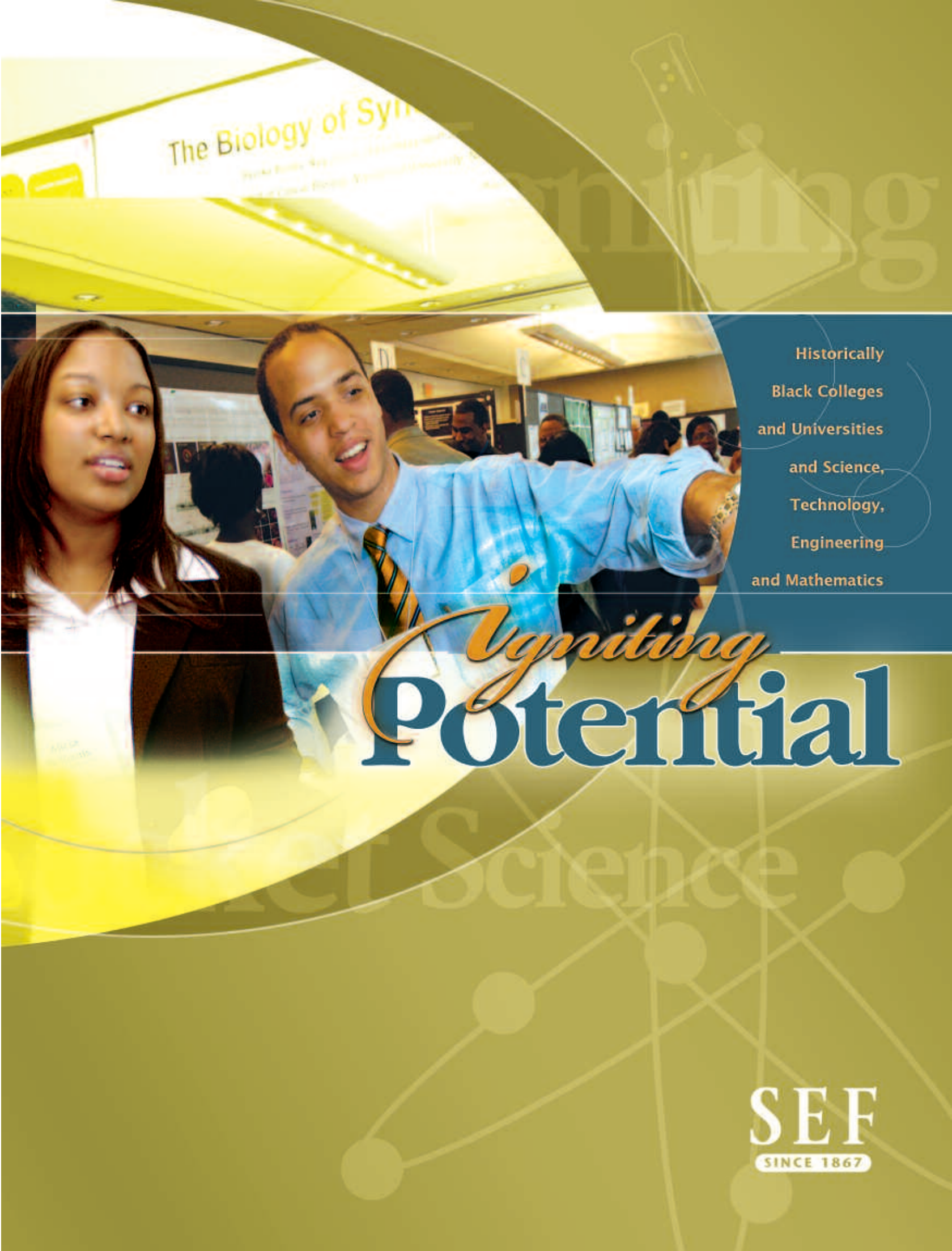

Historically Black Colleges and Universities and Science, Technology, Engineering and Mathematics

Igniting Potential

SEF
SINCE 1867

Southern Education Foundation (SEF)

The Southern Education Foundation, www.southerneducation.org, is a non-profit organization comprised of diverse women and men who work together to improve the quality of life for all of the South's people through better and more accessible education. SEF depends upon gifts and contributions to support its efforts. SEF develops and implements programs of its own design, serves as an intermediary for donors who want a high-quality partner with whom to work on education issues in the South, and participates as a public charity in the world of philanthropy.

SEF's Vision: We seek a South and a nation with a skilled workforce that sustains an expanding economy, where civic life embodies diversity and democratic values and practice, and where an excellent education system provides all students with fair chances to develop their talents and contribute to the common good. We will be known for our commitment to combating poverty and inequality through education.

SEF's Timeless Mission: SEF develops, promotes and implements policies, practices and creative solutions that ensure educational excellence, fairness, and high levels of achievement among African Americans and other groups and communities that have not yet reached the full measure of their potential.

SEF's Values and Principles: SEF is committed to:

- top quality work, assessment and continuous improvement to achieve high impact
- collaborative efforts that draw on the best of diverse institutions and communities in support of educational excellence
- creative problem solving
- integrity, accountability and transparency
- adaptability, flexibility, and future-oriented approaches, and
- honest and intelligent advocacy to achieve results

Igniting Potential

Historically Black Colleges and Universities and
Science, Technology, Engineering and Mathematics

Acknowledgments

This report, made possible through funds from the David and Lucile E. Packard Foundation, highlights the tremendous contribution made by Historically Black Colleges and Universities (HBCUs) to training undergraduate students in the fields of science, technology, engineering and mathematics (STEM).

The Southern Education Foundation (SEF) thanks the staff of the David and Lucile E. Packard Foundation, members of the Packard Foundation's HBCU Graduate Scholars Advisory Committee, and presidents of Morgan State University, Morehouse College, Spelman College, Clark Atlanta University, Xavier University and Tennessee State University, the institutions on which much of the report is focused, for their help in the development of this report.

SEF also lauds the dedicated work of inspired faculty members at HBCUs. We have great expectations of the young STEM scholars whose narratives and pictures enliven these pages. Lastly, but not least, SEF thanks Steve Suitts, SEF's program coordinator, who participated in the HBCU review and authored much of the report, and David Maurrasse of MARGA, Inc. and his colleague, Jaclyn Bliss, for their assistance.

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Foreword

The global revolution in technology and the sciences has created increased demand in the United States for people with expertise in science, technology, engineering and mathematics (STEM) at a time when the baby boomer generation of STEM professionals moves toward retirement. There is an emergent consensus that the United States cannot continue to rely so heavily upon foreign nationals to meet the science-related needs of its expanding economy. It must find more effective ways to increase the production of scientists and engineers at home.

As a result of demand, global trends and national demographics, new attention is now focused on developing the capacities of African Americans, Latinos and women, groups that have historically been underrepresented in STEM fields. These groups are a prime, underutilized and underdeveloped talent pool for the STEM workforce.

This report provides some basic, practical information about how Historically Black Colleges and Universities (HBCUs) at the undergraduate level are able to motivate African Americans to pursue studies and careers in STEM fields. It is written with two ends in mind. The first is to expose donors and policymakers to information about the important and disproportionately large contribution that HBCUs are making to human capital development in these vital fields. If the nation is to optimize the resources that it has to maintain strong leadership, and, as the Preamble to the United States Constitution requires, "provide for the common defense, promote the general Welfare and secure the Blessings of Liberty to ourselves and our Posterity," HBCUs must be helped to enlarge their reach and impact.

The second end for which the report is written is to challenge traditionally White undergraduate institutions (TWIs) to do more to enhance the number of Blacks pursuing STEM training. It is not rocket science. As this report shows, there are some basic ingredients to successful efforts that all institutions of higher education that want to succeed can emulate with the promise of good results. We share these lessons with the field to spark increased attentiveness to the talented young Black women and men who can, with nurturance and support, be tomorrow's top scientists, mathematicians, technology experts and engineers in service to the national interest.

In sum, this report is about igniting the potential of African Americans as a vibrant source of leadership and service in science, technology, engineering and mathematics. It is about igniting the potential of HBCUs by providing more support for their work to train outstanding students in these fields. It is about igniting the potential of traditionally White colleges and universities to recruit, retain, train and graduate African Americans in these fields. The report is about the need for a new era of communication, interaction and collaboration among public and private agencies, donors and educational institutions at all levels to realize the full measure of the potential that reposes among Black students and HBCUs.

The Southern Education Foundation hopes that the lessons shared in this report will ignite a new sense of optimism and activism to help the United States thrive and lead in science, technology, engineering and mathematics in the years that lie ahead.

Lynn Huntley
President
The Southern Education Foundation
Summer 2005

Executive Summary

The United States faces a looming shortage of well-trained scientists and engineers to fill jobs vital to long- and short-term economic growth, productivity and competitiveness. To maintain its leadership role in the global economy and ensure a good quality of life at home, there is a need to increase the mathematics and science achievement of members of minority groups. By the mid-century, the United States will have both a student population and an adult workforce that is "majority minority."

Historically Black Colleges and Universities (HBCUs) are a vital resource for efforts to increase the Black presence in science, technology, engineering and mathematics (STEM). In 2000, almost one out of every four African Americans receiving a bachelor's degree graduated from an HBCU. In 2000, HBCUs graduated 40 percent or more of all African Americans who received degrees in physics, chemistry, astronomy, environmental sciences, mathematics and biology. In almost every STEM field, HBCUs lead the nation's larger, better-equipped colleges in producing Black graduates. The National Science Foundation has found that African Americans who graduate from HBCU undergraduate institutions in STEM are more likely to go to graduate school and complete their doctoral degrees than African American undergraduates from other institutions.

The Southern Education Foundation (SEF) studied six HBCUs with high productivity in STEM—the strategies that they use, best practices in the field and the financial underpinnings of their STEM efforts. Essentially, SEF found that these institutions are not receiving either public or private support commensurate with their STEM undergraduate productivity. During the 1990s, HBCUs received less than 2 percent of the $2.58 billion in federal grants awarded to all higher education institutions. Of that amount, 25 percent supported fellowships, training and teaching-related efforts. Only 1 percent went to support research and development or facilities. SEF found that private foundation grants in STEM are relatively small and declining. HBCUs are the focus of very few foundations.

HBCUs need and warrant support in view of their STEM contributions. Their experiences are also of value to other higher education institutions that are committed to increasing minority group (and female) participation in STEM fields.

Clark Atlanta University, Spelman College, Morehouse College, Xavier University, Tennessee State University and Morgan State University, the institutions on which SEF's study focused, generally conform to "best practices" with good results. More particularly, SEF found that:

- Preseason programs are an important means to encourage African American high school students to pursue STEM studies and careers and help them prepare for success in college. Students who participated in such programs tended to do better than those who did not;
- Financial aid to support students enrolled in STEM is critical, especially in view of the academic rigor of the courses and extended time it takes to graduate. Students participating in scholarship and other such programs develop pride and a sense of identity that helps in retention;
- Strong faculty advisement is a critical component of student success in STEM. HBCUs have small student-to-faculty ratios in STEM fields. This provides the attention, direction and nurture needed by students to excel;
- Involving students in and supporting STEM research is important both to cultivate students' interest in STEM and help students gain entry into graduate school. Enhancing HBCUs' faculty and student research opportunities would enhance student learning and pedagogy and contribute to the generation of scientific knowledge;
- HBCU STEM programs would benefit from more equipment, resources and faculty development opportunities to keep their programs on the "cutting edge" of innovation in research and instruction. Resources in all of these areas are more limited than is optimum and need to be increased;
- STEM programs require periodic curriculum, organizational and structural realignments for which support is needed. HBCUs need resources for study, staffing and other forms of assistance in these areas;
- HBCUs' experiences in STEM at the undergraduate level have not yet been fully or adequately studied for the benefit of the field. At a time when the nation needs more scientists, HBCUs are key to developing large numbers of talented African Americans for STEM careers. Research on what HBCUs do and how they do it is needed to enhance HBCUs' practice and that of other institutions involved in STEM training.

It follows from the foregoing that additional categorical, institutional capacity building, financial aid, research, and community of practice support is needed to strengthen HBCUs' contribution.

The nation's defense, economic growth, and national interest depend upon our actions today.

Igniting Potential

Historically Black Colleges and Universities make a disproportionately large contribution to the STEM pipeline, using best practices to prepare African Americans for advancement to graduate studies and success in science, technology, engineering and mathematics careers.

Science Technology Engineering Mathematics

The United States needs to raise up and train a new, diverse generation of highly talented Americans skilled in science, technology, engineering and mathematics.

Introduction

The revolution in technology and related science fields has transformed the world, diminishing distance and space among nations and their peoples, posing new challenges to government structures, recasting economic relations and dynamics, beginning the new "Information Age" and creating a "global village."

The United States is a world leader in no small measure because it has outstanding educational institutions, top quality students and teachers, a thriving business sector, a national aspiration to excellence and leadership in the global marketplace and a competitive edge in science, technology, engineering and mathematics (STEM). STEM is a major engine of economic development, innovation and transformation. The leaders of the United States understand that human capital development is the key means by which to create a better quality of life for all of the people.

The number of the nation's STEM-trained professionals has not kept pace with demand. There is a present need for more and better-trained people in STEM fields.

The Facts

How will the nation's colleges and universities adapt to changing circumstances and the proliferation of knowledge in STEM? From whence will come the top-flight scientists for industry, public service, teaching and the professorate of the future? What must be done to ensure outstanding training, research opportunities and other supports needed to ensure excellent results? In light of changing population demographics, what can be done to encourage more people of color and women, who have historically been underrepresented in STEM fields, to pursue training and careers in these areas? How can the nation maximize its return on its STEM investment in higher education and reach national goals? All of these are weighty and important questions.

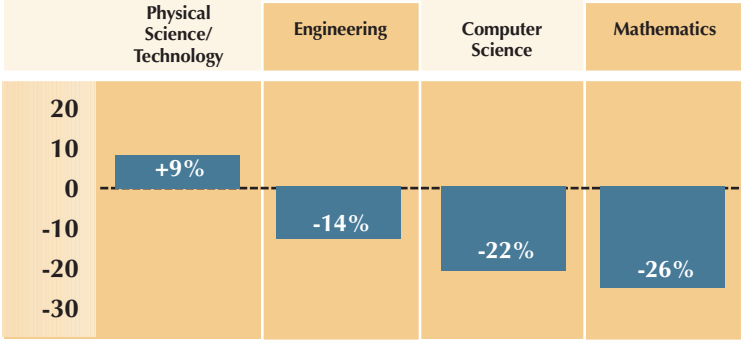
In this report, SEF points to the outstanding contributions made by Historically Black Colleges and Universities (HBCUs) to STEM training and fields. The report provides data about the productivity of HBCUs in STEM undergraduate education; describes best practices in STEM education; highlights creative ways in which selected HBCUs are working to enhance the number of students in STEM fields of study; documents patterns of investment in HBCUs' STEM programs; and shares narratives of the HBCU experience by STEM graduate students.

Finally, the report summarizes some ways in which policymakers, public and private, industry and education institutions can help HBCUs enlarge their vital STEM education programs.

Increased Demand, Dwindling Supply

Today the United States faces the prospect of a shortage of scientists and engineers in the national workforce. At a time when occupations in STEM are mushrooming, a large number of America's scientists and engineers are slated to retire over the next 10 to 15 years.

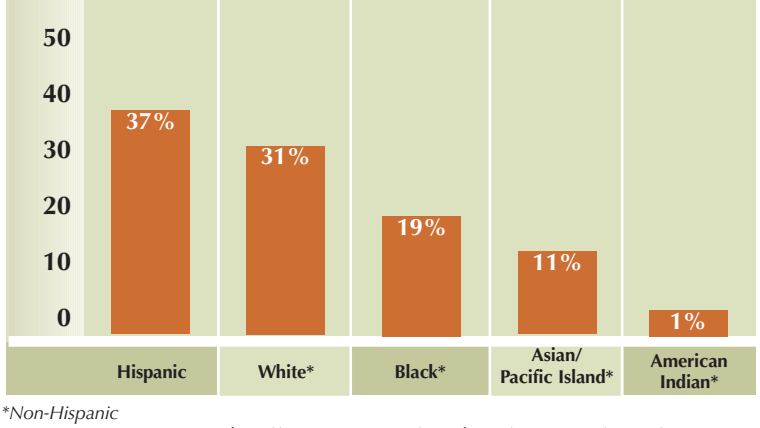
CHART 1. **Percentage Change in Bachelor's Degrees Conferred, 1987-1988 to 1997-1998**



As a leader in the global economy, America may attempt to meet this challenge by increasing the recruitment of trained citizens from other nations, but as recent study by the Education Testing Service (ETS) concludes, this strategy will not be sufficient. The report says: "Meeting our nation's future economic needs will not be possible without improving the math and science achievement of underrepresented minorities."

There are several reasons why this is so. In recent years, both the number of students receiving bachelor degrees and the number going into graduate school in most STEM fields have declined sharply compared to what they were at the end of the previous decade. The drop is as high as 22 to 26 percent for students receiving bachelor's degrees in computer science and mathematics. At the same time, nearly 70 percent of the growth in young adults between the ages of 18 and 24 is among members of minority groups, including a 19 percent increase in the number of African Americans. The net effect is that by the year 2010, 38 percent of all Americans between the ages of 18 and 24 will be people of color.

CHART 2. **Percentage of Total Growth of 18-24 year olds among racial/ethnic groups, 2001 to 2010**

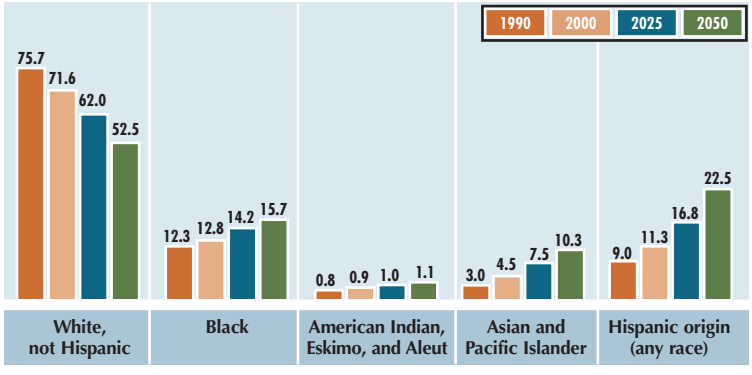


*Non-Hispanic
Source: U.S. Census Bureau. http://www.census.gov/population/projections/nation/summary

The Facts

This projection constitutes the front end of a clear trend in America's shift toward racial and ethnic diversity. By mid-century, the United States will have both a student population and an adult workforce that is primarily "majority minority."

CHART 3. Projected U.S. Population by Race and Hispanic Origin



Source: Day, J.C. National population projections. Population Profile of the United States: 1995. Washington, D.C.: U.S. Bureau of the Census, 1995 (CPS Report No. P23-189).

All demographic data point toward the necessity to educate and train larger numbers of students of color in order to meet the nation's needs for scientists and engineers. America must respond to these changes. It must serve the national interest by helping to undo the lingering effects of the nation's long history of denial and/or underinvestment in African American education. Undoing this legacy is the right and necessary thing to do.

HBCUs' Contribution to STEM Education

During the nation's first two hundred years, HBCUs were primarily responsible for the higher education of African Americans. Indeed, for several generations, these were the only institutions where African Americans could gain an education beyond high school in the South. Operating with scarce resources and very large challenges, HBCUs provided their students with their best and, in many instances, only chance to pursue higher education during the decades when Southern states with the force of law opposed equal opportunity.

In this connection, it is important to note that HBCUs have always been open to White students and have long had diverse faculty, leaders and supporters. Today, the nation's 105 HBCUs have begun to enroll more non–African American students and remain integrated on the faculty and administrative levels. In this sense, HBCUs epitomize constancy and fidelity to American ideals of fair play and equal opportunity. Their continued existence is now part of the answer to the nation's legacy of racial exclusion and denial of higher education opportunities to African Americans.

HBCUs perform a vital role in the higher education of African American youth. Almost one out of every four African Americans who received a bachelor's degree in the United States in 2000 graduated from an HBCU.

In the STEM fields, HBCUs play an even greater role. In 2000, HBCUs graduated 40 percent or more of all Black students in America receiving bachelor's degrees in physics, chemistry, astronomy, environmental sciences (such as oceanographic science), math and biology. These institutions also graduated 23 percent of all Black engineers.

CHART 4: Percent of bachelor's degrees earned by Blacks at Historically Black Colleges and Universities (HBCUs), by field, 2000

Total *(all fields)*	**24.5**
Science and Engineering (S&E)	**26.2**
Engineering	**22.7**
Sciences	**26.6**
Natural Sciences	**37.7**
Physical Sciences	**43.5**
Mathematical Science	**29.6**
Biological Science	**39.8**
Agricultural Science	**47.6**
Social Sciences	**20.6**
Social Science	**19.6**
Psychology	**22.2**
Non-S&E	**23.7**

In almost every STEM field, HBCUs are ahead of the nation's larger, wealthier and traditionally White colleges in producing Black graduates. Last year, for example, HBCUs accounted for 12 of the 13 institutions with the highest number of African Americans graduating with bachelor degrees in biology. They also were 30 of the top 40 schools in this category. In mathematics, HBCUs made up 12 of the top 15 schools graduating the largest numbers of Black students with bachelor degrees, and they constituted 13 of the top 15 schools graduating the most African American students with bachelor degrees in the physical sciences.

The Facts

The National Science Foundation has found that African American students who graduate from HBCUs in the sciences are more likely to go to graduate school and complete their doctoral degrees than Black students from other institutions. As a result, HBCUs are responsible for most of the Black students who acquire doctoral degrees. The Congressional Commission on the Advancement of Women and Minorities in Science, Engineering, and Technology Development reported that a majority of the African Americans receiving doctoral degrees in most fields of science from 1975 to 1992 came through an HBCU undergraduate program. Another recent study of African Americans who earned Ph.D.s from 1985 to 1995 indicates that HBCUs continue to serve this primary role.

Best Practices in STEM Education

During the last few years, several public agencies, institutions and special commissions have sought to identify ways to enhance the quality of STEM education and enlarge the numbers of students, including women and members of minority groups, pursuing degrees in STEM fields. A body of research has begun to emerge that focuses on the most effective programs and practices in this area. These studies have approached the issues in various ways but most have differed very little in their basic findings about the primary barriers to and the best practices for successful undergraduate STEM education. It really is not rocket science!

Most reports have found three factors in high school predict a student's low achievement in science and mathematics at the college level: (1) family poverty and limited parental education; (2) inadequate science and math curriculum and teaching; and (3) tracking into low-level courses.

Family poverty If students come from low-income families and receive limited intellectual guidance from parents, they are likely both to be unaware of STEM careers and have little or no exposure to role models. They are not likely to know how to advance their education interests in this unfamiliar turf called STEM.

Many students of color, especially African Americans, are disproportionately represented among those who come from low-income families or live in poverty. These students attend the least well-maintained public elementary and secondary schools, have the least experienced teachers, face high teacher turnover and, in short, have limited chances to develop the basic and/or high order skills needed to pursue higher education in STEM. HBCUs' collective genius has always been to help such students develop, mature and gain the capacity to do college-level work.

It is important to note that not all HBCU students enter college with developmental needs. To the contrary. Many HBCU students enter school with excellent skills and would be competitive with students at the most selective colleges, had they chosen to attend them. A mix of students are enrolled in the nation's HBCUs.

Inadequate science and math curriculum and teaching Data from the No Child Left Behind Act about the number of "low performing schools" and the yawning achievement gap in most core subjects between affluent and low-income and minority and majority group students documents that many minority group students simply don't have an opportunity to learn or excel in STEM.

Tracking into low-level courses Many minority group students are deprived of opportunities to pursue college-level courses while in high school and are tracked into vocational or "special education" programs with little chance of reentry into academic coursework.

Programs and practices in colleges and universities that effectively anticipate and/or respond to these obstacles have increased the numbers of students who graduate with STEM degrees. The elements that make for success are:

- Intense, personal introductory preseason programs for entering students;
- High levels of counseling, mentoring, and guidance throughout undergraduate studies;
- Rigorous, interactive instruction;
- Adequate financial aid;
- Meaningful research experiences and internships; and
- Hospitable campus climates and caring learning environments.

While supplemental research would be valuable related to these issues—for example, studies on what the best standards are for talent identification, exactly "what aspects of

The Facts

undergraduate STEM interventions increase entry, persistence, and degree attainment or what factors in undergraduate experience lead to doctoral studies—extant data still offer tantalizing insight into what works.

The practices that SEF found in evidence at the HBCUs that it studied—Morehouse College, Xavier University, Tennessee State University, Morgan State University, Spelman College, and Clark Atlanta University—conform to the best practices cited in the literature.

The National Science Foundation has found that African American students who graduate from HBCUs in the sciences are *more likely* to go to graduate school and complete their doctoral degrees than Black students from other institutions.

What STEM Students Say

Historically Black Colleges and Universities are committed to expanding diversity in STEM and helping students succeed in education and life.

Technology
Science
Mathematics
Engineering

Undergraduate School:
Tennessee State University
Graduate School:
Vanderbilt University

Sydika Banks

"Like so many young people, I grew up dreaming about becoming a doctor..."

Like so many young people, I grew up dreaming about becoming a doctor, first a pediatrician, and then a doctor in sports medicine. I didn't know anything about the range of careers in research in the sciences. A new world was opened up to me at Tennessee State. What I find is that a lot of young undergrads want to become doctors and go into medicine, which is fine, but a lot of them don't understand what it takes to get there. A lot of people don't end up getting into medical school, and don't have an idea of alternatives.

A lot of African Americans, sadly, aren't very educated about the sciences. They don't know all of the different avenues that the sciences encompass, so they only think there are doctors. They don't know about research opportunities, and they don't know what research entails. Education at a young age would help improve the numbers of African Americans in the sciences. For me, I needed the experience at Tennessee State to understand the diverse opportunities that are out there. No one in my family is in this field, so I am the first.

I grew up in Seattle, where there are not many minorities, or a large Black population. Because of that, I always knew that I wanted to go to an HBCU. I found Tennessee State on a college tour. Out of the twenty schools that I visited on that trip, I found that Tennessee State, although far from Seattle, seemed like a place that I could call home.

And, it turned out to be that way. I found my career interest, and I was around a lot of people who were like me and shared my goals. Even as woman, entering what is often thought of as a predominantly male field, I've met a lot of other women interested in the sciences. At Tennessee State, there are a lot more females in the classroom. I know that's probably going to change in grad school, but you just have to keep your goals in line. You have to know within yourself what you want regardless of what sex or race, because you might run into those problems as well.

For the past couple of months, I have been at Vanderbilt, focusing on a type of synovial sarcoma, a soft tissue cancer of the joints that affects primarily young adults. This is a relatively new project; the lab that I am working in is only two years old. We are trying to figure out the function of the proteins responsible for causing this form of cancer.

Long term, I am battling back and forth between different things. I'm looking to possibly go into drug abuse research. I am also definitely looking into clinical research, possibly working with some government agencies.

Ronald Copeland

Undergraduate School:
Norfolk State University
Graduate School:
University of North Carolina

"At an HBCU, I felt that I could get a strong bond with the professors."

At an HBCU, I felt that I could get a strong bond with the professors. My experience has taught me the importance of developing strong relations with people in academia. Whenever anyone asks me why I ended up choosing chemistry as my field, I will always say that I had an extraordinary chemistry teacher in high school. She made chemistry fun, and I got it a lot easier than many other subjects. Once I found something that I liked, and fully understood the potential for advancement in chemistry, I just stuck with it.

The potential for one-on-one interaction with professors was what I was looking for when I was deciding where I wanted to pursue my undergraduate education. If I went to a majority institution, the classes would have been large, and I wouldn't have gotten the individual attention as I did at Norfolk State University (NSU), where the classes were smaller and geared towards closer communication between professors and students. Those bonds benefited me to this day: when it came time for references, the professors knew me by name.

In addition to close relations with professors, I got a lot more out of my experience at Norfolk, including a good deal of support for my interest in chemistry. I was in a state-supported program at the Norfolk State called, the Dozoretz National Institute for Minorities in Applied Sciences (DNIMAS), which was designed to get more African Americans interested the sciences. While matriculating through that program, my goal was to go to medical school or graduate school. My decision to pursue a graduate degree came after I had my first taste of what scientific research was like by working during my senior year with my NSU biochemistry/organic chemistry professor, Dr. Joseph Hall, who was conducting research to develop a male contraceptive pill.

Now, I am at the University of North Carolina at Chapel Hill, where I am working with Dr. Jian Liu conducting research on the structural features that heparan sulfate employs to assist in viral infections, specifically herpes simplex virus type I (HSV-1) infections. I am looking to do post-doctoral training for my next step, and then will look toward industry, maybe the FDA, or a large pharmaceutical company, doing research and development. What I can say to young African Americans thinking about careers in the sciences, "Go for it!" I have loved the sciences for a long time, and I am glad that I got the opportunity to make a life out of this. It is my hope that I can leave a unique mark on my field when everything is said and done.

Undergraduate School:
Benedict College
Graduate School:
Georgia Institute of Technology

Kristan T. McGresham

"I really enjoyed math and I found I really enjoyed physics."

My sister, who went to Florida A & M University, would call home when I was in high school, and ask me, "What college are you going to?" She encouraged me to attend an Historically Black College. Eventually, my mother and aunt arranged for my cousin and me to tour selected Black colleges. I chose a small HBCU, Benedict College, in Columbia, South Carolina.

My college tour was during the summer and we arrived at Benedict on July 3rd, when they were closed for the holiday. Despite little activity on campus when I visited Benedict, they still found time for me. That made a significant difference in my choice. I went there for four years, and graduated with a degree in physics. I am currently at Georgia Tech, where I am pursuing a Ph.D. in physics.

When I entered Benedict, I chose to major in education to prepare myself to become a teacher. My mother was a math teacher and had a strong influence in my life. But I changed my major to physics after my first year and my focus became teaching physics. My advisors told me to study areas that are interesting to me, and I will be able to teach others whatever I learn in the process.

In high school, I knew that I wanted the experience of attending an historically Black school. Growing up, I was in a White school system from first grade until I graduated from high school. My sister was already at an HBCU, which fed my anticipation and excitement about having such an experience. I have gotten the feeling that some people consider HBCUs to be on a lower standard. I would say that it is just different from a place like Georgia Tech.

At Benedict, the professors are highly educated and well trained. Most professors do hold their classes to a high standard. The way they go about it might be different, because they are trying to reach everybody. Ultimately, the student holds some responsibility for the knowledge he/she acquires. In some institutions, there are professors who believe if you know the material and you can do the work, then you're fine. But at least at Benedict, most professors accept students where they are and help bring students up to a level where they know the material and can do the work. So, some of the professors might have to start in algebra to get up to calculus, and teach in a manner that helps people on every level.

They prepared me; they prepared me to a state where I knew concepts in my field of science, I knew ideas in areas outside of my major, and I also knew what I needed to study more. They're reaching everyone who wants to be reached. In my small Benedict, in my small hub, they nurtured me so much that I thought, "I am just like everybody else." I didn't realize some of the hardships that I was really overcoming because they didn't make it seem so hard.

My interest in physics started in high school. I took my first physics class in my senior year. It's an interesting field; it involves a lot of math, calculus, but applied to different physical situations. I really enjoyed math, and I found I really enjoyed physics.

I still want to teach; this has been my dream since I was a little kid. I used to say to my mom, "I'm going to be like you. I want to teach." She always said, "OK, you can do anything you want." Anyway, the way I see it now, I want to teach physics at the college level.

Undergraduate School:
Hampton University
Graduate School:
University of North Carolina

Michael Duncan

"I want to help people, especially in the Black community, gravitate toward the sciences."

I always had an interest in the sciences. I can remember while growing up, always going outside to find different things that I could mix together and play with. I would always find bugs and plants and look at them under my microscope.

I am originally from a very small town, Ridgeland, South Carolina, which is close to Savannah, Georgia. I went to high school there for two years, and then I had the opportunity to attend the South Carolina Governor's School for Science and Mathematics for eleventh and twelfth grades. The curriculum there heavily emphasized the sciences. My ultimate desire to pursue a Ph.D. and a career in the sciences was really initiated at the Governor's School, where I had the opportunity to do a research project microbiology. I also took a class in organic chemistry that I really enjoyed. From there, I went on to Hampton University, where I majored in chemistry.

I first set foot on Hampton's campus during a prospective student's visitation weekend. The minute I walked through the door, I felt a strong, positive vibe. I got a chance to talk to a few of the chemistry professors while there, and they were so enthusiastic about the idea of my attending their university. That meant a lot to me. I had already been thinking about going to an HBCU. In the case of Hampton, specifically, I already had friends who had attended and had really great experiences, and I also had a scholarship. Everything just came together, and I'm glad I made that decision. While at Hampton I was strongly encouraged to pursue research, and I had outstanding support from both faculty and my classmates.

My sense about the difference between HBCUs and majority institutions is that because Blacks make up a small minority they may sometimes feel isolated a majority institution. They also don't necessarily have professors and other academic role models that are minorities, and I think that can have a negative impact. At Hampton, I had a sense of community and family, which may not always be the case at a larger majority institution.

Currently, I am a doctoral candidate at the University of North Carolina at Chapel Hill. I was always interested in Carolina because of its pharmaceutical sciences program. I actually got the opportunity to do a summer undergraduate research program at Carolina between my junior and senior years at Hampton, and I had a great experience. My research is in the field of glycobiology and I am having a great time completing my dissertation project.

Looking to the future, I would like to pursue research in industry, but I ultimately would like to come back and teach at a small liberal arts school like Hampton. Hampton left that imprint, to continue to contribute to those that are coming along. I want to help people, especially in the Black community, gravitate toward the sciences. Unfortunately, people don't know about the many different careers in the sciences and the rewards that you can get from pursuing science. Diversity in the sciences can make a unique contribution to society; it's very important that we have new ideas and different ways of approaching the challenges of scientific research. One way to achieve this is by involving many types of people with unique backgrounds and perspectives.

Tucker

Courtney Tucker

Undergraduate School:
Clark Atlanta University
Graduate School:
University of Illinois, Urbana-Champaign

"Students need to get experience to build a resume and form connections at the same time."

I knew I wanted to be in the sciences when I blew up a chemical set in my lab in high school. My teacher said, "Courtney, I'm not going to let you experiment anymore. You don't know what you're doing." For some students, that teacher might have taken the curiosity away, taken away the drive to learn more and experiment with new things. But, I was not going to have it. Standing up for myself, I told him, "I can do this. You cannot tell me I can't do this." From that point on, the consideration was never whether I was going to go into a math- or science-related field, but where I was going to eventually use my skills in industry or academia.

My mom is a kindergarten teacher. She always felt it was necessary to expose her kids to the sciences at a young age. She insisted that I participate in different activities to instill a passion for science in me. When I was young, this included reading programs at the library. But, as I got older, I started going to Saturday Science Academy at Clark Atlanta University. The program not only made science fun, but it also pushed me into the field. I learned how to apply science to different things. I was able to see how you could use it, and how it wasn't just opening a textbook and memorizing. And I got to see other people who looked like me doing it too. I was so inspired by the environment; I decided to attend for four years as an undergraduate.

At Clark Atlanta, you don't just go to school. The professors and staff insist that you participate in something and find something that really drives you. Clark Atlanta knows that just going to Clark Atlanta isn't enough for you to actually compete in the business world. They know that students also need to go out and get an internship or go to a majority institution to participate in research. Students need to get experience to build a resume and form connections at the same time. My advisors always went the extra mile. They were constantly informing me of graduate school programs and fellowship opportunities. They paid for my grad school application fees and made sure I took the GRE classes I needed. My professors and advisors at Clark Atlanta are even at least partly responsible for my Packard scholarship, which has provided me with a support system and the means to work on my Ph.D. in physical chemistry here at the University of Illinois, Urbana- Champaign. If it had not been for Clark Atlanta, I probably wouldn't have gone to graduate school.

HBCUs, like Clark Atlanta, say, "We've helped you get this far. Now you need to help us and keep going." They make an investment in you just as much as you make an investment with them.

My career aspiration is to train someone else to do what I'm doing. I want to teach and to be able to influence other young students. I'm realizing now that it's not just African Americans who need help, it's Americans in general. Too many students are getting lost and are being turned off from science early on. I want to help feed young people back into the field and make sciences more accessible.

Undergraduate School:
Xavier University
Graduate School:
Louisiana State University

Alicia Williams

"I felt ahead of other people when I came out and began this program."

When I first started looking into colleges, I knew a couple of things. I knew I wanted to go to a small school where the teachers would know my name and classes would be small and personal. I wanted to be recognized and feel special for my talents. I had taken classes at larger, majority institutions, but everything seemed so impersonal. I just didn't feel like that kind of person, to be in that kind of setting. My father graduated from Xavier, which led me there for a summer program in science. I loved it. I loved the campus. I loved the atmosphere and the teachers. It was all just unreal. There are lots of good schools out there and lots of schools with great facilities. But, how often do you hear of a professor staying until nine o'clock at night in the chemistry lab because his students wanted to understand, learn more. The professors extended so much to us that I decided to return the following summer and ultimately chose Xavier as my undergraduate university.

At the moment, I am in the middle of my third year at Louisiana State University at Baton Rouge in a Ph.D. program in chemistry. Because Xavier taught me so much and gave me so many opportunities, I felt ahead of other people when I came out and began this program. In chemistry classes, normally, you would just have regular lectures and a three or four hour exam four times a year . . . not at Xavier. It was so much more, which is why my chemistry background is so strong. We had drills and weekly practice exams and worksheets. Part of me wasn't able to appreciate my foundation until I got to LSU. I was able to help my peers out with their work—all because of how the foundation was laid at Xavier.

In ten years, I should be finished with school. When I am finished with my Ph.D., I would like to go to law school and practice patent law in the pharmaceutical industry. Otherwise, I will continue to work on the same type of things I am working on now, natural products and disease prevention.

But I would also like to be a mentor for young people. The greatest challenge is informing people of the possibilities for further study and research. I often think of my own experience—I come from a really smart, intelligent family and even I didn't know much about graduate school when I started Xavier. People think, "My parents don't have money for this. I don't have money for this. I can't do this." Young people need to have other young people like them telling them about their personal experiences.

That will not only inform, but will also provide people with an example they can relate to. I definitely want to give back and be a part of informing others of the vast opportunities available to them, especially in the sciences.

Wilson

Undergraduate School:
Morehouse College
Graduate School:
Georgia Institute of Technology

Jamal Wilson

"HBCUs give you the space to grow personally and find the best path for your career and your life."

Not too many people emphasized applied science or engineering back in Decatur, Georgia, where I grew up. I did have plenty of doctors and lawyers and other professionals to look up to, including my own parents. But, even with that, young people back home were rarely exposed to these other fields at a young age. It really wasn't until late in my experience at Morehouse when I first realized that I wanted to become an engineer.

Education has always been a priority for my family. My mother, an administrator at Georgia Institute of Technology, encouraged me to go to an HBCU, following in the footsteps of my father and older brother, both Morehouse alumni. In choosing a college, I knew I wanted to be in an environment that would surround me with my own people, yet expose me to a diverse atmosphere, perhaps not by race, but by class and background. So, there was a combination of both parental guidance and self-motivation that led me to look into and finally select Morehouse.

I was actually accepted to Morehouse on a football scholarship. Maybe by some kind of divine intervention, I ended up getting hurt playing football, giving me more time to focus on academics. Ultimately, I went into engineering, combining my mathematical and artistic talents, and entered into a dual-degree program with Georgia Tech. After that, I was accepted into a Ph.D. program, also at Georgia Tech, where I now engage in rapid prototyping and manufacturing research.

Like all HBCUs, Morehouse has its share of positives and negatives. Morehouse doesn't have the technology of a major institution like Georgia Tech. For example, laboratories only offer analog systems whereas at larger, more endowed institutions, students learn on digital equipment. At the same time, however, majority institutions are not as nurturing. HBCUs give you the space to grow personally and find the best path for your career and your life.

The environment back at Morehouse also pushed me to set my goals higher. During my studies as a dual-degree student, my advisors at Morehouse approached me and encouraged me to apply for a Packard Foundation fellowship. I took their advice, and I ended up getting a generous scholarship from the foundation, which provided me the financial means to pursue my dream, and focus on obtaining a graduate degree in my field. This path all started at Morehouse, where I was pushed in the direction to be able to take advantage of the opportunities open to me. My experience there exposed me to the field of engineering, and gave me the opportunity to grow, academically and personally, around people who looked like me and have similar goals.

As for the future, I feel the need to graduate and reach back into the community, exposing young people to different career paths. Ten years from now, I see myself running a special program at a major institution, helping minority engineers come through the pipeline, win fellowships, and take appropriate classes to prepare them for the future.

Lessons Learned

There are several basic elements that portend success in ensuring high achievement in science, technology, engineering and mathematics. It's not rocket science.

Science
Technology
Engineering
Mathematics

The diversity in the schools' approaches ... afforded them flexibility to inform planning through experience, refine strategies used and tailor efforts to meet student needs.

The HBCUs that SEF studied in detail—Morehouse College, Clark Atlanta University, Spelman College, Xavier University, Morgan State University and Tennessee State University—are both public and private and small and large. What they all have in common is a dedication to providing excellent education to students in STEM.

Four of the programs involved recruitment, scholarships and a pre-freshman institute for STEM students. Four programs involved deepening the research experience for undergraduate STEM students. All six included some level of faculty training or development. Two concentrated on facilitating students' transition to graduate school. Four provide student scholarships. Two programs included the purchase of substantial equipment. Two programs also reorganized institutional structures or departments.

Beyond these common features, each program was tailor-made to fit unique institutional needs, strengths and priorities. Although all of the institutions share a commitment to increase the Black presence in STEM, they had distinctive institutional strategies for achieving that goal. Morehouse is investing in students who have already shown high academic achievement. Clark Atlanta University and Tennessee State University, by way of contrast, are attempting to enlarge the pool of graduates by including students who have a less well-proven record of academic achievement prior to entry into college. Each of these approaches is valid and appropriate: they are grounded in research-driven findings about best practices and yielding positive outcomes. But they also reflect different institutional values, resources and missions, and they offer the possibility of new insights about how to apply "best practices" to different types of students.

Lessons Learned

The diversity in the schools' approaches and program designs afforded them flexibility to inform planning through experience, refine strategies used and tailor efforts to meet student needs. Pre-fabricated rules imposed by donors often constrain innovation and utility. The programs SEF reviewed are robust and innovative.

Pre-fabricated rules imposed by donors often constrain innovation and utility.

Although the research components undertaken by most of the six institutions to document results were not complete or even in quality, there is significant evidence of the value of the preseason programs. For example, Clark Atlanta University had an independent evaluation of its preseason program funded by the David and Lucile E. Packard Foundation each year and can verify that students involved in it performed better than similarly situated students outside of the program in terms of grades, retention and personal satisfaction. Morehouse also produced evidence that participants in its preseason and STEM scholarship programs were doing better than other students in general. Faculty at other institutions studied reported similar results attributable to preseason and financial aid efforts.

Xavier University demonstrated an important increase in the number of its physics graduates over the last few years and its new pipeline of students in computer engineering. Likewise, Morgan State University was able to show clear results from its preseason, financial and other special outreach for physics students. (For additional information about particular HBCU programs reviewed by SEF, see Appendix 2). During the course of SEF's site visits, meetings, reviews of data and conversations with presidents, faculty members, students and others at these HBCUs, several commonsense points were underscored:

The Need for Encouragement Many high school students need encouragement to go to college and pursue STEM fields. Almost all of the STEM students and faculty members with whom SEF staff spoke said that they knew early in life that they "liked" mathematics or science. But most said that it was only due to the encouragement and support of others that they aspired to go to college and pursue STEM field studies. Many of the STEM students at HBCUs are there as a result of targeted high school recruitment efforts by HBCU representatives, personal relations between HBCU professors and some high school science or mathematics teachers who serve as informal "talent scouts." Some of these high school teachers participate in preseason or summer programs mounted by HBCUs. The preseason programs seek to interest high school students in STEM, give them some advanced preparation in the subject matters that they will study in college, create a comfort level, and help students become part of a highly motivated STEM cohort in the entering class.

While the HBCUs with preseason programs did not uniformly maintain statistics to document differences in grades, retention and graduation between students who participated preseason programs and those who did not, available data show that students in preseason programs have better grades, higher retention and higher graduation rates.

Financial Aid Financial aid to go to college and pursue STEM is vital. A vast majority of HBCU attendees qualify for federal financial aid and/or need financial support in order to pursue the vigorous course of study that STEM education requires. It takes most STEM students six years to complete all requirements for graduation in a STEM field. The difficulty of the subjects makes it hard for many students to hold jobs while attending college. Thus, financial aid earmarked to help STEM students stay in school and excel is vital to successful outcomes. The kind of targeted support provided by the Bill and Melinda Gates Foundation to minority group students majoring in STEM subjects is an example of an effective way of enabling talented students to attend college.

Once in college, the recognition associated with being a scholarship recipient and part of a community of STEM students helps to reinforce students' commitment to stay the course. The HBCUs whose programs are summarized in Appendix 2 all worked to maintain group spirit, a sense of cohesion and a commitment among students to help each other succeed.

Strong Faculty Advisors Strong faculty advisement is a critical component of student success in STEM. Because STEM studies are challenging, having caring faculty members to encourage students not to give up or forsake their dreams of being scientists, mathematicians, engineers or technology experts is very important. Given the reality of race and the nation's history of racial division, having quality faculty, especially African American faculty, is important. This is not to suggest that non-Black faculty cannot be effective mentors/coaches to students. But it is to suggest that there is a value-added from having African American faculty members

Lessons Learned

with whom African American students, especially at undergraduate levels, can directly identify.

HBCUs have relatively small faculty-to-student ratios in STEM, making the kind of relationship building between faculty and students possible. Some undergraduate students may do well in majority or larger institutional settings. But for many African Americans, relationships *in loco parentis* are very important.

Research and Student Involvement in That Research Involving students in and supporting STEM research is important. Students and faculty alike spoke with enthusiasm about their research interests and the issues or areas to which their research was directed. All agreed that research is an essential component of every student's learning and preparation in STEM.

While the HBCUs studied all provide students with research opportunities, HBCU administrators said that they would like to provide a wider array of research opportunities than limited budgets allow. Smaller HBCUs that have faculty members with heavy teaching loads and limited facilities struggle to provide the research opportunities that students need in order to excel in STEM. There is a need for more research opportunities for undergraduate students and faculty both on- and off-campus.

State-of-The-Art Equipment and Resources HBCU STEM programs would benefit from more equipment, resources and faculty development opportunities to keep their programs on the cutting edge of innovation in instruction and/or research. Many HBCUs have small budgets for faculty development, participation in professional meetings and conferences and equipment. Though the commitment of faculty members to excellence is high, their efforts are sometimes impaired by the absence of state-of-the-art equipment for research and instructional purposes. The infrastructure of many HBCUs is aging and in need of refurbishment.

Willingness and Ability to Change STEM advances require periodic curriculum, organizational and structural adjustments. Like all other institutions of higher education, the HBCUs studied periodically reviewed curriculum, trends and innovations in the field, accreditation and regulatory requirements, student needs, faculty credentials and the effectiveness of STEM curriculum content and structure. Some respondents suggested that it would be valuable to them if they had more occasions to interact with peers at other institutions in order to exchange information and ideas about ways to improve education efforts.

Documenting Success HBCUs' experiences in STEM at the undergraduate level have not been adequately studied. As noted above, the evidence of STEM productivity of HBCUs warrants more examination. Unfortunately, most donors either fund STEM projects for too short periods to permit full assessment of program outcomes or fail to provide funding needed to document results. Given limited resources and great need, most of the schools have used human and financial resources for direct services to students or to meet faculty and equipment needs, and have not seen their efforts as vehicles for institutional research. The absence of a common baseline for evaluation and guidance about data collection has resulted in a patchwork that makes comparisons difficult.

Financial Support and STEM

Science Technology Engineering Mathematics

"Because of our legal mandates, we cannot support the strategies for institutional transformation that are as needed—or often more needed—than straight program support,"

—NSF official

Public Support

Despite major contributions to STEM education for African Americans, the governmental and private philanthropic financial base of support for undergraduate STEM education at HBCUs is surprisingly thin.

Between 1994 and 2001, for example, federal agencies provided $2.58 billion dollars in support of STEM research, development and education to a wide range of HBCUs. While this support is significant, it comprised less than 2 percent of the over $134 billion in federal grants to all institutions of higher education for science and engineering programs during that timeframe. Indeed, federal support for HBCU science programs was a billion dollars less than the amount of federal grants provided to Hispanic-serving institutions of higher education during the 1990s (see Appendix 3, Table 1).

In recent years, approximately 76 HBCUs have received support from federal agencies for STEM grants relating to research and development (R&D), instructional facilities, equipment, fellowships, programs and similar activities. In 2000, HBCUs received approximately $333 million in federal dollars for these purposes. In 2001, federal agencies allocated $404 million to HBCUs. Sixty percent of this funding went for support of STEM research and development. (At other colleges and universities R&D was actually a higher proportion. In 2001, 86 percent of total support was allocated for these purposes.)

In 2000, $83.3 million, 25 percent of the federal support to HBCUs in science and engineering, supported fellowships, training programs, and other training or teaching related activities. Only 1 percent of the federal science support to HBCUs—$3.3 million—went toward support for the R&D plants or for facilities for instruction (see Appendix 3, Table 2).

Financial Support

Clearly, the federal government is the largest source of financing for science and science education in higher education and among HBCUs. Yet even representatives of the agencies providing the largest amounts of support to HBCUs express deep concern that the categorical, inflexible nature of the government's funding is not meeting vital needs. "Because of our legal mandates, we cannot support the strategies for institutional transformation that are as needed—or often more needed—than straight program support," observed one NSF official.

Along similar lines, a program director at the National Institutes of Health responsible for supporting science education and research at HBCUs worries that the government is unable to respond to innovative approaches and new opportunities in science education emerging at HBCUs. He also expressed an interest in participating in conversations among private foundations and government agencies to explore how various funding sources might identify these opportunities and work more collaboratively.

Private Support

Trends in private philanthropic support for HBCU science programs or for African American undergraduate education in STEM disciplines cannot be measured accurately since there is no common database.

The Foundation Center's annual survey of over 1000 private foundations suggests that levels of investments in sciences and technology are declining. In 2000, the center's survey estimated that private foundations awarded $450 million to all institutions in the STEM fields (This sum does not include grants by the Howard Hughes Medical Institute and similar grant-making institutes). Much of this total was probably related to medicine, and the vast majority of grants evidently went to research.

Informal inquiries among federal funders and private grant makers in education seem to confirm this general finding. Despite their central role in educating African American undergraduates in the sciences, HBCUs are the focus of few private foundations interested in education or the sciences. In an interview, one NSF official responsible for some of the agency's HBCU education programs could not recall offhand a single private foundation that supports undergraduate science education at HBCUs other than the Packard Foundation. (The Packard Foundation has recently ended its program in this area.) This recollection represents not so much a statement of fact as a suggestion of the general lack of private philanthropic support for this purpose.

A similar indication comes out of the responses to SEF's inquiry of members of Grantmakers for Education, a national organization composed of the nation's largest and most active foundations supporting programs in education in the United States. While several foundations expressed general interest or provided information about defunct programs, only two foundations—the Howard Hughes Medical Institute and the General Electric Fund—stated that they currently support HBCUs in the field of science education at the undergraduate level. (The Burroughs Wellcome Fund in North Carolina and a few others support HBCUs or programs promoting science education among high school and middle school students.)

SEF also conducted both a search in the Foundation Center's grant database for 2000–2001 and a web-based search for philanthropic programs that support undergraduate education at HBCUs in the STEM disciplines. Perhaps the closest match was the Sloan Foundation, which includes a "feeder component" in its minority Ph.D. program. The Sloan Foundation currently supports two HBCUs, among the many colleges and universities it funds, in its effort to support undergraduate "departments that have a record of sending a significant number of their underrepresented minority B.S. or M.S. graduates (African Americans, Hispanic Americans and Native Americans) into Ph.D. programs in mathematics, natural science and engineering."

In addition, the Howard Hughes Medical Institute provides "four-year grants to colleges (baccalaureate and master's institutions) to support science education at the undergraduate, K–12, and community college levels." Funding is provided in four areas: "student research and broadening access to science; faculty development; curriculum, equipment, and laboratory development; and pre-college and other outreach programs." Since 1988, it has awarded $557 million to 236 colleges and universities in 47 states, the District of Columbia and Puerto Rico, including substantial grants to a significant number of HBCUs. The competition is by invitation according to the Carnegie classification of colleges and universities.

There also are private foundations that support scholarships for students attending HBCUs, initiatives to strengthen HBCUs' overall institutional capacities and grant programs that attempt to improve instruction through the use of technology at HBCUs. But the Packard

Foundation was the only private foundation in the United States that SEF's search identified with a categorical and targeted program of support specifically for advancing undergraduate STEM education at HBCUs.

Several factors contribute to this situation. First, many local, state, and regional foundations across the nation have geographic limits that do not include the South, where most HBCUs are located. For example, responding to SEF's inquiry, one grant maker stated that "as a New England funder we don't have HBCUs in our region to support." This point also was echoed in other responses from local foundations across the nation. Second, not many private foundations in the American South support HBCUs. While no publicly accessible study on this subject has been undertaken, the fact is that the annual reports of HBCUs evidence relatively few Southern foundations among their donors, and few private foundations' annual reports show support for HBCUs and almost no sustained support for science education. Finally, overall, there is comparatively little giving among private foundations for science education, particularly at the undergraduate level, and, despite the national imperative for diversity in the sciences, there is an even smaller level of giving for the education of minorities in the sciences.

This absence of substantial private philanthropy does not necessarily reflect a lack of real and potential interest. Several education-focused foundations stated to SEF that they "would be very interested in learning more" about HBCU science programs. But the fact is that, as of the date of this writing, the trend of inadequate investment in HBCUs continues among both private and public donors. The result is promise unrealized and opportunities lost to "grow our own" best and brightest to serve the national interest in STEM.

Many Ways to Help

There are many ways in which donors and policymakers can help HBCUs enhance the number of STEM students served:

Categorical Grant Programs From the data and discussion set forth above, it is clear that there is a need for donor agencies/institutions to exercise some real leadership in STEM education at HBCUs. The current trend of inadequate support, if continued, will marginalize and progressively weaken the contribution that HBCUs presently make to enlarging the Black presence in STEM fields.

If HBCUs are put in broad pools with better-resourced and staffed institutions, they are more often than not put at a competitive disadvantage. Funds that could have been used to increase diversity in STEM fields often go to institutions that have fewer African American students than HBCUs and, even if successful, yield fewer Black STEM graduates.

If HBCUs are to receive both the level and type of financial resources that they require, there is thus a need for categorical programs, in addition to broad programs, for all STEM institutions. Tailoring programs to take into account the unique needs and circumstances of HBCUs would help to ensure that within this sector there is increased productivity and positive outcomes.

Institutional Development Funding There is a pressing need for investment in building the institutional capacities of HBCUs to launch and expand STEM education. Many HBCUs have aging buildings and infrastructure and limited budgets for equipment or to support top-quality research facilities. Providing funds to HBCUs to facilitate development of new facilities, purchase equipment or realign resources, faculty and administrative structures would be of enormous value to hard-pressed institutions.

To be sure, investments of this type have a long timeline before it is possible to document actual outcomes in terms of recruitment, retention and graduation rates in STEM fields. But the counterfactual tells us that without such investments, the afore-noted outcomes will not be achievable. Clearly, all institutions have to enhance their capacities—faculty, buildings, and equipment—if they are to remain on the cutting edge of quality teaching, student learning and ensure outstanding outcomes. Investments in HBCUs' infrastructure for these purposes are sorely needed.

Community of Practice Support Many HBCUs operate at a distance from other institutions involved in STEM education and have limited resources for faculty development and participation in professional meetings and conferences related to STEM. They also lack quality forums at which to exchange information and ideas or forge collaborative relations that stimulate shared learning, innovation and enhanced opportunities.

It is one thing to have a few representatives of a particular institution's faculty or leadership attend conferences and meetings. It is another to provide a quality auspice for in-depth exchange of research ideas, student learning and retention strategies, evaluation measures, benchmarks, promising practices and other domains relevant to outcomes. Events and auspices of the latter type are needed both to

Financial Support

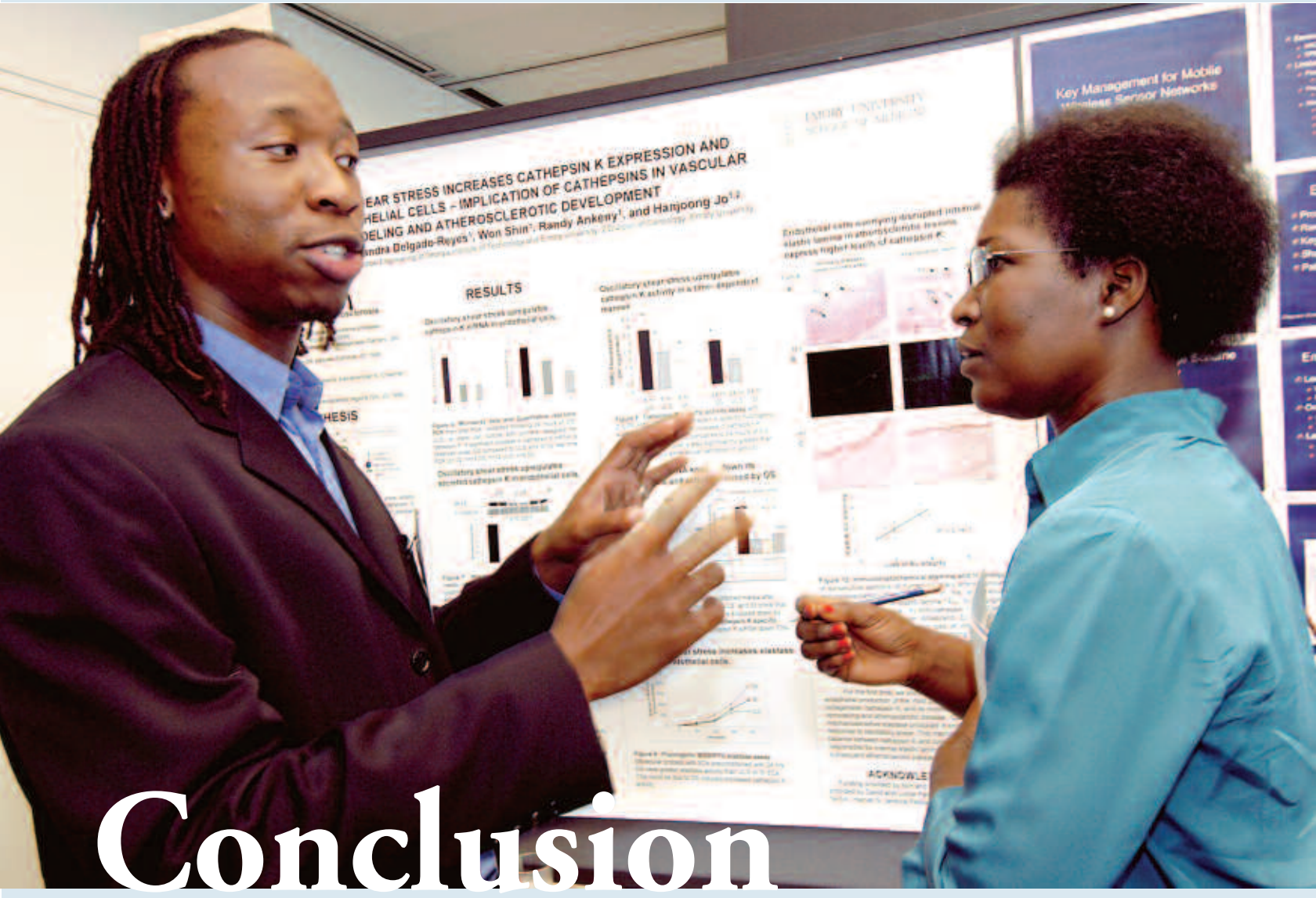
enhance a culture of learning, research and knowledge generation by faculty and enhance relationships among persons in discrete fields of research.

Student Financial Aid Support HBCUs have a disproportionately large number of students who need financial aid—loans and grants—in order to enter and stay in school, especially for rigorous courses of study in STEM fields. The lesson from many of the schools studied by SEF is that student financial aid is needed and definitely helps HBCUs recruit and retain STEM students. Such aid also gives students incentives to stay in school and, in the case of students recruited through preseason programs, a sense of identity and place that eases their transition to college and gives them needed personal support.

Research Support The ability to participate in quality research is a vital part of STEM education. Developing the capacities of both students and faculties to conduct quality research and affording them opportunities to do so is an important element of growth and achievement.

With small STEM faculties at many HBCUs and heavy teaching loads, many HBCU faculty members lack the time to undertake substantial programs of research. This limitation constrains opportunities for research by their students. Since HBCU faculty do not receive as much support for R&D efforts as peers at other larger, better-equipped institutions, both students and faculty at HBCUs would benefit from additional assistance in this area. Whether by pairing students at HBCUs with faculty at other institutions, nurturing research competitions within discrete STEM fields at HBCUs or other such measures, it is important to find ways to enhance funding for research by HBCU students and faculty. The research conducted by students, moreover, often weighs heavily on graduate school admissions decisions and forms the basis upon which awards/fellowships are given in many STEM fields.

The ways in which HBCU STEM programs and outcomes must be enhanced are many. The return on investment would be high, if the past portends the future.



Conclusion

This review discovered real accomplishments, promising practices, and new possibilities for support of undergraduate STEM education at HBCUs. While private funding in this field is considerably smaller than public support, both public and private support are needed to help HBCUs achieve new levels of luster.

The report ends where it began with a reminder that African American minds are needed for the scientific enterprise. Diversity in STEM professions leavens the scientific process with different perspectives and insights borne of experience garnered from many vantage points. Diversity in STEM reinforces the scientific requirement to be open-minded to new ideas, hypotheses and possibilities—to think outside the box. We need more African Americans in STEM — not just to fill positions –but to enhance the nature of the scientific enterprise itself.

Helping African Americans pursue training and careers in science, technology, engineering and mathematics is a national imperative. The nation must find a way to do a better job of developing its most precious treasure — it's human capital. Our future depends on what we do today.

Appendix

Appendix 1: David and Lucile E. Packard Foundation HBCU Advisory Panel

Dr. Jewel Plummer Cobb
Trustee Professor
California State University, Los Angeles

Dr. Norman C. Francis
President
Xavier University, Louisiana

Dr. Shirley Malcolm
Director of Education and Human Resources
American Association for the Advancement of Science

Dr. Walter E. Massey
President
Morehouse College

Dr. James Stith
Director of Physics Resource Center
American Institute of Physics

Appendix

Appendix 2: Portraits of HBCU STEM Initiatives

CLARK ATLANTA UNIVERSITY

Overview

The Clark Atlanta University (CAU) program is designed to support students with GPAs of 2.7 or higher who have the potential to succeed in STEM undergraduate disciplines and to pursue advanced degrees. The program involves academic mentoring, support and undergraduate research.

Program Goals

CAU set some specific goals for its program. They are:

- Increase by 15% the annual rate of freshman students pursuing undergraduate STEM degrees;
- Decrease by 15% the annual number of students who drop STEM as a major by their junior year;
- Improve the curriculum and enhance student learning in introductory STEM courses by emphasizing problem-solving, teamwork, cross-disciplinary applications, as well as critical thinking and writing; and
- Increase the number of African-American STEM students who are admitted to graduate school by 15%.

Program Components

Component 1: Academic Preseason

- Classroom experiences that bridge the understanding of mathematics and science concepts acquired in high school with college-level expectations as a means of preparing students for gateway STEM courses in their freshman year.
- Programs that improve critical thinking, reading, writing, and study skills and that diminish freshmen students' social barriers.
- Opportunities to develop relationships that foster intellectual and personal growth with faculty members, peers who are STEM majors and upper classmates who have successfully emerged through the preseason experience.

Component 2: Faculty Development Programs

- Off-campus workshops on inquiry-based and interdisciplinary teaching techniques; effective team-teaching; different student learning and faculty teaching styles; testing as a teaching tool; critical thinking, reading, and writing across-the-curriculum; and developing a "community of pedagogical thoughts."
- Small group discussions among interdisciplinary teams to design preseason workshops.
- Meetings and workshops on and off campus to facilitate building an interdisciplinary learning environment for all STEM students and expanding or replicating preseason activities within all CAU's STEM programs.
- Travel to STEM-related conferences and workshops (such as the Project Kaleidoscope 2002 Summer Institute and the Faculty Resource Network—2002) in order to share new ideas and lessons learned at monthly STEM faculty meetings.

Component 3: Enhancing Mentoring and Research Opportunities for STEM Students

- Peer mentors and tutors (students with GPAs of 3.0 or above who have completed the preseason summer activity) to support prefreshman and freshman students.
- Undergraduate research opportunities for students who have successfully completed a preseason program and have achieved a GPA of 3.0 or greater by their junior year.
- Opportunities for faculty members and student groups to interact in informal settings.
- STEM Honors Day Program for undergraduate students and their mentors and advisors.
- Yearly incentives and awards for the best faculty advisor or mentor within each STEM department.

Program Self-Evaluation

CAU's program has included an independent evaluation of progress toward its goals since the second year of operations. Using available data over three years, the evaluation has found that:

- Levels of academic progress and performance as measured by hours attempted, hours earned, and grade point averages are significantly greater for

Appendix

preseason students when compared to a comparable student group outside the program.

- Retention rates in school and in STEM majors are more consistent among preseason students than among comparable students outside the program through the sophomore year.
- Program faculty participants received far better ratings from student evaluations of instruction than do faculty who do not participate in the preseason.

Clark Atlanta University's principal investigator summed up the impact of the program this way: "The most salient revelation is that the Academic Preseason Program provides its participants an invaluable "head start" in college. Early exposure to academics, social networks, operating procedures, and the university environment facilitate the student's capacity to attempt more semester hours in the freshman year, to complete a higher percentage of hours attempted, and to obtain higher GPAs. Most importantly, preseason participants are able to maintain these higher levels semester after semester."

CAU hopes to measure matriculation, the completion of the undergraduate degree, and entrance into graduate institutions beginning in the year 2005, five years after the program began.

TABLE 1. Clark Atlanta University STEM Productivity Data: National Ranking of Bachelor Degrees for African Americans, 2000—2001.

STEM Discipline	National Rank	Number of Graduates
Biology	27	30
Computer/ Info Science	52	17
Mathematics	7	13
Physical Sciences	23	8

MOREHOUSE COLLEGE

Overview

The program at Morehouse College improves the school's strategies for graduating students who will pursue advanced degrees in the sciences by establishing a new academic division of science and mathematics and by developing the campus' Packard Scholars, a group of high-achieving students who major in STEM fields and are likely to go to graduate school in the sciences.

Program Goals

To graduate more students who pursue advanced degrees and careers in the STEM fields.

Program Components

Component 1: Establish Science and Mathematics Division

The division structure was established to provide more effective coordination and leadership for the six departments in the STEM fields at Morehouse. The program enabled the creation of a division office, with a division administrator and an administrative assistant. The Division of Science and Mathematics facilitates the development of interdisciplinary educational and research efforts and provides a structure for addressing issues of concern to students and faculty members in the sciences.

Component 2: Recruiting and Supporting Packard Scholars

In 2003, there were 27 Packard Scholars at Morehouse, including 15 rising juniors and 12 rising sophomores. Each group was recruited from among high school graduating seniors selected on the basis of academic performance, standardized exam test scores, letters of support, prior research experience and evident motivation and interest in pursuing a research career in science or mathematics. After selection, the program provided participants with the following support services:

- Precollege summer program;
- Scholarships;
- Research mentors in their departments; and
- A core curriculum that consists of five courses, including Critical Thinking and Philosophy of Science.

Component 3: Immerse Students in Meaningful Research

Morehouse immerses Packard scholars in scientific research throughout their undergraduate years. They engage in research projects in the precollege program, on campus during each school term and off campus during every summer.

Appendix

Program Self-Evaluation

Morehouse has assessed this program in terms of how well it is preparing students for careers in the sciences. The majority of Packard Scholars who began the program remain on track as high-achieving students preparing to enter graduate school after undergraduate school. The average GPA of students in the Division of Science and Mathematics is 2.65, but the average GPA for Packard Scholars is 3.44. Morehouse's principal investigator believes this trend is due to the research-oriented, nurturing but rigorous environment at Morehouse.

Morehouse identifies a secondary effect of the Packard Scholars Program: other students at the college have become more interested in participating in research and in pursuing research careers. In 2003, Morehouse had a larger number of students presenting their research at regional and national meetings and applying for summer research externships than ever before. If the current trend continues, Morehouse believes it will increase significantly its numbers of students pursuing and receiving Ph.D.s in science or mathematics.

Morehouse also notes that its new Division of Science and Mathematics has provided a vehicle for implementing reforms in curriculum that are essential to the success of the students.

TABLE 2. Morehouse College STEM Productivity Ranking: National Ranking of Bachelor Degrees for African Americans, 2000—2001.

STEM Discipline	National Rank	Number of Graduates
Biology	16	43
Mathematics	2	32
Physical Sciences	4	21

The program at Morehouse improves the school's strategies for graduating students who will pursue advanced degrees in the sciences by establishing a new academic division of science and mathematics and by developing the campus' Packard Scholars, a group of high-achieving students who major in STEM fields and are likely to go to graduate school in the sciences. The program also involves academic mentoring, support, and undergraduate research.

MORGAN STATE UNIVERSITY

Overview

Morgan State University's STEM program strengthens student learning and achievement levels in the university's chemistry and physics departments through the purchase of equipment for teaching and research laboratories and through a precollege program.

Program Goals

- Improve the curriculum in chemistry and physics through the use of modernized laboratories;
- Increase the numbers of students majoring in physics and chemistry; and
- Enlarge the number of graduates going onto graduate school in chemistry or physics.

Program Components

Component 1: Redesigning Physics and Chemistry Laboratories

With the purchase of new equipment, all physics laboratories were redesigned to include several completely computerized experiments in each class. This change means that all science and engineering students at Morgan State University benefit, since physics is required for all science and engineering majors. In addition, several chemistry laboratories were enhanced with computers for instructional purposes. These changes allowed the departments to: (1) expose undergraduate students to first-class research experiments; and (2) enable faculty members to develop collaborative research projects with faculty at other universities.

Component 2: Precollege Program

This component is aimed at tenth and eleventh grade high school students in order to introduce them to careers in chemistry and physics and to assist them in preparing for the SAT in the science and math sections. A bridge program also helps to prepare incoming chemistry and physics majors at Morgan State University for success in college.

Program Self-Evaluation

Morgan State University's data show an increase in the number of entering freshmen majoring in physics and an improved retention rate for those majors. Their data also suggest that chemistry and physics graduates at Morgan State are going to graduate school at increased rates. The program's principal investigator noted that the program has shown that "outreach is very important in attracting majors" in physics and chemistry.

Appendix

Table 3. **Morgan State University STEM Productivity Ranking: National Ranking of Bachelor Degrees for African Americans, 2000–2001.**

STEM Discipline	National Rank	Number of Graduates
Biology	13	45
Computer/ Info Science	5	72
Engineering	3	90
Physical Sciences	12	14

Morgan State University's STEM program works to strengthen student learning and achievement of students who want to major in chemistry and physics through a precollege program that provides academic mentoring, support and undergraduate support. Packard Foundation funds have also been used to purchase selected items of equipment and support improvements in laboratory facilities.

Although comparative data for the disciplines of chemistry and physics are not available, the grantees' reports to the foundation show an increase in the number of students majoring in physics compared to the years prior to the Packard grant.

SPELMAN COLLEGE

Overview

Spelman's program is designed to create a world-class science facility for teaching and student research on campus and to assist a growing number of STEM majors to pursue graduate school.

Program Goals

- Improve faculty members' use of technology in teaching;
- Increase the number of STEM students seeking Ph.D.s.
- Acquire multimedia technology for a new science facility;

Program Components

Component 1: Acquisition of Technology

In August 2001, Spelman opened its new state-of-the-art science center of 148,000 square feet. This program helped equip the complex with the most current scientific and audiovisual equipment in its classrooms and laboratories.

Component 2: Faculty Professional Development

Spelman undertakes faculty training to make full use of the new center and its technology to reinvigorate instructional delivery and achieve a more effective science education program, by incorporating hands-on interactive learning experiences and research.

Component 3: Graduate School Services

One-third of the 2,000 Spelman students now have a major in a STEM field. Spelman has established an Office of Graduate Relations to encourage and assist STEM students to prepare for graduate study.

Program Self-Evaluation

It is too early to assess the impact that the new facility will have on Spelman's over 600 students who have declared STEM majors. Clearly the new facility will enhance quality of research, expand instructional capacities and help the institution remain competitive for students and faculty involved in STEM.

Table 4. **Spelman College STEM Productivity Ranking, National Ranking of Bachelor Degrees for African Americans, 2000–2001.**

STEM Discipline	National Rank	Number of Graduates
Biology	19	41
Computer/ Info Science	56	15
Mathematics	3	20
Physical Sciences	20	9

Spelman used Packard Foundation funds to enhance its science facility for teaching and student research on campus and to assist a growing number of STEM majors in their pursuit of graduate school. This program helped to equip the science complex with the most current scientific and audiovisual equipment in classrooms and laboratories. In addition, since one-third of the 2000 Spelman students now have a major in a STEM field, Spelman established an Office of Graduate Relations to encourage and assist STEM students to go to graduate school.

Appendix

TENNESSEE STATE UNIVERSITY

Overview

The program at Tennessee State University (TSU) offers a summer science and mathematics institute to African American students who demonstrate aptitude in STEM fields in order to enlarge the number of African Americans who pursue careers in the sciences. Students who complete the summer institute are awarded a scholarship for their freshman year.

Program Goals

The basic goal of this program is to increase the number of students who attend and graduate in STEM fields at TSU.

Program Components

Component 1: Summer Institute

The institute is a six-week session where prospective TSU students take classes in chemistry, physics, mathematics, and computer science. Students also participate in joint-research projects, hear guest speakers and visit local businesses and industries that employ mathematicians and scientists. The institute is designed to provide a solid grounding in STEM subjects before students embark on their undergraduate education and to encourage them to seek careers in science.

Component 2: Scholarships

Students who complete the Summer Institute and major in a scientific discipline in the fall are awarded a scholarship for the freshman year. The scholarships give many participants the means to attend college.

Component 3: Support Services

The program also provides STEM students with exposure to college professors who know them personally and with academic advisor-mentors as they progress in their studies at TSU. When possible, students also are given the opportunity to attend STEM conferences.

Program Self-Evaluation

TSU faculty say that the program has helped the university increase the number of STEM students, better prepare incoming students for college, both academically and socially, and improve retention rates. The program's principal investigator also believes that the program has improved the faculty by creating space for faculty to interact closely with and get to know students: "We have teachers better in touch with freshman students' needs, and who can effectively advise and mentor them."

Since TSU has being holding a Summer Institute in one form or another since 1994, the university has some basic data on developments over time. For instance, TSU reports that 112 entered the university after attending the Summer Institute from 1994-1999. Ninety-eight of the 112 (87.5%) are still attending TSU or have graduated. This rate is much higher than the average for TSU or the nation. (TSU is now seeking to document student progression patterns over time with greater detail.)

Table 5. Tennessee State University STEM Productivity Ranking: National Ranking of Bachelor Degrees, 2000–2001.

STEM Discipline	National Rank	Number of Graduates
Biology	9	48
Computer/ Info Science	15	42
Engineering	9	55
Health Sciences	4	104
Mathematics	15	8
Physical Sciences	2	25

The program at Tennessee State University (TSU) offers a mathematics institute to African American students in STEM fields in order to enlarge the number of African Americans in science careers. Students who complete the program are awarded a scholarship for their freshman year.

XAVIER UNIVERSITY

Overview

Xavier University of Louisiana has increased its institutional capacity in the sciences by initiating its first four-year program in computer engineering, enhancing the facilities and curricula of the computer sciences and computer engineering department and of the physics and dual-degree engineering departments, and establishing the Center for Undergraduate Research (CUR).

Appendix

Program Goals

- To expand the university's capacity to provide new STEM degrees
- To strengthen its facilities and curricula in current degree programs
- To deepen the research experiences of science undergraduates in order to increase the number of students who pursue graduate degrees in the sciences.

Program Components

Component 1: Computer Engineering Degree Program

Xavier has established a four-year computer engineering degree program. It is the only four-year engineering program offered entirely at an HBCU. In offering this engineering program, Xavier is working to graduate more African American computer engineers, an area where the number of African Americans is extremely small.

Component 2: Facilities and Curricula Improvement

In both physics and computer science, Xavier has made significant equipment purchases to enhance the curriculum offerings and research potential of students and faculty.

Component 3: Center for Undergraduate Research (CUR)

Xavier's science departments have participated in undergraduate research programs funded from a variety of sources. Many of the services needed to run an effective undergraduate research program were duplicated for these programs. By bringing the undergraduate research programs under one administrative structure, Xavier's CUR, the University has been able to centralize its undergraduate research activities and support services.

Program Self-Evaluation

Xavier credits this program with helping the university lead the nation in the number of African Americans receiving bachelor's degrees in physics. The program's principal investigator notes that three years ago, in 1999-2000, the University graduated five physics majors. In May 2002, 23 physics students received such degrees. In addition, after only two years, 39 students are enrolled as computer engineering majors, and Xavier expects that number to grow. The acquisition of equipment also will help the university in its plans to seek accreditation for this program. In addition, the university expects that the Center for Undergraduate Research will enhance a student's undergraduate experience and provide a more solid research-based preparation for graduate school. The center is too early in its development to measure any program or university outcomes.

Table 6. Xavier University Productivity Ranking: National Ranking of Bachelor Degrees for African Americans, 2000–2001.

STEM Discipline	National Rank	Number of Graduates
Biology	1	179
Computer/ Info Science	39	22
Mathematics	44	4
Physical Sciences	1	68

Xavier University of Louisiana used Packard Foundation funds to increase its institutional capacity in the sciences by initiating a new four-year program in computer engineering, and enhancing the facilities and curricula in the computer sciences, computer engineering, physics and dual-degree engineering departments, and establishing the Center for Undergraduate Research.

Appendix

Appendix 3

Table 1. **Federal obligations for science and engineering to minority-serving institutions and other institutions of higher education, fiscal years 1990-1999 (dollars in thousands)**

Type of Institution	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Ten Year Total
HBCUs	$175,187	$214,164	$244,353	$232,667	$281,378	$328,787	$286,388	$327,321	$292,991	$326,427	$2,709,663
HSIs	$253,273	$302,565	$318,168	$320,630	$391,832	$417,269	$393,430	$408,399	$439,505	$483,452	3,728,523
TCUs	$1,270	$3,378	$3,622	$1,698	$3,041	$9,526	$9,537	$13,502	$11,673	$14,804	$72,051
Total for MSIs	$429,730	$520,107	$566,143	$554,995	$676,251	$755,582	$689,355	$749,222	$744,169	$824,683	$6,510,237
Total for all Institutions	10,470,816	11,907,557	12,838,077	12,834,791	13,867,144	14,461,050	14,449,919	15,095,984	16,093,819	18,057,927	$140,077,084
% of Total for MSIs	4.1	4.4	4.4	4.3	4.9	5.2	4.8	5.0	4.6	4.6	4.6

Source: NSF WebCASPAR Database System

Table 2. **Federal obligations for science and engineering (S&E) to Historically Black Colleges and Universities, ranked by total amount received, by type of activity: fiscal year 2000 [dollars in thousands]**

Institution and ranking	Totals	Research and Development	R&D Plant	Facilities for Instruction in S&E	Fellowships, Traineeships & Training Grants	General Support for S&E	Other S&E Activities
Total, all institutions	**333,019**	**191,729**	**2,402**	**1,329**	**25,141**	**29,141**	**83,277**
1 Howard University	27,847	20,761	1,000	46	2,320	1,268	2,452
2 Morehouse School of Med	20,803	16,169	0	0	765	3,869	0
3 Florida A&M University	20,583	14,128	0	0	867	2,151	3,437
4 Tuskegee University	16,576	10,904	0	0	461	1,523	3,688
5 NC Ag & Tech State U	15,852	9,991	0	0	463	444	4,954
6 Hampton University	13,794	8,755	1,029	0	1,547	0	2,463
7 Tennessee State U	13,487	5,747	0	0	725	1,624	5,391
8 Alabama A&M University	13,073	5,831	0	14	966	301	5,961
9 Meharry Medical College	12,547	8,329	337	0	1,276	2,605	0
10 Clark Atlanta University	11,812	7,061	0	0	1,003	1,562	2,186
Total 1st 10 institutions	**166,374**	**107,676**	**2,366**	**60**	**10,393**	**15,347**	**30,532**
11 Prairie View A&M U	11,737	7,283	0	1	183	377	3,893
12 Jackson State University	10,323	6,634	0	0	841	1,216	1,632
13 Southern U A&M All Cmp	10,118	5,450	0	0	426	1,333	2,909
14 Alcorn State University	8,876	3,021	0	0	1,242	993	3,620
15 Morgan State University	8,593	6,497	36	0	747	563	750
16 Spelman College	8,316	4,261	0	0	30	568	3,457
17 Fort Valley State U	6,225	2,795	0	0	0	230	3,200
18 Kentucky State University	5,724	2,552	0	0	311	296	2,565
19 SC State University	5,718	2,682	0	0	181	534	2,321
20 Lincoln U (Jeffersn City)	5,701	2,031	0	0	736	221	2,713

Appendix

Table 2. **(Continued)**

Institution and ranking	Totals	Research and Development	R&D Plant	Facilities for Instruction in S&E	Fellowships, Traineeships & Training Grants	General Support for S&E	Other S&E Activities
Total 1st 20 institutions	**247,705**	**150,882**	**2,402**	**61**	**15,090**	**21,678**	**57,592**
21 Langston University	5,673	2,296	0	0	130	445	2,802
22 U of Arkansas Pine Bluff	5,631	2,913	0	0	355	504	1,859
23 Xavier U of Louisiana	5,552	2,359	0	0	875	1,692	626
24 Virginia State University	4,938	2,086	0	0	321	329	2,202
25 U of the Virgin Islands	4,738	1,423	0	0	325	0	2,990
26 U of MD Eastern Shore	4,456	1,767	0	0	491	80	2,118
27 Norfolk State University	4,096	2,294	0	0	30	0	1,772
28 Morehouse College	3,961	1,504	0	0	807	0	1,650
29 Texas Southern U	3,758	3,096	0	0	577	0	85
30 NC Central University	3,536	2,397	0	0	264	591	284
Total 1st 30 institutions	**294,044**	**173,017**	**2,402**	**61**	**19,265**	**25,319**	**73,980**
31 Grambling State U	3,481	3,037	0	0	248	196	0
32 Delaware State University	3,279	969	0	0	656	500	1,154
33 University of DC	3,213	1,218	0	0	104	842	1,049
34 Benedict College	2,523	873	0	1,268	63	201	118
35 Fisk University	2,289	2,289	0	0	0	0	0
36 Winston Salem State U	2,035	1,073	0	0	175	554	233
37 Alabama State University	1,717	745	0	0	415	417	140
38 Elizabeth City State U	1,570	1,570	0	0	0	0	0
39 WV State College	1,473	1,473	0	0	0	0	0
40 Mississippi Valley St U	1,413	265	0	0	560	0	588
Total 1st 40 institutions	**317,037**	**186,529**	**2,402**	**1,329**	**21,486**	**28,029**	**77,262**
41 Albany State University	1,297	127	0	0	330	0	840
42 Bethune Cookman College	1,285	134	0	0	12	384	755
43 Bowie State University	1,177	629	0	0	0	0	548
44 Le Moyne Owen College	1,153	82	0	0	0	69	1,002
45 Tougaloo College	1,021	516	0	0	403	102	0
46 Lincoln U (Linc U PA)	780	521	0	0	249	0	10
47 Oakwood College	736	132	0	0	0	0	604
48 Johnson C Smith U	726	340	0	0	386	0	0
49 Miles College	718	235	0	0	0	0	483
50 Fayetteville State U	635	227	0	0	0	193	215
Total 1st 50 institutions	**326,565**	**189,472**	**2,402**	**1,329**	**22,866**	**28,777**	**81,719**
51 Bennett Col (Greensboro)	566	32	0	0	70	0	464
52 Virginia Union University	524	32	0	0	492	0	0
53 Savannah State University	481	456	0	0	0	0	25
54 Talladega College	466	146	0	0	134	186	0
55 Morris Brown College	459	223	0	0	236	0	0

Appendix

Table 2. **(Continued)**

Institution and ranking	Totals	Research and Development	R&D Plant	Facilities for Instruction in S&E	Fellowships, Traineeships & Training Grants	General Support for S&E	Other S&E Activities
56 Claflin College	426	160	0	0	266	0	0
57 Hinds CC Raymond	418	418	0	0	0	0	0
58 Stillman College	368	0	0	0	368	0	0
59 Wilberforce University	300	0	0	0	0	0	300
60 Wiley College	267	0	0	0	267	0	0
Total 1st 60 institutions	**330,840**	**190,939**	**2,402**	**1,329**	**24,699**	**28,963**	**82,508**
61 Shaw University	244	150	0	0	0	0	94
62 Concordia College (Selma)	236	0	0	0	236	0	0
63 Harris Stowe State College	224	0	0	0	0	0	224
64 Lawson State CC	206	0	0	0	206	0	0
65 Morris College	206	206	0	0	0	0	0
66 Rust College	178	0	0	0	0	178	0
67 Voorhees College	167	27	0	0	0	0	140
68 Paine College	133	33	0	0	0	0	100
69 St Augustines College	123	92	0	0	0	0	31
70 Central State U (Wlbrfc)	112	112	0	0	0	0	0
Total 1st 70 institutions	**332,669**	**191,559**	**2,402**	**1,329**	**25,141**	**29,141**	**83,097**
71 Jarvis Christian College	100	0	0	0	0	0	100
72 Trenholm State Tech Col	100	100	0	0	0	0	0
73 Florida Memorial College	80	0	0	0	0	0	80
74 Lane College	26	26	0	0	0	0	0
75 Coppin State College	24	24	0	0	0	0	0
76 Dillard University	20	20	0	0	0	0	0
Total 1st 76 institutions	**333,019**	**191,729**	**2,402**	**1,329**	**25,141**	**29,141**	**83,277**

1 See Technical Notes, "Categories of Support."

NOTE: Tied institutions are listed in alphabetical order.

SOURCE: National Science Foundation/Division of Science Resources Statistics, Survey of Federal Science and Engineering Support to Universities, Colleges, and Nonprofit Institutions, Fiscal Year 2000

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