Fostering diversity in science and public science literacy

*The Young Scientist Program at Washington University in St. Louis has a history of changing lives through inspiration and scientific discovery*

By Katherine B. Chiappinelli

Bart Bartlett was a junior in 1995 at Metro Academic and Classical High School in St. Louis when his science teacher put him in touch with an M.D./Ph.D. student at Washington University in St. Louis who was interested in bringing high-school students into his thesis laboratory.

The graduate student, James McCarter, was one of the founders of the Young Scientist Program, which brings scientific laboratory experiences directly to underprivileged middle- and high-school students and their teachers. Bartlett was in one of the first cohorts.

While Bartlett had taken science courses, this was his first exposure to research in a laboratory. Over the course of the summer, Bartlett performed an independent research project doing genetic analysis in the model organism *C. elegans*, a small worm. Bartlett says the most important part of the experience was working in the lab as part of a team.

“I learned by experience how the scientific method works to do cutting-edge research,” he says. “Knowing that scientists work together and have a lot of fun doing it reinforced a career in science.”

The experience changed his life. Bartlett went on to study chemistry in college, earn a Ph.D., do postdoctoral research and become an assistant professor at the University of Michigan. He credits much of this success to YSP and is currently initiating a similar one at his institution.

**An obvious need**

Few would argue that scientific discovery and progress benefit from the diverse perspectives of individuals in the field. Yet, while underrepresented minorities make up 29 percent of the U.S. population, they make up only 5 percent of full professors with science and engineering doctorates, according to the National Science Foundation’s 2011 report on Women, Minorities and Persons with Disabilities in Science and Engineering. While women made up 5 percent of this group in 1979, that figure had increased to more than 20 percent in 2008. Meanwhile, underrepresented minorities made far fewer gains, with their numbers growing from about 2.5 percent in 1979 to 5 percent in 2008.

With these disparities in mind, the Young Scientist Program seeks to expose underrepresented minority students and those from disadvantaged backgrounds to experimental...
science and thus encourage science literacy and the pursuit of careers in science.

“YSP is unique in the United States, as the program is primarily run by volunteers, comprised of Ph.D. and M.D. students and postdoctoral fellows,” says Thomas Woolsey, the program’s faculty adviser.

Each year, YSP works in partnership with St. Louis public schools to engage more than 1,000 high-school students and teachers through a broad repertoire of programs. Over 20 years, about 500 volunteers have worked with more than 7,000 students. YSP was honored for its contributions to the St. Louis community when it received the 2011 Science Educator Award from the Academy of Science of St. Louis.

With the support of the university and community members, YSP continues to have a major impact by attracting students from diverse backgrounds to pursue careers in science. In turn, YSP volunteers benefit from these programs, gaining a variety of skills and experiences not formally taught during graduate and post-graduate training.

Bartlett, who serves as a research adviser for graduate students, says he sees “the profound impact that instructing younger students, including high school students, has on their ability to communicate science.”

Summer Focus

YSP uses several unique initiatives to augment middle- and high-school science curricula and attract young people to scientific careers. One of them is the Summer Focus program, in which students from local high schools conduct independent research at Washington University for eight weeks.

Each student summarizes his or her discoveries in a formal research paper and presents his or her findings at a symposium at the summer’s end. He or she participates in a scientific writing course, attends career presentations by professional scientists, takes part in a journal club and is coached in making presentations.

Each student has both a laboratory mentor, who guides the student through an independent research project, and a tutor, who helps reinforce basic biological concepts. Bartlett says he remembers meeting with his tutor to build on what he had learned in freshman biology so that he could understand the genetics research he was doing in the lab.

“Learning a few functional lab skills to get going right away while also filling in the background information as the summer progresses is a pivotal aspect of keeping students productive and encouraged,” he says. “Focus too heavily on skills, and we become mere technicians. Focus too much on background, and we’d be too overwhelmed to get anything accomplished. YSP has found the right balance.”

So far, more than 230 high-school students have participated in the Summer Focus program. Most have attended college, and many have majored in science, often with scholarship support, and have gone on to pursue advanced degrees in science and medicine.

Lesley Rankin, a 2008 Summer Focus student who attended Gateway High School, says she obtained laboratory, writing, reading and career skills from the experience.

“All of the sessions and lab research incorporated into the entire summer were the building blocks for my decision to continue a career in science,” she says. Rankin explains that before participating, she was deciding between a career in music or...
science, and the program helped her decide on science.

Bartlett adds, “Kids who love science are viewed as nerds, and Summer Focus shows that nerds who work really hard get degrees and ultimately get very good jobs. I don’t think I even appreciated that as much at the time, but given today’s economy, it’s big.”

Teaching Teams
During the school year, teams of YSP volunteers develop and lead inquiry-based, hands-on science modules to increase science literacy in nine different fields: anatomy, chemistry, ecology, evolution, forensics, genetics and genomics, microbiology, neuroscience, and physics. The volunteers present interactive activities in classrooms, after-school programs and community organizations.

One such example is a genetics demonstration of DNA extraction in which students use household items, including shampoo, rubbing alcohol, salt and cheesecloth, to isolate DNA from fruit. The students are excited to find that DNA, the “blueprint” they have read about in textbooks, is a tangible substance that they can purify from living things.

St. Louis-area teaching team visits have expanded from 15 per year in 2001 (reaching about 350 students) to more than 60 per year in 2011 (reaching more than 1,000 students).

Rankin was first exposed to the Young Scientist Program at a genetics teaching team demo at her high school.

“The team leaders kept us engaged by asking many constructive questions related to the material,” she recalls. “The teaching teams allowed me to critically think through the logistics of any experiment.” The experience prompted her to apply for the Summer Focus program, in which she performed an independent research project on hybrid sterility in yeast.

Rankin is now a junior at Webster University majoring in biology with an emphasis on biotechnology. She plans to obtain a Ph.D. and start her own biotechnology company.

In addition to working with local schools, YSP volunteers bring teaching team demos to national scientific meetings to interact with fellow graduate students and engage high-school students in other areas of the country. The effectiveness of such activities in achieving scientific-concept learning is...
evaluated using pre- and post-surveys of participating students.

The Teaching Teams initiative also gives high school students a chance to interact with experts in scientific fields who are young, bright, engaging and enthusiastic about science.

**Lowenstein teaching kits**

In 2010, thanks to financial support from the Leon Lowenstein Foundation, teaching kits were developed to expand YSP’s reach. The stand-alone kits, some based on teaching team demos, can be checked out freely by St. Louis teachers.

Each kit focuses on a specific topic. It contains protocols, supplies and equipment for classes to perform experiments; an instructional video with background material on the topic; handouts and teaching points; and materials for evaluation and assessment of what was learned.

To date, teaching kits for DNA extraction...
from fruit, surface tension and generation of a citrus battery have been created. YSP is working with a community organization, the Youth Learning Center, as well as St. Louis public school science teachers to get feedback to improve the kits. Graduate and medical students at other institutions can now take advantage of online teaching team demos and teacher kits by accessing the online resources at http://ysp.wustl.edu.

Both participants and organizers agree that YSP is a proven and flexible model for a volunteer-based approach to improve science understanding and inspire future generations of science professionals, especially among under-represented groups.

“Summer Focus was one of the best things I have been a part of in my life,” Rankin emphasizes. “Completing the program and, most importantly, walking away with a deeper passion for science was amazing. One day, I want to give a similar experience to young adults so they can explore their strengths and develop career goals. I want them to have that same life-changing experience that will make them strong and effective leaders.”

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