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ABSTRACT

This document presents a 5-year plan for administering a focused and consistent set of aeronautics and space science education programs. The major initiatives outlined in this plan fall into two broad categories of five programmatic priorities and five institutional priorities. The 10 specific priorities are: elementary education; teacher education; underrepresented minority participation; educational technology; aerospace education services; university programs; educational publications and distribution; educational partnerships; educational research and evaluation; and educational affairs administration. Lists 18 references. (YP)

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Educational Affairs Plan:

**A Five-Year Strategy
FY 1988-1992**

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October 1987 (Second Edition)

**Educational Affairs Division
Office of External Relations
National Aeronautics and Space Administration
Washington, DC 20546**



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Educational Affairs Five-Year Plan

Introduction

The major purpose of the Educational Affairs Division Five-Year Plan is to guide the use of our NASA resources in administering a focused and consistent set of aeronautics and space science education programs. The ultimate goal is to directly and indirectly help to ensure an adequate pool of talented scientists, engineers, and technical personnel to keep NASA at the forefront of advancements in aeronautics, space science, and exploration for the 21st century.

The Plan responds to educational initiatives recommended by the National Commission on Space in its May 1986 Report, *Pioneering the Space Frontier* (National Commission on Space 1986). It is also in keeping with the three goals NASA stated in December 1986 (Fletcher 1987)

- To advance scientific knowledge of the planet Earth, the solar system, and the universe beyond,
- To expand human presence beyond Earth into the solar system, and
- To strengthen aeronautics research and to develop technology toward promoting U.S. leadership in civil and military aviation

Underlying the success of each of these goals is the need for a highly trained and skilled work force

The Educational Affairs Division at NASA Headquarters, and its counterpart offices at NASA field centers, provides a focal point for the educational community. The Division's mission is to collaborate with the nation's educational community to help preserve U.S. leadership in aeronautics, space science, and technology. By using existing and emerging expertise unique to NASA and converting it into educational formats, the Educational Affairs Division seeks to develop and nurture those students and educators who will become the scientific and technical personnel of the future

The Educational Affairs Division has four separate but related offices that administer programs and provide services to the entire educational community, from elementary schools through universities. The four offices are Elementary and Secondary Programs, University Programs, Educational Technology, and Educational Publications and Special Services

Although NASA regional field centers are organized differently than headquarters, each has similar organizational components. For example, each center has an educational program or service component under its Public Affairs or External Affairs offices. This component works with the elementary and secondary school community. Each center also has a university affairs officer, who reports to the center's chief scientist or similar person responsible for administering university programs and related issues

Since its creation in 1958, NASA has had close ties with the university community. Universities continue to be key contributors to the NASA research base. In the early 1960s, programs were conceived to provide university faculty with a better understanding of NASA's mission by offering university faculty members an opportunity to conduct research at NASA facilities. Also during that period, NASA reached out to elementary and secondary schools by disseminating educational materials and administering programs designed for both students and teachers

Much of NASA's strength is in its regional field centers, each of which has unique facilities and personnel. The content of NASA's educational programs complements the individual missions of the centers, while reflecting the overall mission of NASA. Each center provides either specific educational programs or uniquely tailored services not replicated at other centers. Each NASA center varies in the number of staff assigned to carry out educational programs. For example, two individuals may conduct the educational programs at one center, while eight or ten may be working at others.

This Five-Year Plan for education provides NASA with a focus for its programs and services to educators at all levels. Because the Plan is not an inventory of every existing NASA educational program, it does not mention all ongoing activities. Instead, it strives to envision themes and initiatives that address the challenge facing NASA and the educational community. That challenge is to preserve U.S. leadership in aeronautics, space science, and technology.

The major initiatives outlined in this Plan fall into two broad and sometimes overlapping categories: programmatic priorities and institutional priorities. They are as follows:

Programmatic Priorities

- Elementary Education
- Teacher Education
- Underrepresented Minority Participation
- Educational Technology
- Aerospace Education Services Project

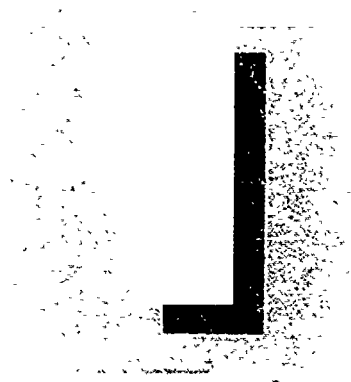
Institutional Priorities

- University Programs
- Educational Publications and Distribution
- Educational Partnerships
- Educational Research and Evaluation
- Educational Affairs Administration

The educational content of the Division's programs and services will reflect the research and development activities of the NASA program offices and field centers. Specific emphases will be placed on space science and applications, aeronautics and space technology, space station, space flight, and exploration. Within the educational system, the disciplines of science, mathematics, and technology will be primarily targeted, although other academic disciplines may be addressed when feasible.

This Plan is the product of a participative process involving not only the Educational Affairs Division but also education and public affairs officials in the field centers and senior management officials of headquarters program offices. This process, along with discussions among science and engineering education groups and individuals outside of NASA, produced strong support for the Plan and its priorities. While it is a roadmap for 1988-92, the Plan will be dynamic, allowing for modifications and adjustments as circumstances may warrant.

Aeronautics and space science give a curious people a reason to do what they do best — to invent, to build, and to overcome great odds. This Educational Affairs Five-Year Plan reflects that spirit by offering a systematic process to envision a desired future and designed initiatives to assure that future.



Programmatic Priorities

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Services Project 10

Priority: Elementary Education

The Challenge

Research indicates that if a child has not developed a meaningful interest in science and mathematics by the third grade, the prospect of his or her doing so diminishes over time. The national average of time devoted to teaching science in the elementary classroom is only 17-28 minutes a day (Weiss 1978). This is not enough to stimulate a meaningful interest in science.

Several major concerns affect the quality of elementary science education in this country.

■ **Preparation of Elementary Teachers**
A recent survey of colleges and universities having the largest number of teacher education graduates discovered that in half of these institutions, eight semester hours or less of science were required for persons preparing to teach science at the elementary school level (National Science Teachers Association 1987).

■ **Time Devoted to Science Instruction**
A study by the Association for Supervisors and Curriculum Developers found that a typical fourth grader receives only 28 minutes of science instruction a day, compared with 34 minutes for social studies, 52 minutes for mathematics, and 100 minutes for language arts (National Education Association 1987). In many schools, science is scheduled for the last period of the day when children are tired and inattentive.

■ **Teacher Salaries.** A Michigan State University survey indicates that average first-year teacher salaries in 1985-86 were \$16,903 in contrast to \$27,775 for college graduates with bachelor's degrees in compute. science (Solorzano 1986).

■ **In-service Programs in Elementary Science.** Many elementary teachers receive too little assistance in developing imaginative science instruction.

■ **Collaboration Between Elementary and Secondary Science Teachers**
Many schools do not encourage elementary and secondary science teachers to share ideas or to devise a strong science and education curriculum.

The NASA Educational Affairs Division does not have the resources to remedy all these problems. However, by attempting to meet the goals in this strategic Five-Year Plan, the Division may help stimulate young students and provide elementary teachers with supplementary curriculum materials and workshop experiences.

1 Review and Assessment of State Curricula

Elementary teachers typically instruct students in reading, language arts, handwriting, spelling, mathematics, science, social studies, health, and art. Instructional guidelines set minimum time allotments, texts, and the amount of subject coverage. For science, many standards require teachers to spend a predetermined amount of time teaching the subject. Over the next five years, NASA plans to design supplementary curriculum materials and teacher workshops that will fit state and local mandates.

The elementary curriculum and standards of learning objectives for science and mathematics for at least three states (New York, California, and Texas) will be reviewed. Findings will be used to design supplementary curriculum materials. Such materials will be developed for integration with existing curricula, serving as resources rather than as added workloads.

Using a multi-disciplinary approach, the materials will be designed in a variety of formats, stressing those formats that have proven effective with teachers.

2 Honors Workshops for Elementary Teachers

Modeled after the NASA Educational Workshop for Math and Science Teachers (NEWMAST) program, three pilot workshops will be conducted at NASA field centers in the summer of 1988. The workshops will be expanded to all centers in the following years. They will be designed to upgrade elementary teachers' proficiency in science, mathematics, and technology, and to increase their ability to help train other elementary teachers. The intended outcome is to enhance the teaching of science, mathematics, and technology in the classroom by using aeronautics and space science educational materials.

3 Pre-service Training

Through the upgraded preparation of NASA aerospace specialists in elementary education, arrangements will be made with teacher education institutions to cooperate in conducting pre-service workshops for students studying to become elementary teachers. The specialists will also work with the elementary methods course instructors. It is expected that institutions will include materials and activities as part of their regular elementary curriculum.

4 Materials Development and Dissemination

Over the next five years, at least 30 percent of NASA's educational materials will be specifically targeted for elementary teachers and students. Such materials will be distributed via teacher workshops, professional journals, Teacher Resource Centers, professional conferences and conventions, and satellite broadcasts.

5 Aerospace Education Services Project (AESP)

Scheduling of AESP specialists will reflect increased service to elementary teachers and students. The specialists will assist in the implementation of the Honors Workshop for Elementary Teachers. They will also participate in the design of new instructional materials.

Priority: Teacher Education

The Challenge

According to studies by the National Science Teachers Association, many classroom teachers ranked in the lower 25 percent of their graduating high school and college classes (National Commission on Excellence in Education 1983). Half of all new mathematics and science teachers are either unqualified or not certified, and over two-thirds of the physics teachers are not qualified (NC Center of Public Policy Research 1982). In 39 states there is a shortage of science teachers, and in all 50 states there is an inadequate supply of physics teachers (NC Center 1982). Many students take no mathematics or science courses beyond the 10th grade, which may account for the number of remedial math courses required for college enrollment (Task Force on Education and the Economy 1983). Students' skills are declining in inference, analysis, interpretation, and problem-solving.

1 Deans of Education and of Science

NASA personnel will meet with various national associations representing Deans of Education and of Science, and individual deans to discuss teacher education in science and technology. Specifically, NASA will offer its expertise and personnel to

- Supplement the content of existing science and mathematics methods courses, as well as other subject matter and methods courses,
- Conduct workshops at NASA centers for science and mathematics methods faculty as well as for pre-service student teachers, and
- Establish internships for pre-service and in-service teachers in the educational offices at centers and in Teacher Resource Rooms

When appropriate, NASA will design teacher workshops for college credit. These workshops will reflect the science and engineering content of NASA programs, suggest methods for integrating curriculum required by federal, state, and local authorities, and specify knowledge and skill competencies to be achieved.

2 Workshops at NASA Field Centers for Targeted Populations

Over the next five years, each NASA field center will develop a plan to identify populations appropriate for teacher workshops. Such plans will be developed in consultation with center educational officers, and include such targeted groups as science and mathematics methods professors, elementary specialists, curriculum specialists, guidance counselors, school administrators, television, radio, and text book writers, and librarians. Plans are to be finalized by January 1988, with the first series of workshops to begin in the summer of 1988.

3 Regional Teacher Resource Center Network

A minimum of one Regional Teacher Resource Center (RTRC) will be established in each state over the next five years. Eleven states presently have RTRCs, leaving 39 states to achieve full coverage. The goal is to establish seven new RTRCs each year, beginning in fiscal year 1988, and to complete the network by fiscal year 1993. Local authorities will provide staff, space, and equipment, making NASA's fiscal 1988 costs for start-up materials \$6,000 per center, or \$42,000. This amount will be required annually for the five year period (until completion).

4 Headquarters Regional Teacher Resource Center

A Regional Teacher Resource Center will be established near NASA Headquarters in fiscal year 1988 to serve residents in the District of Columbia metropolitan area and out-of-town visitors.

5 Teacher Internships

As scheduling and resources permit, teacher internships for 3-12 months will be arranged at the education office of the NASA field centers and at headquarters. Authorized by the Intergovernmental Personnel Act, interns will be teachers of elementary, intermediate, or high school and will be expected to conduct aeronautics and space science education activities with other teachers upon return to their school districts.

The Educational Affairs Division will also explore with the U.S. Department of Education potential internships for recipients of the Christa McAuliffe Fellowship Program. The program will provide fellowships to outstanding teachers to enable and encourage them to continue their education, to develop innovative programs, to consult with or assist local educational agencies, private schools, or private school systems, and to engage in other educational activities that will improve the knowledge and skills of teachers and the education of students.

6 Participation in National Conferences

The Educational Affairs Division will develop a 3-5 year schedule for NASA participation in national educational conferences. A new NASA exhibit will be constructed and the Division's conference participation will range from keynote addresses to exhibit support.

7 Teacher in Space Program

The Educational Affairs Division will continue to support the Teacher in Space Program with some natural modifications as the program matures. Specifically

- The Teacher in Space Designee will remain under contract with NASA on a part-time basis while she continues to teach her elementary class. She will make educational presentations as her schedule permits,
- Six of the seven Teacher in Space Finalists, who have been under contract with NASA for the past two years, completed their contracts on August 31, 1987. It is anticipated that the finalists will function as state-based Teacher in Space Ambassadors along with the larger cadre of Space Ambassadors. One of the Teacher in Space Finalists will work full time during the 1987-88 school year with the Challenger Center for Space Science Education. This action derives from the recent merger between the Teacher in Space Education Foundation and the Challenger Center for Space Science Education,

■ Through our field centers, Teacher in Space Ambassadors in states covered by those centers will continue to have access to the educational affairs program activities and information. In addition, it is requested that the centers convene periodic updating sessions with the Space Ambassadors, and

■ The Coordinator for the Teacher in Space Program will continue to function in that role, along with her new responsibilities for the elementary initiative of our Five Year Plan. She will continue to forward NASA educational materials to the Space Ambassadors and will work closely with the Teacher in Space Finalist at the Challenger Center.

Priority: Underrepresented Minority Participation

The Challenge

Steps must be taken to ensure a pool of capable talent from all groups of our population. Currently, Blacks receive only 4.1 percent of all bachelor's degrees, 2.0 percent of all master's degrees, and 1.2 percent of all doctorate degrees in the physical sciences, mathematics, computer science, biological sciences, and engineering sciences (Grant 1984). Except for Asian Americans, the remaining minorities fare even worse. Hispanics are the most disadvantaged, especially in mathematics at the undergraduate level (Scientific Manpower Commission 1985). At the graduate level Hispanics tend to do slightly better than Blacks in terms of degree conferral rates (Scientific Manpower Commission 1985, Engineering Manpower Commission 1986, American Association of Engineering Societies 1987). In contrast, Blacks are overrepresented in certain non-science disciplines. For example, in 1979-80, 55 percent of all PhDs awarded to Blacks were in education (McBay 1987).

At first it may seem as if women in the work force have made substantial progress over the past ten years. Many programs and activities are conducted to improve the status of women in such areas as science and engineering. Despite this progress, women receive only one in eight of the PhDs awarded in science and engineering. Of the PhDs awarded, women are most likely to receive them in biology (20%), social anthropology (27%), and psychology (28%) (Hodgkinson 1985).

Between 1968 and 1982, the number of U.S. citizens who received PhDs in engineering declined 42 percent, while the number of foreign nationals receiving them almost tripled. Today, nearly half of the PhDs in engineering are awarded to foreign nationals (McBay 1987).

Due to birth rates and the average age of minority groups, Blacks and Hispanics are expected to constitute as much as 40 percent of the college age population by 1995 (Triangle Coalition 1987). Nearing the year 2000, America will be a nation in which one of every three citizens will be nonwhite. If the potential of these minority groups is not nurtured and developed, America will be unable to meet its critical human talent requirements in science and technology for world technological competition.

1. Establish Feeder System

A feeder system will be established inside and outside of NASA's educational programs to identify and track, with program support, minority students from public schools through the universities. Of particular interest will be those students who are highly motivated and who demonstrate academic talents in science, mathematics, and engineering related subjects. The feeder system will

■ Directly contribute to the enrollment of 1,000 underrepresented minority college freshmen in science and engineering each year, beginning in fiscal year 1990.

■ Establish a coordinated set of program activities that results in 800 minority students earning bachelor's degrees in science, mathematics, or engineering by fiscal year 1995, and

■ Result in 200 doctorate degrees a year in science, mathematics, or engineering in aerospace-related areas by fiscal year 2000. (Currently, underrepresented minorities receive about 40 doctorate degrees in science and engineering each year.)

Program policy and resources for this goal will be established in cooperation with the Office of Equal Opportunity Programs, relevant NASA program offices, and appropriate federal agencies and professional associations.

2. Undergraduate Support Program

An undergraduate support program, either through existing NASA university programs or through new NASA-supported legislation, will be established to support high-potential, high-achieving, underrepresented minorities in areas of study important to NASA's mission. Critical elements will include retention activities and work experience at NASA field centers.

3. Summer High School Apprenticeship Research Program (SHARP)

By 1988 annual SHARP apprentices will be increased from 125 to 150, and the overall percentage of minorities in the program will increase from 72 percent in 1986 to 90 percent. A directory of former SHARP apprentices will be established during calendar 1987/88. The directory will be updated annually and will include high potential students from other "feeder" programs. A university-based program for high school students similar to SHARP will be explored in an effort to reach students who do not live near NASA installations. SHARP programs will be established at all NASA centers not currently participating.

4 Summer Day Camp Program

A special program will be developed in cooperation with the Young Astronauts Council and Space Camp for minority elementary students. This program will include a summer day camp on aeronautics, space exploration subjects, and aerospace careers. Outstanding participants will be recognized and their progress tracked for possible future inclusion in SHARP and other NASA-supported educational programs.

Priority: Educational Technology

The Challenge

Full use of space-age technology in public education is nearer than many people suppose. School districts across the nation are not only experimenting with its use, but utilizing it to enhance school curricula. Innovative educational technology can potentially affect the learning process as well as the context in which teaching and learning occur. Furthermore, teachers must prepare their students for competition in a technological environment.

This movement needs assistance and leadership. NASA, as a high-tech agency, will assume that leadership. In carrying out this mission, NASA's Educational Affairs Division and educational offices at the field centers will emphasize and demonstrate the use of modern teaching technology in teaching aeronautics and space science concepts. If such educational technology is used wisely, better schools will emerge.

1 Satellite Broadcast

NASA Educational Affairs will conduct four satellite broadcasts each school year beginning October 1987. These broadcasts will be conducted from the Oklahoma State University Telecommunications Center, Stillwater, Oklahoma. This Center has uplink capability and uses the WESTAR IV satellite. NASA will provide live inserts from headquarters and field centers to enhance program content.

The programs will be live, one hour in length, and interactive. The purpose of the series is to expand the NASA Educational Affairs delivery system for reaching teachers at the elementary and secondary levels. The programs will provide content related to NASA's activities in aeronautics and space science, classroom activities to support this content, and information on materials and programs available for use by teachers in their classrooms.

2 Computer Software Packages

NASA Educational Affairs will develop computer software packages related to aeronautics and space science concepts. These packages will contain a floppy disc, content sheet, and teacher's guide. The software packages will be distributed through NASA Teacher Resource Rooms and used in student and teacher programs by AESP specialists.

3 Aerospace Software Directory

The Office of Educational Technology, Educational Affairs Division, will conduct a survey of aerospace-related computer software currently available from educational and commercial organizations. From this survey an aerospace directory will be produced describing software, how it might be obtained, and its relation to teaching aeronautics and space science concepts. This publication will be distributed through NASA Teacher Resource Rooms and will be updated every two years.

4 Laser Videodisc

Laser videodisc is a new, growing technology. NASA Educational Affairs is considered a leader in the development and use of this technology in the classroom. Educational Affairs will continue to use this technology, develop new materials, and demonstrate the effectiveness of this technology to students and teachers.

5 Interactive Learning Program (Laser Videodisc Microcomputer)

Laser videodisc players interface with microcomputers. Special instructional programs have been developed that establish an interactive dialogue between the presenter, viewer microcomputer, and laser videodisc. NASA Educational Affairs will develop interactive software to provide classroom lessons and activities for elementary and secondary classrooms. AESP specialists will utilize these interactive demonstrations in teacher workshops and student programs. A system will also be added to Teacher Resource Rooms to assist in an orientation to the facility and its available products.

6 Information Access System (Spacelink)

Marshall Space Flight Center submitted a plan to NASA Headquarters to establish an information access system to satisfy NASA educational needs on a national scale. Startup funding was provided by NASA Headquarters. The system titled "Spacelink" will be up and running October 1987. The system will be capable of communicating with a wide variety of personal computers using most types of communication software. The system will provide a readily accessible library of aeronautics and space science information to the educational community. The Spacelink system will be monitored for one year in terms of effectiveness and feasibility.

7 Telelecture Programs

NASA Educational Affairs has utilized the telelecture concept to a limited degree. This technology, which utilizes a conference telephone hookup and slide visuals, will increase communications and teaching of aeronautics and space science concepts to teachers and students. A telelecture capability will be installed where feasible in Teacher Resource Rooms.

8. Science Videotapes

NASA Educational Affairs will develop videotape single topic science segments from Space Shuttle on-board footage. The videotape series will include the best segments from the previous Space Shuttle flights. A teaching guide will be produced to accompany the videotape. One videotape will emphasize the 12 Space Shuttle Student Involvement Program (SSIP) experiments that have flown on Space Shuttle missions.

9. Classroom of the Future - Today

During the next five years, at least one "Classroom of the Future" demonstration site will be established. The site will contain state-of-the-art educational instructional delivery systems and be used for student and teacher programs. High-tech aerospace industry partnerships will be investigated to provide possible hardware, software, and materials in support of demonstration projects.

Priority: Aerospace Education Services Project

The Challenge

The Aerospace Education Services project (AESP) is the Educational Affairs Division's primary method for sharing educational programming with the elementary and secondary populations. Currently 23 specialists are assigned to the field centers, and 5 to headquarters. Demand by the educational community far exceeds current staffing. Furthermore, distribution of AESP personnel at field centers is inequitable, especially at Ames and Lewis Research Centers, and in many instances, specialists are using outdated models and equipment. Despite these difficulties, the program remains strong and is a centerpiece of the Division's elementary and secondary efforts.

1. Establishment of a Formula for Determining Distribution of AESP Personnel at Field Centers

To provide a more equitable method for distributing AESP personnel, a simple center comparison formula has been established. This formula is based on the total number of potential students served by an individual center's AESP personnel. For example, the Ames Research Center's geographical area has over 7,000,000 students. Currently, two AESP specialists serve this population, giving a ratio (or load factor) of 3,500,000 students per lecturer. Most centers have a ratio of between 1,000,000 to 2,000,000 students per lecturer.

2. Expansion of AESP Personnel

Based on the above formula, Educational Affairs will increase AESP personnel within the next three years to distribute AESP resources more equitably throughout the center geographical areas. The expansion will include at least two additional specialists in the Ames Research Center area and one additional specialist in the Lewis Research Center area.

3. Guidelines for Scheduling AESP Personnel and Review of Field Centers Geographical Alignment

A task force will be formed in fiscal year 1988 to develop guidelines for scheduling AESP personnel to ensure that all centers use an equitable method to cover all geographical areas. Current center geographical alignments will be examined. The task force will be chaired by the Chief, Elementary and Secondary Programs Branch and will have optional membership from each NASA center. Recommendations will be submitted to the Director, Educational Affairs Division and will be approved by the Associate Administrator for External Relations.

4. Rotational Assignments to NASA Headquarters Educational Affairs Division

Each year, beginning in fiscal year 1989, one or two Aerospace Specialists will be rotated from the field to Headquarters Educational Affairs Division to perform program management functions. Rotation will be for a period of up to one year.

5. Standardized Lectures

Recognizing the need to individualize presentations to fit specific needs of NASA field centers and allowing for individual differences in specialists' styles and personalities, an effort will be made to standardize certain aspects of AESP presentations by providing each specialist with an outline of suggested program content. This outline will be kept up-to-date by the technical monitor with input by Center Education Program Officers.



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Priority: University Programs

The Challenge

Since its inception, NASA and the universities have been partners in the conduct of research to preserve U.S. leadership in aeronautics, space science, and technology. Colleges and universities, of course, supply us with our highly skilled work force.

The importance of universities to NASA is demonstrated by the size and breadth of our university programs. These programs are composed of both those specifically managed programs by Educational Affairs and the grants, contracts, programs, and other activities that take place in the mission-oriented NASA program offices and the field centers.

Last year NASA obligated approximately \$275 million, or about 3-1/2 percent of the total NASA budget, to universities. Approximately two thirds of these obligations were in space science and applications, and a third in aeronautics and space technology. The university program in FY 1986 involved some 2,815 contracts, grants, and other instruments in 272 domestic and 7 foreign academic institutions. The bulk of this activity arose outside the domain of Educational Affairs. The prototypical element of the university program is a grant relationship between a technical monitor at a NASA center and a university professor and his or her graduate students at a university.

Specific university programs are the Office of Aeronautics and Space Technology Advanced Design program, the Graduate Student Researchers program, the Summer Faculty Fellowship program, and the Resident Research Associateships program. In addition, each NASA center has a variety of local educational programs.

It is through all these programs that faculty and graduate students first become acquainted with NASA, and NASA with them. These same faculty and students subsequently develop ongoing research relationships with the agency and join the national cadre of academic researchers upon which the entire aerospace community, including NASA, is dependent. Many of these students eventually join the agency's rolls as permanent employees, or choose careers elsewhere in the aerospace industry.

However, there are significant problems facing the university community that will eventually have an impact on NASA. These include:

- A decline in the number of students entering college. The nation's birth-rate has decreased since 1970. In 1987 college students, typically 17 years old, will be chosen from a group only 85 percent as large as the 1970 group (Scientific Manpower Commission 1987).
- A need for higher salaries for master's and doctorate engineers in education. In industry, engineering students with bachelor's degrees receive salaries competitive with those of their university professors with doctorate degrees. Faculty positions in chemistry, engineering, and mathematics are vacant in many universities.
- An increase in the number of foreign nationals studying engineering at U.S. universities. In the areas of aerospace, electrical, computer, and mechanical engineering, foreign nationals compose approximately 29.6 percent of classes at the master's degree level and approximately 43.1 percent at the doctorate level (Engineering Manpower Commission 1980-85). Some researchers are not as concerned with these present enrollment percentages as they are with the growing trend.
- A decline in the number of graduating master's and doctorate students, and the resulting decline of qualified personnel in the work force (Engineering Manpower Commission 1980-85), which could cost us our international scientific and technical leadership.

- Increases from 1986 to 1987 of Black students in only 3 of 21 sampled fields of engineering — electrical, mechanical, and computer (Engineering Manpower Commission 1980-85) — that may not actually be increases because of transfers from other fields of engineering, and

- Negative retention of Black engineering students in the fields of aerospace, computer, mechanical, and electrical engineering.

The following activities represent initiatives planned during the next five years:

1. Center Visits by Student Groups

Educational Affairs will explore a systematic program to encourage university student groups to visit the centers. The visits need not be elaborate, but should provide for presentations by NASA personnel and tours of research facilities. Most importantly, these tours should be used by the centers to promote the pursuit of advanced study or motivation toward higher academic achievement. This can arise both from direct expression by NASA personnel and from exposure to the richly rewarding, but demanding center environments. To be effective, such a program must utilize active research personnel who can serve as role models.

2. Contributed Lectures

Educational Affairs will take steps to design a formal program for NASA employees to give lectures in university courses with emphasis at the undergraduate level. NASA researchers could volunteer through university colleagues with whom they are acquainted. These contacts could help to lessen student prejudices about nonrelevance of academic study to real world problems, and will stimulate interest in NASA programs.

3. Grant-supported Student Identification and Recognition

Currently, most NASA grants or contracts to universities involve student support. However, no system currently exists to quantify this data or to recognize the students. Steps will be taken to explore changing the existing CASE reporting system to include student data. In addition, all students supported by NASA grants at their institutions should be recognized by a title. A universal title should be established by NASA such as "NASA Student Research Associate," or something similar. The student should be advised by a letter of appointment from NASA of such a designation and recognized when support from the grant begins. Correspondence with the student should be continued throughout the association.

4. BITNET Nodes

The university community worldwide is served by BITNET, an electronic communications network. Educational Affairs will explore this network and examine its relevance to NASA programs.

5. Student Tracking System

A formal system of records will be explored for the tracking of all university students connected in any way with NASA, and a tracking plan for each student will be developed. The purpose of the system is to permit correspondence with the students to advise them of opportunities and to encourage high academic achievement. The system could be based at headquarters for access by all the centers.

A tracking system will require that all supported students be made known to NASA Headquarters by the principal investigators. It will convey to the students a sense of interest on NASA's part that should provide greater incentive to high academic achievement.

6. Develop Better System for Publicizing NASA Award Recipients

Educational Affairs will develop a system to publicize appropriate fellowships and award recipients in publications such as the *Chronicle of Higher Education*.

7. On-campus NASA Liaison

At universities where there exists sizeable NASA funding, Educational Affairs will explore the feasibility of establishing a NASA liaison office. The liaison officer would be a university professor or staff member who would devote a percentage of his or her time to the task. Some support for clerical services and office space should be provided. Prominent office signs and listings in university directories should be required.

The purpose of the liaison office would be to establish a visible NASA presence on each campus and an available NASA contact for both students and faculty. The liaison officer, with the assistance of NASA, develop numerous contacts throughout the agency and come to understand how it functions. The NASA liaison office would be the first point of contact for students and faculty wishing to deal with NASA. Periodic conferences of liaison officers could be held. The liaison office should be provided with telephone directories of all NASA installations, and could be used as a central distribution point for NASA information and related material.

Priority: Educational Publications and Distribution

The Challenge

Publications are the chief means through which the educational community learns of NASA's programs, plans, accomplishments, and emerging technologies. With current limitations of appropriated resources, the Educational Affairs Division must assure that the educational community and interested publics continue to receive appropriate publications and adequate educational materials with the widest possible dissemination.

1. Publication Services

Headquarters publication and distribution services will continue to provide writing, editorial, illustration, design, layout, printing, and distribution services for educational materials. All educational publications will be designed for specific audiences, such as elementary, intermediate, high school, university, or the general public. Each publication will indicate the primary intended audience along with the date of publication. To ensure a balanced program, publications will continue in the following five categories:

- **Educational Briefs** Publications that are concise, inexpensive, easy to produce, and designed to quickly inform educators and other audiences of NASA's current activities, missions, and their results.
- **Educational Publications** More detailed publications that discuss a mission or program in an in-depth manner.
- **NASA Facts** Publications designed to enhance certain discipline areas by connecting aeronautics and space science concepts with concepts taught in the classroom.
- **Lithographs** Publications that include NASA images in an 8- by 10-inch format, with text on the reverse side to provide teachers with information and suggestions for classroom activities, and
- **Pamphlets** Publications that include reprints, bibliographies, and career information.

2. Educational Publications Planning Board

Chaired by the Director of Educational Affairs, this board is composed of NASA personnel in education, science, and technology from headquarters and field centers (at present one center is represented on the board). It coordinates educational publishing efforts between NASA field centers and program offices, and headquarters to achieve the best possible production and dissemination of materials. Key objectives are to help maintain publishing quality, to target publications toward audiences by educational level, to eliminate duplication of effort, and to reduce expenditures.

The board also addresses coordination requirements with the Scientific and Technical Information Branch of the Information Resource Management Division of the NASA Office of Management

3. Educational Publications Inventory

Each fiscal year an updated inventory of current NASA educational and selected scientific and technical publications will be published by headquarters. Included will be publications available from the U.S. Government Printing Office (GPO) with specific ordering instructions and up-to-date GPO order forms. The inventory will also provide information for obtaining current listings of educational materials from NASA field centers.

4. Management Instruction (NMI)

Under the guidance of the Publications Planning Board, a new NASA Management Instruction (NMI) on Educational Publications will be written and issued during fiscal year 1988 to ensure a coordinated effort for NASA-wide publication standards and procedures

5. Distribution System.

As the Spacelink system evolves and proves effective, it will be expanded to include Educational Affairs publication and distribution requirements

Priority: Educational Partnerships

The Challenge

Alone, NASA does not have sufficient resources to exclusively enhance the teaching of science and mathematics in the nation's schools. Educational partnerships with public and private organizations must be established as an essential means to reach the nation's 83,000 elementary and secondary schools, 45 million students, 3 million teachers, and the 12 million students and faculty in higher education (Grant 1984). Proactive rather than reactive partnerships are needed over the next five years. These partnerships should involve aerospace and nonaerospace industry, as well as federal agencies such as the Department of Education, Federal Aviation Administration, and National Science Foundation.

1 Educational Partnership Guidelines

In fiscal year 1988, guidelines for establishing educational partnerships will be developed and distributed to NASA field centers. This package will define the educational partnership concept and will include case studies, a list of possible types of partnership opportunities, a generic Space Act partnership agreement, and suggested strategies

2 Partnership Staffing

Headquarters Educational Affairs has established a clearinghouse for partnership opportunities. Developed as an ongoing staff function, the clearinghouse will respond to legal and logistical queries, and will provide internal and external communication links

3 Inventory and Analysis of External Organizations

Educational Affairs will compile a list of external organizations. The list will facilitate making contacts and establishing educational partnerships

Priority: Educational Research and Evaluation

The Challenge

It is imperative that the products and services delivered by Educational Affairs correlate NASA program results and institutional needs with the needs of the educational community. Until now there has been no centralized effort within the Division to ensure this. Specifically, it is necessary for Educational Affairs to

- Maintain an awareness and understanding of NASA's future programs and missions,
- Maintain a functional understanding of NASA's programs that are being carried out as well as those that have been completed,

- Assess the appropriate academic levels and disciplines for materials on NASA's past, present, and future programs,

- Keep current with the perceived goals and needs of the educational community, and

- Maintain a continual evaluation of NASA's educational offerings (e.g. publications, programs, educational technology) in order to determine the extent to which they are meeting the desired needs

Headquarters Educational Affairs Division will acquire a research and evaluation capability to help ensure that NASA's educational programs achieve their intended goals and objectives and that program designs reflect current research and evaluation findings on learning theory and program performance. Particular emphasis will be devoted to science educational programs that justify replication as a result of documented effectiveness. Meritorious programs will be widely distributed through various media, including Teacher Resource Centers, for awareness and possible adoption with appropriate local modification

Specifically, it is our intent to

- Maintain a strong liaison with the NASA program offices,

- Utilize the technical expertise of appropriate personnel to prepare succinct reports on appropriate aerospace research,

- Maintain a research library at the NASA Headquarters AESP Office to provide materials relative to NASA programs and results, science education, curriculum guidelines, workshop activities, etc.,

- Utilize extensive field experience to maintain an understanding of actual current conditions in education,

- Provide frequent updates on trends in education from the university viewpoint, and

- Determine suitable evaluative instruments and methods that will not have a negative impact upon the educational community

Priority: Educational Affairs Administration

The Challenge

In order to carry out this Five-Year Plan and to continue to provide the products and services not mentioned within the Plan, a stronger, better-organized institution must be developed. Communications between headquarters and the field centers must be improved. An extensive management data base must be initiated. A proper Division skill mix must be achieved. ADP equipment must be procured. In short the institution itself must be improved.

1 NASA Management Instructions (NMI).

All NMIs that affect the Division are to be revised.

2 Program Sharing and Coordination

An administrative process will be established that strengthens program sharing and coordination among the NASA field center education programs, and between headquarters Educational Affairs and the field centers. The procedures will be incorporated into the revised NMI. Day-to-day program operation relationships with and among Educational Affairs, Public Affairs, and University Programs will be strengthened, both at headquarters and field centers. This process will also be incorporated into the NMI.

3 Reporting System

A new reporting system will be established that provides the least amount of burden to the field centers but provides data on program activities and progress towards implementing activities outlined in the Five-Year Plan.

4 ADP Equipment

The process will begin to procure individual ADP workstations for all Division personnel.

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