The Meyerhoff Scholars Program:

Producing High-Achieving Minority Students in Mathematics and Science

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Reaching the Top,[1] the College Board's 1999 report on minority high academic achievement, pointed out that the greatest disparity in academic achievement between underrepresented minority students and their white and Asian counterparts is in mathematics and science. The report also identified programs across the country that have been successful in elevating academic achievement levels of underrepresented minorities. One such initiative is the Meyerhoff Scholars Program at the University of Maryland, Baltimore County (UMBC), a predominantly white, public research university founded in 1966. Since the Meyerhoff Program's creation in 1988, it has become one of the nation's leading producers of high-achieving African American students going on to graduate and professional study and careers in mathematics, science, and engineering. This article discusses the Meyerhoff Program's major components and focuses specifically on factors influencing students' decisions to select mathematics as a major and possible research career.

One of the Meyerhoff Program's distinguishing features is its operating assumption that every student competitively selected to enroll has the ability not simply to succeed in science, mathematics, and engineering (SEM) fields, given appropriate opportunities and resources, but also to excel, because the program engenders an expectation of excellence. Collectively, the program's components create an environment that continually challenges and supports students, from their pre-freshman summer through graduation and beyond. The components include (1) recruiting top minority students in mathematics[2] and science, culminating in an on-campus selection weekend involving faculty, staff, and student-peers; (2) providing a Summer Bridge program that includes mathematics,[3] science, and humanities course work, training in analytic problem solving, group study,[4] and social and cultural events; (3) offering comprehensive merit scholarship support and making continued support contingent on

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[1]Reaching the Top: A Report of the National Task Force on Minority High Achievement, *The College Board, 1999.*

[2]*Students admitted to the Meyerhoff Program typically have earned A's in high school mathematics, and the majority have had a high school calculus course and often have taken Advanced Placement math. The students' SAT scores are in the top two percent for African Americans, with SAT-M scores generally ranging from the high-600s to 800.*

[3]*Students are required to spend time in the Summer Bridge program prior to their freshman year, and based on university placement tests in mathematics, these students are enrolled in either a rigorous precalculus course (often despite having completed a high school calculus course) or in an advanced problem-solving course, Insights into Mathematics, in which the problems are not of the "cookbook" nature. The course emphasizes creative and innovative thinking and focuses on such topics as limits of functions; evaluation of limits; power and sum rules; product and quotient rules of differentiation; differentiation of trigonometric functions; the chain rule; implicit differentiation; higher-order derivatives; intermediate, extreme, and mean value theorems; related rate problems; indefinite integrals; and trigonometric substitution.*

[4]*Among the Meyerhoff Program's various components, we have found that group study is one of the most important for students in mathematics.*

maintaining a B average in a science, mathematics, or engineering major; (4) actively involving faculty in recruiting, teaching, and mentoring the Meyerhoff students; (5) emphasizing strong programmatic values, including outstanding academic achievement, study groups, collegiality, and preparation for graduate or professional school; (6) involving the Meyerhoff students in sustained, substantive summer research experiences; (7) encouraging all students to take advantage of departmental and university tutoring resources in order to optimize course performance; (8) ensuring the university administration's active involvement and support and soliciting strong public support; (9) providing academic advising and personal counseling; (10) linking the Meyerhoff Scholars with mentors from professional and academic fields in science, mathematics, and engineering; (11) encouraging a strong sense of community among the students (staff regularly conduct group meetings with students, and students live in the same residence halls during their freshman year); and (12) involving students' parents and other relatives who can be supportive, e.g., keeping them informed of students' progress, inviting them to special counseling sessions if problems arise, and supporting the Meyerhoff Family Association.

By all measures, the program's positive outcomes are striking. More than 400 competitively selected undergraduates have enrolled since the first class of Meyerhoff Scholars (19 African American males) launched the program in the fall of 1989. (The initial class's all-male composition reflected the particular interest expressed by Baltimore philanthropists Robert and Jane Meyerhoff, the program's co-founders and most substantial private donors, in the plight of young black males in American society. Beginning with the second year of the program, young African American women started participating.) Since the first group of graduates in 1993, 234 Meyerhoff students have earned degrees in SEM disciplines, with 85 percent matriculating into graduate and professional programs nationwide. More than 95 percent of the remaining students are still enrolled in the program and are performing well. (Ongoing program evaluation funded by the National Science Foundation and the Alfred P. Sloan Foundation also shows that graduates of the Meyerhoff Program are nearly twice as likely to persist and graduate in an SEM discipline than are their student-peers who declined offers of admission to the program and chose instead to enroll in other universities, often ones having national reputations.)

Among the 234 Meyerhoff graduates, 16 have earned degrees in mathematics, including 12 who are now pursuing graduate degrees in mathematics programs at institutions ranging from Rice, Columbia, and the University of Wisconsin-Madison to Georgia Tech, the University of Florida, the University of Maryland-College Park, and George Mason University. The four other mathematics graduates are either teaching in public schools or working at the Johns Hopkins University Applied Physics Laboratory. While the Meyerhoff Program has been very successful in producing large numbers of students who have earned degrees and gone on to graduate and professional studies in the biomedical sciences, physical chemistry, and engineering, our plan is to continue providing opportunities for students both to know more about research careers in mathematics and to interact even more closely with practicing mathematicians. Significantly, Meyerhoff students who have earned degrees in computer science, physics, and engineering have tended to take a number of mathematics courses beyond those required for their majors. (To a lesser extent, this is true also for many of the Meyerhoff students majoring in biological sciences, chemistry, and biochemistry.)

One of the challenges the nation faces in terms of increasing the number of minority mathematicians is that currently there are so few minority mathematicians nationally who can serve as role models. While the students we work with in the Meyerhoff Program are high-achievers in mathematics and science, only a handful have ever given much thought to becoming mathematicians. One reason is that they have rarely seen professional mathematicians, and most have little understanding of the variety of careers available to mathematicians. High-achieving minority students in mathematics and science are much more likely to come to college expressing an interest in engineering or pre-medicine than in mathematics because they have had some exposure to practicing engineers and physicians.

The key to increasing the number of minority mathematicians (as well as scientists and engineers) is to expose young minority students to interesting mathematics- and science-related research. A careful review of the academic records of the Meyerhoff Scholars reveals that almost two-thirds earned A's in their college mathematics courses, not only in the calculus sequence, but in upper-level mathematics courses as well. In most cases these courses were taken to meet the requirements for programmatic majors other than mathematics, though some students continued to take mathematics courses simply because of their passion for the subject. What we have worked to do at UMBC in general, and in the Meyerhoff Program specifically, is to identify those students who not only are proficient in mathematics but also exhibit a special interest in the discipline. We then introduce them to practicing research mathematicians in government and corporate settings (e.g., the National Security Agency and Bell Labs-Lucent Technologies) where the students have opportunities to engage in summer research

internships that involve focusing on mathematics problems and working closely with mentors.

One such mentor is William A. Massey, a research mathematician at Bell Labs, who has played a critical role in the company's two highly successful minority internship programs that have been operating since the early 1970s: Bells Labs' Summer Research Program (SRP), a ten-week program primarily for college juniors and seniors; and the Cooperative Research Fellowship Program (CRFP), launched in 1972 and one of the nation's oldest minority fellowship programs. Through these two programs, Massey has mentored ten Meyerhoff Scholars over the past decade, all of whom have graduated and are in varying stages of completing their doctoral degrees. Interestingly, six of the ten students earned their undergraduate degrees in areas other than mathematics, including physics, computer science, computer engineering, and chemistry, and they are now studying at MIT, Stanford, the University of California at Berkeley, and Georgia Institute of Technology. Massey explains that for his student-interns, whether they are majoring in mathematics or focusing intensively on a particular aspect of mathematics, "the computer becomes a laboratory," and "the students do the mathematical equivalent of laboratory experiments."

In one instance Massey and a colleague developed a new analysis for a telecommunications problem, and they asked one of the Meyerhoff interns to analyze related queuing theory models. "The beauty of this approach," Massey says, "is that you need mathematical theory to develop algorithms, so the student needed to understand the underlying theory of stochastic processes and differential equations to figure out how to develop algorithms for numerical simulations of the original system and to compute the approximation. All this is permeated by mathematical theory. So, rather than have a student spend ten weeks trying only to add to the theory of mathematics, which would take more than ten weeks, we give students the opportunity to use and understand mathematical theory that is new to them and then to apply it to develop algorithms which can then be used to analyze a queuing theory problem." The Meyerhoff student in this case engaged in frequent conversations with Massey during his internship, made steady progress, and made technical presentations of his work both at the end of the summer and later at a telecommunications conference and an applied probability conference, both organized by the Institute for Operations Research & Managerial Sciences. Moreover, the student's paper[5] was refereed and published in the proceedings of the former conference. The collaboration between the Meyerhoff Program and Bell Labs provides a model of success.

Over the past decade my UMBC colleagues and I have had the pleasure of working with hundreds of minority students in the Meyerhoff Program who have excelled in mathematics in high school and college. We have concluded that the decision by a student to select mathematics as a major and possibly as a research career is directly related to the quality and nature of the student's research experiences and to his or her relationships with mentors in mathematics both on the campus and outside the university. An added benefit of the students' research activities is that their mentors are able to get to know them both as students and as people. This is especially important because, as we have often found, the brighter the students, the more complicated their lives are, and they can benefit enormously from mentoring, including seeing the human face of mathematics and science.

[5] *N. Grier, W. A. Massey, T. McKoy, and W. Whitt, The time-dependent Erlang loss model with retrials,* Telecommunication Systems *(R. B. Cooper and R. Doverspike, eds.), Select proceedings of the Third INFORMS Telecommunications Conference, vol. 7, 1997, pp. 229–251.*