A Description and Analysis of
Best Practice Findings of

Programs Promoting Participation of Underrepresented Undergraduate Students in Science, Mathematics, Engineering, and Technology Fields

December 2000

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Programs Promoting Participation of Underrepresented Undergraduate Students in Science, Mathematics, Engineering, and Technology Fields

Prepared under contract #RED 94-52966

by

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Executive Summary

Overview

This report summarizes the findings of an exploratory study to identify "exemplary practices" in federally funded programs designed to increase the participation of minorities in science, mathematics, engineering, and technology (SMET) fields. This study serves two purposes: first to provide a rich description of what the projects do, and second to highlight the features that appear to make them especially promising. While programs from three federal agencies were included—the National Science Foundation (NSF), the National Institutes of Health (NIH), and the National Aeronautics and Space Administration (NASA)—this report focuses primarily on NSF's Louis Stokes Alliances for Minority Participation program (LSAMP). LSAMP is the major endeavor funded by the National Science Foundation to remedy the underrepresentation of minorities at the college level. The main goals of the program are to raise the number of minority students who complete the baccalaureate in SMET fields and to increase the number of degree recipients who enroll in related graduate degree programs.

The LSAMP program constitutes a major departure from traditional scholarship programs. Rather than focusing on supporting individual institutions or supporting students through financial aid, LSAMP is more comprehensive and multidimensional.

- First, the NSF program stipulates the formation of Alliances, conceived as partnerships among academic institutions (universities, colleges, and community colleges), government agencies and laboratories, industry, and professional organizations.
- Second, LSAMP targets undergraduates who have shown interest or aptitude for SMET fields in high school, when they entered college, or during their college career. The program is not focused solely on students with an existing track record but attempts also to nurture those who have still to display their potential.
- Third, while providing some financial support, LSAMP puts major emphasis on offering various activities designed to help minority students fulfill their potential in college and to sustain their interest in SMET fields and graduate study through hands-on research experiences and interaction with other institutions in the Alliance.

The program guidelines for LSAMP projects specify that funding will be provided for 5 years. Contingent on satisfactory progress during the first 5 years of operations (Phase I), a second 5-year span (Phase II) may be funded. At the time the study was initiated, the 28 LSAMP projects operated in 24 states (California, New York, Texas, and Louisiana have 2 Alliances each). Of the existing LSAMP projects, 16 were created between l991 and 1994 and are therefore in Phase II.

Approach

This best practices study starts from a specially selected sample of programs believed to be successful and attempts to deduce and describe factors that relate to that success. Exhibit E-1 presents an overview of the criteria used for selecting the LSAMP sites.

Exhibit E-1
Criteria for selecting LSAMP sites

- "Success indicators" available from the NSF databases, such as annual increases in SMET enrollment, the number of SMET graduates, and graduation rates.
- Sites enrolling different ethnic minorities.
- Programs that had been in operation for 5 years or more.
- Advice of NSF program staff with considerable knowledge of the activities and characteristics of the various LSAMP projects.

Exhibit E-2 provides more information on the selected LSAMPs.

The approach to site selection for the NIH and NASA sites was somewhat different as performance data were not available. In these cases, Washington staff members most familiar with the programs recommended sites for Westat to visit. For Puerto Rico, LSAMP and NIH's Minority Access to Research Careers (MARC) programs were included. Exhibit E-3 shows the NIH and NASA sites.

Exhibit E-3
NIH and NASA sites

Morgan State University (MARC)
Puerto Rico (MARC)
Morehouse College (NASA)
Spelman College (NASA)

Data from projects' annual reports, NSF's database, and site visits were utilized in this study. For the LSAMP sites, arrangements were made with the lead institution for a site visit by two experienced Westat staff members to interview the project director, other administrative and project staff, faculty members, and upperclassmen. Depending on the preferences and time available at each site, interviews were done both individually and in groups. Similar arrangements were made for the MARC and NASA sites, but fewer staff interviews were needed because these are single-site programs.

Exhibit E-2
Characteristics of the LSAMPs selected for this study

California LSAMP:	Lead institution: University of California, Irvine Project Length: 7 years Students Served: Hispanic, African American, Native American Location: West Coast Increase in degrees granted*: 62%
Florida LSAMP:	Lead institution: Florida A&M University Project Length: 6 years Students Served: African American, Hispanic Location: East Coast Increase in degrees granted: 123%
Mississippi LSAMP:	Lead institution: Jackson State University Project Length: 7 years Students Served: African American Location: South Increase in degrees granted: 140%
Cal State LSAMP:	Lead institution: California State University Project Length: 5 years Students Served: Hispanic, African American, Pacific Islanders Location: West Coast Increase in degrees granted: 84%
U. of Texas LSAMP:	Lead institution: University of Texas, El Paso Project Length: 6 years Students Served: Hispanic, African American Location: South Increase in degrees granted: 56%
Puerto Rico LSAMP:	Lead institution: University of Puerto Rico, Rio Piedras Project Length: 7 years Students Served: Hispanic Location: East Coast Island Increase in degrees granted: 63%
Alabama LSAMP:	Lead institution: University of Alabama at Birmingham Project Length: 7 years Students Served: African American Location: South Increase in degrees granted: 118%

*Percentages represent increases in degrees granted to minority students in SMET fields from the program baseline years to the time of this report, as declared in the 1998 GPRA reports.

Findings

Comparisons Among the Three Programs

The three programs examined in this study have a common goal: to increase the number of qualified minority members in SMET fields. But the means to reach this goal are very different.

The NIH-sponsored MARC program provides generous stipends to students who have demonstrated interest and ability in science and in research. Their only obligation during the last 2 years of college is to participate in research projects under the guidance of a research mentor, maintain high grades, and prepare themselves for admission to a graduate program from which they will seek to obtain a Ph.D. Although some of their activities may impact other SMET students on campus, who are invited to hear research presentations made by MARC scholars, and may be motivated to improve their academic performance so as to qualify for the MARC program in future years, the impact on the student population as a whole is not considerable. MARC students, who have successfully weathered the first 2 years of college, do not require the academic and social support that younger students need. They do, however, need help with career decisions and especially with graduate school entrance, and this assistance is provided through GRE preparation workshops or tutoring and faculty efforts and recommendations. The sponsor of this program seeks to direct these scholars toward careers as biomedical researchers, rather than as medical practitioners —often the first choice of students who major in some of the SMET fields. Because of this subgoal, and because the program is limited to juniors and seniors, comparisons between this program and LSAMP are really not possible.

The NASA program is more similar to LSAMP, although it is much smaller, more selective, and provides all participants with a stipend that even after it was cut back 2 years ago, is still much larger than what the majority of LSAMP participants receive. The obligatory summer internship at NASA centers guarantees additional income and also exposes the NASA scholars to research opportunities and contacts, which may lead to job offers or graduate fellowships. Because the number of NASA scholars is small, the staff makes considerable efforts to help each student to succeed. To that end, students' course performance and participation in the numerous program activities is closely monitored. But as is true of the MARC program, there is relatively little opportunity for the student body as a whole to participate in activities other than attending research presentations or ceremonial activities.

The LSAMP program is fundamentally different, and not only because of the Alliance structure. Increasingly, the staff has chosen to accept some students who had not distinguished themselves in their high school academic courses or when they first entered college. Stipends are often tied to academic performance, but more often to the performance of specific tasks, such as research assistance or tutoring. The primary emphasis in participating institution is on retaining and graduating SMET students, although graduate study is stressed for qualified students. There is more emphasis on creating a community of mutually supportive students, rather than on exhortation that individuals must prove themselves to be the best—a view expressed by some of the NASA staff. Perhaps most important, the academic and social support activities that the program has initiated have benefited a large proportion of minority SMET students on the campuses where LSAMP is active.

LSAMP also differs from the other programs in what might be considered its secondary goals and activities. In addition to impacting students, the program also stresses having an impact on the faculty who participate and the institutions that host them. LSAMP works on changing the system and the capacity of the system to meet student needs, as well as the success rate of the students within it. In addition, some LSAMPs have also accepted the charge of providing better teacher education, another area that could be expected to eventually have impacts on the overall system.

Keys to Success in the LSAMP Sites

Each of the seven LSAMP projects that Westat staff visited emphasized different features, largely because each targeted students with such different needs. However, looking across the projects visited, the study has identified a set of features that appear to lay the foundation for success (Exhibit E-4).

Exhibit E-4
Keys to LSAMP's Success

- Summer bridge program
- Research experience
- Mentoring
- Drop-in center
- Caring staff
- Alliance structure

By far the most successful feature of these LSAMP programs is the residential summer bridge program for graduating high school seniors. Typically, students receive a stipend to attend a 3- to 6-week session during the summer prior to college attendance. They enroll in "gatekeeper" courses, usually in math and science, and are taught study skills and time management. Most important perhaps is the exposure to campus life and the opportunity to meet some faculty members and future fellow students. The summer bridge program is especially useful for transfer students from community colleges, but it is helpful for all college freshmen.

For students who have successfully survived the freshman year, the program feature most often described as "most important" by staff and students is the research experience. The opportunity to participate in real, ongoing research projects was seen by some as the centerpiece of the program and the essential element in promoting graduation and graduate enrollment. Where it also leads to opportunities for presenting findings to a wider audience at seminars, symposia or conferences, or through publications, it strengthens students' self-confidence as well as their speaking and writing skills. These opportunities to participate in meaningful research are not universally available, however, since faculty at many institutions within each Alliance are focused on teaching, rather than funded research.

In all LSAMP projects in this study, mentoring was seen as a major and important activity. Students were most enthusiastic about having a peer mentor during their first 2 years in college, because some found it difficult to relate to faculty mentors and were especially uncomfortable in discussing personal problems. Research mentors, on the other hand, were often seen as inspiring and valuable teachers as well as friendly and supportive adults. Not every student has a peer mentor (in the early years) as well as a research mentor as soon as they become eligible for a research assignment, and some LSAMP projects take more initiatives to match students and research faculty than others. But ideally, having these two mentors, especially if they are good matches, seems to be the most productive arrangement.

Another feature is a drop-in center, usually a separate space with resource materials and computer facilities where a graduate student or faculty member is present to answer questions and point students to resources. These centers, which are not usually available on every campus, often become popular meeting places where students can work together or simply socialize.

There is also considerable strength in the Alliance structure itself. For students, the opportunity to learn from others attempting to meet the same goals appeared to us to be a unique and valuable feature. For faculty, who often feel that they are "out there by themselves," the presence of "comrades in arms" provides both a psychological and a practical source of supports.

But over and above specific program features identified as characteristic of successful projects is a more amorphous notion expressed in many of the interviews conducted on campus: the LSAMP project has a caring staff and is a place where students feel that someone (or many individuals) really cares about them. Closely

associated with this characteristic is the existence of a community of LSAMP participants ready to support and help each other. Students (and to some extent faculty) are able to escape the anonymity that a bureaucratic institution (the university or college) imposes on them. Of course, all college students share these needs. However, the traditional undergraduate environment, especially the environment at institutions serving mainly majority students, may pose special barriers for students who are from underrepresented minority groups and may be the first in their families to seek a degree in the SMET fields.

LSAMP, as we saw it, has both purpose and passion. Our study of selected programs clearly shows that these efforts are admirable, are contributing in a variety of ways to the health of the SMET infrastructure, and are providing a variety of lessons for those willing to invest their energies and skills in educating others.

1. Introduction

This report summarizes the findings of an exploratory study to identify "exemplary practices" in federally funded programs designed to increase the participation of minorities in science, mathematics, engineering, and technology (SMET) fields. This study serves two purposes: first, to provide a rich description of what the projects do, and second, to highlight the features that appear to make them especially promising. While programs from three federal agencies were included—the National Science Foundation (NSF), the National Institutes of Health (NIH), and the National Aeronautics and Space Administration (NASA)—this report focuses primarily on NSF's Louis Stokes Alliances for Minority Participation program (LSAMP). LSAMP is the major endeavor funded by the Foundation to remedy the underrepresentation of minorities at the college level. The main goals of the program are to raise the number of minority students who complete the baccalaureate in SMET fields and to increase the number of degree recipients who enroll in related graduate degree programs.

The LSAMP program constitutes a major departure from traditional scholarship programs. Rather than focusing on supporting individual institutions or supporting students through financial aid, LSAMP is more comprehensive and multidimensional.

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- Third, while providing some financial support, LSAMP puts major emphasis on offering various activities designed to help minority students fulfill their potential in college and to sustain their interest in SMET fields and graduate study through hands-on research experiences and interaction with other institutions in the Alliance.

The program has been in existence since 1991, and 28 Alliances are currently active. The program guidelines for LSAMP projects specify that funding will be provided for 5 years. Contingent on satisfactory progress during the first 5 years of operations (Phase I), a second 5-year span (Phase II) may be funded. At the time the study was initiated, the 28 LSAMP projects operated in 24 states (California, New York, Texas, and Louisiana have 2 Alliances each). Of the existing LSAMP projects, 16 were created between l991 and 1994 and are therefore in Phase II.

The Alliances Westat visited had emphasized somewhat different specific activities in the two phases. Most often, changes in the curriculum and teaching methods were emphasized during Phase I, and preparation for enrollment in graduate school and efforts to obtain funding from university or state sources for LSAMP activities after NSF support terminates receive more attention during Phase II. NSF monitors each Alliance's activities on a regular basis, providing data on a variety of program features, including number served and graduation rates. The present study builds on the data from this monitoring system, attempting to develop a better understanding of the factors that contribute to individual projects' successes.

2. Related Work

Before undertaking this study, Westat reviewed existing literature with two goals in mind:

- Obtaining descriptions of the design and results of previous evaluation of programs developed to promote increases in the number and quality of minority students who obtain undergraduate degrees in science, mathematics, engineering, and technology; and
- Obtaining a deeper understanding of the ideas and theories that have guided the development of programs designed for this purpose and that are believed to be essential for bringing about the desired outcomes.

It quickly became apparent that the first objective could not be met because of a lack of comprehensive documentation or database information. While the largest number of programs we found for underrepresented minorities addressed SMET fields, with one exception they have not been systematically evaluated. The only program for which systematic outcome data were found is the Minority Access to Research Careers (MARC), funded by NIH's Institute of General Medical Sciences. The study of this program[1] compared the percentage of MARC graduates and the total population of bachelor's degrees recipients, by ethnic group, in terms of advanced degrees received and found an advantage for the MARC students. A second study,[2] currently in draft form, will present an analysis of 20 major programs established to increase the achievement of underrepresented minority undergraduates. Fourteen of the programs studied support students in SMET areas.

The second objective was easier to meet, as there is a sizable body of information in the social science and educational research literature discussing the underrepresentation of women and minorities in SMET fields, and broader issues of nonpersistence in college and of low undergraduate enrollment in SMET. Appendix A presents a brief overview of these works.

To the extent possible, this literature and the findings presented were used to inform our study questions and our discussions with LSAMP project administrators, staff, and students.

[1] National Institute of General Medical Sciences, *A Study of the Minority Access to Research Careers Honors Undergraduate Research Training Program* (unpublished report, 1995).

[2] P. Gandara and J. Maxwell-Jolly, *Priming the Pump: Strategies for Increasing the Achievement of Underrepresented Minority Undergraduates (*New York: College Board, in press).

3. How This Study Was Done

This best practices study starts from a specially selected sample of programs believed to be successful and attempts to deduce and describe factors that relate to that success. The study reported here is *not* an evaluation in that evaluation starts with a scientific sample, and through carefully designed means attempts to find out whether a program is meeting its goals.

Site Selection

Our selection criteria combined data and expert opinion in selecting LSAMP sites and were guided to some extent by "success indicators" available from the NSF databases such as annual increases in SMET enrollment, the number of SMET graduates, and graduation rates. We also wanted to include sites enrolling different ethnic minorities. Because we felt it important that we look at more mature programs, we focused on those that had been in operation for 5 years or more. Finally, we relied for advice on NSF program staff with considerable knowledge of the activities and characteristics of the various LSAMP projects. Exhibit 1 shows the LSAMP projects included in the study. Exhibit 2 provides more information on the selected LSAMPs.

It should be noted that the seven Alliances chosen for this study also differ considerably with respect to access to participants' research opportunities and doctoral programs. The University of California system consists of eight institutions, six of which are classified as research 1 universities, the highest rating in the Carnegie classification system. No other LSAMP program has comparable access to research and graduate study facilities, although most of those included in this study have at least one institution classified as a research university 1 or doctoral 1 university.[3]

Exhibit 1
AMP projects included in the study

Name	Lead institution
California Alliance (C-LSAMP)	University of California, Irvine
California State Alliance (CSU-LSAMP)	California State University, Northridge
Alabama Alliance (A-LSAMP)	University of Alabama at Birmingham
Mississippi Alliance (M-LSAMP)	Jackson State University
Florida-Georgia Alliance (FG-LSAMP)	Florida A&M University
Puerto Rico Alliance (PR-LSAMP)	University of Puerto Rico, Rio Piedras
University of Texas System (UT System-LSAMP)	University of Texas, El Paso

[3] Following are the four top Carnegie categories:

- Research 1 universities: award 50 or more doctorates per year, and receive annually $40 million in federal support
- Research 2 universities: award 50 or more doctorates and receive between $15 and $40 million in federal support
- Doctoral 1 universities: award at least 40 doctorates annually in 5 or more disciplines
- Doctoral 2 universities: award at least 10 doctorates in three or more disciplines, or 20 doctorates in one or more disciplines

Exhibit 2
Characteristics of the LSAMPs selected for this study

California LSAMP:	Lead institution: University of California, Irvine Project Length: 7 years Students Served: Hispanic, African American, Native American Location: West Coast Increase in degrees granted*: 62%
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The approach to site selection for the NIH and NASA sites was somewhat different as performance data were not available. In these cases, Washington staff members most familiar with these programs recommended sites for Westat to visit. For Puerto Rico, both LSAMP and MARC programs were included. Exhibit 3 shows the NIH and NASA sites.

Exhibit 3
NIH and NASA sites

- Morgan State University (MARC)
- Puerto Rico (MARC)
- Morehouse College (NASA)
- Spelman College (NASA)

Data Collection

Data from projects' annual reports, NSF's database, and site visits were utilized in this study. For the LSAMP sites, arrangements were made with the lead institution for a site visit by two experienced Westat staff members to interview the project director, other administrative and project staff, faculty members, and upperclassmen. Although we could not visit participating institutions as well as the lead institution, we were given ample opportunity to talk with students and personnel from other Alliance members who came to the lead institution.[4] Depending on the preferences and time available at each site, interviews were done both individually and in groups. Similar arrangements were made for the MARC and

[4] In retrospect, it might have been better to visit more Alliance partners, even at the cost of including fewer sites, since it became clear that the lead institution does not always have the largest number of minority SMET students or the same range of services offered by some partners. For example, in Alabama, the lead institution is the University of Alabama at Birmingham, a predominantly white research 1 university. In 1998 it awarded a total of 92 bachelor's degrees in SMET fields to minorities, compared to 1,426 degrees to nonminority students. Conversely, at Tuskegee University, an Alliance partner that is a historically black institution, the respective numbers for minority and nonminority bachelor's degree recipients was 173 and 120. In Mississippi, on the other hand, the lead institution, Jackson State University, a historically black university, had the largest number of minority SMET degree recipients in that state.

NASA sites, but fewer staff interviews were needed because these are single-site programs.

Throughout the study, we enjoyed excellent cooperation from the institutions we visited. They have great pride in the projects' accomplishments and are eager to share information about their activities and their students' success. Permission to tape the sessions was granted without exception by all staff members and students with whom we talked.

4. Study Findings Regarding the LSAMP Program

This section presents our study findings with regard to program operations and outcomes. We provide a broad-brush look at the similarities and differences among the LSAMP projects that we visited. Clearly, there is no simple formula or algorithm that describes an LSAMP program; however, they do share several critical features: a clear-cut focus on a small number of outcomes, a solid management structure, a comprehensive mix of services and supports, a caring and committed staff, and a strong sense of community and mutual respect.

How LSAMP Alliances Function

In this section we describe the LSAMPs from an organizational perspective, describing how the Alliances function and pointing out salient features of the multi-campus strategy. As will be seen, managing an alliance can be challenging, but the synergy that results is a clear strength of the program.

Goals

The overarching program goal of the LSAMP program, to increase the number of minority students who graduate with a degree in a SMET field, was shared by all institutions in the Alliances we studied. Two-year community colleges, while sharing the overarching goal, have a more specific intermediate objective; they must retain students (nationally, 45 percent of students in 2-year colleges leave during the first year) and prepare them to transfer successfully to 4-year institutions.

Some institutions have additional specific goals, depending on the strength of their departments and the needs of their communities. For example, individual Alliances mentioned the following projections as part of their efforts.

- Continuing implementation of systemwide reforms to improve the effectiveness and efficiency of undergraduate SMET programs;
- Increasing by 200 percent the number of underrepresented students who receive middle and high school teacher credentials;
- Establishing several 5-year B.S./M.S. combined degree programs at participating Alliance institutions; and
- Increasing the number of female engineering students in one institution; at another, increasing the number and percentage of minority students at historically white institutions that are Alliance members.

Relationship Between Projects, Lead Institutions, and Host Universities

Lead institutions and Alliance members. As stated earlier, one of the distinctive features of the LSAMPs is their organizational structure, involving multiple institutions working together toward the same goals. Our visits suggested that this organizational structure has a number of benefits, including the sharing of ideas and opportunities to jointly solve problems.

We also found a high degree of cooperation between Alliance members; at the same time, each Alliance member enjoyed autonomy in structuring its program. Because we had not scheduled separate site visits to Alliance campuses beyond the lead institution, we could not explore this issue in depth, but clearly many project directors did not see themselves as micromanagers of participating institutions. For

example, one project director described a "facilitative" style of leadership:

> My leadership style can be captured in one word, and this is, by my own admission, facilitating. I believe that if you have people who are committed to the job, you try and make it clear to them what your vision is as you see it, and they know what their expectations are as a result of that, and they go to it.… Some people have a very dominant, organized, dogmatic style. Mine is more laid back. But my expectations, my standards, are high.

Similarly, in another Alliance, the site visitors concluded that most of the decisions about activities occur locally at each campus. The project director indicated his preference for avoiding micro-management and allowing campuses to have some latitude in following their own course in view of the particular emphases and orientations of their campus. But despite autonomous decisionmaking and differences in the kinds of activities offered, goals and standards tend to be uniform within Alliances. This is typically achieved through joint planning sessions:

> When we started planning Phase II, I brought a group of people together from both community colleges and the universities. There were about seven of us. We sat down and came up with a framework of activities that we wanted to do in Phase II. Some of the things were those that would be continued from what we were doing in Phase I, and some things were new that we thought would move us into some new areas that we thought were important.

In all the Alliances we visited, there is active collaboration between participating institutions, be it in the form of annual or biannual meetings of regional site coordinators or meetings of the presidents of the institutions. Exchanges of ideas or the development of activities involving more than one campus occur frequently. Web pages, e-mail, newsletters, annual retreats, conferences, and faculty workshops were all mentioned as useful mechanisms for learning from others and, especially, for engaging in joint activities. (For example, a summer bridge program at one site was co-sponsored by several institutions, and research opportunities for students on other campuses were identified by institutions with well-established industry contacts.)

Other Alliances have a more formal, centralized structure. One lead institution indicated that all participating institutions in its Alliance administer their programs in a similar manner, based on an LSAMP Operational Manual prepared by the lead institution. In another Alliance, while the project director indicated that innovation and experimentation on the part of partner institutions is encouraged and generally allowed, changes in policy or procedure must receive permission from the central office, i.e., the lead institution.

Relations with host institutions. Administrative support by the college or university where the LSAMP program is located is seen as necessary for the success of the Alliance. It was evident that support was very strong in the seven universities that we visited, and this support was largely due to the efforts of LSAMP project directors. Some sought to involve the host institution by including the president or a dean on the LSAMP governing board or on steering or advisory committees; others did it by keeping high-level administrators consistently informed about LSAMP activities and results.

> Having the presidents on our governing board has been helpful because any of our initiatives pretty much have the support of the presidents. I meet with them periodically, and report to them and indicate any needs, and by and large they have been very supportive.

> Let them (school presidents) know the good things to enhance their ability to market the program. Presidents are impressed with the progress of the program and realize that they need to do something now to help take the next leap, which is to link the graduates that we are producing with graduate institutions within the state.

One project director stated that he introduced the concept of matching funds at his institution, and because of the project's credibility, he can obtain matching funds as needed:

> The way I put it is that I have a line of credit with the President. I come in and say "this is an important project but I need to have a million dollars for that" and they will always sign it because we have the credibility.

Support often translates into financial support for some specific LSAMP activity, released time for faculty involved with the LSAMP program, or the use of some university services. For example, the site coordinator at one campus reported that operation procedures such as LSAMP accounting is taken care of through the Engineering Dean's office. On another campus, LSAMP receives clerical support for orders and purchases from the college where the LSAMP is housed.

University presidents have also been instrumental in obtaining matching funds for scholarships, internships, and operations from state legislatures and corporations. In one case, institutional support for the activities of the LSAMP program has been considerable, with the university system and participating campuses providing more than $2 million to match the $1 million annual NSF award.

Staffing Patterns

There is a great deal of variation in staffing patterns and decision-making authority. Most often the position of project director (PI) is not a full-time job but is held by a university administrator (for example, a dean) or a department chair or faculty member at the lead institution. The LSAMP project director's decisions may be shared with a steering or executive committee and/or a governing board, which usually includes presidents or other administrators of participating institutions. Usually, there is a full-time project manager (called "project coordinator," "co-PI," "project administrator," or "associate executive director") who is responsible for day-by-day project operations. In one university, separate centers have been created to address institution-wide issues and priorities; their LSAMP operations are closely coordinated with the Resource Center for Science and Engineering and with the Curriculum Innovation Center.

At each participating campus, the LSAMP program is organized and implemented by a site coordinator, who is sometimes assisted by a steering committee. The site coordinator is often a faculty member or campus administrator who was granted released time from the institution to work with the LSAMP program. In addition to site coordinators, two of the projects in the study appoint regional directors to take administrative responsibility for the sites in their regions. LSAMP participants, especially juniors and seniors, are assigned paid and unpaid staff roles in the projects. Most often, they perform tutoring or orientation tasks for freshmen or sophomores. They may also assist other staff in conducting workshops, offering assistance in drop-in centers, preparing exhibits, etc. On campuses with graduate programs, graduate students also work with LSAMP participants in workshops, labs, or the drop-in center.

Most lead institutions and campuses have additional staff, usually faculty members or other university personnel available on a part-time basis. Several LSAMP programs employ an evaluator to be responsible for timely data

collection from all participating Alliance partners and preparing mandated periodic reports. Elsewhere, a science coordinator (or science/academic coordinator) has a major role on some campuses, keeping track of students' progress, assisting them in finding internships, and acting as mentor. On other campuses, these functions are carried out by the site coordinator, who may have an assistant. Clearly, it is up to each Alliance to structure staff allocations best suited to their needs and the utilization of existing personnel resources.

Allocation of Funds

The allocation of funds is made in all cases by the project director, who has considerable latitude in making decisions in the distribution of funds among Alliance partners. Because all institutions in this study have been active for more than 5 years, a flexible allocation pattern appeared to be well established. Funding is awarded to participating institutions on a year-to-year basis, and they must submit a proposal each year summarizing past accomplishments and plans for the next year to justify budget requests. In the words of one project director:

> We require them to make proposals each year, and perhaps more often if there are any additional funds (*requested)*. They should never feel the money is guaranteed. They are not guaranteed because they got the money one year that they are going to get it the next year. Secondly, they do not get the money unless there are the results to go with it.

Furthermore on several campuses, LSAMP activities have become subsidized by state and local government agencies and private employers. Several project directors emphasized that the NSF funding is not only matched, but heavily exceeded by funds from other sources. This enables project directors to target NSF funds to different activities. For example, one Alliance has begun to provide mini-grants in the amount of $30,000 to community colleges for piloting programs designed to support retention efforts and establish a visible presence for LSAMP.

Student Recruitment, Enrollment, and Eligibility for Services

Recruitment

One of the idiosyncratic features of the LSAMP program—and the one that differentiates it from most other student support and development programs—is how students are recruited into the program and what participation entails. Some traditional recruitment techniques are used, such as mailing brochures that outline acceptance criteria to high school counselors and displaying information about the program on a web page. Traditional outreach activities, including presentations to high school audiences by past and current LSAMP students and visits to high schools by a site coordinator, were also reported. But we were told of more innovative techniques, such as referrals from the registrar of applications by students with good math scores or interest in science, and followup by telephone of promising recruits.

The availability of the summer bridge program was seen by many LSAMP administrators as the most important recruitment tool. All seven Alliances in this study offered a summer bridge program for new students, which was usually a residential program and included gatekeeper courses in SMET fields, workshops on study skills, and an opportunity to experience college life and become acquainted with future fellow students and faculty[5]. Additionally, students were usually paid a stipend for participating; in one Alliance, the full stipend required attendance at all scheduled activities, and was reduced for absences. In some instances,

[5] While the majority of LSAMPs also offer supports for students going on to graduate school, this support is usually in the form of counseling or assistance in studying for the Graduate Record Exams. One exception to this is the Alabama LSAMP which offers a graduate bridge program.

summer bridge programs accepted students who had applied to institutions without bridge programs in the Alliance.

The application process for acceptance and for the summer bridge program begins early. Here is the description from one site coordinator:

> I get a download of all the incoming freshmen that have been admitted with certain SAT scores so I know they will be math ready for the program. Then I get a download of all the students who are eligible, with ethnicities and majors. Then I make a direct mailing to all these students....Then we put together a meeting and the faculty goes through and we screen out all the applicants to the ones that are really eligible and qualified and ready.

...It just shows that sometimes... that experience benefits the lower GPA students perhaps more. —Project director

The need for aggressive outreach was emphasized by another site coordinator:

> You have to make phone calls to the students just to get the applications in to the program in the first place. Initially we send out an information letter to all the students, and then we follow that up with phone calls until we get all the applications in and we're still calling them usually after the deadline, getting more information from each of the students that we need…. I think one on one contact, a lot of personal contact is really critical.

One institution went to great lengths to attract freshmen to the summer bridge program, inviting students and their parents to an open house with a program involving faculty and deans. There may be as many as 60 or 70 faculty present, as well as students who attended the bridge program in the previous year. Evidently, this approach is very successful:

> There is a lunch, so that parents can approach deans or faculty to ask questions – it "humanizes" the university to an extent that no other program can. If you get accepted to another university, and you receive a packet of information, nowhere is there that personal touch. Students who have already decided to go elsewhere will change their mind after the open house.

Several Alliance partners made special efforts to recruit students in 2-year colleges who were about to graduate. For them, the bridge program was especially useful because these students were often uncertain about transferring to 4-year institutions for academic and social reasons.

Enrollment and Eligibility

When the LSAMP program was first introduced, a traditional "scholarship award" model was followed. High school seniors were accepted into the LSAMP program on the basis of their applications during their senior year of high school; usually about 20 percent of applicants were accepted. They were often called LSAMP scholars, or level I participants, and received financial assistance for 4 years of college attendance if they maintained a satisfactory academic record. Other minority students who majored in SMET were encouraged to participate in some LSAMP activities, and were called level II participants. This policy may still be followed by some Alliances, but there is a trend to adopt a more flexible enrollment policy. While most high school students who are accepted as level I participants must still show good high school performance as measured by GPA and national test scores, some projects report good experiences with students with lower paper qualifications:

> Last year a couple of students were admitted right at the bottom of the summer pool, with dubious GPAs and they turned out to be the students who impressed their professors the most. They went to national conferences and made the biggest splash. And one of them already has a graduate school offer and fellowship, and she's not graduating until March. It just shows that sometimes the good of that experience benefits the lower GPA students perhaps more.

High school seniors are no longer the only recruits, at least in part because of the need to include transfer students from community colleges, a significant educational resource for minority students. Thus, at one site, all SMET minority students are designated LSAMP participants provided they participate in at least one of the LSAMP activities offered on campus. In fact, at the institutions we visited, the terminology for defining the LSAMP population varied a great deal. Most often two categories continue to be defined: direct and indirect participants, or scholars and associates, or level I and level II. The most common pattern was to classify as level I those students receiving some form of financial remuneration, most often in the form of tuition remission or work study on campus (research, peer counseling). In one Alliance, all minority SMET students are considered eligible for activities, but for some activities (such as research, or peer tutoring) students must maintain a higher GPA. It should also be noted that when LSAMP projects report outcome statistics, such as retention and graduation, these are usually based on all (level I and II) participants. Because students' classification status may change from year to year, and because LSAMP students may receive financial assistance from campus-based programs funded by other sponsors, the level I/level II distinction is no longer meaningful for many projects.

AMP-Sponsored Student Services and Activities

Financial Support

Financial aid in the form of cash payments is usually provided either as remuneration for work performed or, less often, as an incentive for good academic performance and/or regular classroom attendance or participation in other academic activities (workshops, seminars). For example,

- One LSAMP project employs a sliding scale incentive program for financial awards, based on GPA. Students who achieve a GPA between 3.0 and 3.19 receive $200 per semester; from 3.2 to 3.4 the award is $400, and it goes up incrementally to $1,000 for a GPA of 3.8 to 4.0. Students told the site visit team that this merit-based system is an effective motivator to maintain a high GPA.
- Most widespread is financial support for attending summer bridge programs. Typically, freshmen receive a stipend of $900 to $1,000, free tuition, and campus housing for attending a 6-week residential program. Bridge programs for seniors, which are designed to facilitate graduate enrollment, provide larger stipends.
- Both summer research internships and academic year research assignments usually provide stipends, and the same is true of peer counseling. These income opportunities are largely limited to juniors and seniors, although each project has its own guidelines.
- In one LSAMP project, low-income students who demonstrate economic need and maintain high academic performance may receive an Award for Excellence ranging from $500 to $2,000. Priority is given to first-generation college students.

Although students who receive financial support feel that it is very helpful to them, primarily because they do not need to hold a job while going to school and can spend more time on their studies, it appears from the data collected during the site visits that few students can rely on LSAMP financial support alone to meet all their college expenses.

Tutoring, Workshops, and Other Academic Enhancement Activities

In most of the projects Westat visited, lower division students who have academic difficulties in a math or science course are offered help through tutoring or participation in workshops or study groups and seminars.

Tutoring. Sometimes tutoring is provided by the peer mentor, but more often there are special tutors, who may be faculty, graduate students, or upper division students. A list of available tutors and their hours may be posted in the LSAMP office or on the project's web site, and students are encouraged to contact someone who fits in with their schedule. Not all projects provide one-on-one tutoring services. For example, the lead institution in one of the visited LSAMP projects did not offer tutoring, but it was an important component for some of the participating community colleges, where tutors are available 7 days a week (5 hours each week day during the week and 3 hours on weekends.) Tutoring in these colleges is targeted on students in difficult gateway courses (precalculus and calculus). Students felt that tutors not only helped them to master difficult subject matter, but also taught them how to study and manage coursework:

> I think the tutoring really helped my first quarter of my freshman year when I was taking general chemistry. Not only did it help me with the subject, it kind of helps you how to study because there is a big difference in studying for college courses and studying for high school. So I think that was a big push. I utilized the tutoring first and second quarter and that kind of set me up. Even now, I use the same techniques I kind of learned in freshman year, how to study for courses.

You know you are there all together and you all try to do well. You don't want to fall behind and be the only one in the group that's doing bad.
—Student

Workshops, study groups, and seminars. These activities are very popular, because they support the philosophy held by many LSAMP staff members: students learn best and are most likely to be retained if the project fosters a sense of community, an environment where they can learn from each other and gain awareness of their strengths and abilities. Project staff members are often familiar with the Uri Triesman approach to fostering improved learning which emphasizes the importance of students working in groups for studying and problem solving, and are following that model.

Workshops were described in one project as the primary LSAMP component. There, workshops led by "peer facilitators" run concurrent with selected SMET gateway courses, with 2-hour sessions held twice each week throughout the semester. Students who complete the workshop with good attendance and a grade of B or better receive $300 per course. Facilitators are often LSAMP students who have successfully taken the course that the workshop supplements and, therefore, know the professor teaching the course and understand the course requirements. They are trained for the work they do and meet each week to discuss how their workshops are going. In another Alliance, workshop leaders are required to have at least a master's degree in the subject area.

In Puerto Rico, a Spanish language version of a program to use cooperative teaching/learning (TaDDEI) was originally implemented in general chemistry courses, but is now being introduced in the context of other SMET courses. The program is seen as very successful

and has improved students' academic performance. One faculty member described the ripple effect that can result from cooperative learning:

> My AMP students have bought their own laptops, and they make very elegant presentations. They sometimes prepare better presentations because they put all the effort into it and work together. They learn very well how to interact with a team group, and that doesn't happen when you're taking these other courses that don't use cooperative learning. And they teach each other, if the teacher knows how to use it well. So it promotes cooperation, and that's good because they learn skills that they're going to use if they're working later or they're going to graduate school.

Students who had participated in these workshops explained that workshops and study groups encourage one's best performance:

> You know you are there all together and you all try to do well. You don't want to fall behind and be the only one in the group that's doing bad.

> The interviewer said "You always seem to have a really good turnout in your study groups, like 15 students some times" and (the student) said: "Well, we push each other...if we're getting B's, we say OK, let's go for the A's." They provide that little push. The counselors and staff provide the supporting environment, but the students push themselves to reach a higher level.

Seminars and workshops are important program components not only for younger students, but for juniors and seniors as well; for the latter they tend to deal with various aspects of the graduate enrollment process. But other techniques are used as well to foster graduate enrollment, including one reported by a site coordinator:

> My far reaching example is that this past year, I took seven kids to enter the Ph.D. program in chemistry. I took them. I didn't ask them to go. I made them give me a resume, I got a copy of their transcript, loaded them into the van,...and took them to a university. They're now in Ph.D. programs and doing well.

The drop-in center. Another feature of LSAMP projects is the creation of a drop-in center, where students can access resource materials and ask questions of the staff or an upper division student (one is always there during the hours of operation). However, only during two of the visits were the drop-in centers discussed; at one of these, it was described as the core of the retention initiative and the primary meeting place for students. In that Alliance, each center is equipped with computer technology and staffed by a combination of students, faculty, and a director. Sometimes, faculty members bring classes to the center for cooperative learning activities and the use of instructional materials. The site coordinators explained that drop-in centers have software that is not available elsewhere on campus. LSAMP scholars (students receiving financial support) are required to serve as drop-in center assistants for at least 5 hours a week.

In another institution, a similar facility is called a Science and Learning Center. It is not a separate LSAMP facility, but a resource for all students enrolled in lower level math and science courses. Similarly, participating institutions may have specialized libraries or math and science labs. But separate drop-in centers for LSAMP students seem to be rare, although they combine many of the functions that LSAMP students need: assistance with locating study resources, informal interaction with fellow students, access to knowledgeable informants, and a meeting place of their own.

Other enrichment activities. Science fairs, research symposia, presentation of student research at local and regional conferences, and travel to attend professional meetings are among many activities that LSAMP projects have developed to enhance student interest in SMET and in graduate study and to strengthen their self-confidence and presentation skills. These activities also encourage joint activities by Alliance members, enable students to network, and lead to contacts for graduate study and future employers. In the words of one student:

> Also one of the major things that happened last summer, I got to present the research I've done for that 12-14 weeks in front of a forum of incoming freshmen, people who are in the program already, and professors and the (staff) people. That was a first. The stuff I was doing, I got to show everybody and people had a chance to ask me questions.

Staff members took great pride in their students' success on these occasions, and in their role in facilitating students' participation:

> Between 1994 and 1998, AMP research students from (a participating institution) made 75 presentations at regional and national meetings.

> At the research conference sponsored by NSF last summer in Montana ...three students who entered papers won....We encouraged them to apply, sending notices to our 20 something campuses, saying if your students have done research with anyone and would like to make a presentation, this is the opportunity. We will pay their travel expenses and their living expenses.

> (At a national conference in Baltimore) everybody had 25 copies of their resume, whether they wanted to or not, that they gave out to the different interviewers. From the 125 we took up there, we had about 15 that got summer internships for math and science.

The Research Experience

In launching the LSAMP program, NSF put a great deal of emphasis on the provision of research experiences and urged the inclusion of nonacademic Alliance partners, in particular industry and government laboratories, that might provide valuable research opportunities for SMET undergraduates. All the projects that Westat visited included a research component during the summer; research activities during the school year were less widespread. Again, there was considerable variation between projects regarding whether access to these opportunities was handled by the LSAMP project or required considerable initiative on the part of students.

Student Research Activities During the Summer

Summer internships are stressed by every LSAMP project as an important activity, because they provide worthwhile hands-on experience to reinforce students' commitment to scientific careers; they also help financially, while exposing students to the workings of their discipline. Placement for summer research opportunities is done in a variety of ways in the LSAMP projects.

- Some institutions provide information about availability of research internships or summer positions in newsletters or by e-mail to lists of eligible students.
- Others maintain databases where the information can be accessed.
- In other projects, most of the search effort is the responsibility of students and their mentors.

Some projects earmark project funds for their summer research program, whereas others rely on external sources, such as corporations or government laboratories. One project director reported that her Alliance had secured 601 summer internships from external sources for eligible LSAMP scholars since 1994, amounting to $350,000 per year. The sparse data we obtained on this subject suggest that LSAMP sites themselves funded not more than 7 to 10 summer research spots, but were quite successful in securing outside participation in the summer internship program.

Academic Year Research

Academic year research programs were primarily found in institutions that offered graduate programs and, with few exceptions, were restricted to juniors and seniors with better than average GPAs.[6] One site visitor obtained a detailed description:

> Student research programs are standardized across LSAMP institutions in terms of application procedures, stipend amounts, and number of work hours required. Students must submit an application, transcripts, a personal statement, a 1-2 page research proposal, and a letter of recommendation, preferably from a potential mentor. They have to be full-time students majoring in a SMET field; most have completed 60 semester hours, and have a minimum GPA of 2.5.

Notification of LSAMP research stipends generally occurs in the late spring. Once students are notified that they are LSAMP research stipend recipients, they go to different laboratories within their area of interest and speak with different professors (if their research assignment has not been firmly determined in advance of application). If a professor/mentor agrees to take on the student, he or she will usually then be brought on to an existing research project. For example, one mentor told us that he brings his student researchers onto projects with grants from Levi Strauss, NASA, Johnson and Johnson, and Boeing. LSAMP student researchers at this Alliance are required to work 20 hours per week, and receive a monthly stipend of $500 ($6,000 total for the year) and a tuition waiver. Mentors receive up to $1,000 for supplies and travel expenses.

Academic year research opportunities for students are predicated on ongoing faculty research grants, which are often unavailable in colleges that emphasize teaching rather than research.

> *It's really rewarding to work with undergraduates…. It's teaching that individual, but at the same time getting quality research good enough to be accepted at conferences and journals. So it takes a lot more, but that's our mission, that's who we are.*
> *—Mentor*

Mentoring

All LSAMP projects mentioned mentoring as one of the important services they provide for LSAMP students. Most often, there is a clear distinction between research mentoring and other forms of mentoring. The research mentor is usually a faculty member, and the LSAMP student participates in the faculty member's research project, either by working as a research assistant or by carving out a research task of his own that is then carried out under the supervision of the mentor. Most mentoring activities—especially for freshmen—are of a different nature: they are designed to help students deal with academic problems, acquaint them with the campus culture, and be alert to the ever-present dropout danger. This role, sometimes defined as peer mentoring, can be performed by faculty members, graduate students, and upper class undergraduates. All types of mentors may

[6] An interesting exception was a research project at a junior college, which involved a NASA-funded experiment. See the site visit report from the University of Texas for a description.

receive some financial support in the firm of stipends, reimbursement for supplies, or travel expenses.

Research Mentoring

The research mentor plays a very important part in influencing a student's future career decisions and opportunities; he or she also becomes an influential role model for students who feel that a career as Ph.D. scientist is beyond their reach. In the words of one student:

> You get into AMP and you start knowing the professors and you know that they are just a person like you and they struggle just like yourself and they have been in school just like yourself.

In one project, where the staff and students see the research component as the centerpiece of the program and the essential element in promoting graduation and graduate enrollment, Alliance partners go to great lengths to select suitable mentors, all of whom have to be faculty members. Good mentors are described as follows:

> Good mentors believe in the abilities and promise of undergraduate students and are willing to entrust students with responsibilities that go beyond glassware washing. They see to it that students begin with a discrete project of an appropriate size, doable within a pre-established time frame, given their skills and levels of knowledge. Mentors should be approachable and should make themselves available to talk with their students, read student papers, and discuss them. A good mentor should talk to students about career opportunities and about graduate school.

Institutions have developed various techniques for recruiting research mentors. Thus, on one campus, a reception is held for faculty to learn about the LSAMP program and to meet with students and with faculty already involved in mentoring. Elsewhere, the LSAMP staff attempts to match students and faculty, and after a satisfactory match has been arranged, prepare a contract to be signed by both parties stipulating their respective responsibilities. For example:

> I will work at least 10 hours per week. *(Student)*

> I will meet with the student at least one hour per week to advise him/her. *(Faculty mentor)*

On other campuses, more of the initiative is left to the students, who must identify a faculty member who is engaged in a project of interest to them and negotiate a research assignment. However, LSAMP staff will tutor the students on how to approach and select a suitable tutor.[7]

For some faculty members, working with undergraduates in research settings requires hard work and a special balance between teaching and good mentoring:

> It's really rewarding to work with undergraduates. Of course it requires X times the work. You have a Ph.D. student and you give that person some directions, and off he goes. You can't do that to an undergraduate. The main purpose isn't research, research, research. It's teaching that individual, but at the same time getting quality research good enough to be accepted at conferences and journals. So it takes a lot more, but that's our mission, that's who we are.

[7] See site reports from C-LSAMP and UT System-LSAMP for additional details about research mentoring.

Clearly, then, one of the tasks of the research mentor is to help students with the preparation of papers and presentations that can be accepted for conferences, forums, or publication in scientific journals. When students' work is accepted, their commitment to graduate work as well as their self-confidence are greatly strengthened. The Westat site visitors reported the impact of conference attendance by students at one institution:

> Students culminate their research experience by attending and/or presenting papers at local or regional conferences.…Among those with whom we spoke, conference attendance is considered greatly beneficial for students, since it provides them with opportunities to meet and network with other students and recognized scholars in their disciplines. It also boosts the self-esteem of students who realize that their work is comparable to the work of students at other universities.

Other Forms of Mentoring

While research mentoring is experienced primarily by juniors and seniors (although some LSAMP projects provide summer research experiences for sophomores), other forms of mentoring are provided primarily for freshmen and sophomores. Such mentoring may overlap with other services provided for these students, such as tutoring and counseling, although typically the mentor's role is seen as that of a day-by-day advisor and trouble shooter. To a large extent, the nature of mentoring activities and the relationships established between student and mentor depend on the status of the mentor. In some of the LSAMP projects, mentors are mainly faculty members and they conceptualize their role primarily as that of an academic advisor:

> Initially, when the students come in they have a 20 minute appointment….We talk about where they are at. If they are transfer students, we assess what they have done already to figure out what they still need to do to get their degree. We talk a little bit about careers and if they know what they want to do we start focusing on that.…So we basically plan out what they should take each quarter and roughly how long it's going to take for them to graduate...Then they come in for a detailed assessment and a detailed development of their academic plan...(Later) we find out whether they have kept the schedule or not or what changes they have made or have they progressed in their courses...We can basically predict when they are going to graduate if they stick to the schedule ...A lot of the students are not aware of all these rules and regulations that the University has that can affect their ability to graduate, so making them aware of all these hidden requirements...is a key to getting them graduated.

...if they had the same problems I did and they are making it, I can make it too.
—Student

Another faculty mentor concentrates on finding the best academic environment for LSAMP students to succeed, rather than putting the entire burden on the student:

> We try whenever possible to group the AMP students in the same, say calculus course if they all are on the same level....At our school that's not that hard because we have only four sections of calculus. We try to group them with the most receptive faculty member also whenever possible.

While mentoring by a faculty member may smooth the academic path for some students, others are reluctant to share problems with a faculty member they hold in awe; furthermore, faculty members are often too busy to spend a great deal of time with individual students. Having an experienced upperclassman as mentor is often a more congenial arrangement. This is particularly beneficial for freshmen who have attended the summer bridge program and continue to work with the same mentor during their freshman year. One project director was especially enthusiastic about the use of upper division students as mentors:

> During our bridge program, each student has a mentor that is assigned to him. Mentors meet with students at least once a week, and this has to be documented in a little notebook. They go over their academic achievements. They go over their social problems. They go over everything that they are not comfortable bringing to me or to anybody else, and it has worked out really well because a lot of the kids have kept their mentors even though I don't pay the mentors during the regular school year. The mentors are interested enough in the progress of the bridge kids that they keep them during the regular year.

In another site, students and staff suggested that the use of peer mentors may make the difference between staying in school or dropping out:

> You see other AMP students who are close to graduating and they tell you: "When I was a freshman, I had the same problems, and I was able to work through it." So you say if they had the same problems I did and they are making it, I can make it too.

Caring is a quality not stated in the job description of AMP staff and faculty, yet it is a quality that could result in someone not being hired if it is perceived that this characteristic is missing.
—Project director

The dedication of the staff is a very vital aspect of this program.
—Project director

Although most institutions did not report that student mentors underwent special training for the mentor role, in one institution, upper division students receive intensive training during an entire quarter to qualify as peer mentors, who can give guidance on academic as well as personal and psychological issues.

Psychosocial Support

Under this heading, we will attempt to summarize an amorphous set of comments made by student respondents and by our site visiting team. They suggest that over and above the activities discussed in the previous sections, other elements in the LSAMP experience have a powerful impact on LSAMP participants, affecting their ability to complete the undergraduate program and influencing career decisions.

Caring Staff

The extent to which individual students felt that project staff saw them as individuals, not as groups of freshmen or sophomores, and were taking a real interest in their welfare and success seems especially important in promoting retention. Many minority students are the first in their family to go to college. Some come from rural environments; others have few friends who have gone on to college, especially to 4-year institutions or universities. While attendance at the summer bridge program may have helped them to become more comfortable with their decision to attend college away from home, these students may still feel lonely and unsure if their decision was a sound one. While a caring mentor is especially important in providing support, other staff

members with whom the student interacts, from the project director to upper division student assistants, also play an important part. A number of students expressed the view that what counts is knowing that there are people who care about how they do. When asked which aspect of the LSAMP program was most responsible for its success, a site coordinator stated:

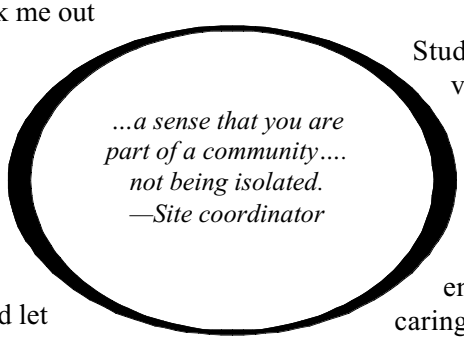
> The thing that comes back on surveys, in the students' words, is: "I felt that somebody cared if I succeed." I'd have to put that as number one.

One site visitor reported that during his staff interviews, caring was identified as the most important characteristic for hiring staff and selecting mentors.

> Caring is a quality not stated in the job description of AMP staff and faculty, yet it is a quality that could result in someone not being hired if it is perceived that this characteristic is missing.

An assistant project director who was also the director of summer programs described her interaction with students:

> I am more familiar with students on paper. Except students seek me out when they have a problem. They see me as a mother figure. Sometimes it's about dormitory assignments. Other times it's more personal like family problems. I always take time to talk with them....I try to help and let them know I care.



One site coordinator illustrated his attitude with the following anecdote:

> I've got one thing to sum it up and I'll make this real short. The first year some of us went over to a neighboring LSAMP and we won't mention the name but the Program Director was going to tell us how to run our LSAMP effectively, and one thing that he said was that you have to count these beans, and I looked at him square in the eye and said, well, we might have to count them, but I know every one of my names, do you? My beans all have names, and I know them all. I think that's important.

One project director emphasized the special needs of many minority students:

> These young people from minority groups come with a context of family life. Family life is important to every group, but some groups seem to have more intensive need for that, and these groups therefore have a need for that family-like environment, even at the university level. And many of our staff, some of whom come from these backgrounds, understand this better than some others. The dedication of the staff is a very vital aspect of this program.

Sense of Community

Students and staff at most of the visited LSAMP projects spoke of the need to create an LSAMP community, so that students, especially in the lower division, did not feel isolated in the college or university environment. Like the need for a caring staff discussed above, the need for community reflects students' discomfort with their situation on a campus where they felt like anonymous strangers. In the words of one project director:

> In general there is the idea that they are connected to the school somewhere personally, as opposed to just feeling like a number. I think

> that's an intangible that is really important, because they feel they have somewhere they can go and not feel alone...Once they belong to something, they cannot feel isolated. The greatest number of students of any type leave school, because they feel isolated, not because they can't cut it, but because they don't feel that they are part of something.

A similar assessment was made by a site director in another LSAMP project:

> Having a sense that you are part of a community as you go through your studies is extremely important. Having people in your classes that relate to you and that you feel care about your success is extremely important. In other words, not being isolated.

...you got to get along, you got to take somebody along, and that's the policy.
—Site coordinator

One student, when asked why the LSAMP program in which he participated was successful, expressed the reason in terms of community:

> I guess to me why I think it stands out above all...referring back to community I just think in today's day and age I just don't see people succeeding individually. You look at sports, you need a team. You look at academics the same way. You look at corporate America, the same. So I think any program that involves community is definitely an advantage to students, incoming students. If you implement that young and early, it will lead to a smooth transition.

The staff in one project talked about the concept of "a learning community" consisting of staff and students, which characterized their approach:

> When I say community of learning, it goes beyond the classroom and all the support services that we do to have a successful student. The learners are not only students,...we have learned from the students and we have learned from ourselves.

The emphasis on community accomplishments was already raised in the discussion of workshop activities. In one LSAMP project there was a more general policy, stipulating that students are expected to treat the success of their peers as elements of their own success. One site coordinator explained:

> In other words you got to get along, you got to take somebody along, and that's the policy. I even tell the kids to their face: "I don't think you are smart if you can only make an A. You're smart to me when you can help somebody else that was going to flunk make a B." That's my whole thing....Reach down and pull somebody else up.

Giving Back

In several projects there are organized opportunities for community service and on-campus services for which students are not paid, but encouraged to "give something back to the community." According to the staff, students feel strongly that it is important for them to make a contribution; staff also sees an impact on students' self-confidence and self-esteem. The most frequently mentioned community service is tutoring elementary and high school students in math and science, but participation in housing projects for Habitat, environmental improvement projects, and assisting at shelters for abused women and children were also reported. On campus, aside from organized mentoring and tutoring by upper division students (for which they are usually paid), much informal help can

be given to newcomers by experienced LSAMP participants.

Measurable and Perceived Results of Project Activities

Clearly the primary goal of the LSAMP program is to assist students, and the LSAMPs selected for this study are believed to be showing great promise in meeting that goal. However, our visits showed that the LSAMPs are also benefiting two other audiences: the faculty who participate and the host institutions.

Student Perceptions: How and Why LSAMP Affected Their Life in College

As shown throughout this report, students have singled out many features of the program as important factors in their ability to survive the college years in spite of initial self-doubts, gaps in academic preparedness, and disruptive stresses. First, dealing with academic difficulties was a major factor in student retention:

> ….That's another thing AMP helped me out with a lot, because before AMP I was doing badly. There was actually one point where they put me on academic probation. I don't know what it was. I was probably hovering right around a 2, maybe a 2.3, and in the last year and a half, I've been above a 3.5 consistently.

In another institution a student also emphasized LSAMP's role in strengthening academically weak students:

> AMP does not restrict its pool to cream of the crop students...even if you are just barely making it, LSAMP helps you become the cream of the crop by giving you all these programs and putting you in research and giving you more experience, so that helps motivate you in your studies and everything.

Another important result of the LSAMP experience was clarification of career goals:

> AMP did a lot of things for me. Before joining, I did not have a goal, I did not know what I wanted to be. Now I do. I want to go for an education degree, I want to be a teacher.

For some students, financial assistance by LSAMP was a major factor:

AMP helps you become the cream of the crop… —Student

> AMP has given me a lot of assistance. You do not have to worry about a whole lot of things—for example, having to get a job, or putting a burden on your parents. That's a large stress off your mind.

But other students stated simply that without LSAMP, they would not have entered a 4-year college, or would not have graduated:

> I would not be graduating if it weren't for AMP.

> I would not be attending without the help of the AMP.

AMP Impact on Faculty

Several of the visited LSAMP projects saw new attitudes, the acquisition of new skills, and greater research opportunities for faculty members as one of the main benefits of LSAMP:

> No longer do faculty members look at minority students and say to themselves they are unprepared. Instead they now look at students as individuals on a case-by-case basis.

> Faculty have learned that if modification of curriculum is beneficial for AMP students, it is beneficial for majority students too.

...now [faculty] look at students as individuals on a case-by-case basis —Project director

One project director explained that the success of the LSAMP research component has led faculty to be profoundly impressed by the abilities of undergraduate students (minority or otherwise) to carry out research.

> Whereas in the early years of the AMP program there were a few faculty members willing to serve as mentors, now there are many who enthusiastically sign on....If you see the list of mentors that we have, it's just extraordinary. They come out of the woodwork.

Another project director pointed out that faculty members are not only adopting LSAMP-inspired curricular changes, but are also becoming aware of students' different learning styles:

> I think in some ways we have increased the sensitivity of some faculty members who may not have been aware of the need to consider ethnic and cultural aspects in way of learning.

In one project, much emphasis is placed on faculty training through teacher workshops on cooperative learning and through the introduction of resource professors, chosen from among a group who were viewed as being successful in their classrooms and had received very good evaluations from their students.

Impact on the Host Institution

In the seven Alliances included in this study, curricular reform was a major activity during the early years of the program, when gateway courses and new teaching and learning strategies were introduced. By the time the Westat team interviewed LSAMP staff members, these curricular changes were no longer in the pilot stage: they had been routinely incorporated in the LSAMP program and, in many cases, made part of the curriculum for all students. For example, the summer bridge program was going to be offered to all entering students in one of the participating universities; in another institution, the success of workshops and collaborative strategies led to their widespread acceptance:

> The AMP program has benefited our campus because it has served as a catalyst to make our own supplemental instruction or academic enrichment program grow. The college said hey, this is working for AMP students, let's spread it to the general college too.

Elsewhere, because of the success of the LSAMP program's research experience component, campuses that are part of this Alliance are beginning to offer undergraduate research experiences to a wider array of students.

5. Other Federally Funded Programs for Underrepresented Minorities

Representatives from several federal agencies that have been involved with special programs for underrepresented minorities at the college level participated with NSF and Westat in planning this study. Only two agencies, NASA and NIH, determined that their programs would be suitable for inclusion in this study and suggested several programs for possible site visits. Our staff conducted four site visits, two at NASA-funded sites and two at sites where a NIH-funded MARC program is active.

Descriptions of the NASA and NIH Programs

NASA-Funded Programs

Spelman College and Morehouse College, both located in Atlanta, are members of the Atlanta University Center, a large private educational complex with a predominantly African American enrollment. Both colleges are single-sex liberal arts colleges, and both are among the most prestigious historically black colleges. Morehouse, with an enrollment of 3,000 male students, offers a dual-degree program in engineering and architecture, and is home to numerous special programs and institutes; Spelman, with an enrollment of 1,900 women, offers a dual-degree engineering program in physics and mathematics and also features several other special programs. While the two institutions are totally separate, there are strong linkages between them, and a number of joint activities take place. Both programs also draw on the resources of other members of the Atlanta University Center and of the Georgia Institute of Technology, a Ph.D.-granting institution.

Both colleges have a long history of involvement with NASA. In addition to Project WISE at Spelman and Project SPACE at Morehouse, the scholarships that were the subject of Westat's site visits, NASA has sponsored other programs, offers internships to undergraduates, and recruits actively at both institutions. It is not alone in these efforts. Given the excellent reputation of both schools, there are other opportunities for student support, and graduates who have majored in SMET fields are very much in demand by industry.

Since neither institution offers a bachelor's degree in engineering, both schools have made arrangements with engineering programs at other institutions for a 5-year dual-degree program. At the end of the fifth year, the students are awarded a bachelor's degree in science or mathematics from their undergraduate institution and an engineering degree from the institution to which they transferred for this degree, in almost all cases the Georgia Institute of Technology.

Project SPACE at Morehouse. Project SPACE (Strategic Preparedness Advancing Careers in Engineering Sciences) was initiated in 1988. For most of the project's history, between 10 and 20 participants each year were selected These participants were called McNair scholars, in honor of the late Dr. Ronald McNair, America's second African American astronaut.

The majority of students are recruited after they had applied to Morehouse and were targeted by the admissions office as potentially eligible based on their high school record and intended major. There is also an up-to-date website describing the program and application process. Eligibility criteria include a 3.0 high school GPA, a minimum SAT score of 1,000 (or comparable ACT score), intended major in SMET, and interest in attending graduate school. The minimum required SAT score is set lower

than in other, comparable scholarship programs for talented students, because both Morehouse and NASA want to reach a cross-section in terms of geography and financial need. Many Morehouse applicants come from well-to-do Atlanta families and, in the words of the project director, "we don't want everybody's mother to be a doctor and father a lawyer."

In past years, the scholarships covered all of the students' educational costs, including tuition and room and board. In addition, all scholarship students are required to spend 10 weeks every summer working as interns in one of eight NASA installations, for which they are paid $3,600. Beginning in 1997, the annual scholarship was reduced by 50 percent in order to increase the total number of participants. Students were expected to find support for the other 50 percent of their educational costs from other scholarships, grants, loans, and work-study programs. Each scholar is funded for a total of 4 or 5 years, with yearly renewal contingent on the student's satisfactory GPA (3.0 minimum). Before final acceptance, students are asked to sign a contract with Project SPACE stipulating that they must be enrolled full time in a SMET field and maintain a GPA of 3.0 during each semester, work for 10 weeks as interns at designated NASA centers, and attend all scheduled meetings, symposiums, and conferences. If these conditions are not fulfilled, students are placed on probationary status and may eventually be dropped from the program.

The project is housed under the Provost and Vice-President for Special Academic Programs. The staff consists of a faculty member who serves as project director, a full-time project coordinator, and an administrative secretary. The project director is a professor of space sciences in the Chemistry Department and was a NASA staff member for 35 years before coming to Morehouse. His experience is especially useful in coordinating curriculum requirements, designing the scholars' research opportunities, and developing NASA research placements and graduate study linkages.

The program engages in a wide array of activities to encourage and reward good academic performance. Much of the responsibility is placed on faculty. The department chairs in the fields in which McNair scholars major (usually physics, math, or chemistry) are responsible for academic advising, especially important for dual-degree candidates, who must complete their 4-year program in science or math in 3 years. According to the Provost, the role of all teachers is crucial:

> Ultimately, it's really the faculty who I think makes the difference in sustaining the students. We obviously start out with quality students, that clearly makes a major, major difference, but it's the faculty and the staff support which sustains the students.

A major program component is the summer science institute, a bridge program for entering freshmen conducted jointly by Morehouse and Spelman, which incorporates a rigorous program of skill improvement and problem-solving courses as well as social activities (for example, field trips to the Kennedy Space Center and to Disney World in Florida). The program coordinator believes that the structure of the summer program helps students to learn to balance their time between academic and social commitments, a frequent problem during the first year of college:

> I think both components (academic and social) are equally important because (students) are going to have to develop those study habits and then balance it off with going to parties, keeping those grades at a level that's acceptable.

Mentoring is another important component. A faculty mentor or advisor is assigned to each student, and his role sometimes involves personal counseling as well. A research mentor is the NASA-based employee who serves as mentor during the summer research internship; this person plays a very important role in solidifying the student's commitment to science and to NASA. As expressed by one student:

> Another good component is the mentor…because of all the exposure. We met astronauts, we met guys getting their MBA's, and things of that sort. My mentor is a mechanical engineer. He has a Master's in mechanical engineering, and he had a professional engineering license. That was one of the things I was trying to grasp, do I want to choose that route? He sort of solidified my own aspirations, and the things I wanted to do.

Peer mentors are usually upperclassmen, who are called upon in project meetings and activities to provide younger students with a personal perspective based on their own freshman and sophomore experience.

The summer internship at a NASA installation is seen by many students as the most important component of the scholarship program, with respect both to knowledge acquisition and to gaining a better understanding of the relationship between their studies and the world of work:

> I learned more in two weeks at NASA than I did in an entire class.

> When you go to actually work at NASA, ...it's all so inspiring to see them actually doing their work, and you are actually able to apply some of the work you learned in school in a real life application.

Project SPACE does a considerable amount of evaluation with respect to the summer internship. Both the research mentor and the student fill out evaluation forms, rating both the student's performance and the student's assessment of the research experience. The insights gathered through these evaluations are then used in improving the planning of future placements.

Academic and psychosocial supports, both formal and informal, are widely available. To begin with, the college offers a more supportive environment than many larger universities, and this is one of its attractions for all students. In addition, tutoring and study groups are frequently offered, and some are mandatory for freshmen. Morehouse has an extensive program of conferences, seminars, and symposia where students discuss their research projects and present research findings they have developed; these activities are open to all interested Morehouse students.

Preparation for graduate school is a major program emphasis. This is often a difficult task, because talented minority students usually are offered lucrative jobs when they graduate from a prestigious school like Morehouse. Workshops during the senior year emphasize the importance of graduate degrees and their long-term financial benefits and provide information about various aspects of graduate education, including available financial support and preparation for the Graduate Record Examination.

Because Morehouse keeps track of the fate of each of its students and graduates, comprehensive information is available about program outcomes. Between 60 and 90 percent of those who first enrolled between 1989 and 1993 had graduated by 1998; for later enrollment years, a high proportion of students were still enrolled in regular or dual-degree programs. For the combined total of 180 students who were being supported, between 1989 and 1997, 36 percent had graduated, 53 percent were still enrolled, and 16 percent had been dropped from the program because of low grade point average or for other reasons. One-third of those who were dropped from the program graduated without program support.

Graduate enrollment statistics are very impressive. As of 1997-98, 67 percent of McNair scholars had been enrolled for a graduate degree. The graduate institutions attended by these students are highly diverse and include MIT, UC Berkeley, and Stanford as well as universities closer to home, such as Georgia Tech, Florida A&M, and the University of North Carolina. While the majority of graduates elect graduate programs in the sciences or

engineering, a few choose MBA programs or medical or law schools.[8]

Program impacts on faculty and staff were summarized by the Provost as due primarily to the high quality of McNair students:

> Clearly the program has attracted very, very good students as NASA scholars...good students really tend to elevate the other students in the environment. And of course they are a challenge to the faculty.

At the present time, the project faces some new challenges. The program as now structured, especially the dual-degree major, conflicts with research participation during the academic year by putting too heavy a burden on the students. Furthermore, the 50 percent funding of the McNair scholarship and other economies introduced to increase the total number of Project Space participants upset the students and faculty. In the long run, the project coordinator hoped to institutionalize the program and to obtain additional funds from new sources. Meanwhile, some of the interviewed students expressed the opinion that McNair scholars have to work too hard for their scholarship money. They also had mixed feelings about the requirement that they work at NASA for three summers. Upperclassmen compared themselves to some of their peers who earned more from private industry than the scholar's set stipend for the NASA internship. But on balance, most students felt that the summer internships were advantageous, especially for lower division students who could not get good summer jobs. Furthermore, once the NASA internship slots have been filled, upper class students may accept jobs from private industry.

Project WISE at Spelman College. Project WISE (Women in Science and Engineering) was founded 1 year earlier than the Morehouse program and there are some differences between the two programs. But in most respects, however, they are very similar. Project WISE has somewhat more selective recruitment criteria: like Morehouse, Spelman requires a GPA of 3.0, but a higher SAT score (1,100 compared to 1,000). A NASA staff member screens and interviews applicants and participates in the final selection of scholarship recipients. WISE scholars are also required to work for one of the NASA centers every summer as paid interns. Their annual scholarships also were cut by 50 percent in 1997 so as to increase the number of awards from 15 to 30 students per year. Following are some students' reactions to the cut:

> I am grateful for the WISE scholarship whether it is full, half, partial, any amount. I would not be able to attend Spelman without it.

> I thought it was a full scholarship but did not find out that it was a half scholarship until I got here. If I had known I probably would have accepted a full scholarship offer from another college.

> I receive funding for the other half of my scholarship from a private source.

The project director is chair of the Chemistry Department and director of the Center of Environment Excellence, which is funded by the Department of Energy. She follows program activities closely, reviews and maintains statistical data on students, and meets frequently with freshmen. The associate director is chair of the Computer Science Department, and project direct of Undergraduate Students Awards for Research. She is responsible for planning and coordinating program activities and advising upper level WISE scholars.

WISE scholars are required to complete one semester of research on campus with a Spelman faculty member as mentor, and are encouraged to give scientific presentations at local, regional, and national conferences. Mentoring,

[8]This information on percentage of students enrolled in graduate school was obtained from exit interviews with each McNair graduate and verified through acceptance letters and award notification announcements. Information about enrollments in non-SMET programs was obtained from the September 1997 performance report submitted by Morehouse College.

workshops, tutoring, and study group offerings are similar to those described for Morehouse.

Outcome data are available for 205 students who entered the WISE program between 1987 and 1998. Of this group, 42 percent have graduated, 43 percent were currently enrolled, and 14 percent had dropped out. Of the WISE scholars who had graduated, 52 percent went on to graduate school. Compared to Morehouse, dropout rates, and graduate enrollment rates are somewhat lower for Spelman.

NIH-Funded Programs

NIH funds several programs designed to increase minority participation in research in the biomedical sciences. The MARC (Minority Access to Research Careers) program supports research training opportunities for undergraduate juniors and seniors and for faculty who are directly involved in special training activities for MARC students. Grants are awarded to institutions that offer the baccalaureate degree and in which student enrollments are drawn substantially from ethnic minority groups that are underrepresented in the biomedical sciences (including mathematics).

Grant funds do not usually fund a separate MARC staff, but full student support and faculty salary support for summer work, conference travel, and lab supplies are included. Undergraduate honor students eligible for awards must be science majors with an expressed interest in a career in biomedical research and intentions to pursue graduate education leading to a Ph.D., M.D./Ph.D., or other combined professional degree/Ph.D. The grant awards are for a period of 24 months, and the current annual student stipend is $8,988. The grant also covers tuition and fees for awardees, limited travel funds for trainees and faculty, and salary support for faculty involved in MARC training activities.

As of February 1999, 57 institutions in the United States and Puerto Rico hosted a MARC program. Except for a few institutions, the number of MARC scholars recruited each year is usually small (fewer than 10). The University of Puerto Rico at Rio Piedras, where Westat conducted a site visit, is one of the larger host institutions; it has places for 25 students and recruits 10-12 juniors each year. Student selection is a very competitive process: student applicants are required to have a GPA of 3.0, prior research experience, and a commitment to graduate study. The applications are reviewed by an advisory board consisting of faculty members. Applicants who look promising are usually interviewed. One of the major concerns in reviewing applications is to restrict the scholarship to students with a commitment to biomedical research, rather than to matriculation at a medical school and becoming medical practitioners, [9] a difficult task, as indicated by one advisory committee member during the interview:

> Sometimes you can't really tell the ones which are really interested and those who are just using the program to get into medical school. We try, but it's very hard to decipher.

For MARC scholars, the most important and influential role is played by their research mentors, and effective matching between students and mentors is critical. The project director in Rio Pedras explained that among the program's strategies for having a high percentage of scholars obtain research doctorates rather than medical degrees, was the assignment of the right mentors:

> I think it is primarily an effect of having a good research mentor, good research experience….some mentors are much more effective in getting students into research areas than others. It has nothing to do with how many publications a mentor has.

[9] An earlier study of the MARC program showed that a high proportion of MARC graduates had obtained M.D. degrees. See NIGMS, *A Study of the Minority Access to Research Careers Honors Undergraduate Research Program* (1995, unpublished report).

The matching of MARC scholars and their mentors occurs in a number of ways. A faculty member may identify a bright and promising sophomore and propose him/her for an award and offer to become that student's mentor; in other cases, the student will take the initiative. At Morgan State, students are required to enroll in a course where each faculty member gives a lecture reflecting his or her major research interest, and students can later choose a mentor on this basis. The relationships between mentors and students are primarily academic, with mentors making serious demands on students to achieve high-quality research. One research mentor explained that he feels that mentors should treat MARC scholars as if they were graduate students, although he recognized that they need more guidance:

> I meet with them more than I would with a graduate student. I think this is the spirit of the MARC program, it's a mentorship program, not an apprenticeship program. An apprentice works for me, and they get what they can because my needs are the primary concern. A mentorship program puts the student first and is concerned about where the student is going and what he needs to get there.

The research mentor plays an important role in providing career guidance and helping the student to apply to graduate schools. At Morgan State, students are also offered the Kaplan GRE seminar to improve their GRE scores. At Rio Piedras, students have done poorly on the GRE because of language difficulties; and an intensive course in English writing is currently planned.

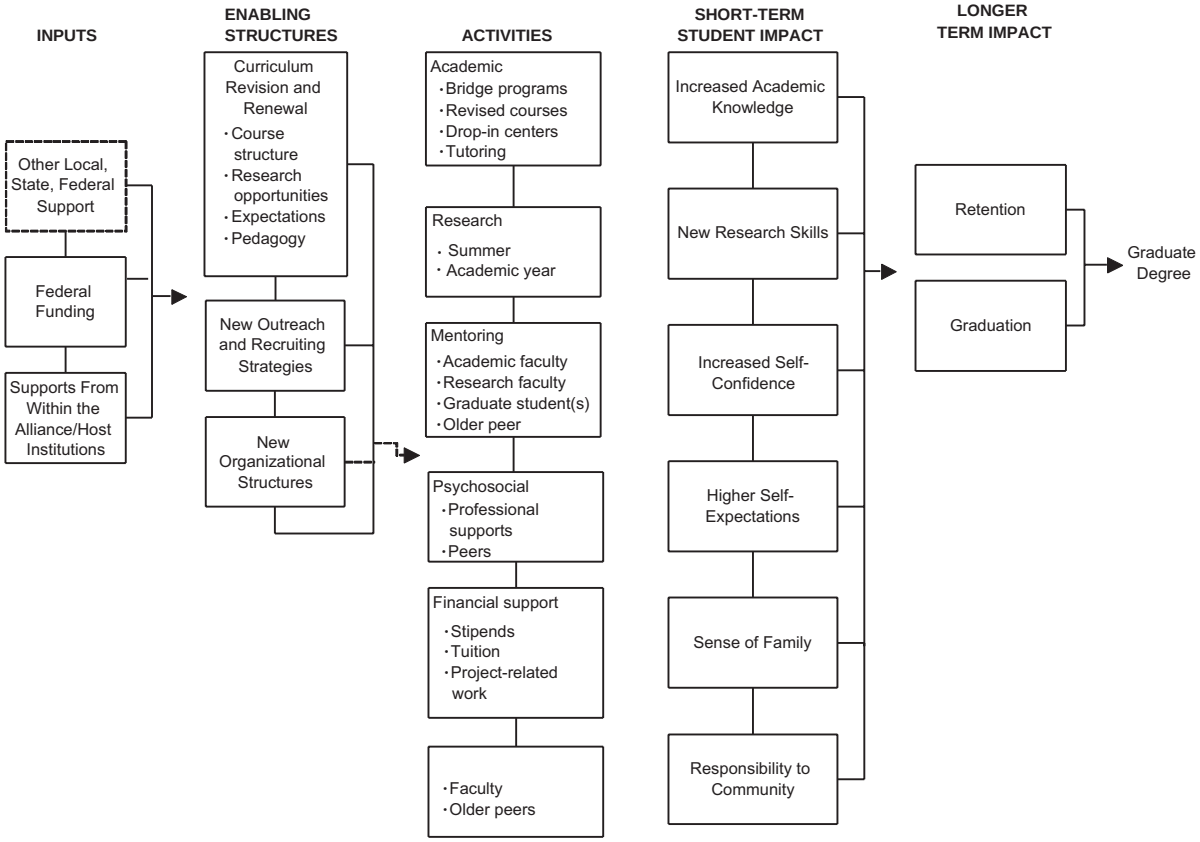
The other major activity for MARC students are summer internships. At Morgan State, an internship coordinator identifies internship openings and transmits the information to students. Some of the MARC activities in both of the schools where Westat conducted interviews, for example, seminars where MARC students present papers, or enrollment in new courses introduced to meet MARC requirements, were available to non-MARC students.

On both campuses, MARC has opened up research opportunities, both among departments and with other institutions that were not previously available. Morgan State MARC, for example, has established a student exchange program with Johns Hopkins, Howard University, and the University of Maryland in Baltimore. The MARC grant has provided a welcome opportunity to network and establish linkages with research-oriented universities, thus providing opportunities for access to graduate study at highly rated institutions for their graduates. At Rio Piedras, 75 percent of MARC students during the past 4 years have entered graduate programs.

Comparisons Between LSAMP and the Other Programs Studied

Our visits to the LSAMP, NASA, and NIH sites provided a rich array of descriptive information on these three approaches to supporting undergraduate students. To better understand the programs—how they are structured and how they may differ—we developed an overall "conceptual model," based on Gandara's work, as well as our own observation (Exhibit 4). This model helps both to tie together and explicate the possible pieces of existing services, as well as to provide a visual framework for contrasting the projects that we have studied.

Exhibit 4
Conceptual model



Different Strategies Toward Meeting Similar Goals

Our analyses suggest that the three programs have similar goals but have undertaken different ways of addressing them. **First and foremost, the fundamental difference between LSAMP and the two other programs included in the study is a conceptual and organizational one.** LSAMP is an alliance of several institutions with common goals and, to some extent, sharing of information and available resources. The programs sponsored by NASA and the NIH-sponsored MARC program involve a small number of students on a single campus although in the case of the NASA programs, there are linkages between these institutions and other schools offering certain undergraduate as well as graduate programs.

Second, they differ in their target populations and the associated recruitment and outreach strategies. The LSAMP program is somewhat less selective than the other two programs. The NIH program, which is limited to juniors and seniors, seeks out the "best and the brightest" among science and math majors; many of the participants major in chemistry or biology. NIH guidelines specify that awardees must be honors students majoring in the sciences with an expressed interest in a career in biomedical research, and intentions to pursue graduate education leading to a Ph.D. or combined professional/Ph.D. degree. In one of the visited programs, applicants for the MARC scholarship are expected to have a GPA of 2.5 to 3.0 during their first 2 years of college, as well as demonstrated interest and experience in research. They must maintain a GPA of 3.0 to remain in the program. In the other program, a GPA of 3.0 in science and math courses during

the first 2 years of college was required. The NASA scholarship, which is awarded to freshmen for a 4-year period, requires a cumulative high school GPA of 3.0; one of the colleges requires a score of 1,100 on the SAT, and the other requires 1,000.

As was discussed earlier in this report, LSAMP admissions policies vary greatly between alliances, and they tend to be more flexible. Although a good high school GPA is generally required for level I participants, exceptions are not uncommon, and high SAT or ACT scores may not be required. These differences between LSAMP and the other two programs are best understood as a corollary of their respective goals: LSAMP's emphasis is on retention and graduation, whereas NASA and especially NIH are seeking students who can qualify for graduate degrees.

Third, they differ in the range and emphasis placed on different program activities. The MARC program is targeted on research and student readiness for graduate school. It provides resources for preparing for the GRE and applications for graduate fellowship programs, as well as opportunities for participating in research programs, meeting professionals in their field, and making presentations of their research findings to groups on campus and at research seminars. Every MARC scholar has a research mentor who plays a major role in helping the student select appropriate research topics and prepare for graduate school admission. NASA, like LSAMP, deals with younger students who need more academic and especially more psychosocial support. And like LSAMP, the NASA projects offer tutoring, peer mentoring, research mentoring, and many opportunities for student presentations of research findings. NASA projects require all students to serve summer internships at NASA centers, and these provide valuable experiences and contacts for subsequent graduate study or jobs. MARC also requires a summer research internship, which these very desirable candidates have no problem locating. Summer internships are also recommended for LSAMP participants, but it appears that there is no guarantee that all students will find suitable opportunities.

One of the main differences between programs is in the area of financial assistance. LSAMP awards very few unrestricted scholarships to participants: student support is provided in exchange for services performed (research, peer mentoring, tutoring). In one alliance, low-income students who can demonstrate the need for support are eligible for a stipend of $500 to $2,000 per year if they maintain high academic performance. On the other hand, NASA students are awarded a 4-year scholarship that covers 50 percent of all their college-related expenses, and the annual stipend for MARC scholars is close to $9,000 per year plus tuition and travel allowances.

Fourth, the goals of the three programs are also somewhat different, although increasing the participation of minorities in the sciences is common to them all. But NASA and NIH are primarily aiming at an increase in the number of minorities who will obtain a doctorate in the sciences or engineering, whereas LSAMP's primary goal is the increase in SMET undergraduate degree recipients, with enrollment in graduate study an important secondary goal. We want to point out, however, that in the case of the NASA and NIH programs, we were not able to include a sufficient number of sites to obtain a comprehensive picture with respect to some aspects of these programs.

Finally, although not captured in the conceptual model, there is also a difference in program size. Prior to 1997, the NASA scholars programs enrolled between 15 and 20 new scholars each year; since 1997, the program has sought to increase the number of participants by cutting their stipends to 50 percent of college costs. Most MARC programs have fewer than 10 new slots each year. The number of LSAMP participants is more difficult to estimate because of the variation in the definition of participants, but even if restricting the definition to level I or "direct" participants (usually those who receive some financial benefits), each Alliance has over 100 LSAMP enrollees. But there are other differences between the programs with respect

to eligibility criteria, financial support, student activities, and outcomes.

Summing Up: Three Unique Programs

The three programs examined in this study have a common goal: to increase the number of qualified minority members in SMET fields. But the means the program sponsors and the participating institutions have chosen to reach this goal are very different.

The NIH-sponsored MARC program provides generous stipends to students who have demonstrated interest and high ability in science and in research. Their only obligation during the last 2 years of college is to participate in research projects under the guidance of a research mentor, maintain high grades, and prepare themselves for admission to a graduate program from which they will seek to obtain a Ph.D. Although some of their activities may impact other SMET students on campus, who are invited to hear research presentations made by MARC scholars, and who may be motivated to improve their academic performance so as to qualify for the MARC program in future years, the impact on the student population as a whole is negligible. Of course these students, having successfully weathered the first 2 years of college, do not require as much academic and social support as do younger students. They need help with career decisions and especially with graduate school entrance, and this assistance is provided through GRE preparation workshops or tutoring and faculty efforts and recommendations. The sponsor of this program seeks to direct these scholars toward careers as biomedical researchers rather than medical practitioners, which is often the first choice of students who major in some of the SMET fields. Because of this subgoal, and because the program is limited to juniors and seniors, comparisons between this program and LSAMP are really not possible.

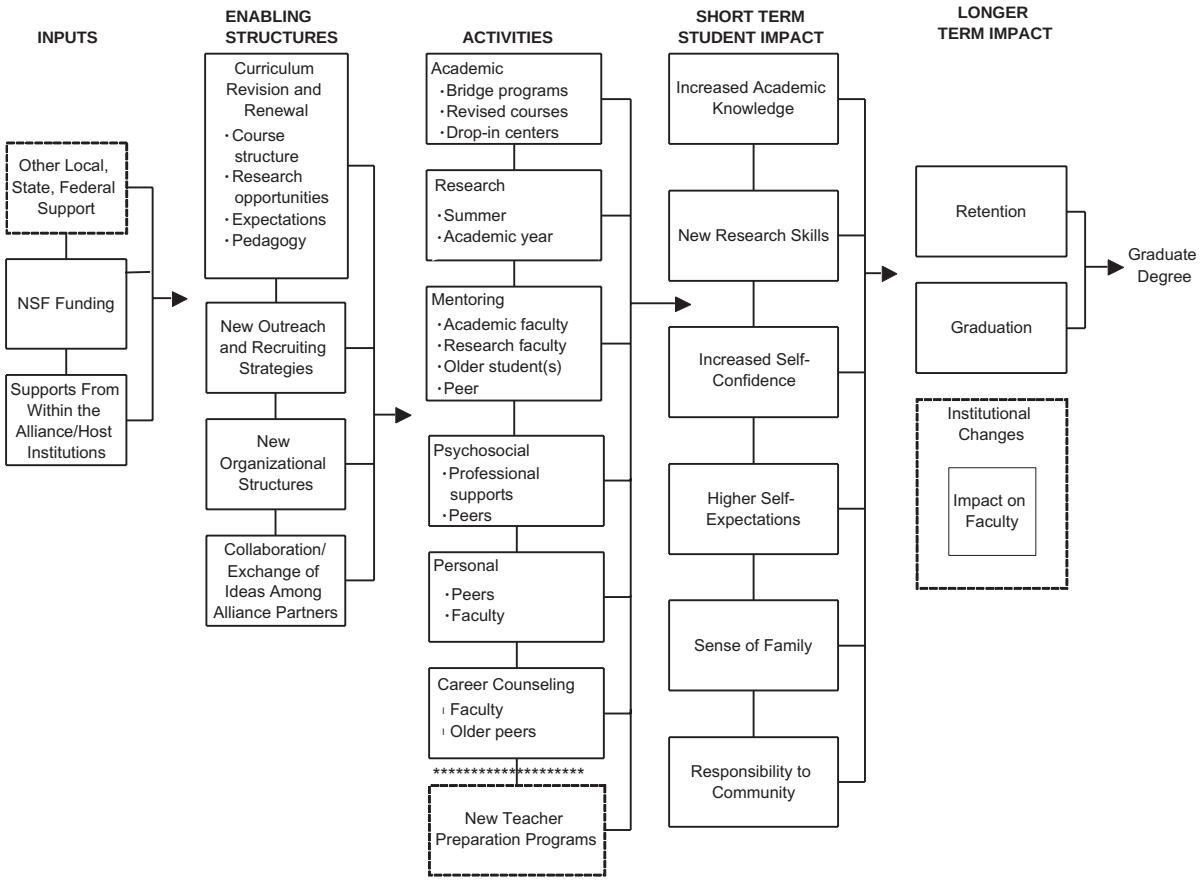
The NASA program is more similar to LSAMP, although it is much smaller, more selective, and provides all participants with a stipend, that even after it was cut back 2 years ago, is still much larger than what the majority of LSAMP participants receive. The obligatory summer internship at NASA centers guarantees additional income and also exposes the NASA scholars to research opportunities and contacts that may lead to job offers or graduate fellowships. Because the number of NASA scholars is small, the staff makes considerable efforts to help each student to succeed, closely monitoring their course performance and participation in the numerous activities they have developed. But as is true of the MARC program, there is relatively little opportunity for the student body as a whole to participate in activities other than attending research presentations or ceremonial activities.

The LSAMP program is fundamentally different, and not only because of the Alliance structure. Increasingly, the staff has chosen to accept some students who had not distinguished themselves in their academic high school courses or when they first entered college. Stipends are often tied to academic performance, or more often to the performance of specific tasks, such as research assistance or tutoring. The primary emphasis in participating institution is on retaining and graduating SMET students, although graduate study is stressed for qualified students. There is more emphasis on creating a community of mutually supportive students rather than exhortation that individuals must prove themselves to be the best, a view expressed by some of the NASA staff. Perhaps most important, the academic and social support activities initiated by the LSAMP program are available and have benefited a large proportion of minority SMET students on the campuses where LSAMP is active.

LSAMP also differs from the other programs in what might be considered its secondary goals and activities. In addition to impacting students, the program also sees as an important goal having an impact on the faculty who participate and the institutions that host them. LSAMP works on changing the system and the capacity of the system to meet student needs, as well as the success rate of the students within it. In addition, some LSAMPs have also accepted the charge of providing better teacher education,

another area that could be expected to eventually have impacts on the overall system. To fully capture the breadth of the LSAMP mission, some modifications are needed in the conceptual model. This revised model is presented in Exhibit 5.

Exhibit 5
LSAMP conceptual model



6. Keys to Success of the LSAMP Sites

Each of the seven LSAMP projects that Westat staff visited emphasized different features, largely because it addressed the varying needs of different types of students. However, looking across the projects visited, the study has identified a set of features that appear to lay the foundation for success (Exhibit 6).

Exhibit 6
Keys to LSAMP's Success

- Summer bridge program
- Research experience
- Mentoring
- Drop-in center
- Caring staff
- Alliance structure

By far the most successful feature of these LSAMP programs is the summer bridge program for graduating high school seniors. Typically, students receive a stipend to attend a 3- to 6-week session during the summer prior to college attendance. They enroll in "gatekeeper" courses, usually in math and science, and are taught study skills and time management. Most important perhaps is the exposure to campus life and the opportunity to meet some faculty members and future fellow students. The summer bridge program is especially useful for transfer students from community colleges, but it is helpful for all college freshmen.

For students who have successfully survived the freshman year, the program feature most often described as "most important" by staff and students is the research experience. The opportunity to participate in real, ongoing research projects was seen by some as the centerpiece of the program, and the essential element in promoting graduation and graduate enrollment. Where it also leads to opportunities for presenting findings to a wider audience at seminars, symposia or conferences, or through publications, it strengthens students' self-confidence as well as speaking and writing skills. The opportunities to participate in meaningful research are not universally available, since faculty at many institutions within each Alliance are focused on teaching, rather than funded research.

In all LSAMP projects in this study, mentoring was seen as a major and important activity. Students were most enthusiastic about having a peer mentor during their first 2 years in college, because some found it difficult to relate to faculty mentors and were especially uncomfortable in discussing personal problems. Research mentors, on the other hand, were often seen as inspiring and valuable teachers as well as friendly and supportive adults. Not every student has a peer mentor (in the early years) as well as a research mentor as soon as they become eligible for a research assignment, and some LSAMP projects take more initiatives to match students and research faculty than others. But ideally, having these two mentors, especially if they are good matches, seems to be the most productive arrangement.

Another feature is a drop-in center, usually a separate space that has resource materials and computer facilities where a graduate student or faculty member is present to answer questions and point students to resources. These centers, which are not available on every campus, often become popular meeting places where students can work together or simply socialize.

There is also considerable strength in the Alliance structure itself. For students, the opportunity to learn from others attempting to meet the same goals appeared to us to be a unique and valuable feature. For faculty, who often feel that they are "out there by themselves," the presence of "comrades in arms" provides both a psychological and a practical source of support.

But over and above specific program features identified as characteristic of the successful projects is a more amorphous notion expressed in many of the interviews conducted on campus: the LSAMP project has a caring staff and is a place where students feel that someone (or many individuals) really care about them. Closely associated with this characteristic is the existence of a community of LSAMP participants, ready to support and help each other. Students (and to some extent faculty) are able to escape the anonymity that a bureaucratic institution (the university or college) imposes on them. Of course, all college students share these needs. However, the traditional undergraduate environment, especially the environment at institutions serving mainly majority students, may pose special barriers for students who are from traditionally underrepresented minority groups and may be the first in their families to attend college or to seek a degree in the SMET fields.

LSAMP, as we saw it, has both purpose and passion. Our study of selected programs clearly shows that these efforts are admirable, are contributing in creative and innovative ways to the health of the SMET infrastructure, and are providing a variety of lessons for those willing to invest their energies and skills in educating students to participate in fields from which they might otherwise be excluded.

Appendix A: LSAMP Bibliography

This bibliography was assembled for the purpose of providing a broader framework for the reader's understanding and interpreting the study of the Alliances for Minority Participation program. As stated in Chapter 2, we had hoped to describe the design and results other programs with goals similar to the project described here and discuss the ideas and theories that have guided the development of programs aimed at increasing minority participation.

It became apparent that the first objective could not be met because of the lack of comprehensive documentation or database information. While the largest number of programs designed for underrepresented minorities targets those in SMET fields, with one exception they have not been systematically evaluated.[10] For most of them, program descriptions were found, usually from the grant applications submitted to funding sources, but there are almost no data on implementation and practices to which success (or the lack thereof) could be attributed. The only program for which systematic outcome data were found is MARC (Minority Access to Research Careers) funded by NIH's Institute of General Medical Sciences.

The second objective was met, since there is a sizable body of information in the social science and educational research literature discussing the underrepresentation of women and minorities in the SMET fields, and broader issues of nonpersistence in college and of low undergraduate and graduate enrollment in SMET. The following bibliography includes books, book chapters, reports, and articles which are relevant to various features of the LSAMP program.[11]

The LSAMP program, and most other programs that seek to increase the number of graduates from underserved populations and the number of students who will subsequently seek more advanced degrees and/or obtain work in SMET fields, focus on one or more of the following program strategies in their activities:

1. Selection and recruitment,
2. Mentoring,
3. Financial support,
4. Academic support,
5. Psychosocial support, and
6. Professional opportunities.

In this review of the literature, we have included documents that provide some useful background information about college students and the education of minority students, as well as basic statistical information about the problem of underrepresentation. We have limited our search to documents published within the last 10 years and to programs that seek to help individual minority students to become successful members of SMET professions. Therefore, we have not dealt with topics (such as affirmative action or changes in admission standards or administrative policies) that may have affected the opportunity structure for minority students. Many of the cited references are relevant to one or more of the topics which deal with program activities (1 – 6 above). After each reference, the numbers in parentheses refer to the above topics.

[10] A recently completed study of 20 major programs that seek to increase the achievement of underrepresented minority undergraduates found that 14 of them only support students in SMET areas (Gandara, draft).

[11] We have excluded the vast body of literature which deals only with underrepresentation of women, since the focus of the LSAMP program is on underrepresented minorities.

Hrabowski, Freeman A. III, Maton, Kenneth I., and Greif, Geoffrey L. (1998). *Beating the Odds: Raising Academically Successful African American Males*. New York; Oxford: Oxford University Press.

This book is based on interviews with 60 families whose sons participated in the Meyerhoff Scholars program at the University of Maryland, Baltimore County. This program recruits outstanding math and science high school seniors and supports them during their undergraduate enrollment through scholarships, tutoring, and personal counseling. A sample of students and their mothers, fathers, and siblings were interviewed to investigate the factors that enable these students, unlike many of their peers, to succeed in high school and college. The authors conclude that strong parental role models and high levels of parental encouragement and support are essential for all these students, although middle-class parents are also able to provide academic support during the high school years. A number of components of the Meyerhoff program (including peer support and financial support) were cited by students in explaining the program's success (very high graduation and graduate school enrollment rates). (1, 4, 5)

Tobias, Sheila. (1992) *Revitalizing Undergraduate Science: Why Some Things Work and Most Don't.* Tucson, AZ: The Research Corporation.

Of the 11 case studies described in this volume, only 1 (Affirmative Action at California State University, Los Angeles) deals exclusively with programs designed to attract and retain minority students. The implementation and results of two programs funded by the National Institutes of Health, MARC—Minority Access to Research Careers—and MBRS—Minority Biomedical Research Support—are discussed in detail. The author attributes the success of this program largely to its research component, which presents the undergraduate students with challenging and rewarding assignments because only undergraduates are available as research assistants to faculty members. She concludes that unlike other experts, her team has seen evidence that "dedicated teaching, access to research, salaries and stipends, opportunities for travel and constant encouragement" can compensate for poor preparation in science at the high school level. Most of the book's chapters provide useful insights about efforts to reform science education and include some evaluation data. The concluding chapter (Chapter 11: The Implementation Challenge) discusses several other programs aimed at minority students. (1, 6)

Tobias, Sheila. (1990). *They're not Dumb, They're Different – Stalking the Second Tier.* Tucson, AZ: The Research Corporation.

Contrary to the widespread belief in the science community that educational reform at the K-12 level is the best (or only) way to remedy the shortage of scientists at the undergraduate and graduate levels, the author argues that much could be done at the college level to decrease attrition and promote success of students who do not fit the theoretical image of "future scientists." By rethinking recruitment and retention of women and minorities, and re-defining the concept of "qualified" science and engineering students, the future science and engineering manpower pool could be considerably enlarged. A case study using seven successful graduates who had not majored in science or engineering was conducted. They were enlisted as "observers" in an undergraduate science course and asked to record their reactions and those of their fellow students, thus shedding light on reasons why students who succeed in other fields did not take science courses or changed fields during their undergraduate careers. The findings were compared with data from a secondary analysis of a tracking study of 300 Harvard-Radcliffe students. The author identified several reasons why qualified students may not major in science or mathematics, among them dislike of the culture of competition that characterizes science departments, inaccessibility of professors, the myth that students have to be exceptionally gifted to succeed in science, and inadequate

recruitment into science during the college freshman year. (1)

Gandara, Patricia. (1995). *Over the Ivy Walls. The Educational Mobility of Low-Income Chicanos.* Albany, NY: State University of New York Press.

An intensive interview study based on semi-structured interviews with 50 Hispanic men and women who had obtained an advanced degree (Ph.D., M.D., or J.D.) from an American university of national stature. Many of the degrees were awarded by the University of California (UCLA, Davis) and the University of Texas (Austin). All of the interviewees were raised by low-income parents who had few, if any, years of schooling. The purpose of the study was to investigate how these individuals, unlike most of their peers, chose education as a vehicle for social and economic mobility.

Gandara has identified a number of factors that may have contributed to the successful careers of the subjects she interviewed, such as strong parental commitment, especially on the part of mothers, and poor health or lack of physical strength, which precluded participation in sports and other nonacademic peer activities. But the brunt of her argument deals with school-related events. One-third of these advanced degree holders attended Catholic schools, which were largely integrated and held students to higher standards than most public schools, especially those with Chicano majorities. Parents whose children attended public schools made strong efforts to place their children in majority Anglo schools; a few families moved to different locations to achieve this goal. Once in high school, track placement became the major issue. Chicano students were predominantly placed in vocational or general tracks, despite prior high grades and achievements. Many of the study subjects showed a great deal of determination and initiative to be placed in the pre-college track or to take pre-college courses; Gandara feels that attending a college-oriented high school and being exposed to a college-going peer group lays the groundwork for high minority achievement. There is little discussion about the undergraduate and graduate/ professional components of minority education. (1)

National Science Foundation. (1999). *Women, Minorities, and Persons with Disabilities in Science and Engineering, 1998.* (NSF-99-338). Arlington, VA: NSF.

This is the ninth in a series of biennial reports to the Congress, the administration, and others who direct public policy. It presents statistical data about the participation of minorities in science and engineering education and employment, as well as narrative sections analyzing some of the findings and historical trends based on NSF surveys and other government and nongovernment sources.

National Science Foundation. (1996). *Indicators of Science and Mathematics Education 1995.* (NSF 96-52). Arlington, VA: NSF.

This 1996 report, part of a series of biennial NSF reports, contains a great deal of material on the genesis and implementation of systemic reform in mathematics and science education. Chapter 4 deals with postsecondary education and contains data about enrollment and science and engineering degrees awarded to minority students from 1976 to 1991, as well as a discussion about the underrepresentation of minorities at the master's and Ph.D. levels.

National Institute of General Medical Sciences. (1995). *A Study of the Minority Access to Research Careers Honors Undergraduate Research Training Program.* Unpublished Report.

This study is the result of a long-term project involving several contractors and NIH staff members. It is an evaluation of the MARC program, funded by NIH, under which "highly qualified institutions receive support to provide

science courses and research training for honors students who are in their third and fourth year of college." In 1994-95, when the program had been in existence for 17 years, it was active in 62 institutions and had supported over 4,000 students. The study was based on a survey of 3,062 former MARC students, surveys of MARC faculty and program directors, and site visits.

The evaluation methodology is based on comparisons between MARC graduates and the total population of bachelor's degree recipients in their ethnic group. Among students who entered the MARC program prior to 1987, 7 percent had obtained a Ph.D. by 1995, and 16 percent had obtained a clinical doctorate (M.D., D.D.S., etc.) Including students who indicated that they are currently enrolled for these degrees, the percentage rose to 25 and 29 percent, respectively. The proportion of MARC students who seek or have obtained advanced degrees is considerably higher than national statistics show for all minority bachelor's degree holders who had majored in biology or chemistry, but this result cannot be solely attributed to the MARC program since it selected the ablest undergraduates for support.

The report includes a short discussion of MARC's impact on faculty and systemic change in the institutions that received funding. There was no indication of an increase in the total number of Ph.D.s in chemistry or biology among those who had graduated from schools with MARC program support. (1, 6)

Vivio, Frank M., and Stevenson, Wayne L. (1994). *U.S. Department of Energy Student Research Participation Program: Profile and Follow-Up Study of 1985 Participants.* (Publisher not identified).

This study is based on data from questionnaires completed in 1993 by 279 former students who had participated in a research experience program offered by the Department of Energy to undergraduates and on a focus group session with 16 former participants. The focus group identified a good mentor-student relationship as the most valuable aspect of the program and mentioned opportunities for informal interaction with scientists other than the mentor, exposure to high-quality laboratory equipment, and the opportunity to make formal presentations and to have one's work published as other valuable experiences. (2, 6)

Saeger, Wain, and Valesky, Jill C. (1984). *The Effects of a Summer Enrichment Program on the Academic Performance of Minority and Disadvantaged Students in the Following Semester.* Eric Document ED 251-548.

The academic performance following a summer enrichment program was measured for two groups: students that participated in the enrichment program, and comparable students who applied for the program but were either not accepted or rejected an offer. Students in both groups had similar ACT scores. The results of the study show that more program participants were enrolled in biology and chemistry during the semester following the enrichment program, while more nonparticipants were enrolled in English and math. They found that participants had a higher mean GPA in the following semester than nonparticipants.

The authors interpret these findings as evidence that the summer enrichment program had a positive impact on the academic progress of its participants. However, the study failed to control for possible selection bias. Therefore, the validity of the results is somewhat suspect.

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