

# Mathematics Programs That Make a Difference

In 2005 the AMS Committee on the Profession (CoProf) began a project to bring recognition to outstanding programs that successfully address the issue of underrepresented groups in mathematics. The project, called Mathematics Programs That Make a Difference, each year singles out two outstanding programs that: (1) aim to bring more individuals from underrepresented minority backgrounds into some portion of the pipeline, beginning at the undergraduate level and leading to an advanced degree in mathematics, or retain them in the pipeline; (2) have achieved documentable success in doing so; and (3) are replicable models.

Two Programs That Make a Difference were designated in 2006: the graduate program at the University of Iowa and the Summer Institute in Mathematics for Undergraduates/Research Experience for Undergraduates at Universidad de Puerto Rico, Humacao.

For 2007 CoProf has identified two Programs That Make a Difference: the ENHANCING DIVERSITY IN GRADUATE EDUCATION (EDGE) program and the MATHEMATICAL THEORETICAL BIOLOGY INSTITUTE (MTBI).

The 2007 CoProf Subcommittee on Programs That Make a Difference consisted of Carolyn Gordon, Chawne Kimber, David Manderscheid, and Ivelisse Rubio.

What follows are CoProf's citations and descriptions of the two programs. The descriptions were prepared by the *Notices* based on information supplied by the programs.

## Enhancing Diversity in Graduate Education Citation

Be it resolved that the American Mathematical Society and its Committee on the Profession recognize the Enhancing Diversity in Graduate Education Program for its significant efforts to increase the presence of women, with a special focus on women of color, in the upper ranks of mathematical scientists.

The Enhancing Diversity in Graduate Education (EDGE) program is a collaborative effort of Bryn Mawr College and Spelman College. Since its inception in 1998, over one hundred women from diverse racial and educational backgrounds have participated in EDGE. Of these women, over 90 percent are either actively pursuing or have already completed graduate degrees in mathematics.

The AMS commends the program co-directors Sylvia Bozeman and Rhonda Hughes for their success in improving the diversity of the profession of mathematics in the United States.

## Description of Program

Begun in 1998, the EDGE Program is founded on the belief that students who have excelled in early mathematics courses but may have had limited exposure to advanced mathematics can still earn doctorates. Moreover, exposure to graduate-level mathematics and the culture of graduate school, along with a rich support network and positive feedback, will significantly enhance a student's ability to obtain a Ph.D. This philosophy is contrary to the popular view that the well-prepared, fast-thinking graduate student with high GRE scores is the most likely to succeed in a graduate program. The experiences of EDGE students show the effectiveness of the EDGE philosophy.

The long-range goals of the program are to increase the presence of women, with a special focus on women of color, in the upper ranks of mathematical scientists and to create models for mathematics programs that allow people from all backgrounds and cultures to thrive, advance, and contribute to the profession.

The cornerstone of the EDGE program, which for the first five years alternated between Bryn Mawr College and Spelman College, is the four-week Summer Program, which has both academic and social components. The academic program consists of two 4-week core courses, one in abstract and linear algebra and one in analysis; problem sessions conducted by three graduate student mentors; a minicourse and guest lectures on current areas of mathematical research; T<sub>E</sub>X sessions; and presentations by participants. The program provides intense exposure to material and mastery through problem solving by a combination of individual effort and teamwork. The social aspects of the program are designed to build a community of scholars in a collegial and supportive environment. The activities include a diversity seminar, panel discussions about graduate school, weekly dinners, and reunions of the previous participants.

In 1998 there were eight student participants. Over the years, as funding has allowed, that number has grown to fourteen. The selection criteria include acceptance into a graduate program in the

mathematical sciences (including statistics and operations research, but not computer science), an expressed desire to obtain a doctorate degree, interest in being part of a network of women scholars, academic and leadership potential identified by faculty recommendation letters, and the need for exposure to graduate-level mathematics or the graduate school culture. EDGE participants have all been stars in their undergraduate institutions.

The second major component of EDGE is the Follow-Up Mentoring Program. The codirectors and local coordinator arrange for a faculty mentor at each student's graduate institution. In addition, they maintain contact with students during the year and provide a small research allowance for books and professional travel. Each student is invited to return to EDGE the following summer for a reunion, and an electronic bulletin board allows alumnae to share triumphs and challenges throughout their graduate school years.

One hundred five outstanding women were accepted into the EDGE Program from 1998 to 2006. In 2003 the Summer Program became portable, moving to Pomona College with Local Coordinator Ami Radunskaya, in 2004 back to Spelman with Coordinator Yewande Olubummo, in 2005 to North Carolina A&T State University with Coordinators Janice Oldham and Patricia Shelton, and in 2006 to New College of Florida with Coordinator Eirini Poimenidou. As of 2005, data show that EDGE participants are from diverse racial (49% underrepresented minorities) and educational (44% liberal arts) backgrounds. In the first eight years of EDGE (1998–2005), 90 EDGE students entered graduate programs. Approximately 93% of them either have earned a graduate degree or are persisting in their graduate programs. To date, seven EDGE participants (7.7%) and three other EDGE graduate mentors have earned the doctorate in mathematics, and several other participants expect to complete degree requirements by the end of 2007. Among the seven doctoral recipients, four are white and three are African-American. Of the total group, by 2006, 29% had earned the master's degree and discontinued their education, most often to accept employment, and 57% were continuing in a graduate degree program.

The program has been supported primarily by the Andrew W. Mellon Foundation and the National Science Foundation. The EDGE Program is a project sponsored by the mathematics departments of Bryn Mawr and Spelman Colleges with co-directors Sylvia Bozeman, Spelman College, and Rhonda Hughes, Bryn Mawr College.

## **Mathematical Theoretical Biology Institute**

### **Citation**

Be it resolved that the American Mathematical Society and its Committee on the Profession recognize the Mathematical Theoretical Biology

Institute for its significant efforts to encourage underrepresented minorities to continue in the study of mathematics.

In the last ten years the Mathematical Theoretical Biology Institute (MTBI) has mentored and supported over 300 students with more than half of these students entering graduate school. MTBI's efforts have significantly increased the number of U.S. doctoral degrees awarded to members of underrepresented minority groups.

The AMS commends the director of MTBI, Carlos Castillo-Chavez, for his high level of commitment and his successful efforts to improve the diversity of the profession of mathematics in the United States.

### **Description of Program**

The Mathematical and Theoretical Biology Institute (MTBI) and the Institute for Strengthening Understanding of Mathematics and Science (SUMS, founded by the late Joaquin Bustoz Jr.) merged in 2004. These two programs have received a total of three presidential mentoring awards.

Since 1996, MTBI/SUMS has offered sequential research experiences for undergraduate and graduate students. Most of the participants have been members of underrepresented minority groups or women. The program has run in conjunction with Cornell University (1996–2003), Los Alamos National Laboratory (2003–2005), and Arizona State University (2004–present). MTBI/SUMS experiences are driven by the applications of mathematics and statistics to questions in the biological and social sciences. The program has been particularly successful in providing continuous research mentorship training for students who want to work at the interface of applied mathematics and theoretical and computational biology.

Since 1996, MTBI/SUMS alumni have coauthored 111 technical reports. Some of these reports have been published or became the basis of the research efforts of MTBI/SUMS-associated faculty, postdocs, graduate students, undergraduate students, visitors, and faculty. MTBI/SUMS has mentored and supported 277 undergraduate students and 31 graduate students. A large percentage of its undergraduates have participated multiple times, and 14 of its graduate alumni had participated previously in MTBI/SUMS as undergraduate students.

Over its first ten years of existence, MTBI/SUMS sent 130 students from underrepresented minority groups to graduate school, and a total of 169 students overall. Furthermore, 52 percent of those were females, including 65 from minority groups and 33 international students, primarily from developing nations. MTBI/SUMS has been supported through grants provided by the National Security Agency, the National Science Foundation, the Sloan Foundation, Los Alamos National Laboratory, and the offices of the provosts of Cornell University and Arizona State University.

MTBI/SUMS's efforts have significantly increased the number of U.S. Ph.D.'s awarded to members of underrepresented minority groups. In 2005 Ph.D.'s in the mathematical sciences were awarded to ten MTBI/SUMS alumni, seven of whom are members of underrepresented minorities. These seven Ph.D.'s account for one-quarter of all Ph.D.'s awarded that year to U.S. citizens who are members of underrepresented minorities (2005 Annual Survey, *Notices*, February 2006). Of the ten total MTBI/SUMS alumni Ph.D.'s, seven took postdoctoral positions and one became an assistant professor at the University of Puerto Rico, Mayaguez, campus. In 2005 approximately fifteen women who are members of underrepresented minorities received Ph.D.'s in mathematics, and this group includes five MTBI/SUMS alumnae. The number of alumni who received their Ph.D.'s in 2006 is about the same as in 2005. As of today, twenty-four MTBI alumni have been awarded Ph.D.'s in the mathematical sciences.

MTBI/SUMS alumni have attended, or currently are attending, universities across the United States, England, Colombia, and Mexico. MTBI/SUMS sequential summer programs have helped establish large underrepresented minority communities at Cornell University, the University of Iowa, and Arizona State University (ASU). MTBI/SUMS alumni have established a community of minority scholars at ASU and facilitated additional recruitment into the graduate program. Currently there are thirty-one minority group members in the ASU graduate program, including twenty-six Latinos and five African Americans. The ASU mathematics graduate program has the nation's largest population of students who are minority group members.

MTBI/SUMS summer research programs are run like NSF-sponsored workshops. New students take three and a half weeks of intense training in dynamical systems (broadly understood to include stochastic processes) and modeling in the biological and social sciences. They also become familiar with computational software packages. Students set the research agenda each summer. Participants form groups of three to four students around a project of their own choice at the end of the initial training period. Each group is assigned a faculty advisor and provided with appropriate graduate student support. Between 20 percent and 33 percent of the undergraduates participate in two summers and often return as graduate student participants or mentors. These summer workshops have produced an average of ten technical reports per year and have instigated the research of a large percentage of its participants (undergraduate, graduate and postdoctoral students, faculty, and visitors).

## About the cover

### Oswald Veblen and colleagues

This month's cover accompanies the article by Steve Batterson about the American mathematician Oswald Veblen, who had a large hand in establishing the School of Mathematics at the Institute for Advanced Study in the 1930s. Einstein (second from left) and Veblen (fourth from left) were the first members of that school. The others in the group photograph, which was taken sometime in the 1940s, are the topologist J. W. Alexander (at left, looking away from the camera, for reasons known only to himself); Frank Aydelotte (third from left), the second director of the Institute; and Marston Morse. The location is what was then Einstein's office in Fuld Hall, subsequently occupied by Arne Beurling and Robert Langlands.

In 1939 all of the men in the photograph had played an important role in bringing about the resignation of the first director, Abraham Flexner, amidst faculty frustration with Flexner's management. Some of the issues involved were important, such as the Institute's relations with Princeton University—among other things, the anti-Semitic attitude of some of the university's faculty (as told by Alexander in a letter to Veblen dated September 1934). The story is recounted in detail in Chapter 9 of Batterson's book *Pursuit of Genius*.

The photographs are from the archive of the Institute. We wish to thank Marcia Tucker, librarian of the Schools of Historical Studies and Social Science, for her generous help.

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