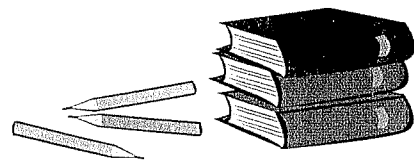


## MENTORING

# Volunteers Bring Passion to Science Outreach



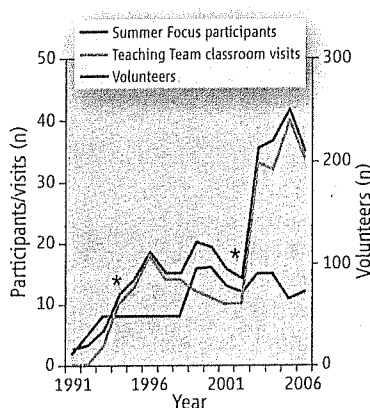
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Partnerships between graduate students and high school students in St. Louis benefit both groups, and bring real laboratory experiences to the high school students.

Scientists in the United States have been called upon to help reform science and math education by engaging in “effective equal partnerships” with primary and secondary schools (1). Such partnerships are often developed as part of research proposals to establish a “broader impact” component. A highly successful program at Washington University in St. Louis, Missouri, shows that such partnerships are valuable not only to the schools but also to the participating scientists.

Many universities have initiated successful science outreach programs that involve professional educators and full-time staff. In contrast, the Young Scientist Program (YSP) at Washington University in St. Louis is led and staffed almost entirely by graduate and medical student volunteers, who as scientists bring enthusiasm directly from the laboratory to the classroom. YSP is a partnership between the university and nearby school systems that improves science education in high schools and also attracts young students to scientific careers.

YSP was founded by two Washington University M.D./Ph.D. students, Jim McCarter and Matt Schreiber, in 1991. They recognized that students often lose interest in science during high school and hypothesized that exposure to hands-on research would attract young students to careers in science (2). They launched a program to bring high school students into biomedical laboratories at Washington University for summer research internships. The program continues to focus on nearby public schools that include



**Growth of the YSP program.** The number of Summer Focus participants (black line), teaching team classroom visits (blue line), and total number of volunteers (red line) per year highlight how the program has developed since inception. Volunteers typically participate in several activities over several years; values approximate the numbers of volunteers participating in any given year. Asterisks mark years when a part-time, and later full-time, coordinator was hired.

children from disadvantaged backgrounds.

### Structure

YSP is run by volunteers who participate for many reasons, including dedication to community outreach, a love of teaching, and a commitment to increase the participation of underrepresented groups in science. Involvement ranges from fundraising to curriculum development and teaching to directing the entire YSP program [see supporting online material (SOM)]. The volunteers—currently about 150 graduate and medical students, postdoctoral fellows, and residents—receive no pay or academic credit.

Schools for the city of St. Louis (population 360,000) and the surrounding metropolitan region of Missouri and Illinois (population 2.7 million) serve about 34,000 students (including kindergarteners to 12th graders), 82% of whom are African American (compared with the Missouri average of 18%) (3). Most of these students are from low-income families. Only 57% of entering freshmen complete high school (compared with the Missouri average of 86%), and of these only 41% enroll in college (Missouri’s average is 64%). Despite efforts toward improvement of the St. Louis schools, the Missouri School Improvement Program currently gives the St. Louis school district only provisional accreditation (4), whereas elsewhere in Missouri, 97% of public school districts have earned full accreditation.

### Programs

YSP volunteers have developed several programs (see SOM) to supplement the educational experience of high school students and their teachers. Successful implementation, continued funding, and institutional support have allowed the program to expand both the number of volunteer opportunities and the number of students reached (see figure, left).

**Teaching Teams.** YSP volunteers develop and lead interactive, inquiry-driven science exercises in

local public high school science classes and after-school programs for off-site conferences and during field trips. The team members provide all necessary equipment and reagents and work in groups of three to seven volunteers with student groups of 10 to 200. Teaching-team activities are modified in collaboration with teachers, integrating classroom curriculum and state standards. Teaching teams have interacted directly with more than 5000 students since 1993.

**Summer Focus.** From 80 to 100 high school student applicants each year, 30 are interviewed and 12 finalists are chosen as Summer Focus Scholars. Each Scholar is mentored by a volunteer graduate student or postdoctoral fellow, completes an independent research project, and writes a formal research paper during an eight-week internship. Projects are related to the research of the mentors and address real scientific questions. Scholars also meet with individual tutors and participate in laboratory technique workshops, weekly seminars, journal clubs, and a science-writing course. More than 165 local students have participated in Summer Focus.

**Teacher and Researcher Partnership.** YSP initiated this program in 2001 to provide summer research and curriculum enrichment experiences for three to six public school teachers each year. Nearly half of the teachers who apply are selected each year to work with scientists on an individual research project and curriculum develop-

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ment activities for their own classrooms. Teachers earn professional development credits and receive a stipend and funds for classroom supplies.

*Mad Scientist Network (MadSci)*. YSP's Web site (5), launched in 1995, includes MadSci (6), a forum designed to answer science questions submitted via the internet. MadSci has evolved into an international resource promoting global science literacy at all education levels. YSP volunteers still serve as moderators, although MadSci was recently incorporated as an independent nonprofit organization under the direction of its creator and former YSP volunteer Lynn Bry.

**Benefits and Outcomes**

YSP asks its participants to evaluate programs shortly after participation. Retrospective evaluations are undertaken every 5 years, most recently in 2002 (see SOM). Thus, both the immediate and long-term effectiveness of YSP programs are assessed.

YSP has had a substantial impact on its volunteers. YSP volunteers become more aware of educational disparities in urban areas and gain a variety of skills that are not formally taught during graduate and post-graduate training. In the 2002 retrospective evaluation, past volunteers ranked teaching, mentoring, and communication as the most valuable skills acquired through YSP participation (see figure, above right). Results showed that 44% of respondents selected the group-teaching experience as one of the greatest benefits (fig. S7). The retrospective evaluation also showed that a third of former volunteers who are no longer at Washington University participate in community outreach at their new locations. Thus, YSP has brought to a cadre of young scientists the resolve, experience, and skills to continue this outreach to the public throughout their careers.

The ultimate objective of YSP is to enrich the scientific experience of local high school students and teachers. Teaching teams reach the most students, primarily during visits to local classrooms. Through hands-on experimentation and small-group discussions, students explore science in an informal but structured setting under the direction of bright and compelling role models. A survey of more than 200 students participating in the neuroscience teaching team at the 2006 Spring Brain Conference demonstrated that the students had a better understanding of the nervous system after participating and they enjoyed the experience (7). Similar data from teaching team visits to St. Louis public schools confirm

that this approach is a viable way to increase science content knowledge in specific subject areas (fig. S3).

For students and teachers participating in the Summer Focus and Teacher and Researcher Partnership programs, the benefits are even greater. Participants experience a professional scientific atmosphere and see the risks and rewards of science. By retrospective evaluation, 65% of former Scholars indicated that the Summer Focus experience confirmed their commitment to a career in science or medicine (fig. S6). Past Scholars (2002 evaluation) ranked laboratory techniques, application of the scientific method, and writing ability as the most important skills acquired through YSP (see figure, right). Partnership teachers benefit as they discuss scientific concepts, share experiences about teaching and connecting with students, and develop new curricula. Once Scholars and teachers get to know Washington University and its faculty, they continue to use this resource after their summer internships.

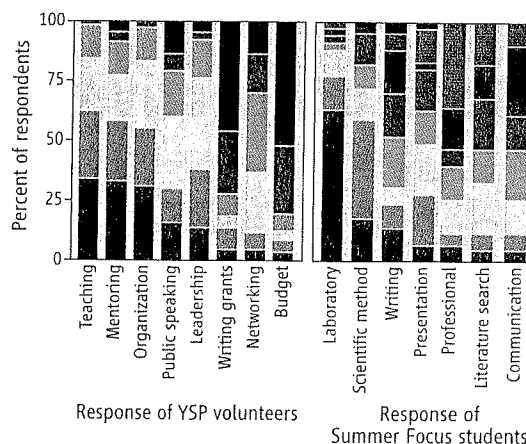
**Support**

YSP's current annual budget (8) is \$53,500 plus the salary of one full-time coordinator, paid for by the university. The program is now building an endowment. A faculty adviser meets monthly with the student director and the coordinator. YSP convenes past participants, community members, and Washington University faculty and volunteers twice a year to solicit feedback and ideas.

**The Future**

YSP was established on the premise that science literacy and access to science-based careers are improved by the active involvement of professional scientists in the education of the local community. Since 1991, more than 350 Washington University volunteers have worked directly with students and teachers from nearby high schools, with a measurably positive impact. A key strength is that YSP is organized and run by volunteers whose commitment to the program springs from a love of teaching and mentoring future scientists. A full-time coordinator, a faculty adviser, and community advisory board allow for evolution, innovation, and growth through successive generations of volunteer leadership.

In the 15 years since its inception, YSP has firmly established its role at Washington University and the St. Louis high schools. YSP's methods and exercises have been dis-



**Skills gained through YSP activities.** In 2002, YSP volunteers (n = 58) (left) and Summer Focus students (n = 28) (right) completed a retrospective evaluation in which they ranked the value of specific skills acquired during participation in YSP. Likert scale categories are represented by the colors of the rainbow, with red indicating most valuable and purple indicating least valuable; black, not applicable.

seminated by former volunteers and faculty via the internet and at outreach seminars in conjunction with national meetings. As YSP continues to adapt and grow, it remains committed to enriching the scientific experience of underserved populations one student at a time.

**References and Notes**

1. R. R. Colwell, E. M. Kelly, *Science* 286, 237 (1999).
2. Committee on Science, Engineering, and Public Policy, *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future* (National Academies Press, Washington, DC, 2006); available online ([http://fermat.nap.edu/execsumm\\_pdf/11463.pdf](http://fermat.nap.edu/execsumm_pdf/11463.pdf)).
3. Missouri Department of Elementary and Secondary Education, *Missouri School District Profiles* (Missouri Department of Elementary and Secondary Education, Jefferson City, MO, 2006); available online (<http://dese.mo.gov/planning/profile/115115.html>).
4. Saint Louis Public Schools, *An Annual Report to the Community 2003-2004* (Saint Louis Public Schools, St. Louis, MO, 2004); available online ([www.slps.org/districtinformation/index.htm](http://www.slps.org/districtinformation/index.htm)).
5. The Young Scientist Program ([www.medicine.wustl.edu/~yosp](http://www.medicine.wustl.edu/~yosp)).
6. The Mad Scientist Network ([www.madsci.org](http://www.madsci.org)).
7. S. R. McIver, C. LaPash, *2006 Brain Awareness Week Report* (Society for Neuroscience, Washington, DC, 2006); available online ([www.sfn.org/baw/bawreport2006](http://www.sfn.org/baw/bawreport2006)).
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**Supporting Online Material**

[www.sciencemag.org/cgi/content/full/314/5803/1246/DC1](http://www.sciencemag.org/cgi/content/full/314/5803/1246/DC1)

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