gathered at Houston, Texas' Reliant Park for the FIRST Robotics Lone Star Competition. They too, participated in a game of Stack Attack to determine the best functioning robots. The winners of the Cleveland and the Houston competitions—sponsored by Glenn Research Center and Johnson Research Center, respectively, in cooperation with local corporations, educational institutions, and organizations—and 21 other regional U.S. contests competed in the FIRST Robotics Championship Competition in May. On a whole, NASA and its Robotic Education Project sponsored 207 of the nearly 800 teams entered in the 2003 FIRST competition. Regional and national awards were presented to students for excellence in design,



At the 2003 For Inspiration and Recognition of Science and Technology (FIRST) Robotics Competition, students participated in a game called "Stack Attack."

engineering innovation, control systems, demonstrated team spirit, sportsmanship, and many other categories.

NASA's Offices of Space Flight and Aerospace Technology, through the NASA Quest program, sponsored a separate robot-design initiative called the Robotic Helper Design Challenge. In May, the 2-month educational activity brought students and NASA experts together for a live Webcast to review the progress of the students' designs, intended to help astronauts living and working on the ISS. Through the Webcast, the students engaged in a virtual tour of the ISS, learned about microgravity, and had questions about their designs answered by NASA experts. An estimated 2,500 students in 100 classrooms (representing 26 states and 7 countries) took part in the final design challenge. Entries included a Space Pet Involving Kinetic Energy (SPIKE) robot that uses propellers to steer itself while floating through low-gravity atmospheres (created by eighth graders at Barkalow Middle School in Freehold, New Jersey), and "Mr. Helper," which comes equipped with a homing device so that it can return to its docking bay to recharge, and a large storage compartment for astronauts' tools (created by fourth, fifth, and sixth grade students at the K.R. Smith Elementary School in San Jose, California). The inspiration for the design challenge was NASA's prototype Personal Satellite Assistant, an astronaut-support tool devised to move and operate autonomously or by remote control in the microgravity environment of the Space Shuttle, ISS, or a future space vehicle.

Collegiate Research Opportunities

Students closing in on their undergraduate and post-graduate degrees are really getting a taste of what it is like to work for NASA, through real-life research opportunities. At North Carolina State University, students enrolled in an aerospace design class are helping NASA expand the exploration of Mars' surface. The team of students and researchers designed a wind-powered rover that can be blown, like a tumbleweed, across the surface of the Red Planet, for the purpose of collecting atmospheric geological samples. To create the Tumbleweed Earth Demonstrator rover, the team studied Langley Research Center concepts, researched wind tunnel testing, and performed actual field-testing. The student-built rover is expected to provide preliminary data that will influence future tumbleweed design concepts.

Three students working toward graduation and advanced degrees are looking forward to adding the title of "inventor" to their names. As participants in NASA's Undergraduate Student Research Program through Marshall Space Flight Center, Amanda LaZar, Dave Broderick, and Andrew Schnell have suggested innovations that soon could be used by the Space Program to



A team of North Carolina State University students designed a wind-powered rover that can be blown, like a tumbleweed, across Mars' surface, to collect atmospheric geological samples.

increase safety, facilitate inspection and maintenance of delicate equipment, and create lightweight structures strong enough to withstand the harsh environment of Earth orbit.

LaZar, a mechanical engineering student at the University of South Carolina on pace to graduate in 2003, anticipates receiving a patent for finding a way to weld joints on the Space Shuttle External Tank that will both improve safety and reduce repair costs. Broderick, an electrical engineering and computer science student at Hartford University also on course to graduate in 2003, completed his first summer as an undergraduate researcher at Marshall in 2002. He helped develop a vision-based guidance system for a miniature robot, allowing technicians to make inspections and repairs without having to dismantle the apparatus. Schnell, now in his third year of the student research program after having graduated magna cum laude from the Georgia Institute of Technology in 2002, came up with a new manufacturing process that uses balloon-like material inflated with gas and filled with hardened foam to create beams and other structures. Expected to be patented, it has potential for both space and ground uses, such as space solar power systems or sporting equipment. If used in place of conventional space structure materials such as

metal alloys, Schnell's innovation could drastically cut payload weights on the Space Shuttle, which currently cost about \$10,000 per pound to launch.

Each year, the Undergraduate Student Research Program offers undergraduates across the Nation mentored research experiences at participating NASA centers, through fall and summer sessions. NASA additionally hosts the Graduate Student Researchers Program to award fellowships for graduate study leading to research-based masters or doctoral degrees in the fields of science, mathematics, and engineering.

Six students from the University of New Mexico, Oregon State University, Utah State University, and the University of Utah are spending the summer of 2003 monitoring the West Nile virus, studying satellite images to assess the potential for dangerous wildfires, and embarking on many other educational adventures involving natural resources. Selected to receive training and complete internships in applied Earth science under the "Develop" program, the students will lead investigations by applying NASA technology to local concerns. Develop provides workforce growth and outreach to communities, enabling students to tap science to help solve real-world problems. The 10-week project began in June at Ames Research Center. The primary objective of the West Nile virus study is to identify potential mosquito habitats and correlate the data to human populations at high-risk. For the wildfire task, the students are mapping and monitoring invasive and noxious plant species that act as fuel for wildfires.

Partnerships to Encourage and Inspire

During a week in May, NASA joined Career Opportunities for Students with Disabilities (COSD) at the group's annual meeting in Redmond, Washington. COSD is actively helping NASA find qualified students with disabilities who are pursuing mathematics, science, engineering, and technical degrees for employment with the Agency. NASA also supports COSD by providing outreach and assistance to Historically Black Colleges and Universities and Minority Institutions to encourage recruitment, development, and academic growth opportunities.

In the past year, NASA helped to launch a new education center to inspire and support socially and economically disadvantaged students in their quest for higher learning. The NASA Center for Success in Math and Science, located on the Avondale, Arizona, campus of Estrella Mountain Community College, was dedicated by NASA astronaut Carlos Noriega and Estrella President Homero Lopez. The center not only reaches out to local Hispanic students in metropolitan Phoenix, it



Astronauts Barbara Morgan and Leland Melvin visit with students and teachers at the Hardy Middle School in Washington, DC.

also engages Hispanic-Serving Institutions currently not involved in NASA programs, especially community colleges. Through the center, NASA will provide educators with unique resources to create learning opportunities that support educational excellence, encourage family involvement, and establish links with local business and community groups.

NASA recently launched its 2003 Summer High School Apprenticeship Research Program (SHARP) after competitively selecting 340 high-achieving students representing nearly every state in the Nation and the U.S. territories of Puerto Rico and St. Croix. In June, NASA SHARP participants, chosen from a pool of more than 2,400 applicants, became apprentices to scientists and engineers at NASA centers and universities around the country. NASA SHARP is a synergistic, research-based program that focuses on NASA's mission, facilities, human resources, and other programs. The effort advances the Agency's goal to involve underrepresented students in academic, workplace, and social experiences, as well as research opportunities to support the educational excellence of the Nation.

In another partnership, NASA and the Foothill-De Anza Community College District will facilitate the development of an academic center in NASA Research Park at Ames Research Center for first-generation college students interested in science, technology, and engineering careers. The agreement will bring community college students to classrooms and laboratories onsite at Ames. Since 1957, the Foothill-De Anza Community College District has responded to the needs of more than 1 million Silicon Valley students.

Educator Astronaut and Earth Crew Programs

It is official: Teachers are more interested in space than ever! NASA's mailroom overflowed with

applications from teachers who want to become members of the permanent Astronaut Corps. NASA received over 8,800 teacher nominations during the 3-month recruitment phase; even more, the Educator Astronaut Program office received over 1,600 applications. NASA will review the applications and select Educator Astronaut candidates to begin training with the Astronaut Corps at Johnson Space Center. After graduation, new Educator Astronauts will be eligible for a Space Shuttle flight assignment as fully trained Mission Specialists.

To promote the program and encourage students to nominate their teachers, astronaut Barbara Morgan and Educator Astronaut Program co-managers Debbie Brown and Leland Melvin (also an astronaut) visited many schools and organizations around the United States and in Puerto Rico. Melvin, for example, enlightened teachers and students at schools, conferences, and community centers such as Rome Free Academy, Proctor High School, and the Gloria Wise Boys & Girls Club & Community Center in New York; and Elliot Middle School and the Vanguard Learning Center of Compton in California.

As a former National Football League player, Melvin was on his way to stardom when his football career was cut short by an injury. He decided to pursue an alternative passion, engineering, which led to his acceptance into NASA's permanent Astronaut Corps in 1998. He is taking his story on the road to inspire students to follow their dreams and always have a back-up plan. "To accomplish great things, you must not only dream, but also plan; and every plan should contain options, like having a spare tire, just in case you get a flat," Melvin said.

A recent survey conducted by the National Science Teachers Association indicated that more than 91 percent of science teachers should have a place aboard future

Space Shuttle flights, to bring the educational value of the missions to the classroom. Science teachers also believe Educator Astronauts could spark student interest in science and mathematics careers, and serve as role models to instill in students how these studies apply to the real world.

Meanwhile, the next phase of engaging students, teachers, and parents to explore space took flight through NASA's Earth Crew activity. International participants are welcomed and encouraged to join the Earth Crew, which currently consists of more than 23,000 U.S. and international members. The Web-based educational program features activities that enable students, educators, and parents to interact with astronauts, scientists, and engineers in projects and missions. New inspiring and educational Earth Crew Missions became available on the Educator Astronaut Web site in May.

With a charter like no other, NASA has led some of the most unique missions in the world. From traveling to low-Earth orbit and walking on the Moon, to viewing the farthest reaches of our solar system, NASA has continually worked to share the discovery and adventure along the way. Each of these achievements is something that only NASA can do; therefore, the Agency is striving even more to share these experiences with inquisitive minds in order to inspire and prepare them for future challenges.

NASA-sponsored education programs create a pipeline that engages a diversity of students in the earliest grades and encourages them to continue through college, graduate school, and postgraduate studies in science, mathematics, engineering, technology, and geography. NASA continues to develop and structure programs incorporating its resources and technologies to inspire the next generation of explorers ... as only NASA can.



Making way for future explorers: (from left to right) Dr. Clifford W. Houston, NASA Deputy Associate Administrator for Education Programs; Peggy Steffen, Program Manager, NASA Explorer Schools Program; Dr. Shelley Canright, NASA Director of the Office of Technology & Products, Education Enterprise; and Dr. Huan Ngo, Team Lead, Sheridan Magnet Middle School, New Haven, Connecticut (NASA Explorer School). NASA astronaut Ed Lu (left background) and Russian cosmonaut Yuri Malenchenko (right background) join the NASA Explorer School officials via a live feed from the International Space Station.