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NATIONAL EVALUATION OF THE ALLIANCES FOR GRADUATE EDUCATION AND THE PROFESSORIATE

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SUBMITTED TO

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Chapter I. Introduction

In the fall of 2008, the National Science Foundation (NSF) awarded the American Institutes for Research (AIR) a 2-year grant to conduct a national evaluation of NSF's Alliances for Graduate Education and the Professoriate (AGEP) program.[1] AGEP aims to develop the human capital and administrative and academic infrastructure to enable the doctoral completion and progression of underrepresented minorities (URMs), that is, African Americans, American Indian and Alaska Natives, Hispanic Americans, and Native Pacific Islanders, to faculty positions. Joining together as an "alliance," colleges and universities have developed administrative strategies and programmatic infrastructures to enhance the recruitment, retention, and advancement of underrepresented students in science, technology, engineering, and math (STEM) within and across campuses.

AIR's evaluation of the AGEP program focused on the efforts of the 23 STEM AGEP alliances, which included 111 colleges and universities across the United States. AIR employed a mixed-method approach to the evaluation, concentrating on the alliances' programming, structures, and participants. We conducted extensive analyses of extant national databases to analyze national-level trends in PhD programs over time, both before and during the AGEP funding period. Site visits to 11 AGEP grantees provided a rich source of qualitative information about the AGEP program at the local level. We also administered an AGEP Student Survey to collect data on the overall graduate student population served by AGEP and these students' ratings and perceptions of AGEP's activities, including AGEP's influence on their studies, experiences on campus, and career decisions.

This report synthesizes AIR's findings about the AGEP program, and also includes recommendations to NSF and to the AGEP community for future direction.

Context for the Evaluation

More than a quarter century ago, the National Board of Graduate Education convened a special advisory group to examine the status of URMs in graduate education. The advisory group characterized the underrepresentation of some minority groups—that is, African Americans, American Indians and Alaska Natives, and Hispanic Americans—in graduate school and among doctoral degree recipients as "striking" (Nettles & Millet, 2006, p. 12). The group declared that "increased minority participation in graduate education is an important national goal to be realized for the social, economic, intellectual, and cultural well-being of all persons" (Nettles & Millet, p. 15). In addition, the group noted that greater graduate education completion among these individuals will yield a "collective benefit" to society.

Today, there is still concern about the low participation rates of URMs in STEM fields, particularly because there has been a marked decline in the number of people seeking STEM

[1] NSF funds two AGEP grant programs, one focused on science, technology, engineering, and math (STEM) and one focused on the social, behavioral, and economic sciences (SBE). This evaluation focused on the STEM AGEP program.

PhDs. As of 2003, fewer than 17% indicated that they planned to seek academic employment (National Science Foundation, 2008).

This trend has profound implications for the American scientific and engineering workforce, and particularly strong implications for the American STEM professoriate. URMs have been identified as “an untapped reservoir of talent that could be developed to fill technical jobs.” However, underrepresented minorities frequently confront obstacles to their entry and continuation in STEM education and workforce pathways (George, Neale, Van Horne, & Malcom, 2001, p. 4; National Science Foundation, 2005). These obstacles, which can reinforce one another, often include limited access to rigorous, high-quality, and relevant math and science curricula in elementary and secondary schools; and in the postsecondary arena, general issues of educational affordability, including the high cost of pursuing a solid education in STEM (National Science Foundation, 2005). A lack of culturally appropriate student support systems that help integrate URMs into the social and academic culture of STEM graduate programs may exacerbate these challenges and ultimately lead to student frustration and attrition (Gay, 2004; Herzig, 2004).

AGEP as an NSF Response to STEM PhD Production Trends

The NSF’s AGEP program is specifically designed to address some of these obstacles and increase the number of URMs completing STEM doctoral degrees and entering the professoriate. AGEP’s roots began in 1998 under the NSF Minority Graduate Education (MGE) program. MGE awarded eight universities $2.5 million each over 5 years to increase the number of URMs earning PhDs in STEM fields. One year later, in 1999, NSF changed the name of the MGE program to the Alliances for Graduate Education and the Professoriate. Whereas MGE targeted individual institutions for grants, AGEP grants were awarded only to formal alliances of multiple institutions. Furthermore, the AGEP program signaled a new emphasis on increasing not only the number of URMs receiving PhDs in STEM but the number of URMs entering the professoriate in STEM fields.

As alliances, the AGEPs are expected to work within their own campuses and across alliance campuses to achieve the program’s goals and objectives. In addition, alliances are encouraged to collaborate with other programs funded through NSF and other federal, state, and nonprofit agencies that broadly share AGEP’s programmatic goals. These include, for example, NSF’s Research Experiences for Undergraduates (REU), Louis Stokes Alliances for Minority Participation (LSAMP), Integrative Graduate Education and Research Traineeship (IGERT), and the Alfred P. Sloan Foundation’s Minority PhD Program.[2]

Preliminary AGEP Evaluation Efforts

Preliminary evidence gathered by NSF suggests that universities participating in AGEP are reversing the aforementioned downward trends in STEM PhD production. According to NSF data, colleges and universities funded under the initiative are reporting rising enrollments,

[2] See http://www.nsfagep.org/index.php/history/ for more information on the history of NSF’s AGEP program.

increased retention rates and PhD completions, and successful transitions of graduates into the STEM workforce (National Science Foundation, 2006).

However, these and other extant data on the program's outcomes have historically been limited. At the macro level, each alliance produces annual reports for NSF as part of the alliances' respective formative evaluations, and these data have informed NSF about the incremental progress of each funded alliance. Separately, the American Association for the Advancement of Science (AAAS) has worked with the alliances to build their capacity for individual project evaluation and, in collaboration with Campbell-Kibler Associates, has collected descriptive data from AGEP-funded institutions and built data-collection templates for the alliances to use in their own evaluation endeavors. As of 2007, each AGEP project was reporting on the race and gender of applicants and participants in master's and doctoral programs in 14 AGEP disciplines, as well as on the status or plans of each participant at graduation.

In light of a growing national concern for a deeper understanding of AGEP, NSF awarded AIR a short-term grant (July 2007–December 2007) to conduct a pilot study to determine the feasibility of a national evaluation. This pilot study focused on the North Carolina Alliance to Create Opportunity Through Education (OPT-ED) and the Michigan AGEP Alliance, and was designed to be a preliminary examination of issues related to the structure and implementation of AGEP, AGEP's influence on students and faculty, and the institutional cultures that promoted URMs' success in doctoral education at these two alliances. Through the study, AIR and NSF built a stronger understanding of how AGEP programs were being implemented and of the potential effects AGEP might be having on URMs' PhD production in STEM. This study also revealed other areas of potential interest and exploration, and served as a basis on which to build the framework for a national evaluation.

The National Evaluation of AGEP

AIR's National Evaluation of AGEP was a 2-year effort (October 2008–September 2010), funded through a grant from NSF. AIR examined the AGEP program with both wide-angle and microscopic lenses. The evaluation framed the following research questions about the national AGEP program:

At the institutional level

- What are the national trends at non-AGEP and AGEP institutions in the enrollment of URM students in STEM master's and doctoral programs? How do trends in enrollment at AGEP institutions compare with the trends at similar non-AGEP institutions?
- What are the national trends at non-AGEP and AGEP institutions in underrepresented minority students' graduation rates from doctoral programs in the STEM disciplines? How do completion trends in AGEP institutions compare with the trends in similar non-AGEP institutions?

At the student level

- Among those students completing STEM PhDs nationally, what are the trends in PhD recipients' backgrounds? How do the individual-level trends for URM students compare with those of majority students? Do these trends vary when aggregated to the institutional level for AGEP and non-AGEP institutions?

- What are the trends in the plans beyond the PhD for persons who recently earned doctorates in the STEM disciplines? How do these trends vary for URM PhDs?

Ultimately, this evaluation was designed to determine the value added by AGEP to doctoral education, and the role the program played in creating a diverse graduate student population and, subsequently, a racially and ethnically diverse STEM professoriate.

Structure of Evaluation Report

Descriptions of and findings from our evaluation work are presented in the chapters that follow. Chapter II gives an overview of the methodological approaches used in the evaluation, and Chapter III provides a description of the AGEP and non-AGEP institutions included in our analyses, as well as descriptive statistics about the population of current AGEP students who participated in the evaluation. Chapter IV discusses findings about AGEP's influence on enrollment in STEM programs and AGEP institutions' recruitment practices; Chapter V focuses on findings concerning AGEP's influence on PhD completion; and Chapter VI explores how AGEP has contributed to building a pipeline to the professoriate. In the final chapter, Chapter VII, AIR provides a discussion of the findings and presents its own recommendations as to what future steps NSF might take in funding the grant program.

Chapter II. Methodological Approaches to the National Evaluation of AGEP

This chapter summarizes the methodological approaches used to evaluate the AGEP program. The evaluation was built around four key activities:

- A comprehensive review of the research literature on URM participation in STEM PhD programs
- Statistical analyses of extant national data on enrollments in and completions of STEM PhD programs, along with analyses of job choices of recent STEM PhD graduates
- Structured site visits to carefully selected AGEP alliances
- A survey of current graduate students taking part in AGEP programs[3]

Descriptions of these activities will by necessity be brief. More thorough methodological information appears in the appendix at the end of this report.

The Research Questions

All evaluations are built around a desire to gauge how programs are working and where programs can improve. To determine the impact of AGEP, AIR structured the evaluation around a series of research questions. Our analysis sought to answer the following:

At the institutional level

1. Between 1990 and 2007, what were the national trends at non-AGEP and AGEP institutions in the enrollment of URM students in STEM doctoral programs? How did trends in enrollment at AGEP institutions compare with the trends at similar non-AGEP institutions?
2. Between 1990 and 2007, what were the national trends at non-AGEP and AGEP institutions in URM students' graduation numbers from doctoral programs in STEM disciplines? How did completion trends in AGEP institutions compare with trends in similar non-AGEP institutions?

[3] At the onset of the evaluation, AIR also planned to survey faculty, but after consultation with NSF, this plan was reconsidered.

At the student level

3. Between 1990 and 2007, what were trends in STEM PhD recipients' racial/ethnic, gender, and marital status compositions nationally? How did these trends vary
   a. Between AGEP and non-AGEP institutions?
   b. Within AGEP, between the pre-AGEP and post-AGEP periods?
4. In terms of time to completion for the STEM PhD degree
   a. Among the AGEP schools, did time to completion change between the pre- and AGEP-funding years?
   b. How did URM students, as a group, and as discrete groups, in AGEP institutions differ from the same URM students in non-AGEP institutions?
5. What were the trends in career plans and choices of employment for persons who earned doctorates in the STEM disciplines?
   a. In AGEP and non-AGEP institutions?
   b. In URM PhDs and non-URM PhDs?

Any analysis of the above-enumerated trends requires contextualization and an appreciation of the situational nuances of individual alliances, campuses, and people who are a part of the AGEP program. Seeking such contextualization, the study also posed the following two questions to contextualize our analyses:

1. What explains the variation in trends among AGEP alliances, institutions, and departments?
2. How do sociohistorical and contextual factors influence enrollment, completion, and career choice trends?

Each of the research activities described below helps address these questions, either individually or collectively.

Literature Review

A review of current research literature on URMs in STEM programs was essential to ground the evaluation work in the latest scholarship. The literature review documented issues about URMs' pathways to the professoriate and the obstacles that URM students confronted along the way.

The literature review required a thorough search of online databases, including ERIC and JSTOR, as well as STEM-related Web sites and industry-specific journals. At NSF's suggestion, the team also searched the Science Citation Index and the Web of Science databases. The team used combinations of the following key search terms to identify relevant sources of information:

- Doctoral education
- Science, technology

- Engineering
- Mathematics
- Underrepresented minorities (URMs)
- Retention
- Completion
- Doctoral pathways
- STEM pipeline

This initial search yielded more than 300 references for review. An overview of this list of 300 references, in turn, reduced our sources to approximately 80 books, articles, and reports. Six team members took part in summarizing articles, with each team member assigned several of the identified sources to review and summarize.

The literature review identified several challenges and barriers that influence the doctoral and postdoctoral participation and persistence of URMs in STEM fields of study and, subsequently, the professoriate and other STEM careers. A few salient themes emerged.

- In the pregraduate school experience, individuals from underrepresented racial and ethnic groups are often disadvantaged early in their academic careers, especially those from low socioeconomic backgrounds (e.g., limited access to highly qualified mathematics and science teachers in high schools and limited research opportunities at the undergraduate level). Consequently, URMs often feel discouraged from pursuing STEM courses of study and careers.
- At the graduate level, educational affordability often denies access due to the high costs associated with pursuing an advanced STEM degree and the pressure to obtain more lucrative alternatives.
- Notwithstanding efforts to increase the participation of individuals who are underrepresented, African American, Hispanic, and American Indian students remain a small proportion of the overall STEM graduate student population. This contributes to a sense of isolation, in which URMs lack sufficient student support systems to help them integrate academically and socially into their departments and introduce them to the rewards of doctoral and postdoctoral work.
- Minority students are also concerned about the possibility of their future success. Studies suggest that external demands and responsibilities place disproportionate pressures on minorities, both in academe and the larger workplace. All these factors can affect a student’s commitment to his/her educational goals and the institution.
- Individuals entering or continuing in the STEM professoriate and larger workforce undoubtedly encounter similar challenges regardless of their race or ethnicity. These may include economic and social (family) pressures. However, URM students may also experience marginalization because of academic environments and support systems that lack cultural relevance. The lack of diversity and the small numbers of URMs in academic positions therefore becomes a vicious circle, which can perpetuate itself.

- URMs experience unique challenges relative to their advancement and retention in postdoctoral and tenure-track faculty positions. Moreover, students in STEM graduate programs may have limited information about STEM careers outside of academe. For those who attain this information, nonacademic careers may be more attractive than academe because of their higher salaries and greater social status.

This extensive literature review provided us with the framework and constructs to develop the survey, focus group, and interview protocols. AIR released the literature review, entitled *The Road to the STEM Professoriate for Underrepresented Minorities: A Review of the Literature*, in October 2009 (Poirier, Tanenbaum, Storey, Kirshstein, & Rodriguez, 2009).

Analyses of Extant Datasets

An important component of AIR's evaluation was a careful analysis of national data that compared the performance of AGEP institutions to similar institutions that had not received AGEP funding. An interrupted-time-series approach was used to assess the influence AGEP had on the trends in the number of unrepresented minorities enrolled in graduate programs and the number of PhDs awarded to URMs in six major STEM fields.

The Data Sources

Data used to analyze these trends were drawn from the following national datasets:

Survey of Graduate Students and Postdoctorates in Science and Engineering (Graduate Student Survey or GSS). GSS is administered annually by the NSF Division of Science Resource Statistics on behalf of NSF and the National Institutes of Health. The survey's target population includes all academic institutions in the United States that grant master's degrees or research doctorates, appoint postdocs, or employ doctorate-holding nonfaculty researchers in science, engineering, and health fields. Data are collected separately for each reporting unit within a university (academic department or program, research center, or health facility), and include the number of graduate students enrolled and the number of postdoctoral appointees. This database allows for analysis of PhD enrollment trends at the departmental level by race/ethnicity, citizenship, and field of study.

Survey of Earned Doctorates (SED). The SED includes all individuals receiving research doctorates from accredited U.S. institutions. Administered to individual students on completion of their PhDs, the SED collects data on degrees awarded, the demographic characteristics of the degree recipients, and respondents' postdoctorate plans.

Survey of Doctoral Recipients (SDR). The SDR is a longitudinal survey that collects data over time from a sample of individuals who have earned a PhD in a science, engineering, or a health field. The SED provides the sampling frame for the SDR. Conducted every two years, the SDR collects information primarily on the education and employment history of PhD recipients. At the department and individual level, the SDR allows for analysis of first job choices of new PhD holders by race/ethnicity, citizenship, and field of study.

Integrated Postsecondary Education Data System (IPEDS). IPEDS is a system of interrelated surveys conducted by the U.S. Department of Education's National Center for Education

Statistics (NCES). The surveys gather information from more than 6,700 public and private universities, community colleges, and both nonprofit and proprietary technical and vocational institutions. IPEDS provides institutional characteristics such as fall total enrollment, faculty size by race, and financial information including tuition and room and board costs. IPEDs data were used in propensity score matching (PSM) analyses to identify a set of institutions to serve as a comparison group.

Publicly available data from the above-described surveys do not allow for all the analyses necessary for this evaluation. Indeed, many demographic data and data on the timing or interruption of a particular individual's studies are withheld from the general public in order to ensure privacy of the survey respondents. Because the evaluation team needed access to specific variables that would provide information on matters such as time to completion from the SED or first job after PhD completion from the SDR, AIR received a license from NSF to use these more restricted-use data.

Analytic Approaches to Data

Drawing on the SED, GSS, and SDR, the team created a baseline of data from 1990 to 1998, the years prior to the creation of AGEP. The study then continued to look at enrollment and completion trends specified in Research Questions 1–5 from the initial year of AGEP (1998) through 2007, the year of the most recently available data.

In addition, Research Questions 1–5 entailed comparisons of trends in AGEP institutions with trends at non-AGEP institutions. Such comparisons have necessitated the creation of a matched comparison group between AGEP institutions and non-AGEP institutions. Because institutions were not randomly assigned to participate in AGEP, comparable non-AGEP institutions were identified using a PSM approach. PSM is a statistical method for providing unbiased estimates of treatment effect. Similarly, within AGEP institutions, participants were not randomly assigned. The study again used the PSM approach to match URMs with non-URMs within AGEP institution STEM departments, to assess changes in the amount of time needed to complete the PhD degree and the difference in doctoral degree recipients' choices of first jobs. For more details in the PSM process, please refer to the appendix. Technical details on the statistical techniques used are also presented in the appendix.

Variability in the number of AGEP and non-AGEP institutions included in each type of analysis is due to the fact that all alliances and institutions were not included in each of the evaluation's quantitative data collection and analysis efforts. Specifically, enrollment trend analyses included 111 AGEP institutions and 230 non-AGEP institutions. Enrollment analyses include PhD-granting institutions in which students were enrolled in both masters and PhD programs in STEM. Conversely, the analyses on PhD completion included fewer institutions: 106 AGEP institutions and 201 non-AGEP institutions. The total number of institutions in these two analyses differed because the completion trends analysis only included those institutions that graduated at least one PhD student in STEM during the observed period. Thus, completion analyses' total number of institutions differs from enrollment analyses because completion analyses only included institutions where students graduated with PhDs in a STEM discipline in the years of interest. Finally, matched comparison analyses using PSM involved matching AGEP and non-AGEP institutions by discipline; therefore, the number of institutions used for each matching set varied (see the appendix for details on matched analysis procedures).

The evaluation team looked at all trends by STEM discipline. The decision on which disciplines to include was based on a review of the available data. GSS, SED, SDR, and IPEDS provide discipline-level information in myriad fields and subfields. The SED, for instance, collects data on degree completion in more than 160 individual STEM fields. In consultation with NSF, AIR chose to aggregate data from the many fields into six broad disciplines: agricultural sciences/natural resources, biological/biomedical sciences, computer and information sciences, engineering, mathematics, and physical sciences. By aggregating the data, AIR was able to streamline what would have been a very unwieldy and complicated analysis process. In addition to the convenience of reducing more than 160 STEM fields to 6, the decision was also based on the following considerations:

- The numbers of URMs enrolled in and graduating from the specialized subfields are relatively small. Therefore the data at the subfield level are vulnerable to reporting errors and unstable estimates.
- Different data sources changed their internal classifications of STEM fields over time. For instance, in 2007 the GSS modified its specialized field classifications from previous years. As a result of the modification, STEM departments that once fell within one particular field were reclassified into another. For example, a department that was originally reported as biology in earlier years of the GSS may be separated into biochemistry and biophysics in subsequent years. Given that our analyses were conducted longitudinally, going from 1992 until 2008, this change in categorization schemes would lead to problems in linking specialized field data across years. Aggregating subfields into more general broad fields alleviates this problem. In the given example, biochemistry, biophysics, and biology would be grouped into the major field of biological/biomedical sciences, ensuring continuity of data for the evaluation’s analyses and providing more stable estimates of populations.
- Although the team conducted separate analyses of PhD enrollment and completion data, data from the GSS and SED were linked for PSM. In the SED, the specialized field in which the individual received a degree is self-reported and may not reflect the field label given to his or her degree by the doctorate-granting department responding to the GSS. For example, a student may report his or her PhD field to be atmospheric chemistry in the SED, but his doctorate-granting department could list the discipline as chemistry or atmospheric sciences in the GSS. Aggregating data to the major STEM field of physical sciences made it possible to link the datasets and helped to reduce possible error caused by these discrepancies.

The actual departments/specialized fields that constituted the six broad disciplines varied somewhat within the four cited databases. We therefore had to create a crosswalk between the databases that allowed for the aggregation of multiple fields into the six. The appendix presents the crosswalk between these different data sources, and a listing of specializations that constitute each major field used in this study.

Qualitative Data Collection and Analysis

AIR collected qualitative data through site visits to targeted alliance institutions in order to help provide context for the trends identified and analyzed through the above quantitative methods. The evaluation team met with AGEP program leadership, staff, faculty, and students during these site visits to learn stakeholders' perceptions of the influence of AGEP on recruitment, enrollment, retention, and graduation of URM students in STEM disciplines, as well as URMs' interest in and placement into academic careers. The information gathered at each alliance was also used to determine patterns of AGEP program implementation within and across alliances and individual institutions.

The Data Sources

The evaluation team visited 13 alliances (two of which were visited during the pilot study: North Carolina Opt-Ed Alliance and Michigan Alliance). These alliances were selected to help us obtain an understanding of how AGEP was implemented across several contexts. We hypothesized that the different attributes might affect issues such as program implementation, cooperation between partner institutions, recruitment and retention efforts with URMs, and efforts to institutionalize programmatic supports and cultural change that positively affect the success of URMs in STEM and their movement into the professoriate. The distinguishing attributes used to select the sites included

- Number of partner institutions in an alliance
- Geographic distances between the alliance partners
- Composition of an alliance (i.e., whether the alliance included primarily undergraduate institutions, Minority-Serving Institutions [MSIs])
- Specific populations targeted by an alliance
- Geographic setting of an alliance

Additional factors affected the site-selection process. Independent of this evaluation effort, NSF asked Merrimack Consultants, LLC, to conduct a series of site visits to AGEP institutions. AIR coordinated with NSF and representatives from Merrimack to ensure that site selection for the national evaluation did not overlap with the six sites visited by Merrimack.[4] Finally, NSF expressed particular interest in having the AIR evaluation team visit certain sites, and this request was factored into the site-visit-selection process, as well.

Over the course of 2009 through 2010, the evaluation team visited select institutions from a total of 13 alliances.[5] In addition, focus groups and interviews were conducted with AGEP students at

[4] The Merrimack site visits were designed to obtain perceptions of participants in the AGEP program through semistructured discussions conducted by small groups of external visitors who were not part of NSF but who were well connected with academia and who were committed to the larger goal of broadening participation of URMs in STEM. Merrimack visited the lead institutions in six AGEP Alliances.

[5] Two alliances, the North Carolina OPT-ED and Michigan AGEP Alliance, were also visited in 2007 as a pilot study.

two specialty conferences—the American Indian Science and Engineering Society (AISES) national conference and the Southern Regional Education Board (SREB) conference. Also, a focus group was held with the University of California (UC) AGEP institutions within the Office of the President of the UC system. (See Chapter III for a description of the alliances.)

Two AIR staff members, a lead interviewer and a note taker, participated in each site visit. At each site, the team conducted focus groups of faculty, AGEP graduate and/or undergraduate students, AGEP staff administrators, and staff administrators from related programs (e.g., LSAMP, Ronald McNair Scholars Program). The teams also conducted individual interviews with university administrators, select students, and select AGEP staff administrators. The focus groups and interviews were conducted using protocols the AIR team designed prior to the visits on the basis of findings from the AGEP pilot study and the literature review.

Analytic Approaches to Data

The AIR team conducted a content analysis of the notes from focus groups and interviews conducted at each site visit. Specifically, we identified salient emergent thematic categories from a review of site visit notes from AIR's pilot study of AGEP and from notes taken during the first set of alliance visits as part of the current evaluation (three of the seven alliance visits were conducted in spring 2009; the latter four were conducted in fall 2009 through spring 2010). AIR also reviewed notes provided by Merrimack, LLC, from its visits to the lead campuses of six AGEP alliances.

AGEP Student Survey

Survey data provided other contextual information about AGEP. In fall 2009, AIR administered an online survey, using Vovici software, to STEM graduate students who were enrolled at the time of the survey and who were identified as AGEP participants by AGEP project administrators. The 81-question student survey was informed by the pilot study and the literature review and was designed to provide an understanding of how AGEP activities influenced students' experiences, ranging from the decision to enroll in a PhD program to thoughts about a career after the PhD. The survey was also designed to gather demographic information on these students. Themes that were developed for and that emerged from AIR's pilot study were expanded into mostly closed-ended questions; however, respondents were also given six opportunities to freely compose their answers in open-ended text boxes on topics about AGEP, about their undergraduate experiences, and about their experiences in their current graduate program. The survey contained built-in skip patterns, and most questions required an answer before a respondent could continue to the next question.

We were provided student contact information from AGEP project coordinators at most AGEP institutions. In September 2009, AIR sent a request for student e-mails to these project coordinators, asking that they send a list of names and e-mail addresses for any current graduate students involved in AGEP. With many reminder e-mails and follow-up phone calls, we were able to gather AGEP student names and e-mail addresses from 75% (64 of 85) of the doctorate-granting AGEP institutions. An additional 16% (14 campuses) were unable to send us student names and e-mail addresses because of institutional review board (IRB) restrictions in place on their respective campuses. The AGEP project directors at these campuses agreed to distribute the survey to their AGEP students themselves. Thus, 78 of the 85 doctorate-granting institutions either provided student names and e-mail addresses or agreed to send the survey to students themselves.[6]

AIR administration of the survey. In total, AIR received 3,495 unique student e-mails from 64 AGEP campuses. The initial survey request was sent to students on Friday, November 6, 2009. AGEP project directors at these schools were sent weekly e-mails throughout the course of the survey, reminding them to encourage their AGEP students' participation. These students received reminders every other day (Mondays, Wednesdays, and Fridays) until they responded to the survey or until December 7, 2009, when reminders began to be sent daily (Monday through Friday). Reminders stopped completely on the last day of the survey, Friday, December 18, 2009.

AGEP project director administration of the survey. Because of the IRB restrictions in place on 14 of the AGEP campuses, AIR was not able to administer the survey directly to students via e-mail. Instead, the AGEP project directors on each of these 14 campuses agreed to distribute the survey link to students on AIR's behalf. To administer the survey to these campuses, AIR created a second, "gateway" survey on Vovici that was identical to the original AGEP Student Survey except that, to access the gateway, students had to log in, using a unique identifier. These AGEP project directors were provided with a list of unique log-ins that would grant their students access to the survey prior to the survey start date, which the directors then distributed to every individual AGEP student on their campuses. In total, 896 AGEP students from these 14 campuses received a unique log-in to the student survey.

Because AIR was unable to be in direct contact with students from these schools, the team relied completely on AGEP staff to remind students to complete the survey. AIR sent reminders to the AGEP project directors weekly throughout the course of the survey, asking them to encourage their AGEP students' participation. On the basis of feedback from our contacts at these schools, students were sent between 2 and 7 reminders throughout the course of the survey. At least one of these campuses offered its AGEP students an incentive for participating, a $250 fellowship.

Survey response rate. As discussed above, survey data were collected from 78 of the 85 doctorate-granting AGEP institutions. The following response rates were calculated based on the AGEP student counts (as provided by the institutions) for these 78 institutions. For the AIR-administered survey, 59% of students from responded (1,968 out of 3,332 students), and for the campus-administered surveys, 36% of students responded (321 students of 896 students). Together, 53% of students from the 78 institutions responded to the survey (2,289 of 4,289 students). Initial screening of the data revealed that some respondents needed to be excluded from analysis for one of the following reasons: they were not current students or they were not enrolled in an AGEP school. The final analysis sample is 2,139 students.

[6] For various reasons specific to individual situations (e.g., unresponsive AGEP staff, restructuring of graduate school, very strict IRB regulations) on certain campuses, we did not receive student contact information from 7 of the 85 doctorate-granting AGEP institutions.

Although the intended population for the survey was STEM graduate students, a sizable number of non-STEM students responded to the survey (20% of the analysis sample). These students were primarily in the fields of education, psychology, sociology, public policy, and anthropology; overall, about 150 additional non-STEM fields are represented. These non-STEM students are included in the descriptive analysis because they were identified by AGEP staff as participating and benefitting from their campuses' AGEP programs.

Analysis of survey responses. Findings from the AGEP Student Survey are based on descriptive statistics. Descriptive statistics provide useful information on the types of students who participate in AGEP and the types of activities in which they are involved. Analyses were conducted for the whole student survey population and by groups of students based on

- Race/ethnicity
- Gender
- Immigration status
- Parental education levels
- Participation in particular AGEP alliances
- U.S. region of graduate institution
- Type of undergraduate institution attended
- PhD discipline

Although the majority of the AGEP Student Survey asked students to respond to closed-ended questions with predefined responses, six open-ended questions allowed students to provide more detailed information. Responses to these questions were coded using a bottom-up approach. As a theme emerged in the students' expressions of their experiences, it would receive a code. At times, multiple codes were applied to a response to fully capture a student's experience. Two coders independently coded all responses using the same set of codes as a first stage of quantifying students' written responses and as a test of inter-rater reliability. At this stage, across all six questions, coders matched codes exactly for 67% of respondents who had written comments. The percentage increased to 86% when including respondents for whom coders at least partially agreed on coding. The coders then engaged in a reconciliation process in which every disputed code was reviewed and discussed until codes were agreed on. Responses to these open-ended questions then became a part of the qualitative analysis, providing valuable contextual information.

Chapter III. AGEP Alliances and Institutions

Introduction

From 1998 to 2007, the National Science Foundation (NSF) funded 23 alliances, which included 111 different colleges and universities. The goal of these alliances was to increase the number of underrepresented minority (URM) students who were U.S. citizens or permanent residents obtaining PhDs in science, technology, engineering, and mathematics (STEM) and pursuing academic careers in these disciplines. Alliances were to achieve this goal through recruitment, retention, and career-planning strategies. Although all alliances focused on these three main strategies, implementation varied considerably from one alliance to the next. This chapter profiles the 23 AGEP alliances and their member institutions. A comparison of the universities that offered STEM PhDs but did not receive AGEP funding (non-AGEP institutions) is also provided. The chapter concludes with a discussion of how the alliances were structured and the types of programming and activities they implemented.

AGEP Alliances and Institutions Profile

AGEP alliances are made up of a lead institution and at least one partner institution. The NSF solicitation for AGEP awards stated the following criteria:

> The alliance must consist of two or more doctoral degree granting institutions serving STEM graduate education needs. One of these primary institutions must be designated as the lead institution for the project. Secondary partner institutions (non doctoral degree granting) may participate in an alliance as subawardees. An institution may be a primary member in only one alliance (AGEP Program Solicitation).

Institutions established alliances on the basis of these guidelines and other factors that met their specific needs and mission. For example, some alliances took into consideration the geographical proximity of potential member institutions, preexisting relationships with institutions, and the type of institutions that would support their programmatic goals, such as including a minority-serving institution (MSI). Because of the myriad factors affecting the different alliances' compositions, the resulting group of AGEP alliances was notably diverse in size, programming, and governance. In addition, all alliances had primary partner institutions and some had secondary partners. Primary partners were institutions that were written into the NSF grant and received funding from the grant. Conversely, secondary institutions did not receive any direct funding from the grant but were involved with an alliance through its recruiting and other activities. For example, the Howard–UTEP (University of Texas at El Paso) alliance had only 2 primary partner institutions, but also had 22 secondary partner institutions, which they recruited and partnered with for other AGEP activities. Thus, although the total number of AGEP institution is 111, the AGEP program touched many more institutions, given the inclusion of secondary partner institutions. However, for the purposes of this evaluation, we focused our data collection only on the primary institutions included in the grant since they were the beneficiaries of the funding and responsible for program implementation.

Exhibit 3-1 lists all the AGEP alliances funded since 1998–1999, the first year of the program.[7] The exhibit illustrates the diversity in AGEP alliances in terms of the number of institutions within an alliance and the type of institutions. The number of institutions ranged from as few as 2 institutions to as many as 12 institutions. Most alliances had between 3 and 5 partner institutions. Additionally, the characteristics of the institutions varied within each alliance. According to the Carnegie classification of AGEP institutions, the lead institutions tended to be larger, public, PhD research universities.[8] Most of the lead institutions were public universities (19), and two of the lead institutions were MSIs (1 historically black college and university [HBCU] in the Howard–UTEP alliance and 1 Hispanic-serving institution [HSI] in the University of Puerto Rico Alliance). Also illustrated in Exhibit 3-1 is the fact that AGEP alliances comprised both public and private universities and colleges, with the vast majority being public institutions (85 public and 26 private, not for profit). Similarly, most of the AGEP institutions (85) were research (PhD-granting) universities, with about an equal number of master's (13) and baccalaureate granting (10) institutions. There were also 3 community colleges among the AGEP institutions. The predominance of participating PhD institutions (85) is consistent with the goal of the AGEP program: targeting the enrollment, persistence, and completion of URMs in STEM PhD programs. Nevertheless, the inclusion of non-PhD institutions (of which there were 26) contributed to the pipeline to the PhD.

As ascertained through site visit interviews, baccalaureate-, associate's-, and master's-degree-granting partner institutions typically served as feeder schools from which URM students could be recruited into STEM graduate programs at the PhD-granting partner institutions. Some alliances also included MSIs as partners, although about three-quarters of the AGEP institutions were non-MSIs (25 [23%] MSIs and 86 [77%] non-MSIs). Among the 25 MSIs, there were 16 HBCUs, 8 HSIs, and 1 tribal college and university (TCU). MSIs that did not offer graduate STEM programs (or a PhD in STEM), like other non-PhD-granting institutions, served as sources of URM students who could be recruited into STEM PhD programs.

[7] No alliances were funded in 2001 and in 2005.

[8] The Carnegie Foundation for the Advancement of Teaching defines a PhD-granting university as follows: Includes institutions that award at least 20 doctoral degrees per year (excluding doctoral-level degrees that qualify recipients for entry into professional practice, such as the JD, MD, PharmD, and DPT). Excludes Special Focus Institutions and Tribal Colleges.

Exhibit 3-1. Characteristics of AGEP Alliances

Alliance Lead Institution	Number of Institutions			Number of MSIs			Number of PhD-Granting Institutions
	Total	Public	Private	HBCUs	HSIs	TCUs	
Funded in 1998							
Alabama AGEP University of Alabama, Birmingham	12	7	5	7			4
Facilitating Academic Careers in Engineering and Science (FACES) Georgia Institute of Technology	4	1	3	2			2
Howard–UTEP AGEP Howard University	2	1	1	1	1		2
Michigan AGEP University of Michigan at Ann Arbor	4	4					4
Missouri AGEP (MAGEP) University of Missouri, Columbia	4	4					4
Rice–Houston AGEP Rice University	7	5	2	1	1		2
South East Alliance for Graduate Education and the Professoriate (SEAGEP) University of Florida	3	3					3
University of Puerto Rico AGEP University of Puerto Rico, Mayaguez	2	2			2		1

Exhibit 3-1. Characteristics of AGEP Alliances—continued

Alliance Lead Institution	Number of Institutions			Number of MSIs			Number of PhD Institutions
	Total	Public	Private	HBCUs	HSIs	TCUs	
Funded in 1999							
Minority Access/Graduate Networking in the Sciences, Technology, Engineering and Mathematics (MAGNET-STEM II) City University of New York (CUNY), Graduate Center	4	2	2				4
Mississippi AGEP University of Mississippi	5	4	1	2			4
More Graduate Education at Mountain States Alliance (MGE@MSA) AGEP Arizona State University	6	5	1				6
North Carolina Alliance To Create Opportunity Through Education (OPT-ED) North Carolina State University	4	4		1			3
Northeast Alliance for Graduate Education and the Professoriate (NEAGEP) University of Massachusetts, Amherst	10	8	2				10
State University of New York (SUNY) AGEP SUNY, Stony Brook	4	4					4
University of California AGEP University of California System	9	9					9

Exhibit 3-1. Characteristics of AGEP Alliances—continued

Alliance Lead Institution	Number of Institutions			Number of MSIs			Number of PhD Institutions
	Total	Public	Private	HBCUs	HSIs	TCUs	
Funded in 2000							
Colorado AGEP University of Colorado, Boulder	3	3					3
New Mexico AGEP New Mexico State University	6	5	1		4		4
Funded in 2002							
Central New York–University of Puerto Rico (UPR) AGEP Syracuse University	4	1	3		1		3
Graduate Alliance for Education in Louisiana (GAELA) Tulane University	6	3	3	4			2
Iowa AGEP University of Iowa	3	3					2
PROMISE: Maryland's AGEP University of Maryland, Baltimore County	3	3					3
Funded in 2004							
Midwest Crossroads AGEP Purdue University	4	3	1				4
Funded in 2006							
Student to Academic Professoriate for American Indians (SAPAI) University of Montana	3	2	1			1	2
Total							
23 Alliances	**112**	**86**	**26**	**16**	**9**	**1**	**85**

Note: The Carnegie Foundation for the Advancement of Teaching defines a PhD-granting university as follows: Includes institutions that award at least 20 doctoral degrees per year (excluding doctoral-level degrees that qualify recipients for entry into professional practice, such as the JD, MD, PharmD, and DPT). Excludes Special Focus Institutions and Tribal Colleges. The numbers here reflect this definition. However, this study's analyses includes institutions—specifically, AGEP institutions—that do award doctoral degrees in a STEM field but are not classified as doctorate-granting institutions. These institutions are: Alabama A&M University; Alabama State University; Southern University, Baton Rouge; Texas Southern University; Tuskegee University; University of Northern Iowa; University of Puerto Rico, Mayaquez.

AGEP Alliance Structure

AGEP alliance governance and leadership. Although each of the visited alliances had a lead institution and a principal investigator (PI) who was ultimately responsible for the management of the grant, the person responsible for day-to-day program operation varied across alliances and institutions. In some cases, the PI delegated the responsibility to a project coordinator. For example, Central New York–UPR, GAELA, FACES, Maryland PROMISE, Midwest Crossroads, the Colorado Diversity Initiative, and SEAGEP had AGEP project directors or coordinators who spent between 50% and 100% of their time on AGEP project management. These individuals' positions were sometimes funded solely with AGEP monies, while in other instances, AGEP staff positions were partially supported by AGEP and partially supported by other university funds. PROMISE, SEAGEP, SAPAI, and Midwest Crossroads had AGEP coordinators on each constituent institution's campus, but this was not the case in all alliances. For example, Cornell was the only institution in the Central New York–UPR Alliance with an AGEP coordinator.

Placement of AGEP within the university structure. AGEP projects within the university structure tended to be centralized in the graduate school, graduate studies division, or office of graduate programs. However, on two campuses, Xavier University, of the GAELA Alliance, and Rensselaer Polytechnic Institute (RPI), of the Central New York–UPR Alliance, AGEP was located in a STEM department. Cornell University, of the Central New York–UPR Alliance, housed its AGEP program in a diversity programming office. Also, two campuses, Tulane University, of the GAELA Alliance, and the University of South Carolina, of SEAGEP, ran their AGEP programs out of the provost's office.

Distribution of AGEP funds. The lead institution in all visited alliances subcontracted and/or divided the total grant award among the partner institutions. In the case of each alliance, with the exception of North Carolina OPT-ED, the lead research university received the largest portion of the total grant award, while the partner institutions in the alliance received smaller amounts, which tended to be a point of contention in some alliances. The rationale, in the case of alliances with nonresearch institutions as partners, was that the research universities had doctoral programs and therefore required more money for optimal implementation of program efforts. Similarly, in other alliances, some partner institutions received a lesser portion of the total grant award because they were viewed as "feeder schools" to the research universities in the alliance.

Functioning as an Alliance. NSFs decision in 1998 to fund alliances of institutions rather than individual institutions was made to foster and facilitate cross-institution collaboration and was thought to be a more effective mechanism for achieving the goals of AGEP. Our findings suggest that AGEP increased cross-institution communication and facilitated alliance-wide events in *some* alliances, but in many other cases, cross-campus interaction remained limited to only monthly (or fewer) meetings among AGEP leadership, or was limited to only some of the institutions within the alliance, with others essentially not participating. Nevertheless, even if limited in scope, AGEP leaders generally believed that the interactions that did occur among institutions were or had the potential to be beneficial to them and to the students and faculty.

For example, being part of an alliance helped some campuses with their recruitment of graduate students. Alliance leaders at UC Riverside, for instance, noted that, because the university was part of the UC Alliance, they were in a better position to recruit at some HBCUs in the South. The HBCUs had a history of welcoming high-profile institutions such as UC Berkeley and UCLA, but UC Riverside recruiters felt that, without the alliance imprimatur, they would not have been invited to visit the HBCU campuses.

Some PIs also mentioned that a benefit of the alliance structure was that it allowed them to build relationships with universities that might not have existed were it not for AGEP. For example, the AGEP coordinator at Clemson in the SEAGEP Alliance acknowledged

> It's even difficult to say there would be the Clemson–USC interchange because essentially we're rivals for state support. The Alliance helps us to build a bridge between the campuses and provides a way for us to collaborate and interface more around SC-AMP [South Carolina Alliance for Minority Participation] and developing our relationships with HBCUs.

Similarly, a co-PI in the UC Alliance noted: "Because California is so big, if there was not an alliance . . . we probably wouldn't collaborate as much . . . but we would not be able to do what we do without AGEP funding."

Cross-campus interaction among students was not common across all visited alliances. But, at the alliances where students were engaged in cross-campus activities, respondents noted several benefits to URMs. Students benefitted from the alliance structure through greater access to research opportunities, resources, and collaborations with departments at partner institutions. As noted by respondents from UPR, Mayaguez, a benefit of being part of the Central New York–UPR Alliance was the opportunity students were provided to mingle with students from other campuses and to study at schools in New York. Similarly, FACES participants also mentioned that collaborations with the partner institutions was beneficial to students, especially students from Morehouse and Spelman, who could be introduced to the more resource-rich environment of Georgia Tech through summer research opportunities. The Maryland PROMISE Alliance and the North Carolina OPT-ED Alliance also offered cross-campus activities for students. All activities in the PROMISE alliance were coordinated across the three partner institutions, with the location of activities rotating among the three campuses. Likewise, a shuttle was provided to bring students to and from cross-campus activities, thereby increasing the participation of students and faculty across institutions and creating more of an alliance community. The North Carolina OPT-ED Alliance offered cross-campus mentoring workshops and opportunities for undergraduate students to meet graduate students from other campuses. UNC-Chapel Hill also housed an OPT-ED office that served as the "nerve center" through which cross-campus activities were facilitated.

AGEP Activities

Although all the AGEP alliances were formed with the objectives of increasing URMs' enrollment and completion in STEM doctoral programs and increasing the number of URMs entering academe, the manner in which the alliances—and even the institutions within a single alliance—implemented the AGEP program varied considerably, particularly with respect to student-level activities. Alliances offered a wide range of activities to achieve these goals.

Recruitment of students into AGEP. AGEP activities to recruit and retain URM students, and to encourage them to pursue academic careers in STEM, varied across alliances. However, data gathered from surveyed and interviewed AGEP students revealed numerous activities that were common across multiple alliances. Common recruitment practices across alliances included campus-sponsored recruitment visits, summer research opportunities, staff and faculty travel to conferences of minority-serving associations, and efforts to build relationships with MSIs and minority-serving campus organizations.

In the visited campuses, AGEP students were recruited into the AGEP program in essentially three ways:

1. Students had to submit a separate application specifically for AGEP.

2. Students were targeted, nominated, or recommended by faculty or department staff on the basis of merit, as demonstrated through their general application to the graduate program.

3. All students who were interested in AGEP were eligible for participation. Faculty or staff recommendations were not required; nor was there any application process.

In addition, at some institutions, a combination of these approaches was used. For example, on some campuses there were identified AGEP students who received special benefits, funding, or had certain responsibilities, but all interested students were provided the opportunity to participate in other AGEP activities and services. Typically, campuses within the same alliance recruited students using the same or a very similar process, but this was not uniformly the case. Institutions from 6 of the 13 Alliances in the sample (Central New York–UPR, FACES, GAELA, PROMISE, SEAGEP, and UC Alliance) varied in their approaches.

AGEP retention activities. Retention activities tended to be academic, social, and financial, and included dissertation- and thesis-writing workshops; systems to track student progress and implement necessary interventions; and regular seminars, lectures, workshops, and panels on how to succeed in graduate school. One of the primary activities of the SAPAI Alliance (an alliance that targets Native American students) was a 6-week writing retreat to assist with thesis and dissertation completion. Students received guidance on their writing process, received feedback from instructors and peers, and ideally completed a draft of the thesis or dissertation. These seminars, lectures, workshops, and panels served not only to support their academic success, but also served as an important social support mechanism for URM students.

In addition to these formal activities, school supported students socially through mentoring relationships with faculty, AGEP staff, and peers. These were frequently reported retention mechanisms. The Midwest Crossroads Alliance, for example, has an emissary program in which more advanced graduate students serve as “go-to” people for incoming graduate students to help get them acquainted with the university and their departments. Also, the building of a community through AGEP activities was often mentioned as a social support that AGEP students and other stakeholders credited with URM student retention and persistence in graduate programs.

Financial supports also emerged as an important retention strategy. Although not an AGEP activity per se, financial support provided to AGEP students influenced their persistence in graduate study. Financial supports included supplemental funding to buy AGEP students out of teaching assistantships; stop-gap funding; assistance with the purchase of lab equipment; and in special situations, financial assistance for medical needs and housing. In some rare cases, AGEP students also received fellowships to cover the costs of tuition and fees. Finally, all AGEP programs funded students' travel to and participation in national conferences.

Most alliances also offered professional development workshops aimed at helping students choose careers in STEM and giving them the tools to successfully apply for postdoctoral appointments and jobs, such as preparation of a *curriculum vitae*, statement of interests, and practice for job talks. Multiple alliances had activities designed to prepare students for faculty positions (e.g., Howard–UTEP Alliance, Midwest Crossroads Alliance, and SEAGEP), and the SAPAI Alliance took professional development a step further by facilitating job placement in a TCU on completion of the graduate degree.

Chapter IV. AGEP Student Profile

Who counted as an AGEP student? This was a conundrum well known to the AGEP community. As indicated in the above discussion on the AGEP student recruitment and selection process, there was no uniform definition of what constitutes an AGEP student. Rather, the various campuses taking part in AGEP had elastic definitions of the term, with criteria largely shaped by the contours of an individual AGEP project. On campuses where project activities included an undergraduate component, the AGEP-student category may have included undergraduates, some of whom were enrolled full time at the sponsoring campuses and others of whom were visiting from other campuses to take courses or conduct research. In addition, some campuses limited AGEP students to a fixed number of graduate students who had gone through specific selection criteria, while other campuses deliberately invited a wide range of students to AGEP-sponsored activities and counted every student who attended any of these as a member of the AGEP community. In these latter instances, most—but not necessarily all—students were URMs.

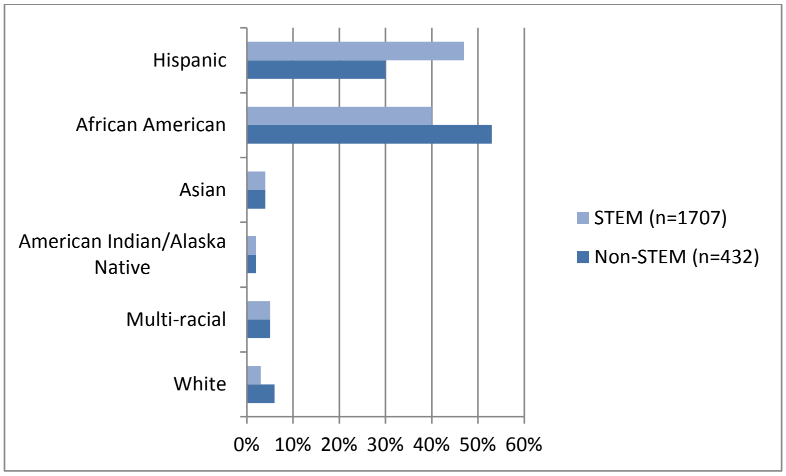
Campuses' definitions of AGEP students even changed internally at times. Through site visits, we learned that some campuses made a distinction between more active and more occasional participants. On other campuses, however, every student who had ever taken part in an AGEP activity was considered part of the institutions' AGEP family or network, including STEM, non-STEM, international, URM, and non-URM students.

For the purposes of the AGEP Student Survey, we asked AGEP administrators to identify all graduate students on campus whom they considered AGEP students, and we targeted these students for the data collection (although we chose not to include undergraduates in the survey even if the institution included them in AGEP activities). Thus, our data include responses from AGEP students who may not fit NSF's definition target population, such as non-U.S. citizens, non-STEM students, and non-URMs. Since the focus of the AGEP program is URMs in STEM, we report the survey results presented in subsequent chapters by STEM and non-STEM and by race/ethnicity, as appropriate. In this section, we provide results from the survey related to students' fields of study, race/ethnicity, gender, and work status, as well as background information about their parents. As with the institutional profile provided in Chapter II, these data provide important contextual information about the AGEP program and the universe of AGEP students.

Racial/Ethnic Background

The plurality of student respondents who were enrolled in a STEM graduate program were Hispanic (47%), followed by African American (40%). The percentage of students who were American Indian/Alaska Native, Asian, Multiracial, and White all equaled less than 10%, respectively. Of the 20% of students who were enrolled in a non-STEM graduate program, over half were African American (53%), followed by Hispanic (30%). See Exhibit 4-1.

Exhibit 4-1. AGEP Students by Race/Ethnicity



Source: AGEP Student Survey

Fields of Study

Across all racial and ethnic groups, almost one third of the STEM students surveyed were enrolled in biological/biomedical sciences and one third in engineering. About 20% of students were in the physical sciences, 8% in computer and information sciences, 7% in mathematics, and 1% in agricultural sciences/natural resources. In addition, about 7% of students were in a multidisciplinary STEM program, and 20% were in a non-STEM program. Some of the more common non-STEM fields were anthropology, education, psychology, public policy, and sociology. Exhibit 4-2 presents data on the STEM discipline in which STEM students of different demographic backgrounds were enrolled. Since AGEP's focus is primarily on STEM students, the non-STEM student respondents are not included in this exhibit.

Exhibit 4-2. AGEP Students By Discipline and Race/Ethnicity

		American Indian/ Alaska Native	Asian	African American	Hispanic	White	Multiracial	Other
Engineering	*n*	4	26	239	192	13	23	0
	%	1	5	48	39	3	5	0
Physical Sciences	*n*	11	8	118	179	4	18	4
	%	3	2	35	52	1	5	1
Computer and information sciences	*n*	1	26	58	29	10	7	0
	%	1	20	44	22	8	5	0
Mathematics	*n*	1	2	48	65	2	3	0
	%		2	40	54	2	3	

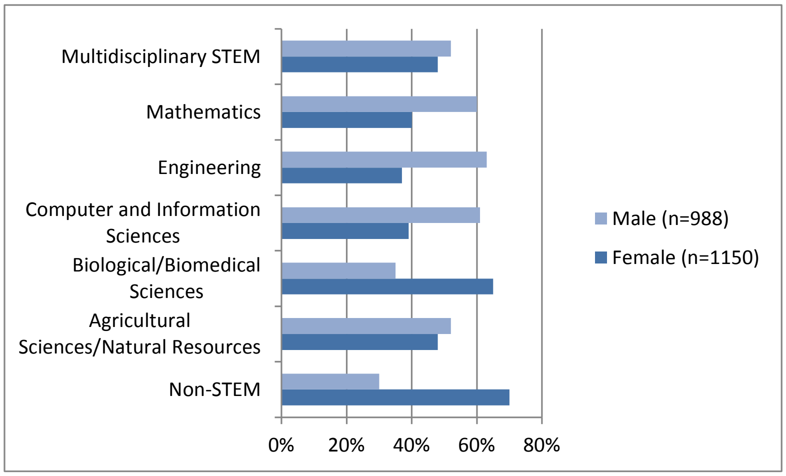
Agricultural sciences/natural resources	*n*	2	0	12	7	1	1	0
	%	9	0	52	30	4	4	0
Biological/ biomedical sciences	*n*	7	7	147	269	11	25	1
	%	2	2	32	58	2	5	0.5
Multidisciplinary–STEM	*n*	2	4	58	54	3	4	1
	%	2	3	46	43	2	3	1
Total	*n*	28	73	680	795	44	81	6
	%	2	4	40	47	3	5	0.5

Source: AGEP Student Survey

Gender and Discipline

The surveyed population was split almost evenly between the males and females in STEM graduate programs, with about 50% of the population female and about 50% male. However, for the 20% of the surveyed population who were earning degrees in non-STEM fields, 70% were female and 30% were male. In many instances, there were interesting relationships between the fields in which students studied and their gender. A larger percentage of women were in biological/biomedical sciences and in non-STEM programs (65% and 70%, respectively), while a larger percentage of men were in engineering (63%), mathematics (60%), and computer and information sciences (61%) programs. Exhibit 4-3 shows the distribution of surveyed students by discipline and gender.

Exhibit 4-3. AGEP Students By Discipline and Gender



Source: AGEP Student Survey

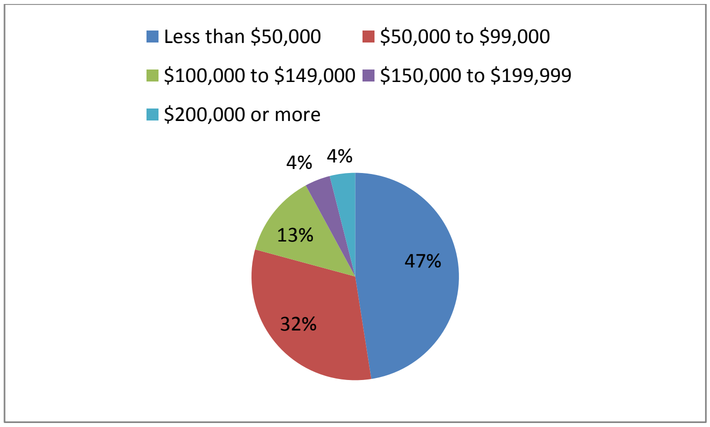
Work Status

Most surveyed students, STEM and non-STEM (75%), were working[9] while they were in graduate school. Of the students who were working, 64% were working full time. Seventy-seven percent of all working students were working on campus. An additional 4% of students were working both on and off campus. Twenty-eight percent of students had been employed in their current jobs for less than 1 year, and 13% of students had been employed in their current jobs for more than 5 years. The majority of students were conducting research in their jobs (48% in lab research, 13% in non-lab research), and more than one third of students (37%) were teaching. The remaining students (22%) had jobs that did not involve research or teaching.[10] Most students (84%) were working in a STEM field. Of the students who were not currently working, 31% indicated that they were looking for work, and one-quarter indicated that while in their current academic program they had been employed in the past, and that that employment had predominantly been in a STEM field.

Parental Education and Income

The total survey population (STEM and non-STEM) included a cross-section of socioeconomic and parental education levels. Twenty-one percent of surveyed students were first-generation college-goers, with neither parent having attended any college. Forty-six percent of students came from families whose combined parental income was under $50,000 (for just STEM students, the percentage is 48%). However, one-third of students (33%) had at least one parent who had graduated from a graduate or professional school, and 22% of students were from families whose parents' combined income was over $100,000. (For just STEM students, the percentage was 21%.) Exhibit 4-4 shows the distribution of surveyed students by combined parental income for STEM students.

Exhibit 4-4. Parental Income Level Among STEM Students



[9] Students who held graduate assistantships are included in this count.

[10] Percentages do not add up to 100% because some students had more than one job of different types.

Source: AGEP Student Survey (n=1291)
Note: Data were missing for 416 STEM survey respondents.

Familial and Personal Immigration Status

Nearly one fourth (24%) of the surveyed population was born outside the United States and Puerto Rico, and17% attended high school and 9% attended an undergraduate institution outside the United States and Puerto Rico.

Although 24% were born outside the U.S., most AGEP students surveyed were U.S. citizens (89%). This suggests that many of the students born outside the United States either were the children of Americans abroad or acquired U.S. citizenship at a later point in life. The remaining students were evenly split between having permanent residency or another status. The sample of survey respondents included 116 students (5% of the total) who were neither U.S. citizens nor permanent residents. Two thirds of these students were born in Southeast Asia (35%), South America (19%), or East Asia (12%).

In examining the composition of students majoring in specific STEM fields by students' place of birth, agricultural sciences/natural resources, computer and information sciences, engineering, and mathematics had higher proportions of students who were born outside the United States, ranging from 24% to 36% within a given field. By contrast, multidisciplinary STEM studies, non-STEM fields, and physical sciences had the lowest percentages of students born outside the United States, ranging from 10% to 16% within a field. Exhibit 4-5 presents the world regions where these students born outside the U.S. completed their undergraduate degrees.

Exhibit 4-5. World Regions Outside the U.S. Where Undergraduate Degree Completed

World Region (Outside U.S.)	STEM		Non-STEM	
	n	%	*n*	%
South America	37	23	10	28
West and Southern Africa	26	16	7	20
Central American and Spanish Caribbean	15	9	n/a	n/a
Mexico	8	5	2	6
Southeast Asia	43	27	1	3
French and English Caribbean	3	2	n/a	n/a
Western and Eastern Europe	9	6	2	6
Middle East and North Africa	10	6	4	11
East Asia	9	6	6	17
Canada	n/a	n/a	3	9

Exhibit 4-5. World Regions Outside the U.S. Where Undergraduate Degree Completed

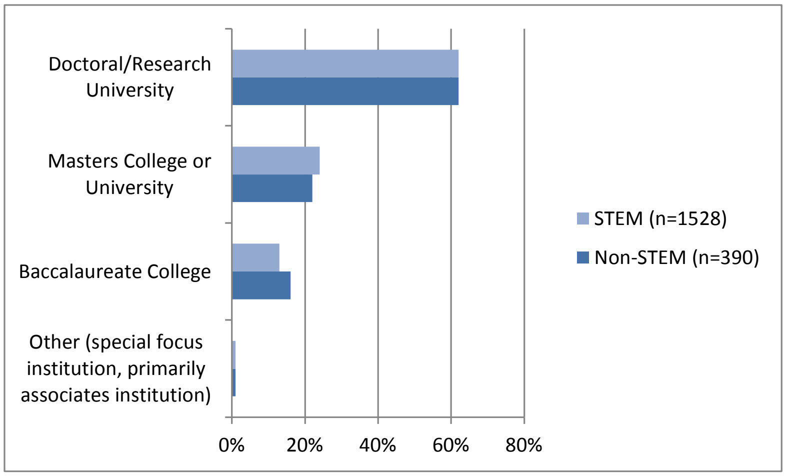
World Region (Outside U.S.)	STEM		Non-STEM	
	n	%	*n*	%

Source: AGEP Student Survey

Undergraduate Education

By Carnegie classification, the majority of our surveyed AGEP students (more than 60%), STEM and non-STEM, received their undergraduate degrees from research universities. This finding may suggest that at least some of the AGEP students may have had exposure to graduate education and research before enrolling in their graduate programs. Exhibit 4-6 shows the distribution of surveyed students' by Carnegie classification of their undergraduate institution.

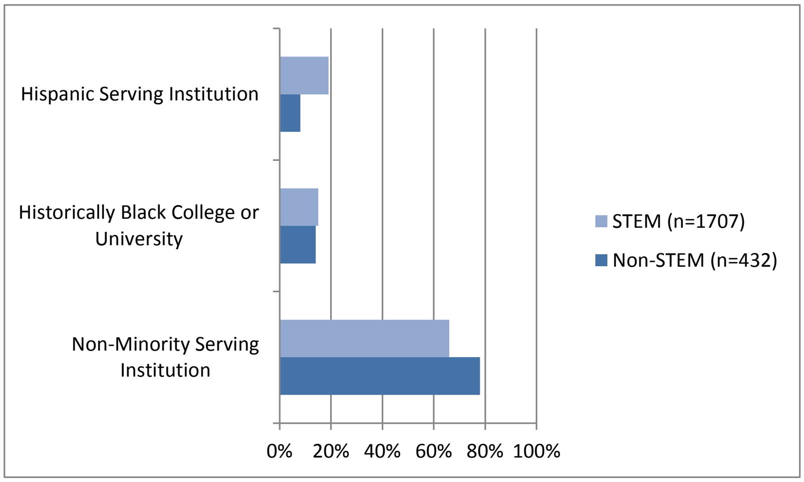
Exhibit 4-6. Carnegie Classification of Undergraduate Institution



Source: AGEP Student Survey

About 30% of surveyed students attended MSIs as undergraduates. All these students went to either an HSI or HBCU. No surveyed student went to a TCU as an undergraduate. Exhibit 4-7 shows the distribution of surveyed students who attended MSIs as undergraduates.

Exhibit 4-7. Undergraduate Education, by MSI Classification



Source: AGEP Student Survey

Summary

AGEP institutions were largely public research institutions that granted PhDs in STEM. It is important to note that alliances also strategically included a significant number of non-PhD-granting and minority-serving institutions as primary and secondary partners in order to address the goal of increasing the number of URMs earning PhDs in STEM and pursuing academic careers. Non-AGEP PhD institutions were primarily private research institutions and had fewer MSIs among them. This noteworthy difference has important implications for the trends in enrollment and completion observed among AGEP and non-AGEP institutions. Because AGEP institutions tended to include more MSIs, their greater URM enrollment should be interpreted with some caution. However, by and large, MSIs are not doctorate-granting institutions; so the overrepresentation of MSIs in AGEP institutions is not likely to affect URM completion findings.

The structure and implementation of alliances varied considerably. Some alliances were able to take advantage of the alliance structure to build stronger relationships between partner institutions and to facilitate cross-campus interactions, while others had only limited opportunities for cross-institution collaboration. Factors such as geographical distance, lack of prior existing relationships, and unequal distribution of grant funds among partner institutions were noted as reasons for the degree to which alliances operated as alliances, as parallel institutions, or even fairly autonomously from one another. These findings have implications for future NSF solicitations for AGEP regarding forming and structuring alliances and implementing AGEP activities.

In addition, as the foregoing discussion indicates, AGEP graduate students are a diverse group. The breadth of the AGEP student population is arguably a testament to how thorough individual alliances have been in reaching out to students in need of support for their graduate studies. The ramifications of these broad differences, for AGEP project elements are discussed in Chapters V, VI, and VII, where responses to the student survey are analyzed in relationship to different demographic groupings of the AGEP students, and by institutional type. Chapter VIII focuses on whether certain differences in student backgrounds and alliance and institutional characteristics raise policy questions for the AGEP program overall.

Chapter V. URM Graduate Enrollment

Historical data indicate that individuals enrolling in science, technology, engineering, and math (STEM) fields have been predominantly (almost 70%) White, non-Hispanic males (Congressional Commission on the Advancement of Women and Minorities in Science, Engineering and Technology Development [CCAWMSETD], 2000). This trend persists, even as underrepresented minorities (URMs) are becoming an increasing share of the U.S. population. Noting forthcoming changes in the demographic breakdown of the United States, the U.S. Census Bureau projects that the number of White, non-Hispanic 18- to 24-year-olds will decrease by 10.5% between 2010 and 2025; however, because of higher birthrates and immigration, the Hispanic population will increase by 59.4% during this period (U.S. Census Bureau, Population Division, 2008a). The Asian population is also projected to increase by 39.0%.[11] These demographic changes raise challenges and have implications for the labor and faculty supply in STEM: If the nation does not actively recruit URMs into STEM fields, the country may face shortages in the STEM workforce (George et. al, 2001).

In this chapter, we explore the trends in enrollment for URMs and non-URMs nationwide and in Alliances for Graduate Education and the Professoriate (AGEP) and non-AGEP institutions in STEM, using data from the Survey of Graduate Students and Postdoctorates in Science and Engineering (Graduate Student Survey or GSS) . The trends analyses specifically address the study's first set of research questions:

- Between 1990 and 2007, what were the national trends at non-AGEP and AGEP institutions in the enrollment of URMs in STEM doctoral programs?
- How did trends in enrollment at AGEP institutions compare to the trends at similar non-AGEP institutions?

This chapter also presents findings related to enrollment from an analysis of the data collected through the AGEP Student Survey and the analysis of data collected through site visits to 13 AGEP alliances. Together these data help contextualize the trend analysis and provide an appreciation of the situational nuances of individual alliances, campuses, and persons who were taking part in AGEP.

Key Findings

- Despite the steady increase in overall URM STEM enrollment nationally, there remain far fewer URMs enrolling in STEM graduate programs than are represented in the national population. The trends also vary considerably by discipline and by students' race/ethnicity. Most notable in the AGEP institutions are the increased enrollment trends

[11] Current U.S. Census Bureau estimates project that the number of Black 18- to 24-year-olds will decrease slightly, by 3.4%, whereas American Indians/Alaska Natives will increase slightly, by 3.3%, between 2010 and 2025.

for the biological/biomedical sciences, computer and information sciences, and engineering, as well as for Hispanics.

- Students' decisions to pursue graduate education in STEM were most influenced by advice from and recommendations by undergraduate advisors and faculty. Other factors affecting students' decisions included the reputation of the institution or program, availability of financial support and social support for URMs on campus, research opportunities, and location.
- Overall, AGEP leadership indicated that the grant has enhanced institutions' efforts to recruit URMs into STEM graduate programs. Common recruitment practices across the visited sites included campus-sponsored recruitment visits, summer research opportunities, staff and faculty travel to conferences of minority-serving associations, and efforts to build relationships with minority-serving institutions (MSIs) and minority-serving campus organizations. Although member institutions of AGEP alliances typically operated in silos regarding their recruitment efforts, AGEP has facilitated some cross-campus coordination and facilitated innovative strategies in some institutions.
- Alliances and institutions encountered both successes and challenges in their recruitment efforts. Reported successes included increased URM enrollments in specific disciplines and a change in campus culture to one that was more supportive and welcoming of diverse students into STEM programs. Challenges included the limited pool of students that universities were drawing from and competition with industry or other institutions.

URM Enrollment in STEM

For this evaluation, *enrollment* is defined as graduate enrollment in any one of six broad STEM disciplines, where at least one department within the broad discipline reported offering a PhD at least 1 year from 1992 to 2007. As indicated in Chapter II, these disciplines are agricultural sciences/natural resources, biological/biomedical sciences, computer and information sciences, engineering, mathematics, and physical sciences. It is important to note that this definition of enrollment also includes students enrolled in STEM masters' programs if a PhD is offered in their discipline at their institution; thus, the data do not represent enrollment of PhD students only.

The first AGEP alliances were funded in 1998, so the findings below provide data for a prefunding period of 5 years (1992–1997) and an AGEP-funding period of 9 years (1998–2007).

National Trends

Nationally, the trends in URM enrollment in graduate-level STEM programs allow for cautious optimism. Exhibit 5-1 present the percent change in student enrollment for both URMs and non-URMs in STEM from the years 1992 to 1997 and 1998 to 2007 (the years prior to AGEP and the AGEP funding years, respectively). Graduate URM STEM enrollment increased steadily during both periods of time, with the percent change nearly doubling during the AGEP funding period. Over the same period, non-URM graduate STEM enrollment did not experience the same continuous increase. Indeed, non-URM enrollment declined from 1992 through 1997, however, from 1998-2007, the non-URM enrollment recovered to just above the 1992 level.

Exhibit 5-1. URM and non-URM Enrollment in STEM, 1992-2007

URM Enrollment in STEM					
1992	**1997**	**% Change**	**1998**	**2007**	**% Change**
11,092	13,816	25	13,919	20,559	48
Non-URM Enrollment in STEM					
1992	**1997**	**% Change**	**1998**	**2007**	**% Change**
161,674	147,210	-9	143,885	162,640	13

Source: NSF-NIH Survey of Graduate Students and Postdoctorates in Science and Engineering

Although the steady increase in URM participation in STEM graduate programs since 1992 is a positive development, in comparison with the overall U.S. population, far fewer URMs were enrolling in STEM graduate programs than were represented in the national population. Exhibit 5-2 illustrates the URM enrollment in STEM in 1992, 1998, and 2007 compared with the total URM representation in the United States for the same years.

Exhibit 5-2. Percent URM of STEM Graduate Enrollment and of U.S. Population, 1992, 1998, 2007

	1992	1998	2007
Estimated U.S. Resident Population	22.1	24.0	28.1
STEM Graduate Enrollment	6.4	8.8	11.2

Source: US Census Bureau, Population Estimates Program

Enrollment Trends in AGEP and Non-AGEP Institutions

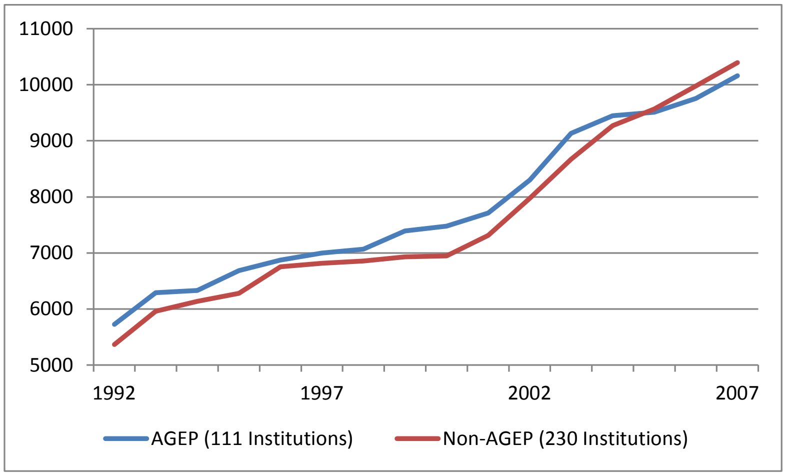
AGEP versus non-AGEP enrollment trends must be interpreted with caution, especially when the trends are examined at the institution level, for the following reasons:

- There were proportionally more AGEP institutions than non-AGEP institutions that were HBCUs and HSIs: Ten (9%) of the 111 AGEP institutions were HBCUs, and 6 (5%) were HSIs, as compared with 8 (3%) and 9 (4%), respectively, among the 230 non-AGEP institutions.
- Prior to AGEP funding, between 1992 and 1998, the average number of URMs enrolled per AGEP institution in 1992 was about twice that per non-AGEP institution.
- AGEP institutions were larger and enrolled more URMs in graduate programs (the average number of URMs enrolled per AGEP institution in 1992 was about twice that per non-AGEP institution). As a result, even if the rate of increase in enrollment stayed the same for both AGEP and non-AGEP institutions over time, the actual number of students enrolling would be greater for AGEP institutions.

Keeping these factors in mind, the data demonstrate that the 111 AGEP institutions that offered a doctoral degree in at least one of the six STEM fields consistently accounted for about half the URM graduate enrollment between 1992 and 2007. The 230 non-AGEP institutions accounted for the other half.

In 1992, the 111 institutions that received an AGEP grant during the AGEP-funding years (1998–2007) had a total URM STEM graduate enrollment of 5,725 students. In the same year, the 230 institutions that never received AGEP funding had a total URM STEM graduate enrollment of 5,367. By 2007, 111 AGEP institutions enrolled a total of 10,161 URM STEM graduate students and the 230 non-AGEP institutions enrolled a total of 10,398 students. As these data demonstrate, between 1992 and 2007, the average increase in URM STEM graduate enrollment for AGEP institutions was 288 students a year. In contrast, in non-AGEP institutions, the average increase was 313 students per year (see Exhibit 5-3).

Exhibit 5-3. URM STEM Enrollment: AGEP and Non-AGEP Institutions, 1992–2007

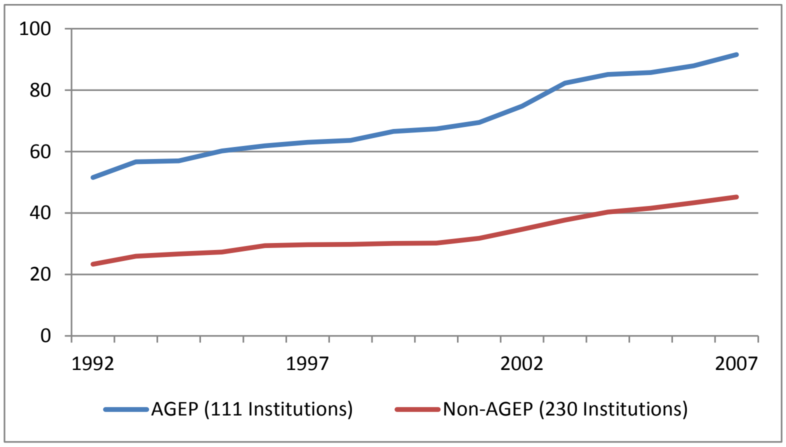


Source: NSF–NIH Survey of Graduate Students and Postdoctorates in Science and Engineering

Although the average enrollment increase at AGEP institutions was less than at non-AGEP institutions when the data are aggregated, when the data are reviewed on a per-institution basis,[12] the enrollment trends slightly favor AGEP campuses. In 1992, an institution that was funded during the AGEP-funding period, on average, enrolled about 52 URM STEM graduate students, whereas a non-AGEP institution enrolled about 23 students. By 2007, the figures were 92 and 45, respectively (see Exhibit 4-4). However, as discussed above, these results must be interpreted with caution, given the inherent differences between the AGEP and non-AGEP institutions.

[12] *Per institution* in our discussion of enrollment means the total number of URM graduate enrollment numbers divided by the total number of institutions. This calculation was done to correct for the unequal number of AGEP to non-AGEP schools. On average, AGEP institutions were larger, include more MSIs, and were enrolling more URM graduate students in STEM prior to AGEP funding.

Exhibit 5-4. Average URM STEM Enrollment per Institution, AGEP and Non-AGEP, 1992–2007



Source: NSF–NIH Survey of Graduate Students and Postdoctorates in Science and Engineering

URM Enrollment Trends, by Discipline and Race/Ethnicity

As presented in Exhibit 5-5 below, AGEP and non-AGEP institutions experienced a yearly increase in overall URM graduate STEM enrollment in most of the six broad disciplines included in this study, and these increases were larger in the AGEP-funding years (1998 and after). However, the variation in the trends across disciplines merit further exploration:

- The URM graduate enrollment trend in mathematics illustrates a situation favoring AGEP. The total URM enrollments in AGEP and non-AGEP institutions were similar in the years before 1998, but the URM enrollment figures diverged from 1998 onward, favoring AGEP institutions. Enrollments in mathematics at non-AGEP institutions decreased.
- The reverse is true for the agricultural sciences/natural resources discipline. Non-AGEP institutions experienced an increase in enrollment in this discipline in and after 1998, while AGEP institutions' enrollment in this discipline decreased.
- Although both sets of institutions experienced enrollment gains in and after 1998 in the computer and information sciences and the biological/biomedical sciences, non-AGEP institutions experienced larger enrollments in both the prefunding and AGEP-funding years. Indeed, the gap appears to have been widening in the biological/biomedical sciences in 1998 and afterward, in favor of non-AGEP institutions. However, AGEP institutions experienced a greater percent change.

Exhibit 5-5. Average Yearly Increase of URMs Enrolled in STEM, by Discipline, 1992-2007

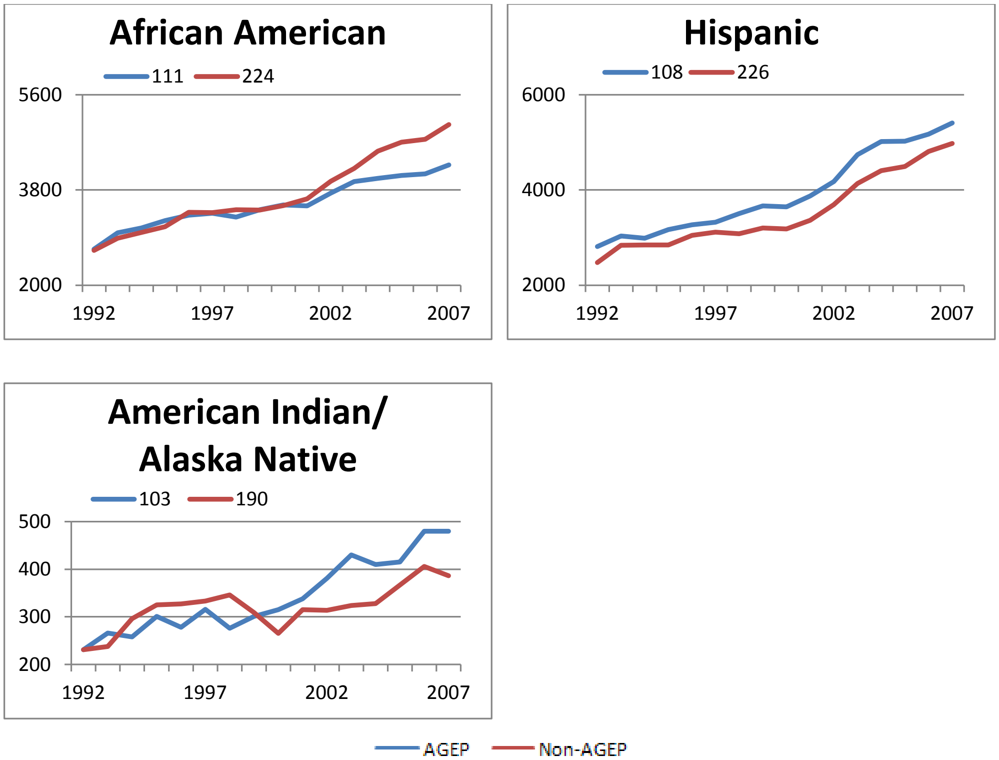
Discipline	AGEP			Non-AGEP		
	Pre-funding years	AGEP-funding years	% change	Pre-funding years	AGEP-funding years	% change
Agricultural sciences/natural resources	25	18	-28	6	10	66
Biological/biomedical sciences	66	102	55	132	184	40
Computer and information sciences	9	45	400	27	68	152
Engineering	90	128	42	90	136	51
Mathematics	3	20	566	9	6	-33
Physical sciences	49	54	10	15	36	140

Source: NSF–NIH Survey of Graduate Students and Postdoctorates in Science and Engineering

The data presented in Exhibit 5-6 demonstrate largely positive trends across AGEP and non-AGEP institutions from 1992 to 2007 with respect to race/ethnicity. However, while the enrollment gaps widened in favor of AGEP institutions for Hispanic[13] and American Indian/Alaska Native students, the opposite was true for African American enrollments.

[13] There are two Puerto Rican institutions offering PhD degrees in STEM disciplines that are part of AGEP alliances. These institutions represent a distinctive experience for Hispanic students. Because Hispanics constitute a majority in Puerto Rico, both in the individual universities and in the culture at large, the experiences of Hispanic students within Puerto Rican universities is arguably different from that of Hispanic students on the U.S. mainland, where Hispanic students are culturally a minority. We therefore analyzed whether enrollment trends at Puerto Rican institutions in some way skewed the analysis of enrollment trends in the rest of the United States. Our analyses demonstrated that the Hispanic enrollment trend in AGEP institutions was not positively skewed by including the Puerto Rican institutions. Instead, including these two institutions dampened the difference in the average increase in enrollment per year between the pre- and AGEP-funding period.

Exhibit 5-6. URM STEM Enrollment in AGEP and non-AGEP institutions, by Race and Ethnicity, 1992–2007



Source: NSF–NIH Survey of Graduate Students and Postdoctorates in Science and Engineering
Note: The *n*-counts vary from the 111 AGEP institutions and 230 non-AGEP institutions, since not all institutions enrolled African American, Hispanic, and American Indian/Alaska Native students in STEM graduate programs.

Analysis From Similar Institutions

Additional analyses, matching AGEP institutions to comparable non-AGEP institutions, explore the relationship between receiving an AGEP grant and enrollment of URMs in STEM graduate programs. Specifically, we examined whether AGEP institutions' rate of graduate enrollment in the AGEP-funding years increased more than that of comparable non-AGEP institutions.[14]

[14] For the matched analysis, enrollment is defined the same way as for the above-presented analyses, thus including students who were enrolled in either the doctoral or masters' programs. Matched variables include, for example, broad STEM department, number of students enrolled, and number of graduates. See the appendix for a detailed description of the matching process.

As Exhibit 5-7 illustrates, the results of the matched analysis failed to show statistically significant improvement in the average yearly increase between the prefunding and AGEP-funding period in AGEP institutions when matched to non-AGEP institutions. However, the enrollment of Hispanic students and URMs, as a group, in computer sciences, and of African Americans and URMs, as a group, in mathematics suggest some evidence of AGEP's potential influence.

Exhibit 5-7. Relationship Between AGEP Program and URM Graduate Enrollment in STEM per Discipline, 1992–2007

	URMs	Hispanics	African Americans
Biological/Biomedical Sciences	+	+	-
Engineering	-	-	-
Physical Sciences	+	+	-
Computer and Information Sciences	+*	+*	+
Mathematics	+*	+	+*

Source: NSF–NIH Survey of Graduate Students and Postdoctorates in Science and Engineering
Plus sign (+) = AGEP had a greater increase.
Minus sign (-) = non-AGEP had a greater increase.
*Statistically significant at 0.05 level, but not significant after adjusting for multiple comparisons of 10 tests.

The changes in enrollment presented in this chapter may be the result of many factors. These factors may include a decline in the economy, which may make graduate school seem more attractive to some than the pursuit of a job. Individual academic institutions may introduce new programs that attract a new student population, or the federal government or the institutions themselves may make more funding available for fellowships. Determining possible influences on enrollment is beyond the scope of this study. However, in the next section, we look at factors that influence students' decisions about attending graduate school and the influence of AGEP-sponsored recruitment practices on these decisions.

Factors Affecting Students' Enrollment Decisions

During focus groups and interviews, students identified the factors that affected their decisions to attend their current institution. AGEP Student Survey data were also analyzed in an effort to gain a better understanding of why students selected particular institutions. As stated earlier, because the Student Survey population included both STEM and non-STEM respondents, we have elected to report the results accordingly.

The majority of students (74% of STEM and 73% of non-STEM) who completed the AGEP Student Survey reported that faculty recommendations and the advice of others who are knowledgeable about graduate school most influenced where they decided to apply (see Exhibit 4-8). Sponsored research events by clubs and organizations on their undergraduate campus had the least reported influence on students (7% and 2% of STEM and non-STEM students, respectively).

Exhibit 4-8. Factors Affecting Students' Decisions To Apply to Graduate School

Factors	Percent of Respondents	
	STEM (*n* = 1707)	Non-STEM (*n* = 432)
Advice from faculty or other people with knowledge about graduate school	74	73
Resources provided by undergraduate department	20	13
Graduate school fair	13	8
Visit from graduate program representatives	12	6
Sponsored events by clubs and organizations on undergraduate campus	7	2

Source: AGEP Student Survey

These data may have important implications for the AGEP program. AGEP focuses primarily on encouragement and support for URMs at the graduate level, but these student responses suggest that they are influenced most heavily by the one-on-one faculty and advisor relationships formed at the undergraduate level, at least in terms of making the decision to pursue an advanced degree, and at which institution(s) to apply.

Institution and program reputation. Students interviewed during case study visits also identified an institution's prestige, program reputation, and qualifications of faculty as factors affecting their application and enrollment decisions. Students wanted to be assured of research opportunities that would challenge and stimulate them in areas and fields that aligned with their primary interests. Like the survey respondents, students interviewed during site visits reported that they often relied on the advice of their undergraduate advisors, faculty, or other people knowledgeable about graduate school to help them identify such institutions.

Welcoming environment for URMs. In addition to having high-quality environments and opportunities available to them, students also indicated the importance of carrying out their work and studies in a friendly and supportive environment. In speaking of the existence of AGEP on campus, one interviewed student explained why he selected his current institution: "I was interested in going to a school that had a community and would support students of color." Another focus group participant remarked that her decision to attend her particular university was influenced by the number of programs available to help "Native Americans with the unique problems we face." Others mentioned the importance of entering a program where there was diversity and where URM graduation rates were high.

Positive faculty relationships. Beyond program diversity and supports for URMs, interviewed students also indicated the importance of positive faculty–student relations and, related to this, having the opportunity to meet and establish relationships with faculty prior to entering the program. As one student remarked, "The weekend where they fly you out, that really made the decision for me. Meeting the faculty and students had a big impact on my decision."

> *"The weekend where they fly you out, that really made the decision for* me. Meeting the faculty *and students had a big impact on my decision."*
>
> —Graduate Student

Early research opportunities. Students were also attracted to institutions that offered summer research opportunities for either undergraduates or first-year graduates prior to their first semester. Interviewed students who had participated in such activities highlighted them as another factor that affected their decisions. The opportunity to conduct research and "get a jump" on their graduate work was perceived as a major benefit. In addition, these research opportunities provided students with an occasion to interact with faculty and gain a sense of the campus culture and the culture of their specific program area, which, as discussed above, were both factors affecting students' application and enrollment decisions.

Funding. Funding was another important factor influencing students' decisions according to site-visit data. Whether through AGEP or other scholarships and funding sources, the amount of money students were offered to cover their academic studies and outside living expenses frequently determined not only what school they would attend, but whether graduate studies would be an option for them at all.

AGEP and Enhanced Recruitment Efforts

As some of the student commentary suggests, changes in enrollment of URMs may in part be a function of enhanced recruitment efforts on AGEP campuses. AGEP leadership from several of the institutions we visited indicated that recruitment activities targeting increased URM participation in graduate STEM programs began "in tandem" with AGEP. Indeed, the emphasis on recruitment was identified as one of the greatest benefits to a campus from receiving an AGEP grant. Although the recruitment strategies varied somewhat across institutions and across alliances, typically, AGEP was providing the funding and resources to expand institutions' outreach efforts. As one AGEP PI stated, "AGEP stimulated, renewed and revitalized attention to recruitment such as expanding the pipeline instead of cultivating the handful of students already in the pipeline."

The data suggest that alliance institutions may especially have benefited from AGEP with regard to outreach and recruitment of URMs when they (a) did not previously have strong connections with MSIs, (b) were not MSIs themselves, or (c) were not located in racially and ethnically diverse communities. Administrators from non-MSIs suggested that AGEP helped change the culture and perceptions on their campuses around issues of diversity. The grant raised the profile of the URM recruitment issue with university administrators and communicated to them that this issue was of national concern. AGEP funds gave NSF's imprimatur to the importance of increasing URM involvement in STEM programs on campus and provided the impetus for institutions to develop more focused outreach and recruitment strategies.

In reference to the recruitment of URMs, AGEP leadership from an institution in the Midwest Crossroads Alliance stated, "AGEP has multiplied our recruitment reach. The reach of both alliance directors and campus directors has increased greatly. Before there was only one person focusing on this." Furthermore, AGEP's reputation helped draw students to campuses they otherwise may have dismissed. A respondent from Purdue remarked,

> There is a status associated with being an AGEP campus. When we present information about Purdue, we include that we are an AGEP and LSAMP [Louis Stokes Alliances for Minority Participation] campus. We would never want to downplay how these programs have influenced the national view of Purdue.

AGEP also provided financial resources for students, and funding was a common concern of incoming students. As a faculty member at one of the GAELA institutions suggested,

> One of the ways that AGEP helps in recruiting is that it provides financial resources that students can use to go to conferences and professional meetings. Whenever you can offer students more resources, then they are more likely to consider coming to the institution.

This benefit may have been of particular advantage to alliances and institutions located in states with laws limiting or prohibiting race-conscious recruitment and admissions policies. Since AGEP was funded under federal regulations, some grantees were held harmless against state-level legal restrictions on race-conscious recruitment. Several respondents from the University of California (UC) Alliance reported that Proposition 209, which prohibits public institutions in California from considering race, sex, or ethnicity in administration of state programs, curtailed any recruitment efforts using state funds to target URMs. AGEP funds, however, could be used for this purpose and provided these institutions with a mechanism for actively recruiting URM STEM graduate students. As one UC respondent remarked,

> Particularly over the last decade we would have had a hard time recruiting underrepresented minorities without the presence of AGEP. It is the federal involvement and the exclusion of the 209 limitation to federal efforts that has allowed us to continue our work in trying to increase domestic minority participation in graduate education and STEM fields.

We also found this to be the case in one of our pilot study sites. Western Michigan University of the Michigan AGEP Alliance used funds to support an AGEP fellowship for URM graduate students, an important component of their recruitment strategies. The university was able to provide such a stipend, despite the passage of Michigan's State Proposal 2, which places limits on race-conscious recruiting, because AGEP is federally funded.

It should be noted, however, that not all the alliances and institutions included in this evaluation used AGEP funds to develop or enhance recruitment. Leadership from at least 3 of the 13 alliances reported that only limited or no AGEP funding was used for this purpose. For two of these alliances, Howard–University of Texas at El Paso (UTEP) and Facilitating Academic Careers in Engineering and Science (FACES), AGEP leadership indicated a preexisting and long history of targeted outreach activities to draw URMs into STEM graduate programs, thereby allowing these alliances to more efficiently use AGEP funds for other purposes. Leadership at the third alliance, the University of Puerto Rico (UPR) Alliance, indicated that faculty indifference or lack of interest in engaging in recruitment activities influenced their decision to target funds elsewhere.

It should also be noted that the advent of AGEP did not necessarily result in a high degree of cross-campus collaboration within alliances for recruitment purposes. Many campuses remained reliant on traditional recruiting venues to connect with potential URM graduate school candidates. With few exceptions (see the discussion on "Innovative Recruitment Strategies," later in this chapter), alliance institutions tended less toward coordinated recruitment activities and more toward campus-specific efforts. They sent recruiters to HBCUs and HSIs, as well as to minority-focused conferences and events sponsored by organizations such as the Society for the Advancement of Hispanics/Chicanos and Native Americans in Science (SACNAS) and the American Indian Sciences and Engineering Society (AISES). Typically, when alliances did collaborate around the recruitment of URMs into STEM, activities centered on an annual cross-campus fair or event. As one example, the mainland members of the Central New York–University of Puerto Rico (UPR) Alliance hosted a recruitment event at UPR to encourage students to apply to graduate school at one of their campuses.

AGEP leadership expressed challenges to coordinating efforts, such as geographic distance between campuses and the fact that the different institutions, although connected through the alliance, are ultimately separate entities, offering students different academic experiences. Moreover, individual campuses had their own, established recruitment strategies and partnerships in place on which they wanted to build.

Primary Role of AGEP Staff in Recruitment

We also explored whether receipt of AGEP funding led to an increased faculty role in the recruitment of underrepresented minority students. Most of the faculty with whom we met indicated that they largely relied on their institution and designated AGEP staff to coordinate events and engage in targeted outreach. One respondent indicated that faculty may actually have "pull[ed] back" their recruitment efforts, since they knew that the AGEP program existed. When faculty described their role and their department's role in recruiting URMs, they described attending conferences or working, interacting, or speaking with students who were on a campus recruitment trip or who were participating in a summer research opportunity.

> *"We have one underrepresented minority faculty member in the bio-medical sciences that singlehandedly is a one-man recruiting machine."*
>
> —AGEP PI

Faculty members who were themselves members of ethnic or racial minority groups commented that their involvement in recruitment also might encourage nonminority faculty members to disengage from recruitment efforts. According to these respondents, the involvement of minority faculty in recruitment may have led to the perception that minority faculty were primarily responsible for recruiting URMs. The PI at one of the UC Alliance institutions stated, "We have one underrepresented minority faculty member in the biomedical sciences that singlehandedly is a one-man recruiting machine."

Innovative Recruitment Strategies

At some institutions, AGEP's influence on recruitment practices may have resulted in more innovative strategies, providing institutions with a means to perhaps more effectively diversify their STEM graduate student population.

Purposeful faculty engagement. Despite the overall trend of limited faculty involvement, a few institutions appeared to have faculty who were more actively engaged in recruitment efforts on behalf of AGEP. As just one illustration, the AGEP PI at Purdue described an innovative strategy for increasing faculty involvement in the recruitment of URMs. At this institution, faculty were viewed as the "real resource" for supporting large numbers of minority students due to the significant amount of money they were able to bring in (as opposed to other scholarships, fellowships, and funding sources, which were limited). Purdue asked faculty to serve as "AGEP professors" and commit to graduating at least one minority student in 10 years. At the time of the visit, about 20% of faculty in each STEM department had made this commitment. The participating faculty were identified on the school's Web site so potential students could see who they were and gain a sense of Purdue's commitment to AGEP and to diversity. The PI explained,

> We are trying to make it easier for the faculty to recruit minority students. We are trying to create a climate of embracing diversity. In the way that faculty typically thinks, they tend to look for the best student that they can fund. We are trying to get them to think in terms of the best for your graduate students group. We are trying to get them to think about having a diverse group of students working with them; if we can get them thinking that way, then we can easily increase diversity.

Faculty respondents from this same institution also indicated a change in faculty recruitment since AGEP. One faculty member illustrated this change by describing how his department approached recruitment prior to AGEP:

> At least in my department, it [was] let's just wait and see what comes in the doors. We weren't proactive about making the connections with HBCUs or showing up at the doors. Basically, we weren't jumping to make the connections to get those students of color to come here.

Campus visits and research opportunities. Fifteen institutions (from 7 of the 13 visited alliances) provided support for undergraduate students or newly admitted graduate students to visit their campuses or to participate in summer research experiences. Through such experiences, students had the opportunity to meet and interact with current graduate students, faculty, and peers who were also considering graduate school. In most cases, AGEP funds were used to support or partially fund these activities. For example, Indiana University, Bloomington, and Indiana University–Purdue University Indianapolis (IUPUI), both members of the Midwest Crossroads Alliance, used AGEP money to fund a recruitment program that brought in potential graduate students to visit with faculty in departments and programs across the two campuses. According to AGEP staff, these efforts helped the prospective students see the campuses as welcoming and inviting, and highlighted the URM community in STEM.

Some of the institutions that offered formal research experiences for students included Georgia Tech, Northwestern, and North Carolina State and the University of North Carolina at Chapel Hill. Georgia Tech, the lead institution in the FACES Alliance, invited about 35 undergraduate students to a 10-week, on-campus summer research experience with faculty mentors. Similarly, Northwestern, part of the Midwest Crossroads Alliance, established a partially AGEP-supported Summer Research Opportunities Program (SROP) that included a noteworthy recruitment innovation. Undergraduate students (juniors and seniors) from peer institutions and HBCUs were invited to engage in research activities on this campus with STEM faculty. The students were provided with housing and a stipend, and all their research costs were covered. If the students were juniors, they could come back for two summers, and at the recommendation of their advisor, they could be admitted into Northwestern's graduate programs without taking the GRE General Test and without undergoing the full application process. Current graduate students ran workshops, gave talks, provided mentoring, and explained the process of applying to graduate school, to further encourage these summer researchers to submit applications.

Faculty and staff at institutions that engaged in practices such as these typically viewed them as a positive experience for students and a helpful recruitment strategy. Students were able to make personal connections with graduate students and faculty and became familiar with the campus and campus culture. Moreover, the research opportunities, in particular, offered students an opportunity to learn how to conduct research and to operate in a research setting prior to starting their graduate studies. These experiences helped students envision themselves at the institution and offered them a sense that they would be welcomed and part of a community. Furthermore, as discussed earlier, students who had an opportunity to meet with staff and engage in research opportunities prior to graduate school indicated that these experiences were important factors in their decisions to apply to and attend a specific institution.

Indeed, the literature supports the use of summer research opportunities as an effective recruitment strategy. An NSF-sponsored study[15] found that students who participated in undergraduate research opportunities as undergraduate STEM majors were almost four times more likely to pursue a doctorate than their peers who did not engage in sponsored research (Ailes et al., 2003). The results of this same study also suggest that URMs may be differentially affected by these experiences. The researchers state, "Blacks and especially Hispanics were more likely than Asians or Whites to have shown gains in understanding, confidence, and awareness" (Ailes et. al, p. ES-5).

Targeted outreach. In addition to activities that brought students in, institutions also engaged in proactive outreach activities. In contrast to several of the other alliances, the Midwest Crossroads Alliance took advantage of the alliance structure to coordinate recruitment efforts across campuses, as well as maintain institution-specific recruitment practices. This alliance established an AGEP-supported subcommittee that developed an alliance-level recruitment plan detailing the campuses and conferences that campus representatives would visit as part of their joint outreach. The approach leveraged their shared resources and ensured that recruitment efforts were

[15] For this study, approximately 3,400 STEM graduates were surveyed. All respondents had received a STEM bachelor's degree between 1998 and 2003.

maximized and not duplicated. As one respondent stated, "We recruit minorities as a consortium. . . . It's a major benefit to be able to operate this way. We couldn't offer everything on our own." Another respondent reported that, as a result of AGEP, the alliance had also created a database of matriculating undergraduate URMs who might move into graduate programs, making their recruitment efforts more targeted and effective. In addition, the Midwest Crossroads campuses used AGEP funds to send "student ambassadors" to their undergraduate institutions to recruit URMs. During the pilot study we learned that the Michigan Alliance was also beginning to explore and use this strategy.

> *"We recruit minorities as a consortium. . . . It's a major benefit to be able to operate this way. We couldn't offer everything on our own."*
>
> —AGEP leadership, Midwest Crossroads Alliance

Other institutions focused considerable efforts on building the pipeline early for URMs in STEM. Louisiana State University (LSU), a member of GAELA, extended its outreach efforts to local high schools to "plant the idea of a STEM PhD program" early on in students' academic careers. LSU also custom-tailored MS or PhD programs as a means of enticing students into graduate study, especially those who might otherwise have left after earning a bachelor's degree in STEM. Similarly, the lead institution of the Central New York–UPR Alliance incorporated community service into its AGEP program, which paired graduate student mentors with undergraduates and sent graduate students into community high schools to advertise the benefits of graduate school and the AGEP program.

As a final illustration, a respondent from one of the UC Alliance institutions reported that AGEP had resulted in a stronger relationship with the California State University (CSU) institutions. CSU campuses typically enroll a larger proportion of URM undergraduates, and thus serve as a potentially strong pool of URM talent in STEM. This coordination resulted in STEM faculty from CSU communicating to their UC colleagues about potential graduate students. STEM faculty from the two systems also came together in an attempt to align curricula in ways that allowed CSU students to move into a UC graduate program with greater ease.

Recruitment and Enrollment Challenges

Small pool of potential students. Despite the often positive trends in URM enrollment at AGEP institutions, interviewees acknowledged that they confronted challenges in their recruitment and enrollment efforts. The most frequently cited challenge to recruiting and enrolling URMs in STEM graduate programs was that AGEP institutions were largely recruiting from the same pool of students—students who attended MSIs and/or who attended minority-focused conferences and events, such as SACNAS, AISES, Compact for Faculty Diversity. Furthermore, the highest performing students, who were the most targeted, were being recruited not just by AGEP campuses but by other top-tier non-AGEP institutions.

Unfavorable geographic location. Geographic location was identified as another challenge, particularly for institutions located in ethnically homogenous communities with few minorities, or for campuses with very low URM enrollments overall. The respondents from institutions in the Midwest were particularly sensitive to this obstacle, indicating difficulty in recruiting African Americans and Hispanics.

The recruitment of American Indian students was also affected by location. Respondents noted that American Indian students with close ties to their reservation and tribal communities were generally wary of attending an institution far from home, where there might be little support or understanding for their situations, backgrounds, and culture. Alliances with institutions in the Southwestern and Western states were more successful in recruiting this population of students, reporting higher percentages of American Indian STEM graduate students than at other alliance institutions. However, these same respondents also reported that their institutions, being located in the West and Southwest, struggled to attract African American students because of the smaller representation of African Americans on their campuses and in the surrounding community.

Speaking to this issue, the head of recruitment at UC Davis reported that the school tried to build a relationship with Spelman, but that it was difficult to recruit Spelman students to California, "because culturally we are not as attractive as places like Georgia Tech." Likewise, UC Santa Barbara's attempt at building a partnership with Jackson State University failed to prove fruitful. According to AGEP leadership, the inability to fully capitalize on the relationship was partly due to the geographic distance between the campuses and to Santa Barbara's remote and relatively homogenous population. Santa Barbara is on the central coast of California and not near any major cities. It has a reputation for inclement weather and suffers from the perception that it is a "White" city.

Additional data suggest that graduate school location may play a critical role in where undergraduates decide to apply and enroll. During the pilot study, which involved data collection and analysis for two alliances, the North Carolina OPT-ED Alliance and the Michigan AGEP Alliance, analyses of interview data revealed that graduate students in the North Carolina OPT-ED Alliance largely stayed within the same region for both undergraduate and graduate education (63% remained within the Southeast). In contrast, graduate students in the Michigan Alliance demonstrated greater mobility, with only 32% of students remaining within the Great Lakes region.

To gain a better sense of the "geographic mobility" of students and how mobility might vary across alliances and particular URM groups, we compared the location[16] of students' undergraduate institutions with the location of their current graduate school. We found that geographic mobility was limited, with about half of the surveyed STEM and non-STEM students (47% and 49%, respectively) moving from one region to another for graduate school. Of URMs, African American students were generally the least likely to attend graduate school outside their undergraduate institution region, as were students who had not attended an MSI as an undergraduate. Students who did not attend a research or doctoral institution as undergraduates were the most likely to move to different regions (see Exhibit 5-9).

Exhibit 5-9. Geographic Mobility From Undergraduate Institution to Graduate Institution, by Race/Ethnicity and Type of Undergraduate Institution

Total	Moved out of Region for Graduate School

[16] Seven regional locations were identified for this analysis: U.S. Pacific West, U.S. Mountain West, U.S. Southwest, U.S. Midwest, U.S. Mid Atlantic, U.S. Southeast, and U.S. Northeast.

	STEM		Non-STEM	
	n	Percent	*n*	Percent
All students	1543	47	397	49
Race/Ethnicity				
	STEM		**Non-STEM**	
	n	Percent	*n*	Percent
African American	646	45	222	42
American Indian/Alaska Native	28	57	9	56
Hispanic	733	49	118	61
White	33	33	19	47
Multi-racial	79	48	23	52
Type of Undergraduate Institution				
	STEM		**Non-STEM**	
	n	Percent	*n*	Percent
Nonminority-serving institution	1019	42	310	43
Minority-serving institution	301	57	87	69
Carnegie Classification of Undergraduate Institution				
	STEM		**Non-STEM**	
	n	Percent	*n*	Percent
Research and doctoral	949	42	240	46
Masters	373	52	83	54
Bachelors	198	64	63	54
Other special focus	5	80	3	0

Source: AGEP Student Survey

These data suggest that, since about half the students decided to attend a graduate program located within the same region as their undergraduate institution, graduate schools may garner more success by recruiting students from nearby colleges and universities. However, students who didn't attend a research or doctoral institution (per Carnegie Classification), were more likely to move across regions than any other students and could serve as a strong candidate pool, particularly for graduate programs located in a region with fewer undergraduate institutions enrolling URMs in STEM.

Other recruitment challenges. Respondents also mentioned such recruitment challenges as the draw of industry (better pay), the lack of a racially and ethnically diverse faculty on campus, student financial packages that were not competitive with other institutions, and the perceived value added (or lack thereof) of the PhD. Some faculty in particular fields suggested that the master's degree might be a more appropriate option for students. For example, the chair of the Geology Department at a SAPAI institution explained that a master's degree in geosciences is a professional degree and results in a good livelihood in the discipline. He remarked,

> The master's is actually a very important degree in the geosciences and it is often devalued by others. So, I understand the PhD level is important for AGEP and to move them into the professoriate, but there is variation in the disciplines and getting students out of the master's program and into the field is a really big deal and a big contribution to the field.

Summary

In summary, AGEP institutions were engaged in targeted and focused activities that escalated efforts to recruit URMs to their institutions and specifically into graduate studies in STEM. For several institutions, AGEP was the primary catalyst for these improved efforts. Although challenges remained in the recruitment of URMs into STEM, the trends analysis and the reports of AGEP leadership, staff, and faculty suggest that AGEP institutions were succeeding in increasing the enrollment of URM STEM graduate students in some disciplines. Site visit and survey data also indicated that AGEP was helping to create an environment of support that attracted URM students to AGEP campuses. However, given the myriad of factors that may affect enrollment trends at any one institution, it is difficult to isolate the effect of AGEP on URM enrollments in STEM graduate programs.

Chapter VI. AGEP and PhD Completion

Based on the literature review we conducted prior to beginning our data collection (Poirier et al., 2009), URM students face common obstacles in completing PhD programs including:

- Academic, social, and cultural barriers
- Expense of education
- Admissions policies and practices
- Prior educational experience and quality
- Lack of social and academic integration
- Lack of faculty–student mentorships

In addition, URM students, compared with their non-URM counterparts, tend to require more financial aid, take out more loans, and need part-time jobs to supplement living expenses, all of which, the literature notes, influence persistence in graduate programs and increase time to degree (Fenske, Porter, & DuBrock, 2000; Nettles, 1991). In addition, the nature of graduate-level work and pedagogical techniques present obstacles to the retention of underrepresented minorities (Fogg, 2009). These obstacles are compounded by a lack of support groups for URM students (Ibarra, 2000). The literature suggests that support systems are especially important for URM students' academic and social integration, particularly for success in science, technology, engineering, and math (STEM) (Busch-Vishniac & Jarosz, 2007). Thus, mentoring is an important support mechanism for retaining URM students. Effective mentoring relationships with faculty can offset negative feelings and experiences and positively affect educational experiences and completion rates (Davidson & Foster-Johnson, 2001).

This evaluation of AGEP focused on the extent to which AGEP programs helped URM students surmount these common obstacles and complete their STEM PhDs. This chapter addresses this issue, first by comparing URM completion trends in STEM at AGEP and non-AGEP institutions. Specifically, this chapter presents findings from quantitative analyses related to the study's research question on degree completion:

- Between 1990 and 2007, what were the national trends at non-AGEP and AGEP institutions in URM students' graduation numbers from doctoral programs in STEM disciplines? How do completion trends in AGEP institutions compare with trends in similar non-AGEP institutions?

The chapter also explores survey and site-visit data that contextualize AGEP projects' efforts to help students complete their degrees.

Key Findings

The Survey of Earned Doctorates (SED) provides the primary data used to examine URM graduate school completion in STEM at the national and institution levels for AGEP-funded and non-AGEP institutions. Data from 1990 to 2007 were analyzed to determine trends by discipline and race/ethnicity. Findings include the following:

- On a per institutions basis, AGEP institutions are producing more URM STEM PhD graduates than non-AGEP institutions[17] Total URM STEM PhD production increased an average of 29 students per year from 1990 to 2007. The 106 AGEP institutions produced, on average, 16 of these PhDs, while the 201 non-AGEP institutions produced, on average, the remaining 13.
- Completion trends by discipline and race/ethnicity varied for AGEP and non-AGEP institutions. On average, physical sciences, engineering, and biological/biomedical sciences produced the greatest number of URM PhDs in both AGEP and non-AGEP institutions. In engineering, mathematics, and physical sciences, AGEP institutions consistently produced more URM PhDs than did non-AGEP institutions. In agricultural sciences/natural resources, AGEP institutions produced more URM PhDs, but there were also more AGEP institutions than non-AGEP institutions with programs in this area.
- AGEP institutions consistently produced more African American and Hispanic PhDs in STEM, but the average yearly increase for African Americans decreased in the AGEP-funding years and increased for Hispanics.
- Puerto Rican institutions accounted for 9% of the average yearly increase of Hispanic PhDs in STEM at AGEP institutions; however, the trends in AGEP's production of Hispanic PhDs were similar regardless of whether Puerto Rican institutions were included in the analysis with institutions only on the U.S. mainland.
- The percentage of female PhD completers in STEM was about the same at AGEP and non-AGEP institutions. However, the share of the total percentage of females completing PhDs in STEM steadily rose from about 25% to just less than 50% over the period between 1990 and 2007. Within the URM population, there tended to be a slightly greater number of females completing PhDs in STEM than in the overall population.
- Among URM students, the median number of years to completion in AGEP institutions was slightly lower than that of URM students in non-AGEP institutions. From 1990 to 2007, URM students in both AGEP and non-AGEP institutions took about the same amount of time to complete their PhDs. However, in the post-AGEP years, URMs at AGEP institutions were finishing at a slightly faster rate than those at non-AGEP institutions. For example, in 2007, URM students at AGEP institutions took a median of 6.3 years to finish and those at non-AGEP institutions took 6.7 years.
- Thirty-four percent of surveyed AGEP students indicated that they had considered leaving their STEM PhD programs. The most salient factors affecting those students' thoughts about leaving were an unsupportive atmosphere in the graduate program (19%), difficulty with coursework or other requirements of the program (13%), lack of a mentor (11%), loss of interest in the field (10%), and inadequate funding (9%).

[17] AGEP institutions are larger, include more MSIs, and were producing more URM PhDs in STEM pre-AGEP.

- The key obstacles to degree completion noted by the students interviewed included feeling isolated because of their racial/ethnic background, feeling a lack of support from faculty, and the absence of a mentoring relationship with an advisor. However, AGEP offered opportunities to combat these obstacles by facilitating mentoring opportunities with faculty and peers and creating a sense of community among URMs in STEM.
- Academic retention efforts at AGEP institutions included dissertation- and thesis-writing workshops; systems to track student progress and implement necessary interventions; and regular seminars, lectures, and panels on success in graduate school. Seminars, lectures, and panels also served as an important social support mechanism for URM students. Mentoring relationships with faculty, AGEP staff, and peers were also a frequently reported retention and social support mechanism, as were financial support programs.

In our trend analysis of SED data, *completion* refers only to students graduating with a PhD in STEM. The analysis does not include terminal master's degree recipients. The completion analysis concentrates on the six broad STEM disciplines identified earlier: agricultural sciences/natural resources, computer and information sciences, mathematics, physical sciences, biological/biomedical sciences, and engineering.

National Trends

Nationally, the total number of STEM PhDs earned by URM students has been increasing. The total number of STEM PhDs awarded to URM students increased from 471 in 1990-91 to 1,008 in 2006-07. However, the percent change of URM PhD completions was greater from 1990-91 to 1997-98, the years prior to AGEP funding (58% and 34%, respectively. During these same time periods, non-URM enrollments did not increase at the same rate. Although non-URM completions increased from 1990-91 to 1997-98, completions declined in the subsequent years (see Exhibit 6-1).

Exhibit 6-1. URM and non-URM STEM PhD Completion

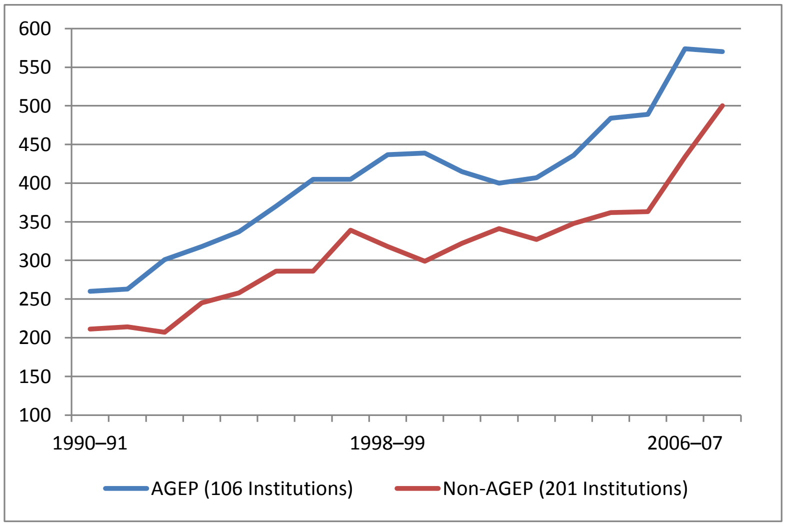
URM PhD Completion in STEM					
1990-91	**1997-98**	**% Change**	**1998-99**	**2006-07**	**% Change**
471	744	58	755	1,008	34
Non-URM PhD Completion in STEM					
1990-91	**1997-98**	**% Change**	**1998-99**	**2006-07**	**% Change**
9,348	10,803	16	10,184	10,202	>1

Source: Survey of Earned Doctorates

URM PhD Completion Trends, AGEP Versus Non-AGEP

With roughly half as many institutions, AGEP has awarded more STEM PhDs to URMs than have non-AGEP institutions. Across all institutions, in 1990, 471 STEM PhDs were awarded to URMs; the 106 AGEP institutions produced a total of 260 PhDs, and the 201 non-AGEP institutions produced a total of 211. By 2007, the same 106 AGEP institutions produced 570 URM PhDs in STEM, whereas the 201 non-AGEP institutions produced 500 (see Exhibit 6-2).

Exhibit 6-2. URM PhD Completions in STEM, AGEP and Non-AGEP Institutions

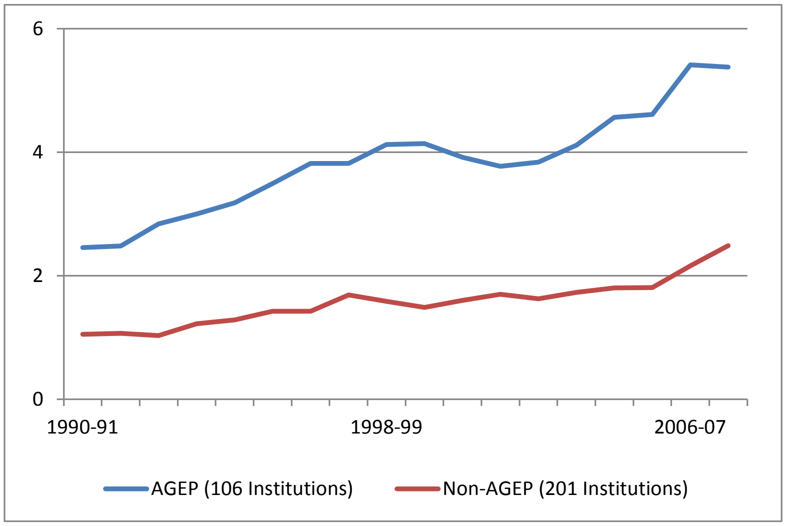


Source: Survey of Earned Doctorates

On a per-institution basis, AGEP institutions consistently produced more URM PhDs in STEM than did non-AGEP institutions.[18] In 1990, the average number of URM PhDs completed in STEM was 2.5 at AGEP institutions. In the same year, non-AGEP institutions produced an average of 1 URM PhD in STEM. By 2007, the numbers were 5.2 and 2.5 respectively (Exhibit 6-3).

[18] *Per institution* in our discussion of completion means the total number of URM graduate completion numbers divided by the total number of institutions. This calculation was done to correct for the unequal number of AGEP to non-AGEP schools. On average, AGEP institutions were larger, included more MSIs, and were producing more URM Ph.D.s in STEM prior to AGEP funding.

Exhibit 6-3. Average Annual URM PhD Completions in STEM per Institution, 1990-2007

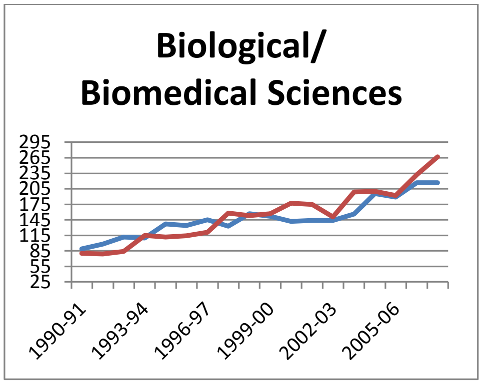


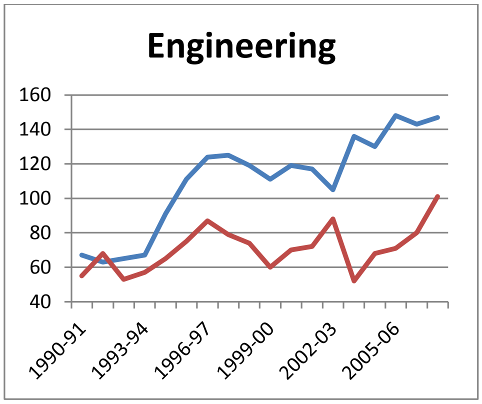
Source: Survey of Earned Doctorates

URM STEM PhD Completion Trends, by Discipline

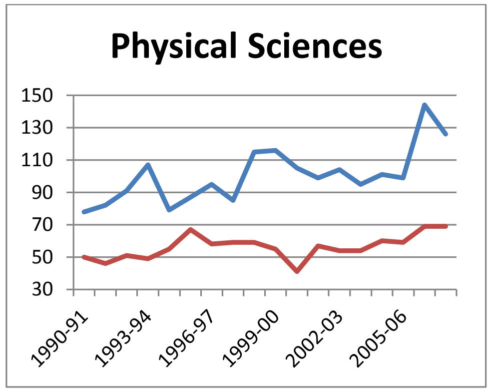
From 1990-91 to 2006-07, among the six broad disciplines included in this study, PhD completion among URMs increased over time in both AGEP and non-AGEP institutions. However, AGEP institutions consistently produced more URM PhDs than did non-AGEP institutions in mathematics, engineering, agricultural sciences/natural resources, and physical sciences (see Exhibit 6-4).

Exhibit 6-4. URM PhD Completions at AGEP and non-AGEP Institutions, by Discipline[19]





[19] Due to the small numbers of URM graduates in both AGEP and non-AGEP institutions and to protect student confidentiality, graphs displaying the PhD completion for URMs in agricultural resources/natural sciences, computer and information sciences, and mathematics are not provided.

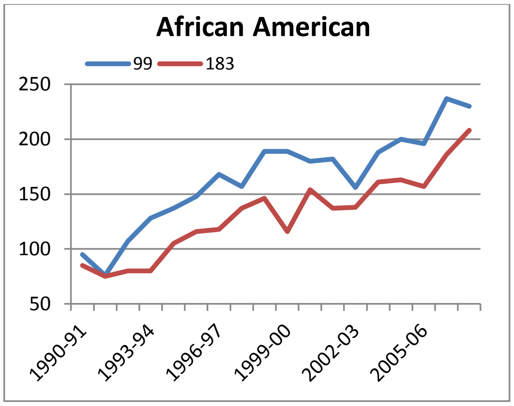


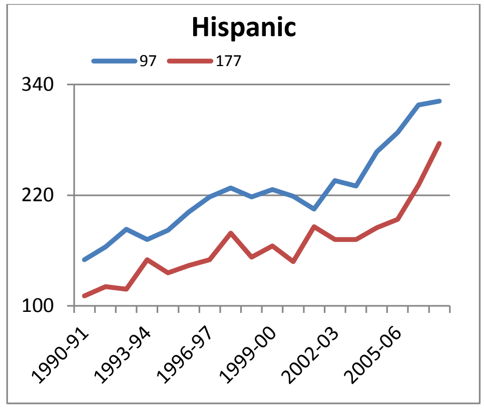
Source: Survey of Earned Doctorates

URM PhD Completion Trends, by Race/Ethnicity

In 1990-91, fewer than 100 African Americans received PhDs in STEM from both AGEP and non-AGEP institutions. By 2006-07, the number increased to more than 200, with the AGEP institutions consistently producing more African American PhDs in STEM than non-AGEP institutions (see Exhibit 6-5). Similar observations can be made for Hispanic STEM PhD completions. The number more than doubled; 150 Hispanics completed PhDs at AGEP institution in 1990, and the number increased to about 320 in 2006-07. At the same time, the number at non-AGEP institutions increased from 110 to 275. However, for American Indians/Alaska Natives, while between-year differences show great fluctuation, the 2006-07 numbers closely mirror the 1990-91 numbers.

Exhibit 6-5. URM PhD Completions in STEM Disciplines at AGEP and non-AGEP Institutions, by Race/Ethnicity[20]





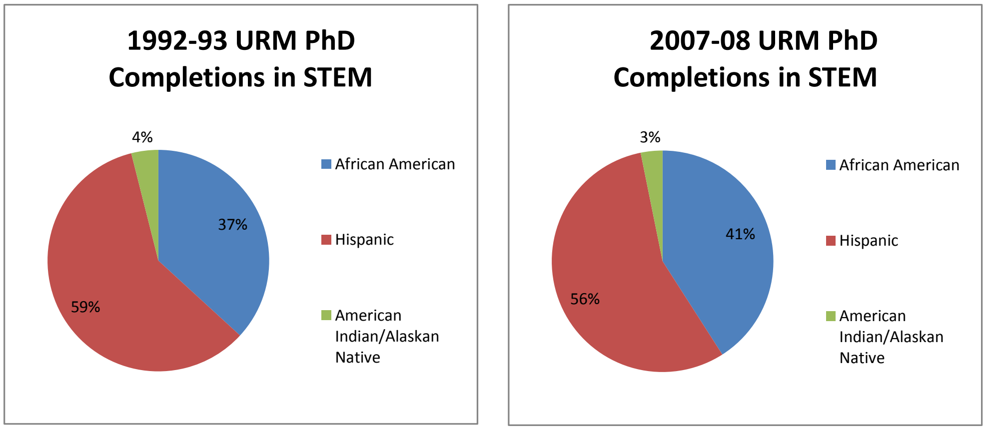
AGEP — Non-AGEP

Source: Survey of Earned Doctorates

[20] Due to the small number of American Indian/Alaska Native graduates from AGEP and non-AGEP institutions and to protect student confidentiality, a graph displaying American Indian/Alaska Native PhD completions is not provided.

The charts in Exhibit 6-6 present the distribution of URM STEM PhD completions over time.[21] These data demonstrate modest gains in PhD completions for African American and Hispanic students.

Exhibit 6-6. Percentage Distributions of Racial/Ethnic Groups Among URM PhDs



Source: Survey of Earned Doctorates

Completion Trends for URM Females in STEM

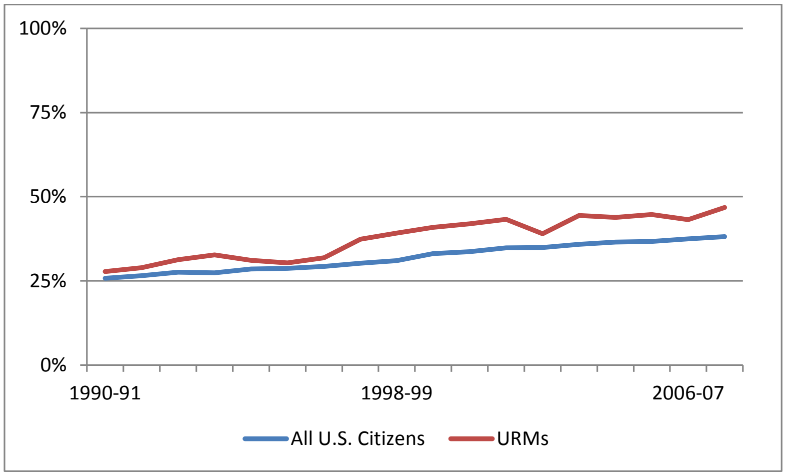
Although AGEP programs focus on increasing the representation of URMs in the STEM professoriate, independent of students' gender, representation of females in STEM disciplines and the STEM professoriate is recognized as vital to national interests. The Commission on Professionals in Science and Technology (2009) reported that women accounted for fewer than half the ranking faculty at four-year colleges in the United States. Moreover, only one fourth of STEM PhD students overall were women (The Commission on Professionals in Science and Technology, 2009).

In 1990-91, about 25% of STEM PhDs completed by U.S. citizens or permanent residents were completed by females (see Exhibit 6-7). In the same year about 25% of STEM PhDs completed

[21] As noted in Chapter V, Puerto Rican universities serve primarily Hispanic students in a cultural environment that is predominantly Hispanic or Latino. Two Puerto Rican institutions have AGEP grants. Including these institutions, in 1990, 150 Hispanic STEM PhDs were produced. Without the two Puerto Rican institutions, the count was 145. By 2007, the comparative counts were 322 and 276, respectively. A comparison of the Hispanic completion trends in AGEP institutions, both including the Puerto Rican institutions and excluding them, showed that the trends were relatively similar. (From 1990 to 2007 the average increase of Hispanics earning STEM PhDs was nine per year with the two Puerto Rican AGEP institutions included, and eight without the Puerto Rican institutions.)This at least cautiously suggests that the Hispanic enrollment at Puerto Rican institutions is not skewing the overall AGEP trends for STEM PhD completions by Hispanics.

by URMs were completed by females. By 2006-07, about 38% of STEM PhDs completed by U.S. citizens were completed by females, while almost 48% of STEM PhDs completed by URMs were completed by females. Thus, the percentage of PhDs awarded to URM women is higher than the percentage awarded to women in the overall population.

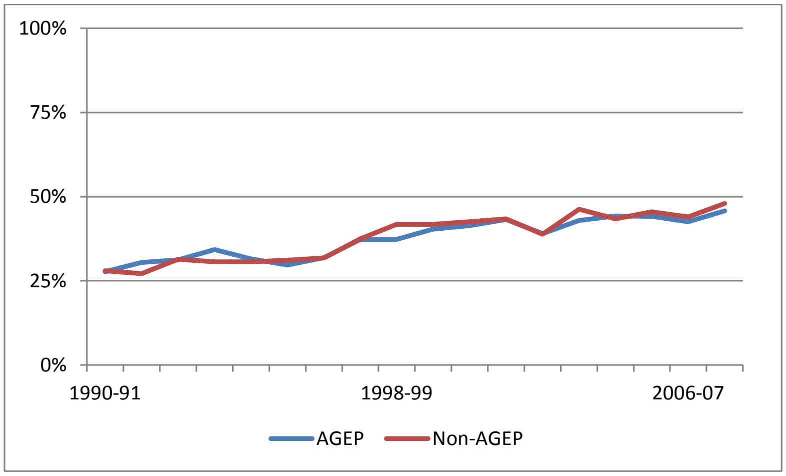
Exhibit 6-7. Percentage of STEM PhDs Completed by Females, 1990-2007



Source: Survey of Earned Doctorates

Exhibit 6-8 shows that the percent of URM females completing PhDs in STEM at AGEP institutions was essentially the same as at non-AGEP institutions, and the trend from 1990-91 to 2006-7 mirrored the national trend. In 1990-91, 25% of URM STEM PhDs were female, and this rate steadily climbed to just less than 50% in 2006-07.

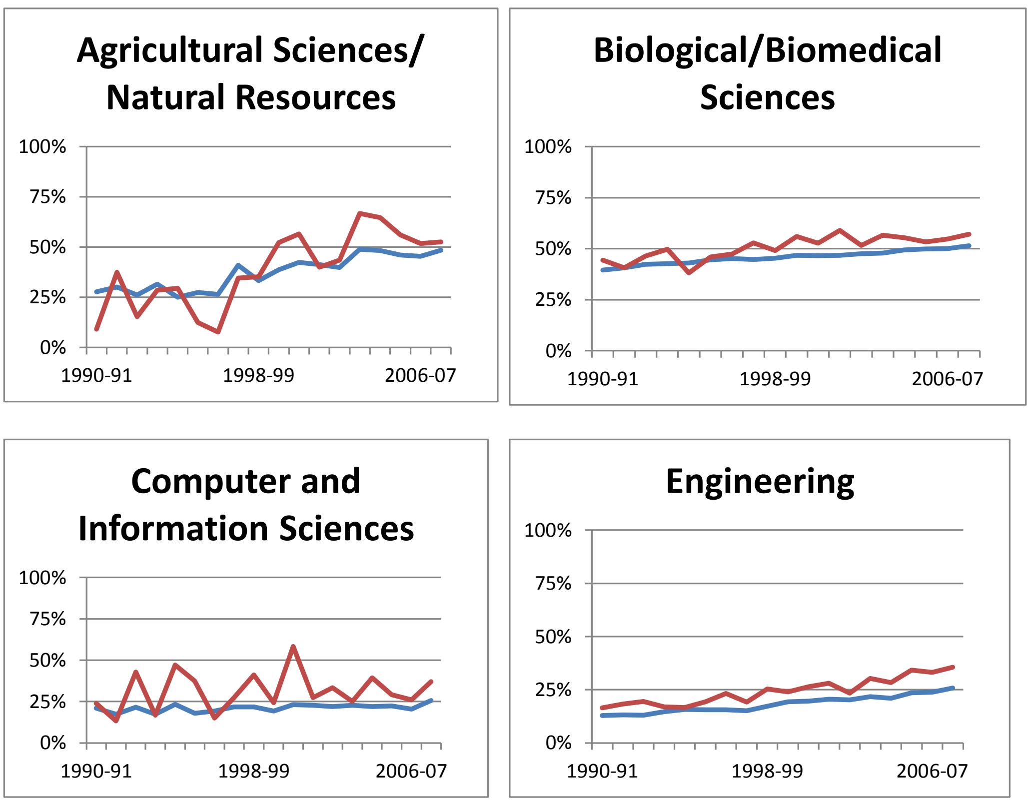
Exhibit 6-8. Percentage of STEM PhDs Completed by URM Females at AGEP and non-AGEP Institutions, 1990-2007

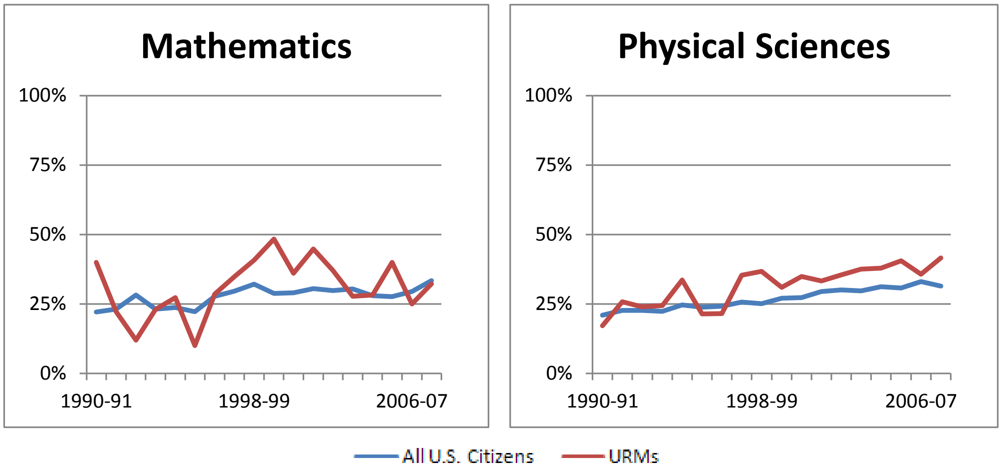


Source: Survey of Earned Doctorates

When broken down by disciplines, the biological/biomedical sciences showed a larger concentration of females than in other STEM disciplines. In 2006-07, for example, females accounted for slightly more than half the PhDs awarded in biological/biomedical sciences among URMs and for all races combined. In all six disciplines, completion trends for females also did not differ much between URMs and non-URMs over the time period under consideration (see Exhibit 5-10). It should be noted that the number of PhDs awarded to URM females is usually small. In agricultural sciences/natural resources, computer and information sciences, and mathematics, for example, the number of PhDs awarded to URM females was usually fewer than 10 students a year, resulting large year-to-year variance (see Exhibit 6-9).

Exhibit 6-9. Percent STEM PhDs Completed by Females in Overall Population, by Discipline, 1990-2007





Source: Survey of Earned Doctorates

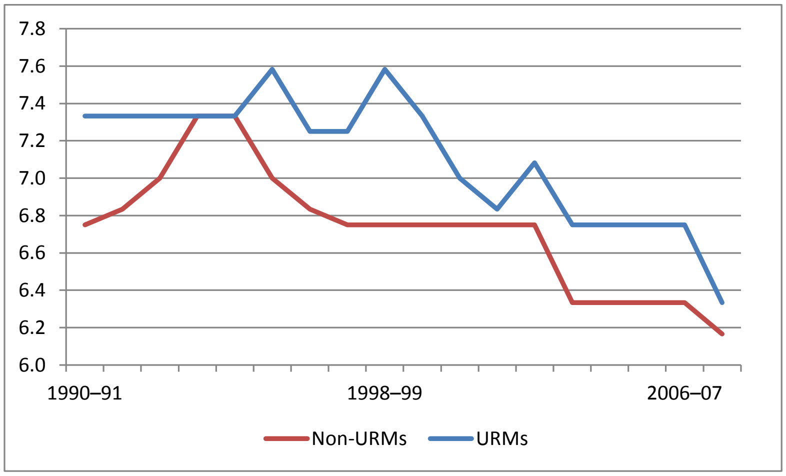
Time-to-Completion Trends

Absolute increases in the numbers of URMs completing STEM PhDs were not the only indication of the influence of the AGEP program. As a program, AGEP focuses on improvements in the experiences of URM students while the students are in graduate school—specifically, with helping mitigate or remove obstacles to completion. Consequently, the time that URM students take to complete their PhDs is also an important potential measure of how AGEP might be affecting URMs.

The analyses here focus on median years to completion, as opposed to the mean number of years to PhD completion. This measure was used to remove the effect of outliers. For example, there could be a student on a particular AGEP campus who, for various idiosyncratic reasons, took 12 to 13 years to complete his or her PhD. Such experiences would skew the time-to-completion findings.

Overall, from 1990 to 2007, the median number of years to STEM PhD completion for URM students was a bit longer than for non-URM students, as seen in Exhibit 6-10. However, the median for both URM and non-URM students' years to completion declined over time, with URM students having a larger decline (from a median of 7.3 years in 1990 to a median of 6.3 years in 2007). Non-URM students in 1990 had a median of just 6.7 years to completion, and this figure declined to 6.3 years in 2007.

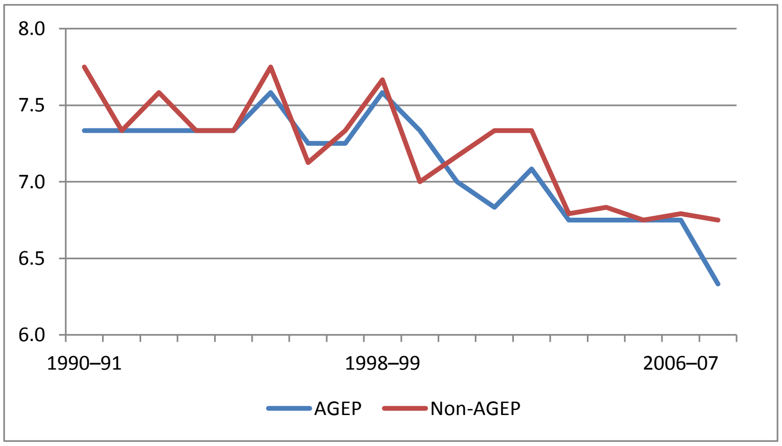
Exhibit 6-10. Median Years to Completion for STEM PhDs Among URMs and Non-URMs, 1990-2007



Source: Survey of Earned Doctorates

There was a similar trend in time to completion for URM students at AGEP and non-AGEP institutions from 1990 to 2007. Both groups had steady declines in median years to completion, but as seen in Exhibit 6-11, the median years to completion for URM students in AGEP institutions was slightly lower than that for URM students in non-AGEP institution.

Exhibit 6-11. Median Years to Completion for URM STEM PhDs at AGEP and Non-AGEP Institutions, 1990-2007



Source: Survey of Earned Doctorates

Analysis From Similar Institutions

So far the analyses conducted on PhD completions have included all non-AGEP, as well as AGEP, institutions. We also matched AGEP institutions to comparable non-AGEP institutions to make comparisons between AGEP and non-AGEP production of URM PhDs in STEM. The actual matching methodology is described in the appendix.

The matched analysis sought to answer the following question: During the AGEP-funding years, how do completion numbers from doctoral programs in STEM disciplines differ between the matched AGEP and non-AGEP institutions?

In this analysis, we compared key matching variables, that is, pre-AGEP funding trends and graduate enrollment size for a broad discipline. To report results, only matched institutions in a broad discipline have been used. Eighty-five percent of AGEP broad discipline departments were able to be matched.

As is evident in Exhibit 6-12, the matched analysis does not show any statistically significant differences between AGEP and non-AGEP institutions in their rate of PhDs awarded subsequent to AGEP funding. Although not statistically significant, the analyses suggest greater increases at AGEP institutions

- For URMs overall in the biological/biomedical sciences, engineering, and mathematics.
- For Hispanics in engineering, physical sciences, and mathematics.
- For African Americans in biological/biomedical sciences and engineering.

The national trend analysis and matched-group-comparison analysis are separate analyses. Neither one disproves the findings of the other. Rather, both demonstrate a positive direction for AGEP influence on PhD production.

Exhibit 6-12. AGEP Institutions' Rate of PhDs Awarded in Years Subsequent to AGEP Funding, Compared With Rate in Matched Non-AGEP Institutions[22]

Disciplines	URMs	Hispanics	African Americans
Agricultural sciences/natural resources			
Biological/biomedical sciences	+	-	+
Computer and information sciences	-	-	-
Engineering	+	+	+
Physical Sciences	-	+	-
Mathematics	+	+	-

Source: Survey of Earned Doctorates
Plus sign (+) = AGEP had a greater increase.
Minus sign (-) = non-AGEP had a greater increase.
Note: None of the differences was statistically significant. See the appendix and Exhibits A-1, A-2, and A-3 for table values.

Factors Affecting PhD Completion

The national trend analyses presented above compares STEM PhD completion among AGEP and non-AGEP institutions in terms of URMs completing STEM PhDs. Just as in Chapter IV, such analyses allowed for comparisons in enrollment in STEM graduate programs. Neither set of analyses, however, provide information on how specific AGEP programs may be contributing to these trends. Furthermore, the literature review identifies several common obstacles to URM PhD completion in STEM. The possible influence of these obstacles on PhD completion does not

[22] After matching, American Indians/Alaska Natives were not analyzed separately because of their small numbers.

appear in the trend analyses. For contextual information concerning student retention and PhD completion, we turned to the survey of AGEP students and to focus group and interview data gathered from the site visits to the AGEP alliances.

Obstacles to Completion

The student survey revealed that about 17% of STEM students and 28% of non-STEM students were considering leaving their program or had considered doing so in the past. Among these students, the largest proportion considered leaving because of an unsupportive atmosphere in the graduate program. Other important reasons (at least 10% of students responding) were inadequate funding, difficulty with coursework or other requirements of the program, lack of a mentor or poor quality of mentoring, and loss of interest in the field.

Variability by discipline, race/ethnicity, and gender among students who considered leaving their program was also examined. The most frequently reported reason for considering leaving, for STEM students, was an unsupportive atmosphere in the graduate program (see Exhibit 6-13).

Exhibit 6-13. Factors Affecting Students' Decisions To Leave Graduate School, Variability by Discipline

Factors	Percent of Respondents
	STEM (*n* = 561)
Unsupportive atmosphere	17
Difficulty with coursework	14
Lack of a mentor, poor quality of mentoring	11
Loss of interest in the field	10
Inadequate funding	8

Source: AGEP Student Survey

When disaggregated by race, the most frequently reported reasons for considering leaving were the same for STEM African Americans, Hispanics, and American Indians/Alaska Natives (see Exhibit 6-14). Unsupportive atmosphere was the most frequently reported reason for considering leaving among African Americans, Hispanics, and American Indians/Alaska Native. For African Americans, however, difficulty with coursework was reported as frequently as an unsupportive atmosphere.

Exhibit 6-14. Factors Affecting STEM Students' Decisions To Leave Graduate School, Variability by Race

	African Americans	Hispanics	American Indian/Alaska Natives	Multiracial

Unsupportive atmosphere	16% *n* = 232	18% *n* = 258	27% *n* = 15	15% *n* = 26
Difficulty with coursework	18% *n* = 42	12% *n*= 31	N/A*	N/A
Lack of a mentor	10% *n* = 23	12% *n* = 32	N/A	N/A
Loss of interest in the field	10% *n* = 24	12% *n* = 30	N/A	N/A
Inadequate funding	8% *n* = 18	8% *n* = 20	N/A	N/A

*"N/A" means that the results are not available due to the low number of students responding.

Source: AGEP Student Survey

Female and male students reported reasons for considering leaving similar to the overall sample (see Exhibit 6-15). For both female and male STEM and non-STEM students, an unsupportive atmosphere in the department was the most often cited reason for considering leaving their graduate program, but this was particularly a concern for female students (30% of females vs. 18% of males). Female students also cited difficulty with coursework and other requirements (18%) and a lack of mentoring or poor-quality mentoring (12%). On the other hand, only 10% of male students felt challenged by coursework and mentoring. The findings for non-STEM females and males were similar to those for STEM students; however, only 4% of non-STEM females considered leaving because of difficulty with coursework; whereas 13% of non-STEM males considered leaving for this reason.

Exhibit 6-15. Factors Affecting STEM Students' Decisions To Leave Graduate School, Variability by Gender

	Females	Males
Unsupportive atmosphere	18% *n* = 314	16% *n* = 247
Difficulty with coursework	18% *n* = 57	10% *n* = 24
Lack of a mentor	12% *n* = 39	9% *n* = 22
Loss of interest in the field	10% *n* = 31	11% *n* = 27
Inadequate funding	6% *n* = 19	11% *n* = 26

Source: AGEP Student Survey

Comment [ARB1]: Table below is for overall female and male, not by stem and non-stem. Give that above isn't by STEM and non-stem, should be consistent conversation here. Seems to be just STEM above, is it here?

Comment [ARB2]: Table shows 18% of females and 16 of males, hardly worth mentioning. But if do, get the numbers right.

Comment [ARB3]: Whole paragraph needs to be updated to match the table.

If want to do stem vs non-stem, need to add table, but I recommend just keeping this table and changing the text.

Comment [ARB4]: This should be a separately titled and numbered table.
YES CHANGE
Same comments about % as above.

Unsupportive atmosphere. Seventeen percent of STEM students who considered leaving their graduate programs did so because of an unsupportive atmosphere in the graduate program. Student respondents' further explanations on this point ranged from having an unsupportive advisor and lab mates to feelings of isolation and racism in their labs and departments. Some specific student comments include

- I was ignored by my research advisor for four and a half years.
- Unsupportive atmosphere in my research laboratory.
- Racism from lab mates.
- Unsupportive atmosphere toward Natives in Multicultural Affairs, not in my home department.
- Verbal abuse from advisor and general unsupportive atmosphere.
- Extremely bad advis[o]r who only took me because of AGEP money. He dropped me when AGEP lost funds.

Because the number of URM students is small in STEM graduate programs, these students often experience social and academic isolation (Ibarra, 2000). The individualistic nature of graduate study also adds to the isolation of URM students in STEM departments (Fogg, 2009). Isolation such as this contrasts with the communal and people-oriented nature of some URM cultures, like that of African Americans, Hispanics, and Native Americans. The literature reviewed also suggested that these cultural differences can lead to marginalization of URM students and a lack of social support (Ibarra, 2000).

Some of the students' responses during site visits supported which described general feelings of isolation on their campuses, within their departments, and in their respective labs, seems to support this literature. One student stated, "There really is a tendency to deny the climate issues that underrepresented students face. . . . And the students themselves don't know how to name what is happening to them." Although this sentiment was expressed by several students at most sites, these feelings of isolation and experiences of marginalization were not necessarily reported as insurmountable obstacles to students' completing their respective programs. Rather, the experiences were reported as challenges along the way.

Students interviewed during site visits also reported challenges faced because of their racial/ethnic minority status on campus. Students reported that they were challenged in finding a community to connect with. One student commented, "It makes it hard when the people you work with in the lab don't look like you so they don't understand what you're going through. There are barriers to socializing." A student in the UC Alliance acknowledged, "I would guess that African American students have the hardest time—there are not very many on campus."

Expense of education. Eight percent of STEM and 13% of non-STEM students who had considered leaving their graduate program indicated that lack of financial support or the end of an existing source of financial support was a primary factor in their deliberations. In addition, 15% reported that AGEP could have been more helpful by providing more funding or more information about funding. When responding to a question about how their graduate program

> *"A lot of students that enter graduate programs are stressed with financial burdens, and higher pay than what we receive now would be much better!"*
>
> —Graduate Student

could be better, 5% of students' written comments were about financial support or lack thereof. Representative comments included the following:

> More financial support would better prepare me for my future career. I have a $15,000 loan/scholarship, which includes the stipulations of the completion of my degree and subsequent professorial teaching of 3 years. Not only are the stipulations stressing, but also the amount of the fellowship is not proportional to the cost of living in Oxford, Mississippi, which has significantly higher costs of living than other areas in the state. Living on such a limited supply can be stressful. Due to the high demands of my graduate program, my department's ruling of not allowing jobs outside of the department and my desire to excel, I am not able to find other means of income. Therefore, I was forced to live in low-income housing and other means to lower my cost of living.

Students interviewed during the site visits also reported financial challenges, such as not having enough financial support, needing to find funding each year or semester, or living on a graduate student stipend. A student in the UPR Alliance exclaimed, "You are always looking for money." Another student talked about being married and not having enough money to support a family while a graduate student: "There is the need to find a fellowship that pays enough," he reported.

Difficulty with coursework or other requirements of the program. As noted above, the AGEP literature review indicated that weak prior educational experience and quality is a frequent obstacle to PhD completion. For this study, we did not collect information about students' prior educational experience, other than the undergraduate institution they attended. However, 7% of STEM and 14% of non-STEM survey respondents indicated that difficulty with coursework or other requirements of the program were factors contributing to their thoughts about leaving. In some cases, this difficulty appears to be associated with students' undergraduate academic preparation. Twenty-five percent of STEM students felt that they were somewhat less prepared or far less prepared for graduate school than other students in their program (19% of non-STEM students reported feeling this way). STEM students coming from non-MSI undergraduate institutions felt much less prepared (5%) to somewhat less prepared (21%) than students coming from MSIs (2% and 10%, respectively).

> *"The [undergraduate] coursework did not cover a sufficient breadth of material and was not challenging enough."*
>
> —Graduate student

When asked to comment on how their undergraduate experiences could have better prepared them for graduate school, nearly a third (32%) of the students cited more rigorous coursework and greater exposure to research opportunities and the research process. As an example, one student stated, "I had little if any undergraduate research experience in a lab or with reading scientific papers."

Other academic and department-related challenges emerged as themes among the interviewed students. Interviewed students reported that choosing a lab and/or advisor was a challenge for them—and the relationship between students and advisors is germane to students' successful completion of their programs. Students also indicated that the difficulty of the coursework and the workload was an academic challenge. Many students reported that managing their time to balance coursework, research, lab duties, and teaching challenged them. Likewise, inadequate preparation in undergraduate programs for graduate coursework and research and not knowing the culture of graduate school (expectations, steps to being successful) were challenges students faced. One student referred to these challenges as "discovering the graduate school mentality." Another student, when asked what had been a challenge while in graduate school, said,

> Definition of expectations. These things are incredibly vague. It depends on your professor and lab and how they work. . . . I had been around the graduate school environment for a while, and I thought I would know what was involved, but I truly didn't.

In addition, interviewed students for whom English was not the first language stated that using English was an academic barrier for them, particularly in understanding teachers in class and in completing assignments.

Poor faculty–student mentoring relationships. Ten percent of STEM and 11% of non-STEM respondents indicated that a poor mentor relationship or lack of mentor relationships was a factor contributing to their deliberations about leaving. Moreover, when students responded to a question about how their graduate program could be improved, 16% commented on the quality of relationships with mentors and/or advisors. Indeed, comments about mentorship were the most frequently occurring type of comment on how graduate programs could be better. Representative comments included the following:

> I think that my experience as a student could have been better if I had a better advisor or mentor. In a sense I have reflected on what I have not gotten from my advisor and decided on what I WOULD DO if I were to become one.

The support systems in graduate school enhance academic and social integration, and are a critical factor in students' decisions to complete a graduate degree. Faculty mentoring relationships are one such support system, and they can offset URM students' feelings of isolation and marginalization, and lead to more positive educational experiences. According to the literature, positive faculty mentoring relationships can influence the academic, interpersonal, intellectual, and professional lives of students, as attrition of students in STEM disciplines has been associated with incompatible student-advisor relationships (Golde, 2005).

> *"I receive amazing mentorship through the AGEP program but I receive very minimal mentorship in my actual career field from my PI. I self direct mostly and that is a great opportunity for independence but I could use more involvement from my PI."*
>
> —Graduate Student

In accordance with AGEP Student Survey findings, some interviewed students indicated a lack of support and at times the absence of a mentoring relationship, particularly with advisors and other department faculty. One student commented, "Sometimes I think that no one in my department cares if I succeed or not, so that's been a challenge."

Loss of interest in the field of study. Among students who reported that they had considered or were currently considering leaving their graduate programs, 10% of STEM students indicated loss of interest in the field contributed to their considerations. A few students explained this loss of interest. For example, one student wrote that he or she considered leaving because of a "loss of interest in academia/research/'publish or perish' model, with no impact in real life." Another student said he or she had a "loss of interest in receiving a doctorate in general." Still other students wrote that they had a "loss of personal enthusiasm about [the] department and field" and a "lack of mentoring [and] peers in the program led to loss of interest."

Reasons for Staying in the PhD Program

Despite the obstacles AGEP students mentioned in both the survey and interviews, they were all persisting with their graduate studies. It was beyond the scope of this evaluation to identify and speak with former graduate students who left their programs. The students who indicated that they had considered leaving their program, yet decided to stay attributed their decision to multiple factors. Fifty-five percent of the surveyed students who indicated that they had thought about leaving graduate school reported personal perseverance, personal goals, personal realizations or changes, future opportunities, or time already spent in the graduate program as reasons why they stayed.

A small number of the surveyed STEM students who reported considering leaving (3%) specifically reported that AGEP opportunities and involvement affected their decision to stay in the graduate program after they had considered leaving. These students reported that social, academic, and financial support offered by AGEP and AGEP staff factored into their decisions to stay. One student wrote, "I received extra support and encouragement from my AGEP program director and got past the difficulty I was experiencing."

Similarly, another student wrote,

> The primary reason I have decided to stay is because of the supportive environment that I feel in graduate school from the PROMISE staff, from my advisor and from my lab mates. They are equally determined to see me graduate with my PhD. I am not sure if the other graduate program I am considering is supportive of [my] obtaining my graduate degree.

In addition to the aforementioned support provided by AGEP, students also reported that academic support received from AGEP staff influenced their decision to stay. Students also wrote that AGEP fellowships, scholarships, and financial support were "hard to say no to," thus explaining their decision to stay in their current graduate program. Again, the provision of financial support addresses the difficulty that URM students often face in financing their degrees.

AGEP Efforts To Address Obstacles to Completion: Retention Efforts and Student Supports

Over half (53%) of the surveyed STEM students reported that AGEP played a strong or very strong role in their success in graduate school, however, there was some variability in student responses by discipline. The highest percentages of students reporting that AGEP played a strong role in their success in graduate school were in the agricultural sciences/natural resources, engineering, biological/biomedical sciences, and multidisciplinary STEM fields (30%, 28%, 28%, and 31%, respectively). The highest percentages of students who reported that AGEP played a very strong role were in the physical sciences (28%) and mathematics (34%). In contrast, students in the computer and information sciences were almost just as likely to report that AGEP played no role in their success in graduate school (26%).

When reports were examined by race/ethnicity, related to the value attributed to AGEP in promoting success in graduate school, 26% of URM students reported that AGEP played a strong role and 28% reported AGEP played a very strong role in their success in graduate school. Males and females did not differ in reports of the role AGEP played. Fifty-five percent of females and 52% of males reported that AGEP played a strong or very strong role in their success in graduate school.

AGEP retention strategies. Retention efforts and support mechanisms to retain students and address the obstacles URM students in STEM faced at alliance sites included but were not limited to AGEP efforts. Indeed, many of the AGEP retention efforts and student supports mirrored or overlapped with department- or school-level efforts. In an effort to try to separate the effect of AGEP activities on student retention and completion of the PhD from other campus activities, the following discussion focuses primarily on those supports that are identified as AGEP. In addition to reporting on the effect of AGEP on their decisions to stay in their respective graduate programs, students reported on the value of AGEP activities and programs to them more generally.

Academic Supports

Students, faculty, and AGEP staff at sites reported multiple academic supports aimed at retaining and helping students successfully complete their graduate programs. Stakeholders reported workshops, institutes, and "boot camps," or retreats aimed at giving students one-on-one guidance on completing theses and dissertations. A Maryland PROMISE co-PI commented, "Dissertation House and PhD Completion Project, these two have accounted for much of our success in graduating PhDs." These focused and intensive dissertation- and thesis-writing workshops give students the extra push toward completion. A department chair at the University of Maryland stated, "PROMISE activities like the PhD completion project and dissertation house affect retention and graduation rates."

> *"PROMISE activities like the PhD completion project and dissertation house affect retention and graduation rates."*
>
> --Department Chair

One of the primary activities of the SAPAI Alliance is a 6-week writing retreat to assist with thesis and dissertation completion. Students receive guidance on their writing process, receive feedback from instructors and peers, and ideally complete a draft of the thesis or dissertation. In speaking of the importance of this activity, the writing retreat instructor, an American Indian himself, remarked, "Tribal PhDs are very, very rare. We are the

URM of the URMs. We are actually increasing the number of professionals and this [the writing retreat] was a step in that process."

Formal tracking of student performance is another support tactic used by some AGEP campuses. On these campuses, when the tracking system flags poor student performance, AGEP project leaders can intervene to help the students. Common interventions include providing or recommending tutoring, counseling students through choosing courses, counseling students through personal issues, or recommending an appropriate course of action when a student feels he or she is in a difficult situation or faces significant choices. On campuses where tracking systems were in place, the co-PI, PI, or some other AGEP program coordinator generally took the lead in tracking student progress and implementing interventions for students experiencing academic trouble.

Faculty also noted the impact of the AGEP PI's role in monitoring student progress. For example, faculty at the Central New York–UPR Alliance noted that the PI had a very hands-on approach to ensuring the success of AGEP students and thus it would be quite difficult for those students "to fall through the cracks." Conversely, findings from the Student Survey revealed that AGEP students did not find that grade tracking made a difference in their success in graduate school. However, the nature and consequences of the tracking might explain why tracking student performance emerged as a *positive* theme on the site visits. For example, when tracking was punitive, as it was at one university in the GAELA Alliance, where students would be in danger of losing AGEP financial support if their grade point average fell below a minimum requirement, tracking might not be perceived as supportive by these students. However, at an institution like one in the Central New York–UPR Alliance, student performance and overall well-being was monitored in order to offer students academic and social-emotional supports that might influencing their performance. Thus, there was a different perception on the part of students between the affect of student monitoring versus grade tracking.

In addition to tracking students and offering support to address student's academic needs, most alliances reported regularly occurring seminars, workshops, and/or panels that addressed student success in graduate school. This more proactive retention strategy included seminars on making progress each year, choosing the right courses, negotiating relationships with professors and advisors, improving writing skills, improving teaching skills in science, and working in labs. Most alliances also offered professional development workshops aimed at helping students choose careers in STEM and giving students the tools to successfully apply for postdoctoral appointments and jobs, tools such as preparing a *curriculum vitae*, statement of interests, and practice for job talks. For example, the SAPAI Alliance implemented the Tribal College and University Faculty Preparation program to train and prepare AGEP scholars for faculty positions at TCUs, and to follow up with job placement in a TCU on completion of the graduate degree. Perhaps because of these academic supports, several respondents indicated that AGEP students demonstrated more confidence. AGEP leadership at one of the GAELA institutions stated that AGEP/GAELA Scholars

> …are more successful across the board, it's just unmistakable. They are more confident. They know that there are things out there for them. They know if they need help and they are not afraid to ask for it.

Likewise, referring again to SAPAI's Writing Institute, the co-PI described one student who particularly benefitted from the experience, largely because of the self-assurance she gained. The co-PI reported that this student initially was not interested in a PhD. "She didn't think she could even finish her master's. But the institute gave her great confidence, and now she is completing her masters and wants to go on to get her PhD."

Social Supports

> *"The key piece for retention besides the workshops is that they [students] know there is a central location in the graduate office, a safe place for people who look like them."*
>
> --AGEP Administrator

In addition to academic supports, efforts to create a sense of community both among AGEP students and URM students more broadly is a common AGEP philosophy and practice. Stakeholders across all alliances highlighted the importance of creating environments of support for URM STEM students, environments where students felt reassured that they were not "the only one" in their program who cared about their academic success. Support mechanisms provided by AGEP gave students a community with which they could connect academically and socially. An administrator at an institution in the Midwest Crossroads Alliance stated, "The key piece for retention besides the workshops is that they [students] know there is a central location in the graduate office, a safe place for people who look like them."

Moreover, interviewed faculty participants cited activities such as retreats, social events at professors' homes, and meetings to connect with other AGEP students as important community-building opportunities. One faculty member stated, "PROMISE is a program that gives participants a sense of identity." Faculty stakeholders also noted that AGEP provided opportunities for URM students to connect with students in other departments, thereby building a sense of a larger community, especially at larger universities. A faculty member in the SEAGEP Alliance stated,

> The students I work with who are part of SEAGEP, they have colleagues who are from underrepresented groups in other departments and other colleges. SEAGEP makes a critical mass across the campus. It builds bridges and makes a social network. Students feel that they are part of a much bigger whole. I think it is bigger than just the departments.

A SEAGEP student commented, "Spending time with other minority students that were a part of SEAGEP has really helped me. Not verbally saying 'yes you belong,' but when I'm with them I can feel that I'm not the only one having these issues." In a similar vein, a UC Alliance student stated that making connections "with other students coming in through Competitive EDGE and STEM feels like [having] a family away from home."

Mentoring. In addition to the social support provided by an AGEP community, mentoring from faculty, peers, and especially AGEP staff emerged as an important AGEP retention strategy. Stakeholders at all alliances visited reported encouraging and facilitating mentoring relationships between AGEP students and faculty. In some cases, students' faculty advisors served as their mentors; in other cases, students were assigned mentors in addition to their academic advisors. Quite often, students would also form mentoring relationships with AGEP staff.

Peer mentoring efforts within alliances tended to be formally structured. The Midwest Crossroads Alliance, for example, has an emissary program in which more seasoned graduate students serve as "go-to" people for incoming graduate students, to help get them acquainted with the university and their departments. One student in the Midwest Crossroads Alliance noted,

> I participated in the PEER-WISE program since being a freshman here. I can't tell you how many times having [peer mentor] around was beneficial to me, being able to discuss what was going on personally and academically. She was my biggest cheerleader. Now I'm a graduate student in bioengineering instead of being in industry right now because of the path she showed me.

Similarly, Maryland PROMISE's peer mentoring program involves advanced graduate students' serving as mentors to first- and third-year graduate students (the years stakeholders in this alliance identified as those when student attrition is most likely to occur). Mentors and mentees met on a weekly basis and conferred with the AGEP program coordinator about student progress. Several students in the PROMISE Alliance stressed that "if it weren't for PROMISE, [they] would have dropped out."

Following a similar format, the University of Puerto Rico AGEP required students to have a student mentor during the first year, and then required the same students in their second year to serve as mentors to incoming students. One student at UPR Rio Piedras commented,

> I had a mentee, a senior who was in the chemistry department. I also met every week with my own mentor. We talked about graduate life and things you have to do in the process. You start feeling confident. You can face these things better.…I was very fortunate to have her as a mentor.

Financial Supports

Like academic and social supports, financial supports are an important mechanism for retaining URM students in graduate programs. Examples of AGEP-sponsored financial support include the Central New York–UPR Alliance's supplemental funding for students in the first and third years to combat possible attrition during these years. In some alliances, financial support came in the form of stop-gap funding, assistance with the purchase of lab equipment, and in special situations, financial assistance for medical needs and housing.

Some AGEP participants also highlighted the fact that AGEP-sponsored financial support could sometimes buy students out of their teaching requirements. This buyout freed up time for the students to focus more on their research. A faculty member in the SEAGEP Alliance noted, "The SEAGEP fellowship can be used to release a student from teaching to spend more time on [his or her] coursework. That's an important factor in terms of retention." In fact, a SEAGEP postdoc directly attributed his finishing to financial support received from AGEP: "Financially, the stipend helped me through that last year. I just couldn't teach. If I were teaching, I guarantee you that I would still be in grad school."

All the visited alliances reported providing financial support for students to attend and present at conferences. Many students saw this support as pivotal to their academic and professional development. Many noted that the networking opportunities and exposure to new and innovative research at professional conferences reinvigorated them and motivated them to persist with their graduate study.

Some alliances also provided fellowships to AGEP students, to cover the costs of academic fees and, in some cases, tuition. For example, at Howard University, a cadre of students is selected through a competitive process to be full participants in the AGEP program. Many AGEP activities were open to all students, but students who were full participants received an AGEP scholarship, funded through several different sources. Although the scholarship is not exclusively funded using AGEP monies, it was considered an AGEP intervention. Similarly, AGEP students in another alliance received a fellowship that would buy them out of teaching assistantships. The campus awarded $13,000 a year to 5 to 10 students through an application process. The fellowship covered stipends, travel money for conferences, and money for research materials.

Perceived Impact of AGEP on Retention and Completion Rates

The majority of respondents who were familiar with or involved in AGEP activities, as indicated in the above discussion, highlighted the benefits of AGEP and suggested that the presence of AGEP on campus enhanced URM students' experiences. However, when asked specifically about the possible influence AGEP was having on the retention and completion rates of URMs in STEM, responses varied across the alliances, across institutions, and even across departments within individual institutions. Many respondents, especially those from alliances that had been funded more recently, felt that the program had not been in place long enough to make any firm judgments or statements about its success in retaining and graduating more URM PhD candidates. Others attributed the increases they had seen partially to AGEP but also to a whole change in campus culture, in terms of leadership and faculty perceptions of URMs in STEM, or to the multitude of programs and supports, including AGEP, aimed at building the pipeline to the PhD for URMs.

AGEP staff from other alliances and institutions also reported data demonstrating greater retention and completion rates among URMs since starting the AGEP program. During the visit to the UPR Alliance, leadership at the Rio Piedras campus reported that, prior to AGEP, only 40% of the students entering graduate programs completed the PhD. Completion had since increased to 90%. As another example, the associate dean at one of the Midwest Crossroads Alliance institutions stated that the institution had doubled the number of URMs completing a PhD. UC Alliance leadership also reported that AGEP students had better retention rates than the general student body, particularly since beginning a specific AGEP activity that connected AGEP students with AGEP leadership, postdocs, and invited speakers around topics related to student support. Indeed, a faculty member at this same institution stated, “For bang for buck, I have never seen a program as effective as AGEP. . . . When you leverage AGEP you see more PhDs come out of that.”

Summary

Overall, AGEP appears to be meeting one of its primary goals, positively affecting the PhD completion of URM STEM graduate students. Nationally, the number of URMs completing PhDs in STEM doubled from 1990 to 2007, and the increases were greater in AGEP institutions than in non-AGEP institutions, especially on a per-institution basis. The increases in completion were most notable in the biological/biomedical sciences and engineering disciplines, and among Hispanic students.

AGEP participants reported numerous obstacles in their graduate school experiences, such as lack of academic and social integration and poor-quality faculty–student mentoring relationships. However, AGEP students highlighted academic, social, and financial support mechanisms put in place by AGEP as having significantly influenced their decisions to remain in their graduate programs and promoted their success in graduate school.

Chapter VII. AGEP and the Pipeline to the Professoriate

African Americans, Hispanics, and Americans Indians are significantly underrepresented in science, technology, engineering, and math (STEM) tenured faculty positions (Turner, Viernes, & Myers, 2000). In recent years URMs have accounted for only 7.9% of science and engineering, doctorate-held academic positions in universities and 4-year colleges (National Science Foundation, 2008). The percentage increases slightly (to 12.8%) when we look only at teaching positions. It decreases, however, for research faculty positions (7.5%) and adjunct faculty positions (6.3%). The numbers are even worse for URM women. Underrepresented females are nearly invisible as science and engineering faculty, and studies find that they are less likely to attain tenure than are White women or males of any racial group (Nelson, 2007). The overwhelming majority of doctorate-holding scientists and engineers employed as STEM postsecondary faculty are White or Asian males.

The small numbers of URMs in faculty positions can be traced to several phenomena. URMs may find careers in academe unattractive because of negative, hostile, or indifferent experiences they had with graduate school professors or faculty advisors. They may also perceive faculty positions negatively based on their observations of their professors. For example, they may view academic positions as associated with an imbalance in work and family life for junior faculty members, inadequate compensation for lengthy postdoctoral work, the possible marginalization of faculty of color at non-MSIs, and a lack of support for research endeavors (Clewell & Anderson, 1997; George et al., 2001; Golde, 2005). URM PhDs in STEM—particularly those who are the first generation in their family to attend college—may also be drawn away from the professoriate to nonacademic careers because of better earning potential in the latter (Turner et al., 2000).

Because a key goal of AGEP is to increase the numbers of URM STEM faculty, we examined URM STEM students' postgraduate career plans and the role that AGEP may play in students' decisions to pursue careers in academe. Specifically, we aimed to answer the following research question:

- What are the trends in the plans beyond the PhD for persons who recently earned doctorates in STEM disciplines? How do the plans differ between URM and non-URMs?

This chapter presents data on URM students' postgraduate plans, including national trends for URM graduates from AGEP institutions. Findings from the AGEP Student Survey and site visits are also discussed with regard to the encouragement students received to enter the professoriate through AGEP programming, as well students' perceptions of an academic career and students' long-range career goals.

Key Findings

- The analyses of Survey of Doctoral Recipients (SDR) data demonstrate that, overall, the trends in URM students entering the professoriate 1 and 2 years after graduating from AGEP institutions have remained fairly stable over time. From 1993 to 2005, about 11% (annually) of graduates of AGEP institutions entered the professoriate the first year after graduating. The percentage jumps to around 25% (annually) the second year after graduating.

- All visited alliances had programming aimed at promoting careers in academe; these programs ranged from workshops, seminars, and panel discussions on obtaining and maintaining a faculty position to professoriate preparation or future faculty institutes. Only one of the visited alliances had a faculty placement program.
- The AGEP Student Survey and site-visit data indicate that, although more than half of AGEP students planned to enter academia, a significant number of AGEP participants desired an alternate career path.
- Thirty-two percent of the surveyed students reported that they received strong encouragement through AGEP to pursue a career in academe.
- Survey results suggest that activities and services that had a positive influence on AGEP students' decision to pursue the professoriate were funding for research and travel to conferences, workshops, feelings of being a part of a community of underrepresented students, and participation in a student monitoring or tracking program.
- Site-visit data indicate that faculty varied in the extent to which they encouraged AGEP students to pursue an academic career. Several faculty members remarked that their primary objective was to ensure that students were prepared to enter the profession they were most interested in and had the aptitude for, regardless of whether that position was one in academe or the nonacademic workforce.
- Students most commonly perceived the following as benefits of an academic career: flexible work schedule; intellectual freedom; service as a role model, mentor, and advisor; and job security (once tenure is obtained). Students most commonly perceived the following as drawbacks to an academic career: the challenges associated with the tenure process; the pressure to publish and bring in grant money; the difficulty of balancing teaching, research, grant writing, and administrative duties of a professor; the isolation and discrimination experiences of faculty of color; and low salary (compared with industry or government lab salaries).

New STEM PhDs in Academic Positions

AGEP institutions versus non-AGEP institutions. SDR data for 1993–2005[23] were analyzed to examine trends in the employment decisions of URMs from AGEP-funded institutions after earning a graduate degreed in STEM. The data were analyzed to compare the percentage of URM STEM doctoral recipients from AGEP institutions and non-AGEP institutions who were working in professorial positions the first and second year after graduation. In reviewing the results of these analyses, it is important to note that, since the AGEP program did not begin until 1998, we would not expect to see the affects of AGEP on increasing URMs in the STEM

[23] The SDR was conducted every 2 years (except for one 3-year stretch, between 2003 and 2006), and thus data are available from every other year.

professoriate (at least for students who would have had full exposure to the program throughout their doctoral studies) until at least 2003.

The analyses demonstrated that, overall, largely similar percentages of URMs from AGEP and non-AGEP institutions were in professorial jobs in the first year after they received their PhDs. Since 1999–2000, the percentage of AGEP institution graduates working in professorial positions has remained fairly steady, at nearly 11%, whereas the percentage of graduates in professorial positions in the first year after graduation from non-AGEP institutions has decreased slightly. However, the differences between the two groups are negligible (see Exhibit 7-1).

Exhibit 7-1. Percent URM STEM Doctoral Recipients Working in Professorial Positions *First* Year After Graduation

Year of PhD	AGEP	Non-AGEP
1993–1994	11.8	11.3
1995–1996	10.8	12.9
1997–1998	12.2	10.4
1999–2000	10.8	10.1
2001–2002	10.9	9.3
2004–2005	10.7	9.6

Source: Survey of Doctoral Recipients

As Exhibit 7-2 illustrates, URMs who graduated from both AGEP and non-AGEP institutions were more likely to hold professorial positions in the second year after graduation than in the first year, averaging close to one fourth. These data also show the percentage gap between AGEP institution graduates and non-AGEP institution graduates in professorial positions widening beginning in 1996–1997. However, the difference between the two groups remains not slight. Furthermore, as mentioned above, since the AGEP program did not begin until 1998, we would not expect to see the affects of AGEP on increasing URMs in the STEM professoriate (at least for those students who had full exposure to the program) the second year after graduation until 2004 at the earliest.

Exhibit 7-2. Percent URM STEM Doctoral Recipients Working in Professorial Positions *Second* Year After Graduation

Year of PhD	AGEP	Non-AGEP
1992–1993	24.5	23.5
1994–1995	22.3	23.2
1996–1997	24.9	20.3
1998–1999	25.3	20.3
2000–2001	28	20.9
2003–2004	26	21

Exhibit 7-2. Percent URM STEM Doctoral Recipients Working in Professorial Positions *Second* Year After Graduation

Year of PhD	AGEP	Non-AGEP

Source: Survey of Doctoral Recipients

URMs and non-URMs at AGEP institutions. Comparing URMs to non-URMs within AGEP institutions reveals that a higher percentage of URMs were in professorial positions the first and second years after they received their PhDs than non-URMs, although the difference is not statistically significant. These data also demonstrate that, both in the years prior to the beginning of the AGEP program (the years prior to 1998) and during the AGEP-funding years (1998-2005), URMs were consistently more likely to enter the professoriate after graduation than were non-URMs. (See Exhibits 7-3 and 7-4.)

Exhibit 7-3. Percent STEM Doctoral Recipients From AGEP Institutions Employed in Professorial Positions *First* Year After Graduation

Year of PhD	URMs	Non-URMs
1993–1994	11.8	9
1995–1996	10.8	9.6
1997–1998	12.2	8.8
1999–2000	10.8	9
2001–2002	10.9	8.8
2004–2005	10.7	8.7

Source: Survey of Doctoral Recipients

Exhibit 7-4. Percent STEM Doctoral Recipients From AGEP Institutions Employed in Professorial Positions *Second* Year After Graduation

Year of PhD	URMs	Non-URMs
1992–1993	24.5	19.1
1994–1995	22.3	20.1
1996–1997	24.9	19.1
1998–1999	25.3	19.8
2000–2001	28	19.5
2003–2004	26	19.7

Source: Survey of Doctoral Recipients

Differences in career choice, by race/ethnicity and discipline. SDR data were disaggregated by race/ethnicity and discipline and then analyzed to examine the first careers of students who graduated from AGEP institutions pre-AGEP funding and during the AGEP-funding years. Overall, the difference in the percentage of URMs in professorial positions 1 to 2 years after graduating prior to and during the AGEP-funding years was not statistically significant. Despite the lack of statistically conclusive findings, it is apparent that more Hispanics are moving toward professorial positions than are African Americans. Also, more PhD recipients in the physical sciences show signs of moving toward professorial positions than do PhD recipients in engineering or biological/biomedical sciences (other discipline numbers were too small to analyze separately). See Exhibit 7-5.

Exhibit 7-5. Percent STEM Doctoral Recipients Working in Professorial Positions Within 2 Years After Graduation, 1992–1993 to 2003–2004

	Pre-AGEP Funding Years (1992–1997)	AGEP-Funding Years (1998–2004)
All STEM		
URMs	26.3	27.4
Hispanics	24.1	30.4
African Americans	30.1	26.5
URMs		
Engineering	27.4	26.5
Biological/biomedical sciences	19.9	19.2
Physical sciences	15.7	20.8

Source: Survey of Doctoral Recipients

AGEP Students' Career Plans Postgraduation

To supplement the SDR data, survey items asked students to report their long-range career goals and interest in pursuing careers in academe. The results of this data collection are presented below.

Overall interest in academic careers. Fifty-two percent of STEM surveyed students indicated that they wanted to hold a position in academe in some higher education setting: 33% reported a faculty position at a research-focused institution as their first choice; 17% desired a position at a teaching-focused, 4-year institution; and 2% wanted to teach at a 2-year institution. These data indicate that, although a faculty position at some type of institution of higher education was desirable to more than half the STEM surveyed population, many AGEP students anticipated an alternate career path. Given the almost equal split between students who were interested in the professoriate and those who were not, and given the variance even among those who wanted a career in academe with respect to the type of institution at which they wanted to work, we disaggregated the data to determine any trends or patterns in the characteristics of students who desired different career paths (see Exhibit 7-6). Those most likely to report wanting a faculty position at any academic institution as a long-range career goal were:

- Students attending an MSI as a graduate student
- Of URMs, Hispanic and American Indian/Alaska Native students
- Male students
- Mathematics students

Exhibit 7-6. STEM Student Characteristics Related to Selecting Academe as a Long-Range Career Goal

Student Characteristics	*n*	Research University Position	4-Year Institution Position	2-Year Institution Position	Non-Academic Position
Type of institution attending					
Non-MSI	1484	33%	17%	2%	48%
MSI	136	49	18	1	33
Race/ethnicity					
African American	646	29	16	1	54
American Indian	28	43	25	0	32
Asian	68	21	10	0	69
Hispanic	760	41	18	2	39
White	40	23	18	0	60
Multiracial	74	32	19	1	47
Gender					
Female	784	30	21	2	47
Male	835	39	13	1	47
STEM discipline					
Engineering	475	29	13	1	57
Physical sciences	323	38	17	1	44
Computer and information sciences	126	23	12	1	64
Mathematics	116	47	22	2	28
Agricultural/ natural sciences	22	32	27	0	40
Biological/ Biomedical sciences	438	29	21	5	45
Multidisciplinary STEM	120	29	21	5	45

Exhibit 7-6. STEM Student Characteristics Related to Selecting Academe as a Long-Range Career Goal

Student Characteristics	*n*	Research University Position	4-Year Institution Position	2-Year Institution Position	Non-Academic Position

Source: AGEP Student Survey
Note: Students who indicated their long-range career goal was to take a position as an elementary or secondary school teacher are counted in the nonacademic group. Students who indicated the following career goals were also included in the nonacademic group: administrator or manager in the private sector, administrator or manager in the public sector, researcher in the private sector, researcher in the public sector, private sector employee, public sector employee, professional in a clinic or health care agency or hospital, self-employed or private practice, and other.

Interest in careers at MSIs. As noted in Chapter IV, 30% of the surveyed AGEP students had attended an MSI as an undergraduate. Since MSIs were an important source of AGEP graduate students, we sought to learn the degree to which AGEP participants were interested in faculty positions at MSIs. Overall, the majority of STEM surveyed students reported a moderate to high interest in a faculty position at an MSI. As presented in Exhibit 7-7, our analyses show that for both STEM and non-STEM students

- Students who were attending an MSI were more likely than those attending a non-MSI to express a moderate to high interest in obtaining a faculty position at an MSI (91% and 77%, respectively)
- At least 80% of African American, American Indian/Alaska Native, and Hispanic students reported a moderate to high interest.
- There was a negligible difference between male and female students interested in a faculty position at an MSI (77% and 79%, respectively).
- Students earning a degree in mathematics and agricultural sciences/natural resources were most likely to report an interest in obtaining a faculty position at an MSI (91% and 96%, respectively).

Exhibit 7-7. STEM Student Characteristics Related to Interest in Faculty Positions at an MSI

Student Characteristic	Moderate to High Interest	
	n	%
Type of institution attending		
Non-MSI	1,471	77
MSI	140	91
Race/ethnicity		
African American	653	80
American Indian/Alaska Native	28	86
Asian	62	71
Hispanic	755	80
White	37	46
Multiracial	71	65
Gender		
Female	799	79
Male	811	77
Discipline		

Engineering	464	72
Physical sciences	320	81
Computer and information sciences	117	71
Mathematics	116	91
Agricultural sciences/natural resources	23	96
Biological sciences/biomedical sciences	450	81
Multidisciplinary STEM	121	78

Source: AGEP Student Survey

In addition to the data collected through the AGEP Student Survey, undergraduate, graduate, and postdoctoral students were asked about their career goals and plans during the site visits to AGEP campuses. Although these students did not necessarily comprise a representative sample of the AGEP student population, their responses largely support the Student Survey findings and provide additional insight into how AGEP students were thinking about their future work in STEM and the extent to which entering the professoriate was a common goal.

The majority of students who responded to questions about future career goals and plans indicated at least some interest in entering academe or holding a teaching position. However, a number of students also indicated an interest in an industry position or a position with a federal agency (e.g., NSF, NASA), and some students were still undecided about their future plans and career paths. Overall, students' stated career goals essentially fell into six major categories:

- Faculty position at a research university
- Faculty position at a 4-year institution
- Faculty position at a community college
- Faculty position at an MSI
- Industry position first and then a move into a faculty position, either full time or as an adjunct
- Industry position or a position with a federal agency

AGEP's Role in Encouraging Students to Pursue an Academic Career

Given that one of AGEP's key objectives is to diversity the STEM faculty workforce by encouraging URMs in STEM to enter the professoriate, we also used survey and interview data to examine the extent to which AGEP students felt encouraged to pursue an academic career and the types of supports AGEP institutions were providing to students to prepare them for future faculty positions.

Encouragement from AGEP to pursue an academic career. To assess AGEP's role in encouraging students to enter the professoriate, students were asked to "rate the level of encouragement you have received from AGEP to pursue a career as a professor." Students responded on a 5-point scale that ranged from not encouraged to strongly encouraged. About one third (34%) of the STEM respondents felt strongly encouraged; 26% felt encouraged;15% felt moderately encouraged; and 7% felt little encouragement. (The percentages for non-STEM students were 26%, 18%, 14%, and 8%, respectively.) Eighteen percent of the STEM students (34% of non-STEM students) reported that they received no encouragement from AGEP to pursue a career as a professor.[24]

Although 80% of the total surveyed population reported receiving at least a little encouragement, it is interesting that only 32% reported strong encouragement, given the program's focus on moving students into the professorial positions. Although the data reveal some variability by discipline and by race/ethnicity, in all instances, the percentages were lower than 50%. The agricultural sciences/natural resources and mathematics fields had the highest percentages of students reporting that they received strong encouragement (44% and 39%, respectively). The computer and information sciences had the lowest (24%). By race/ethnicity, African Americans most frequently reported feeling encouraged (44%). See Exhibits 7-8 and 7-9.

Exhibit 7-8. Percentage of Students Reporting Strong Encouragement to Pursue Career as Professor, by Discipline

Discipline	Strongly Encouraged	
	n	%
Agricultural sciences/natural resources	23	44
Biological/biomedical sciences	467	35
Engineering	497	35
Mathematics	121	39
Physical sciences	342	36
Computer and information sciences	131	24
Multidisciplinary STEM	126	34
Non-STEM	432	26

Source: AGEP Student Survey

[24] It is possible that those students who reported an unfamiliarity with AGEP comprised at least part of this 18% of STEM students and 34% of non-STEM students. Students who may have known AGEP by another name on campus may not have attributed any encouragement they received to the program.

Table 7-9. Percentage of Students reporting Strong Encouragement to Pursue Career as Professor, by Race/Ethnicity

Race/Ethnicity	Strongly Encouraged			
	STEM		Non-STEM	
	n	%	*n*	%
American Indian/Alaska Native	28	36	9	22
African American	680	41	230	32
Asian	73	7	15	20
Hispanic	795	33	131	21
White	44	11	13	24
Multi-racial	81	32	23	22

Source: National Survey of AGEP Students

The data collected through the site visits were largely consistent with the survey data. AGEP staff, faculty, and students who participated in on-site interviews and focus groups were asked to describe the extent to which AGEP encouraged students to pursue an academic career, as well as the types of AGEP programming available on campus to encourage and prepare students for a faculty position. The level of encouragement and activities varied considerably across alliances and even within alliances, but for the most part, moving students into the professoriate received less emphasis than recruiting students into graduate school and ensuring that they completed the degree. This may be one reason why only one third of surveyed students reported strong encouragement to pursue careers as professors.

Faculty encouragement to pursue careers in academe. When interviewed, faculty and AGEP staff described a range of views on the role that AGEP should play in encouraging students to enter the professoriate. Some faculty thought that, although AGEP's goal was to increase the number of URMs in the STEM professoriate, URMs are underrepresented in all areas of the STEM workforce. Therefore, AGEP should provide opportunities for URM student awareness of and preparation for multiple career trajectories. A department chair in PROMISE noted,

> *[Academe] is not the primary route for a lot of graduate students. Providing them with the knowledge about what's involved, if it is a realistic option for them, that's really what we do.*
>
> —Department Chair

> I'm comfortable with the idea of simply increasing the pool. If AGEP increases the number of people who earn the PhD and have a decent experience, a certain percentage of them will want to go into higher education and be professors

> themselves, then the feedback loop will amplify. There are students who want PhDs but have no interest in academia. If you increase the supply, enough students will feed back in and that's success.

Explaining his perspective, a chemistry professor in the Central New York–UPR Alliance stated, "I don't think everyone is suited to go into academia. It requires independence and intent, so I think it would be wrong to encourage everyone to do this." Similarly, a PI from another alliance thought that projects "…should track who goes into Research I [universities], industry, teaching, [and other] jobs, but students should be allowed to explore all aspects."

"I think that AGEP, being the first effort of the institution to do cross-discipline training to help students think about becoming professors, was important for students and faculty."

--Faculty Member

Several interviewed faculty members felt that AGEP should best be viewed as support for getting students through the PhD program, with less concern about career choices subsequent to completion. Chapter V illustrated the myriad challenges that URM students encountered in their graduate school experiences, and the significant role of faculty mentoring in their success in graduate school. Correspondingly, some faculty noted the importance of focusing on URM students' PhD completion as the primary goal.

Other interviewees indicated that some faculty members strongly encouraged students to consider academic careers. In fact, some students noted that support from faculty waned if students expressed an interest in a career other than the professoriate—in particular, a career as a professor at a research institution. One graduate student at the AISES conference commented, "[T]eaching is low on the cultural hierarchy. People push you toward research or working in industry. Support slows down when they see that you are interested in a different track."

Some faculty also noted the importance of encouraging URM students to seek academic positions, in order to increase diversity in the STEM professoriate. A dean in the PROMISE Alliance stated, "It is very important because if we get more people who are coming from underrepresented groups into positions of authority and decision making, I think programs like PROMISE may become superfluous." Similarly, a faculty member in the Howard–UTEP Alliance remarked,

> I think that AGEP, being the first effort of the institution to do cross-discipline training to help students think about becoming professors, was important for students and faculty. It made us think about steps that are needed to better train students and make them aware of how to become better professors.

AGEP programming aimed at careers in academe. Despite the varying reports of encouragement students received through AGEP and the faculty to pursue careers in academe, the alliances implemented a range of programs aimed at exposing students to and preparing students for such careers. Examples of these activities and services were workshops, seminars, and institutes on preparing for faculty positions; conferences that provided career networking opportunities; teaching and peer mentoring experiences; and postdoctorate "boot camps."

Workshops, seminars, and panels covered such topics as searching for academic positions, preparing a *curriculum vitae*, giving job talks, writing grants, publishing, and attaining tenure. These findings suggest that, for students with an interest in academe, supports are available through AGEP. However, these opportunities may not be as forthcoming for students who do not express such an interest.

Students who took advantage of the activities geared toward faculty preparation expressed widespread appreciation for what they were able to gain. A Howard–UTEP AGEP alumnus stated, “Providing information about the professoriate through workshops and panels is critical,” and another commented, “I’m very thankful for AGEP . . . it prepared me for [a position at a] Research I [university].” In speaking of the Preparing Future Faculty program offered at one of the Midwest Crossroads institutions, an associate dean explained,

> [The Preparing Future Faculty program] is something that I very strongly value. It’s very complimentary of the things that we do. It’s a good example of the continuum of support. There are postdocs in there, and it really builds relationships across the disciplines. It builds networks, and people get best practices about how to get to the next step.

The SAPAI Alliance’s AGEP program, however, was the only one specifically designed to place graduates into faculty positions. The alliance sponsored an annual Faculty Development Institute to help students prepare for a faculty position at a Tribal College or University (TCU), and AGEP staff facilitated the placement process. The alliance sponsored part of the students’ salaries the first year they were at the TCU, after which they were expected to bring in research grants to help support their positions.

Teaching experience, opportunities to mentor undergraduates or junior graduate students, and mentoring and courses aimed at how to teach well were also identified as AGEP activities that encouraged and prepared students for faculty positions. The UC Alliance had a faculty–student partnership program in which students shadowed faculty at community colleges. Similarly, students in the PROMISE Alliance attended panels in which current community college faculty and faculty at teaching institutions spoke about academic positions at nonresearch universities. Although students often complained that teaching courses took time away from their research efforts, they agreed that the courses were a good experience and served as good preparation for future faculty positions.

Support for postdoctoral opportunities or postdoctoral boot campus also was an AGEP mechanism that encouraged student participation in the professoriate. Partners in the UC Alliance provided workshops on finding postdoc opportunities and postdoc boot camps to help students move into faculty positions. SEAGEP also funded minority postdocs.

Factors Influencing Students’ Decision To Pursue a Career in Academe

The literature review (Poirier, et al., 2009) identified several challenges affecting URM students’ pursuit of faculty positions:

- The desire for work–family balance, which an academic life is perceived to preclude

- Marginalization and isolation of faculty of color at majority institutions
- Negative or indifferent experiences with professors or faculty advisors while in graduate school
- Inadequate compensation for lengthy work
- Lack of financial support for research endeavors

Many of these obstacles emerged in focus groups held with STEM graduate students; however, many students also noted numerous benefits of a career in academe.

Drawbacks of an academic career. Students' perceptions of the drawbacks of a career as a professor were strongly influenced by their experiences with, observations of, and relationships with faculty in their graduate programs. Not all faculty members served as positive role models for an academic career. In fact, a few faculty members themselves indicated that they were poor models for students. For example, a faculty member in the UC Alliance stated,

> I'm not very successful at getting my students into professor-style jobs. . . . It's difficult because students see what we go through as professors; I'm not sure they want that. It takes a special kind of person to want to be a professor after exposure to 5 or 6 years with somebody like me.

In many instances, students seemed more convinced about the drawbacks than about the benefits of an academic career. The need to balance multiple responsibilities—such as teaching, research, committee work, grant writing, and administrative tasks—made faculty positions less appealing than non-academic positions. A student from the Central New York–UPR Alliance noted, "[I]t is an ideal job once you get past the tenure track, but it isn't for everyone." Similarly, a UC Alliance student communicated a lack of interest in a faculty position, citing "the stress of tenure and getting out publications—you can work hard and still not be rewarded." Several students were put off by the "publish or perish" culture of universities, particularly at research universities.

Students also noted the challenges associated with writing and bringing in grant money, which could result in a lack of reliable and consistent funding for one's research. For example, a student in the Midwest Crossroads Alliance explained,

> My boss is always writing grants. He spends more time writing grants than he does paying attention to the people in the lab. This seems to be part of just being a professor, but this is stifling undergraduate research. . . . I don't think professors are given the resources they need to really pay attention to undergraduate students. . . . I would like to get a PhD, but this is worrisome seeing this. I think he is more interested in getting money than doing interesting work.

Students also perceived that faculty salaries were not commensurate with the amount of work that professors actually did. Moreover, students perceived the available academic positions to be scarce and highly competitive.

A few students also noted discrimination and unique obstacles faced by minority and female faculty in STEM departments. Female students raised the concern that university culture is not amenable to the desire to start or have a family, and observed that professors seemed to lack a balance between their family and work lives.

For example, one student remarked,

> My professor is a female, and I can see how her family time suffers. She doesn't give as much time to her son. I don't see it as much with male professors. You can't be a woman and a professor; you have to keep [family and work] separate, at least in my department.

The reports of negative pressures on family life were not limited to female faculty, however. Speaking of a male laboratory leader, another student commented that, "My PI has two kids, and sometimes brings them to the lab. His little girl said, 'I don't want to be a scientist; all you do is work, work, work.'"

Tensions between teaching and research careers. Although many students talked about enjoying teaching and mentoring students, some also mentioned that teaching unmotivated students would be a drawback to a career in academe. Nevertheless, some students stressed the desire to emphasize teaching over research when contemplating faculty careers. Students lamented the challenges of balancing teaching with research, especially among those who desired and enjoyed teaching more than research.

One AGEP student remarked, "AGEP seems to be concerned with research careers. AGEP ought to communicate an interest in developing teaching careers. We feel embarrassed about our interest in teaching."

Moreover, when considering their postgraduate career plans, students expressed a desire to teach at teaching institutions or community colleges rather than research universities where the emphasis is placed on doing research, getting research funded, and publishing.

Benefits of an academic career. Notwithstanding the aforementioned barriers and drawbacks that students perceived to be associated with faculty careers, students consistently stated that an academic career carried some benefits. Students highlighted the job security of a faculty position once tenure is achieved, and also noted that in academe, unlike industry or government labs, one is able to have sole control over his or her research projects. A student in the Midwest Crossroads Alliance stated, "There is no one but you that is guiding your program. You just don't get that freedom in industry; there is always someone else pulling the strings. That independence is something for me that is very appealing." Furthermore, for a research professor, there are opportunities to coordinate and collaborate with research faculty at other universities.

Another benefit students perceived was the opportunity to teach, mentor, and advise undergraduate and graduate students, and serve as a role model for minority students interested in STEM disciplines. A Midwest student stated explicitly, "One of the major benefits is teaching particular undergraduate students." Similarly, a UC Alliance student noted, "I think it would be really cool to influence and motivate students, have more control, and have a bigger interaction working with people or mentoring them." Of course, these statements also reflect the tension between a teaching and a research faculty position, as discussed above.

Desire to give back to community. Another important theme that came up among the AGEP students in considering careers in the professoriate was the desire to give back to their communities and serve as role models to other racial/ethnic minority students, both inside and outside the university community. A student in the UC Alliance plainly stated, "My main goal is outreach and giving back to the community or to the students." Students expressed such desires as wanting to help others through their educational process and to be in a position to mentor students. They also expressed the desire to have an impact on the number of disadvantaged URM students pursuing higher education and the opportunities and access it can provide. In addition, students noted that a career in the professoriate would give them the status to impact youth in the larger minority community. A GAELA student commented, "I would hope that if I had a faculty position, it would allow me to be involved in the community some kind of way—not just teaching and research."

Some students expressed a specific interest in teaching at an HBCU, HSI, or TCU. As an example, one student stated, "It's my personal experience that leads me to want to go back and teach at an HBCU. I had wonderful experiences and some really good memories at my HBCU." Similarly, a student at the AISES conference commented,

> From the time I entered college, I knew that I wanted to work in a Tribal College. In my reservation, tribal leadership is poor. They are educated in Western philosophy and are degrading tribal values. I want to maintain identity and culture. Teaching science in a tribal college allows me to do that. My goal is to have undergrads present their work in our own language.

Summary

The survey data and data collected through on-site student focus groups and interviews with AGEP staff and faculty suggest that, although close to half of AGEP students plan to pursue a career in academe, the other half desires an alternate career path. SDR data show that only about 11% of graduates of AGEP institutions enter the professoriate within the first year of graduating and only about 25% enter within 2 years of graduating. These findings have implications for AGEP programming and activities if the professoriate is to remain a primary objective. There may be an ongoing tension between using limited funds to facilitate PhD enrollment and completion, and spending them for activities designed to guide students into an academic career. Many institutions seem to focus largely on the former rather than the latter. Faculty also appear to reflect the tension between encouraging students to pursue faculty positions and supporting students to reach their own, self-identified career goals—which leads to other major tensions that several students expressed: for example, those of pursuing a research career versus a teaching career or a position that allows them to give back to their home community, or of a career in academe versus a higher paying position in industry or government.

Chapter VIII. AGEP Challenges and Recommendations

Previous chapters of this report have presented evaluation findings about the AGEP program focused on its implementation at individual alliances and trends in enrollment, PhD completion, and first career position. A key finding that arose from the data was the increases in URM STEM PhD completion at AGEP institutions. This finding suggests that AGEP may be having a positive influence on the retention and completion of URM STEM graduate students. Given this finding, this chapter reflects on how AGEP can ensure it is capitalizing fully on its potential affect on the production of URM STEM PhDs. Specifically, this chapter discusses two challenges facing the AGEP program as it moves forward and presents recommendations to NSF and to the AGEP community related to the alliance structure, the involvement of students in AGEP, the involvement of faculty in the AGEP projects, AGEP's role in moving students on to the professoriate, and the role that program evaluation should play in the implementation of AGEP.

Potential Challenges Facing the AGEP Program

Visibility and Branding of the AGEP Program

In addition to the perceived strengths and limitations of AGEP, students' actual knowledge of and familiarity with AGEP-sponsored opportunities are potentially critical components in weighing the program's influence. The low visibility and "branding" of AGEP on alliance campuses was an important theme that arose both during site visits and in the AGEP Student Survey.

In the survey, when students were asked to rate their level of knowledge about AGEP, only 9% of respondents were very knowledgeable about AGEP. Just over half the respondents (51%) reported that they were moderately knowledgeable to knowledgeable about AGEP. Forty percent reported little to no knowledge of AGEP. Although these percentages may be misleading, since some students may know AGEP by another name on campus (e.g., by the adopted name of the alliance, i.e., PROMISE, GAELA, etc.), these data have implications for the manner in which the AGEP name has been branded at participating institutions.

In addition, when students were asked how AGEP could have been more beneficial to them in getting into graduate school, 34% reported that AGEP needed better advertising and more exposure, and would benefit from more recruitment and outreach to undergraduates. This was the most frequently reported response category. Examples of students' comments are below:

> I did not know about AGEP that much in undergraduate school. I heard about it because a friend of mine was a part of an undergraduate AGEP summer program because she was a member of a psychology lab. However I think she only participated because her lab mentor told her to. AGEP should have reached out to more undergraduates who were not members of research labs.
>
> I did not know AGEP existed until after I had already attended graduate school for a year. Knowing AGEP existed could have helped in the graduate school selection process.

> On our campus, I was not aware of AGEP until I became a graduate student. More exposure for the program would be beneficial to help students know what the program is, and to realize all that the AGEP programs can offer not only to graduate students, but to undergrads as well.

Similarly, when students were asked how AGEP could have been more helpful to them while in graduate school, the top response category (16%) was more visibility, better recruitment, and better communication. Also, when students were asked to comment about how AGEP could be improved, the most frequent comments (12%) were about the lack of visibility and poor communication about what AGEP is and what it does. Students wrote,

> It would be nice to have more information about what AGEP has to offer and more contact with other institutes.

> I didn't know about AGEP until my third year in graduate school once I was on the executive board of a student group. It would have been helpful if I knew about AGEP as a student, during my first year. Perhaps through a phone call or visit from an AGEP representative.

> Make your programs more AGEP visible. Some things that I'm a part of I had no idea that AGEP put them together.

AGEP visibility also came up during site visits to the 13 alliances. On-site interviews and focus groups indicate that AGEP recognition varied across institutions and alliances, and even within individual institutions. For example, in the Midwest Crossroads Alliance, there was variability in visibility and branding from campus to campus, as well as among departments on a given campus. For example, the IU co-PI emphasized, "When it's an AGEP-sponsored activity we are very careful to be sure that it's labeled AGEP. The programs that have grown beyond AGEP, the funding tends to be from other places; however, we still give AGEP credit." However, AGEP students at IU, Bloomington, noted that, campus-wide, students may not know AGEP exists. At IUPUI, a department chair noted: "The branding of AGEP-funded activities . . . maybe other departments do that better than me but in psychology we don't have that much." Thus, despite efforts at the AGEP administrative level to make students and faculty aware of AGEP, there remained a lack of visibility.

Respondents from the FACES Alliance also varied in their familiarity and knowledge of AGEP. For example, at Spelman, faculty reported that they were not familiar with AGEP and that the AGEP: FACES name had not been applied to resources or opportunities provided to students. One faculty member even stated, "When I hear FACES, I think Georgia Tech." All the students interviewed at Spelman, however, knew about FACES and the partner institutions.

In the SAPAI and PROMISE Alliances, students and faculty who participated in the respective AGEP projects knew of AGEP, but they noted that, campus-wide, PROMISE and SAPAI, were generally unfamiliar to students and faculty. Moreover, faculty typically found out about AGEP only if they were working with or knew a student who was actively involved in program activities. A PROMISE department chair noted, "I can honestly say that a lot of faculty don't know about it." In other cases faculty were aware of AGEP activities and opportunities, but didn't realize they were "AGEP." Faculty at SAPAI institutions, for instance, often thought of AGEP as part of the Sloan Fellowship program. Similar confusion existed among the faculty at one of the UC Alliance institutions.

AGEP visibility on the GAELA campuses appeared to have been affected by a gap in program implementation. Respondents at Southern University and Tulane University described AGEP as "a little invisible;" whereas, two students and most of the faculty interviewed at Xavier had no knowledge of AGEP or that their campus was a part of an AGEP alliance. When asked about this, the PIs at both Xavier and Tulane attributed the lack of knowledge about AGEP to the fact that AGEP programming ceased at many of the GAELA institutions after Hurricane Katrina.

Delays in Receipt of AGEP Funding

Regardless of their approach to AGEP programming, all the alliances and institutions we visited appreciated the funding AGEP provided and lauded the influence AGEP has had on focusing institutions' attention on the increased recruitment and retention of URMs in STEM graduate programs. On the other hand, they also strongly lamented the delays in receiving program funding, indicating that such delays had hindered their ability to implement a full AGEP program and also had resulted in faculty and other stakeholders' questioning the program's stability and future.

Respondents from 6 of the 13 visited alliances (FACES, Midwest Crossroads, PROMISE, SEAGEP, UPR Alliance, UC Alliance) listed the delay in AGEP funding as a major drawback of the program. Because of the funding delays, program services and/or staff were cut, the number of students served was decreased, and confidence in the stability of the program and NSF's commitment to the program was affected. One co-PI commented,

> There have been sort of structural issues with NSF that [have made AGEP implementation] difficult. Our funding has not been timely. That's a problem because we are having to use other resources to pay for AGEP expenditures. This creates a lot of hardships for the university. . . . We haven't had the issues to the extent that we have had to reduce staff. We are lucky in that because other schools have had to reduce staff; the funding just wasn't there.

At another institution, a student retreat had to be cancelled because AGEP funding had not arrived as expected and AGEP staff positions had to be eliminated. AGEP leadership at yet another institution stated that they were forced to use money intended to cover just 1 year for 2 years. As a result, they had to cut back on the number of students participating in a summer research program.

Perhaps more harmful, however, was the loss of enthusiasm for AGEP because of the funding issues. One campus PI voiced the following concern, "We were without funding for a year. We had to carry students on our own. That created some negative feelings among students and among faculty. We had heads of departments knocking on my door saying, 'Why am I taking this risk? Shut the program down.'"

Similarly, AGEP leadership from another program stated,

> AGEP money is incredibly important to us. [But] the program is in a terrible mess. . . . We have no money, we are floating the program with the hope that the bills will be paid. There is no money for next year. . . . It's really devastating to think that we will lose momentum because of what appears to be mismanagement.

Recommendations

Alliance Structure

The findings in Chapter III about AGEP alliances indicate that, when implemented successfully, the alliance structure can help AGEP campuses leverage resources and use economies of scale to create opportunities for students that single campuses may not be able to provide. Because the number of URM students pursuing PhDs in a STEM discipline on any one campus is small, the successfully implemented alliance can help students forge communities of support and professional networks that will assist them later in their careers. The same discussion, however, indicates that, while alliances can add value, not all current alliances are maximizing this potential. In a number of instances, the campuses taking part in the AGEP project are operating as autonomous, "siloed" projects. In these instances, the alliances are not adding as much value as they might.

To strengthen the benefits of the Alliance structure, future AGEP alliances may wish to consider the following:

- **Alliance relationships should be based on a strategy that maximizes leveraging of campus resources and the creation of intercampus communities.** A loose coupling of partner campuses creates a loose alliance, one where participating campuses' interactions are comparatively perfunctory. In an extreme version of this scenario, campus PIs speak occasionally on the phone and student participants may meet once a year for a very limited social or intellectual exchange. By contrast, some alliances have been able to structure monthly activities among students on different campuses. In these activities—workshops, shared seminars, research presentations, and social gatherings—students travel from one campus to another, or interact through telecommunications technology. The more frequent interaction helps create an alliance culture that is difficult to achieve through infrequent interactions. Moreover, the sharing of workshops, seminars, and presentations allows for greater and more frequent leveraging of the resources of the member institutions.
- **Shared alliance decision-making mechanisms among campuses may strengthen alliance cohesion**. As a corollary to the notion of leveraging resources, alliance partners may add greatest value to their efforts if they share more equal roles in the decision making for the alliance. In a few instances, representatives from partner institutions within an alliance suggested to the evaluation team that their campus did not enjoy the same governance stature within the alliance as the lead institution. This lack of parity meant that some campus concerns about alliance activities were inadequately addressed, and that concerned campuses felt subordinate to the lead campus. By contrast, we noted greater alliance cohesion when the partner institutions shared governance—including the

decision making about budget allocations. One alliance even had an office for the lead PI on each of the partner campuses to facilitate intercampus communication and to instill a greater sense of a shared vision among the partners.

- **Alliances should consider whether geographic proximity between member institutions leads to stronger partnership.** As another corollary to the notion of leveraging resources, AGEP alliances may best be based on partnerships between geographically proximate institutions. The sharing of resources and activities across great distances is not impossible. However, coordination of such activities and the interaction of graduate students were unquestionably stronger when the distances between campuses were more easily negotiated. The evaluation team saw the greatest alliance cohesiveness when the participating campuses were within commutable distances of one another.
- **Alliances would experience greater stability if the roles of alliance PI and project coordinator were filled by highly placed university administrators and faculty members.** As indicated above, financial difficulties on individual campuses and delays in the receipt of NSF funding have led to disruption in the staffing of AGEP projects. Project coordinators who were on soft money had their positions evaporate, and AGEP project activities and support services were interrupted or discontinued on some campuses as a result. While no staffing procedures can guarantee against project interruption, AGEP projects may best ensure continuity of activities if the PI and project coordinators are either highly placed campus administrators or tenured faculty members. These individuals are less susceptible in tough economic times to job elimination than individuals who are hired on project money or may hold lower ranks in their campus administrations. Moreover, we have seen throughout the evaluation that faculty knowledge about and participation in AGEP was limited. An additional benefit of having a faculty member in the role of project coordinator is that he or she may have greater leverage than a nonfaculty member to get their colleagues interested in project activities.

AGEP Students

AGEP project administrators have all shown a commitment to using AGEP funds to maximize opportunities for PhD students on their campuses. The notion of student participation varied across the projects. In some instances, there was a discrete, well-defined population of AGEP students who met regularly and had clear requirements that they had to meet in order to take part in the project. In other cases, AGEP students were defined as any URM on the funded campus, and “participation” meant as little as attending one sponsored AGEP event. In some cases, campuses had structured AGEP to avoid being exclusionary. As a result, AGEP projects were serving a wide range of students and these students did not always fit the demographic specified in the AGEP program guidelines. While the vast majority of students were pursuing a PhD or master’s degree in a STEM discipline, many students were URMs in fields outside of those traditionally considered STEM. There also were “pockets” of international or recent immigrant students on some campuses; other students were non-URM U.S. citizens and permanent residents.

Finally, although AGEP grants are supposed to be used for programmatic support and not for student fellowships, in practice, some AGEP funding provided a few graduate students with funds to help meet tuition or living expenses. In some cases, the AGEP fellowship was the students' only participation in the project—that is, the student did not have a history of taking part in project activities or taking on project-related responsibilities. This kind of support was well intentioned, but it may run against the expectations of the AGEP program.

With these phenomena in mind, we make the following recommendations:

- **NSF and the AGEP community should refocus AGEP on the population that is intended to benefit from the program.** AGEP projects should be held to greater accountability relative to U.S. URM students. The issue of permanent residents is problematic. The fact that 25% of the surveyed population was born outside the U.S. and that 17% of the surveyed population completed high school outside the U.S. may suggest that many AGEP students fall outside the target population. With good intentions, some projects were clearly including in their AGEP population students who were foreign nationals, as well as some immigrants who had gained permanent residency as late as college age and who did not share the same historical legacy of inequity as U.S. minority students. The inclusion of these students may be at odds with AGEP program goals and NSF's concern with broadening participation of U.S. URMs.
- **NSF should offer guidance to programs and engage PIs in dealing with the increasing interdisciplinarity in STEM fields.** In recent months, NSF has led a national conversation on broadening participation in STEM by URMs historically without full access to advanced STEM training. The dialogue has been couched in terms of equity with the intention of developing a strong STEM workforce from within the U.S. population. Given this contextual backdrop, AGEP projects should benefit from reemphasizing very clear definitions of what fields constitute STEM for the purposes of the program.
- **NSF should encourage and grantees should carefully consider a uniform definition of what constitutes an "AGEP student."** Going beyond specifying that AGEP students should be U.S. citizens and clarifying permanent residency criteria, grantees should be encouraged to limit AGEP funding so that it supports only active program participants. "Active participation" should ideally include a requirement that students apply to participate and agree to take part in a requisite minimum number of activities. Without such provisions, the benefits of AGEP dollars and project activities may be too diffuse to be meaningful or measurable.
- **NSF should offer greater clarification on the parameters of financial support with AGEP funds.** NSF may wish to limit such funding to students who are active participants in AGEP program activities pursuant to the preceding recommendation. Such a limitation would lead to great project cohesiveness and help create the sense that AGEP is something more than an inchoate funding stream.
- **Since many URM graduate students do have severe financial needs, the AGEP program should build a financial case-management component into AGEP projects.** During student interviews and focus groups, many students described anxiety about funding as a major contributor to thoughts about leaving graduate school. AGEP can encourage individual projects to train project personnel to work with graduate students to create a long-term financial plan for their studies. This financial case management should be a formal part of the project. In tandem with AGEP project personnel, students should

be encouraged to create financial plans with milestones for applying for and obtaining external and internal financial support. Generally, AGEP students need greater guidance than they currently receive regarding sources of financial support.

Faculty Involvement in AGEP

On the majority of campuses visited by the evaluation team, most STEM faculty interviewed had limited awareness of AGEP and the project components on their particular campuses. Faculty generally expressed support for the program's goals, but their actual involvement in their campus project was minimal, usually not extending beyond having a student in a class or lab who was an AGEP participant. This low degree of faculty familiarity with and involvement in AGEP is a missed opportunity to enhance the profile of the project on the respective AGEP campuses. This also represents a missed opportunity to harness faculty interest in ways that could benefit URM students. To these ends, we make the following recommendations:

- **NSF and individual AGEP projects should encourage the creation of intercampus steering committees.** These steering committees should be made up of faculty members from each partner campus and should meet regularly over the course of the academic year. These faculty members could be drawn from several campus departments and charged with the responsibility of communicating the goals and opportunities of the AGEP program to their colleagues and students in their departments. The AGEP project would gain additional credibility and cachet through such faculty involvement, and students would undoubtedly benefit from the attention that faculty participation would engender. The steering committees could encourage greater intercampus collaboration on AGEP events and stimulate intercampus research projects. In particular, these committees could more directly support specific AGEP goals by collaborating on postdoctoral and professoriate planning to benefit their AGEP graduates.
- **The AGEP program should consider greater outreach to the individual STEM directorates within NSF.** As indicated above in the discussion of AGEP students, NSF is currently engaged in a national conversation about broadening participation of URMS in STEM fields. Such a conversation, ideally, would involve all the STEM directorates and not just the Human Resource Development Division of the Directorate for Education and Human Resources (HER). The AGEP program may wish to explore with the individual directorates whether research grants made to faculty ought to require greater participation by the grantee faculty in efforts to broaden participation. An AGEP PI commented in a national meeting that "NSF will fund an individual researcher for years to conduct research, but expects AGEP grants to be short-term and catalytic." To strengthen the NSF commitment to broadening participation, for example, the longevity of research grants could be tied to working in a more integrated manner with AGEP grantees.

Moving Students on to the Professoriate

The AGEP goal of moving students into the STEM professoriate is clearly articulated in AGEP program materials and emphasized in national meetings. However, some AGEP PIs, project coordinators, and project-affiliated faculty members suggested that the goal of moving students into the professoriate is too narrow. Under this perspective, URMs who hold PhDs in STEM fields can also contribute to the American research enterprise in private companies or in the government, and students' doing so in no way diminishes the efforts of AGEP and the grantee campuses.

In focus groups, interviews, and in the Student Survey, many AGEP students indicated they would like to enter the professoriate, but not necessarily immediately after graduate school, and not always in a role where research is their primary professional obligation. As discussed in Chapter VI, some students would like to enter the private sector before going on to academia. Others sought to make important contributions as professors teaching at 4-year institutions and community colleges—on either a part-time or full-time basis.

Against this backdrop, the evaluation team makes the following recommendations:

- **The AGEP program should engage in dialogue on expanding the professoriate goal to one of more broadly creating STEM professionals**. We recognize that, as currently defined, the program is about moving URMs into the professoriate. We also note, however, that many project participants—students and faculty included—are questioning this specific goal. Given the broad needs of the American STEM workforce, and the paucity of URMS with PhDs in any sector of that workforce, there may be reason for NSF to redefine the *P* in *AGEP*, from *professoriate* to *professional*.
- **The AGEP program should recenter professional development needs within AGEP projects to be more inclusive of multiple paths to the professoriate.** Not all AGEP students wish to become research professors, and the national need for STEM professionals will have to be met by undergraduate institutions and community colleges, as well as research universities. Having AGEP graduates work in such institutions helps train the American STEM workforce and is consistent with the overall objectives of broadening participation of all sectors of the American population. To this end, the AGEP program and AGEP projects should foster teaching postdocs and positions for AGEP graduates across the spectrum of higher education institutions—from research universities to undergraduate and community colleges.

AGEP Project Evaluation

Over the course of the national evaluation, it has become apparent that individual AGEP projects are not well positioned to provide the national program with strong data about their impact. Evaluation efforts within individual projects are underdeveloped and idiosyncratic, and previous attempts at an aggregation of individual projects' data collection have not provided NSF the information it needs. In addition, AGEP grantees expressed concern that the program's requirements for evaluation go beyond what the individual projects can afford, given current funding levels.

Against this backdrop, the national evaluation team makes the following recommendations:

- **The AGEP program should continue to support data-tracking efforts.** Specifically, we recommend that NSF support the AGEP Tracking System and Registry (AGEP–TSR), a student tracking system developed by AIR and Xcalibur, LLP. This tracking system provides individual-level data on students within AGEP projects that can be aggregated to the national level. The system's report-generating capabilities make it attractive to individual campuses, AGEP alliances, and NSF, while its privacy provisions ensure the security of the sensitive date of the individual campuses. The system will provide NSF with material for perhaps the most efficacious program evaluation that AGEP has thus far undergone.
- **NSF should continue to emphasize evaluation training at the Joint Annual Meeting (JAM) for student support programs and at the AGEP National Meeting.** Evaluation is a complicated process, and individual projects need encouragement and training on how they can make the best effort to evaluate their programs. NSF may also wish to consider augmenting regular AGEP grants to support evaluation efforts, in order to maintain the strong environments of support benefiting URMs in STEM at the AGEP campuses.

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Appendix: Matching of AGEP and non-AGEP Institutions

This appendix explains the methodology used by the AIR research team to match AGEP institutions with comparable non-AGEP institutions. The two sets of institutions are compared in the trend analyses of Chapters IV and V. The data used to match the two sets of institutions were drawn from the Survey of Earned Doctorates (SED) and the Survey of Graduate Students and Postdoctorates in Science and Engineering (GSS).

The AGEP program started in 1998, and for this study, we included any alliance that received a grant award between the years of 1998 and the 2006–2007 academic year (23 alliances total). Because randomization as a technique of equating the departments in the treatment (AGEP) and control (non-AGEP) needed to occur prior to the implementation of the program, this technique was not feasible for the current study. Instead, the study used propensity score matching (PSM) to create a non-AGEP comparison group. Propensity score matching is a quasi-experimental technique that is often used to estimate treatment effect when experimental design is not feasible.

The theory underlying PSM to estimate treatment effects is to find individual units (e.g., schools, departments, persons) within a large comparison group that are similar in pretreatment characteristics to individual units that received the treatment. The outcome differences between these two similar groups can then be attributed to the treatment (Caliendo & Kopeinig, 2005). In this study, the treatment group included all STEM departments from institutions that received AGEP funding anytime between 1998 and 2008–2009 for PhD completions and 2006–2007 for graduate enrollment. The initial pool of nontreatment participants included STEM departments from all other U.S. institutions.

PSM involves generating a propensity score for each STEM department (AGEP and non-AGEP) and using this score to find the best possible matches. The propensity score for each department is the probability that the department will participate in AGEP, given a known set of pretreatment covariates. For our quantitative analyses, two sets of PSM were conducted, one to analyze completion and enrollment, and one for time to completion. A summary of each matching set is provided below in the "Completion and Enrollment" the "Time to Completion" sections, followed by a detailed description of the matching procedures that were used.

In the study, matching was conducted at the level of the six broad STEM departments identified for this study— engineering, biological/biomedical sciences, agricultural sciences/natural resources, math, computer and information sciences, and physical sciences. We assumed that, when an institution joined AGEP, all its STEM departments were eligible to participate in the project and in fact would receive benefits from project participation at the same time. That is, there was no staggering of the years in which individual departments within AGEP institutions and AGEP institutions within an AGEP alliance began to receive AGEP funding. All STEM departments within an AGEP institution and all member institutions within a given alliance received funding from the inception of the alliance's AGEP grant.

Completion and Enrollment

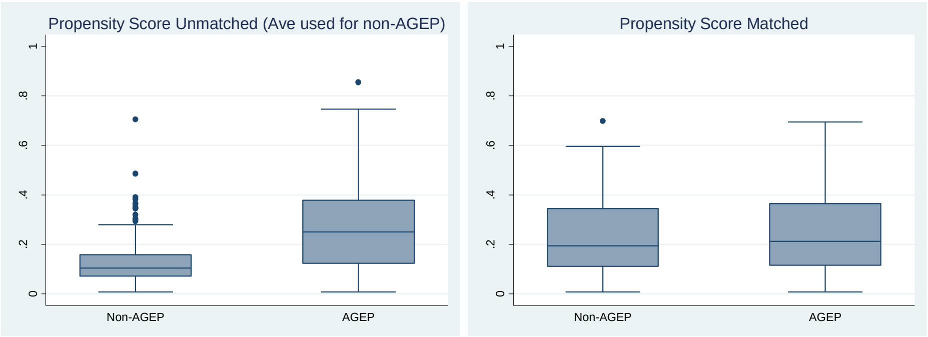
We first matched departments on the basis of enrollment and completion data for all URMs. Because enrollment and completion are closely related, we conducted one set of matching for both outcomes. To control for trends that were already occurring before institutions joined AGEP, the linear trend of URM completion and URM enrollment from prefunding years was used in modeling the propensity score for each group of funded institutions within an alliance. In addition to these trends, other variables were added to the model to increase matching precision on other key factors. A variety of model specifications were tested and diagnostics were run on the results for each model. Diagnostics included testing the difference between the groups of matched departments by running two-sample *t* tests on continuous variables or Chi Square tests on categorical variables within each of the six STEM disciplines. Exhibit A-1 presents the variables that were included in the final propensity score model and Exhibit A-2 presents the box plots of propensity scores before and after matching.

Exhibit A-1. Variables in Propensity Score Model for Completion and Enrollment Matching

Variable	Description
URM completion trend	The slope of the regression on URM PhD completions in STEM, prefunding
URM enrollment trend	The slope of the regression on URMs enrolled in STEM graduate programs, prefunding
Average URM completions	Average yearly URM PhD completions in STEM, prefunding
Average URM enrollment	Average yearly URM graduate enrollment in STEM, prefunding
Average total enrollment	Average yearly total graduate enrollment in STEM, prefunding
Average % URM enrollment	Average yearly % URM of total graduate enrollment in STEM, prefunding
Public/private institution	Public/private institution indicator (one dummy)
2005 Carnegie classification	Research I, Research II, or Other (two dummies)
Broad discipline	Broad discipline indicator (five dummies)

Note: All data used in matching were from prefunding years only (except Carnegie classification).

Exhibit A-2 Matched and Unmatched AGEP Propensity Scores



Time to Completion

A separate set of matching was conducted to analyze time-to-completion data. A similar procedure to that of completion and enrollment matching was used to determine a final propensity score model. Note that time to completion for prefunding trends were not included in this model because of missing data and the potential of outliers to greatly skew the data (for example, a student who took 20 years to complete a degree could cause a small department to have a very large prefunding trend). Instead of trends, institutions' median time to PhD completion was used. The variables included in the final model are presented in Exhibit A-3.

Exhibit A-3. Variables in Propensity Score Model for Time-to-Completion Matching

Variable	Description
URM time	URM median time to completion, prefunding
Non-URM time	Non-URM median time to completion, prefunding
Average URM completions	Average yearly URM PhD completions in STEM, prefunding
Average total enrollment	Average yearly total graduate enrollment in STEM, prefunding
Average % URM enrollment	Average yearly % URM of total graduate enrollment in STEM, prefunding
Public/private institution	Public/private institution indicator (one dummy)
2005 Carnegie classification	Research I, Research II, or Other (two dummies)
Broaddiscipline	Broad discipline indicator (five dummies)

Note: All data used in matching were from prefunding years only (except Carnegie classification).

Hispanics and African Americans

After conducting the matching of STEM departments on the basis of all enrolled URMs, additional matches were done separately for both Hispanics and African Americans. The same propensity score models were used as above, but data on all URMs were replaced by race-specific data (i.e., URM completion trend data were replaced by Hispanic or African American completion trend data).

Matching Procedures

Determining Eligible Departments

Among the AGEP institutions, there were 569 STEM departments that either offered (from GSS) or awarded (from SED) STEM PhD between 1992–1993 and 2007–2008.

1. There were some instances where the SED reported that a PhD was awarded in a particular STEM department in a given year, but the GSS reported that, in that year, the department in fact did not offer a PhD. This discrepancy could be the result of a reporting error in the GSS, but could also be the result of the difference in reporting units and academic classifications between GSS and SED. SED is a survey of individuals. A student respondent could have reported receiving a PhD in, for example, biochemistry, which, as a field, is included in this current study as part of the broader field of biological sciences. The GSS, by contrast, is a department-level report. So while the student reported his/her major was biochemistry in the SED, the same student's institution may have reported this student under the Chemistry Department in the GSS and reported that the Biological Science Department did not offer a PhD. Under this scenario, the Biological Science Department of the institution in question would not be eligible to be matched; the department as a whole does not actually offer PhDs and, as discussed above, the research team decided that individual student outliers should not be the basis to qualify an entire department for matching. Of the 569 departments, 66 reported to have awarded a PhD but did not offer a PhD degree in the period. These departments were considered not eligible for matching, which left 503 departments eligible.
2. Departments that did not report offering PhDs until after their institution's AGEP funding began were not eligible to be matched because, as discussed later in this appendix, the AGEP effect models compare prefunding to AGEP-funding trends. We did not want a comparison to be made between an AGEP-funding trend and a prefunding trend that was static. This approach resulted in the ineligibility for matching of 47 of the 503 departments (569 – 66) that offered PhDs after receipt of AGEP funding, leaving 456 departments eligible to be matched.

The research team next identified non-AGEP departments that were eligible for matching with the AGEP departments. In general, the same criteria were used as for AGEP departments. However, non-AGEP departments were deemed eligible or ineligible to be matched to each of the AGEP groups of institutions on the basis of whether they offered a PhD in any year from 1992 up to each AGEP start-up year. This approach meant that each group of AGEP departments was eligible to be matched to a slightly different group of non-AGEP departments. For example, a non-AGEP department that did not offer a PhD until 2001 would be eligible to be matched with 2002 AGEP departments but not with 1998 AGEP departments.

Customizing the Prefunding Trends When Generating Propensity Scores

A propensity score was generated for each AGEP department on the basis of prefunding trend data and covariates listed in Exhibits A-1. Prefunding trend data was generated by fitting a linear line to the enrollment and to the completion data from 1992 up to the year that preceded the first year of receiving AGEP funding. For example, each department in the 1998 AGEP group had a prefunding enrollment and PhD completion trend of up to 1997, and the 1999 AGEP group had prefunding trends up to 1998, and so on.

For each non-AGEP department, six propensity scores were generated. Each propensity score was generated from fitting a linear trend line from the beginning year (1992) up to the year preceding funding to a group of AGEP institutions. That is, one of the six propensity scores for a non-AGEP department was generated from using the trend data from the first year (1992) up to 1997, another propensity score was generated using data up to 1998 and so on. This score-generating method allowed the non-AGEP department eligible to be matched with six different starting years (1998, 1999, 2000, 2002, 2004, and 2006). Propensity scores were generated without stratifying by discipline; however, discipline dummies were included in the model.

Region of Common Support

After all propensity scores were generated, departments outside the region of common support (i.e., funded in the same period) for each group year were dropped. For example, within the set of propensity scores that was generated for the 1999 group of funded institutions, the highest propensity score for a non-AGEP department was 0.86, while two AGEP departments had propensity scores higher than this. The two AGEP departments with the highest propensity scores were deemed ineligible to be matched. The same procedure was followed for the lowest propensity scores.

Matching

In our next step, the departments within the common support group were stratified by discipline, so that, for example, an engineering department was not matched with a biological/biomedical science department. The matching procedures went as follows:

1. An engineering AGEP department was selected at random from any of the AGEP groups of funded institutions.
2. The non-AGEP engineering department with the closest propensity score to the randomly selected AGEP department was "matched."
   a. The propensity score for the non-AGEP department that corresponded to the randomly selected AGEP departments within that funded group was used. For example, if the randomly selected AGEP department was from the 2000 group, the non-AGEP propensity scores that were generated using data up to 2000 were searched for the closest match.
   b. We also applied a 15% caliper to the matching. This approach meant that in order for two departments to be matched, their propensity scores had to be within 0.15 standard deviation of each other.
3. The non-AGEP engineering department that was matched was no longer eligible to be matched to any other AGEP engineering department from any group of funded institutions.

4. Another engineering AGEP department was randomly selected from any group of funded institutions, and the process was repeated until no engineering AGEP departments remained unmatched (or no non-AGEP engineering departments remained with a propensity score within the 15% caliper of remaining AGEP departments, whichever came first).
5. The entire process was repeated for each STEM discipline.