MEASURING DIVERSITY

An Evaluation Guide for STEM Graduate School Leaders

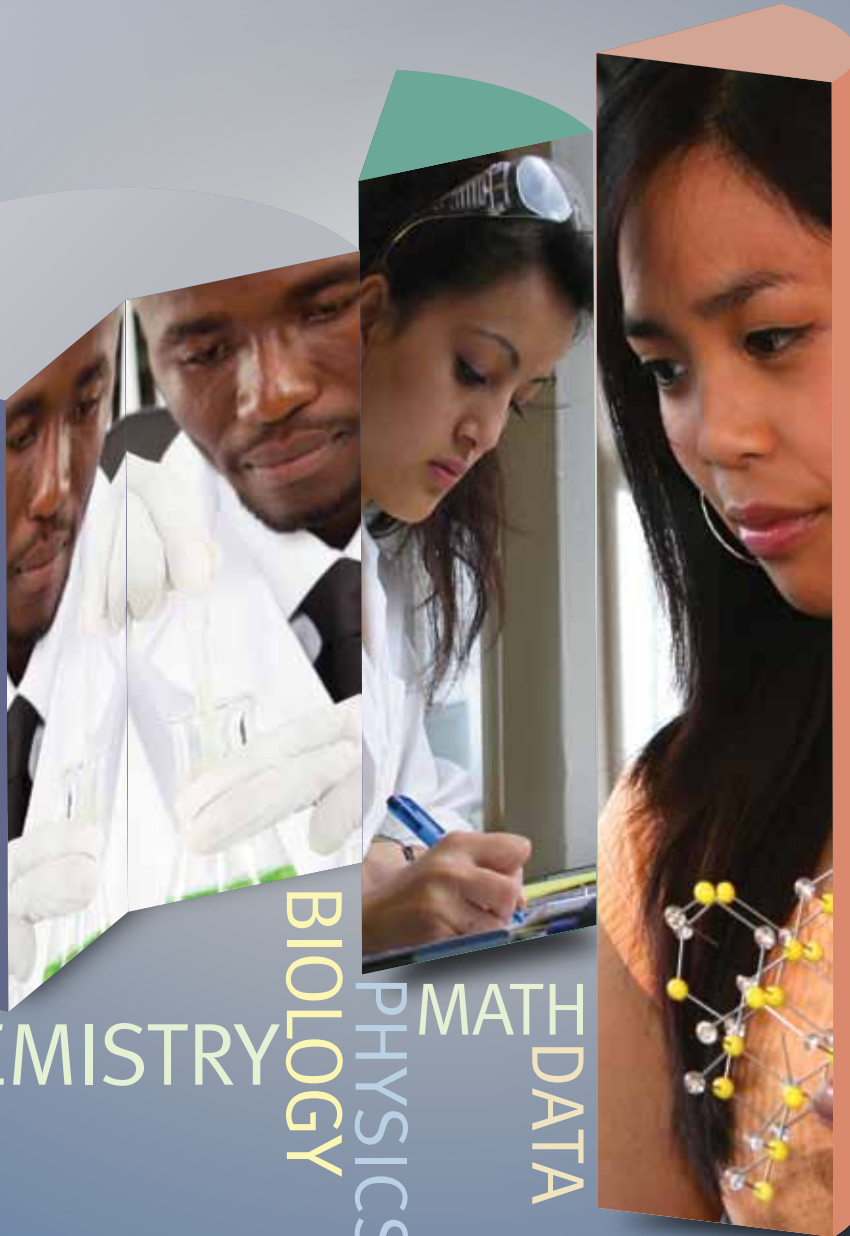ENGINEERING

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Preface

Six years ago, the American Association for the Advancement of Science (AAAS) and Campbell-Kibler Associates, Inc. (CKA) implemented an evaluation capacity project with grantees of the NSF Alliances for Graduate Education and the Professoriate (AGEP) and funding from NSF's Evaluative Research and Evaluation Capacity Building (EREC) and Research on Learning and Education (ROLE) unit. The goal of the project was to provide advice, tools, and resources to assist administrators, faculty, and staff with the evaluation of science, technology, engineering, and mathematics (STEM) diversity initiatives at the graduate school level. This project included:

■ Development of a framework for examining and collecting evidence about changes in graduate school that would lead to increases in the number of underrepresented minority students (URM) who earned Ph.D. degrees and entered the professoriate. URM students include students who are African Americans, Hispanic Americans, American Indians, Alaskan Natives, Native Hawaiians, or other Pacific Islanders.

■ Evaluation capacity building meetings and workshops that incorporated opportunities to brainstorm and network with evaluators and researchers involved in graduate education research or evaluation, particularly as related to URMs.

■ Meetings with graduate school leaders to discuss the challenges and lessons learned about the implementation of high-quality, innovative, useful, and credible STEM graduate education evaluation studies, particularly as related to URM students.

■ Developing and testing tools and protocols for use in evaluation of STEM graduate school diversity projects.

■ Development of a series of four interactive tools to help graduate school faculty and administrators:

• Assess their progress toward their diversity goal.

• Determine enrollment yields (the proportion of applicants who are admitted and go on to enroll) for different demographic populations.

• Easily compute approximate retention rates for different demographic populations.

• Track student progress to degree.

■ Identifying quantitative and qualitative indicators and research questions that might be useful in evaluation of STEM graduate school diversity projects.

The result of this work is summarized in this guidebook. The guidebook includes eight chapters and an epilogue with information written by 25 graduate school administrators and faculty and evaluators and researchers. The authors from the graduate schools are grant recipients of the NSF AGEP, a major graduate education diversity initiative focused on increasing the number of minority students who earn a Ph.D. in STEM and enter the professoriate.

Chapter 1 provides the framework and context for evaluation of STEM diversity programs. The main messages in this chapter are that funders, policymakers, and accreditation groups want evidence that practices, programs, or interventions are having a positive impact on all students and that evaluation need not be a burden. This chapter also includes a set of questions to use to examine the diversity context of graduate schools and STEM departments. A summary of graduate school diversity strategies is also outlined, with mention of Appendix A, which has references and Web links to selected graduate education research studies.

Chapter 2 provides general indicators and other experimental design tips, including information about a tool and format that can be used to examine changes in graduate student data for admits, applicants, new enrollees, enrollment, and degrees awarded. Appendices B and C provide sample reports generated using the tool. Suggestions are also provided on how to set up comparison groups that show that programs, practices, or interventions are having a positive effect or resulting in positive outcomes for participants.

Chapters 3, 4, 5, and 6, respectively, contain more specific indicators and suggested evaluation studies for examining:

- Recruitment strategies and admissions practices;
- Retention and Ph.D. completion;
- Faculty mentoring; and
- Preparation for the professoriate.

Chapter 7 provides tips on reporting, organizing, and displaying data. The last chapter, *Chapter 8,* points out national data sources that can be used to collect additional information about your institution or doctorate recipients for institutional benchmarking. The *Epilogue* summarizes the book's findings and emphasizes the importance of continuing to use evaluation as a tool to increase diversity.

More tools and resources for use in evaluation of STEM diversity graduate programs can be found on the project website (http://www.nsfagep.org/).

This guide is not intended to serve as a "how to" guide for evaluation. Rather, its goal is to lay out the framework that needs to be established when designing evaluation studies that will lead to increased numbers of URM students who earn a STEM Ph.D. and enter the professoriate.

For more specific information about the "why" and "how" of evaluation, please see The 2010 User Friendly Handbook for Project Evaluation (http://www.westat. com/westat/pdf/news/ufhb.pdf). In addition, another useful evaluation tool is the Framework for Evaluating Impacts of Broadening Participation Projects: http://www.nsf.gov/od/broadeningparticipation/framework-evaluating-impacts-broadening-participation-projects_1101.pdf.

Letter from AAAS

Dear Colleagues:

It is in the interest of U.S. universities and their STEM graduate schools to assess the quality of their programs so that they remain highly competitive in what is becoming a world market for STEM talent. High-quality graduate programs must work to become more efficient and even more effective.

At present, estimates of the overall rate of Ph.D. completion in STEM fields range from less than four in ten for African American students in the physical sciences to around seven in ten for international students. For any group the non-completers represent a tremendous loss of talent, especially considering the profile of entering students and the sizable investment being made in their education. The tremendous challenges that we face now and into the future as a country and a planet can only be addressed by preparing the best minds to attack the biggest problems.

This guide is intended as a tool for assessing the strengths and weaknesses of graduate programs. While developed to support better outcomes for underrepresented minority students (URMs), evaluation, program improvement, and interventions will likely yield positive outcomes for all students. Women and URM graduate students in STEM have been considered the "canaries in the coal mine"; weaknesses in program structures have often affected them first and most severely.

In the past, when differential outcomes have appeared for students from different population groups, researchers have often attributed these to differences in student characteristics (e.g., levels of preparation, quality of baccalaureate programs completed, etc.). Less attention has been paid to the impact of program characteristics and their effectiveness in providing highly capable students with what they need to be successful in the graduate program and beyond. This much needed focus is what the NSF Alliances for Graduate Education and the Professoriate Program has provided, the idea that monitoring, evaluation, and changes in the structure of graduate programs and faculty behavior, based on evidence, could lead to significant improvements in program outcomes, especially for populations that have not seen such levels of success.

To get things right, what is required is a systematic approach to understanding the movement of students through graduate programs, from before the point of entry to post-Ph.D. completion. For example, what are the critical milestones for the program, and what are indicators of success? What happens at the decision points; is guidance provided to students as to how they might respond to these? What does successful performance look like? Is each student getting whatever she or he needs to succeed in the graduate program? And are the strengths that each student brings to the program being tapped? Careful evaluation of programs and measures of outcomes can tell administrators and faculty where they stand.

Every program wants to be known for its quality, and the success of its students

is an important measure of quality. From the graduate school level, STEM departments build networks of alumni and research collaborations across institutions and around the world. Many of these networks lead to development of R&D centers that attract business ventures and become engines for economic development. In the U.S. we need only look at Research Triangle in North Carolina, Silicon Valley in California, and Route 128 in Massachusetts to underscore how the integration of research and education in area universities can lead to innovation and support business development.
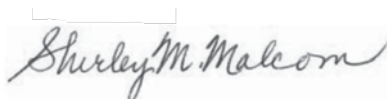
Given the importance of graduate program quality to department and institutional reputation, the ability to attract and retain top faculty and students, as well as gain funding and enjoy research productivity, it is critical that high priority be given to assessing—rather than just assuming—program effectiveness.

When all students are given the opportunity to succeed in graduate education in STEM, all benefit:

- Programs gain the talents and diverse perspectives these students bring to research.
- Society benefits from the production of a diverse professoriate for an increasingly diverse student population.
- Institutions gain insights into overall program improvement leading to greater success for all, saving money and enhancing research environments.

Evaluating the effectiveness of graduate programs makes sense, even for ones that are currently viewed internally and externally as high quality. Continuously improving and evolving programs remain competitive, and forward looking programs stay in the lead.

Wishing you success,

Shirley M. Malcom

Director, AAAS Education
and Human Resources Programs

Alan Leshner

CEO of AAAS & Publisher, Science

Acknowledgments

Finally, we would like to thank Marilyn Fenichel (publication management) and Gail Peck, Peck Studios, Inc. (graphic design) for finalizing this guidebook.

We do not see this publication as an end for the learning community, but rather as a new stage, where STEM graduate education diversity leaders are equipped with the tools and resources to form their own evaluation learning communities. We sincerely hope that this guidebook and the website tools will be useful in helping graduate school administrators, faculty, and staff scale-up the number of URM students who earn STEM doctorates and enter the professoriate.

Best Regards,

Yolanda S. George , AAAS

Patricia B. Campbell,
Campbell-Kibler Associates, Inc.
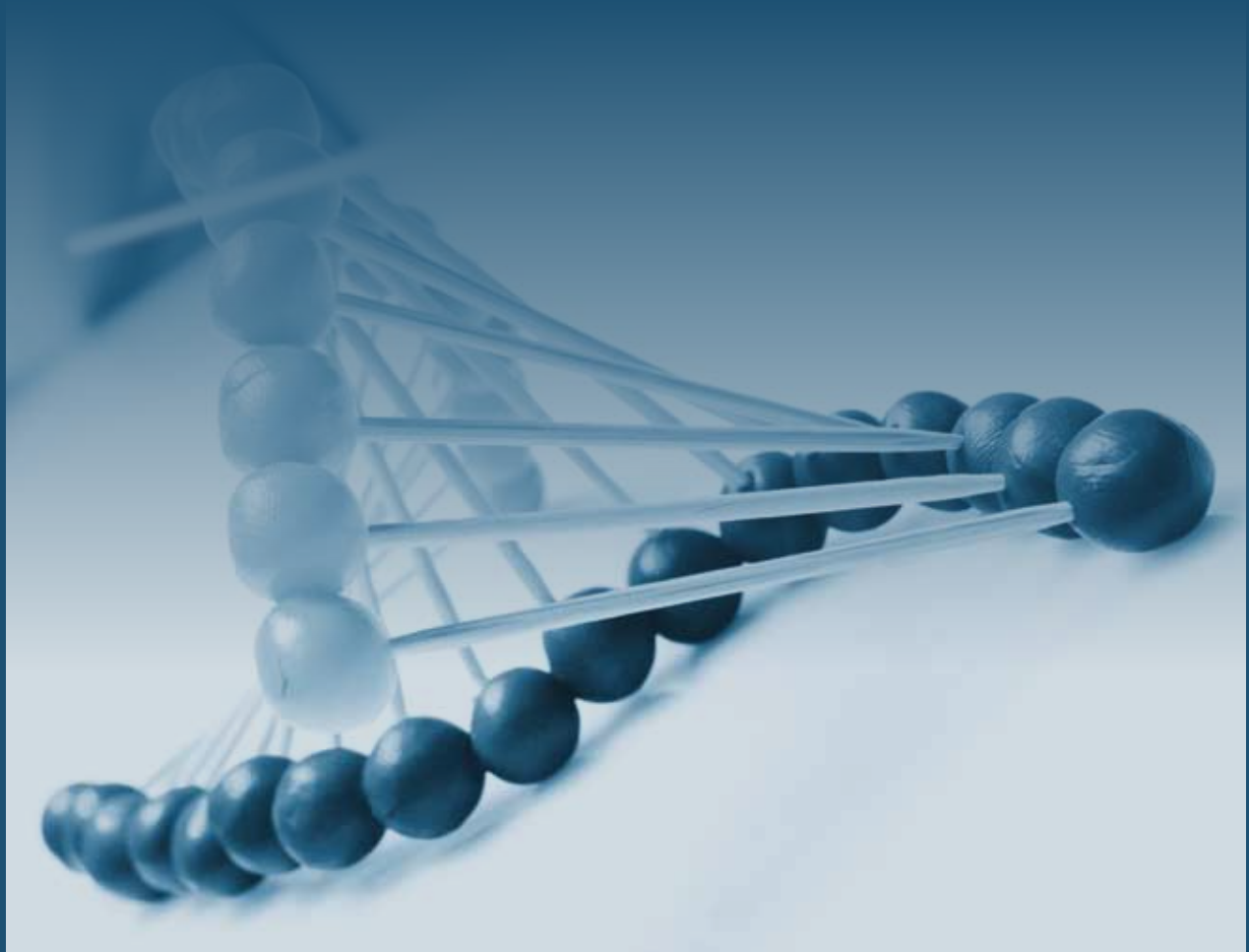
The Framework and Context for Evaluation of STEM Diversity Programs

CHAPTER HIGHLIGHTS

- Funders, policymakers, and accreditation groups want evaluation evidence that practices, programs, or interventions are having a positive impact.

- For institutions and departments, data can help in decision making and show evidence of progress, and it should be collected and produced in a simple, cost-effective way.

- Data must be disaggregated by race/ethnicity, sex within race/ethnicity, disability, citizenship, and STEM department when appropriate. Using disaggregated student data should be a part of regular management practices at the graduate school and departmental level.

CHAPTER 1

The Framework and Context for Evaluation of STEM Diversity Programs

Introduction

This guidebook is designed to provide advice to vice presidents, provosts, deans, other administrators, and faculty about the evaluation of science, engineering, technology and mathematics (STEM) diversity programs at the graduate school level. African Americans, Hispanic Americans, American Indians, Alaskan Natives, Native Hawaiians or other Pacific Islanders continue to earn a small percentage of the U.S. STEM college and university degrees, particularly doctorate degrees (http://nsf.gov/statistics/wmpd/). This underrepresentation of these racial/ethnic groups has serious implications for the nation's ability to compete in a global economy driven by innovations in science and technology.

In general, STEM diversity graduate school programs are intended to increase the number of underrepresented minority (URM) students who pursue and receive master's and/or Ph.D. degrees. Figure 1-1 illustrates the way these different factors work together to create significant institutional change. Leadership and the use of data are important components of institutional change.

Achieving this goal will require ongoing assessment and evaluation of institutional and departmental policies, practices, programs, and interventions related to:

- Recruitment;
- Admissions and selection;
- Financial aid;
- Advising and mentoring;
- Culture and climate; and
- Professional socialization.

Figure 1-1

Framework for Institutional Change

FOR MORE INFORMATION, SEE HTTP://WWW.NSFAGEP.ORG/
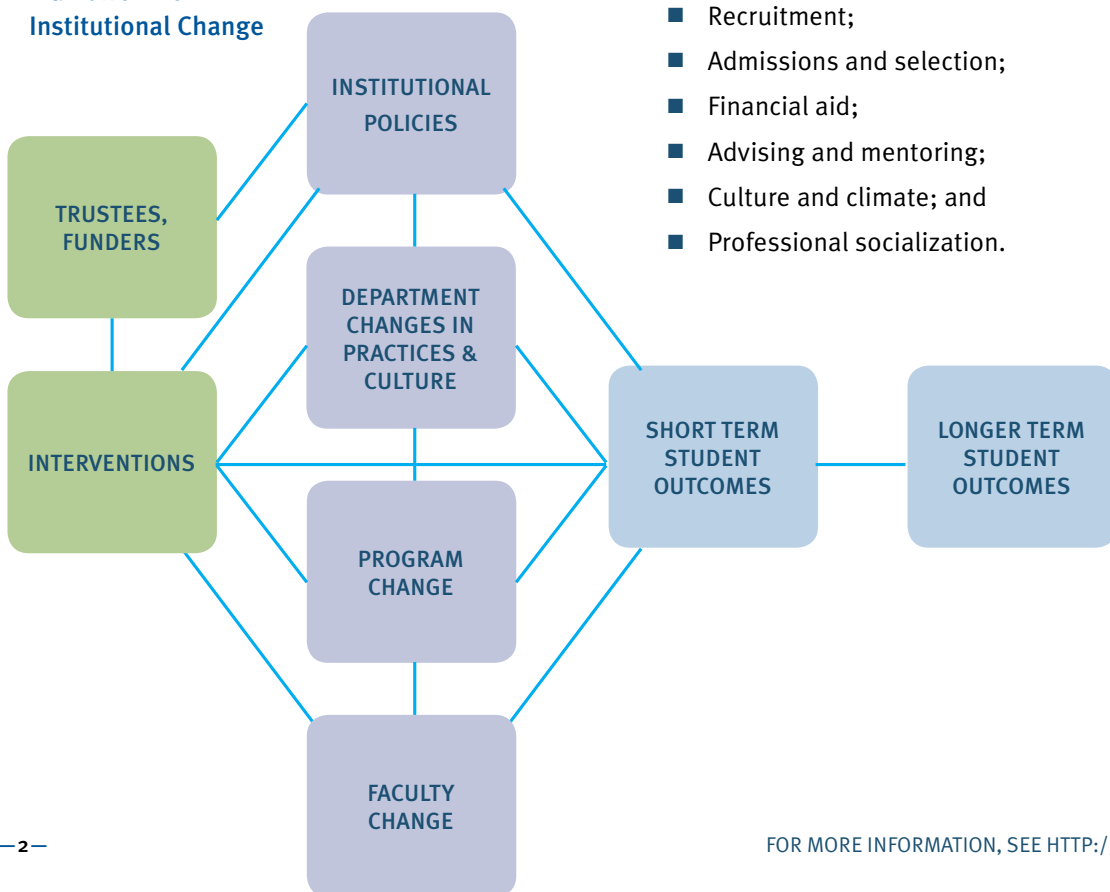
Since the management of graduate programs is usually distributed across multiple units and committees, all decisions makers should be involved in the collection and use of disaggregated student data, including:

- University trustees;
- Graduate school administrators, such as vice presidents, provosts, and deans;
- Admissions and financial aid officers;
- Department chairs;
- Department admissions and selection committees;
- Departmental graduate program directors or advisors;
- Faculty; and
- Staff.

To understand the experiences of all students within graduate programs, when appropriate, data must be disaggregated by race/ethnicity, sex within race/ethnicity, disability, citizenship, and STEM department. Using disaggregated student data should be a part of regular management practices at the graduate school and departmental level; it should not be viewed as added work.

Evaluation studies with disaggregated student data can help administrators, faculty, and staff set goals related to their duties and responsibilities (including student advising and mentoring) and be more reflective about their decision-making process for all graduate students. Also, data collected for evaluation purposes can be used to provide evidence where practices, programs, or interventions are having a positive impact, particularly for use in:

- Preparing reports for university administrators and trustees, policymakers, accreditation groups, and others;
- Making the case for funding, including internal and external funding; and
- Making the case for recognitions and awards for the institution, department, or individuals.

Conducting cost-effective evaluations requires building an effective cross-campus evaluation community and mechanisms for ongoing planning and coordination. Decisions will have to be made about how best to coordinate an effective evaluation of STEM diversity programs at the graduate school level across multiple offices and committees, including addressing the following questions:

- What unit will lead the effort and which key person(s) will be responsible? What administrator(s) will be team leaders? Ideally, this type of work should be located in the office of a Vice President or Provost for Research.
- What are the goals, objectives, and responsibilities for the evaluation group?
- What are the appropriate evaluation questions and timeline?
- What data should be collected (quantitative and qualitative indicators)?
- What student data are already being collected by units or special project? Are these data disaggregated?
- What evaluation studies are already in place? What studies are needed?

- How should the data be collected, analyzed, and displayed?
- When and how often should data be collected and reports prepared?
- What units or committees will collect and compile the data?
- How will the data and reports be distributed? It is important that all stakeholders, including graduate students, have access to summary reports.

Data collection and evaluation should be as simple and cost-effective as possible. The goal is to collect evidence periodically that is useful in decision making and shows overall institutional or departmental progress.

TOOL ALERT

Are You on Target?

An important first step for universities striving to increase the diversity of STEM graduate students is to set a goal—and most universities have already done so. To examine continual progress towards this goal, universities should assess progress annually.

Tool #1

Getting To Your Goal: Are You on Target? (www.campbell-kibler.com/NSF-AGEP/ GettingToYourGoal.html) is an interactive tool to help institutions look at the progress they've made toward their diversity goal and see the numbers they will need annually in order to achieve that goal within their timeframe.

The Context for STEM Diversity Programs

The context for STEM diversity programs is linked to both the strategies and resources in place for (a) increasing the number of URM students in STEM graduate programs and (b) determining whether a "culture of diversity" has been established at the institutional or departmental level. To increase the number of URM students completing a Ph.D. at institutions, administrators, faculty, and staff need to periodically assess their policies, practices, and programs and implement appropriate strategies.

Diversity Strategies

In an effort to increase the number of URM STEM doctorates, as well as the number of minorities entering the professoriate, government agencies and private foundations have implemented grant-based programs, including the following:

- National Science Foundation (NSF) Alliances for Graduate Education and the Professoriate (AGEP). AGEP was created in 1998 with the goal of increasing the number of URM doctorates, as well as the number of minorities entering the professoriate. Since its inception, over 100 institutions have been involved in this effort (http://www.nsf.gov/funding/pgm_summ.jsp?pims_ id=503563&org=HRD&from=home).

- NSF Louis Stokes Alliances for Minority Participation (LSAMP) program, Bridge to the Doctorate (LSAMP-BD) Activity. Created in 2003, the goal of this activity is to remove minority students' hesitancy about entering graduate school and the fear of creating additional financial indebtedness associated with graduate education (http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=13646&org=HRD&from=home).

- The National Institutes of Health (NIH), Division of Minority Opportunities in Research (MORE). These programs include research and research training programs aimed at increasing the number of minority biomedical and behavioral scientists (http://www.nigms.nih.gov/Minority/).

- Council of Graduate School (CGS) Ph.D. Completion Project. This grant-funded project addresses the issues surrounding Ph.D. completion and attrition. Supported by Pfizer Inc. and the Ford Foundation, the goal of this program is to create intervention strategies and pilot projects and to evaluate the impact of these projects on doctoral completion rates and attrition patterns (http://www.phdcompletion.org/index.asp).

These grant-based programs provide resources to implement research-based strategies that have been effective in the recruitment, retention, persistence, and attainment of STEM graduate degrees, especially for populations underrepresented in STEM disciplines. Graduate school intervention activities that have been developed as a result of these programs include:

- Establishing undergraduate research programs with minority serving institutions.

- Recruiting prospective students via campus visits and meetings where undergraduate or graduate students are presenting posters and oral presentations, including the annual meetings of SACNAS (a society of scientists dedicated to fostering the success of Hispanic/Chicano and Native American scientists), the Annual Biomedical Research Conference for Minority Students (ABRCMS), and the AAAS/NSF Historically Black Colleges and Universities Undergraduate Program (HBCU-UP) Conference and the Emerging Researcher National (ERN) Conference.

- Reviewing and monitoring institutional and departmental practices, including practices related to graduate student admissions, financial aid, advising and mentoring, academic requirements, and milestones to the Ph.D.

- Providing financial aid packages that reduce the debt burden of graduate students.

- Offering professional development programs for faculty, with an emphasis on strategies for recruiting and retaining URM students and effective graduate student mentoring.

- Offering supplementary academic support workshops or tutoring for graduate students in writing, statistics, computer-modeling, and other subjects.

- Providing activities that foster the social and early intellectual integration of graduate students into the department and research, including graduate student bridge programs, early research mentor identification, and strategies for family/work balance.

- Providing graduate student travel awards and other incentives to increase research productivity (poster or oral presentations at professional meetings, publications, international travel and research experiences, etc).

- Monitoring graduate student progression with attention to early achievement of Ph.D. milestones.

Some of the key research studies that have identified strategies for increasing the number of underrepresented minorities in STEM graduate programs are listed in Appendix A.

Institutional and Departmental Context for Diversity

Legal Context

Before deciding which strategies are appropriate for increasing diversity at a particular institution, it is important for leaders in the STEM community to gain a better understanding of the institutional and departmental context for diversity, including understanding the legal landscape for fostering diversity in both higher education and in your state. Many complex legal structures govern access and diversity efforts, and many legal issues are different for faculty than they are for students. This legal context makes designing successful diversity programs very challenging.

To help institutions understand these issue, AAAS, with participation by the Association of American Universities (AAU), has published a valuable tool, *Handbook on Diversity and the Law: Navigating a Complex Landscape to Foster Greater Faculty and Student Diversity in Higher Education*. The handbook provides extensive legal and policy resources for academic and legal leaders to help them collaborate to improve access and broaden the diversity of their faculties and student bodies, particularly in STEM. The handbook can be downloaded, for free, at (http://tiny.cc/LawHandbook).[1]

Diversity Context at the Graduate School Level

In addition to understanding the legal context for diversity, some key assessment questions should be addressed to help faculty members and administrators understand the diversity context at the graduate school level. These questions include:

- How are diversity goals and objectives integrated into the regular operations and management of the graduate school office and departments?

- In general, what policies, practices, activities, and resources are in place to build leadership and accountability with administrators, faculty, and staff in terms of fostering and maintaining diversity in the graduate student population, including
  - Department chairs;
  - Departmental admissions committees;
  - Departmental academic faculty and staff student advisors; and

- Departmental graduate studies coordinators.

■ How is financial aid used to foster and maintain diversity in the graduate school? Is financial aid offered as part of the admissions letter? How many years of financial aid is a new enrollee given? Does the admissions letter include information about how graduate students are supported to Ph.D. completion?

■ What are the sources of funds for student recruitment (e.g., campus visitations, visits for interviews, graduate student days, etc.) and retention? Are grant overhead recovery funds a source for recruitment?

■ How are graduate school departments evaluated in terms of fostering diversity in the graduate student pool and in the professoriate?

■ How are faculty evaluated in terms of fostering diversity in the graduate student pool and in the professoriate?

■ Are there other general or targeted programs that the graduate school operates to recruit and retain STEM graduate students, not just URM graduate students?

■ Has the graduate school conducted any research or evaluation studies on graduate student recruitment, admissions, retention/ attrition, climate, degree attainment, or post-Ph.D. employment within the last five years?

■ Does the graduate school conduct exit interviews with:

- Those who leave graduate school (leavers)?

- Master's degree graduates?

- Ph.D. graduates?

■ Is an annual report with disaggregated data about graduate school recruitment, applicants/admits, new graduate school enrollment, overall graduate school enrollment, graduate school retention or attrition, number advancing to doctoral candidacy, or degrees awarded distributed to departments? If yes, who gets the report? Are the data disaggregated by departments? Are the data disaggregated in other ways? How are the reports used? How are they distributed?

Diversity Context at the STEM Department Level

Recognizing that STEM departments vary by size and resources, general questions to consider for increasing diversity at the department level include:

■ How does the department recruit graduate students?

■ What are the sources of funds for student recruitment (e.g., campus visitations, visits for interviews, graduate student days, etc.) and retention? Are grant overhead recovery funds a source for recruitment?

■ How is the graduate student application/admissions process managed within departments? What are the selection criteria?

■ How is financial aid used to foster and maintain diversity in the graduate school? How does the department decide on the financial package for new

graduate student admits? Is financial aid offered as part of the admissions letter? How many years of financial aid is a new enrollee given? Does the admissions letter include information about how graduate students are supported to Ph.D. completion?

■ What types of academic support or programs exist for graduate students within the department?

■ What is the process for providing academic advising:

• Pre-assessment exams in the first semester to determine courses needed?

• Lab rotations to make sure that the doctoral research lab and dissertation selection is a good match, both personally and professionally?

• Advisor/mentor committee?

• Annual assessment of student progress with attention to time-to-degree (i.e., what are the remaining requirements)?

■ How is graduate student academic progress monitored?

■ Does the department monitor graduate student retention/attrition? If, yes how?

■ How are diversity concerns being integrated into the regular operations and management of the department?

■ Does the department conduct exit interviews with students who leave the department?

• Those who leave graduate school (leavers)?

• Master's degree graduates?

• Ph.D. graduates?

■ What are the departmental challenges related to disaggregated student data collection and reporting?

■ What are the departmental challenges related to tracking former students?

• Graduate school leavers?

• Ph.D. graduates?

■ Does the department collect data for departmental purposes that are not required by the graduate school?

■ Has the department conducted any research or evaluation studies on graduate student recruitment, admissions, retention/attrition, climate, degree attainment, or post-Ph.D. employment within the last five years?

■ What resources would STEM departments need to manage the collection, analysis, and reporting of disaggregated graduate student data about recruitment, admissions, enrollment, retention/attrition, advancement to doctoral candidacy, degree attainment, and post-Ph.D. employment?

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[1]Keith, Jamie Lewis and Daryl E. Chubin. (2011). *Handbook on Diversity and the Law: Navigating a Complex Landscape to Foster Greater Faculty and Student Diversity in Higher Education.* Washington, DC: American Association for the Advancement of Science.

Indicators and Other Experimental Design Tips

CHAPTER HIGHLIGHTS

- Both quantitative data (numbers) and qualitative data should be collected in evaluation studies of STEM graduate school programs. Quantitative data are very useful in determining what is happening, especially what is happening over time, but they are less useful in determining why things are (or are not) happening.

- For both the qualitative and the quantitative data to be of value, they need to be collected at multiple time points and include comparison groups made up of members who are similar to participants and/or have not participated in the program or activity. In an educational study, the two groups should be matched by educational characteristics.
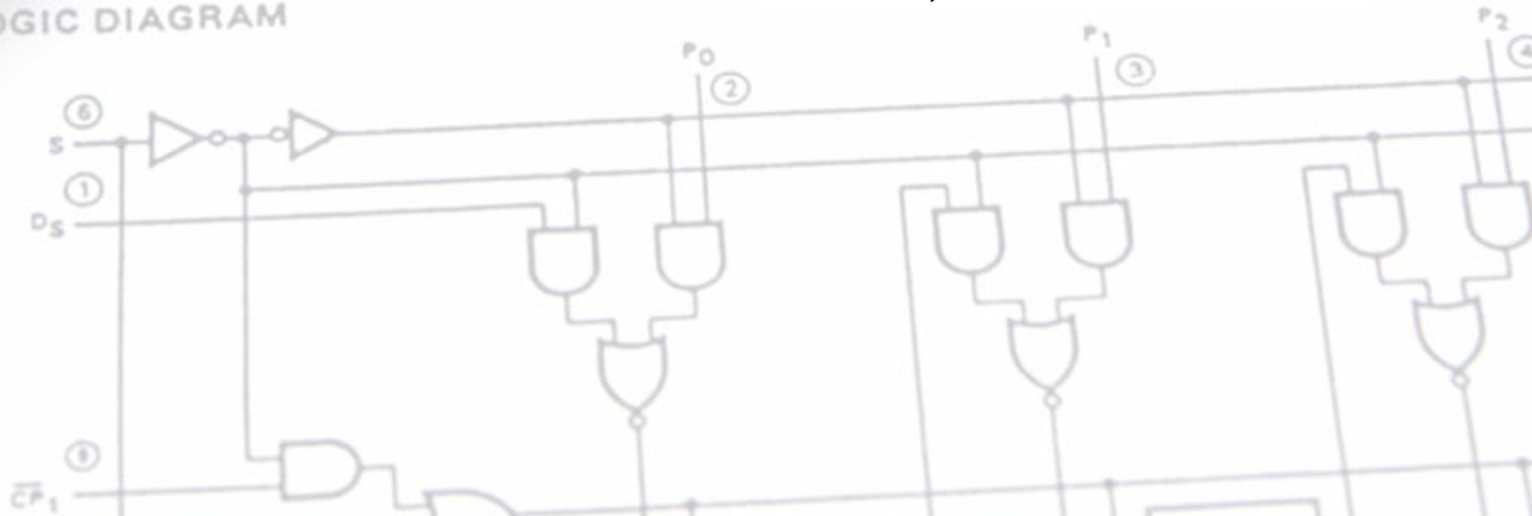
CHAPTER 2

Indicators and Other Experimental Design Tips

Both quantitative and qualitative data should be collected in evaluation studies of STEM graduate school programs. Quantitative data, numerical information that can be collected and compiled into tables, charts, or graphs, are very useful in determining what is happening, especially over time, but are less useful in determining why things are (or are not) happening.

Qualitative data, information collected through surveys, interviews, and focus groups, rely on individual responses of program participants. As a result, this information is more likely to include responses to meaningful questions related to the graduate school or departmental experiences of both students enrolled in a particular institution and those who chose to leave. Through periodic surveys, interviews, or focus groups, evaluators can collect information about whether students were satisfied or dissatisfied with a variety of practices and activities, including: recruitment; admissions; financial aid; academic support workshops, activities, and resources; and faculty behavior and attitudes, as well as students' attitudes toward these activities.

But the down side is that qualitative data are often more difficult and time consuming to collect and to analyze. Therefore, it is important to determine how high-quality qualitative data can be collected and analyzed without adding too great a burden to faculty and staff.

For both the qualitative and the quantitative data to be of value, they need to be collected at multiple time points and include a comparison group; how to assign comparison groups is discussed later in this chapter. In addition, appropriate administrators and/or faculty members need to have some discussion about the time periods for data collection, particularly for studies related to leavers and degree completers and those examining institutional and departmental culture and climate.

Using Quantitative Data to Examine Trends

For studies on student entry into a STEM graduate program to Ph.D. degree completion, disaggregated data can be collected for multiple years to examine changes in number and percentage of:

- Applicants;
- Admits;
- New or first time enrollees;
- New or first time enrollees in master's programs;
- New or first time enrollees in Ph.D. programs;
- Overall enrollment;
- All master's enrollees;

- All Ph.D. enrollees;
- Students advancing to doctoral candidacy; and
- Students completing master's or Ph.D. degrees.

In addition, post-Ph.D. employment information can be collected, particularly as related to employment in academic, government, business, and other sectors. When possible, these data should be disaggregated by race/ethnicity, sex within race/ethnicity, disability, citizenship, and STEM fields.

As part of an NSF evaluation capacity building project with colleges and universities funded by the NSF AGEP Program, AAAS and Campbell-Kibler Associates, Inc, collected longitudinal disaggregated data, as described above. Data were collected and compiled for 73 institutions. In many cases, graduate schools were already collecting disaggregated data for:

- New or first time enrollees;
- Overall enrollment; and
- Students completing master's or Ph.D. degrees.

However, only 11 institutions could provide disaggregated data on post-Ph.D. employment for some of the years between 2000 and 2009.

The data collected from the AGEP institutions were compiled into a format for use by the individual institutions and aggregated to report on the overall progress of AGEP institutions. Appendices B and C include sample reports of how the data were compiled and reported. Appendix C also contains information on how the data were collected and analyzed. More AGEP Info Briefs are posted on the NSF AGEP website: http://www.nsfagep.org/publications/info-briefs/.

Other Quantitative Indicators for Evaluation Studies

In addition to examining data disaggregated by race/ethnicity, sex within race/ethnicity, disability, citizenship, and STEM fields, data for students and faculty can be disaggregated in a variety of other ways. A good source of information about graduate school indicators for evaluation studies is the NSF Survey of Earned Doctorates (SED): http://www.nsf.gov/statistics/srvydoctorates/.

A sampling of indicators often used to disaggregate graduate student data are listed below:

- Age.
- Marital or partnership status and number of dependents.
- Type of undergraduate institution where the baccalaureate degree was earned. These data can be grouped using the Carnegie Classification of Higher Education Institutions (http://classifications.carnegiefoundation.org/) or by Historically Black Colleges and Universities (HBCUs), Hispanic-serving Institution (HSIs), women's colleges, or colleges with a high enrollment of students with disabilities.

- Academic background, including: overall undergraduate GPA; graduate school GPA; and verbal, analytical, and/or quantitative scores on the GRE.

- Participation in extracurricular programs during the undergraduate years, including participations in undergraduate research programs or in minority STEM undergraduate programs.

- Sources of graduate school financial support, including fellowships, scholarships, dissertation grants, teaching assistantships, research assistantships, traineeships, internships, loans, personal savings, family savings, and employer reimbursement.

- Duration and continuity of financial support.

- Amount of education and non-education debt at time of bachelor's degree completion.

- Amount of education and non-education debt at time of Ph.D. completion.

- Highest educational attainment of mother and/or father, including less than high school/secondary school, high school/secondary graduate, bachelor's degree, master's degree, professional degree, or doctoral degree.

- Time-to-Ph.D. degree.

Information about classification on colleges and universities can also be located at the following websites:

- Historically Black Colleges and Universities (HBCUs): http://www2.ed.gov/about/inits/list/whhbcu/edlite-list.html.

- Hispanic-Serving Institutions (HSIs): http://www.molis.org/hsis.asp.

- Tribal colleges: http://www.aihec.org/.

- Women's colleges: http://www.womenscolleges.org/.

- Colleges and universities with high enrollment of disabled students: Gallaudet University (http://www.gallaudet.edu/) or the National Technical Institute for the Deaf at Rochester Institute of Technology (http://www.ntid.rit.edu/).

The U.S. Department of Education also has a list of minority postsecondary institutions: http://www2.ed.gov/about/offices/list/ocr/edlite-minorityinst.html.

Comparison Groups

In order to make a strong case that programs, practices, or interventions are having a positive effect or resulting in positive outcomes for participants, it is important to identify an evaluation design that includes comparison groups. It is also important to ensure that sufficient data can be collected to permit appropriate and convincing comparisons.

In general, comparison groups are usually made up of members who are (a) similar to participants and/or (b) have not participated in the program or activity. For an educational study, depending on its objectives, it is generally important that the two groups be matched on characteristics that are correlated with:

- Students' educational achievement prior to graduate school entry;
- GRE scores;
- Type or rank of undergraduate institution where bachelor's degree was earned;
- Age when entering graduate school;
- Race/ethnicity, sex, disability, or citizenship;
- STEM department or undergraduate major;
- Number of years in a graduate program; or
- Type, duration, or timing of financial aid.

In evaluation studies about URM graduate students, there is a tendency to only ask the target population critical questions about the educational program, practices, or interventions. The problems with this evaluation design are as follows:

1   Members of the targeted group might be reluctant to share any negative information with evaluators out of concern for potential repercussions.

2   It is difficult to determine the extent to which data from such a small sample can be used to paint a representative picture of the larger context in which the graduate educational process occurs. Also, with small numbers, it might be difficult to keep information from being associated with individuals.

3   Conclusions cannot be used to indicate that problems are particular to race/ethnicity. In addition, it is difficult to separate out problems not associated with race/ethnicity but related to more general issues that affect all graduate students regardless of race/ethnicity, sex, disability, or citizenship.

The example on the next page illustrates how comparison groups were used for a large-scale group study.

A Large-Scale Comparison Group Study: Evaluation of the Louis Stokes Alliances for Minority Participation (LSAMP)

In 2005, a team of researchers at the Urban Institute in Washington, DC, completed an evaluation of the Louis Stokes Alliances for Minority Participation (LSAMP), an undergraduate-focused program that had been funded by NSF since 1991. The purpose of the program is to increase the representation of underrepresented minorities in the STEM disciplines. At the time the evaluation report was written, there were 34 alliances involving 450 different institutions across the country.

As a large-scale evaluation, many dimensions of the program required investigation. This example discusses only one of these dimensions: the number of LSAMP participants who completed their degrees compared to minority students not in the program. The example illustrates important points related to presenting data and the issue of comparison groups. The full report is available online at http://www.urban.org/UploadedPDF/411301_LSAMP_report_appen.pdf.

Comparison groups are critical in large-scale evaluations. Unlike a control group, however, comparison groups often differ in important ways from the subject "treatment" group. The term "control group" is used only when the people participating in a program and those in the comparison group are assigned to their respective groups via a random process.

To set up a control group for a program such as LSAMP, all interested students would be required to apply, followed by a random selection process for participants. This approach is not usually feasible with programs of this type. Rather, students are selected via non-random processes (e.g., selected due to high grades or as a result of a recommendation by a professor). This means that the participants in such programs, by definition, are a self-selected group.

To a large extent, self-selected groups generally differ from those who do not choose to participate in programs, making a classical experimental design impossible. Instead, quasi-experimental designs are more commonly used for evaluations. Quasi-experimental designs follow a similar framework as the "gold standard" – the randomized control trial – but deviate by lacking random assignment to treatment (i.e., the program) and control (i.e., not participating in the program). The goal, then, becomes to identify appropriate comparison groups. For the LSAMP evaluation, two natural comparison groups emerged: URM students who had not participated in the LSAMP program and U.S. students of white, non-Hispanic, and Asian descent who were not the original targets of the program.

By comparing the outcomes for LSAMP participants to URM non-participants, a general sense of the program impact can be gained – but with the important caveat that the participants are already known to be a self-selected group (and, hence, possibly already more personally motivated, with higher GPAs and stronger connections to professors in their universities). That said, however, the comparison to the white and Asian students does provide a sense of the extent to which the playing field for the program participants was effectively leveled. That is, how did the graduate school outcomes compare for the LSAMP participants to those of students who were not eligible to participate in the program, presumably those students who were already implicitly advantaged within the higher education system?

Figure 2-1, taken from the Urban Institute report, illustrates findings from LSAMP participants and those from the two comparison groups. The data are from two sources: (1) LSAMP participant data gathered from a survey of those who had graduated between 1992 and 1997 and (2) for the comparison groups, nationally representative data available from NSF via the National Survey of Recent College Graduates.[2]

The graph in Figure 2-1 shows the overall rates of transition to graduate school as well as the specific rates of transition into STEM fields, which were the ones of predominant interest to the LSAMP program. In this case, the two comparison groups are, indeed, random samples of people who were recent bachelor's and master's degree recipients and were contemporaries of the LSAMP participants.

This example shows the effective use of the comparison group method. Researchers from the Urban Institute took advantage of large-scale, national data, which are accessible to everyone through a public-use tool known as SESTAT (see Chapter 8 for more information about national sources of data). These data also can be used for more detailed analyses by those who have access to the restricted-use datasets. Chapter 8 also discusses these data.

Because the researchers decided before starting the study that they were going to use the national data, they crafted the survey questions to allow for national-level comparisons. Even with the recognized flaws associated with the self-selected LSAMP participants, the use of the comparison data strengthens the case that the LSAMP program did have a positive impact. Without these data, the question of whether the

LSAMP students were more or less successful than others in their graduation cohorts in making the transition to graduate school would persist, making it more difficult to prove the value of the program.

Source: Clewell, B. C., C. Cosentino de Cohen, L. Tsui, L. Forcier, E. Gao, N. Young, N. Deterding, & C. West. 2005. Final Report on the Evaluation of the National Science Foundation Louis Stokes Alliances for Minority Participation Program. pg. 47.Urban Institute, Program for Evaluation and Equity Research http://www.urban.org/UploadedPDF/411301_LSAMP_report_appen.pdf. Accessed August 8, 2010, p. 47.

[2]For more information about the National Survey of Recent College Graduates, including reports of findings, go to the National Science Foundation, Science Resource Statistics site at: http://www.nsf.gov/statistics/srvyrecentgrads/.

Figure 2-1

Graduate Coursework, Degrees Pursued and Degrees Completed: LSAMP Participants Compared to National Data
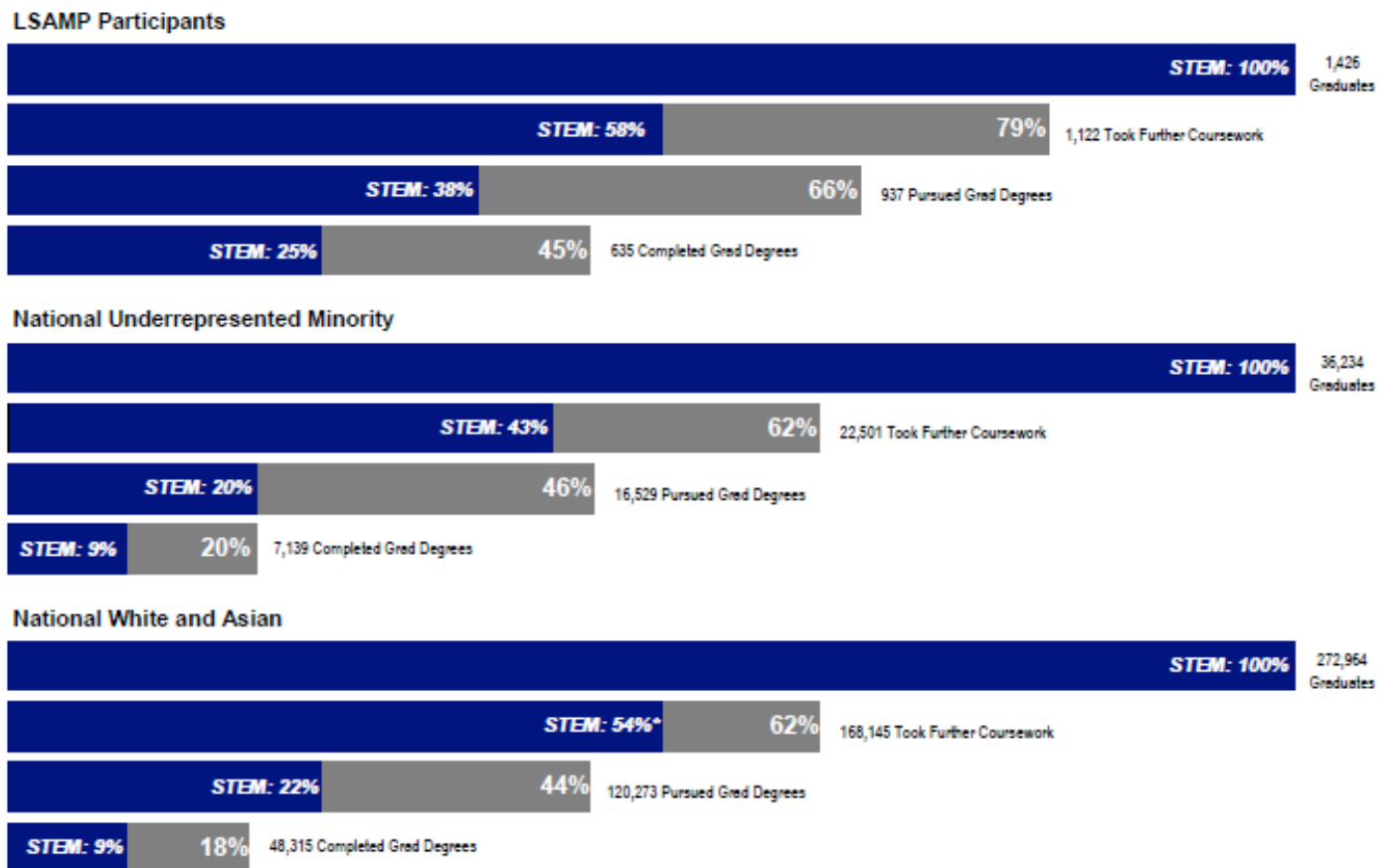
Sources: LSAMP Graduate Survey (UI) and NSRCG longitudinal file (NSF).
*National comparison group statistic is not significantly different from LSAMP.

Evaluation of Graduate Student Recruitment Strategies and Admissions Practices

CHAPTER HIGHLIGHTS

- To examine the impact of recruitment strategies and admissions practices: (a) conduct surveys of new graduate school enrollees; (b) have follow-up phone interviews with admits that did not choose to enroll; and (c) include relevant questions on the graduate school application forms.

- Ideally, departmental or laboratory climate studies should include surveys, interviews, or focus groups with student enrollees and leavers, faculty, postdoctoral students, and staff. When climate studies include all stakeholders, gaps between the perception of faculty, students, and others can be evaluated so that commonalities can be identified and used as a basis for change.
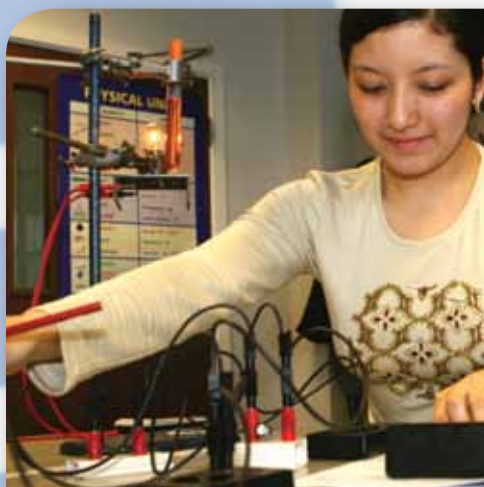
CHAPTER 3

Evaluation of Graduate Student Recruitment Strategies and Admissions Practices

Recruitment is an important part of the effort to increase URM students in STEM graduate programs. To be effective, recruitment must result in new URM student enrollees in these programs. As a result, individual faculty in every department needs to be broadly involved in recruitment activities and have an understanding of admissions practices that result in enrollment of qualified URM students in STEM graduate programs.

It is not enough to leave the critical task of recruitment to the department or college diversity officer or the few faculty who are always active on behalf of URM students. It is also important that graduate student admissions committees examine their processes to ensure that all highly qualified applications are fairly reviewed.

The primary indicators used for examining recruitment and admissions activities are disaggregated data related to number of applicants, admits, new enrollees, new master's enrollees, and new Ph.D. enrollees. Where possible, these types of data should be disaggregated by race/ethnicity, sex within race/ethnicity, disability, citizenship, and STEM fields.

To understand current institutional trends in graduate applicants, admits, and new enrollees, disaggregated data should be collected for the last 7- to 10-year period. Appendix B has examples of data disaggregated for URM graduate students, other U.S. students, and non-U.S. students. These types of quantitative data, coupled with other evaluations, can be used to help top level administrators, department chairs, and faculty:

- Determine recruitment goals and activities; and
- Assess if changes in recruitment activities and admissions practices are resulting in increases in URM graduate student applicants, admits, and new enrollees.

Recruitment Strategies

In general, graduate student recruitment strategies can be divided into three broad categories:

1 *Tools for recruiting, including websites and printed materials.* Increasingly, websites are being used as sources of information. The design and content of websites represent graduate schools or academic departments to the world. It should be easy to find information about the graduate program and admissions requirements; financial aid; requirements for earning a Ph.D.; faculty research interests; curriculum vitae, publications, and patents; mentees; departmental

or institutional academic support programs; and graduate student professional societies and groups. Also, there should be information about current students and alumni, including where alumni are currently employed.

In most institutions, graduate schools and departments also have printed materials, such as brochures, posters, and exhibits about their graduate programs. Evaluations of these resources should include an examination by focus groups of graduate students or external evaluators to see how effectively and appropriately diversity is reflected in the language and images. For both online and print materials, the information should be reviewed for clarity.

2   *Uses of graduate student referrals databases or databases of programs that encourage URM students to enter graduate schools.* Databases should be used for email and surface mail campaigns to prospective students, followed by calls and even invitations for campus visits to departments.

3   *On- and off-campus recruitment strategies.* On-campus recruitment strategies include: open houses/campus visits; partnerships with undergraduate institutions that serve large numbers of URM students, including hosting faculty researchers; and hosting URM undergraduate research students. Off-campus recruitment strategies include graduate school recruitment fairs, professional conferences, and faculty seminars at undergraduate institutions. Recruiting undergraduate students from your own institution is an obvious strategy, but is often not pursued.

Faculty members in STEM departments need to participate in recruitment activities and should be able to communicate with prospective graduate students. They also need to make their department sound inviting and supportive, as well as intellectually interesting.

Evaluation of campus recruitment strategies should examine perceptions about institutional, departmental, or laboratory environments, including perceptions about academic support, faculty attitudes towards racial/ethnic diversity, faculty mentoring about pursuit of a Ph.D., student peer attitudes towards racial/ethnic diversity, and faculty attitudes toward students with children. Perception indicators could be used with participants in undergraduate research programs or a hosted faculty researcher's exchange, as well as with undergraduate majors at the institution.

Also, surveys of new graduate school enrollees can be conducted to determine which specific recruitment strategies influenced their decisions to apply and enroll in the institution or enter the graduate department. In addition, follow-up phone interviews can be done with admits that did not choose to enroll in a particular institution to determine what influenced their decision to apply and not to enroll. Depending on the reason for not accepting the admissions offer, if this type of follow-up is done in a timely fashion, it may be possible to influence the applicant's decision and persuade that individual to enroll in the university.

As a way to collect data about recruitment strategies, questions about participation in recruitment activities could be included on the graduate school application forms.

Annual evaluation of on- and off-campus recruitment strategies should examine recruitment activity patterns, including:

■ A list of recruitment strategies implemented by the graduate school or STEM departments.

■ Number of faculty participants in recruitment events by STEM departments. Data on faculty should be disaggregated by race/ethnicity, sex within race/ethnicity, and faculty rank.

■ Individual demographic data on student participants by types of recruitment events.

■ Number and types of higher education institutions that participated by types of events.

■ Faculty research partnerships by types of higher education institutions.

These types of data, collected annually and complied for multiple years, can be used as evidence for institutional or departmental cultural change studies. As a reminder, any type of data collected from individuals or about institutions should be disaggregated to better understand how recruitment and admissions processes impact the graduate school enrollment of the different groups of students.

TOOL ALERT

LOOKING AT ENROLLMENT YIELD

Enrollment yield is the proportion of applicants admitted to graduate school that go on to enroll in the program. Examining trends in the percent of applicants admitted and the percent of admitted students who then enroll in graduate school can help decision makers assess the efficacy of their recruitment and admissions policies, programs, and practices.

Tool #2

Looking at Enrollment Yield Applicants, Admits, and New Enrollees is an online tool (www.campbell-kibler.com/NSF-AGEP/AppAdmitNew.html) to help institutions compute and interpret the enrollment yield for different departments and for demographically different groups of students.

Student Admissions Practices

In order to develop questions that can best address graduate student admissions practices, it is important to be aware of the following:

- In some cases, faculty members, not deans and administrators, hold the power with respect to graduate admissions in the form of voting authority on admissions committees.

- Faculty members are not generally involved in national conversations on good practices in graduate admissions, especially those that suggest more creative, fair, and valid ways of judging academic talent beyond the GRE and other standardized tests. In fact, the GRE recommends use of multiple criteria for admissions. Information about the use of GRE scores as related to race/ethnicity and sex can be found on the GRE website: (http://www.ets.org/s/gre/pdf/gre_guide.pdf).

- To bring about change in graduate admissions, some institutions have tried the "champion" approach, use of an individual faculty advocate in a STEM department or a faculty member from a STEM department at a prestigious institution who has been successful in using admissions criteria not heavily dependent on standardized tests.

- Changes in graduate admissions practices cannot be undertaken without sensitivity to the number of applicants typically reviewed by a given department annually. In general, the larger the applicant pool, the harder it is for more qualitative procedures to be used. Numbers, therefore, become a convenient way to categorize students' admissions qualifications in departments with a large number of applicants—especially as a first cut.

Given these realities, evaluation of graduate student admissions and selection processes could include the following questions:

- What, if any, relationship is there between GRE scores and successful completion of different STEM graduate programs at your institution?

- Is the general first cut screening process eliminating highly qualified URM students?

- Does the admissions process include timely decisions about financial aid?

- Does the amount or number of years of financial aid offered at the time of admissions affect students' decisions to enroll in the graduate program?

- Does the type of financial aid or number of years it is offered at the time of admissions affect students' decisions to enroll in the graduate program?

Finally, in surveys of new graduate school enrollees or follow-up phone interviews with admits that did not choose to enroll, questions can be added about the timeliness of the admissions decision and the role that financial aid played in the applicant's final decision.
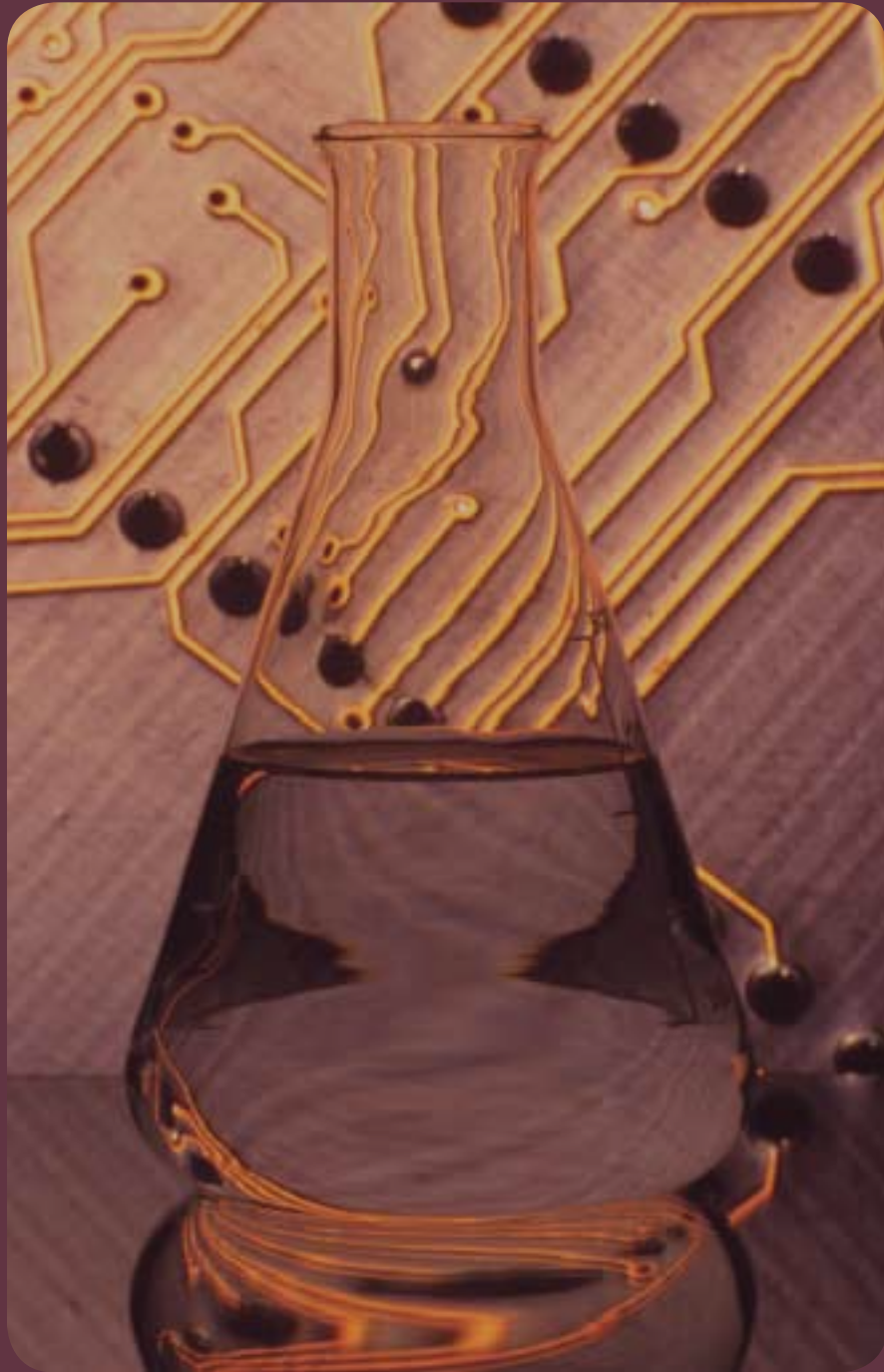
Graduate Student Retention and Ph.D. Completion Studies

CHAPTER HIGHLIGHTS

- Retention studies of doctoral students usually involve tracking the progression of a group of students, called a cohort, by the year that they entered the Ph.D. program for the first time. Data should be collected for the cohort after the first, second, and third year of graduate studies. These studies should be coupled with surveys or interviews examining institutional and departmental support programs and environment.

- For time-to-degree studies, Ph.D. completion data should be collected for a cohort at five, seven, and ten years after the cohort enters a graduate school program.

CHAPTER 4

Graduate Student Retention and Ph.D. Completion Studies

In general, collecting quantitative data on graduate student retention and Ph.D. completion is difficult for a number of reasons. First, students are usually enrolled in more than one graduate degree program, including terminal or required master's or Ph.D. programs. Determining whether any program, only one, or both were completed can be difficult. Second, the amount of time it takes to get a Ph.D. varies by STEM discipline. Finally, some students earn a master's degree first and come back later to earn a Ph.D. These factors need to be taken into account when studying graduate school retention and completion of Ph.D. studies.

Nonetheless, evaluation studies measuring retention and Ph.D. completion can be useful in determining trends in a department, even if the graduate program requires a master's before students can enroll in a Ph.D. program.

Retention measurement usually involves tracking the progression of a group of students by the year that they entered the Ph.D. program for the first time. This group is called a cohort. In retention studies, data should be collected for the cohort after the first, second, and third year of graduate studies. If a master's degree is required for entry into the Ph.D. program, a study could examine time to master's degree completion by cohort.

TOOL ALERT

COMPUTING APPROXIMATE RETENTION RATES

Computing actual student retention rates is expensive and time consuming. But there is a fairly easy way to compute an approximate rate of annual student retention. It is based on the assumption that 100% retention means that the only students who leave the program are those who graduate.

Tool #3

Approximating Underrepresented Minority (URM) Ph.D. Student Retention: A Quick and Dirty Tool (www.campbell-kibler.com/NSF-AGEP/Retention.html) helps institutions quickly compute approximate retention rates. This tool does NOT involve tracking cohorts of individual students and will not give exact retention rates. It will, however, give approximate year-to-year student retention rates and trends that can inform decision making.

Time-to-degree studies also include collecting data for a cohort of graduate students. For these studies, it is best to collect Ph.D. completion data at five, seven, and ten years after the cohort enter a graduate school program. Studies by the Council of Graduate Schools (CGS) indicate that Ph.D. completion rates vary by STEM disciplines (http://www.phdcompletion.org/quantitative/book1_quant.asp). In some studies, information can be collected about students who have completed all other requirements to earn the Ph.D. but have not completed the research or written the dissertation; this is known as an "all but dissertation" (ABD) study.

In any retention and time-to-degree study, it is important to clearly define the characteristics of the cohort of students that will be studied as well as those of the comparison groups. Retention and time-to-degree studies should include those students who take a leave of absence or leave the institution and return within the designated time set by the institution.

TOOL ALERT

TRACKING STUDENTS' PROGRESS TOWARDS DEGREE

The road to the Ph.D. is often long and twisted. Knowing where students are on that road, what obstacles they've overcome, and what they have yet to face is an important strategy for both retaining students and moving them on to degree completion. Tracking tools are an important part of that strategy.

Tool #4

Where Are They? Tracking Students' Progress toward Their Degree offers prototypes of two different types of tracking tools to help institutions monitor individual students' progress. These customizable tracking tools can downloaded as an Excel file (www.campbell-kibler.com/NSF-AGEP/Tracking.html) for use on spreadsheets or as an Access file for use in a database.

Examining Institutional and Departmental Environments

Retention studies should be coupled with surveys or interviews that examine institutional and departmental support programs, as well as the overall environment at the institution. Indicators for such studies include students' perceptions about and satisfaction or dissatisfaction with:

- Financial support;
- Curricular breadth and flexibility;
- Faculty assistance with troubleshooting experiments;
- Preparation for research;
- Preparation for teaching;
- Adequacy of department resources for students (equipment, computers, office and lab spaces, library resources);

- Career guidance and placement;
- Time-to-degree completion;
- Faculty-student interactions;
- Opportunities for professional socialization, including opportunities to present posters and papers at professional meetings;
- Family and emergency leave; and
- Departmental practices related to recruitment and retention of URM students, women, persons with disabilities, and international students.

Evaluation of student perceptions and satisfaction with departmental or institutional policies, practices, and programs is usually referred to as a climate study. Climate studies can also be done on faculty perceptions and satisfaction with departmental or institutional policies, practices, and programs. Data from student climate studies should be disaggregated by individual demographics and number of years that a student has been enrolled in the graduate program. Faculty data should be disaggregated by individual demographics and rank.

In some cases, climate studies include observations of the classroom, research laboratory, and departments, including faculty-student interactions. This type of evaluation is usually conducted by an external evaluator, who conducts observations for a period of time.

Information about departmental support and climate can also be obtained from student exit surveys. This type of survey is usually administered to students who leave graduate programs. Tracking students who leave graduate programs usually includes collecting addresses, phone numbers, and email addresses of students' parents and siblings, as well as close friends of the students while they were enrolled in the graduate program.

Ideally, departmental or laboratory climate studies should include surveys or interviews of student enrollees and those who leave graduate programs, faculty, postdoctoral scholars, and staff. Perceptions of each of these groups usually vary based on prior knowledge or experiences. When climate studies include all stakeholders, gaps between perceptions of students, faculty, and others can be evaluated so that commonalities can be identified and used as a basis for change.

Exit interviews or surveys should identify reasons why students leave, including:

- Lack of financial aid (institutional vs. faculty grant money);
- Unusual amount of debt;
- Family responsibility;
- Negative perception of the departmental environment;
- Negative experience with advisor/mentor;
- Poor GPA in courses outside of department; and
- Poor GPA in department courses.

A Retention Study by the CGS Ph.D. Completion Project

With funding from the Sloan Foundation, Pfizer and the Ford Foundation, CGS obtained demographic completion data for 29 institutions starting with the 1992-1993 academic year that are being analyzed by the Ph.D. Completion Project. A general description of the project is at: (http://www.cgsnet.org/Default. aspx?tabid=157). For reporting and other information, visit the Ph.D. Completion project website: (www. phdcompletion.org/).

The data collected by CGS were used to determine the extent to which students completed a doctoral degree within 10 years of initiating graduate study. The CGS baseline analysis showed that 80 percent of students who complete a Ph.D. do so within seven years of entering a program. Therefore, the 10-year completion time frame most likely captures a vast majority of those who enter graduate school and never complete the doctoral degree.

While the initial study was based on data from only 24 institutions, these are some of the largest and well-funded research universities in the nation. These institutions have some of the largest enrollments in graduate programs and, as a result, a high production of doctoral degrees. To some extent, because these institutions generally have high levels of research funding, the information based on an analysis of outcomes of students at these institutions may overestimate retention. Put another way, consistent funding for graduate education may be more likely at these institutions, in stark contrast to the situation at smaller or less research-focused universities.

Figure 4-1 presents a summary of the data related to engineering and mathematics and physical sciences from the CGS report. Overall (not shown in the chart), 55 percent of women and 58 percent of men completed a doctoral degree within 10 years, with 54 percent of domestic students and 67 percent of international students completing their doctoral degree in that timeframe. Women in engineering completed doctoral degrees at about the same rate as women in all fields. However, men in engineering completed their degrees at a higher rate—65 percent versus 58 percent—most likely because of the predominance of international students in engineering, which as a group has a higher overall completion rate than domestic students. In 2007, according to the most recent data from NSF's Survey

Figure 4-1

Doctoral Ten-Year Completion Rates for Engineering by Group

(Source: CPST analysis of data from Council of Graduate Schools, 2008)
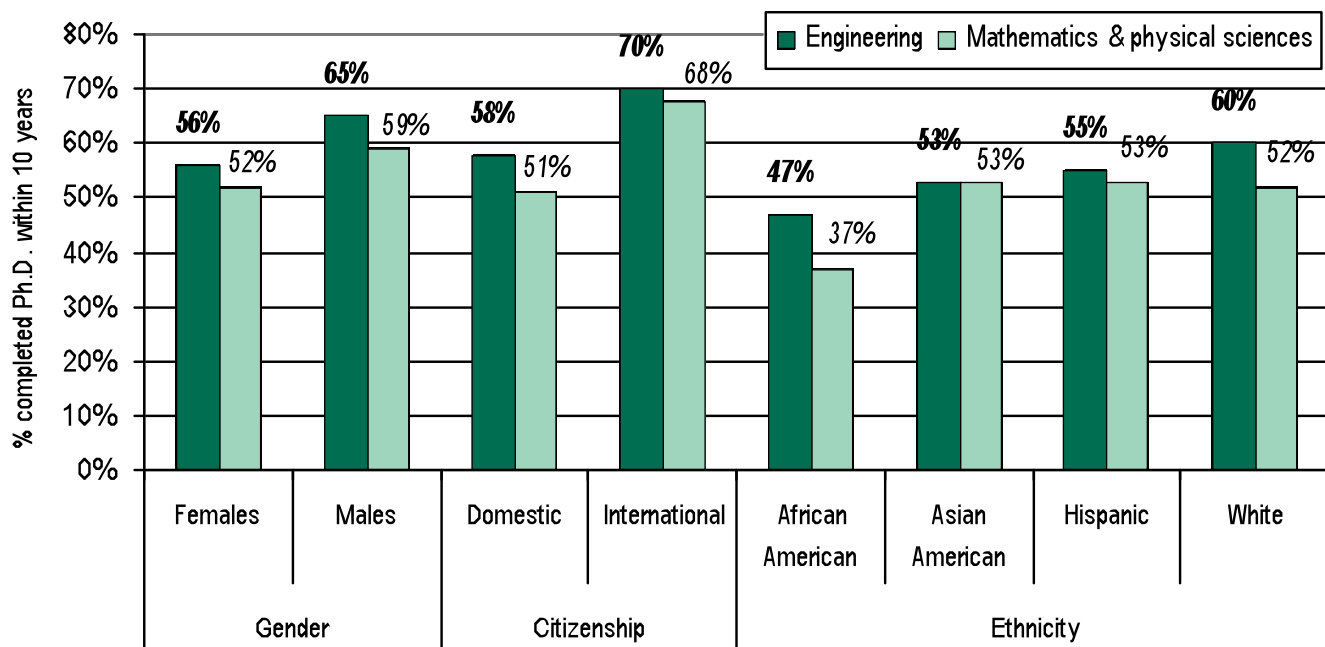
of Earned Doctorates, 62 percent of engineering doctoral degrees were awarded to non-U.S. citizens.

Whites had the highest doctoral completion rate in engineering within 10 years (60 percent), while African Americans had the lowest rate (47 percent), with Asian Americans and Hispanics between these extremes. The 10-year completion rates for both whites and African Americans were higher in engineering than they were in mathematics and physical sciences. Indeed, there is no substantial difference between Asian Americans, Hispanics, and whites in mathematics and physical sciences, which are 52-53 percent, so that the 37 percent figure for African Americans in these fields poses a stronger contrast than in engineering.
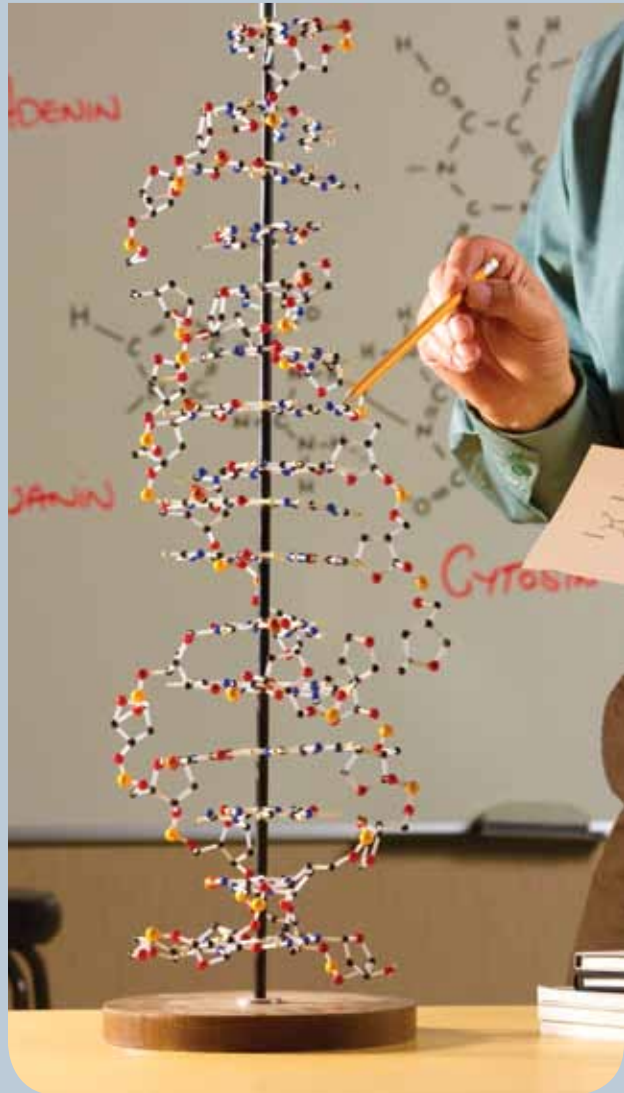
Reflections about Evaluation Studies on Faculty Mentoring Activities

CHAPTER HIGHLIGHTS

- Sources of data used for studying the faculty-student mentoring relationship include department chairs, faculty, database systems, and graduate students.

- In faculty mentoring studies, collecting data about faculty race/ethnicity and citizenship, as well as sex and disability status, is important.

- Data can be collected about three different aspects of the faculty mentoring role: (a) confidence with mentoring; (b) cross-cultural mentoring; and (c) mentoring practices.
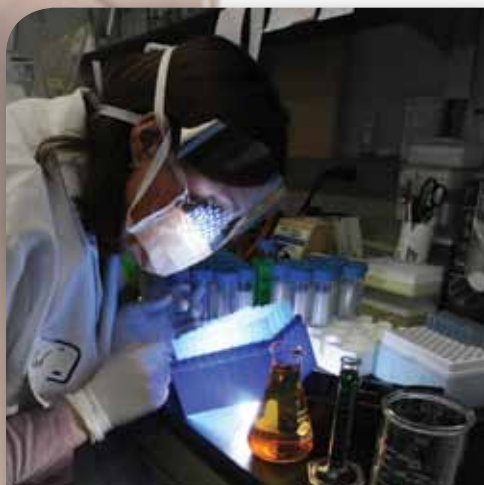
CHAPTER 5

Reflections about Evaluation Studies on Faculty Mentoring Activities

STEM faculty are among the primary agents for achieving diversity goals because they play many roles in the lives of graduate students. Faculty can be the classroom teacher, the research lab leader, advisor, trusted mentor, or the person who signs the student's administrative paperwork.

The ideal student-faculty relationship is mentoring, a very special connection for which both parties have responsibilities. The faculty member is responsible for guiding the student through the graduate school experience, and the student is responsible for working with the faculty member. They have to learn to work with each other within the context of school, home responsibilities, and other considerations.

In designing an evaluation study about faculty mentoring, it is important to outline the elements of the mentoring relationship from the faculty perspective. What are the existing research data on faculty mentoring, and what data are still needed? The two types of data may overlap in some instances. The objective is to capture the activities that ideally should be part of the graduate mentorship relationship.

Figure 5-1 presents a model of students' flow through their doctoral programs. Each of the five steps presents an opportunity for specific mentoring activities to occur. At each step, the goal of the mentoring activities should be to position the student for success in the next step. A by-product of student preparedness for progression to the next step may actually be a stronger mentoring relationship.

An effective mentor anticipates the opportunities and potential challenges their students will experience at each stage in order to guide them toward the ultimate goal: a tenured academic position. Similarly, mentors recognize that the pathway a student may take to a tenured faculty position can vary—especially across the STEM disciplines—and provide appropriate guidance to enable students to be able to return to academia successfully if their career path involves non-academic experiences.
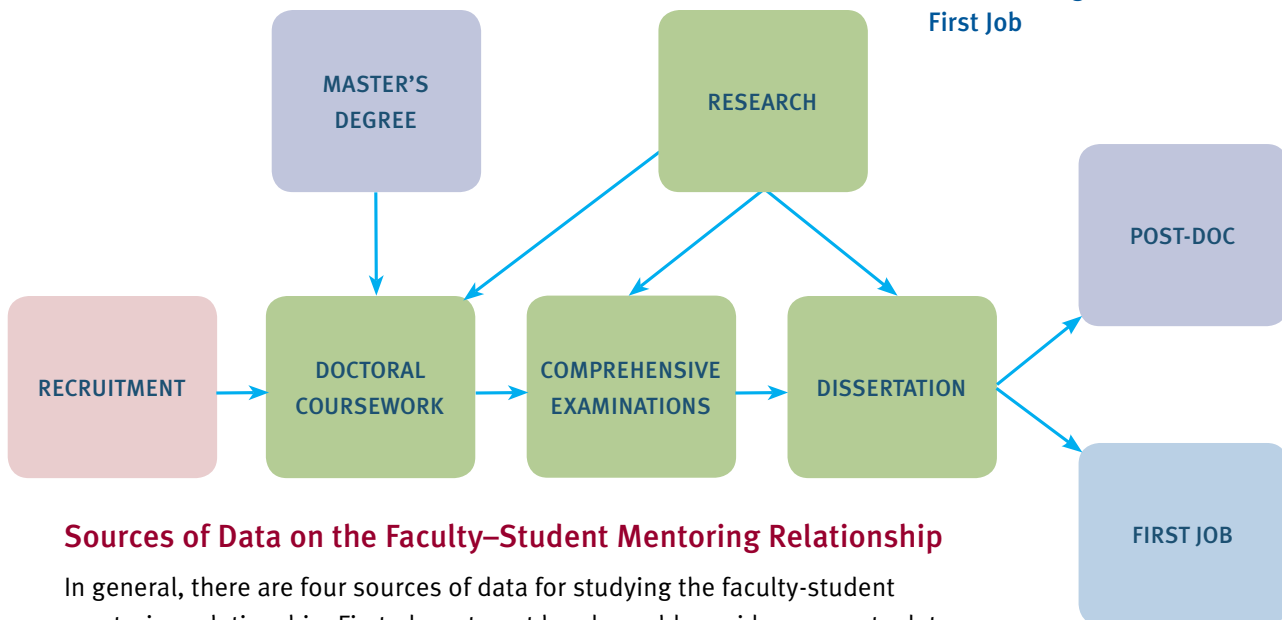
Sources of Data on the Faculty–Student Mentoring Relationship

In general, there are four sources of data for studying the faculty-student mentoring relationship. First, department heads could provide aggregate data on various aspects of faculty interactions with students. Second, faculty themselves are a natural source of data on student mentoring. Third, database systems may be useful in monitoring graduate students' mentoring and progress through a doctoral program and early career. Although such databases are not, at this point, in widespread use at the graduate school level, these systems hold forth some promise for better understanding the ways in which students move into the professoriate. Fourth, graduate students themselves are a source of data, providing valuable qualitative insights.

The method by which data are collected should be determined by the evaluator based on available institutional sources. Questions the evaluator may consider include the following:

■ Should data be collected via institutional online records or surveys?

■ When are interviews and focus groups appropriate?

■ What are the cost implications for programs that are related to methodological questions?

Surveys and other quantitative institutional data can be useful when general information about large groups is desired. In some cases, information about some of the mentoring relationship issues—especially those about the quality and perceived effectiveness of mentoring—may be obtained more efficiently through focus groups or individual interviews than by quantitative means.

Qualitative interviews of both faculty and students may be useful for learning how faculty deal with difficult situations during mentoring. Surveys, interviews, and focus groups involve possible selection biases and responses from students and faculty that are designed to "please" the researcher. Therefore, whenever possible, institutional records should be used as additional, unobtrusive indicators of the extent and quality of mentoring.

Faculty Background Data

Collecting data on faculty race/ethnicity and citizenship, as well as sex and disability status, is important. Other data, such as faculty rank, tenure status, doctoral degree-granting institution, and the year faculty members earned their degree, will provide an opportunity for a more nuanced analysis of faculty mentoring. These analyses may be useful for faculty development programs.

In addition to faculty background characteristics, learning about a faculty member's own mentoring experience may be insightful. Are faculty modeling good (or not so good) mentoring practices from their doctoral training? Have they participated in any campus-based mentor training workshops? Why or why not? Are there any campus-based mentoring training workshops? How do faculty feel about mentoring? Is mentoring normative within the faculty member's department?

Student Recruitment and Faculty Mentoring

The faculty mentoring relationship can be set in motion as early as recruitment to graduate school. At this stage, faculty and students are checking each other out. Both parties want to know if the mentoring spark will ignite. Are there indications that a fruitful intellectual relationship will develop if a graduate program admits a student and, in turn, does the student see the potential for a beneficial relationship with a faculty member or members? Early in the recruitment process, faculty can set the tone for a prospective student's experiences in graduate school, which can then have implications for whether or not that student pursues a career in the professoriate or a career outside academia.

The overarching question for the relationship of mentoring to recruitment is "who owns recruitment?" Is it the academic department, the graduate school, and/or the provost's office? Determining the answer to this question provides a context for answers to other important questions about the student recruitment process.

Who recruits? Is it faculty and/or administrators from the academic department or the graduate school? Who decides which faculty members participate in student recruitment? Is it the graduate dean, the chair, or the department? How are faculty selected or identified to do recruitment? Is it self-selection or a rotating assignment? Do faculty travel for recruitment trips or are they only part of the annual on-campus recruitment effort? Are faculty recruiters trained to discuss recruitment issues, such as financial aid, time-to-degree, and Ph.D. completion rates?

If faculty have training, how is it done (given a program recruitment handbook, attended a workshop, provided with a program fact book)? If faculty participate in recruitment, what are the rewards or recognitions? Do the same faculty who do recruitment actually supervise dissertations or are these processes not connected? Do the recruiting faculty receive financial compensation, course release, letters of thanks for their personnel file, or are they expected/required to do this as part of their service to their department?

For junior faculty, it is important to know if their involvement in recruiting will help at tenure review and if it reduces their productivity.

Finally, where do faculty recruit graduate students? Do faculty discuss graduate school opportunities in their undergraduate classes as well as in advising sessions with undergraduates? Do graduate faculty participate in undergraduate research opportunity programs on their own campus? Do they contact their colleagues at other colleges and universities to ask about promising students and their plans for attending graduate school?

Aspects of the Mentoring Role

Table 5-1 presents three different aspects of the faculty mentoring role: (a) confidence with mentoring; (b) cross-cultural mentoring; and (c) mentoring practices. Following the table is a discussion of each of these areas.

Table 5-1

INDICATORS FOR STEM FACULTY GRADUATE STUDENT MENTORING

Confidence with Mentoring

Confidence with advising students on:
- Types of departmental financial aid
- Non-departmental sources of financial aid
- Careers in science by career type
- Preparation of papers, posters, and oral presentations
- Grant writing
- Teaching
- Family-related issues
- Preparation for teaching
- Research ethics

Cross-Cultural Mentoring

Comfort with advising and sensitivity to students who are African Americans, Hispanics, American Indians, Alaskan Natives, Native Hawaiians or other Pacific Islanders, foreign nationals, female, or physically disabled.

Mentoring Practices
- Frequency of office hours
- Frequency of student progress reports or evaluation
- Number of hours per week spent advising graduate students
- Number of graduate student/postdoctoral/faculty social events attended last academic year
- Number of graduate student/postdoctoral/faculty social events sponsored at a faculty member's home during the last academic year
- Number of times a faculty member assisted graduate students with family issues last academic year
- Number of papers published or patents with graduate students in the last three years
- Number of graduate students provided with travel funds from faculty grants for conferences or skill- building activities last academic year
- Evaluation of mentoring relationship on an annual basis

Confidence with Mentoring

A goal for the mentoring relationship should be to provide students with a sense of the trajectory of the doctoral student experience and the relative rate of progress that students in their particular program at their particular graduate institution make toward degree completion. Mentoring is a proven strategy for helping students receive coaching, counseling, and nurturing support essential to developing needed skills and attributes. In order for faculty to be effective in the conversations they have with students, it is important that they be knowledgeable about the topics listed under the "Confidence with Mentoring" section of Table 5-1. Furthermore, faculty have a responsibility to make students cognizant of the timing of each stage in their career trajectory in their particular discipline that leads, at some point, to a tenured academic position.

Cross-Cultural Mentoring

Given the current faculty demographics in most graduate school STEM departments, the odds of underrepresented students having a faculty mentor of the same race (and/or sex) are quite low. Therefore, it is important that faculty be comfortable with students from diverse backgrounds and be aware of how they interact with them in the language they use, attitudes they convey, the type of advice they give, and the subtle messages sent via body language. These subtle messages are called "micro-inequities" if they inhibit students or "micro- affirmations" if they enhance students. Are faculty sensitive to students' experiences of micro- inequities and affirmations that either enhance or inhibit their career? Do faculty have cross-cultural competency in working with students from backgrounds different from their own? How can departments/schools develop programs that will prepare faculty for these roles?

To make matters even more complicated, teaching faculty how to mentor, especially in terms of cross-cultural issues, can be challenging for departments because mentoring is viewed as not being a problem; that is, faculty believe they know how to mentor. As a result, workshops/seminars can be challenging. On the one hand, if they are voluntary, only those who recognize the importance of the issue may attend (the "preaching to the choir phenomenon"). But if they are mandatory, faculty may resent the requirement. So the question remains, "How do you foster the conversation when people may frame and devalue the conversation as "political correctness?"

For information about mentoring students with disabilities, resources include *New Career Paths for Students with Disabilities: Opportunities in STEM* (http://ehrweb.aaas.org/entrypoint/paths/index.html#summary) and *Roadmaps & Rampways* (http://ehrweb.aaas.org/rr/cover.html).

Mentoring Practices

In Table 5-1, under "Mentoring Practices," many good practices that faculty should be doing for all students are listed. Processes for self-evaluation of mentoring relationships—by both the faculty member and the student—are important but often not made explicit. In addition, over the course of a year, one of two things could conceivably happen, necessitating a change of mentors for a student. First, a student's research interests could change, which could mean that a different faculty member may be better suited to work with the student. Second, in some instances faculty and students realize that their relationship is not evolving into a personal (non-sexual) relationship. That is, the student and faculty may not be "clicking" (or they may be "clicking" too well!). In both of these cases, there needs to be a way for the student to identify a new mentor without any negative feelings on the part of the former mentor or the student.

In terms of informal social events where faculty invite students to their home, there could be concerns that this practice is awkward for single faculty or places an undue burden on some women faculty members. In either case, the normative events for particular departments need to be taken into account. That is, if it is customary for a department to have informal social events at which students and faculty interact, then such social events should be available to all; mentors should encourage their students to participate. On the other hand, if such events are not normative for a particular program, but do occur occasionally, then care should be taken to ensure that individuals are not treated differently based on ethnicity, sex, religion, or any other factor.

Faculty Mentoring and Retention

Given the low Ph.D. completion rates for URM students, it behooves faculty and departments to develop strategies for helping all students succeed. A piece from the retention puzzle is how faculty work with students who are not performing as expected and, consequently, may leave their program, voluntarily or involuntarily.

A second piece of the puzzle is how faculty work with students who enter a graduate program with the goal of earning a "terminal" master's degree. These students may not receive the attention they deserve, because faculty may concentrate more on doctoral students.

What can be done to ensure that faculty provide optimal experiences for all students, regardless of the graduate level? What can students do to have faculty support their exit plan? What can be done to ensure that all students are provided with the same kinds of information about opportunities, especially for those students who may have the capability to earn doctoral degrees but may not have considered themselves "Ph.D. material?" The way institutions resolve these issues will have an impact on their retention rates and on how many master's candidates change their minds and decide to continue on through to the Ph.D.

Career Placement

All of these questions about mentoring and its relationship to degree completion ultimately come down to a single issue: How do graduates get jobs, either in academia or other sectors? What is the role of the mentor in the student's career planning? When do conversations about jobs and careers take place? What role does the mentor or faculty patronage play in the student's landing of that first job? Do faculty mentors call colleagues at other institutions? Do they write letters of recommendation?

What are the subtle messages that faculty members give students about where they should be applying for jobs? Do these messages differ by student characteristics such as race/ethnicity, sex, age, and personal circumstances? As a first step in answering these questions, it is important to collect information about what jobs students who have graduated from a program have, where they are employed, and how those jobs were obtained (if possible).

Students who are mentored should come to their career knowledgeable about what to expect and armed with materials to demonstrate their training and skills to prospective employers. Increasing faculty members' understanding of where their students go and what kinds of work their graduates do can also be important for the recruitment of future students, curriculum development, and skill building within graduate programs.

Evaluation of Preparation for the Professoriate

CHAPTER HIGHLIGHTS

- Indicators used to assess the effectiveness of graduate programs in preparing students for the professoriate include those that focus on preparation of students and those that look at policies, practices, and programs at the institution and in the STEM departments.

- Each STEM graduate program should collect and maintain quantitative and qualitative data focusing on demonstrated competencies related to preparation for the professoriate.

- Evidence that an institution or a department is providing systematic and programmatic efforts to enhance preparation for the professoriate include programs, written guidelines, curriculum, seminars, and online resources.

CHAPTER 6

Evaluation of Preparation for the Professoriate

STEM Ph.D. programs have a responsibility to prepare graduate students for possible careers in the professoriate. National data suggest that diversity of college and university faculty in general, and in STEM disciplines in particular, continues to fall far short of acceptable levels (http://nsf.gov/statistics/wmpd/race.cfm). Two factors contribute to the lack of diversity in the professoriate:

(1) Many STEM Ph.D. graduates, regardless of race/ethnicity, increasingly prefer to pursue careers outside of academia.

(2) More and more, successful faculty careers require experiences beyond the acquisition of the Ph.D. degree.

The first factor can perhaps be best addressed by increased mentoring for potential Ph.D. graduates about the opportunities and joys of academic careers in various types of academic institutions.

The second factor can be addressed only by providing the prospective Ph.D. graduates with the information and the experiences required for a successful career in academia. What this comes down to is preparing doctoral students for placement in postdoctoral programs. Clearly, this latter requirement presumes some experience in the art and science of teaching, but it also involves exposure to the many other roles and responsibilities required of faculty members, including developing curriculum and assessment instruments, research and publishing, and career mentoring.

In the past decade, there has been considerable progress in many of the nation's graduate schools with respect to preparing graduate students for careers in academe. Perhaps the best known of these efforts is the national Preparing Future Faculty (PFF) Project (http://www.preparing-faculty.org/) conducted by CGS and the Association of American Colleges and Universities. The Compact for Faculty Diversity, conducted by the Southern Regional Education Board, the New England Board on Higher Education, and the Western Interstate Commission on Higher Education, is another example of a faculty preparation program (http://www.instituteonteachingandmentoring.org/Compact/index.html).

Indicators of Preparation for the Professoriate

To assess the effectiveness of STEM graduate programs in preparing Ph.D. recipients for careers in the professoriate, two types of indicators seem appropriate. One type focuses on preparation of students, and the other focuses on the work of individual departments and institutions.

Assessing Student Preparation for the Professoriate

Each STEM graduate program should collect and maintain quantitative and qualitative data for students focusing on activities related to preparation for the professoriate, leading to demonstrated competence in:

- Writing papers for peer-reviewed journals and preparing patent applications, including understanding how journal articles and patent applications are reviewed.
- Grant writing and management.
- Teaching and learning, including: understanding research on teaching and learning; how to develop curriculum and student assessments; use of student-centered teaching strategies; use of technology for classroom management and teaching; and issues of adult learning and cognition.
- STEM student career counseling and advising, including advising and mentoring across cultural and sex lines and mentoring students with disabilities.
- Managing a research laboratory and teams, including understanding research ethics.
- University citizenship, including: understanding types of universities; requirements for promotion and tenure; navigating departmental politics; and time management skills for balancing time for teaching, research, service—and life.

To the extent possible, preparation for future academic careers should be documented in faculty and/or student journals. As related to competencies for preparation for the professoriate, some attention should be given to determining criteria that demonstrate that students are proficient.

Assessing Institutions

Evidence that an institution or a department is providing systematic and programmatic efforts to enhance preparation for the professoriate through, for example, programs, written guidelines, curriculum or resources is essential. Such evidence includes:

- Establishment of a teaching requirement for all doctoral students.
- Participation and preparation of graduate students in assisting with undergraduate teaching and lab preparation and undergraduate research programs.
- Mentoring about the value and selection of postdoctoral opportunities and academic careers.
- Preparation for the academic job search, including finding and applying for employment opportunities, interviewing for academic positions, and negotiating the first faculty contract and start-up package.
- Establishment of competencies and assessments related to preparation for the professoriate.
- Networking by faculty for placement of graduate students in postdoctoral or academic positions.
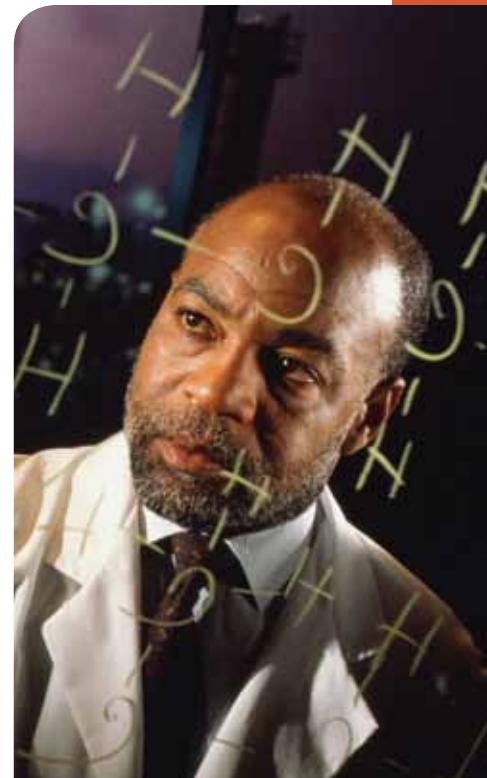
Examples of evaluation questions to use to examine preparation for the professoriate include the extent to which:

• Students are given teaching assignments, including different types of assignments and the preparation for such assignments.

• Students are mentored on the need for postdoctoral experiences through seminars and workshops, especially if they are seeking career paths in research universities.

• Faculty mentors introduce graduate students to networking opportunities related to academic careers, including seminars, workshops, and professional meetings.

• Students are prepared for job searches in the academic sector.

Also, evaluation studies to assess institutional or departmental efforts in regard to preparation for the professoriate should include collection of follow-up data from doctoral recipients, including data on employment sectors. If any of these individuals are employed in academe, data also should be collected on faculty rank.

Any studies about preparation for the professoriate should include comparison groups with URM graduate students or doctoral recipients, and non-URM graduate students or doctoral recipients. Finally, for an institutional study, data can be disaggregated by departments.
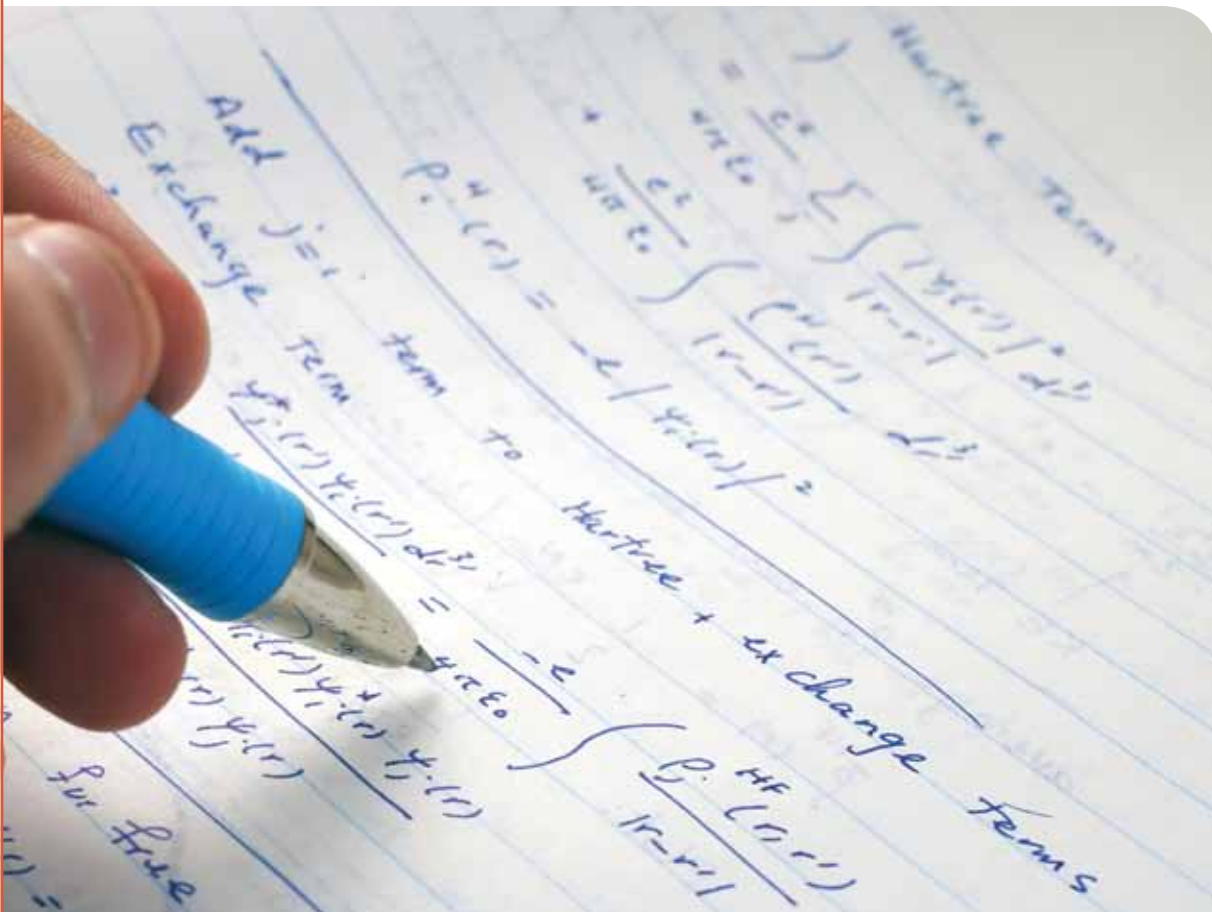
Reporting Formats

CHAPTER HIGHLIGHTS

- Reporting formats can include a full report, an executive summary, a two-page brief, or PowerPoint presentations.

- Reports can include tables, graphs, figures, testimonials and "raw" data as evidence of positive impact. When using testimonials or raw data, careful attention needs to be paid to maintaining participants' confidentiality.
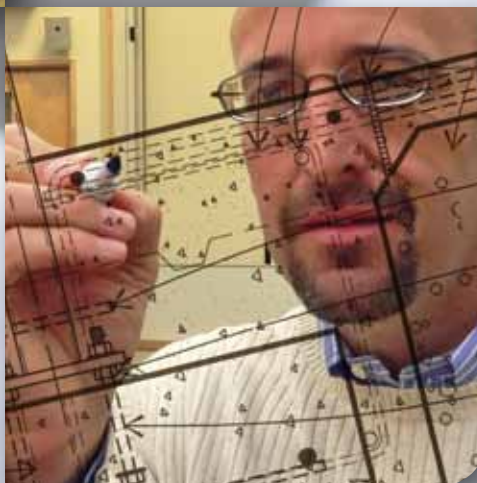
CHAPTER 7

Reporting Formats

Audiences play a role in determining report formats in terms of length, level of detail, and the media that will be used to convey results. At one end of the spectrum, a funder may need a lengthy, comprehensive report about the program, especially at the end of the funding cycle. At the other end of the spectrum, faculty members who have had some involvement in a program may want a quick overview of the program's outcomes. In order to best promote the program to the general public or to show to policymakers that a program has had important impacts, a "just the facts, ma'am" approach is often best for these audiences, too.

While it is customary to write an executive summary that distills the important points from a report, even an executive summary can be too wordy and a less effective communication tool than a two-page brief. The two-page brief should provide a quick description of the program (i.e., a sentence), including its key elements without too many details. Those who are interested in details can visit your website or, if the brief is on the Web, such details can be more easily accessible via pop-up boxes or embedded hyperlinks to the information.

The two-page brief will need to be a convincing document that provides all the relevant information. The format for the brief should include short paragraphs, bulleted statements, and charts and graphs that explain programmatic goals and objectives; strategies and activities; evaluation findings; recommendations for action; acknowledgment of key funders; and key individuals to contact. Participant testimonials (quotes from interviews) can be useful, but they are more critical for small-scale programs. An example of a two-page brief is on pages 47 and 48.

PowerPoint presentations and conference posters are two other ways to present evaluation findings. The audience for these presentations is important in determining the aspects of the program that are emphasized, as well as the evidence highlighted to demonstrate program impact. If you are unfamiliar with the audience, seek guidance from those on your campus who are familiar with this group.

Full reports can include tables, graphs, and figures as evidence of positive impact. In full reports "raw" data can include redacted comments written in response to questionnaire items or basic frequencies of variables without any subsequent data reduction. When using testimonials or raw data, careful attention needs to be paid to maintaining participants' confidentiality.

Organizing Data

Regardless of the audience for whom a presentation product is prepared, careful attention to organizing information can make it easier for readers to capture the most important details. For example, Table 7-1 shows findings about 35 different possible impacts of the Women's International Scientific Cooperation (WISC) mini-grants program administered by AAAS between 2001 and 2003.[3]

The 35 items appeared in various places in the online survey instrument but were collected and reported in groups related to the type of impact (e.g., "Self," "Teaching," "Institutional," etc.). Then these groups were organized by the maximum percentage; for example, 97.6 percent of respondents indicated they "Gained new knowledge" in the "Self" category, while just 34.9 percent reported "Other research collaborators at my institution are more likely to participate in international research collaboration because of my participation in WISC" in the "Institutional" category. Finally, the separate items within each of the eight categories were arranged from the highest to the lowest in terms of the frequency of response.

Data reduction is a critical task. Knowledge of the research literature in the relevant field can be important in guiding how the data reduction analytical tasks are accomplished.

Many questionnaire items have Likert scale response categories. A Likert scale is typically four or five categories such as: very satisfied, somewhat satisfied, somewhat dissatisfied, and very dissatisfied. With items of this type, there are usually few responses at the extreme ends of the scale, so aggregating "very satisfied" and "satisfied" is likely to provide an adequate number of cases but still permit reporting of important findings. However, if there are questionnaire items for which a substantial number of respondents did report at one or the other extreme, then reporting these separately to highlight the extreme answers, which are indicative of the strong feelings held by respondents, can be powerful.

[3]George, Y., S. Malcom, & L. M. Frehill. 2009. Evaluation of the AAAS Women's International Scientific Cooperation (WISC) Program for the American Association for the Advancement of Science. http://www.aaas.org/programs/international/wist/WISC_REPORT_2009-02-09.pdf.

Table 7-1

Impacts of the AAAS Women's International Scientific Cooperation (WISC) Mini-grants Program*

Scale	Item	N	Percent
Self	Gained new knowledge	81	97.6%
	Result in research project w/ foreign collaborator	61	73.5%
	Read journal articles about international science research	57	68.7%
	Developed a foreign research collaboration	57	68.7%
	Read journal articles about international science policy issues	39	47.0%
	Joined an international professional society	37	44.6%
	Continued research development without funding for the collaboration	40	48.2%
	Joined an international women in science organization	8	9.6%
Teaching	Impacted student advice I give about international collaborations	69	83.1%
	Impacted my teaching	55	66.3%
	I developed new courses, class modules, or seminars because of WISC	38	45.8%
	Applied for a science education grant to provide an international project for students	21	25.3%
Productivity	Co-authored publications w/ foreign collaborator	54	65.1%
	Submitted a research article to a foreign journal	35	42.2%
	Patents w/ foreign collaborator	0	0.0%
Presentations	Made presentations since WISC at international science organization meetings	71	85.5%
	Made presentations about WISC at my campus or department	55	66.3%
	Communicated research findings w/ the general public	42	50.6%
	There were articles or news printed or broadcast about WISC project	18	21.7%
	Website or webpage produced	12	14.5%
Advancement	Impacted my promotion or tenure	34	41.0%
	Collaborator recommended me for international research committees or working groups	21	25.3%
	Appointed to committees or working groups because of WISC	15	18.1%
	Helped me obtain a research position or employment	9	10.8%
	Shared awards or recognition w/ foreign collaborator	8	9.6%
Travel Grants	Applied for a travel grant to attend an international research conference	62	74.7%
	Applied for a travel grant for an international project	52	62.7%
	Applied for a travel grant to attend an international science meeting	33	39.8%
Research Grants	Applied for funds for a project that resulted from the WISC collaboration	57	68.7%
	Plan to apply for funds for the project that resulted from the WISC collaboration	40	48.2%
Institutional	Other research collaborators at my institution are more likely to participate in international research collaboration because of my participation in WISC	29	34.9%
	Impacted departmental policies related to international research	11	13.3%
	Changed practices of picking seminar speakers	11	13.3%
	Impacted institutional policies related to international research	7	8.4%
	University started an exchange program because WISC	4	4.8%

* In the table, "w/" means "with."

Displaying Data in Graphs

Different types of graphs can be used, depending on the type of data. Figure 7-1 shows a line graph, which can be used to show trends over a long period of time. This chart makes quite clear that URM representation in 1977 was quite similar in all of the STEM fields and that the greatest increase in URM representation occurred in the life sciences, with far more modest increases in the other STEM fields.

Figure 7-1

An Example of a Line Graph

Percent of Natural Science and Engineering Doctoral Degrees Awarded to Underrepresented Minorities, 1977-2009

Source: Analysis of Integrated Postsecondary Education Data System (IPEDS) degree completions data accessed via National Science Foundation WebCASPAR database system, December 28, 2010. Note: underrepresented minorities includes African Americans, American Indians and Alaska Natives and Hispanics. Geosciences included with "Physical sciences" until 1995, separate data not available prior to 1995.

Figure 7-2

An Example of a Pie Graph

Pie graphs show a distribution of cases on a specific variable. Figure 7-2 shows the percentage of doctoral degrees awarded at 68 AGEP institutions between 2000 and 2009 in different STEM fields. The graph shows the dominance of the life sciences, in which 43% of STEM doctoral degrees were awarded during the 2000-2009 period, followed by engineering, at 27%.

Fields of Natural Science and Engineering Doctoral Degrees Awarded by 68 AGEP Institutions, 2000-2009

Source: Analysis of data in George, Y.S. et al. 2010. "AGEP Info Brief VIII". Note: Life sciences includes biological and agricultural sciences; Geosciences are reported as Earth, Atmospheric, and Ocean Sciences; and Computer engineering included with Engineering data for Computer Engineering: 2000-2003 8: 2003-2006 7: 2006-2009 9.

The final example, a bar graph (Figure 7-3), shows trends over time, but has aggregated years into three-year periods that coincide with specific timeframes associated with the AGEP program. By consolidating years, the upward trend in doctoral degree awards to URM students is apparent. Since the program seeks to increase the number of degrees, percentage increases, such as those shown in Figure 7-2 , provide the larger context, but with the relatively small numbers of URM degrees, the growth shown in Figure 7-3 would be hard to detect in the line graph format.

The example on the next two pages shows how these graphs are used as part of a more comprehensive analysis of the number of URMs completing their Ph.D. in a STEM discipline. Graphs enhance the analysis and make it easier to grasp what the findings are and what they mean.

Figure 7-3

An Example of a Bar Graph

Three-year Average PhD Awards to URMs at 68 AGEP Institutions

377 — 2000-2003
448 — 2003-2006
563 — 2006-2009

Period

Source: Analysis of data in George, Y.S. et al. 2010. "AGEP Info Brief VIII" (Washington, DC: American Association for the Advancement of Science), accessed online at http://www.nsfagep.org.
Note: URM = underrepresented minority, includes African American, American Indian/Alaska Native, and Hispanic.
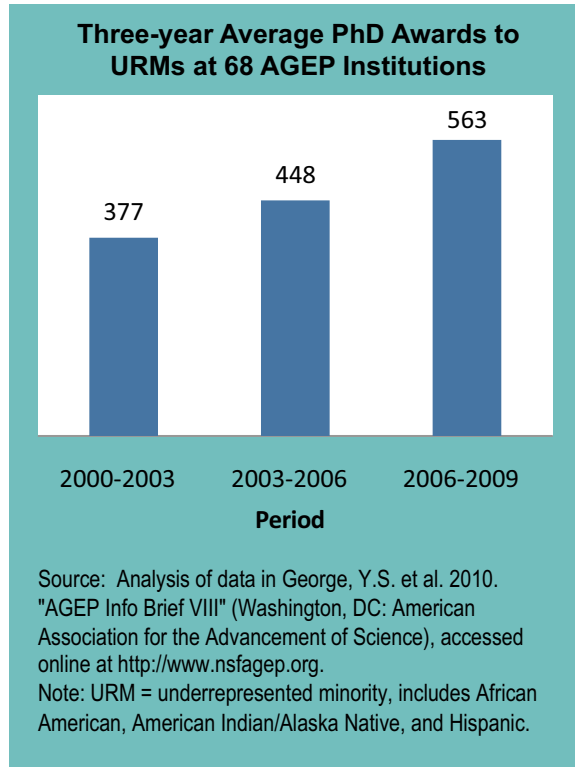
AGEP   Alliances for Graduate Education and the Professoriate
Research Brief #7

The National Science Foundation (NSF) Alliances for Graduate Education and the Professoriate (AGEP) Program began in 1998 to increase the number of underrepresented minorities (URMs) receiving PhDs in science, technology, engineering, and mathematics (STEM). The 19 Alliances participating in this program engage in comprehensive institutional cultural changes to:

1) Significantly increase the number of URMs (i.e., African Americans, Hispanics, American Indians, Alaskan Natives, and Native Hawaiians or other Pacific Islanders) earning STEM doctoral degrees;
2) Develop effective strategies for identifying and supporting URMs who want to pursue academic careers; and
3) Enhance the preparation of underrepresented minorities for faculty positions in academia.

WHY AGEP?

Percent of Natural Science and Engineering Doctoral Degrees Awarded to Underrepresented Minorities, 1977-2009

Source: Analysis of Integrated Postsecondary Education Data System (IPEDS) degree completions data accessed via National Science Foundation WebCASPAR database system, December 28, 2010. Note: underrepresented minorities includes African Americans, American Indians and Alaska Natives and Hispanics. Geosciences included with "Physical sciences" until 1995, separate data not available prior to 1995.

➢The 15,448 URM doctoral-degreed STEM faculty at U.S. 4-year institutions accounted for only 6% of STEM faculty in 1999.

➢By 2006, there were 20,002 URM STEM faculty, 8% of doctoral-degreed faculty.

➢In 1977, there were only 323 doctoral degrees awarded to URMs by U.S. colleges and universities.

➢Since 1977, there has been a four-fold increase in the number of doctoral degrees awarded to URMs in 2009.

➢Doctoral degree awards have increased most and fastest in the life sciences: like non-URMs, largely due to the expansion of NIH funding.

➢Change was least apparent in mathematics and computer sciences over the 32-year period.
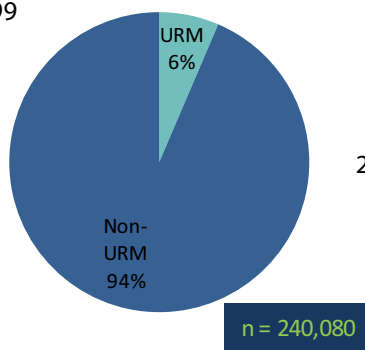
URMs as a percentage of all doctoral-degreed STEM faculty at four-year institutions.
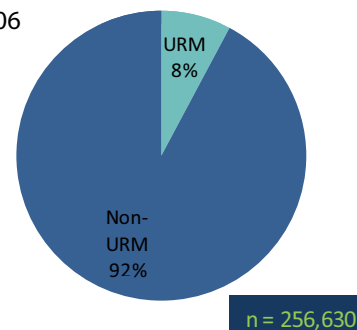
Source: National Science Foundation, Survey of Doctorate Recipients, Detailed Statistical Tables, 1999 and 2006. Includes only faculty who earned a doctoral degree from a U.S. college or university.

Strategies to Increase Recruitment of URM Graduate Students

➢Establish undergraduate research programs with minority-serving institutions.
➢Actively recruit at meetings where undergraduate students make research presentations.
➢Review and monitor departmental admissions, selection, and financial aid processes.
➢Provide financial aid packages to reduce students' debt burden.
➢Train faculty in active recruitment and holistic applicant review processes.

Between the 2000-01and 2008-09 academic years, the NSF-funded AGEP Program has led to a dramatic increase in the annual average number of PhDs awarded in the natural sciences and engineering to URMs.

Strategies to Improve Retention of URM Graduate Students

Three-year Average PhD Awards at 68 AGEP Institutions

Period	
2000 - 2003	377
2003 - 2006	448
2006 - 2009	563

Source: George, Y.S. et al. 2010. "AGEP Info Brief VIII" (Washington, DC: American Association for the Advancement of Science), accessed online at http://www.nsfagep.org.

➢Review and monitor departmental advisement and advancement to candidacy policies.
➢Offer supplemental academic support (e.g., statistics, writing, presentation workshops).
➢Implement activities to foster URMs' early intellectual integration into graduate programs.
➢Provide graduate student travel awards to enhance research productivity and professional development.
➢Develop and encourage faculty to attend professional development programs to improve mentoring and to better understand unique issues for URMs in graduate school.

Undergraduate STEM students rarely encounter a faculty member of color. Movement of URMs through the STEM pipeline to earn doctoral degrees and enter the professoriate has been slow*.*

Fields of Natural Science and Engineering Doctoral Degrees Awarded by 68 AGEP Institutions, 2000-2009

- Other Physical Sciences 5%
- Chemistry 16%
- Engineering 27%
- Mathematics 5%
- Geosciences 2%
- Computer Science 2%
- Life Sciences 43%

Source: George, Y.S. et al. 2010. "AGEP Info Brief VIII". Note: Life sciences includes biological and agricultural sciences; Geosciences are reported as Earth, Atmospheric, and Ocean Sciences; and Computer engineering included with Engineering data for Computer Engineering: 2000-2003 8; 2003-2006 7; 2006-2009 9.

National Sources of Data

CHAPTER HIGHLIGHTS

■ Data from national-level sources can be useful when evaluating a graduate program. Reliable sources are:

- The NSF National Center for Science and Engineering Statistics (NCSES) [formerly the Division of Science Resources Statistics (SRS)]
- Survey of Earned Doctorates
- Integrated Postsecondary Education Data System (IPEDS)
- National Research Council Data-Based Assessment of Research-Doctorate Programs

CHAPTER 8

National Sources of Data

N ational data sources can be important ways to benchmark the performance of a program. This section will provide an overview of the various sources, how they can be accessed, and some of the strengths and weaknesses associated with each source. The majority of sources are public: the Federal government invests heavily in data collections and in systems to permit users access to these data. Professional societies are another source of data.

Table 8-1 provides an overview of the sources of data that might be useful for graduate programs. As indicated in the table, in several cases, such as the Institutional Postsecondary Education Data System (IPEDS), data are reported at the institutional level. Other data are collected at the individual level, such as those associated with the Survey of Earned Doctorates. These data are from an annual survey of all recipients of research doctorate degrees awarded by U.S. colleges and universities. These individual-level data provide more details about a specific population. Finally, professional societies collect and report data on graduate degrees. Each of these data sources varies in important ways.

Table 8-1

Overview of National Data Sources with Key Variables

Data Source and Web Location	Responsible Agency	Individual or Institutional – Population	Key Variables	Frequency
Integrated Postsecondary Education Data System (IPEDS)	National Center for Education Statistics (NCES)	Institutional: all Title IV institutions.	Degree levels, disciplines, race/ethnicity, sex, citizenship, institution.	Annually
Survey of Earned Doctorates (SED)	National Opinion Research Center (NORC) conducted for NSF and five other federal agencies: USDA, NIH, NASA, DOE, and NEH	Individual: recipients of doctoral degrees from U.S. colleges and universities in their graduation year.	Discipline, sex, race/ethnicity, citizenship, funding mechanism, post-graduation plans (among others).	Annually
Graduate Student Survey	NSF	Institutions: all U.S. institutions with at least one post-baccalaureate program.	Enrollment by level (masters or PhD), type (full or part time), race/ethnicity, sex, citizenship.	Annually
Data-Based Assessment of Research-Doctorate Programs	National Research Council	Institutional	Most comprehensive collection of information about graduate programs to date.	Infrequently, episodic

Public Data Sources

The NSF National Center for Science and Engineering Statistics (NCSES) [formerly the Division of Science Resources Statistics (SRS)] collects, analyzes and reports on many datasets related to STEM education and the STEM workforce (http://www.nsf.gov/statistics).

For many datasets, NCSES produces an InfoBrief, which is a 4- to 8-page data publication. In addition to the InfoBrief, more detailed data are often made available in "Detail Statistical Tables," which are compiled and published online.

The division also produces two major publications biennially:

■ Science and Engineering Indicators (http://www.nsf.gov/statistics/seind10/) is produced for the National Science Board.

■ Women, Minorities and Persons with Disabilities in Science and Engineering is produced for the U.S. Congress (http://www.nsf.gov/statistics/wmpd/).

NCSES has also produced State Profiles (http://www.nsf.gov/statistics/states/). These profiles include a range of information about each state, compiled from the many surveys under the NCSES umbrella.

Survey of Earned Doctorates

Of the five data sources listed in the table, only one compiles information gathered from individuals rather than institutions. The primary source of data used to examine doctoral degree recipients is the Survey of Earned Doctorates (SED) (http://www.norc.org/projects/survey+of+earned+doctorates.htm).

Conducted every year in partnership with U.S. research universities, the SED has a greater than 95 percent response rate. The survey provides key information about the individuals who receive research doctoral awards from U.S. colleges and universities each year, including information about sub-fields, sources of support, demographic information, and plans for the next year. The amount of time it took to complete the doctoral degree and whether or not the individual earned a master's degree on the way to the doctoral degree are also included in this dataset.

The SED data are used by some university systems to establish "availability pools" for equal employment opportunity procedures. A large report is completed by the National Opinion Research Center (NORC) each year under contract to NSF. In addition to this report, later in the year a more comprehensive set of analyses are made available on the NSF NCSES website. These are called "detailed statistical tables" for the survey of earned doctorates. Many SED data publications are available online as PDFs and Excel files.

Web Location

Survey of Earned Doctorates main page:
    http://www.nsf.gov/statistics/srvydoctorates/

Detailed statistical tables and reports are compiled each year from the Survey of
    Earned Doctorates: http://www.nsf.gov/statistics/doctorates/

Information about the more than 250 disciplines or fields that are reported in the Detailed Statistical Tables of the Survey of Earned Doctorates can be located on the website. Table 8-2 shows an example of one of the regular tables. Tables from the 2009 SED report can be located on the website: (http://www.nsf.gov/statistics/nsf11306/).

NSF makes these data easy to download as spreadsheets for use in additional analysis or as PDF files, which makes printing and distributing data to relevant audiences a little easier.

Table 8-2

U.S. Citizen and Permanent Resident Doctorate Recipients, by Race/Ethnicity and Major Field of Study: 2009

Field of study	All U.S. citizen and permanent resident doctorate recipients (number)	Percent							
		Total	American Indian[a]	Asian	Black	Hispanic[b]	White	Two or more races	Other/ unknown[c]
All fields	32,231	100.0	0.5	8.3	6.9	5.8	74.6	2.0	1.9
Life sciences	7,783	100.0	0.4	10.3	5.4	5.0	75.2	2.0	1.7
Agricultural sciences/natural resources	710	100.0	0.6	4.5	4.9	4.8	81.0	1.8	2.4
Biological/biomedical sciences	5,513	100.0	0.3	11.4	4.4	5.5	74.5	2.1	1.7
Health sciences	1,560	100.0	0.5	9.0	9.1	3.3	75.1	1.7	1.3
Physical sciences	4,414	100.0	0.2	9.9	3.1	4.2	78.7	1.8	2.2
Chemistry	1,390	100.0	0.3	9.5	4.5	5.5	76.7	1.7	1.9
Computer and information sciences	735	100.0	0.0	17.0	3.8	2.7	72.1	2.3	2.0
Earth, atmospheric, and ocean sciences	556	100.0	0.4	3.6	1.4	4.5	86.3	1.4	2.3
Mathematics	772	100.0	0.4	10.9	3.2	4.7	76.8	1.9	2.1
Physics and astronomy	961	100.0	0.0	7.7	1.2	3.0	83.6	1.7	2.8
Social sciences	5,605	100.0	0.5	6.3	6.8	7.1	74.6	2.7	2.0
Anthropology	403	100.0	0.2	4.2	5.7	9.2	75.4	3.2	2.0
Economics	415	100.0	0.0	13.7	3.1	2.4	76.1	1.7	2.9
Political science/international relations	482	100.0	0.8	6.2	6.0	5.2	74.1	3.5	4.1
Psychology	2,896	100.0	0.4	5.1	6.3	7.8	76.2	2.8	1.5
Sociology	507	100.0	0.2	7.7	8.7	6.3	72.8	2.8	1.6
Other social sciences	902	100.0	1.0	7.0	10.0	7.3	70.1	2.3	2.3
Engineering	3,148	100.0	0.4	16.3	4.3	5.0	69.8	1.9	2.4
Aerospace/aeronautical engineering	159	100.0	0.6	9.4	1.9	6.3	76.7	1.3	3.8
Chemical engineering	411	100.0	0.7	13.9	3.2	5.8	73.2	1.5	1.7
Civil engineering	261	100.0	0.0	11.1	3.4	6.1	77.4	0.4	1.5
Electrical/electronics engineering	577	100.0	0.3	27.6	4.9	4.0	59.8	1.4	2.1
Industrial/manufacturing engineering	70	100.0	1.4	21.4	8.6	8.6	55.7	1.4	2.9
Materials science engineering	251	100.0	0.4	12.7	6.8	3.6	70.5	2.8	3.2
Mechanical engineering	421	100.0	0.5	11.4	4.8	5.5	73.6	1.9	2.4
Other engineering	998	100.0	0.2	15.8	3.8	4.7	70.3	2.6	2.5
Education	5,566	100.0	0.8	3.9	14.5	6.9	70.8	1.6	1.4
Education administration	1,971	100.0	1.0	2.3	18.4	7.2	68.4	1.6	1.0
Education research	2,222	100.0	0.9	4.5	12.4	6.8	72.2	1.8	1.4
Teacher education	261	100.0	0.8	3.4	17.2	3.8	72.0	0.8	1.9
Teaching fields	741	100.0	0.3	5.5	9.9	5.0	76.8	1.2	1.3
Other education	371	100.0	0.5	6.2	14.0	12.4	62.3	1.3	3.2
Humanities	3,880	100.0	0.4	5.2	4.3	6.6	79.2	2.2	2.1
Foreign language and literature	387	100.0	0.5	5.4	2.8	23.3	64.3	1.3	2.3
History	876	100.0	0.2	4.0	5.6	5.4	79.9	2.2	2.7
Letters	1,166	100.0	0.3	5.5	3.9	3.9	82.7	2.2	1.5
Other humanities	1,451	100.0	0.6	5.7	4.3	5.1	80.0	2.3	2.0
Other non-S&E fields	1,835	100.0	0.3	8.9	9.6	5.1	72.5	1.7	1.9
Business and management	776	100.0	0.4	11.0	9.4	5.2	70.5	2.1	1.5
Communication	442	100.0	0.5	6.6	8.4	2.5	78.3	1.1	2.7
Fields not elsewhere classified	617	100.0	0.2	8.1	10.7	6.8	70.8	1.8	1.6

[a] Includes Alaska Natives.

[b] Persons reporting Hispanic ethnicity, whether singly or in combination with one or more races, are included in the respondent-selected Hispanic ethnicity category.

[c] Includes doctorate recipients who did not indicate their race and ethnicity, non-Hispanic doctorate recipients who did not indicate their race, and non-Hispanic Native Hawaiian or Other Pacific Islanders.

NOTES: Major field of study definitions are detailed in appendix A. Due to rounding, the sum of percentages may not equal to 100.

SOURCE: NSF/NIH/USED/USDA/NEH/NASA, 2009 Survey of Earned Doctorates.

IPEDS

The Institutional Postsecondary Education Data System (IPEDS) is one of the principal sources of national data on degrees. IPEDS data must be reported by all U.S. Title IV institutions: that is, any institution that receives federal educational funds, such as Pell Grants—which is virtually every institution in the nation. The National Center for Education Statistics collects and manages IPEDS data.

While the SED data are from a survey of the recipients of doctoral degrees, IPEDS data are provided by the institution, typically the institutional research office. Data on level of degrees and demographic characteristics of degree awardees are available. Importantly, though, the IPEDS data have special utility in looking at particular sets of institutions.

IPEDs data can be run at the institutional level, and those who access these data via the NSF's Web CASPAR database system (with a login id, no charge) can establish groups of institutions for which they wish to examine data. So, for example, if you register with Web CASPAR and get a login, you can establish a set of peer institutions within the system and then run data for your own institution and make comparisons to a specified set of peer institutions.

Graduate Student Survey

Another institutional-level survey by the NSF is conducted annually to collect data on graduate students and postdocs. Information about this survey is available at: http://www.nsf.gov/statistics/srvygradpostdoc/

Reports generated from this survey are available at: http://www.nsf.gov/statistics/gradpostdoc/

The data from this survey are also accessible via Web CASPAR, as are the data from the IPEDS survey. Information in the Graduate Student Survey (GSS) includes demographic data, fields, levels, part-time/full-time status, and institutional characteristics.

National Research Council

The Research Council's most recent report "A Data-Based Assessment of Research-Doctorate Programs in the United States" is a comprehensive examination of research doctorate programs in the United States. Details about more than 5,000 programs in 62 fields at 212 institutions are included: (http://sites.nationalacademies.org/pga/resdoc/index.htm).

The website for the publication includes excellent access to the data and reports. In addition, there are a number of examples about how to use this information, along with demonstrations of how to access these specific data. The demos can also be helpful in learning more about the capabilities of Excel.

Data about the following 20 characteristics are provided for each program:

- Publications per allocated faculty member
- Citations per publication
- Percent faculty with grants
- Awards per allocated faculty member
- Percent interdisciplinary faculty
- Percent non-Asian minority faculty
- Percent female faculty
- Average GRE scores
- Percent first-year students with full support
- Percent first-year students with external funding
- Percent non-Asian minority students
- Percent female students
- Percent international students
- Average number of Ph.D. degrees earned, 2002 to 2006
- Average completion percentage
- Median time-to-degree
- Percent students with academic plans
- Student work space
- Student health insurance
- Number of student activities offered

Data Sources from Professional Societies

Many STEM professional societies collect and report their own data. These data are often made available to members in reports or via Web-based database access systems. In most cases, access to this information is part of the membership benefit; non-members may need to pay various fees in order to access information. In general, though, professional societies that do collect data are usually quite willing to share this information. The following societies collect various data on a regular basis:

- American Mathematical Society (AMS)
- American Institute of Physics (AIP)
- Computing Research Association (CRA)
- American Psychological Association (APA)
- American Economic Association, Committee on the Status of Women and the Committee on the Status of Minorities (AEA-CSW and AES-CSM)
- American Society for Engineering Education (ASEE)
- American Chemical Society (ACS)
- American Sociological Association (ASA)
- Association of American Medical Colleges (AAMC)

Summary

Data from national-level sources can be useful when evaluating a graduate program. Faculty and students, as well as other stakeholders, are often interested in how their particular program measures up against others. There are a number of outcomes that might be of interest:

- The most recent National Research Council report and associated products, mentioned earlier, provide information on a range of metrics on program quality.
- The IPEDS, professional societies, and SED data provide more detailed and timely information on degrees.
- The GSS and professional societies provide information on enrollments.

Each of these sources provides information about a different dimension of graduate programs and can be quite helpful in benchmarking.
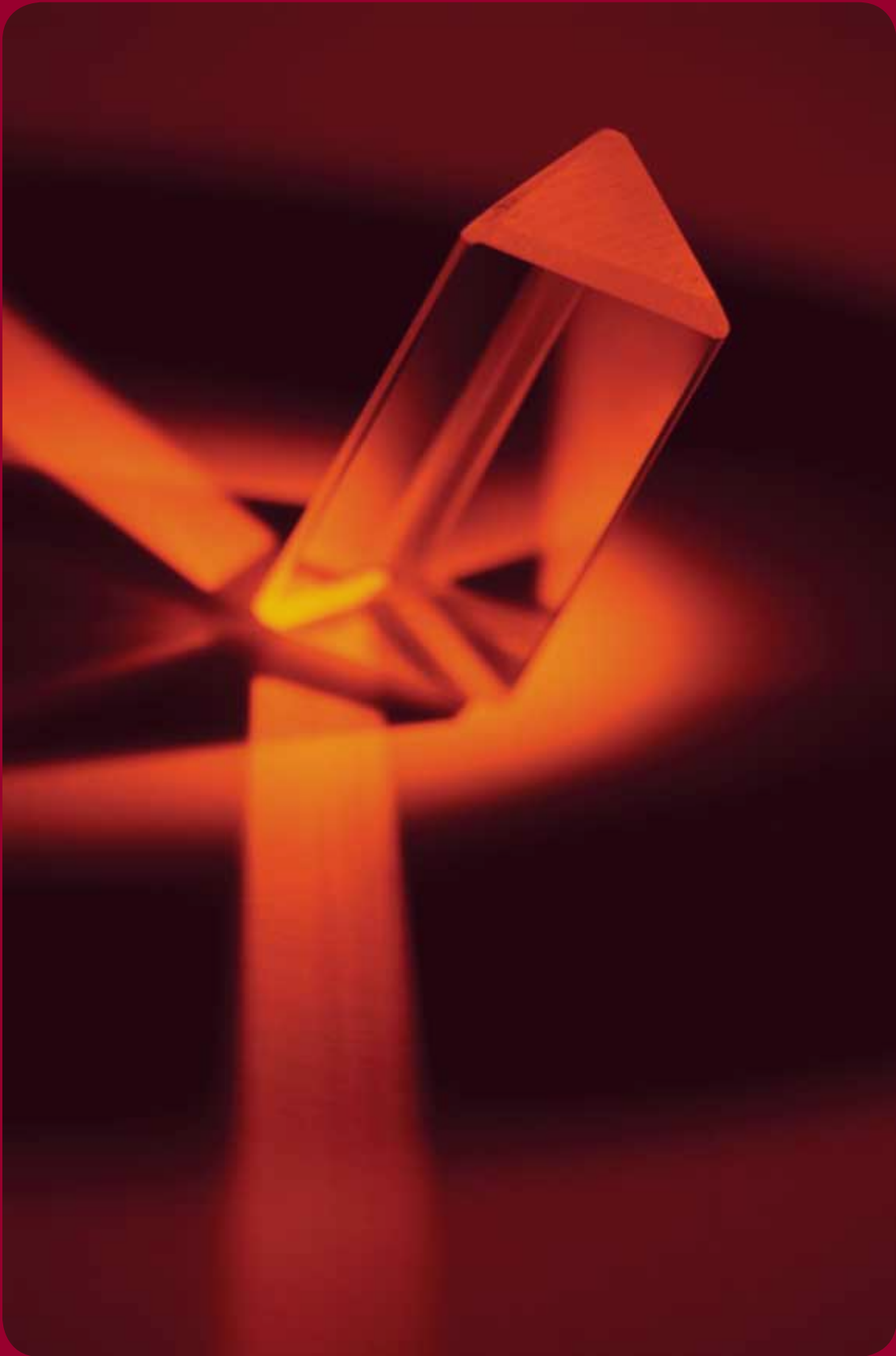
Epilogue

Scaling-up the production of URM graduate students who receive Ph.D. degrees and enter the STEM workforce will help the U.S. maintain its competitive edge in the global marketplace. Achieving this goal requires the help of every STEM department in every institution in this country. This goal cannot be reached without building leadership-based learning communities that periodically assess and examine all parts of the graduate school infrastructure in terms of STEM diversity. Leadership and the use of data are powerful components in understanding what works and what needs to change.

This book provides a blueprint on how to implement change and benchmark progress, with particular emphasis on STEM graduate school diversity. We hope the recommendations and ideas in this evaluation guidebook and the related website, as well as other evaluation tools, will be useful in helping vice presidents, provosts and other administrators, and STEM department chairs, faculty, and staff :

- Better understand the experience of all graduate students, regardless of race/ethnicity, sex, disability, or citizenship. Using disaggregated student data should be a part of regular management practices at the graduate school and departmental level and not viewed as added work.

- Work to increase the number of URM new enrollees in graduate programs. Assessing recruitment activities and admissions practices and collecting disaggregated data for graduate student applicants, admits, and new enrollees is an important step in trying to understand how to identify and attract talented URM students into STEM graduate school programs.

- Strive for increases in graduate student retention and Ph.D. completion rates. Retention and time-to-degree studies, coupled with qualitative studies about the departmental and research laboratory environments, can help leaders and faculty better understand why students leave, what is pushing them out, and what can be done about it.

- Improve STEM faculty mentoring efforts. Data can be collected about three different aspects of the faculty mentoring role: (a) confidence with mentoring; (b) cross-cultural mentoring; and (c) mentoring practices. Improving faculty mentoring can help improve recruitment and Ph.D. completion.

- Improve the way that graduate students are prepared for the professoriate. National data suggest that diversity of college and university faculty in general, and in STEM disciplines in particular, continues to fall far short of acceptable levels. Improving the number of URM faculty may also lead to increases in the number of URM students who enter graduate school and complete their Ph.D. degrees.

We hope this guide and the related Web resources will assist graduate school leaders in building a community of like-minded individuals who use data to add even more diversity to the academic landscape in the STEM disciplines, as well as other disciplines. We cannot wait any longer to accomplish this important work.

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Sample AGEP Institution Report for University X

Note for all tables: 0 in a cell means there are no students in that category; blank means there are no data available for that category.

Table 1

Number of Underrepresented Graduate Students in All Natural Sciences & Engineering at University X

	2000/01	2001/02	2002/03	2003/04	2004/ 05	2005/06	2006/07	2007/08	2008/09
Applicants	251	231	267	329	283	280	318	260	300
Admits	145	130	143	133	120	127	154	114	161
New Enrollees	75	73	75	63	63	71	79	51	78
New Masters Enrollees	56	48	52	44	38	46	51	27	53
New PhD Enrollees	19	25	23	19	25	25	28	24	25
All Enrollees	286	277	285	291	291	285	303	292	318
All Master Enrollees	137	130	129	134	130	127	128	111	133
All PhD Enrollees	145	143	150	153	156	153	172	178	183
Masters Recipients	84	79	67	76	71	73	68	71	71
Advance to Candidacy									
PhD Recipients	17	17	10	22	8	22	18	13	21

Table 2

Number of Underrepresented Graduate Students in All STEM Disciplines at University X

	2000/01	2001/02	2002/03	2003/04	2004/ 05	2005/06	2006/07	2007/08	2008/09
Applicants	301	275	341	405	374	363	432	373	411
Admits	161	147	165	154	140	148	180	149	194
New Enrollees	82	85	83	75	76	81	92	64	96
New Masters Enrollees	62	56	57	54	48	52	59	39	69
New PhD Enrollees	20	29	26	21	28	29	33	25	27
All Enrollees	320	321	331	343	341	340	365	359	388
All Master Enrollees	156	153	152	161	155	149	153	142	170
All PhD Enrollees	160	162	171	177	180	182	206	212	213
Masters Recipients	93	93	76	86	86	84	79	90	86
Advance to Candidacy									
PhD Recipients	17	17	10	23	10	25	20	17	23

Table 3

Number of Underrepresented Graduate Students in Engineering at University X

	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
Applicants	145	126	143	170	156	146	174	131	169
Admits	91	75	84	87	77	70	85	58	93
New Enrollees	45	33	36	39	38	37	40	27	38
New Masters Enrollees	33	23	25	31	21	25	27	17	27
New PhD Enrollees	12	10	11	8	17	12	13	10	11
All Enrollees	146	148	150	164	164	154	148	148	155
All Master Enrollees	75	75	72	85	80	71	65	64	80
All PhD Enrollees	70	69	74	76	83	80	83	82	75
Masters Recipients	41	50	32	45	41	44	36	36	39
Advance to Candidacy									
PhD Recipients	9	5	5	10	4	14	9	9	13

Table 4

Number of Underrepresented Graduate Students in Biological & Agricultural Sciences at University X

	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
Applicants	5	9	8	5	12	12	8	10	9
Admits	1	2	5	1	6	6	3	4	4
New Enrollees		2	2		3	4		2	1
New Masters Enrollees			1		1	2			
New PhD Enrollees		2	1		2	2		2	1
All Enrollees	1	3	4	3	8	10	11	8	9
All Master Enrollees			1	1	5	5	6		
All PhD Enrollees	1	3	3	2	2	5	5	8	9
Masters Recipients				1	1	1	4		
Advance to Candidacy									
PhD Recipients			1						1

Table 5

Number of Other US Graduate Students in All Natural Sciences & Engineering at University X

	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
Applicants									
Admits	772	803	899	1,016	885	980	1,054	1,100	1,011
New Enrollees	358	453	445	517	378	441	483	487	462
New Masters Enrollees	243	337	325	351	277	318	344	353	329
New PhD Enrollees	115	116	120	166	101	123	139	134	133
All Enrollees	1,499	1,604	1,725	1,914	1,907	1,887	2,001	2,062	2,050
All Master Enrollees	739	821	850	928	938	938	996	1,011	971
All PhD Enrollees	734	752	840	940	942	923	979	1,036	1,064
Masters Recipients	360	368	418	448	496	458	452	477	577
Advance to Candidacy									
PhD Recipients	102	106	84	96	127	128	137	122	160

Table 6

Number of Other US Graduate Students in All STEM Disciplines at University X

	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
Applicants									
Admits	860	907	1,067	1,178	1,018	1,169	1,241	1,292	1,204
New Enrollees	408	510	521	602	447	508	563	554	544
New Masters Enrollees	279	378	375	409	318	360	390	399	391
New PhD Enrollees	129	132	146	193	129	148	173	155	153
All Enrollees	1,710	1,824	1,981	2,210	2,205	2,218	2,364	2,456	2,451
All Master Enrollees	841	933	982	1,072	1,078	1,076	1,135	1,170	1,134
All PhD Enrollees	837	854	958	1,082	1,092	1,110	1,193	1,265	1,296
Masters Recipients	406	419	481	519	571	521	533	564	659
Advance to Candidacy									
PhD Recipients	114	122	94	116	138	146	148	143	195

Table 7

Number of Other US Graduate Students in Engineering at University X

	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
Applicants									
Admits	486	473	505	624	553	582	615	680	622
New Enrollees	195	250	245	288	208	243	271	301	269
New Masters Enrollees	151	199	187	217	169	186	210	237	205
New PhD Enrollees	44	51	58	71	39	57	61	64	64
All Enrollees	784	816	895	1,010	1,040	1,010	1,071	1,130	1,128
All Master Enrollees	458	488	519	565	599	577	613	646	647
All PhD Enrollees	310	312	359	411	425	422	445	475	475
Masters Recipients	214	220	227	242	294	267	256	270	345
Advance to Candidacy									
PhD Recipients	58	51	45	39	57	64	73	71	80

Table 8

Number of Other US Graduate Students in Biological & Agricultural Sciences at University X

	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
Applicants									
Admits	19	35	31	42	23	21	18	29	19
New Enrollees	7	20	11	16	9	14	7	12	11
New Masters Enrollees	1	11	4	8	4	6	2	7	8
New PhD Enrollees	6	9	7	8	5	8	5	5	3
All Enrollees	36	48	57	66	65	62	53	60	63
All Master Enrollees	9	15	16	24	24	21	13	17	20
All PhD Enrollees	27	31	39	41	41	40	39	42	42
Masters Recipients	4	5	10	12	14	11	7	6	10
Advance to Candidacy									
PhD Recipients	4	2	4	3	5	7	1	8	3

Table 9

Number of Non US Graduate Students in All Natural Sciences & Engineering at University X

	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
Applicants									
Admits	839	990	929	904	706	836	990	1,336	1,228
New Enrollees	335	467	412	360	276	341	389	603	482
New Masters Enrollees	238	295	274	235	194	241	273	480	385
New PhD Enrollees	97	172	138	125	82	100	116	123	97
All Enrollees	1,427	1,740	2,015	2,113	2,085	2,018	2,096	2,344	2,378
All Master Enrollees	446	621	642	582	556	524	599	871	962
All PhD Enrollees	949	1,082	1,342	1,502	1,505	1,469	1,483	1,453	1,406
Masters Recipients	354	378	547	485	464	421	426	477	707
Advance to Candidacy									
PhD Recipients	112	105	117	161	186	210	265	268	240

Table 10

Number of Non US Graduate Students in All STEM Disciplines at University X

	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
Applicants									
Admits	930	1,074	1,042	1,026	836	1,005	1,144	1,569	1,496
New Enrollees	360	496	451	389	307	380	430	687	551
New Masters Enrollees	249	313	299	252	213	262	304	553	444
New PhD Enrollees	111	183	152	137	94	118	126	134	107
All Enrollees	1,502	1,840	2,155	2,276	2,262	2,241	2,327	2,642	2,686
All Master Enrollees	476	663	707	649	617	603	685	1,025	1,126
All PhD Enrollees	991	1,135	1,413	1,588	1,611	1,609	1,621	1,593	1,547
Masters Recipients	366	398	571	538	504	467	469	550	800
Advance to Candidacy									
PhD Recipients	114	105	120	163	200	220	276	294	258

Table 11

Number of Non US Graduate Students in Engineering at University X

	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
Applicants									
Admits	530	566	555	555	410	392	518	518	569
New Enrollees	205	233	198	177	126	123	159	172	199
New Masters Enrollees	161	167	144	131	90	88	110	129	154
New PhD Enrollees	44	66	54	46	36	35	49	43	45
All Enrollees	756	895	994	1,015	1,004	928	954	1,009	1,007
All Master Enrollees	297	368	401	342	309	231	249	313	353
All PhD Enrollees	433	502	575	657	684	682	697	688	649
Masters Recipients	198	206	307	243	246	200	174	206	251
Advance to Candidacy									
PhD Recipients	55	57	60	67	94	102	123	130	119

Table 12

Number of Non US Graduate Students in Biological & Agricultural Sciences at University X

	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
Applicants									
Admits	12	15	26	27	31	32	41	37	52
New Enrollees	4	7	9	10	10	6	13	14	21
New Masters Enrollees	4	5	7	5	7	1	9	7	13
New PhD Enrollees		2	2	5	3	5	4	7	8
All Enrollees	18	26	33	46	45	48	52	60	67
All Master Enrollees	9	15	22	24	20	20	14	17	21
All PhD Enrollees	9	11	10	21	25	28	38	42	45
Masters Recipients	5	4	9	14	8	14	7	10	9
Advance to Candidacy									
PhD Recipients	1	1	1		2	1		4	10

AGEP Alliances for Graduate Education and the Professoriate
Info Brief VIII

The AGEP Program has led to Dramatic Increases in the Annual Number of PhDs Awarded to URMs from 2000/01 to 2008/09

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SUMMARY

One of the goals of the National Science Foundation (NSF) Alliances for Graduate Education and the Professoriate (AGEP) Program, which began in 1998, is to increase the number of underrepresented minorities (URMs)[1] receiving PhDs in science, technology, engineering, and mathematics (STEM). *(See program description at bottom of page.[2])* Analyses of PhD recipient data from 68 AGEP institutions from 19 Alliances indicate that the AGEP Program has dramatically increased the annual number of URM PhD recipients in STEM fields.

An analysis of URM PhD recipient data from 2000/01 to 2008/09 for 68 AGEP institutions from 19 Alliances indicates that the average annual number of URM PhD recipients in graduate programs in STEM increased from 609 (Early AGEP (2000/01 to 2002/03)) to 772 (Current AGEP (2006/07 to 2008/09)), an increase of 163 or 26.8%. During this same period, the average annual number of URM PhD recipients in graduate school programs in Natural Sciences & Engineering (NS&E) increased from 377 to 563, an increase of 186 or 49.3% *(Table 1 and Figure 1).*

MORE ABOUT THE AGEP DATA

A. About the Average Annual Number and Percent of URM PhD Recipients in STEM at 68 AGEP Institutions in 2006/07, 2007/08 and 2008/09

For 2006/07, 2007/08 and 2008/09, the average annual number of URM PhD recipients in STEM fields at 68 AGEP institutions was 772. By broad STEM fields, the average annual number and percent of URM PhD recipients at 68 AGEP institutions in 2006/07, 2007/08 and 2008/09 were:

- 563 or 72.9% in NS&E.
- 79 or 10.2% in Psychology.

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[1]URM students are African-Americans, Alaskan Natives, Native Americans, Hispanic Americans, and Native Pacific Islanders.

[2]Program Description: The goal of the National Science Foundation (NSF) Alliances for Graduate Education and the Professoriate (AGEP) Program is to increase the number of underrepresented minority students pursuing advanced study, obtaining doctoral degrees, and entering the professoriate in STEM disciplines (including Social Sciences). Alliances participating in this program are expected to engage in comprehensive institutional cultural changes that will lead to sustained increases in the conferral of STEM doctoral degrees, significantly exceeding historic levels of performance. Specific objectives of AGEP are: (1) to develop and implement innovative models for recruiting, mentoring, and advancing minority students in STEM doctoral programs, and (2) to develop effective strategies for identifying and supporting underrepresented minorities who want to pursue academic careers.

- 62 or 8.0% in Other Social Sciences.
- 28 or 3.6% in Sociology.
- 15 or 1.9% in Political Science.
- 14 or 1.8% in Interdisciplinary Sciences.
- 11 or 1.4% in Economics *(Table 1)*.

Of the average annual number of 563 URM PhD recipients in NS&E at 68 AGEP institutions in 2006/07, 2007/08 and 2008/09, the average annual number and percent of URM PhD recipients were:

- 244 or 43.3% in Biological, Agricultural Sciences.
- 141 or 25.0% in Engineering.
- 84 or 14.9% in Chemistry.
- 27 or 4.8% in Other Physical Sciences.
- 25 or 4.4% in Mathematics.
- 17 or 3.0% in Computer Sciences.
- 16 or 2.8% in Earth, Atmospheric, and Ocean Sciences.
- 9 or 1.6% in Computer Engineering *(Table 1)*.

B. About Changes in the Average Annual Number of URM PhDs Awarded In STEM at 68 AGEP Institutions from 2000/01 to 2008/09

An analysis of URM PhD recipient data from 2000/01 to 2008/09 for 68 AGEP institutions from 19 Alliances indicates that the average annual number of URM PhD recipients in graduate programs in STEM increased from 609 (Early AGEP (2000/01 to 2002/03)) to 772 (Current AGEP (2006/07 to 2008/09)), an increase of 163 or 26.8%. During this same period, the average annual number of URM PhD recipients in graduate school programs in NS&E increased from 377 to 563, an increase of 186 or 49.3% *(Table 1 and Figure 1)*.

The average annual number of URM PhD recipients at 68 AGEP institutions increased in 11 fields between 2000/01 and 2008/09 from:

- 153 to 244 in Biological, Agricultural Sciences (an increase of 91).
- 95 to 141 in Engineering (an increase of 46).
- 70 to 84 in Chemistry (an increase of 14).
- 6 to 17 in Computer Sciences (an increase of 11).
- 4 to 14 in Interdisciplinary Sciences (an increase of 10).

- 7 to 16 in Earth, Atmospheric, and Ocean Sciences (an increase of 9).
- 20 to 27 in Other Physical Sciences (an increase of 7).
- 18 to 25 in Mathematics (an increase of 7).
- 73 to 79 in Psychology (an increase of 6).
- 7 to 11 in Economics (an increase of 4).
- 8 to 9 in Computer Engineering (an increase of 1).

During this same nine year period, there were decreases in the average annual number of URM PhDs awarded in graduate programs in AGEP institutions in Sociology, Political Science and Other Social Sciences *(Table 1 and Figure 1).*

Almost 20% (18.4% or 30 of the 163) of the increases in the average annual number of STEM PhDs awarded to URMs at AGEP institutions between 2000/01 and 2008/09 was due to increases at the nine University of California (UC) campuses. In NS&E, UC campuses accounted for 26.3% (49 of 186) of the increases in the average annual number of PhDs awarded to URMs at AGEP institutions between 2000/01 and 2008/09 *(Table 3).*

C. Comparison of Percent Change in the Average Annual Number of URM PhD Recipients and All Other U.S. Citizens and Permanent Residents at 68 AGEP Institutions from 2000/01 to 2008/09

From 2000/01 to 2008/09, the percent change in the average annual number of PhD recipients at the 68 AGEP institutions was higher for URM than for all other U.S. citizens and permanent residents in NS&E (49.3% vs 35.8%) and in all STEM fields (26.8% vs 24.5%). The percent change in the average annual number of PhD recipients was higher for URMs than for all other U.S. citizens and permanent residents[3] in Interdisciplinary Sciences (250.0% vs 11.8%), Computer Sciences (183.3% vs 92.6%), Earth, Atmospheric, and Ocean Sciences (128.6% vs 22.1%), Biological, Agricultural Sciences (59.5% vs 42.3%), Economics (57.1% vs 1.0%), Engineering (48.4% vs 40.5%), Mathematics (38.9% vs 33.7%), Other Physical Sciences (35.0% vs 25.7%), Chemistry (20.0% vs 10.3%), and Psychology (8.2% vs -1.0%) *(Figure 2 and Table 4).*

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[3]All other U.S. citizens or permanent residents does not include African Americans, Hispanic Americans, and Native Americans.

At the nine UC campuses from 2000/01 to 2008/09, the percent change in the average annual number of PhD recipients was higher for URMs than all other U.S. citizens and permanent residents in graduate school programs in NS&E (60.5% vs 32.6%) and in all STEM fields (21.6% vs 18.7%) and much higher in the Engineering (88.9% vs 50.2%) *(Table 5)*.

D. AGEP Institutions With the Largest Numbers of STEM URM PhD Recipients in 2008/09

In 2008/09, the 16 AGEP institutions with the largest numbers of STEM URM PhD Recipients were:
- UC: Berkeley, 71
- Howard University, 52
- UC: Los Angeles, 45
- University of Florida, 39
- University of Michigan, 33
- UC: Davis, 26
- University of Puerto Rico: Rio Piedras & Mayaguez, 24
- City University of New York: Graduate School and University Center, 23
- Georgia Institute of Technology, 23
- Rice University, 22
- University of North Carolina: Chapel Hill, 21
- Massachusetts Institute of Technology, 20
- UC: Irvine, 20
- Rutgers University, 19
- UC: San Diego, 19
- University of Utah, 19

In 2008/09, the 16 AGEP institutions with the largest numbers of NS&E URM PhD Recipients were:
- UC: Berkeley, 46
- UC: Los Angeles, 36
- Howard University, 28
- University of Florida, 28
- University of Puerto Rico: Rio Piedras & Mayaguez, 24
- Georgia Institute of Technology, 21
- UC: Davis, 21
- Rice University, 19
- University of Utah, 19
- Massachusetts Institute of Technology, 18
- Arizona State University, 17

- University of Michigan, 17
- Rutgers University, 14
- UC: Irvine, 14
- University of Colorado: Boulder, 14
- University of North Carolina: Chapel Hill, 14

Figure 1: Changes in Average Annual Number of PhDs Awarded to Underrepresented Minorities* (URMs) by Broad STEM Categories at 68 AGEP Institutions from Early AGEP (2000/01-2002/03), Mid-AGEP Years (2003/04-2005/06), and Current AGEP (2006/07-2008/09)
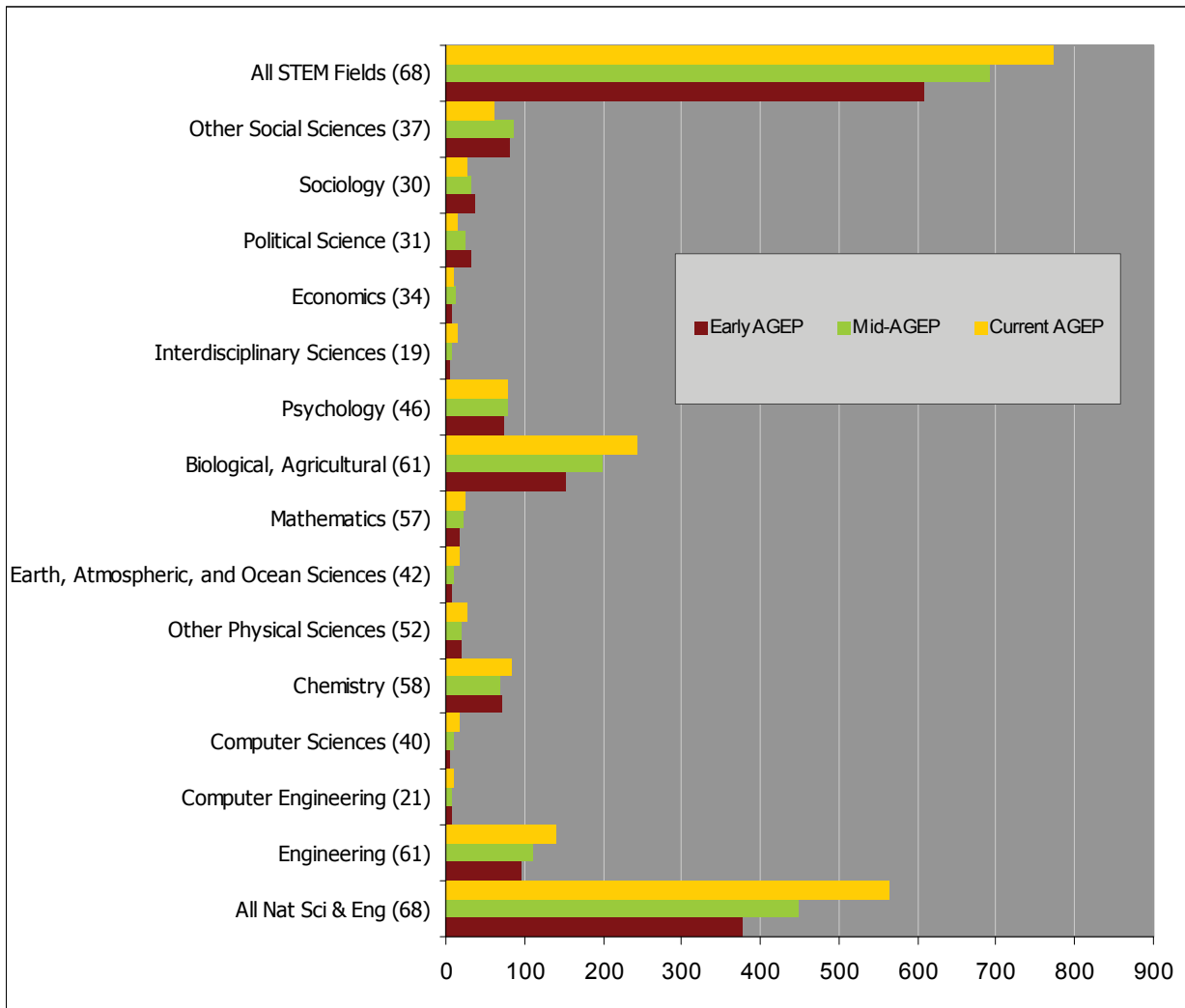
Numbers for this Figure are in Table 1.

(The numbers in parentheses represent the number of institutions reporting data in the field.)

*Underrepresented Minorities (URM) include African Americans, Hispanic Americans, and Native Americans.

Figure 2: Percent Change in Average Annual Number of PhDs Awarded to Underrepresented Minorities* (URMs) and All Other U.S. Citizen** and Permanent Residents in STEM Graduate School Programs at 68 AGEP Institutions from Early AGEP Years (2000/01-2002/03) to Current AGEP (2006/07-2008/09)
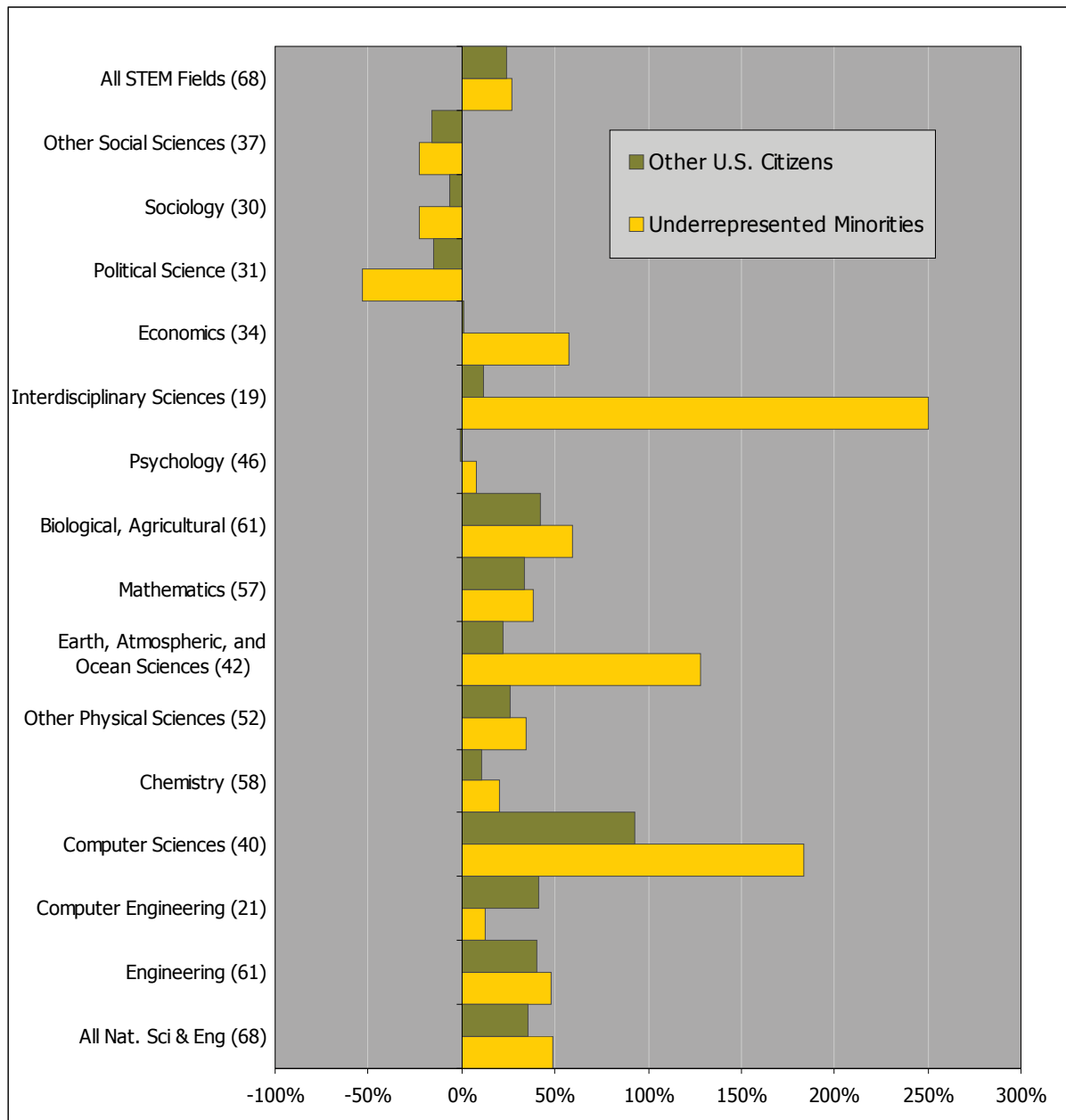

Numbers for this figure are in Table 4.
(The numbers in parentheses represent the number of institutions reporting data in the field.)

*Underrepresented Minorities (URM) include African Americans, Hispanic Americans, and Native Americans.

**Other U.S. Citizens includes permanent residents and does not include African Americans, Hispanic Americans, and Native Americans.

Table 1 – Number and Percent Changes in the Average Annual Number of PhDs Awarded to Underrepresented Minorities* (URMs) in STEM from 2000/01 to 2008/09 at 68 AGEP Institutions, including Nine Campuses of the University of California (UC)

PhD Recipient URMs	Average Annual Number for Early AGEP Years 2000/01 to 2002/03	Average Annual Number for Mid-AGEP Years 2003/04 to 2005/06	Average Annual Number for Current AGEP Years 2006/07 to 2008/09	Changes in the Average Annual Number for Early to Current AGEP Years	Percent Changes in the Average Annual Number of PhDs Awarded to URMs for Early to Current AGEP Years
All Natural Sciences & Engineering (68)	377	448	563	186	49.3%
Engineering (61)	95	110	141	46	48.4%
Computer Engineering (21)	8	7	9	1	12.5%
Computer Sciences (40)	6	10	17	11	183.3%
Chemistry (58)	70	69	84	14	20.0%
Other Physical Sciences (52)	20	20	27	7	35.0%
Earth, Atmospheric, and Ocean Sciences (42)	7	11	16	9	128.6%
Mathematics (57)	18	23	25	7	38.9%
Biological, Agricultural (61)	153	198	244	91	59.5%
Psychology (46)	73	78	79	6	8.2%
Interdisciplinary Sciences (19)	4	8	14	10	250.0%
Economics (34)	7	12	11	4	57.1%
Political Science (31)	32	25	15	-17	-53.1%
Sociology (30)	36	33	28	-8	-22.2%
Other Social Sciences (37)	80	87	62	-18	-22.5%
All STEM Fields (68)	609	691	772	163	26.8%

(The numbers in parentheses represent the number of institutions reporting data in the field.)

*Underrepresented Minorities (URMs) include African Americans, Hispanic Americans, and Native Americans.

Table 2 – Number and Percent Changes in the Average Annual Number of PhDs Awarded to Underrepresented Minorities* (URMs) in STEM from 2000/01 to 2008/09 at Nine Campuses of the University of California (UC)

PhD Recipient URMs at UC only	Average Annual Number for Early AGEP Years 2000/01 to 2002/03	Average Annual Number for Mid-AGEP Years 2003/04 to 2005/06	Average Annual Number for Current AGEP Years 2006/07 to 2008/09	Changes in the Average Annual Number for Early to Current AGEP Years at UC	Percent Changes in the Average Annual Number of PhDs Awarded to URMs for Early to Current AGEP Years at UC
All Natural Sciences & Engineering (9)	81	81	130	49	60.5%
Engineering (9)	18	14	34	16	88.9%
Computer Engineering					
Computer Sciences					
Chemistry (9)	12	14	22	10	83.3%
Other Physical Sciences (8)	5	6	8	3	60.0%
Earth, Atmospheric, and Ocean Sciences					
Mathematics (9)	3	5	4	1	33.3%
Biological, Agricultural (9)	43	42	62	19	44.2%
Psychology (8)	15	16	14	-1	-6.7%
Interdisciplinary Sciences					
Economics					
Political Science					
Sociology					
Other Social Sciences (9)	43	41	25	-18	-41.9%
All STEM Fields (9)	139	138	169	30	21.6%

(The numbers in parentheses represent the number of institutions reporting data in the field.)

Note: UC data for Computer Engineering and Computer Sciences are included in Engineering. Data for Earth, Atmospheric, and Ocean Sciences are included in Other Physical Sciences.

*Underrepresented Minorities (URMs) include African Americans, Hispanic Americans, and Native Americans.

Table 3 – Percent Changes in the Average Annual Number of PhDs Awarded to Underrepresented Minorities* (URMs) at AGEP Institutions due to Nine Campuses of the University of California from 2000/01 to 2008/09**

PhD Recipients	Changes in the Average Annual Number for Early to Current AGEP Years at UC***	Changes in the Average Annual Number for Early to Current AGEP Years at all 68 AGEP Institutions	Percent Increase in the Average Annual Number of PhDs Awarded to URMs for Early to Current AGEP Years due to UC
All Natural Sciences & Engineering	49	186	26.3%
Engineering	16	46	34.8%
Computer Engineering		1	
Computer Sciences		11	
Chemistry	10	14	71.4%
Other Physical Sciences	3	7	42.9%
Earth, Atmospheric, and Ocean Sciences		9	
Mathematics	1	7	14.3%
Biological, Agricultural	19	91	20.9%
Psychology	-1	6	****
Interdisciplinary Sciences		10	
Economics		4	
Political Science		-17	
Sociology		-8	
Other Social Sciences	-18	-18	100.0%
All STEM Fields	30	163	18.4%

Note: UC data for Computer Engineering and Computer Sciences are included in Engineering. Data for Earth, Atmospheric and Ocean Sciences are included in Other Physical Sciences.

*Underrepresented Minorities (URMs) include African Americans, Hispanic Americans, and Native Americans.

**See Table 2 for more details about the changes in the average annual number of PhD recipient URMs at UC.

***See Table 1 for more details about the changes in the average annual number of PhD recipient URMs at the 68 AGEP institutions.

****Only positive percent increase is reported.

Table 4 – Number and Percent Changes in the Average Annual Number of PhDs Awarded to All Other U.S. Citizens and Permanent Residents in STEM at 68 AGEP Institutions and the Percent Changes in the Average Annual Number of PhDs Awarded to Underrepresented Minorities* (URMs) in STEM from 2000/01 to 2008/09

PhD Recipients All Other U.S. Citizens and Permanent Residents (not including URMs)	Average Annual Number for Early AGEP Years 2000/01 to 2002/03	Average Annual Number for Mid-AGEP Years 2003/04 to 2005/06	Average Annual Number for Current AGEP Years 2006/07 to 2008/09	Changes in the Average Annual Number for Early to Current AGEP Years	Percent Changes in the Average Annual Number of PhDs Award to All Other U.S. Citizens & Permanent Residents for Early to Current AGEP Years	Percent Changes in the Average Annual Number of PhDs Awarded to URMs for Early to Current AGEP Years
All Natural Sciences & Engineering (68)	4,042	4,675	5,490	1,448	35.8%	49.3%
Engineering (61)	1,058	1,210	1,487	429	40.5%	48.4%
Computer Engineering (21)	48	65	68	20	41.7%	12.5%
Computer Sciences (40)	95	155	183	88	92.6%	183.3%
Chemistry (58)	582	598	642	60	10.3%	20.0%
Other Physical Sciences (52)	338	342	425	87	25.7%	35.0%
Earth, Atmospheric, and Ocean Sciences (42)	154	146	188	34	22.1%	128.6%
Mathematics (57)	208	257	278	70	33.7%	38.9%
Biological, Agricultural (61)	1,559	1,902	2,219	660	42.3%	59.5%
Psychology (46)	486	445	481	-5	-1.0%	8.2%
Interdisciplinary Sciences (19)	34	35	38	4	11.8%	250.0%
Economics (34)	98	86	99	1	1.0%	57.1%
Political Science (31)	128	116	109	-19	-14.8%	-53.1%
Sociology (30)	113	110	106	-7	-6.2%	-22.2%
Other Social Sciences (37)	542	578	455	-87	-16.1%	-22.5%
All STEM Fields (68)	5,443	6,045	6,778	1,335	24.5%	26.8%

(The numbers in parentheses represent the number of institutions reporting data in the field.)
*Underrepresented Minorities (URMs) include African Americans, Hispanic Americans, and Native Americans.

Table 5 – Number and Percent Changes in the Average Annual Number of PhDs Awarded to All Other U.S. Citizens and Permanent Residents in STEM and the Percent Changes in the Average Annual Number of PhDs Awarded to Underrepresented Minorities* (URMs) in STEM at Nine Campuses of the University of California from 2000/01 to 2008/09

PhD Recipients All Other U.S. Citizens and Permanent Residents (not including URMs) at UC only	Average Annual Number for Early AGEP Years 2000/01 to 2002/03	Average Annual Number for Mid- AGEP Years 2003/04 to 2005/06	Average Annual Number for Current AGEP Years 2006/07 to 2008/09	Changes in the Average Annual Number for Early to Current AGEP Years	Percent Changes in the Average Annual Number of PhDs Awarded to All Other U.S. Citizens & Permanent Residents for Early to Current AGEP Years	Percent Changes in the Average Annual Number of PhDs Awarded to URMs for Early to Current AGEP Years
All Natural Sciences & Engineering (9)	1,112	1,150	1,474	362	32.6%	60.5%
Engineering (9)	255	282	383	128	50.2%	88.9%
Computer Engineering						
Computer Sciences						
Chemistry (9)	156	164	194	38	24.4%	83.3%
Other Physical Sciences (8)	133	128	159	26	19.5%	60.0%
Earth, Atmospheric, and Ocean Sciences						
Mathematics (9)	54	67	81	27	50.0%	33.3%
Biological, Agricultural (9)	514	509	657	143	27.8%	44.2%
Psychology (8)	88	95	100	12	13.6%	-6.7%
Interdisciplinary Sciences						
Economics						
Political Science						
Sociology						
Other Social Sciences (9)	263	282	163	-100	-38.0%	-41.9%
All STEM Fields (9)	1,463	1,527	1,737	274	18.7%	21.6%

(The numbers in parentheses represent the number of institutions reporting data in the field.)

Note: UC data for Computer Engineering and Computer Sciences are included in Engineering. Data for Earth, Atmospheric, and Ocean Sciences are included in Other Physical Sciences.

*Underrepresented Minorities (URMs) include African Americans, Hispanic Americans, and Native Americans.

E. About Data Collection and Analysis of the Average Annual Number of STEM PhDs Awarded to URMs at AGEP Institutions (2000/01 to 2008/09)

To examine changes in the annual number of STEM PhDs awarded to URMs from 2000/01 to 2008/09, data were collected from 68 AGEP institutions representing 19 Alliances. Between June 2009 and January 2010, the 68 institutions submitted data on URMs and other U.S. citizens and permanent residents for at least one category of STEM fields.

To reduce the volatility of the annual data, the data were grouped into three categories, and the average annual number was calculated for each of the three categories.

- Early AGEP Years (2000/01 to 2002/03);
- Mid-AGEP Years (2003/04 to 2005/06); and
- Current AGEP Years (2006/07 to 2008/09).

Also, data were collected and analyzed by race/ethnicity, gender, and citizenship for the following fields:

(a) Biological & Agricultural Sciences

(b) Chemistry

(c) Computer Engineering

(d) Computer Sciences

(e) Earth, Atmospheric, and Ocean Sciences (including Geosciences, Environmental Sciences)

(f) Economics

(g) Engineering (including Electrical Engineering; excluding Computer Engineering)

(h) Interdisciplinary Sciences

(i) Mathematics (including Mathematical Statistics)

(j) Other Physical Sciences (including Astronomy, Physics)

(k) Other Social Sciences

(l) Political Science

(m) Psychology (excluding Clinical Psychology)

(n) Sociology

The category NS&E includes Biological & Agricultural Science; Chemistry; Computer Engineering; Computer Sciences; Earth & Atmospheric Sciences; Engineering; Mathematics; and Other Physical Sciences.

F. Strategies to Increase Enrollment and Retention of URM Graduate Students

To increase the annual number of URM graduate students entering and completing STEM PhD STEM programs, AGEP institutions implemented a variety of strategies, where appropriate including:

- Establishing undergraduate research programs with minority serving institutions.

- Recruiting prospective students at meetings where undergraduate students are presenting posters and oral presentations, including the annual meetings of SACNAS (a society of scientists dedicated to fostering the success of Hispanic/Chicano and Native American scientists), the Annual Biomedical Research Conference for Minority Students (ABRCMS), and the AAAS/NSF Historically Black Colleges and Universities Undergraduate Program (HBCU-UP) Research Conference.

- Reviewing and monitoring institutional and departmental practices, including practices related to graduate student admissions/selection, financial aid, advising, and advancing to candidacy.

- Providing financial aid packages that reduce debt burden of graduate students.

- Offering professional development programs for faculty, with an emphasis on strategies for recruiting and retaining URMs and effective graduate student mentoring.

- Offering supplementary academic support workshops or tutoring for graduate students in writing, statistics, and other subjects.

- Providing activities that foster the social and early intellectual integration of graduate students into the institution and department, including graduate student bridge programs and strategies for family/work balance.

- Providing graduate student travel awards and other incentives to increase research productivity (poster or oral presentations at professional meetings, publications, etc).

- Monitoring graduate student progression with attention to early achievement of PhD milestones.

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Jennifer L. Weisman, Research Associate at C-KA, has worked on a variety of projects, including AGEP and FairerScience. As part of FairerScience she co-created the guide "Using Women in Science Blogs to Encourage Girls in Science." Her BA (Psychology and Women's Studies) is from Randolph-Macon College, MS (Counseling Psychology) is from Northeastern University, and PhD (Counseling and Personnel Services) is from the University of Maryland, College Park. Her dissertation research focused on the experiences of college students who have a sibling with a developmental disability. Dr. Weisman's publications include an entry in "Women in Higher Education: An encyclopedia" and the co-authored article "Different by design: An examination of student outcomes among participants in three types of living-learning programs." Her professional experience also includes work for The Civil Rights Project at Harvard University.

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