Minority Programs That Get High Marks

RICHARD KOZAK

UC Them Now. Future scientists at the University of California. Will you see them later?

A handful of programs are models for the future.

It's a Wednesday night at the beginning of the fall term at the University of Maryland, Baltimore County, and a lecture hall in the biology building is crowded with 113 science and engineering majors—all black, and all honors students. One young woman—Takisha Cannon, a 20-year-old junior with a 3.6 GPA—stands up to tell the younger students how she earned an A in genetics, a notoriously difficult course. "You have to get together and study with other people," she says. "Otherwise," adds another junior, "genetics will kick you in the butt."

Other older students chime in with their advice for making the grade at the university: "Don't be afraid to visit your TAs. Have them work out problems you don't understand." "Find the smartest students and study with them—even if they're not African American." "Optional study sections are not optional. They are mandatory." After a lively discussion, a relentlessly upbeat black man in his early forties springs to the front of the room and challenges the younger students. "Did you get the point?" asks Freeman Hrabowski, a mathematician who is the interim president of the university. "I don't want any freshmen feeling alone. You need to be calling other people. If you fall behind in calculus or chemistry, it's impossible to catch up."

Welcome to a routine meeting of the Meyerhoff Scholars, a 4-year-old program founded by Hrabowski that aims to take the cream of the black students from high schools in Maryland and turn them into scientists and engineers. The program, started with a gift from Baltimore philanthropist Robert Meyerhoff, provides scholarships and free room and board to promising students, plus an array of incentives to excel—including assistance finding internships and the intense interest of certain faculty. Says Olitha Minto, a 19-year-old who's double-majoring in biochemistry and chemistry: "The support you get is special: You're not allowed to fail."

This is merely one of thousands of such programs across the country. All are trying to attract minority students to science and engineering careers. But unlike many of the well-intentioned programs launched in the past 20 years, this relatively new one works. And Hrabowski has the data to prove it: He's turned out more black students in 4 years who get As and Bs in science and engineering than had been done in the history of the university. And a study comparing the Meyerhoff Scholars with other blacks on campus (who had similar SAT test scores and GPAs when they entered the university) found that the Meyerhoffs were earning on average a 3.5 GPA compared with the other group's average of 2.8.

In several dozen interviews with educators, government funding officers, industry scientists, and students, *Science* searched for programs like the Meyerhoff Scholars that are getting high marks for producing minority scientists, mathematicians, and engineers. Naturally, it's not possible to highlight every promising effort. And although many programs seem to be making an impact, few have tracking data to prove they're filling the pipeline. So this story profiles a select group of programs that have hard data to back up their claims.

A close look at these ventures—which are aimed at students of widely different ages and backgrounds—turns up some surprising similarities. "We found that many of the programs, through their own trial and error methods, were arriving at the same practices and strategies," says Beatriz Clewell, a senior research scientist for the Educational Testing Service in Princeton, who evaluated kindergarten to ninth grade science education programs (for more on these model programs, see story on page 1195).

What works? The single most important feature is that these programs expect—in fact, demand—hard work and academic excellence from their students. Whether elementary school children or undergraduates, all students in these programs are required to enroll in rigorous science and mathematics courses and are offered tutoring and support services to make sure they learn good study habits. Students must study with each other and get involved in hands-on research. Programs do everything from dressing elementary school kids in lab coats and taking them to a university lab to sending a graduate student to AT&T for an internship. For their part, faculty and industry mentors are convinced these students can excel, and that belief extends from the top administrators all the way down to the teachers in the classrooms and scientists in the lab.

If all this sounds like common sense, that may be because it is: "There's nothing fancy about the old-fashioned success of mentoring and expecting a lot from students," says James Wyche, a black biologist who is associate provost of Brown University.

Starting from scratch. But back in the 1960s, when colleges were launching their first programs to help minorities get into science, educators had forgotten these lessons. Wilbur Somerton, who was head of the petroleum engineering group at the University of California, Berkeley, in 1969, recalls that he began to get calls from industry trying to recruit minorities: "Several oil companies were asking me, 'Where are your trained graduating minority engineers?' " recalls Somerton. "I said 'I don't know. I don't have any idea.'" He decided to find out, and the answer shocked him: Blacks entering Berkeley were not prepared in science and math because their

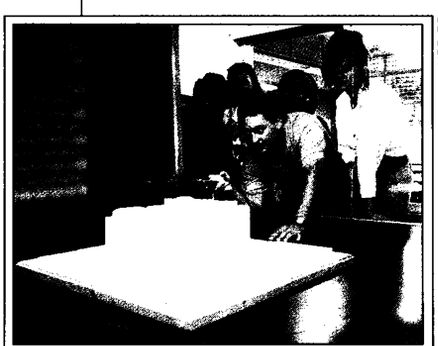
high school advisers had told them to avoid these subjects in order to keep their GPAs high. At that point, Somerton realized he had to leave his campus and go to the source of the problem: the high schools in the toughest parts of downtown Oakland. And that's where he met Mary Perry Smith, a science teacher at Oakland Technical High School. She told him: "If teachers spent as much extra time and energy on promising math and science students as the school coaches spend on promising athletes, the schools of Oakland would produce as many engineers as professional athletes."

Within a year, Somerton and Smith, backed by grants from Somerton's department, Smith's high school, and Bay Area industry, were testing out her idea by working intensively with 25 average high school students at Oakland Tech, whose students were mostly poor and black. They called the program MESA, for the Mathematics, Engineering, Science Achievement program. It was tough going in the early days: "We certainly dropped the ball sometimes," admits Somerton. But they learned from their experience, and from the start, they got good results: Most of the original 25 students went on to graduate from 4-year colleges. Today, MESA is reaching 14,000 students in grades three through college in California. At least 73% of the high school students who go through the program end up enrolling in 4-year colleges, with an average GPA of 3.25—compared with a 2.37 GPA and a 13% college enrollment rate for minorities statewide. At the university level, the MESA Minority Engineering Program (MEP) is responsible for two-thirds of the bachelor's degrees awarded to blacks, Hispanics, and American Indians in California—producing a total of 600 engineers last June. Not everyone thought the program was perfect, of course (see story on page 1231, for one MESA student's opinion), but those strong statistics are partly why the NSF's director of education and human resources, Luther Williams, counts MESA among the few such efforts he believes have worked in the past 20 years.

High expectations. What makes MESA work? "It is simple, really," says Somerton. "You encourage students, you back them up, but you demand excellence." The first thing Smith and Somerton did was to take over advising these students from their counselors and to require them to take the advanced math, science, and English courses that are prerequisites for admission to top colleges. And "we recruited average students who had a little spark, who seemed a little interested in science and math," says Somerton.

Smith and Somerton tutored the students whenever they could—at lunch, after school, weekends (with the help of students from the University of California, Berkeley)—and they used the Socratic method, asking questions to make sure the students understood basic concepts. "All the while," says Somerton, "Mary was tough. She was a real stickler for excellence." They also required the students to work together in study groups, which not only set them up with better study habits for college but also created a peer group that reinforced the notion that it was OK to be a good

Puerto Rico Exports Hispanic Scientists



UPR-AP

Puerto Rican gold. Science students are setting these high standards.

Mainstream colleges and universities in the United States haven't had much success in attracting Hispanic science students or keeping them in the pipeline once they're there. In 1988, for example, less than 2% of the U.S. science and engineering pipeline leading to the Ph.D. level was filled with Hispanics, who make up 9% of the population. But does that mean Hispanics aren't interested in science, or don't have an aptitude for it? Not at all—as illustrated by the results of a remarkable program in Puerto Rico that supplies many of the Hispanic science doctorates in the United States.

Like many other successful efforts at attracting and keeping minority students, the program has been propelled by the passion of one person: physicist Manuel Gomez of the University of Puerto Rico (UPR). In 1980, with support from the Commonwealth government, the NSF, and local industry, Gomez launched an all-out offensive on scientific illiteracy that has since become the seed of a national effort.

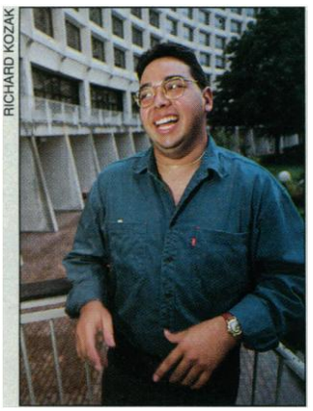
Of course, a science program in Puerto Rico can't be compared directly to efforts to recruit minority students to programs in the United States. After all, one reason for Gomez' success is the social support students experience when they're part of a student body that is 98% Hispanic. But social support alone can't account for the program's success. Another factor is that the UPR program is a total conception beginning from the bottom up. "Puerto Rico has really taken on the charge of looking at education in science and engineering from kindergarten through faculty development," says NSF's Joe Danek, director for Research Initiation and Improvement.

Coordinated throughout the Commonwealth by UPR's Resource Center for Science and Engineering, programs for grade-schoolers include Saturday academies for elementary school students, total-immersion summer camps for junior high students, and Math and Science Bowls and university research apprenticeships for high school students. The programs even send teachers back to school to learn better ways to teach science and to develop novel curricula.

At the college level, reforms shepherded by UPR attempt to increase undergraduate retention in the sciences. Undergraduates attend scientific meetings and lecture series, Gomez says; each year, more than 250 participate in research projects. Other major initiatives have strengthened the research infrastructure at the island's universities.

The proof that this top-to-bottom effort succeeds is in the numbers: In 1990, 74 of the 356 science and engineering doctorates granted to underrepresented U.S. minorities went to Puerto Ricans, with UPR baccalaureates leading the pack. "In the '40s we exported sugar cane," says Rafael Torrech, director of the development office at UPR's Rio Piedras campus. "In the '90s we will export technologically competent people." If the recent efforts are any indication, the new export program is already well under way.

–Dawn Levy


RICHARD KOZAK

"If I hadn't met Dr. Rodriguez, I don't think I'd be here."
—Gary Fontan

student. And it worked: Students who usually talked in the hallways about their girlfriends, boyfriends, and cars began to talk about their math and chemistry problems.

A decade later and 3000 miles away, Maxine Bleich applied the same principles to prove you can start with average minority students from poor, uneducated backgrounds in equally grim high schools in Harlem, Brooklyn, and rural Alabama, and turn them into college science majors. In 1980, Bleich, a long-time program officer at the Macy Foundation in New York City, launched Ventures In Education (VIE) with funding from the foundation. Her goal was to prevent average students from slipping out of the pipeline—students who often had not been exposed to science and math by the time they got to college.

It was no easy task. First, Bleich pushed comprehensive reform at these high schools, restructuring the school day to make sure all students took rigorous curricula of math and science. "We had to change the whole paradigm of sorting and sifting kids out of school," she says. Instead of putting some kids in honors courses and others in vocational classes, the VIE program was open to anybody who signed up for its good "old-fashioned curricula." VIE included 4 years of English, math, science, and social studies; 2 years of a foreign language; advanced placement courses in biology, calculus, English, and social studies; as well as specially designed summer academic programs and classes preparing them for the SAT exam.

Today, the program draws rave reviews: "Ventures in Education is a real winner," says Williams at NSF. As of 1991, 837 students had graduated from VIE programs that now have been expanded to 39 schools across the country. More than half of the VIE graduates responded to a survey earlier this year, which found that more than 90% of the minority students were attending college. Eighteen had already graduated from colleges such as the City University of New York and Yale University. VIE minority students are also enrolling in higher percentages in the sciences than their cohorts nationwide: 14.7% of blacks in the program, for example, were majoring in the biological sciences, compared with a nationwide average of 0.2% for blacks.

Making the grade. Meyerhoff Scholars at the University of Maryland, Baltimore County. From left, Kimani Stancil, Takisha Cannon, Lance Hester, and Aliceson King.

Faculty commitment. Despite that record, Bleich still runs into skeptical teachers: "We can talk about high expectations and high curricula, but the majority of the teachers still don't believe that all the kids can learn," says Bleich. From the start, she realized she had to provide seminars and workshops to help teachers change their attitudes and refine their teaching skills. "We've shown the kids can learn," she says.

Wilfred Easter, executive director of MESA of California, shares that sentiment. "Too often minority kids go to an institution and people expect them to fail. They take on a kind of syndrome of the terminally ill, where they stop really caring, because they know sooner or later the ax will fall on them."

This is true at every stage of the pipeline—and for A students as well as marginal achievers. At the University of Maryland, Baltimore County, Hrabowski works with top black students and has taken some heat from critics who say his students would succeed anyway. But Hrabowski and other educators disagree: "There is a belief that kids who are strong will make it anyway," says Uri Treisman, a mathematician at the University of Texas, Austin, who recently was awarded a MacArthur "genius grant" for his pioneering work teaching college students mathematics in California and Texas. "In fact, national data show that's false. If you control for socioeconomic background and class rank in high school, black kids still do less well than nonminorities. These are measures of institutional inhospitality."

Hrabowski bolsters his students' self-esteem by citing case after case of older students who have exploded the negative stereotypes. Their example, he says, shows that there is no reason why *all* the sophomores in his program can't get 4.0 GPAs this semester. "The key is if you start believing you can get an A, you can," urges Hrabowski. When the students look doubtful, he adds: "Yes, you can if you're really willing to work hard."

Science culture. "It's important to be organized around the culture of science, not just ethnic identity," says Treisman. Students who are "marginalized" miss out on important cues from faculty and other students about which professors to work with, which courses to avoid—and later, where to publish papers, what meetings to attend, and what references they need for graduate school or jobs.

That's why Hrabowski reminds his students to study in mixed study groups—with the smartest students of all races. "It's very important to have students working with each other and with faculty and staff," says Hrabowski. "They need to understand how things work in a department." By working with others they also learn about their own intellectual and emotional strengths and weaknesses. And they begin to change the culture of the school around them: "I've had colleagues saying, 'I don't recall African Americans earning As in organic chemistry and genetics before.'" says Hrabowski.

Hands-on research. From kindergarten to graduate school, most educators now agree that the best way to learn science is to do science. "If they're going to become excited about research, they have to do research and understand the culture of the lab," says Hrabowski. "You can't get that from a book."

Take the case of the minority students at the University of California, Irvine, which has "the best upper-division research apprenticeship program," according to Treisman. It was started informally in the early 1980s in the lab of Eloy Rodriguez, a highly energetic and nationally respected biological chemist who unwittingly became a magnet for minority students: "My lab is like the United Nations," says Rodriguez, who himself overcame humble beginnings in the poorest county of Texas. As he worked with minority students,

Growing Scientists for the 21st Century

When biologist Eloy Rodriguez asked a group of Hispanic children to draw a picture of a scientist last summer, he says most drew pictures of "nerds who look like Bart Simpson." But by the end of a 4-week summer science program in the labs and lecture halls of the University of California, Irvine, where Rodriguez teaches, many of the kids had a different image of a scientist: They were drawing pictures of Hispanic boys and girls as scientists. Exults Rodriguez: "I know I'm really making an impact when the boys are drawing little girl scientists."

This conversion came about during an intense summer program for 125 children in grades K-6 called KIDS, for Kids Investigating and Discovering Science, one of hundreds of efforts seeking to improve science and math instruction for minorities in grades K-8. A look at a few outstanding programs like KIDS shows what works to capture children's interest in science, and to keep them on track, at least for the crucial formative years. These programs are proof that hands-on relevant experiments, taught by well-trained teachers who are enthused by their subjects, can turn kids on to science. And at this age, it also helps if parents are involved in the program.

Indeed, children arrive at school intensely curious about how the natural world works, educators say. But studies in the past decade have shown that school quickly erodes that interest. Minorities start to fall behind in science and math by fourth grade, and sometimes as early as second grade. The reasons are complex, but they include teachers who expect little from minorities or fail to teach them science if they haven't mastered English. And many kids are turned off by the unimaginative way that science is taught by teachers who "drill and kill," teaching facts from a book.

Class of 2010. Eloy Rodriguez hopes one day to see these kids as students doing research in laboratories at UC Irvine.

Hands-on science. That's why it's important "to put in front of these kids things that really interest them," says Rachel Lotan, associate director of the Program for Complex Instruction at Stanford University, which 14 years ago developed a highly regarded program in a public school in San Jose, California, where the students were from low-income, Spanish-speaking families.

For starters, Lotan says, the children learn by doing. The class splits up into groups of five or six, with each group having its own task, described on a cartoon-illustrated activity card (in Spanish and English) that relates science to everyday life. While the children work, the teacher circulates, making sure the students grasp the higher order concepts behind the task, such as the principles of electricity, heat, magnetism, or chemical change.

The cost of the program is minimal; even the most impoverished school districts can afford the inexpensive tools needed for this hands-on science: rulers to measure dolls to explain the metric system or litmus paper to test whether foods are acidic or alkaline. And when children in grades two to five were tested to see how this method was working, reviewers got a surprise: Not only did the students show significant gains in their ability to understand abstract scientific and mathematic concepts, but they also were reading and speaking English better. All that interaction among students—and their need to read task cards—had improved their language skills. A host of evaluations—including 13 doctoral theses—judged the project so successful that it is used to train teachers in the California State University system.

Science in context. Rodriguez, who grew up in the poorest county in Texas, is a strong believer that all students have the capacity to learn science—whether or not they have mastered English. Perhaps because he remembers having to write on a blackboard "I will not speak Spanish in class," he and the teachers in his program now speak Spanish, English, Japanese, or whatever language they can to capture students' attention. And he makes a point of talking to Hispanic children about subjects that are familiar: When he talks about the biochemistry of plants, for example, he uses chili peppers to exemplify why they evolved their hotness. He also makes sure they meet other Hispanic scientists, who take the fledgling scientists—dressed in lab coats—into their labs to see first-hand how antibiotics are isolated or what a grasshopper looks like under a microscope.

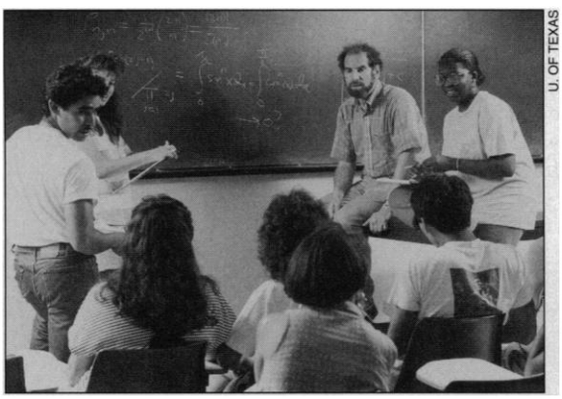
Just as crucial, Rodriguez says, is the help of parents. Indeed, he even pays some parents to do homework with children whose parents are working and cannot assist them.

Teacher training. But even the best programs won't succeed without teachers who both know their subjects and can inspire students with their own enthusiasm for science. And that's why they are sending their teachers back to school in science and math. Take, for example, Chicago's public school system, which has started a massive new experiment to make school meaningful for its 400,000 students—85% of whom are minorities. As part of that experiment Nobel prize winning physicist Leon Lederman has helped create the Teachers Academy for Math and Science (TAMS), which so far has tapped 700 elementary school teachers for 16 weeks of intensive training in math and science. There's extensive follow-up in classrooms, plus a teachers' resource center at the Illinois Institute of Technology, where teachers can meet with scientists and get resource materials they can take back to their classrooms. The idea is to help teachers make science "so warm and interesting and illuminating that we can compete with the streets and the other burdens these kids have," says Lederman. "If we can keep them in school, then we have a crack at getting them into science."

In the end, though, it isn't enough to give students an infusion of science and math in elementary school—only to abandon them later in mediocre high schools. That's why programs like these are part of a comprehensive effort to improve science education from elementary school up through high school and into college. For Rodriguez, the overriding goal is for children to return each year to summer school—and eventually, enroll in his classes at the University of California, Irvine. Says he: "I can't wait to see my kiddies at the university."

–A.G.

Rodriguez realized that they were gaining confidence by doing research in his lab. He recalls the story of Esquiel Barrera, the son of farm workers in Oxnard, California, who was at first extremely "unsure of himself. He was afraid to get up and talk," says Rodriguez. But the young man continued to work with Rodriguez, helping to find an antibiotic in leaves that are often consumed by chimpanzees in Uganda, thus strengthening the theory that chimps may medicate themselves. Barrera presented his data at meetings, got an enthusiastic response, and "just blossomed," says Rodriguez. Today, Barrera is a graduate student studying molecular toxicology at MIT.



U. OF TEXAS

Mathmeister. Uri Treisman adds students to the science pipeline at the University of Texas.

Another student in Rodriguez's lab is Gary P. Fontan, a self-described "hot shot" when he was in high school at Garfield, an inner-city Los Angeles school where the dropout rate was 58%. For Fontan, who says he comes from a family in which more of his cousins have gone to jail than to college, simply getting into Irvine was an impressive feat. But in his first semester, he got a D in English, failed chemistry, and was put on probation. "If I hadn't met Dr. Rodriguez, I don't think I'd be here," says Fontan, who now works on an allergen in plants and spices—called falcarinol—that has neurotoxic effects in the brain and liver of rats. His GPA is up from 1.8 to 3.0.

These anecdotal accounts are backed up by data: Since the program won $1.2 million from the Howard Hughes Medical Institute in 1989, it has reached more than 500 minority undergraduates in the biomedical sciences—almost all of whom are first-generation college students, who have worked on average 20 hours a week in the labs of about 150 participating faculty (whose participation is critical for the success of the program, says acting Irvine chancellor L. Dennis Smith). Of the 300 students who participated in the first 3 years and who have graduated, almost 100% have gone on to pursue graduate degrees in science, says Joan Bissell, a nationally known expert on science education at Irvine.

"You have to catch them early and sustain them at every age of their education."
—Jeanne Narum

Those impressive statistics caught the attention of the NSF, prompting it to award $5 million to Irvine last year to expand the project to more than 1000 students a year at other colleges and public school districts throughout California. The grant, from NSF's Alliance for Minority Participation (AMP) program, will also extend the effort into the physical sciences, mathematics, and engineering.

Industry internships. Although many of these programs have been launched from within the education system, industry, which has a vested interest in expanding the minority science pipeline, is playing a growing role. AT&T, for example, can claim that 22% of all the minorities who have earned Ph.D.s in electrical engineering in the past 20 years have been part of a program the company has sponsored. AT&T has helped 67 students earn Ph.D.s by paying their graduate tuition, giving them a $13,200 annual stipend and summer employment, and setting them up with a mentor, says Frank Johnson, AT&T's manager of university relations.

The mentoring, in particular, is "frightfully important," says Johnson. "We've always had a close relationship with major universities and colleges, so a mentor from Bell Laboratories can help open doors and improve the relationship between a student and a thesis adviser, for example." Often, these students end up with such good rapport with their mentors that they end up working at the company that has paid for their education and summer internships. Jacinta Williams was a graduate student in biology at Atlanta University when she began a research fellowship in the lab of Cecil Pickett, a black biochemist who is now vice president of research at Merck & Co.'s Frost Center for Therapeutic Research in Montreal. She worked on "how genes encoding drug-metabolizing enzymes are regulated by foreign chemicals," says Pickett. "She was so good she stayed and did her Ph.D. dissertation in my lab." After she did a postdoc at Yale, she was hired as a senior research biochemist at Merck's pharmacology department in Westpoint.

These programs, however, are drawing from a pool of top students that is so small recruiters can name virtually all the leading candidates. "The issue," says NSF's Williams, "is how by several orders of magnitude to increase the number of minority students to join the S&T [science and technology] enterprise."

A clue might come from NACME, the National Action Council for Minorities in Engineering Inc. With the backing of 200 industry donors led by DuPont Co., Exxon Education Foundation, General Electric Foundation, IBM Corp., and Southwestern Bell Foundation, NACME has provided almost $40 million in financial aid to minority engineering students since 1975. So far, more than 4700 of those students have graduated with engineering degrees, and they now make up 10% of the minority engineers entering American industry. But NACME realized in the early 1980s that it wasn't enough to target college students. So now it is shifting more of its resources to programs that reach all the way down to kids in the fourth grade "before they get channeled out of science," says NACME president George Campbell Jr., a physicist on leave from AT&T Bell Laboratories.

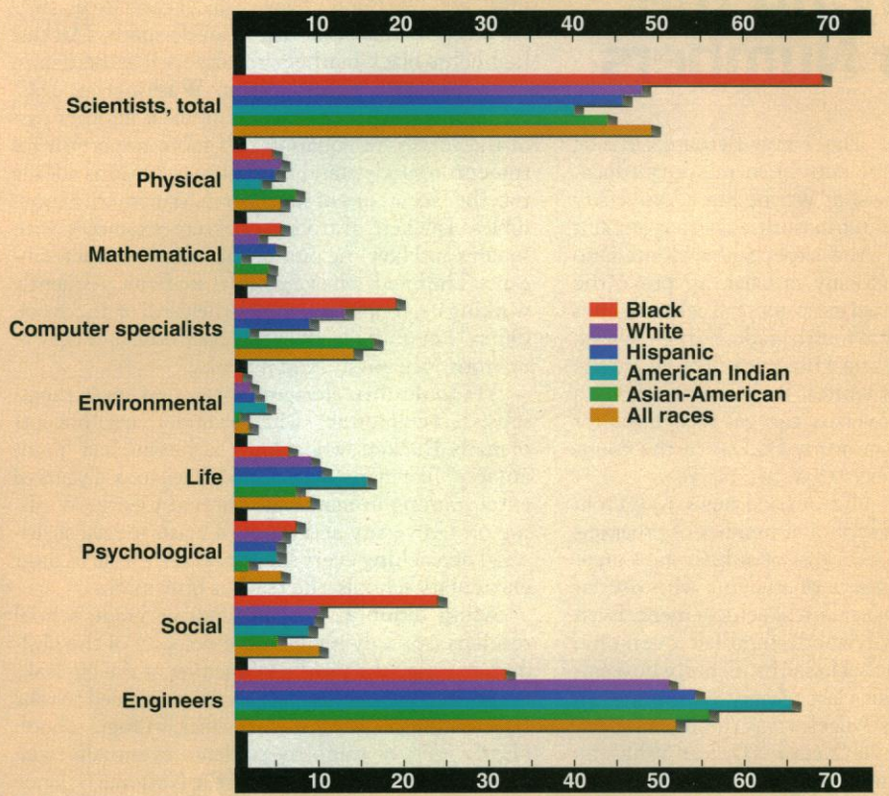
Campbell is convinced that the only way to widen the pipeline is to take the lessons learned from the best programs—which basically embody the concepts of good teaching and mentoring—and apply them in a systemic way to students of all ages.

Indeed the founders of outstanding programs all agree on two key aspects of ventures that work: Start young, and work with the whole class, not just the one or two students who happen to stand out. "You have to catch them early and sustain them at every stage of their education," says Jeanne Narum, director of the Independent Colleges Office's Project Kaleidoscope, which has created an agenda for strengthening science and mathematics education in liberal arts colleges. "You can't just wait for the stars to emerge."

–Ann Gibbons

Data Points II: Workplace

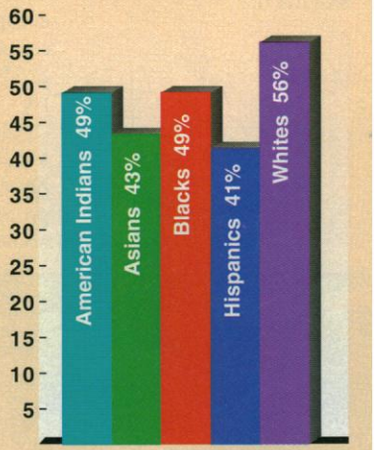
Field Distribution of Employed Scientists and Engineers, 1988



SOURCE: NATIONAL SCIENCE FOUNDATION, 1992

Disciplinary differences. Blacks are more likely to be employed in the social sciences, while Hispanics, Asian-Americans, and American Indians are more likely to be engineers, according to National Science Foundation data.

Percentage of Minority Ph.D.s & Engineers With Tenure



SOURCE: NATIONAL SCIENCE FOUNDATION, 1992

Tenure trap. The percentage of minority scientists— including Asian-Americans— who have tenure lags behind that of whites.

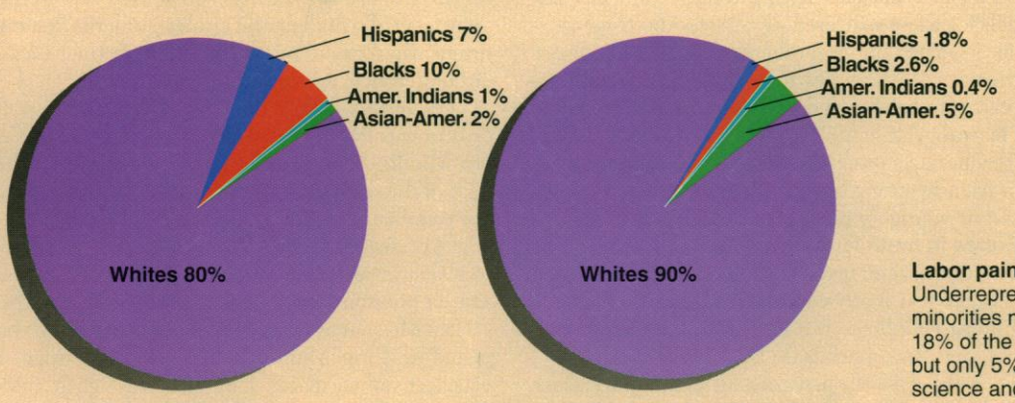
Median Annual Salary For Baccalaureates (1990) and Doctorates (1989)

	Bachelor's Salary	Doctoral Salary
Asian-American	30,000	55,000
White	26,100	54,800
Hispanic	25,100	50,000
Black	24,000	48,500
American Indian	21,900	50,100

SOURCE: NATIONAL SCIENCE FOUNDATION, 1992

Dollar disparity. Underrepresented minorities earn less than Asian-Americans and whites at both the bachelor's and doctoral degree levels.

Minorities in the Work Force



SOURCE: NATIONAL SCIENCE FOUNDATION, 1992

Labor pain. Underrepresented minorities made up 18% of the work force but only 5% of the science and engineering work force.