

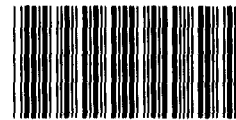
GAO

Report to the Chair, Subcommittee on
VA, HUD, and Independent Agencies,
Committee on Appropriations,
U.S. Senate

June 1991

NASA PERSONNEL

Shortages of Scientists and Engineers Due to Retirements Unlikely in the 1990s



144160



United States
General Accounting Office
Washington, D.C. 20548

National Security and
International Affairs Division

B-243596

June 17, 1991

The Honorable Barbara A. Mikulski
Chair, Subcommittee on VA, HUD,
and Independent Agencies
Committee on Appropriations
United States Senate

Dear Madam Chair:

This report responds to your concern about the increasing number of scientists and engineers eligible for retirement at the National Aeronautics and Space Administration (NASA) and addresses the impact of this situation on NASA's work force in the 1990s. We briefed your staff on the results of our work on April 11, 1991. This report summarizes the information we provided at that time.

We are distributing copies of this report to the Administrator of NASA; the Director, Office of Management and Budget; and other interested parties.

If you or your staff have any questions concerning this report, I can be reached at (202) 275-5140. Other major contributors to this report are listed in appendix IV.

Sincerely yours,

A handwritten signature in cursive script that reads 'Mark E. Gebicke'.

Mark E. Gebicke
Director, NASA Issues

Executive Summary

Purpose

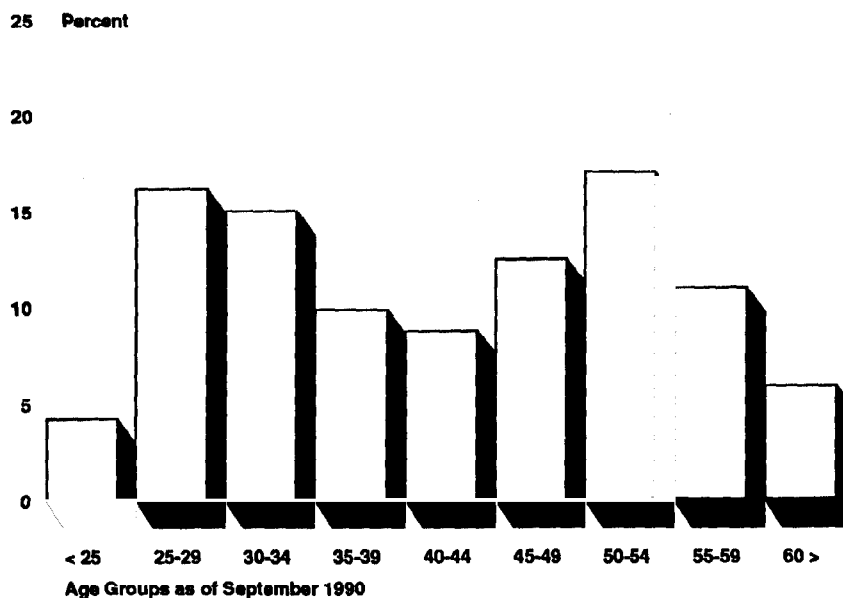
Scientific and engineering personnel capable of meeting the technical and managerial challenges posed by NASA's projects are critical to U.S. predominance in space science, aeronautics, and technology. However, 29 percent of NASA's scientists and engineers are, or soon will be, eligible for retirement. The Chair of the Subcommittee on VA, HUD, and Independent Agencies, Senate Committee on Appropriations, requested GAO to examine the age profile of NASA's scientists and engineers—specifically, the increasing number of retirement eligible scientists and engineers. GAO evaluated the potential loss of experienced scientists and engineers at NASA in the 1990s and NASA's performance in recruiting highly qualified scientists and engineers.

Background

NASA was established in 1958. The substantial growth of U.S. space programs in the 1960s brought a dramatic increase in the size of its work force. Between 1960 and 1967, NASA's overall work force doubled from 17,471 to 35,860. During the 1970s and early 1980s, however, NASA's overall work force was reduced and hiring was restricted. By 1981, total employment at the agency was down to 21,844; this figure included almost 11,000 scientists and engineers.

Throughout the 1980s, NASA's proportion of scientists and engineers increased significantly to keep up with program growth and respond to management's concern about a growing number of potential retirements in the 1990s. Beginning in the early 1980s, the agency focused its hiring efforts on recent science and engineering graduates. As a result, by the end of 1990, total full-time equivalent employment was 24,566, of which 13,181 were scientists and engineers, and their average age had declined from 44 in 1981 to 42. The age profile of NASA's scientists and engineers as of September 1990 is shown in figure 1.

Figure 1: Age Profile of NASA's Scientific and Engineering Work Force for Fiscal Year 1990



Source: NASA's Personnel Management Information System

Results in Brief

The age profile of NASA's scientists and engineers is skewed toward the over-44 and under-35 age groups, with relatively fewer of these professionals in between. Despite their eligibility, older employees are not likely to retire in large enough numbers to create a serious shortage of experienced personnel in the 1990s. NASA personnel officials anticipate that voluntary retirements of NASA's scientists and engineers may be somewhat higher than average beginning in the mid-1990s, but they have taken steps to minimize potential shortages of experience. As these older employees retire, the agency's overall age profile will gradually become younger and reflect a more "bell-shaped" distribution.

Overall, NASA is able to recruit the number of highly qualified scientists and engineers that it needs, even though it does not always get its first selections. Also, NASA has some difficulty obtaining highly specialized scientists and engineers in areas such as microgravity, robotics, and artificial intelligence. Agency officials expect shortages in these areas to become even more severe as these fields take on more importance in the 1990s.

Principal Findings

Manageable Rate of Retirement at NASA in 1990s

As of September 1990, 29 percent (or 3,865) of NASA's scientists and engineers were, or would become, eligible for retirement by the mid-1990s. Despite this high percentage, the actual rate of retirements is expected to be relatively constant and span most of the 1990s. An excessive number of retirements over a short period of time appears unlikely.

GAO's survey of NASA's scientists and engineers found that of those eligible for retirement, or of those that would become eligible in the next 5 years, on average no more than 18 percent planned to leave or retire in any given year. In absolute terms, we are 95% confident, barring unforeseen circumstances, that no more than 21% of NASA's scientists and engineers plan to leave in any given year. This is within the 20 to 22 percent annual rate anticipated by the agency. Most of these retirements will occur later rather than sooner. Over 60 percent stated they did not intend to leave or retire before 1994. Of these, 44 percent indicated they did not intend to retire until after 1995.

While the overall age profile of NASA's scientists and engineers is expected to improve, NASA's management must remain vigilant in a constantly changing environment. Factors influencing employees' personal choices to retire can occur every year and affect the agency's overall work force. Recent examples of these factors are changes in ethics legislation affecting post-federal employment options, termination of the lump sum payment option at retirement, and increases in federal pay (including the introduction of higher pay rates in designated high-cost areas).

There is a possibility that any given NASA organization could be disproportionately affected by several simultaneous retirements. NASA officials stated that there existed some vulnerability in certain laboratories and offices where several layers of managers might retire at the same time. The result could have negative impact on programs or segments of programs, but it is very difficult to predict where or when this situation might occur.

Adequate Number of Experienced Employees

Early attention by NASA management to the emerging shortage of experienced scientists and engineers resulted in the hiring of a large number of scientists and engineers over the last 5 years at both the entry- and mid-

levels. As a result, the agency has a pool of about 4,100 scientists and engineers in the 35 to 49 age group from which to fill senior-level vacancies created by retirements. These employees will have 10 or more years of experience at NASA by the mid-1990s. In addition, NASA currently employs about 4,600 scientists and engineers under age 35. This large group provides management with flexibility in choosing a solid middle-management corps.

Increase in NASA Scientists and Engineers—Highly Qualified Recruits

The number of scientists and engineers working for NASA has been increasing since the mid-1980s. This growth is a direct result of the agency's success in recruiting the number of scientists and engineers it is permitted to employ. In 1989, NASA hired 1,531 scientists and engineers. An additional 962 scientists and engineers were hired in 1990. An in-house study of the quality of the professional staff, including scientists and engineers hired since the mid-1980s, concluded that the agency was attracting highly qualified personnel at both the entry- and middle-levels. The quality of recruits was based on supervisors' opinions, academic achievement, and the proportion of employees with degrees from top-ranked schools.

Recommendations

GAO is not making recommendations in this report.

Agency Comments

In commenting on this report, NASA stated that it agreed with GAO's two primary conclusions: that (1) it is unlikely that NASA will experience an excessive number of retirements of scientists and engineers over a short period of time and (2) the retirement rate of scientists and engineers in NASA during the 1990s is expected to be manageable, barring unforeseen circumstances.

NASA also stated that the report was reassuring with respect to the agency's ability to fill senior engineering and scientific positions vacated by retirees during the 1990s. However, NASA pointed out that the scope of the report did not include the outlook of potential shortages in the entire aerospace community, including universities and private industry. The full text of NASA's comments are reprinted in appendix III.

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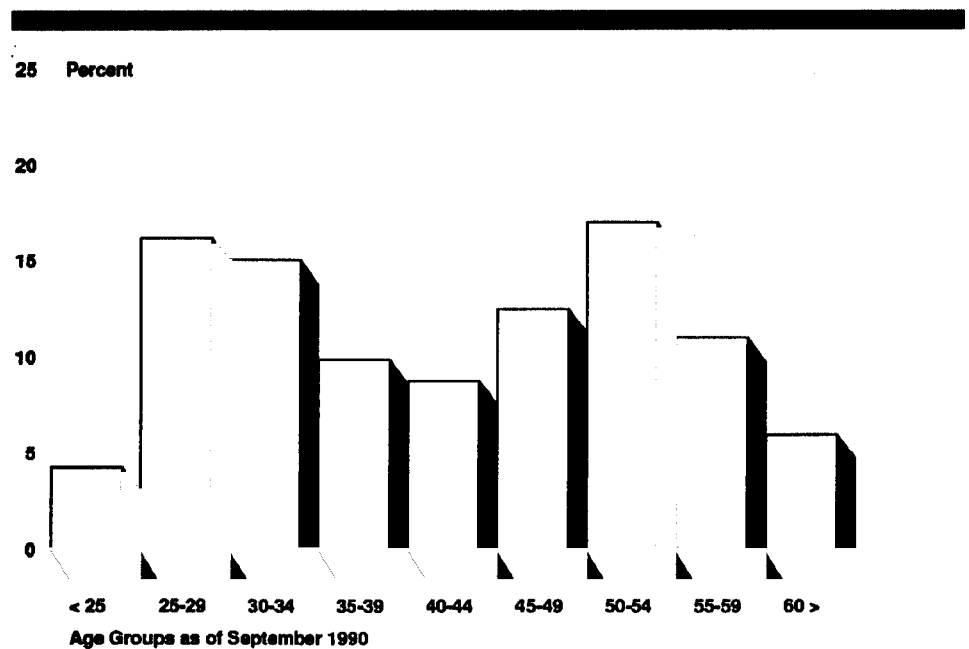
Abbreviations

GAO General Accounting Office
NASA National Aeronautics and Space Administration

Introduction

A changing emphasis on the U.S. space program since NASA's establishment in 1958 has contributed to the development of a unique age profile for the agency's scientists and engineers. As shown in figure 1.1, the age profile of NASA's scientists and engineers at the start of fiscal year 1990 was skewed toward the under-35 and over-44 age groups with a relatively smaller number of professionals in between.

Figure 1.1: Age Profile of NASA's Scientific and Engineering Work Force for Fiscal Year 1990



Source: NASA's Personnel Management Information System

The valley appearing on this graph is of concern primarily because of the large number of scientists and engineers at NASA who are, or soon will be, eligible for retirement. The relatively low number of scientists and engineers in the 35 to 44 age group raises the possibility that the agency could lose many of its most experienced employees before a sufficient number of younger staff would be in position to take their place. That concern was publicly expressed by NASA's Administrator, who testified to the Congress in February 1989 that 37 percent of NASA's senior executives would be eligible for voluntary retirement within 2 years and 14 percent of NASA's entire work force was already eligible for retirement. He went on to describe a work force profile short of mid-level employees available to fill the vacancies left by retirees, creating a "desperate problem" for the agency.

In the 1960s, NASA's civil service employment was much larger than it is today. Between 1960 and 1967, NASA's overall work force doubled from 17,471 to 35,860. During the 1970s the space program experienced substantial program retrenchment, with associated personnel reductions. By 1981, total civil service employment at the agency was down to 21,844. To help realize these reductions, NASA cut down on hiring. Today the reductions of the 1970s are reflected in a work force profile with relatively fewer scientists and engineers in the 35 to 44 age group than in older age groups.

Throughout the 1980s, NASA's proportion of scientists and engineers increased significantly to keep up with program growth. The increases were also due, in part, to management's concern about a growing number of potential retirements in the 1990s. Beginning in the early 1980s, the agency focused its hiring efforts on recent science and engineering graduates. As a result, by the end of 1990 total full-time equivalent employment was 24,566, of which 13,181 were scientists and engineers; their average age had declined from 44 in 1981 to 42.

Objectives, Scope, and Methodology

Our objectives were to examine the age profile of NASA's current scientific and engineering work force, investigate problems this profile might cause, and describe NASA's efforts to ensure the quality and continuity of its work force.

To address these objectives we interviewed agency officials at NASA headquarters and selected field installations. We developed age profiles of scientists and engineers from data in the agency's Personnel Management Information System and its annual Civil Service Work Force Report to management. We also analyzed information from NASA's Office of Personnel and Evaluation; we surveyed an agencywide sample of scientists and engineers eligible, or soon to be eligible, for retirement to determine their retirement intentions through the mid-1990s. Our sample is statistically valid and can be projected to the universe of NASA's retirement eligible employees at the 95-percent confidence level.

We did not attempt to directly measure or estimate the actual or potential impact of broad, national issues or policy changes on NASA's present or future ability to attract and retain highly qualified scientists and engineers. These issues include the future competitiveness of federal pay and benefits, the adequacy of the number and quality of scientists and engineers being educated in this country, the effects of changing U.S. immigration laws, retention implications associated with the recent

change to a new Federal Employees Retirement System, the future effects of more restrictive federal ethics regulations, and the potential impact of major reorganizations and other programmatic changes within NASA. We also did not assess how NASA used its scientists and engineers in the areas of research and development, contract administration, and contract management.

We performed our work from October 1989 to March 1991 in accordance with generally accepted government auditing standards. We interviewed officials at NASA Headquarters in Washington, D.C.; the Goddard Space Flight Center in Greenbelt, Maryland; the Langley Research Center in Hampton, Virginia; the Johnson Space Center, Houston, Texas; and the Ames Research Center, Moffett Field, California.

Manageable Rate of Retirements at NASA in the 1990s

The probability is low that a large number of scientists and engineers will leave NASA over a short period of time and create a serious gap of experienced personnel. The annual attrition rate for NASA's scientists and engineers as a percentage of their total was only 5.4 percent in fiscal year 1989 and 4.9 percent in 1990. On average, these employees do not retire until about 3 years after their initial eligibility. Employment levels at NASA have historically been influenced more by agency cutbacks, program restructuring, and external factors than by eligibility for voluntary retirement. Our survey of the retirement intentions of scientists and engineers who were already, or soon would be, eligible for retirement showed that a surge in retirements was not likely. This survey result supports the agency's projections that indicate, barring any unexpected events, that the retirements of scientists and engineers will occur at a normal rate of 20 to 22 percent of those eligible each year throughout the 1990s. Retirements of NASA's senior executives are also expected to occur at a manageable rate and not create a vacuum of experienced personnel.

NASA's Historical Retirement Pattern

During the first half of the 1970s NASA experienced a large number of retirements, especially "early-outs," because of program reductions. During this period NASA hired only essential personnel, which included relatively few newly graduated scientists and engineers. Over time, this retrenchment created the valley in NASA's current age profile. Then, from 1975 to 1978 the number of employees becoming eligible for retirement each year grew larger than the number actually retiring, resulting in a buildup of personnel eligible for retirement. By the end of fiscal year 1977 the number of employees eligible for voluntary retirement had risen to approximately 1,800. Two years later this number was over 2,700.

About that time, economic conditions were becoming conducive to retirement for those eligible. Double-digit inflation rates had resulted in significant increases in the cost-of-living adjustments for retirement annuities, while pay adjustments for federal employees had been limited to relatively modest increases. Retirement was also particularly attractive to those professionals with highly marketable technical skills who were subject to the legislative pay cap. These factors combined to help make fiscal year 1980 the peak year for NASA retirements, including 458—44 percent—of the 1,041 scientists and engineers eligible for voluntary retirement. At the time, NASA officials predicted the agency could experience at least one more year in which 25 to 40 percent of those eligible to retire would opt to do so. But this has not occurred. In 1981,

23 percent of those eligible to retire did so; this figure dropped to 19.4 percent in 1982. Currently, NASA estimates retirement rates among its eligible scientists and engineers will be 20 to 22 percent through 1999.

Historically, substantial retirement losses at NASA have been associated with major program reductions. Since 1980 and 1981, when reductions in force, "early-out" programs, the reorganization of some field installations, and economic conditions resulted in a large number of retirements, relatively modest personnel management actions have been necessary to adjust to program changes. For example, Goddard Space Flight Center and Johnson Space Center reorganized in 1984 and effectively used the "early-out" option to reduce the impact of personnel reductions on employees. More recently, NASA put a hiring freeze into effect at Marshall Space Flight Center in response to a lower-than-anticipated fiscal year 1991 budget for the space station program.

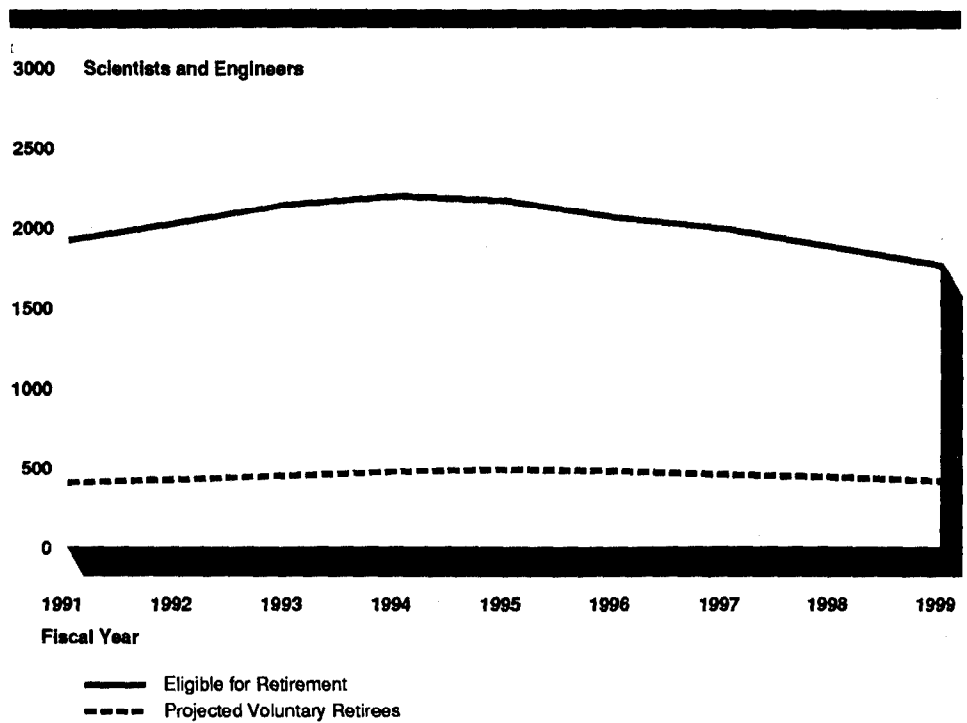
Probable Rate of Retirement for the 1990s

In the 2 years since the former Administrator testified on the potential for a surge in retirements at the agency, NASA has not, in fact, lost a large number of its most experienced employees. While the current double-peak profile shown in figure 1.1 illustrates a potential problem, a surge in retirements such as that experienced in 1980 is highly unlikely. The overall key to effectively managing the transition of the age profile from a bimodal distribution to a "bell-shaped" one, which NASA officials consider more desirable, is time; it looks like adequate time will be available, since large numbers of retirements do not appear likely in the near term or throughout the 1990s.

As of September 30, 1990, 11.1 percent of NASA's scientists and engineers were eligible for voluntary retirement, with an additional 18.2 percent becoming eligible through 1995. However, only a portion of these employees may actually retire, since typically, NASA's scientists and engineers do not retire until almost 3 years after initial eligibility.

NASA estimates that the retirement rate of its scientists and engineers will increase only slightly throughout this decade, with the peak years in the mid-1990s, as shown in figure 2.1. The retirement rate among NASA's eligible scientists and engineers is expected to be within the agency's typical agency-wide range of 20 to 24 percent of the total eligible to retire.

Figure 2.1: Projected Retirements of
NASA's Scientists and Engineers



Source: NASA's Personnel Management Information System

To assess the reasonableness of these projections, we surveyed the intentions of a sample of those scientists and engineers who were currently, or within the next 5 years would become, eligible for retirement. As of September 30, 1990, NASA's Personnel Management Information System indicated that 3,865 scientists and engineers were, or would become, eligible for retirement through 1995. We surveyed a random sample of 672 of these employees, 272 of 1,467 scientists and engineers eligible to retire on September 30, 1990, and 400 of the 2,398 eligible to retire within five years of that date. Our survey covered NASA headquarters and eight field centers. A copy of the survey questionnaire and the summary responses is presented in appendix I.

We received 667 responses—a response rate of over 99 percent. Most of the respondents indicated a high or very high likelihood of their leaving or retiring from NASA by the end of calendar year 1995. However, when asked which year they were most likely to leave or retire, 61 percent indicated 1994 or later. This percentage is consistent with agency data, which shows no surge in retirements of scientists and engineers through 1999. In our survey, employee responses indicate that, on average, no

more than 18 percent of the scientists and engineers eligible for retirement plan to leave or retire in any given year. All population estimates were made at the 95% confidence level. In absolute terms, we are 95% confident, barring unforeseen circumstances, that no more than 21% of NASA's scientists and engineers plan to leave in any given year. This rate of loss is within the 20 to 22 percent annual retirements anticipated by the agency.

The responses to the survey indicate that there will be no surge of retirements at any of NASA's field centers through 1995. With the exception of the scientists and engineers retiring from Ames Research Center in 1994 and Stennis Space Center in 1995, no more than 23 percent of those eligible for retirement plan to retire in any given year; in most cases the retirement rates are much lower than 23 percent. Table 2.1 shows the results of the survey by installation. The percentages in the table represent the statistically valid weighted averages of the upper and lower confidence levels. Therefore, the totals shown may differ slightly from the actual raw data presented in appendix I.

Table 2.1: Estimated Retirement Rates (by NASA Installation) of Scientists and Engineers Eligible for Voluntary Retirement

Figures in percentages

Installation	1991	1992	1993	1994	1995	After 1995
Headquarters	1.0	12.2	20.4	19.8	22.3	24.1
Ames	9.4	2.7	17.6	29.8	14.9	25.7
Goddard	10.4	7.0	23.2	14.0	19.8	25.7
Johnson	11.8	13.6	15.8	16.9	16.0	25.9
Kennedy	13.9	9.8	14.9	14.0	20.2	27.2
Langley	8.7	14.4	17.1	18.6	12.6	28.6
Lewis	12.0	12.0	15.5	14.3	21.4	24.8
Marshall	10.0	10.0	16.8	12.4	18.0	32.8
Stennis	15.8	0.0	21.0	21.0	31.6	10.5 ^a
All locations	10.4	10.6	17.6	16.3	18.0	27.3

^aThe Stennis Space Center is a small installation and had only 19 scientists and engineers eligible to retire within the next 5 years. The actual number of planned retirements reported by these employees for 1991-95 and after 1995 were 3, 0, 4, 4, 6, and 2 respectively.

A number of respondents noted that their retirement plans were more closely linked to the status of the program they were working on and their satisfaction with their contribution to it, than to retirement eligibility. Many of the respondents retiring in early 1991 stated they did so because the government was canceling the lump sum payment option for retirees after November 30, 1990.

Manageable Senior Executive Retirement Rate

At the end of fiscal year 1989, NASA's Senior Executive Service totaled 502, including 385 scientists and engineers. Of the scientists and engineers, 80 (21 percent) were eligible at that time for voluntary retirement, and an additional 162 (42 percent) would become eligible through September 1994. However, the number of senior executives retiring has not been excessive. Of the total 502 senior executives, only 60—about 12 percent—left the agency in 1989. Moreover, 17 of these losses involved a one-time situation in which the employees opted to change jobs before the effective date of the new post-employment ethics restrictions (P.L. 100-679). Excluding these cases, less than 9 percent of NASA's senior executives retired in 1989.

The total attritions among senior executives in 1990 was 29, about half the total in 1989. In fact, the agency had a net increase of 24 senior executives in 1990, including 15 scientists and engineers. The expectation of the major pay increase in January 1991 encouraged many senior executives to delay retirement plans to increase their annuity, which is based on their three highest salary years. NASA personnel officials said this could result in a large number of senior executive retirements in 1994. However, the agency is already beginning preparations to minimize the impact of these departures. For example, several NASA field offices are starting to match two or three mid-level managers with senior executives so the mid-level managers will have enough experience to replace the departing employees.

NASA's personnel officials stated that, statistically, retirements were expected to occur within a manageable range and not create a vacuum of experienced personnel. Early attention by NASA management to the emerging shortage of experienced scientists and engineers led to increased hiring over the last 5 years at both the entry- and mid-levels. As a result, the age group 35 to 49, while smaller than the younger and older age groups, contains about 4,100 experienced scientists and engineers. These employees will have 10 or more years of experience at NASA by the mid-1990s and be available to fill most vacancies created by the retirement of senior executives. Similarly, the large pool of employees under age 35 (about 4,600) created since the early 1980s is expected to provide NASA's management with flexibility in choosing a solid middle-management corps. However, there is a possibility that any NASA organization could be disproportionately affected by several simultaneous retirements. NASA officials stated that there existed some vulnerability in certain laboratories and offices where several layers of managers might retire at the same time. The result could have a negative impact

on programs or segments of programs, but it is difficult to predict where or when this situation might occur.

NASA's Success in Maintaining the Quality and Continuity of Its Scientific and Engineering Work Force

Recruiting and maintaining an effective work force is a substantial challenge to any federal agency, but even more so to an agency that draws about half of its employees from a relatively small, highly educated population. NASA appears to be meeting this challenge well. Since 1983, although it has had some difficulty filling certain highly specialized positions, it has done a commendable job hiring a large number of qualified scientists and engineers for both entry- and mid-level positions.

NASA Attracts Large Number of Scientists and Engineers

In 1989, the most successful recruiting year in its history, 2,590 employees were hired, including 1,531 scientists and engineers. Fiscal year 1990 was also a very successful hiring year: 1,937 total hires including 962 scientists and engineers. Hiring a sufficient number of scientists and engineers has not been a serious problem for NASA; it has far more applicants for employment each year than it has positions to fill. Overall, NASA is able to recruit the necessary number of scientists and engineers, although it does not always get its first choice. The scientists and engineers who do the recruiting at the centers we visited attribute their recruiting success to the prestige of the agency, the opportunity for meaningful hands-on research, and the potential for career advancement. The agency's success has been in spite of some difficulty in recruiting highly specialized scientists and engineers in areas such as microgravity, robotics, and artificial intelligence. The shortage in these areas is expected to become increasingly severe as these fields take on more importance in the 1990s.

The Quality of New Scientists and Engineers

In February 1990, NASA's Office of Management began a review of the agency's ability to recruit and retain a sufficient number of highly qualified scientists, engineers, and administrative personnel. The review team evaluated the qualifications of recent recruits using three criteria: (1) their skills and abilities as assessed by senior- and first-level managers, (2) their academic records, and (3) the number of those who graduated from top-ranked science and engineering colleges and universities.

Forty out of 58 directors or first-level supervisors interviewed characterized the quality of recent recruits as "very good" or "excellent." There were no negative responses. The review team determined that the scientists and engineers hired from 1986 to 1989 averaged between 3.2 and 3.3 grade points on a four-point academic grading scale, with no center reporting less than a 3.0 average. This matches the agency's recruitment performance during the Apollo era. Finally, the review team found that a significant number of the scientists and engineers hired as

new graduates in 1989 and NASA's mid-level employees hired from 1986 to 1989 came from top-ranked science and engineering schools.

The review team concluded that, overall, NASA was hiring highly qualified scientists and engineers at both entry- and mid-levels. This conclusion was compatible with the views of the recruiters at four field centers, who told us that the quality of scientists and engineers they hired had not deteriorated over the years.

Strategies for Attracting Highly Qualified Personnel

NASA has cooperative education (co-op) agreements with 183 colleges and universities, including 27 of the 37 top-ranked schools previously referred to. This program is a major source of new scientists and engineers for NASA. From 1985 to 1990, an average of 1,030 science and engineering students participated in the program each year. Of those graduating and eligible for conversion to permanent employment, about 68 percent were hired by NASA. On average, about one fourth of all newly graduated scientists and engineers hired by NASA come through the co-op program. Agency officials expect that the cooperative education program will continue to be a major source of new talent.

NASA's support of continuing education helps make it an attractive employment choice. New scientists and engineers frequently cite the opportunity for continuing study as a major benefit of NASA employment. Most NASA scientists and engineers pursue advanced degrees; for instance, 83 percent of the scientists and engineers that NASA hired in 1987 were taking post-graduate courses at the agency's expense in 1989. All installations offer continuing education benefits and assistance, including flexible work schedules that permit employees to attend day-time classes. Also, in January 1991, Johnson Space Center began televised broadcasts of graduate engineering courses from local universities.

NASA's success in recruiting a sufficient number of highly qualified scientists and engineers is also due in part to local initiatives at NASA installations. For example, Langley Research Center has a mentor program in which senior scientists and engineers are teamed with junior staffers on specific projects to expose the junior staffers to the skills and abilities required at higher levels of responsibility. Goddard Space Flight Center also has a mentor program that requires new science and engineering employees to work on a project of their choice under the guidance of a senior staff member. Other centers offer informal mentor programs.

Chapter 3
NASA's Success in Maintaining the Quality
and Continuity of Its Scientific and
Engineering Work Force

According to NASA officials, the programs are primarily intended to facilitate the rapid development of staff. Nevertheless, they are also attractive recruitment vehicles.

Finally, NASA sponsors various educational programs to support teachers and students and inform the general public about NASA activities. These programs are performed as part of the agency's responsibility to keep the public informed and help to foster educational interest in science and mathematics. However, these activities are not intended to directly support the recruiting of scientists and engineers, and there is no direct measure of the extent to which they may ultimately benefit NASA. A brief summary of NASA's primary educational and community awareness efforts is presented in appendix II.

Conclusions

Approximately 29 percent of NASA's scientists and engineers are, or will become, eligible to retire within the next 5 years. Nevertheless, agency personnel officials expect that retirement rates will be within the normal range of 20 to 22 percent of those employees eligible during the early 1990s and rise only slightly in the peak retirement years of the mid-1990s. Agency officials caution, however, that unforeseen circumstances such as changes in legislation, program reductions, or economic conditions could quickly impact the retirement-eligible population. Our survey of NASA's scientists and engineers eligible for retirement, or who will become eligible through 1995, shows that potential retirement rates over the next several years appear to be consistent with NASA's estimates and should be manageable. Barring unforeseen events or circumstances, NASA's age profile for its scientists and engineers will gradually become younger overall and reflect a more desirable distribution of age groups than it does now.

The number of NASA's scientists and engineers has increased every year for the last 5 years, and there is a larger pool of mid-level employees from which to select replacements for the relatively few senior executives retiring each year. Plans are already being made to mitigate the effects of a potential surge in senior executive retirements in 1994. Also, the large number of scientists and engineers under 35 sets a trend for a younger work force in the 1990s and provides management with considerable flexibility in building a solid middle-management corps.

NASA has done a commendable job in maintaining the continuity and quality of its work force in a very challenging environment. Overall, the agency has been able to recruit the number of highly qualified scientists and engineers that it needs, and successful recruiting since the early 1980s has put the agency in a favorable position for dealing with the peak retirement years later in the decade.

While the overall age profile of NASA's scientists and engineers should become more bell-shaped, NASA's management must remain vigilant in a constantly changing environment. Factors influencing employees' personal choices to retire can occur every year and affect the agency's overall work force. Recent examples of these factors are changes in ethics legislation affecting post-federal employment options, termination of the lump sum payment option at retirement, and increases in federal pay (including the introduction of higher pay rates in designated high-cost areas).

Survey Questionnaire and Results



U.S. General Accounting Office

Survey of NASA
Scientists and Engineers

The U.S. General Accounting Office (GAO) is currently reviewing the profile of NASA's scientists and engineers to determine future personnel needs. As part of this study, we are using this questionnaire to survey a random sample of NASA scientists and engineers who are now or will be eligible to retire in the next 5 years. The purpose of this questionnaire is to determine individuals' intentions to leave or retire from NASA.

We would appreciate your assisting us by completing and returning this questionnaire in the enclosed, pre-addressed business reply envelope as soon as possible. The questionnaire should take only a few minutes to complete. Your responses are confidential and will not be released to anyone in NASA or elsewhere outside of GAO except in summary form in our report. If you have any questions about this questionnaire or our study, please call Bill Crocker on (202) 275-6522.

1. At what work installation were you assigned as of 9/30/90? (CHECK ONE.)

- 1. Headquarters 67
- 2. Goddard Space Flight Center 86
- 3. Marshall Space Flight Center 89
- 4. Johnson Space Center 86
- 5. Kennedy Space Center 80
- 6. Stennis Space Center 19
- 7. Ames Research Center 74
- 8. Langley Research Center 82
- 9. Lewis Research Center 84
- 10. Other (PLEASE SPECIFY.)

2. What is your date of birth?

19
 Month Day Year

3. In total, how many years of federal service, including military service, had you completed as of 9/30/90? (Please "round down" partial years of service.)

_____ Total years of federal service

4. The next two questions ask about your intentions to leave or retire from NASA. We recognize the difficulty in providing information of this kind; however, we ask that you base your responses on your best estimate of your future plans.

First, what is the likelihood that you will leave or retire from NASA sometime between now and 12/31/95? (CHECK ONE.)

- 1. Very high 306 45.9 percent
- 2. High 142 21.3 percent
- 3. Moderate 101 15.1 percent
- 4. Low 68 10.2 percent
- 5. Very low 50 7.5 percent

5. In what year are you most likely to leave or retire from NASA? (CHECK ONE.)

- 1. 1991 71 10.6 percent
- 2. 1992 68 10.2 percent
- 3. 1993 119 17.8 percent
- 4. 1994 115 17.2 percent
- 5. 1995 121 18.1 percent
- 6. After 1995 173 25.9 percent

6. Please record any comments or suggestions you might have in the space below and on the back side of this form.

Thank you!

Preparatory Education and Community Awareness Activities

For more than 25 years NASA has worked to preserve U.S. leadership in aeronautics, space science, and technology. NASA has established a wide range of programs aimed at fostering a continuing interest in science and mathematics from primary through graduate school. NASA also sponsors a variety of public awareness activities. There is, however, no direct measure of the extent to which these efforts ultimately contribute to NASA's recruiting success.

University Programs

NASA has established a number of university programs specifically dedicated to increasing the number of students majoring in science and mathematics. In fiscal year 1991, NASA plans to spend over \$45 million on these programs.

The Advanced Design Program and graduate fellowships are two current university programs. In the Advanced Design Program undergraduate senior engineering students in 41 participating universities study advanced mission topics (in space and aeronautics design) for NASA within the context of their university courses. In 1990, 1,000 undergraduate students participated in this program. NASA also has several programs to disseminate grants for fellowships to undergraduate and graduate students. In fiscal year 1990, NASA funded 526 graduate fellowships directly. Additionally, through the National Space Grant College and Fellowship Program, NASA provided an additional \$2.1 million in fellowship funds to be administered by the universities for both undergraduate and graduate students with an emphasis on recruiting underrepresented groups.

NASA also has university level programs that target minority populations. Since the late 1960s, the Minority University Program has focused on increasing the number of science and engineering majors at historically black colleges and universities. In addition, since the early 1980s, NASA has established other programs targeting African Americans, Native Americans, Hispanics, and Pacific Islanders. Currently, minorities in the work force at NASA make up 12.9 percent of NASA's scientists and engineers, up from 7.4 percent 10 years ago. Women now compose 29.1 percent of the agency; one in every seven scientists and engineer at NASA is female.

Elementary and Secondary School Programs

Research by the National Science Board indicates that an interest in science and mathematics is developed at an early age in those students who ultimately choose a career in these fields. NASA established its first education program for elementary and secondary school students in 1961. Of the \$55.1 million that NASA plans to spend on educational programs in fiscal year 1991, about \$10 million is allocated to elementary and secondary school programs.

Perhaps the most well-known program is the Aerospace Education Services Program—the “Spacemobile.” The program uses a fleet of 26 vans staffed by educational specialists who visit elementary and secondary schools in order to stimulate interest in mathematics, science, and technology by showing their applications in aeronautics and space science. The education specialists bring a unique and entertaining perspective to science, using models of the shuttle, a space suit, a variety of space food, and many other exhibits. NASA estimates that the program reaches approximately 1.3 million students each year.

Among the other elementary and secondary programs is the Summer High School Apprenticeship Research Program. This program, which started in 1979, provides high school students with an opportunity to work at a NASA facility during the summer on a topic or project of their choice under the supervision of a NASA scientist or engineer. NASA estimates that between 80 and 90 percent of the students subsequently pursue math- and science-related careers. The program has become so popular with students, educators, and NASA personnel, that NASA plans to introduce a similar program for university students.

NASA also has a Teacher Resource Center Network to provide information to teachers for use in the classroom. A Teacher Resource Center, containing video and audiotapes, lesson plans, slides, and other information, is located at each of NASA’s eight field centers and is available to elementary and secondary school teachers. In geographic areas not reasonably accessible to a field center, NASA has established Regional Teacher Resource Centers in partnership with universities and museums. NASA also handles, through an educational nonprofit organization, national and international requests for information, including audiovisual material, which is provided for a nominal fee.

Community Awareness Activities

NASA promotes community awareness and involvement in aeronautics and space education through its community outreach programs. It provides technical judges to approximately 300 science fairs a year and

**Appendix II
Preparatory Education and Community
Awareness Activities**

responds to public requests for information by providing displays in shopping malls, addressing civic organizations, and participating in radio and television programs related to science and mathematics education.

Comments From the National Aeronautics and Space Administration



National Aeronautics and
Space Administration

Washington, D.C.
20546

Office of the Administrator

MAY 10 1991

Mr. Frank C. Conahan
Assistant Comptroller General
National Security and International
Affairs Division
United States General Accounting Office
Washington, DC 20548

Dear Mr. Conahan:

This is the National Aeronautics and Space Administration's (NASA) response to the General Accounting Office (GAO) draft report GAO/NSIAD-91-XXX, entitled, "NASA Personnel: Shortages of Scientists and Engineers Due to Retirements Unlikely in the 1990s," dated April 25, 1991.

The draft report provides an optimistic commentary and response to the concern about the increasing number of scientists and engineers eligible to retire at NASA in the 1990s. The agency is proud of the fact that it has been able to maintain a quality workforce in a very challenging environment. We agree, fundamentally, with the report's conclusions that (1) it appears unlikely that NASA will experience an excessive number of retirements of scientists and engineers (S&Es) over a short period of time and (2) the retirement rate of S&Es in NASA during the 1990s is expected to be manageable, barring unforeseen circumstances.

We are especially pleased that the draft report amplifies that NASA's favorable position now and its anticipated situation throughout the 1990s are because NASA management recognized the potential problems early and took steps, within its bounds and control, to minimize any negative impact.

Further, NASA recognizes, as the draft report indicates, that it must remain vigilant in a constantly changing environment. In this regard, we agree with your assessment that NASA is vulnerable to external factors which could trigger employee decisions to retire. Therefore, we will continue our efforts to minimize the effects of such factors and, whenever possible, try to influence the legislative or regulatory processes involved.

**Appendix III
Comments From the National Aeronautics
and Space Administration**

2

The report is reassuring with respect to NASA's ability to fill senior engineering and scientific positions vacated by retirees during the 1990s. However, it does not address, and we do not want to mask, the outlook of potential shortages in the entire aerospace community, including universities and private industry. We realize that these longer-term needs of the space workforce require long-range educational and workforce planning.

We appreciate the cooperation and professional courtesies extended by your staff during the development of this report and the efforts made to solicit and consider NASA's views through the data collection and review processes. The information contained in this report is useful as we prepare for expected growth in significant areas.

Sincerely,



John E. O'Brien
Assistant Deputy Administrator

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