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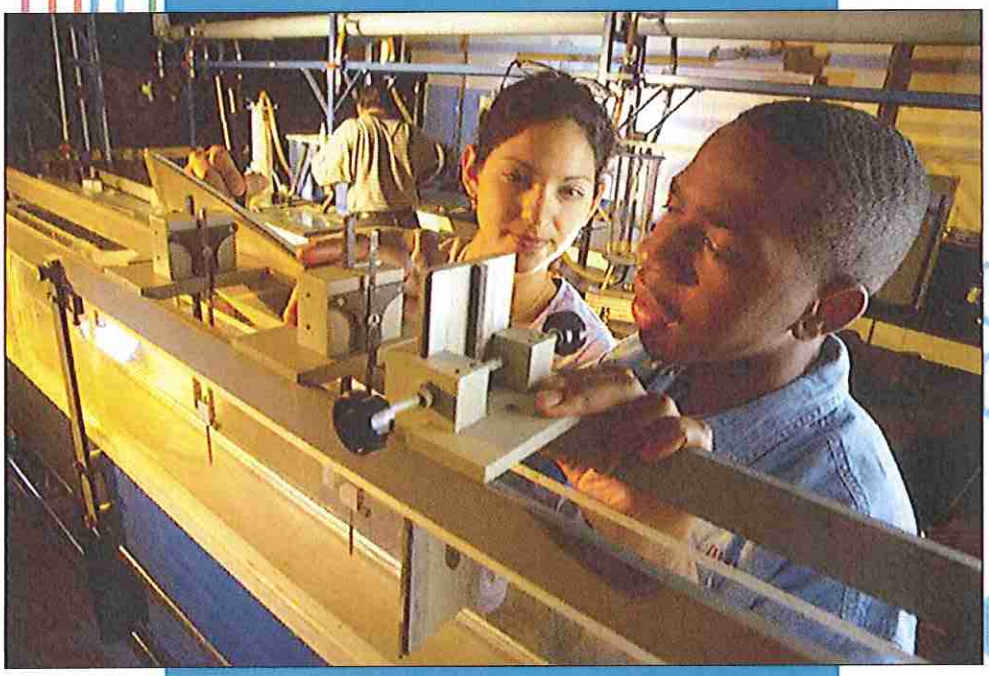

STEM Specialty Programs: A Pathway for Under-represented Students into STEM Fields

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Addressing the under-representation of women, minorities, and persons with disabilities in science, technology, engineering, and mathematics (STEM) fields has been an initiative of the U.S. Congress for the past 30 years, but the challenge still remains unresolved. The National Science Foundation (NSF) and the Congressional Committee on Equal Opportunities in Science and Engineering (CEOSE) have been assigned to work together in an attempt to broaden the diversity of the U.S. STEM workforce across the past three decades (Martens & Hopkins, 2006). As diversity continues to increase among the U.S. population and since many STEM professionals are nearing retirement, this initiative has never been more important for the economic success of the country.

With the U.S. not being the leading country in science and mathematics according to measures such as the 2007 Trends in International Mathematics and Science Study (TIMSS), one important strategy is to direct the attention of the NSF and CEOSE to data and trends related to under-represented students participating in advanced high school STEM programs. Our suggestion is to explore programs that allow under-represented students to overcome issues linked to educational underachievement, including socioeconomic status, cultural trends, and awareness of STEM opportunities and career fields (Perry & McConney, 2010). In this article we share our experiences with STEM magnet schools, a university-supported high school student research internship program, and extracurricular competitions that have launched under-represented students successfully into STEM fields.

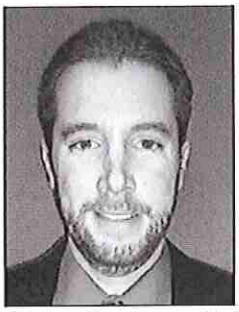
STEM Magnet Schools

Westlake High School (WHS), located in a middle socio-economic and primarily African-American area of southwest Atlanta, Georgia, was formed in the fall of 1988 by consolidating Westwood High School and Lakeshore High School. In 2009 WHS enrolled 2,357 students: 98% were African American, 1% Asian, 1% multicultural, and 48% were eligible for free/reduced meals. The Georgia Department of Education and the Southeastern Association of Colleges and Schools accredited WHS as the magnet school for math and science for South Fulton County in 1999.

WHS's Math/Science Magnet Program prepares students for STEM academic and career fields through rigorous instruction, relevant experiences, and supportive relationships. Students must complete twelve credit hours of math and science courses approved by the magnet program coordinator in order to receive a magnet seal on their diploma. The freshmen and sophomore years require honors courses in mathematics, biology, and chemistry. During their junior and senior years students choose a course of study focused on medical science, engineering, or digital media/computer science.

Students in the medical science program take courses that include human anatomy, genetics, microbiology, Advanced Placement (AP) chemistry, and AP biology. Students in the engineering program take pre-engineering concepts, drafting, engineering, AP calculus, and AP Physics. Students in the computer science program complete courses in web design, digital media concepts, programming, AP calculus, and AP computer science.

As freshmen and sophomores, students take a research methods course that requires them to develop a research paper that is submitted to the school science fair. During the sophomore year, students participate in a math technology course that



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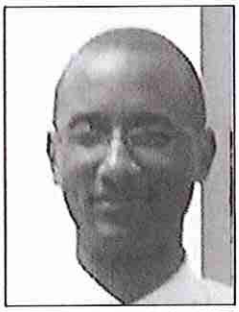

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incorporates statistical analysis, enabling the students to perform hypothesis testing as part of their science fair topic. These two courses prepare students for competitive activities and for the application and interview process to apply to the Research, Experiment, Analyze, & Learn (REAL) summer research program at the Georgia Institute of Technology.

Typically, during their sophomore through senior years, students engage in extracurricular clubs such as Medical Sciences Club, Digital Design Club, Math Team, Robotics Team, NSBE Jr., or Engineers Without Borders (EWB). Georgia Tech graduate student fellows have worked with these clubs and science and math classes since 2002 to provide role models, mentors, tutors, and guest instructors for Westlake students. Through the work of a Georgia Tech Fellow, Westlake became the only high school to ever have an officially chartered chapter of EWB. As part of EWB, students traveled to Arusha, Tanzania in the summer of 2007 to install and demonstrate solar cooking systems as an alternative to kerosene, which is harmful when used in enclosed cooking spaces.

Magnet students compete as part of the previously mentioned clubs and have won the NSBE Jr. regional competition (2003, 2006, 2007) and national Try-Math-A-Ion competition (2008). Their participation in the Georgia Tech REAL summer research internship program since 2004 has resulted in the development of award-winning student science fair projects at the state level, a Regional Award at the Siemens Competition, and a National Biology Award. Finally, to ensure continued success, WHS students were offered over 19.5 million dollars in academic and athletic scholarships in 2010.

Students at the Rockdale Magnet School for Science and Technology (RMSST) in Conyers, Georgia and The Academy of Research and Medical Science Magnet at South Cobb High (ARMS) in Austell, Georgia, have attained similar successes. The two magnet schools had a majority female and minority student body of 72 (RMSST-38 and ARMS- 34) during the 2009-2010 school year. Students from each of the schools collectively received 15 million dollars in academic scholarships and participated in multiple STEM initiatives, including the REAL university internships at Georgia Tech.

University STEM Internships

Founded in 2004 as a program of Georgia Tech's Center for Education Integrating Science, Mathematics and Computing (CEISMC), the Georgia Intern-Fellowship for Teachers (GIFT) initiated the REAL Program to provide summer STEM research internships for rising high school juniors and seniors. Students, primarily from populations underrepresented in STEM, spend five weeks in a Georgia Tech laboratory, conducting research under the guidance of a Georgia Tech professor, their GIFT teacher, and a Georgia Tech graduate student.

REAL is designed to provide students:

- increased exposure to real-life examples of math, science, and technology use;
- first-hand understanding of career options and skills necessary for the workforce of the future;
- increased awareness of inquiry-based learning strategies;
- additional knowledge and strategies for use in the classroom;
- and an enhanced network of resources.

REAL students are encouraged to use their summer experiences as the basis for STEM research papers submitted to local and state science fair competitions. Students also enter their research into the national Siemens Competition in Math, Science and Technology, an annual science research competition administered by The College Board and funded by the Siemens Foundation, that offers a top prize of a $100,000 scholarship.

Since its inception in 2004, REAL has provided Georgia Tech research opportunities for more than 200 high school students to conduct and present research in teams of 2-3 students. Student teams meet once a week during the summer to participate in sessions that focus on topics ranging from university admissions requirements to scientific presentations. REAL participants have also garnered awards in local and state science

fair competitions. Students participating in REAL have gone on to major in engineering, medical sciences, and computer science at universities and colleges throughout the United States as a result of interests, talents, and research experience gained through REAL.

STEM Competitions

National outreach opportunities and STEM competitions such as the National Science Bowl, Science Olympiad, Intel Science Fairs, and the Siemens Competition allow educators to incorporate additional opportunities for hands-on experiences, leadership development, and communication skills at any school. Kressly (2009) referred to a school's investment in STEM outreach programs and competitions as "portable inspiration" for students. Through these competitions students and teachers can discover creative and scholastic aptitude unrevealed previously (Cropper, 1998). An early introduction to STEM competition can therefore be an important stimulus to develop and foster under-represented student success in related STEM fields (Karnes & Riley, 1999). We have served as sponsors, mentors, and managers for such competitions and have observed how portable inspiration and unveiling of talent has led many under-represented students to decide to pursue STEM majors and career goals.

Summary

Based on our experiences, a STEM magnet school's smaller learning community, summer internships, and extracurricular competitions provide opportunities for student growth. Internships stimulate academic achievement, leadership qualities, and communication skills, and can influence the career pathways students pursue (Little, Kearney, & Britner, 2010). Taken together, STEM specialty programs and internships provide a promising approach for increasing the number of under-represented students in the U.S. STEM workforce and for the nation to reclaim the title of "World Leader in STEM".

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