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NASA's Educational Programs

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NASA's role in aeronautics and space research and development has resulted in many referring to NASA as an education agency. They say this because of the mandates in the Space Act to expand human knowledge of space, to arrange for participation in space endeavors by the scientific community, and to disseminate information to the widest practicable audiences. Aeronautics and space topics have long been known to be a magnet for learning. Today, with the increased attention on educating our citizens, NASA hopes to assist the educational community in the use of this magnet through its educational programs.

To achieve this goal, the Educational Affairs Division has designed educational programs to capture students' interest in science, mathematics, and technology at an early age, and to maintain their interest throughout higher learning. At the high school and university levels, these educational programs seek to channel more students into engineering and science careers. For teachers and university faculty, NASA's educational programs recognize the importance of upgrading knowledge, skills, and experience.

Excellence in education becomes more important than ever as NASA continues Space Shuttle operations and begins construction of Space Station Freedom, a permanently manned space station.

The national goals that will extend U.S. leadership include a permanent lunar base, expeditions to Mars, and extensive exploration of our solar system. Meeting these goals, however, will require years of planning and preparation. Intensive research and technology development in robotics, automation, space sciences, life sciences, space transportation, and many other areas must take place. Such research and development depend on a well-educated workforce. A large pool of highly motivated, talented workers must be developed and available. Action must be taken now to ensure that our youth are equipped with the educational tools they will need. This effort will require the cooperation of government,

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industry, the educational community, and the public. NASA will continue to play a pivotal role in the development of this workforce through its Educational Affairs Division and its installations.

PIPELINE ISSUES

In the Educational Affairs Division, much of our attention is occupied by trying to keep the "pipeline" of science and engineering students filled. These same issues preoccupy other organizations throughout the country. Significantly, the United States is faced with:

- a decline in the number of students who choose science and engineering careers;
- a low level of literacy in science and mathematics for our middle- and high-school students compared with similar-level students in other industrialized countries;
- a declining proportion of 18- to 24-year-olds who represent the traditional college students;
- a projected 36 percent increase in scientists and engineers needed by the year 2000;
- a large increase expected in the early 21st century in under-represented minorities and women, a group not traditionally drawn to the physical sciences and engineering; and
- a decline in the proportion of U.S. citizens pursuing Ph.D.s in science and engineering, compared with an increase in foreign nationals pursuing these advanced degrees from American universities.

These issues are compounded when one takes a close look at the poor preparation our teachers receive. For example, the 1983 Yearbook of the National Science Teachers Association reports that nearly one half of all high-school science teachers have never had a course in computer science or calculus. It further states that only one-third of all elementary science teachers have taken a college chemistry course, and that only one-fifth have had a course in physics.

NASA AEROSPACE EDUCATION PROGRAMS

Covering fiscal years 1988 through 1992, the Educational Affairs Division's Five-Year Plan provides the framework for NASA's overall aerospace education program. It encompasses our developmental planning in elementary education, teacher education, university programs, educational partnerships, and emerging educational technologies. The five-year plan states critical objectives for increasing the teaching of space science and technology in elementary and secondary schools, development of educational partnerships, the new Space Grant College and Fellowship Program, ambitious goals for reaching increasing numbers of under-represented minorities, and strategies for improving the longstanding and immensely popular Aerospace Education Services Program, commonly known as the Spacemobile Program.

In August 1988 an agencywide inventory of NASA educational programs was completed. Using data from 1987, the inventory revealed that NASA administers 162 aerospace education programs and projects, which cover elementary, secondary, university, and post-graduate levels. These programs reached more than 6 million participants with the annual cost for all programs at almost \$64 million.

Some of our educational programs are designed to address specific pipeline issues, such as how to capture a student's interest in science, mathematics, and technology at an early age and grade level. In the late 1950s, the United States was also concerned with increasing interest in mathematics and science education, but focused energies on students at the secondary level. Since then we have learned that if students do not develop a significant interest in these subjects by the third or fourth grade, their prospects of developing an enduring interest diminish over time.

Our aerospace education programs typically seek to channel more students at the junior and senior high and undergraduate levels into science, engineering, and related career paths. For university graduates and post-graduates, our focus is on attracting and retaining students in critically needed aerospace disciplines, and for teachers and university faculty, we strive to upgrade their knowledge, skills, and experiences.

Pre-College Student Programs

The Aerospace Education Services Program (AESP), or Spacemobile as it is better known, was initiated in 1961. The program gets its name from the fact that its corps of 26 aerospace education specialists drive specially equipped NASA vans to elementary and secondary schools around the country. At the schools, these specialists conduct school assemblies, give classroom lectures, conduct teacher inservice and preservice workshops, and hold community education enrichment programs. They use models of the Space Shuttle, rockets, and satellites, as well as actual spacesuits and space food. They also use interactive computers and laser disc players.

During fiscal year 1988, the Spacemobile Program reached 876,000 students and 27,700 teachers through 4,200 assembly programs. Specialists visited 3,000 classrooms in 1,900 schools, and conducted 1,600 teacher workshops. Unfortunately the extensive demand for Spacemobile visits and the current funding limit, which keeps us at 26 specialists, means that a school requesting a Spacemobile visit could have to wait anywhere between two and four years.

The Urban Community Enrichment Program (UCEP) is conducted by a small subset of the aerospace education specialists. By working collaboratively with up to 20 schools in an urban area for up to eight weeks (or a semester) at a time, these aerospace specialists conduct a program that reaches out to an entire community.

The Summer High School Apprenticeship Program (SHARP) is designed for academically superior under-represented minority students. The program provides selected students eight weeks of summer employment at NASA installations under the mentorship of a NASA scientist, engineer, or other technical specialist. Over the past eight years the program has averaged 150 students a year and has been one of NASA's most effective programs. Nearly all of the students graduate from high school, attend college, and major in science, engineering, or other disciplines germane to NASA's interests. Many who have since graduated from college are either working professionally in aerospace fields or attending graduate schools.

The Space Science Student Involvement Program (SSIP) is a partnership program administered through a contract with the National Science Teachers Association (NSTA). The program is designed to encourage students in grades 6 through 12 to develop aerospace-related experiments and to compete for an opportunity to have their experiments tested

by NASA. During the 1987-1988 program year, 1,945 students submitted entries, and many who reached the regionals were called upon to defend their proposals before a team of NASA scientists and engineers. The competition resulted in 11 national winners at the senior-high level and three national winners at the junior-high level.

SSIP also reaches thousands of students who do not submit formal entries. They are exposed to the program by the creative teachers, who incorporate aerospace concepts and materials into classroom activities. SSIP's Mars Settlement Illustration and Journalism competition also involve students in aerospace activities.

The program's immediate predecessor, the Space Shuttle Student Involvement Program, has permitted 19 student experiments to fly on the Shuttle. The final two Shuttle experiments were on board STS-29. They investigated animal bone healing in weightlessness, and the effects of space flight on the development of fertilized chicken embryos. President Bush invited those students, their faculty advisers, and commercial underwriters to the White House for special recognition, along with the STS-29 astronauts.

The NASA Orbiter Naming Program was initially sponsored by Congressman Tom Lewis (R-Florida) in March 1986 and authorized by Congress in October 1987. The legislation called for the name of NASA's replacement orbiter to be selected from suggestions submitted by students in elementary and secondary schools. Its purpose was to increase students' interest and enthusiasm for space exploration, research, and discovery.

NASA consulted other federal agencies and educational associations in designing the clear educational content of this program. Over 71,000 students representing 6,100 teams, each led by a school faculty member, entered the national competition. They prepared and submitted interdisciplinary classroom projects to justify the name they proposed. The winning name, selected by President Bush, was Endeavour, the name of the ship James Cook sailed to explore the South Pacific and the Antarctic in the 18th century. It was the name entered by both the winning elementary and secondary teams. The winning teams were from Senatobia, Miss., and Tallulah Falls, Ga. They were honored, along with their faculty team coordinators, by President Bush in a White House ceremony on May 16, 1989, along with the STS-30 astronauts.

The Space Exposed Experiment Developed for Students (SEEDS) will allow students from grade 5 through the university level to determine what effects the weightless environment of space has had on tomato seeds orbiting Earth since April 1984. The 12 million Rutgers tomato seeds aboard the Long Duration Exposure Facility (LDEF) are the crucial components of the program. The Space Shuttle has now retrieved LDEF, and the seeds will be distributed to the more than 116,000 teachers who have registered for the program. Participants will also receive a set of control seeds that have not been in space. Students will compare the two sets of seeds when studying germination and plant growth rates, the number and size of tomatoes produced, the effect of soil types on plant growth, and more advanced experiments involving chromosome mapping and enzyme and hormone tests. This program represents an educational partnership between NASA and the Park Seed Company of Greenwood, S.C.

Teacher Education Programs

NASA conducts workshops and programs designed to increase the knowledge, skills, and experience of teachers. For example, the Spacemobile Program, besides its student

workshops, supports a number of teacher education programs. During the 1988 school year more than 1,600 workshops were conducted involving 27,700 teachers.

The NASA Education Workshops for Mathematics, Science, and Pre-college Technology Teachers (NEWMAST) and the NASA Education Workshops for Elementary School Teachers (NEWEST) are specialized aerospace education programs for teachers. Designed for high school and elementary teachers, respectively, these honors workshops provide a two-week structured experience for 215 teachers under the tutelage of NASA scientists, engineers, and education specialists.

Drawing upon the science and technology resources of these facilities, teachers develop classroom curriculum materials to use at their schools when they return. Some lesson plans have used information about the Apollo landing sites to enable students to read polar coordinate systems and to identify locations by latitude and longitude. Other lesson plans have taught mapping skills and grid coordinate systems by helping students correlate Landsat images with conventional road maps. The Space Station Freedom mock-up at Marshall Space Flight Center was used by some teachers to help their students design and construct a habitation module for a space station.

NASA's Teacher Resource Center Network provides teachers access to a variety of aerospace materials such as videotapes, slides, audiotapes, publications, lesson plans, and activity plans. Resource rooms were first developed at each of NASA's nine field installations, and their success led to the development of a series of Regional Teacher Resource Centers across the country, usually located at universities. Regional centers are coordinated by the Central Operation of Resources for Educators Center (CORE), and in fiscal year 1988 they served over 60,000 teachers.

The Teacher in Space Program is another extremely important and active element in our teacher education programs. Barbara Morgan, NASA's Teacher in Space Designee, remains under contract to the Educational Affairs Division while teaching part-time at McCall-Donnelly Elementary School in McCall, Id. Since the Challenger accident, this intelligent, dedicated, and energetic teacher has made over 200 educational appearances to schools, universities, professional societies, civic organizations, and other groups. We hear from teachers around the world, who feel that their status as teachers has been enhanced through identification with the pioneering images of Christa McAuliffe and Barbara Morgan.

NASA remains committed to long-term opportunities for persons outside the professional categories of Astronaut or Payload Specialists to experience space flight, especially when it contributes to our approved objectives or is in the national interest. When the time comes that NASA determines a flight opportunity is available, first priority will be given to a Teacher in Space in fulfillment of space education plans.

In the meantime, Barbara Morgan and many of the 113 Teacher in Space Ambassadors actively conduct a variety of aerospace activities, which is what the program is really about. For example, Barbara Morgan is involved in a nationwide effort with the National Congress of Parents and Teachers (National PTA) to promote mathematics education. Some of the ambassadors are engaged in developing classroom activities that promote space science and technology. Still other ambassadors conduct public television programs that use aerospace topics.

NASA Educational Publications represent the primary resource for teachers who seek current, accurate information about aeronautics and space research and development. These publications bring aeronautics and space activities to the teacher for use in the classroom.

An average textbook takes from 5 to 7 years to produce, whereas a NASA educational publication is usually available in 5 to 7 months. Teacher and student demand for NASA educational publications is intense. Many titles are quickly exhausted and must be reprinted to keep pace with demand. The most popular titles include *A Meeting with the Universe*, *What's New on the Moon*, *How We Get Pictures from Space*, *Space Mathematics*, *This Is NASA*, *Aerospace Careers*, *Space Station: The Next Logical Step*, and educational wallcharts on Space Shuttle and Spacelab.

We distribute our publications to mailing lists that include more than 80,000 educators. Most of our educational publications are also sold by the Superintendent of Documents, U.S. Government Printing Office. Sometimes commercial publishers produce and distribute our publications at no cost to NASA. We are continually seeking new avenues to reach the widest possible audiences for our books and other materials. We actively seek and develop partnerships with other government agencies and commercial publishers.

Educational Technology promises new methods to deliver aerospace services and information. For the past 2 years, for example, we have conducted eight interactive satellite videoconferences for elementary and secondary teachers. These 1-hour videoconferences covered such topics as the Hubble Space Telescope, Space Station Freedom, Aeronautics, Living in Space, Future Exploration, Launch Vehicle Preparation, and Technology for Your Classroom. Receiving sites ranged from a one-room elementary school in Alaska with a receiving dish, to a state satellite network in Missouri. PBS stations in Los Angeles, Calif., and Norfolk, Va., also received the transmissions and rebroadcast them. At a videoconference, aerospace educators present demonstrations and lectures on a particular topic and teachers call in with questions. The events are downlinked to more than 400 sites and have so far reached about 2,000 schools and 20,000 teachers.

NASA Spacelink, an electronic information system for educators, is another of our educational technology programs. NASA information and educational materials are stored in a computer file at the Marshall Space Flight Center in Huntsville, Ala. Spacelink can be accessed over a regular telephone line, and is designed to communicate with a variety of modems and computers, especially those most commonly found in classrooms and homes. The only charge to the user is the cost of a telephone call to Huntsville. Established in February 1988, Spacelink received 14,200 calls during its first year of operation. Each call averaged 8 minutes.

The Aerospace Education Software Directory is an inventory of commercial and public domain computer software on aerospace education programs. The publication lists software intended for grade 3 through the university level. Topics include astronomy, aeronautics, aerospace physics, manned space exploration, rocketry, and satellites.

UNDERGRADUATE, GRADUATE, AND UNIVERSITY FACULTY PROGRAMS

The NASA Graduate Student Researchers Program, with its Minority Graduate Program component, and the NASA/NRC (National Research Council) Resident Research Associateship Program are two of NASA's larger programs administered for graduate students, postdoctoral researchers, and university faculty. Although these programs provide fellowship and research opportunities to approximately 600 graduate students and university faculty, they are exclusive of NASA's larger relationship to the university community.

The Baccalaureate Cooperative Education Program, which is NASA's single largest undergraduate program, is a partnership between NASA and many of the nation's colleges and universities. Cooperative education (co-op) integrates college-level study with periods of meaningful, full-time work. This is achieved through agreements between NASA installations and certain universities in which students enhance their academic knowledge, personal development, and professional preparation. Approximately 940 undergraduates participated in the fiscal year 1988 co-op program.

The NASA/USRA (Universities Space Research Association) University Advanced Design Program is a similarly large, but different, undergraduate program. It is directed primarily at undergraduate senior engineering students and intended to heighten enthusiasm for design within the engineering curriculum; to produce innovative advanced designs in aeronautics and space; and to encourage U.S. students to seek graduate study or employment within aerospace fields. Currently, 36 universities and 8 NASA installations participate. During the year, students work on 21st-century design problems such as a lunar storage and transfer system or long-term space habitats. Students present their design projects to each other and to NASA officials at a summer conference. After the conference, graduate teaching assistants spend a 10-week internship at a NASA center to plan the next semester's course.

The NASA/American Society for Engineering Education Summer Faculty Fellowship Program has a direct impact on undergraduate students although it is not an undergraduate program. Each summer, approximately 250 university faculty members spend 10 weeks at NASA installations conducting research on topics of mutual interest, with about 10 percent of their time spent at seminars. The program is designed to enhance career development of university faculty, particularly those from smaller institutions without extensive research facilities. Participating faculty return to their institutions with new knowledge to incorporate into coursework and additional research opportunities for students. A follow-up study conducted in 1987 on the program between 1981 and 1985 showed that participants were able to support more than 300 undergraduates with research grants and that almost 52,000 students benefited from participants' experience through new courses or course material.

University Programs also include the many small and specialized programs that NASA sponsors. For example, 17 students participate in the Ames Work Engagement Program for Scientific Technicians and 10 students take part in the Jet Propulsion Laboratory's Planetary Geology Undergraduate Researcher Program. Specialized programs, such as minority outreach, are designed to augment the nation's engineering and science work force by helping to eliminate under-representation of minorities, women, and the handicapped. An example is the Xavier University Engineering Bridge Program, in which 46 black students prepare for an engineering curriculum. Another program, the Recruitment and Retention for Excellence in Engineering, supports 17 Hispanic and 3 Native American students at the University of New Mexico. In addition, more than 200 undergraduate and graduate students through the Historically Black Colleges and Universities (HBCU) program are given opportunities to work in a research environment at NASA installations. Besides the obvious advantages to the students, the program increases the relationship and the involvement of HBCUs in NASA-sponsored research.

The Space Grant College and Fellowship Program is NASA's newest university program, and will eventually serve many undergraduate and graduate students. The program was mandated by Congress in 1987, which directed the program to:

- establish a national network of universities with interests and capabilities in aeronautics, space, and related fields;
- encourage cooperative programs among universities, aerospace industry, and federal, state, and local governments;
- encourage interdisciplinary training, research, and public service programs related to aerospace;
- recruit and train professionals, especially women and under-represented minorities, for careers in aerospace science, technology, and allied fields; and
- promote a strong science, mathematics, and technology education base from elementary school through university.

Up to 12 space grant colleges or consortia will be selected via a competitive, peer-reviewed process in 1989.

COORDINATION OF AEROSPACE EDUCATION ACTIVITIES

We realize that NASA does not have sufficient resources to enhance the teaching of science, mathematics, and technology in the nation's schools by itself. We believe that if aeronautics and space concepts are to have some presence in this country's 83,000 elementary and secondary schools, with 45 million students and 3 million teachers, and the 12 million students and faculty in higher education, we must form educational partnerships. This is one of our greatest challenges because successful partnerships do not magically materialize, and it is much easier to talk about them than to actually engage in the meaningful coordination that is required to develop them.

To date, our programs are best characterized by three types of coordination. The first type of cooperation is with organizations that operate aerospace programs for us through grants or contracts. Such arrangements include the National Science Teachers Association, Oklahoma State University, the Universities Space Research Association, TRESP Associates, American Society for Education Engineering, the National Research Council, and the Council of Chief State School Officers. These are our strongest coordination efforts.

Our second coordination effort is with other nonprofit education organizations. They include the Challenger Center for Space Science Education, the Young Astronaut Council, the Astronauts Memorial Foundation, the U.S. Space Foundation, the Alabama Space and Rocket Center (U.S. Space Camp), and the Science Service. Our relationships with these groups are relatively new, but we are increasing them.

Finally, coordination efforts are made with other federal agencies. One example is our strong partnership with the National Air and Space Museum. We have also worked closely with other Federal agencies such as the National Science Foundation, the U.S. Department of Education, the Department of Energy, the Department of Defense, and the Federal Aviation Administration.

Partnerships are also being established between corporate leaders and educators. NASA believes these efforts are vital, especially in science, mathematics, and technology. We are, therefore, beginning to work with the aerospace industry to replicate proven models.

The Industry Initiatives for Math and Science Education (IISME) is one such model.

This 5-year-old program results from a consortium of San Francisco area educators and employers, including the NASA Ames Research Center. IISME gives science and math teachers a chance to step into the business world each summer. More than 270 teachers have participated in the program, translating their research into schoolwork and influencing some 40,000 students each year.

By teaming with aerospace contractors, NASA has under review a plan to help replicate this industry initiative. A consortium, composed of a NASA installation and local businesses, would be established near each of the NASA installations. It would provide structured summer employment for teachers. We are discussing this effort as a partnership opportunity with the Triangle Coalition for Science and Technology Education. Costs would be funded by the National Science Foundation with some help from NASA.

In addition, we plan to encourage aerospace employees to consider second careers in science, mathematics, and technology teaching. This supports President Bush's program to encourage alternative certification, which would allow talented Americans from every field to teach in America's classrooms. As a result of recent orientation sessions at the NASA Goddard Space Flight Center, several federal and contract engineers are now taking education courses in preparation for certification and a retirement career in science and mathematics teaching.

However, there are some disincentives to participate in this program. First, such employees may not be given administrative leave to attend their certification courses, nor to meet the requirements for observation and practice teaching time. Annual leave or other personal leave must be taken for these periods. Tuition is another problem because certification courses are not related to current duties and personnel may not be compensated.

A third inhibitor is the federal tax law. It discourages those engineers and scientists who might volunteer to become science, mathematics, and technology teachers. The tax law will not allow the deduction of tuition expenses because the required education courses are unrelated to current employment. The tax law also taxes stipends, should any of these employees decide to pursue graduate study and obtain fellowships after retirement.

It is clearly beyond NASA to recommend the resolution of these problems, and reasons not to make changes may exist. However, as long as these conditions do exist, efforts to encourage retiring scientists and engineers to prepare for second careers in teaching are unlikely to succeed.

Our experiences during the first 2 years of our five-year plan for aerospace education signal the need to accomplish a more strategic impact, rather than a greater volume impact on the nation's science, mathematics, and technology education system. The current constrained budget environment forces us to focus on activities that make the broadest and most effective impact.

Future Plans

As Lennard A. Fisk, NASA's Associate Administrator for Space Science and Applications, has testified, we will launch 36 science missions in the next five years. And if we are smart, we will use these missions to conduct the biggest and most public science and engineering lesson ever for the youth of this nation. Each mission will reveal a different and wondrous aspect of science—whether it is in planetary exploration, or in material and life science research. And each is an engineering marvel. Let the youth of our nation learn

from what we are doing and be inspired to do better in their generation.

President Bush best summed up our space goals in his July 20, 1989, address from the steps of the National Air and Space Museum to honor the 20th anniversary of the first lunar landing. He said, space is the inescapable challenge to all the advanced nations of the Earth. And there's little question that, in the 21st century, humans will again leave their home planet for voyages of discovery and exploration. What was once impossible is now inevitable.

The time has come to look beyond brief encounters. We must commit ourselves anew to a sustained program of manned exploration of the solar system—and yes—the permanent settlement of space. We must commit ourselves to a future where Americans and citizens of all nations will live and work in space. Our goal is nothing less than to establish the United States as the preeminent spacefaring nation.

To advance our aerospace education programs, we would like to:

- modify, but retain, the priorities of our five-year plan, namely, elementary education, teacher education, university programs, the Space Grant College and Fellowship Program, under-represented minorities, educational technology, Spacemobile Program, and educational partnerships;
- design and structure some of our pre-college programs as demonstrations to test different approaches, assess outcomes, document results, and disseminate findings for adoption by others;
- use NASA's newly emerging Space Grant College and Fellowship Program as a model to promote partnerships and cooperation among universities, federal, state, and local governments, and aerospace industry to encourage and facilitate the application of university resources to aerospace and related fields;
- seek opportunities for joint and coordinated funding and programs between NASA and the National Science Foundation, the Department of Education, and other federal agencies;
- expand the Spacemobile Program by establishing a spacemobile for each state with justifiable school population and distribution. Diversified approaches and experimental projects among the states will be used to assess the effectiveness of motivating more student and teacher interest in science, mathematics, and technology;
- target colleges of education to support a set of pilot projects to teach future educators how to infuse aeronautics and space concepts into the existing curriculum of any school system in which they may be employed;
- establish a wide talent pool of technical writers to produce, for NASA's dissemination, modular sets of supplementary curriculum materials featuring aeronautics and space. The materials will be drawn from NASA's aeronautics, space science, and technology missions and activities and tailored to specific school courses and subjects. The science and engineering expertise of the Astronaut Corps will be a key resource;
- implement the proposed National Scholars Program (NSP), which is designed to produce 320 Ph.D.s from under-represented minorities in science and engineering by the year 2000; and
- continue to demonstrate alternative uses of technology to deliver aerospace education services to teachers and students.

CONCLUSION

We are convinced that the aeronautics and space program represents a powerful magnet for learning. The range of aerospace education programs and activities that NASA has established for elementary through postgraduate school helps to expand students' interests in science, mathematics, and technology. Through our teacher education programs, NASA enriches other academic subject areas as well.

In anticipation of Space Station Freedom, a permanent lunar base, manned Martian expeditions, and the projected series of planetary missions and other aerospace developments, our students will be exposed to a rich set of incentives to help prepare them for key roles in this nation's future work force. NASA's educational efforts will be further strengthened by partnerships with other federal agencies and both public and private organizations.

NASA's relationship with the educational community has been a long and beneficial one. Our programs are many and diverse. In one dimension, certain programs contribute directly to NASA's research into problems of flight within and outside the Earth's atmosphere. In a second dimension, other programs integrate the knowledge derived from aerospace research and development into the educational system at all levels—elementary through postgraduate. What is significant, however, is not the size or number of individual programs or projects, but their diversity and how each contributes to the mission of the National Aeronautics and Space Administration and, therefore, to the United States civilian aerospace effort.

