



Overcoming the Intractable Problem

For many years, colleges and universities across the United States have sought to increase the numbers of African American, Hispanic and Native American students who pursue scientific careers. Yet the College Board reported in 1999 that underrepresentation of minority students had become even “more intractable.”*

African Americans now constitute 12 percent of the U.S. population yet earned only 1 percent of the doctorates in 1997. Hispanics make up 11 percent of the population but earned 0.9 percent of the 1997 doctorates. Although the numbers of African American and Hispanic students earning bachelor’s degrees in 1996–1997 hit an all-time high, there was a decline in those entering graduate school, according to the American Association for the Advancement of Science. Native Americans also remain underrepresented in the sciences.

Despite the best of intentions, many programs designed to prepare minority

undergraduates for advanced scientific training have had uneven results. Some have been unclear about whether their goal is to produce scientists or just to help minority students graduate. Others have been inadequately funded or lacked institutional commitment; many have never been evaluated rigorously.

Some programs *do* succeed in helping minority students graduate and pursue scientific careers. Examples include programs at Xavier University of Louisiana, the University of California, Berkeley, and the University of Maryland, Baltimore County (UMBC). Although different in important respects, these programs share

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BY RENEE TWOMBLY

Increasing the Numbers of Underrepresented Minorities in Science



key features, such as clearly articulated objectives, strong institutional commitment, effective mentors and an emphasis on building community among participants.

All are being carried out in a legal environment that has become increasingly complex. The University of California, for example, now operates under a state law that forbids using state funds for special programs for minority students. In other states, court cases have led colleges and universities to redesign or even drop such programs. HHMI has assisted thousands of minority students through its undergraduate biological sciences education program by awarding more than \$476 million to 232 colleges and universities. In 1998, it began requiring its grantees to certify that they are complying with all relevant laws in the conduct of these programs.

Eugene Cota-Robles, cochair of the task force that commissioned the College Board report, says colleges and universities must do more to help minority students become scientific leaders. “Up to now, everyone working on the pipeline approach has been thinking that bringing more students into college would solve the problem,” he says. Cota-Robles, a professor emeritus of biology at the University of California, Santa Cruz, calls for more effort to help minority students move beyond the bachelor’s degree.

Corey Goodman, codirector of the Biology Scholars Program at UC Berkeley, says the emphasis should be on “taking

great students and helping them succeed.” At large universities such as UC Berkeley, even well-qualified minority students may lose their confidence amid impersonal introductory courses in crowded lecture rooms during their first and second years. “The best thing we can do,” says Goodman, a neuroscientist and HHMI investigator, “is to give these students mentoring and professional advice to help them see where they are headed and then offer them an environment in which they can identify themselves as biologists.”

Programs such as UC Berkeley’s and UMBC’s are models for others to “learn from and promulgate,” Cota-Robles suggests. Campuses differ in their goals, however, such as whether to focus on the minority students most likely to succeed, even if they come disproportionately from affluent families, or to reach out to a broader group that includes students whose paths may be rockier.

Jacob Varkey, who heads a program at Humboldt State University in Arcata, California, argues for the latter strategy. “There are talented individuals who, because of circumstances beyond their control, have never had a chance to showcase their abilities,” he argues. “Everyone should have an opportunity to realize their potential.”

Merna Villarejo, who runs a program at the University of California, Davis, agrees, saying that a more inclusive approach opens the door for students such as Brandon Willis, whose weak math skills initially barred him from the UC Davis

program. Today, after Villarejo took a chance on Willis, he is a Ph.D. candidate studying protein regulation at the University of Washington. His goal is to teach at a small college where he can mentor students. “Minority students fall through the cracks all the time, and professors don’t often look at them and say, ‘You might need an opportunity,’” Willis says. “That can make all the difference in the world.”

Increasing the numbers of underrepresented minorities in science is a “seemingly intractable task”—but it can be accomplished, says Peter MacLeish, chairman of the Department of Anatomy and Neurobiology and director of the Neuroscience Institute at Morehouse School of Medicine. The “necessary precursors to any solution,” he says, are “sound academic advice, rewarding extracurricular experiences and solid foundations in mathematics, reasoning and writing.”

On the following pages, the *Bulletin* examines what three universities—in Alabama, California and Maryland—are doing to help minority undergraduates succeed and profiles a Chicago program that seeks to interest inner-city students in science long before they even finish high school.

* *Priming the Pump: Strategies for Increasing the Achievement of Underrepresented Minority Undergraduates* (New York: College Board Publications, December 1999).

NUTURING FOR SCIENCE *at Tuskegee University*



Makeecha Tenale Reed's professors call out as they see her sniffle her way down the hall, her voice cracking from a bad cold. "Makeecha! Are you better today?" asks geneticist John Williams, who also inquires about her medical school applications. Biology professor Velma Richardson drapes her arm around the young woman, and James H.M. Henderson—Tuskegee's 83-year-old statesman of science education—teases her about being named Miss Tuskegee University. Then he asks about her latest lab assignment.

Reed, a 21-year-old from North Carolina who has a 3.9 grade-point average, came to this historically black university for just such support. "Professors know me, and I feel appreciated," she says. "They drive me hard and they challenge me constantly." Reed hopes to become a pediatrician specializing in kid-

ney disorders that are more prevalent among African American children.

Latasha Sellers, a student from Georgia, also hopes to become a physician—in her case, to provide primary care to an underserved community. As she entered her final semester at Tuskegee, she was preparing for several medical school interviews.

The small Alabama campus illustrates both the importance and limitations of the nation's historically black colleges and universities, which produce a disproportionate number of African American students who apply to medical school. The Association of American Medical Colleges (AAMC) notes that 18 Tuskegee students applied to medical schools in 1999 and eight were accepted. Xavier University of Louisiana topped the AAMC's list, followed by Howard University, Spelman College and

Morehouse College, all of which, like Tuskegee, have received HHMI grants.

Graduates of these schools are much more likely to pursue M.D. rather than Ph.D. degrees; since 1996, only seven Tuskegee students have entered graduate school in the life sciences. Stephen Nurse-Findlay, 29, who graduated from Tuskegee in 1995 with degrees in both biology and chemistry, is among those who became physicians. A recent graduate of an M.D., M.P.H. program at The Johns Hopkins University, he looks back and says that Tuskegee's primary appeal was "the feeling of being very supported and nurtured. If you want to accomplish something, the people at Tuskegee are going to help you. I loved it."

Another Tuskegee alumnus, Emmitt Jolly, took the other path and will soon receive a doctorate in biochemistry at the University of California, San Francisco.

NATIVE AMERICAN STUDENTS *Straddling Two Worlds*

In the living room of a bungalow on the Humboldt State University campus in northern California, Rachel Mayfield, a Cherokee Indian who hopes to earn both an M.D. and a Ph.D., is rehearsing a medical school entrance interview. "If they ask if my medical education comes before everything else in my life, I'm going to have to say no," she declares. "Medical school is very important to me, but if someone in my family needs me, I'm on my way home. Family comes first."

"Rachel," says Russell Boham gently, "we need to talk."

Boham, who sports long black braids and has a bachelor's degree in biology and a Ph.D. in adult education, heads a program at Humboldt State that helps Native American students succeed in the sciences. His goal, he says, is to help students walk with one foot in their tribal

society and the other in the larger world. Indian culture stresses cooperation rather than competition, Boham points out, and some tribes proscribe practices such as dissection. Family generally takes precedence over school or career, poverty is common, and both educational resources and role models are limited.

"We want to help students develop the traits that will enable them to succeed in the dominant society and at the same time strengthen their connection with their tribal culture," Boham explains. "We're not taking anything away from them. We're giving them additional tools, so they can walk in both worlds."

To do that, the program provides students with academic assistance, career advice and personal counseling, which helped keep Mayfield on track while weathering family problems. The program also helps students find summer

research opportunities and introduces them to role models such as Boham, a Little Shell-Chippewa Indian, and members of organizations such as the Society for the Advancement of Chicanos and Native Americans in Science (www.sacnas.org) and the American Indian Science and Engineering Society (www.aises.org).

Then there's the program house, which Mayfield calls her home away from home. Although they don't live there, students have access 24 hours a day and band together there. "We all have attacks of self-doubt," says Mayfield, who has a 3.8 grade-point average with a major in cellular and molecular biology and minors in applied mathematics and Native American studies. "When I feel like I don't belong in college and couldn't possibly go to medical school or graduate school, someone who is feeling more confident that day helps me through it."

*akeecha Tenale Reed can count on encouragement and academic challenge from professor
meritus James H.M. Henderson and other faculty members at Tuskegee.*

Jolly, the 26-year-old son of a rural Alabama locksmith, is now deep in the hunt for a transcription factor that controls meiosis. He says Tuskegee offered limited opportunities on campus to carry out cutting-edge research but provided “a firm grasp of who I was and personal support that pushed me to go to the next level.”

Still at Tuskegee, Sellers adds that “biology is biology, whether here or at Harvard. What you get here are small classes and faculty that know your name and work with you one on one. The faculty want you to achieve here, and they expect you to.”

This emphasis on personal attention offsets some of the problems that a school like Tuskegee faces in attracting top high school students. As a small private university established in what was then an officially segregated society, it still lacks many resources. “Success in attracting the best students revolves around money,” says Henderson, a Howard University-trained plant physiologist whose office is blanketed with photographs of present and former students. Even within Alabama, many

promising African American students go to state schools such as Auburn or the University of Alabama, which have both lower tuition and environments quite different from that at Tuskegee.

In the late 1980s, Henderson applied successfully for an HHMI grant, subsequently renewed three times for a total of \$2.7 million, that has enabled Tuskegee to provide an eight-week summer program for entering students interested in science. The program helps the students not only prepare for science classes but also improve their computer and reading skills. Many of these “bridge program” participants spend subsequent summers doing research at top-notch universities and research institutions across the country, an experience that leads more than half of them to enter professional health fields or pursue advanced degrees in science or medicine.

“We don’t propose to be a research-intensive university, but students are more than prepared when they leave here,” says Richardson, who notes that Tuskegee recently established a laboratory facility where students can carry out research in molecular biology, biochem-

istry and related fields. Henderson concurs, arguing that success in science depends more on a student’s attitude and confidence than on high-tech equipment.

When it comes to producing successful science graduates, Nurse-Findlay suggests that historically black colleges and universities like Tuskegee can hold their own against larger, better-funded predominantly white institutions because of the high level of emotional comfort they are able to provide. “While funding is clearly important, I believe that intellectual challenge combined with consistently positive reinforcement from faculty is a more accurate predictor of success in science and medicine,” he says.

Like many colleges and universities across the country—large and small, public and private—Tuskegee has found that nurturing and mentoring are essential to helping minority students pursue scientific careers successfully. Like every campus, it also has incorporated those ingredients into a unique recipe that fits its own niche and goals.

Renee Twombly

Then I do it for someone else who is down when I am up.”

Mayfield grew up in a rural area in northern California, both on and off reservations. She finished high school and went to work. “I didn’t know anyone who had gone to college, so I never even thought about it,” she recalls. Lured back into school by a friend’s physics teacher at Mendocino Community College, she met Boham at a Native American day there and braved a visit to Humboldt State. “For the first time I thought, ‘I could do this,’” she says. She now works in the lab of her adviser, biology professor Jacob Varkey, who heads an HHMI-supported undergraduate biological sciences education program on the campus. She hopes to practice medicine and do genetics research on Native American health issues, such as the high rates of diabetes and breast cancer.

Although small, Humboldt State’s program seems to be having an impact, attracting the highest percentage of Indian students in the California State University system. During the past three years, 10 Native Americans have majored in life sciences at Humboldt State. Of the four who were chosen to conduct research in the HHMI program, one is now in medical school, another is in graduate school, a third is applying to medical school, and the fourth is Mayfield. Last year, the university was recognized nationally with one of 10 Presidential Awards for Excellence in Science, Mathematics and Engineering Mentoring.

“These are talented students,” says Humboldt State President Alistair McCrone. “Our role is to catalyze and release those talents.”

Jennifer Boeth Donovan



Rachel Mayfield (left) and Laurel Prince practice playing a traditional Native American drum.

UMBC's *Formula for Success*



PAUL FETTERS

Michael F. Summers (left) and Freeman A. Hrabowski III both serve as mentors for UMBC students.

The Meyerhoff Scholars Program succeeds “because the faculty and administration are committed to making the production of minority scientists a major priority.”

What *specifically* can a university do to boost the number of minority students who will go on to pursue graduate studies in science?

The University of Maryland, Baltimore County (UMBC), offers answers. Recent studies point to a remarkable record of success at this public research university. Much of the success focuses on the university's Meyerhoff Scholars Program, which attracts promising minority students to the predominantly white school. Participants in the program, which began in 1988, are nearly twice as likely to graduate in a science, engineering or mathematics discipline as peers who decline admission to the program and enroll elsewhere. Since 1993, 234 Meyerhoff scholars have earned degrees in these disciplines, with 85 percent going on to graduate and professional programs nationwide.

The students work part time in laboratories during the school year and full time during the summer. These sustained research experiences lead to close ties with faculty mentors and, often, to publication of scientific papers. Freeman A. Hrabowski III, UMBC's president, and Michael F. Summers, an HHMI investigator and professor at the university, tell the *Bulletin* that the program succeeds “because the faculty and administration are committed to making the production of minority scientists a major priority.”

They also maintain that “with a similar commitment, other universities can replicate many of the program's best practices and help to produce many more minority graduates in science, engineering and mathematics across the country.”

Hrabowski and Summers say the following components are critical to the success of the program, which is described online at www.umbc.edu/Programs/Meyerhoff/Undergrad:

- n Recruiting top minority students in math and science, in part by bringing potential students to the campus for a

weekend to visit with faculty, staff and current undergraduates.

- n Providing entering freshmen with a summer “bridge” program that includes math, science and humanities coursework; training in analytic problem solving; opportunities for group study; and social and cultural events.
- n Offering comprehensive merit scholarship support and making continued support contingent on maintaining a B average in a science or engineering major.
- n Fostering active faculty participation in recruiting, teaching and mentoring.
- n Emphasizing the importance of outstanding academic achievement, participation in study groups, collaboration with faculty and preparation for graduate or professional school.
- n Involving the students in sustained, substantive research experiences during both the school year and the summer.
- n Encouraging the students to use departmental and university tutoring resources, with an emphasis on high academic achievement.
- n Maintaining strong support by the university's administration.
- n Providing academic advising and personal counseling.
- n Linking the students with mentors from professional and academic fields in science, engineering and health.
- n Encouraging a strong sense of community among the students.
- n Involving the students' parents and other relatives who can be supportive.
- n Soliciting public and private financial support.

The program also encourages students to talk with a variety of scientists, on and off campus, about research in order to gain as much information as possible to help in making decisions about their own research interests and career paths.

HOOK THEM YOUNG *Hold Them in Science*

ROBBE HILL



Program coordinator Morgan Scholten (left) and intern DeAngelo Jones show Girl Scouts a box turtle that is native to the Chicago area.

By 2020, Memory Cain may be a surgeon. Then again, she may not. “It’s a lot of school,” says the 16-year-old high school junior from the gritty streets just west of downtown Chicago. “But that’s what I want to do.”

Colleges and universities, which often compete with one another to attract the most talented minority students, need more teenagers like Cain to help expand the pool of qualified applicants. The Chicago Academy of Sciences is trying to make sure that she and others are truly prepared. With HHMI support, the academy brings Cain and 15 other sophomores and juniors from Chicago public high schools to its Peggy Notebaert Nature Museum on Saturdays to work with scientists and talk about career opportunities. The teenagers also serve as museum volunteers, learning science as they explain it to younger children and their families.

The program focuses on mentoring at every level, with museum staff guiding the teenagers, who in turn teach younger children such as Girl Scouts working on science badges. For the same price, the museum could have reached hundreds of

students with a one-time auditorium-style program. “We chose to try a different approach,” explains Jennifer Blitz, the academy’s vice president of education and HHMI program director. “We wanted to see if intensive attention could make a big difference in a small number of lives.”

Recognizing that academic grades do not necessarily predict scientific performance, particularly at a young age, Blitz’s staff decided to target average students who express an interest in science. Some of the teenagers have barely a C grade-point average, says Melanie Napoleon, the museum’s manager of enrichment programs. “We take kids at different stages in their development,” she explains, “and we expose them to each other and to as much science and as many scientists as possible, because you never know which seed will take root and grow.”

The program, which includes children of recent immigrants, is a labor-intensive, high-maintenance effort, supported since 1993 by two HHMI grants totaling \$450,000. Just over 100 youngsters have completed it. Is it worth the price? “We think it is,” says Blitz. Most of its

graduates are in college or planning to go, many with hopes of pursuing careers in science and medicine. Otilia Pineda, who participated in 1996, will complete a bachelor’s degree in biology and psychology at DePaul University this spring and plans to go to graduate school. Eduardo Roman, a high school senior, hopes for a career in biochemistry. All the participants, regardless of their plans, have learned more about science.

Program coordinator Morgan Scholten has advice for other institutions that might develop similar programs to help prepare more minority teenagers to pursue careers in science and medicine. “Involve teachers and families from the beginning and keep them informed; they are essential in recruiting participants and keeping them in the program,” she says. “You also need to help the teens get to know each other, and put them at ease with games and other group activities. And give the youngsters *real* work to do, even if it is not directly related to science. Being entrusted with independent tasks helps teens develop self-confidence.”

Jennifer Boeth Donovan