

AC 2009-1904: ON THE SUCCESSFUL IMPLEMENTATION OF AN NSF-FUNDED BRIDGE TO THE DOCTORATE PROGRAM IN STEM DISCIPLINES

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On Successful Implementation of an NSF-Funded Bridge to the Doctorate Program in STEM Disciplines

Abstract

As a result of competitive review, North Carolina State University won a grant from the National Science Foundation to serve as the 2008-2010 Bridge to the Doctorate Project institutional site for the NSF-funded North Carolina Louis Stokes Alliance for Minority Participation (NC-LSAMP) Program. The primary goal of the NC-LSAMP BD project is to broaden participation in science, technology, engineering, and mathematics (STEM) disciplines by attracting underrepresented minority students.

With more than 31,000 students and nearly 8,000 faculty and staff, NC State University is a comprehensive university known for its leadership in education and research, and globally recognized for its STEM leadership. As one of the leading land-grant institutions in the nation, NC State is committed to playing an active and vital role in improving the quality of life for the citizens of North Carolina, the nation and the world. With the NSF grant of \$987,000, NC State will support a critical mass of 12 Bridge to the Doctorate fellows in each of the two years of this program.

The BD program at North Carolina State University will have a significant impact on the retention and graduation rates of underrepresented minority STEM graduate students. This will occur because the BD funding will allow us to compete more strongly for STEM undergraduates at our NC-LSAMP partner institutions and nationally. It will also help fill the funding gap for students seeking the Ph.D. degree, but are currently not admissible to top ranked engineering programs such as NC State because we do not admit undergraduate scholars directly into most of our Ph.D. programs. The number and quality of graduate research experiences as well as NC-LSAMP support to participate in regional and national conferences will also serve as a catalyst in the retention of talented graduate students.

This paper provides summary information on the NSF Bridge to Doctorate Program and then discusses the need to increase the number of US STEM graduates. It then shares a portion of our winning proposal elements. These include university infrastructure support, our comprehensive graduate student funding model, prior NC-LSAMP BD success, and strategies for successful implementation given the short recruiting cycle. The paper concludes with unanticipated challenges to success.

Summary Information on NSF Alliances for Broadening Participation (ABP) in STEM¹

The Alliances for Broadening Participation (ABP) in STEM solicitation includes the Louis Stokes Alliances for Minority Participation (LSAMP) program, Bridge to the Doctorate (BD) Activity, and the Alliances for Graduate Education and the Professoriate (AGEP) program.

This portfolio seeks to increase the number of students successfully completing quality degree programs in science, technology, engineering and mathematics (STEM). Particular emphasis is placed on transforming STEM education through innovative academic strategies and experiences

in support of groups that historically have been underrepresented in STEM disciplines: African Americans, Alaskan Natives, Native Americans, Hispanic Americans and Native Pacific Islanders.

Managed synergistically, the ABP cluster enables seamless transitions from the STEM baccalaureate to attainment of the doctorate and entry to the STEM professoriate. ABP support begins at the baccalaureate level through the LSAMP program. LSAMP emphasizes development of broad based regional and national alliances of academic institutions, school districts, state and local governments, and the private sector to increase the diversity and quality of the STEM workforce. Eligible LSAMP undergraduate students may receive continued support for up to two additional years of STEM graduate study through the Bridge to the Doctorate (BD) Activity. The Bridge to the Doctorate provides significant financial support for matriculating candidates in STEM doctoral programs at eligible alliance sites.

Alliances for Graduate Education and the Professoriate (AGEP) furthers the graduate education of underrepresented students through the doctorate level, preparing them for fulfilling opportunities and productive careers as STEM faculty and research professionals. AGEP also supports the transformation of institutional culture to attract and retain STEM doctoral students into the professorate.

The LSAMP program also supports education research projects focused on STEM baccalaureate degree attainment.

Proposals may only be submitted by Universities and Colleges: Universities and two- and four-year colleges (including community colleges) located and accredited in the US, acting on behalf of their faculty members. Such organizations also are referred to as academic institutions. Solicitations for proposals under the ABP are released annually.

NSF Bridge to the Doctorate Program Description

LSAMP alliances at the senior level, including NC-LSAMP, are eligible for Bridge to the Doctorate support. BD funding provides financial support for eligible students for two years of graduate study.

Proposals for BD support must describe effective strategies for recruiting, retaining, educating and graduating the participants. Proposers must provide documentation of past performance at the designated graduate institutional site of retaining, graduating, and placing significant numbers of LSAMP graduates into doctoral-degree programs. A plan for formally connecting a significant number of newly matriculated LSAMP students, including master's degree graduates, to doctoral degree programs is expected.

Successful projects must demonstrate substantive and formal connection to other NSF-funded programs, such as CREST, NSF research centers, Integrative Graduate Education and Research Training Program (IGERT), Graduate Teaching Fellows in K-12 Education Program (GK-12), and AGEP. Successful BD projects must ensure that a substantive number of first year BD participants apply to NSF's Graduate Research Fellowship Program (GRFP). Similarly, BD

applicants must present an action plan describing dollar support and sources for continuing students in years three and beyond towards doctorate degrees. Action plans identifying strategies for connecting the transfer of third-year BD recipients interested in and eligible for admission to AGEP graduate programs are required.

Recruitment of students is expected from all STEM disciplines. A concentration of students in one discipline within a cohort is strongly discouraged.

Tracking of project participants into doctoral degree programs and into the workforce, including the professoriate is also expected. Other highly valued activities include regular BD meetings, mentoring of students, and resources to support annual student participation at professional meetings and seminars on productive academic efforts, demystify degree programs, and available career options. A critical mass of twelve (12) LSAMP STEM graduate students is required under this activity.

The NSF contribution to graduate student stipends is \$30,000 per year (12 months) for each of twelve students for 24-months. Successfully matriculating graduate students are expected to receive a second year stipend at this dollar support level.

NSF will provide a cost-of-education allowance to the institution for tuition, health insurance, and other normal fees of \$10,500 per year up to two years for each of twelve students. Costs for project evaluation may be included. A flat allowance of \$15,000 per award may also be requested in lieu of indirect costs. The maximum request per alliance is \$987,000.

NSF Proposal Processing and Review Procedures

Proposals received by NSF are assigned to the appropriate NSF program where they will be reviewed if they meet NSF proposal preparation requirements. All proposals are carefully reviewed by a scientist, engineer, or educator serving as an NSF Program Officer, and usually by three to ten other persons outside NSF who are experts in the particular fields represented by the proposal. These reviewers are selected by Program Officers charged with the oversight of the review process. Proposers are invited to suggest names of persons they believe are especially well qualified to review the proposal and/or persons they would prefer not review the proposal. These suggestions may serve as one source in the reviewer selection process at the Program Officer's discretion. Submission of such names, however, is optional. Care is taken to ensure that reviewers have no conflicts of interest with the proposal.

All NSF proposals are evaluated through use of the two National Science Board (NSB)-approved merit review criteria: intellectual merit and the broader impacts of the proposed effort. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities. Brief descriptions of merit review criteria follow:

1. **What is the intellectual merit of the proposed activity?** How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields? How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of the prior work.) To

what extent does the proposed activity suggest and explore creative, original, or potentially transformative concepts? How well conceived and organized is the proposed activity? Is there sufficient access to resources?

2. **What are the broader impacts of the proposed activity?** How well does the activity advance discovery and understanding while promoting teaching, training, and learning? How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)? To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships? Will the results be disseminated broadly to enhance scientific and technological understanding? What may be the benefits of the proposed activity to society?

Need To Increase Stem Graduates

For at least the past 10 years, it has been common knowledge in academia, government and industry, that this country's future needs of engineers and scientists cannot be met by simply recruiting from traditional male populations. Diversity in this country has evolved to the point that women and underrepresented minorities comprise a significant portion of our society. More and more programs and activities have existed or are being developed to increase the participation and success of these populations in STEM disciplines and professions.

Many students face obstacles in attempting to pursue advanced degrees. These obstacles include: 1) the lack of adequate financial support to attain an advanced degree; 2) the fear of not completing the degree; 3) the inability to transition from an undergraduate environment to a graduate environment; and 4) the failure to engage in a successful mentoring relationship. Strategies currently in place or proposed to address these obstacles include activities that are designed to attract a talented pool of underrepresented minority students interested in pursuing terminal degrees in the STEM fields^{2,3}.

As a land grant university as designated by the United States federal government, our university has a mandate to provide practical education to the citizens of this state, while maintaining nationally ranked and recognized research programs. Through its responsibility as a land grant university our College of Engineering seeks to recruit the highest achievers while maintaining a diverse and inclusive campus community. Our enrollment rates of underrepresented students (African Americans, Hispanic, Native Americans), have shown steady progress over the past twenty years. Our Minority Engineering Programs Office was established in 1982 to address the needs of a growing number of students attending the university, with particular emphasis on underrepresented engineering student success. As success was proved with our engineering model, it was replicated across campus in other schools and colleges. Research has shown that first year student success is highly dependent on support services and programs, particularly for minority students. These same studies also point to sound foundation in STEM disciplines, coupled with strong mentors and support programs are keys that directly influence underrepresented students success in graduate school^{2,4}.

Attracting minority students to rigorous engineering programs is a challenge that colleges and universities across the country continue to face. This challenge is even greater for traditionally white institutions (TWI) in comparison to Historically Black Institutions (HBCUs)⁵. Efforts to recruit and attract African American, Native American, and Hispanic American students must be effective in making the student feel “comfortable” in an environment where familiar faces are few. Our Minority Engineering Programs Office continues to seek innovative programs to recruit and ultimately enroll students in our engineering programs. In order for these programs to be effective, the student as well as their family must be embraced⁶.

The remainder of this paper reports on our success in the NSF paper review and awards process, and provides details on both our winning proposal and how we are successfully implementing it.

North Carolina State University Bridge to Doctorate Winning Proposal Elements

Intellectual Merit

The 2008 NC-LSAMP BD Project will facilitate increased cross-disciplinary exchange among STEM majors and faculty, and provide opportunities for underrepresented minority students to obtain their graduate degrees in science, technology, engineering and mathematics disciplines. BD Fellows will gain knowledge in both science and engineering fields through research and transfer these skills through their participation in the broader science community as scientists, researchers, faculty and administrators in STEM jobs.

Broader Impact

The BD program at NC State University will have a significant impact on the retention and graduation rates of underrepresented minority STEM graduate students. This will occur because the BD funding will allow us to compete more strongly for STEM undergraduates at our NC-LSAMP partner institutions, and nationally. It will also help fill the funding gap for students seeking the Ph.D. degree, but are currently not admissible to top ranked engineering programs such as NC State because we do not admit undergraduate scholars directly into our Ph.D. programs. So the BD funding will allow us to integrate these scholars into the Ph.D. track a couple of years earlier, even as they earn the M.S. STEM degree. This integration should then increase the overall national Ph.D. production of STEM graduates. The number and quality of graduate research experiences as well as NC-LSAMP support to participate in regional and national conferences will also serve as a catalyst in the retention of talented graduate students. Moreover, there are significant benefits to the student, the university, and the scientific community that can be realized.

Benefits to the Student

BD Fellows will benefit from participation in this project in three significant ways. First, they will have the opportunity to pursue a graduate degree without incurring debt. Eliminating this barrier is a major motivator for further graduate studies. Second, students will conduct research in internationally acclaimed research facilities. This experience will provide BD students the opportunity to work with world renowned scholars and researchers, and gain invaluable knowledge in their field of study. Third, this invaluable knowledge will be transferred to other

students and learning communities through the dissemination of their work through publications and presentations, therefore strengthening the participants' professional portfolio.

Benefits to the University

NC State will benefit from having some of the best students in the scientific community on its campus. Because the Bridge to the Doctorate program is nationally recognized as a premier graduate fellowship program, the university will be able to leverage this project in developing linkages with other Ph.D. programs and institutions. Moreover, the Bridge to the Doctorate program provides another venue for recruiting the best and brightest STEM students in the nation, thus further strengthening the University's national reputation.

Benefits to the Scientific Community

The scientific community still lacks an adequate number of minority scientists, technologists, and engineers to replace those who are leaving due to attrition and retirement. The BD program at NC State will contribute to the scientific community through the production of 12 additional skilled STEM professionals. It is anticipated that the BD Fellows will have the requisite skills and abilities to contribute significantly to this body of knowledge through innovative and cutting edge practices that are essential to building the STEM workforce for the millennium.

About the University

With more than 31,000 students and nearly 8,000 faculty and staff, North Carolina State University is a comprehensive university known for its leadership in education and research, and globally recognized for its science, technology, engineering and mathematics leadership. As one of the leading land-grant institutions in the nation, NC State is committed to playing an active and vital role in improving the quality of life for the citizens of North Carolina, the nation and the world. As a major research university, NC State has the people - from undergraduate and graduate students to faculty - and the responsibility to advance knowledge, transfer technology, and discover and develop innovations that solve some of the world's most pressing problems.

North Carolina State University's research expenditures are approaching more than \$315 million annually, with almost 70 percent of faculty engaged in sponsored research and 2,500 graduate students supported by research grants. For the 2006-07 academic year, NC State was ranked third among all public universities (without medical schools) in industry-sponsored research expenditures.

About the NC State College of Engineering

With over 6,000 undergraduates and 2300 graduate students, the College of Engineering (COE) is the largest college at NC State and one of the biggest engineering colleges in the nation. It consists of twelve highly ranked departments, nine of which are administered within the College. These are Biomedical Engineering; Chemical and Biomolecular Engineering; Civil, Construction, and Environmental Engineering; Computer Science; Electrical and Computer Engineering; Industrial and Systems Engineering; Materials Science and Engineering; Mechanical and Aerospace Engineering; and Nuclear Engineering. The Biomedical Engineering department is jointly administered with the UNC-Chapel Hill College of Medicine. In addition,

there are three engineering programs that are administered in other NC State colleges: Textile Engineering in the College of Textiles, Biological and Agricultural Engineering in the College of Agriculture and Life Sciences, and Paper Science and Engineering in the College of Natural Resources.

In 2006-07 the College ranked 4th in the number of BS degrees awarded and 6th in the total number of degrees among all US engineering colleges. It also ranked 4th in BS degrees awarded to women and 5th in BS degrees awarded to African Americans. The COE offers 18 Bachelor's, 17 Master's and 13 doctoral degree programs and awards more than 1200 undergraduate and 500 graduate degrees annually. Annual research expenditures for 2005-2006 academic year exceeded \$103 million, placing the college 17th in research expenditures and 14th in industry support among all engineering colleges in the US. The college houses 930 faculty and staff, including 246 tenured/tenure-track faculty members. Eleven faculty are members of the National Academy of Engineering and 77 have received Presidential and National Science Foundation recognitions for achievement, including 52 NSF Career Awards.

Undergraduate Programs

The fall 2008 undergraduate enrollment (including biological engineering and textile engineering) of 6,170 (1,618 freshmen, 1,419 sophomores, 1,382 juniors, and 1,731 seniors, 20 unclassified), represents an increase of nearly 200 over the fall 2007 enrollment of 5,975. Enrollment of women increased to 967 (15.7%) in fall 2008 compared to 915 (15.3%) the previous year. Enrollment of minority students increased to 1,081 (17.5%) in fall 2008 compared to 1,037 (17.4%) the previous year. Fall 2008 minority enrollment included 428 African Americans, 436 Asian-Americans, 181 Hispanic students, and 36 Native Americans. The number of bachelor's degrees awarded for 2007-08 was 976 compared to 1,040 for the 2006-07 year.

Graduate Programs

Graduate student enrollment in the College of Engineering for fall 2008 was 2306 (1332 master's and 974 doctoral) compared to 2,125 in fall 2007 (1187 master's and 938 doctoral). International students made up 53% (1222 students) of the enrollment; 21% (484) of the students were women. Minority enrollment was 8% (187 students: Asian-American 92, African American 54, Native American 5, Hispanic 36). The number of graduate degrees awarded during 2007-08 was 615 (501 master's degrees and 114 doctoral degrees).

North Carolina State University Framework to Insure Success of our Bridge to the Doctorate

According to the Diverse Issues in Higher Education, through 2007, our university consistently ranked in the top five nationally in undergraduate engineering degrees awarded to African Americans⁷. This accomplishment is even more significant when one considers that the engineering program on our campus comprises approximately 25% of the total student population, and African Americans comprise approximately 9% of our total undergraduate engineering student enrollment. Further, across the United States, there are nine Historically Black Engineering Colleges, all of which are over 90% African American. Only one or two of these nine produce more African American undergraduate engineers than our university⁷.

At the graduate level, significant research contributions have been made by our College of Engineering African American Ph.D. students in computer science⁸, electrical engineering⁹, and computer engineering¹⁰. The all-time national record at that time in 2000, of six Ph.D. degrees awarded in one year to African American females by our engineering college, resulted from a long-standing commitment to hiring, mentoring, promoting and celebrating a faculty that at that time included eight African American professors. These faculty mentors and scholars provide additional credibility to campus-wide commitments through national recognition of their own accomplishments.

Three of these African American faculty members are recipients of the 1998¹¹, 2000¹², and 2003¹³ Presidential Award for Excellence in Science, Engineering and Mathematics Mentoring. Another is the first and only African American winner of the US Air Force Research and Development Award for research work done in support of the NASA International Space Station^{14,15}.

Project Description

In response to NSF Program Solicitation # 08-545, NC State proposed to serve as the 2008 Cohort VI Bridge to the Doctorate (BD) Project institutional site for the North Carolina Louis Stokes Alliance for Minority Participation (NC-LSAMP). The Alliance consists of eight partner institutions—North Carolina A&T State University (lead institution), Fayetteville State University, North Carolina Central University, NC State University, University of North Carolina-Chapel Hill, University of North Carolina-Charlotte, University of North Carolina-Pembroke and Winston-Salem State University. STEM graduates from all NC-LSAMP partner institutions who are admissible to our NC State University STEM Ph.D. programs will be eligible to become BD Fellows. We will also use this extremely attractive grant to recruit nationally.

Cost of Education Allowance

The cost of education allowance provided by the NSF supplement will be utilized to:

- facilitate the BD Fellows' research and training activities;
- cover the cost of tuition and normal educational fees for BD Fellows at NC State;
- cover travel costs for the NC-LSAMP BD Fellows to attend meetings for their academic disciplines, encouraging them to become members of key professional societies;
- cover costs associated with BD Fellows' participation in GRE exam preparation courses if required, and for a one-time fee to take the GRE exam at the end of the first year of participation;
- provide health insurance coverage for all BD Fellows;
- cover the cost for BD Fellows to attend the annual NSF/JAM meeting in Washington, DC.

Proposed Activities

Our BD Fellows will be fully integrated into existing, successful programs and activities available to STEM graduate scholars on our campus. Specific programs and activities supported out of our graduate school under the NSF-funded AGEP program will serve as the core basis for

this integration. BD participants will receive a special invitation to apply to serve as researchers in our NC State Summer Bridging Program. Funded by NSF-AGEP, the Bridging Program at NC State provides a combination of summer research experience, coursework, and professional development for students interested in STEM and Ph.D.'s at three stages in their graduate education: 1) after receipt of a bachelor's degree and immediately prior to entrance into a graduate program; 2) between the first and second years of a master's degree; and 3) after receipt of a master's degree and immediately prior to entrance into a Ph.D. program.

In addition to the above NSF AGEP-sponsored programs and activities, the following activities have been designed to foster academic preparation, professional development, demystify the doctoral degree experience, and promote research advancement and community building among BD Fellows throughout the NC-LSAMP Alliance. These activities include:

- graduate student recruitment and the selection of BD Fellows;
- GRE test taking workshop;
- NC-LSAMP BD Project activities focused on retention and community building;
- professional skills (presentation, teaching, grantsmanship, communication, etc.) development as needed;
- participation in the NC-LSAMP Annual Research Conference and Annual NC OPT-ED Day;
- faculty-mentored graduate research;
- opportunities to participate in and present at national professional society meetings.

Professional Development Related Activities

- BD fellows will have access to seminars and workshops designed to prepare them for doctoral work. These workshops are already an integral part of our current STEM graduate students experience, and adding the BD Fellows will only enrich the participants and workshops. These workshops include such topics as: Graduate School Survival Techniques, How to Select Doctoral and Post-Doctoral programs, Dissertation Preparation, Skills for Transitioning to the Workforce and the Professoriate and others.
- The BD program will also tap into the existing interdisciplinary colloquium series sponsored by NC Alliance to Create Opportunity through Education (NC OPT-ED) to provide information on professional development and networking opportunities with graduate students from other UNC institutions. Based at North Carolina A&T State University, NC State University and the University of North Carolina at Chapel Hill, NC OPT-ED is designed to provide comprehensive recruitment and mentoring activities for master's and Ph.D. students. Special cluster groups address graduate problem solving and career exploration. Seminar programs are open to graduate students and faculty focusing on the themes of inclusiveness and retention. Participant support includes an incentive stipend and travel to STEM conferences and professional seminars.

Recruitment and Retention

The North Carolina Louis Stokes Alliance for Minority Participation (NC-LSAMP) is uniquely structured consisting of three majority institutions, four Historically Black Colleges and/or Universities (HBCUs), and one historically Native American institution. This configuration provides a diverse pool of talented Master's and Ph.D. degree potential applicants from which to recruit. Eligible students from the Alliance will be provided first opportunity for selection; however, a national recruitment effort will include participants from among other LSAMP projects.

It is anticipated that 12 BD slots will be filled in the fall of 2008. Strategies for recruitment include recruiting at the joint NC OPT-ED Day/NC-LSAMP Alliance Conference in Greensboro, NC this fall where over 1,000 STEM students and faculty are projected to attend; solicitation through the LSAMP website, and a national email campaign. Moreover, the NC-LSAMP program at North Carolina A&T has developed strong relationships with other BD institutions resulting in NC-LSAMP BD students being enrolled in Master's and Ph.D. programs at premier institutions such as the University of South Florida, and the City College of New York. Reciprocal recruitment from these and other LSAMP institutions is expected.

Finally, during the 2008-2009 academic year, we will have approximately 60 mathematics, statistics, computer science and engineering undergraduate scholars supported on substantial scholarships through a grant from the NSF Computer Science, Engineering and Mathematics Scholarships (CSEMS) Program. Dr. Tony L. Mitchell, PI on this BD proposal, is also PI on the NSF CSEMS grant. The 2008-2009 academic year will be the fourth and final year of this project that is providing funding to our undergraduate STEM transfer scholars. Any of these scholars seeking a STEM Ph.D. degree from NC State will be given priority acceptance into our Bridge to the Doctorate Program.

Application and Selection

Application Process

BD Fellows will be required to adhere to the admissions criteria of the institution and prospective STEM departments. In addition, the application process for BD applicants will include a request for the following information:

- a personal statement
- three reference letters
- official transcripts
- a signed statement of commitment

Selection Process

BD Fellows will be selected based on the following criteria:

- US citizen or permanent resident
- Minimum cumulative GPA of 3.0
- Commitment to pursue a terminal degree in a STEM field
- References
- Recommendations from faculty
- Gaining admissions to their STEM discipline of choice

Assessment and Project Evaluation

A rigorous and extensive evaluation of the NC-LSAMP BD project will be conducted by an external evaluator. The Alliance is currently exploring contract opportunities with evaluators who are well versed in the complexities of grants administration. It is anticipated that a contract will be in place prior to the end of the 2008 fall semester. The external evaluator hired for NC-LSAMP will also evaluate our BD project.

Although the evaluation criteria will be discussed and developed with the external evaluator, it is anticipated that a mixed method analysis of the project's ability to meet proposed goals will be conducted. Qualitative data collected will include an assessment of the effectiveness of the project approaches to achieve the desired objectives. Possible methods of collecting data include on-line and paper surveys, face to face focus group sessions and one-on-one interviews with BD Fellows as well as their faculty mentors. We anticipate quantitative data will include at a minimum:

- 1) Number and percentage of fellows who successfully complete their Master's degree and enroll in doctoral programs;
- 2) Number and percentage of fellows who complete the doctoral degree in a STEM field;
- 3) Number of fellows, if any, who pursue doctoral degrees in other fields;
- 4) Number of fellows who enter into the professoriate;
- 5) Number and percentage of Ph.D. graduates who pursue other STEM-related careers;
- 6) Number and percentage of fellows who pursue other careers.

Data will also be collected beyond the two year program for tracking purposes through ongoing communication with BD Fellows. An exit interview will be conducted with each fellow to collect contact information for follow up purposes. It is also anticipated that a web-based communication system will be developed to allow BD alumni to remain connected to each other and project administrators. This system will also be utilized for tracking purposes.

Examples of Graduate Student Funding Success: Academic Year 2006-07

In addition to seeking external funding, our BD Fellows will also have access to several existing NC State graduate student funding sources, including the following.

Dean's Fellowships

The Dean's Fellowships provide funds for high-quality graduate students. For the 2006-07 year, there were 51 Dean's Fellowships with values of \$10,000 non-renewable (3), \$5,000 non-renewable (22), \$5,000 renewable (22), and \$10,000 renewable (4). For the 2007-08 year, there will be 34 new fellowships and 21 carryover renewable fellowships from 2006-07 for a total of 55 Dean's Fellowships with values of \$2,500 non-renewable (1), \$5,000 non-renewable (34), \$10,000 non-renewable (5), \$2,500 renewable (1), \$5,000 renewable (10), and \$10,000 renewable (4). The total package for an out-of-state student will be approximately \$34,327.

GEM Consortium

The College of Engineering is a member of the GEM Consortium, which provides opportunities for minority students to obtain a master's degree in engineering through a program of paid summer engineering internships and financial aid. Recipients of the awards receive tuition, fees, and a stipend of approximately \$6,666 per academic year. The summer internship brings the total award value to between \$15,000 and \$30,000. For 2006-07, the College matched the \$6,666 GEM fellow stipend for those students who did not have an assistantship.

NSF Graduate Research Fellowships

Ten students received NSF Graduate Research Fellowships with stipends of \$30,000 plus tuition, fees, and health insurance. For the purposes of this summary, a list of other fellowships received this year is included in Appendix A.

Graduate Student Support Plan

The University implemented a new student support plan in fall 1997. Colleges are given slots allowing full-time (with some exceptions) students who are supported with \$3,000 per semester (or \$8,000 per year annualized) with nine or more hours to receive out-of-state tuition, in-state tuition, and health insurance. This year, the GSSP provided tuition remission slots for 1,018 graduate students valued at \$5.66 million. This included 138 slots, valued at \$836,000 provided through the College matching requirement. Funds were available to cover all requests for students who were eligible during 2006-07.

Past NC-LSAMP Bridge to Doctorate Project Performance

Since 2002, NC-LSAMP Alliance institutions have conferred 5,880 Master's Degrees, and 2,479 Doctoral degrees to STEM majors. Of these 1,009 Master's (17%) and 200 Ph.D.s (8%) were to underrepresented minorities. The NC-LSAMP has been previously funded to support Bridge to the Doctorate Cohorts I through III.

Bridge to the Doctorate Cohort I at North Carolina A&T State University (2003-2005)

In Cohort I, ten (10) BD Fellows were supported at North Carolina A&T State University. Each of the original ten fellows at North Carolina A&T State University completed their Master's degree within two years. To date, four have pursued Ph.D. degrees in STEM-related fields. Two fellows are scheduled to complete their Ph.D. requirements in May, 2008.

One former BD fellow is expected to earn the Ph.D. in December 2008, and another is expected to complete the Ph.D. no later than fall 2010. The remaining six former BD Fellows are employed in STEM-related fields at major corporations.

Bridge to the Doctorate Cohort II at the University of North Carolina- Charlotte (2004-2006)

To date 12 of the original Cohort II BD Fellows enrolled at the University of North Carolina at Charlotte completed their Master's degrees. As of fall 2008, seven of the original 12 are enrolled in Ph.D. programs

Bridge to the Doctorate Cohort III at North Carolina Central University (2005-2007)To date, five BD Fellows at North Carolina Central University attained a Master's degree in December, 2007.

Of those, two have been accepted into Ph.D. programs. Two others have applied to Ph.D. programs and are awaiting responses.

Four additional BD Fellows graduated in May, 2008. All four applied to and most are now enrolled in Ph.D. programs in STEM disciplines.

Initial North Carolina State University BD Fellows Cohort Activity

BD Grant Start-up Posture

Notification of our NSF Bridge to Doctorate grant came to campus well into the fall 2008 semester. We were expected to identify and support new fellows for the current academic year and the next. Although we were delighted to receive word of this significant funding, and had preliminary procedures in place to move forward, a program of this nature is best implemented as truly intended if this notification came in the fall before we were to begin supporting new fellows.

So instead of having a normal recruiting cycle to distribute information and applications nationally, our best effort at getting the program on track rested with our ability to identify currently enrolled new graduate students in STEM disciplines, and move them over from currently supported programs to our new BD grant. An additional factor contributing to our sense of urgency in selecting these new BD Fellows was the NSF expectation that we will prepare and submit a one-page pictorial summary of our new fellows in time to be added to the annual National NSF Bridge to Doctorate Fellows Directory. Deadline for this submission to the publisher was early November 2008.

Several important, key factors allowed us to move forward with success. First, and most important, the PI on this grant has electronic access to ALL academic records of students currently enrolled or who have applied to any program on campus. This access includes detailed information on the first semester they enrolled, academic major, correspondence and local addresses, ethnicity, gender, state of residency, total hours completed, academic advisor, etc. Another important characteristic of our environment is our network of Associate Deans for Academic Programs and Deputy Department Heads for Graduate Programs. The PI was able to quickly notify them of the grant details, and once lists of eligible students were identified, solicit their assistance in getting quick response from candidates. A final strength that assisted us in moving quickly on this grant was the lucrative support package for each student. Annual stipend of \$30,000, plus all tuition, fees, health insurance, coupled with funding to support research-related travel, all from a single source, is an excellent support package for any STEM graduate student.

Identification and Recruitment

From our database of currently enrolled students, the PI filtered the data and pulled a list of 60 underrepresented STEM graduate students whose first semester at our university was either July or August 2008. These dates represent the beginning of our second summer and fall sessions respectively. These students were enrolled in one of three colleges that matriculate disciplines of

interest for our BD Fellows selection: College of Physical and Mathematical Sciences, College of Agricultural and Life Science, and College of Engineering. Table I is a summarization of the initial 60 candidates.

	CALS		PAMS		COE		Total		All
	Female	Male	Female	Male	Female	Male	Female	Male	
MS	6	4	3	2	5	13	14	19	33
PhD	7	3	8	6	0	3	15	12	27
Total	13	7	11	8	5	16	29	31	60
All	20		19		21		60		

Table I. Initial NC State University Bridge to Doctorate Candidates

This list of 60 initial candidates was then pared down by removing academic majors not eligible for the BD grant (i.e. entomology, financial management, food science, sociology, pulp and paper science, accounting, etc.). With the resulting list of 46 who now appear to be eligible for the award, the PI sent a one-page qualification form to each, copying respective graduate administrators or associate deans to insure they were aware that candidates existed in their programs, and to solicit their support in getting quick responses from candidates. The one-page qualification form confirmed US citizenship status, academic major, Ph.D. intent for those not currently enrolled in a Ph.D. program, and whether or not the candidate participated in an undergraduate LSAMP program - a key criteria for selection. To expedite our selection process, we used this one page form to select the new BD Fellows, leaving the more comprehensive formal application for later. We were able to do this because of the pre-screening done in selecting the short list of candidates.

Twenty of the 46 information forms were returned as requested. From that list, 10 were eligible for the grant and selected. Those not selected either were not US citizens or permanent residents, did not graduate from an undergraduate LSAMP program, or were not enrolled in the degree program reflected in their official campus record. Nine of the 10 selected began their graduate program fall 2008; the 10th moved into a graduate program January 2009 after completing the undergraduate degree here at NC State.

In addition to meeting NSF criteria for selection, our 10 initial BD Fellows are also quite diverse. Five are pursuing graduate degrees in mathematics, chemistry or statistics; and five are majoring in electrical, industrial, computer or civil engineering. Four are African American females, two African American males, two are Hispanic American females and two Hispanic American males. Three earned undergraduate STEM degree here at NC State and the others from public and private schools ranging from small historically black universities to a large Hispanic university with substantial enrollment of women in engineering.

We now have time to recruit nationally to fill the remaining 12 slots for fall 2009, while we continue the challenge of getting our currently selected new BD Fellows switched over to this NSF grant.

Unexpected Challenges Associated With Initial Selection and Appointment

Most of the selected BD Fellows were already identified in their academic department, and have been receiving support. A significant component in our graduate student support packages is the Graduate Student Support Plan. These funding packages are coordinated by our university graduate school dean in conjunction with academic deans. The number of these GSSPs is fixed, allocated based on enrollment and need. Once students are selected for this and other support packages of national interest, the numbers are reported nationally. They are used as national rankings input and provide some measure on how well heavily recruited graduated students are treated on our campus. Also, other BD Fellows were appointed initially as teaching assistants on departmental funds. Determining how best to move these fellows off their current support plans is proving to be very difficult since we do not want to negatively impact any aspect of our graduate posture. One other compounding factor is support for the BD Fellows after the two year of NSF money runs out. As part of our proposal to the NSF, the College of Engineering provided a written commitment to find comparable funding for any engineering BD Fellow selected for the program. Although we have commitments to insure priority consideration and involvement for other STEM BD Fellows, there is no firm commitment from those colleges to continue funding once the NSF funds are gone.

Conclusion

The National Science Foundation Bridge to Doctorate Grant of \$987,000 to NC State is proving to be an important component of our plans to increase Ph.D. production of underrepresented students earning STEM degrees. We now have the opportunity to recruit additional, top quality students into our programs, and are confident that they will succeed in their quest to help improve the dismal state of this populations' contribution at the top level of STEM professions.

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