GROWING FUTURE SCIENTISTS

BU students stimulate K-12 kids to get excited about science

By Brian Fitzgerald

Much attention has recently been given to the poor state of the nation's kindergarten through 12th grade science education. But at the college and graduate levels, the story is quite different: it's among the best in the world.

So BU students have been sharing their expertise in science, mathematics, engineering, and technology with students in local schools, with the help of a program funded by the National Science Foundation that seeks to bridge "the chasm between the universities and K-12 education," says NSF director Rita Coldwell.

A $1.4 million grant from NSF's Graduate Teaching Fellows in K-12 (GK-12) program enables BU to train graduate students and advanced undergraduates as expert resources in Boston-area classrooms. At present, 10 students are participating in the second year of the three-year grant.

Also, thanks to a supplemental grant, five Boston-area high school teachers can participate as research assistants in BU laboratories, gaining a better understanding of the scientific process. The additional funds support up to $10,000 in professional development education for each teacher. Two took advantage of the grant this summer, and more are expected to do so for the academic year and next summer.

"This program enables motivated undergrads and graduate students to partner with high school teachers to find ways to improve the quality of science education at the primary and secondary level," says CAS Physics Professor H. Eugene Stanley, the program's project leader at BU. "It's one of the most successful classroom innovations in this country to stimulate interest in the subject."

At present, BU students are working at Boston's MATCH Charter School, Brookline High School, Chelsea High School, and Wayland High School. By next year, Stanley expects the project to reach approximately 3,000 middle and high school students in 156 science classes.

The GK-12 effort at BU is a collaboration among the CAS department of chemistry, the School of Education, the College of Engineering, and the GRS Center for Polymer Studies, which Stanley directs. Co-primary investigators of this effort are CAS Chemistry Professor Morton Hoffman, SED Dean Douglas Sears, SED Professor Mary Shann, and ENG Dean David Campbell. Center for Polymer Studies scientists involved in GK-12 focus primarily on instructing teachers how to use computer-based modeling tools to teach science concepts to high school and middle school students.

" A major goal nationally is to provide students with an opportunity to understand macroscopic processes in terms of microscopic interactions," says Stanley. "At the Center for Polymer Studies, we have developed a set of instructional materials do this through other NSF grants. A key feature of these materials is the use of molecular motion, a technique developed in recent years that programs the motion of atoms and molecules based on the laws that govern their motion."

Stanley says that by using split-screen software programs, students can observe, in real time, the microscopic behavior on one half of the screen, and on the other half see what's going on at the macroscopic level. "By changing the conditions of the system -- for example, volume, pressure, or temperature," he says, "the student can better understand how both microscopic and macroscopic properties depend on these conditions."

Brookline High School chemistry teacher Reen Gibb, a GK-12 investigator who also leads workshops on how to use the computer as a virtual laboratory in the chemistry classroom, says that the teachers she trains use computer technology to enhance their students' appreciation of physical processes at the atomic level. "Kids see water freeze and ice melt, but their mental images of what is happening at the microscopic level are usually pretty incorrect," she says. "Computer modeling allows them to instantly discover what happens, for example, if they change the pressure at the freezing point, or if they change the mass of the molecules. It allows kids to get scientifically accurate results when they vary the parameters, such as temperature, pressure, particle mass, and volume."

Gibb says that this technology is not designed to replace textbooks, but simply to augment their content. "Images in books are static," she says. "The computer images are moving, and graphs are available to see the continuous changes. I use it for everything from advanced placement chemistry to first-year chemistry classes."

The GK-12 project, initiated by the NSF in 1999, is modeled after a BU program started a decade earlier. That program put a twist on the traditional fellowship process, in which graduate students earn a stipend to teach undergraduate college students or to do research. "They now have another choice," says Stanley. "They can go the traditional route, or they can work with area high schools, which also help them develop their communication skills."

Stanley points out that because so many young people today are deficient in science, many don't even consider pursuing professions in biology or electrical engineering. "Children of scientists know that they can become scientists, but other children don't," he says. As the United States threatens to fall increasingly behind the rest of the world in science performance, programs such as GK-12 can help stimulate students' interest in science and technology early in their education.

GK-12 fellow Gregg Surdi (GRS'04), who conducts biology labs at Wayland High School, says that not only are the students learning from the labs, "but the teachers are learning how to teach the labs, so they can perform them on their own when I am no longer with the program."

Other GK-12 fellows this year are Eric Meyer (CAS'05), Amit Bansil (CAS'03), Eliza Kamenetsky (GRS'04), Raegan O'Lone (GRS'04), Andrew Ingilis (GRS'04), George Kierstein (GRS'04), Michelle Paquette (GRS'04), Aaron Schweiger (GRS'04), and Rouben Meschian (GRS'04).

Paul Trunfio, a research associate at the Center for Polymer Studies, directs the center's education programs. He says the program is vital because the country desperately needs more people adequately trained in science. When science teachers connect with kids, he says, they generate excitement about the subject matter. "And it's not only high school teachers and students who benefit from GK-12," he says. "BU professors and students benefit as researchers. Simplifying and adapting science research materials to education brings new physical insights. It transforms how we think about science."

Schweiger, who is assisting chemistry teachers at Chelsea High School, agrees. "Working with high school students demands that I dig to the core of my understanding of the material," he says.