Promoting Science Education

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PRESIDENT OBAMA HAS CALLED ON SCIENTISTS AND health professionals to stand side-by-side with entertainers and athletes to "show young people how cool science can be."[1] As part of his Educate to Innovate campaign,[1] the President is promoting science education, with a focus on activities outside public school classrooms. The President's campaign encourages a broad sector of organizations and companies, including public television, private businesses, and foundations to champion science education. However, this campaign will be limited unless another vital sector—private and public universities—is included.

Universities, along with medical schools and other professional schools, have a unique capacity to promote excitement about science and medicine to young people by connecting them with strong role models, state-of-the-art laboratories, innovative technology, and hospital and laboratory internships. Given the greater flexibility of university extracurricular programs compared with public high school instruction, there is also the opportunity to focus on learning processes that promote stimulating, experiential, and cooperative learning as opposed to learning outcomes. Furthermore, universities can expose low-income and ethnic minority students to the culture of higher education, expand their knowledge base, and convey the need for them to enter science and health-related careers. In return, university-affiliated programs provide opportunities for faculty, staff, and students to develop skills in teaching science and create a positive awareness of universities among local communities.

Many students develop a lasting interest in science and medicine in informal settings: 75% of Nobel Prize winners in the sciences report that their passion for science was first sparked in nonschool environments.[2] Furthermore, science activities that take place outside classrooms allow for activities to be tailored to students' experiences, "where the nature of knowledge can be explored and a lifetime commitment to self-directed learning can be forged."[3]

Crisis in Science Education

The art of teaching and promoting an interest in science has traditionally been the purview of teachers within public schools; however, experts acknowledge that science education in many public schools is all but collapsing. An increasing number of reports document the decline of science education in the United States and lack of personnel from the scientific, technical, engineering, and mathematics fields in the US workforce.[4] A 2007 survey of 923 California elementary school teachers from 80 school districts found that 80% of teachers spent less than 1 hour each week teaching science, and 16% spent no time doing so.[5] More than 40% of teachers felt unprepared to teach science whereas only 4% felt unprepared to teach math.[5] Other reports emphasize the acute shortage of science and health professionals from underrepresented ethnic minority groups, an issue that will become increasingly important with health care reform.[6]

The most common approach for addressing the crisis in science education has been to direct resources to "fix" teaching and curricula at public schools. While some school-based reforms have demonstrated success, these efforts have often resulted in teaching to the test[2] and have been compromised by changing federal, state, and district teaching mandates.[4] Severe budgetary cuts compound the problem. In his annual address, the California superintendent of public instruction spoke of soaring class sizes and schools that put duct tape on light switches to conserve electricity. Students attending low-income schools are disproportionately affected by facilities that are overcrowded, in disrepair, or simply unsafe; teachers who lack adequate credentials or preparation; poorly equipped laboratories; inadequate technology; and outdated science textbooks.

Taking Advantage of Changing Demographics

The increasing number of older US individuals illustrates the need for new approaches to reach students who have potential in the sciences, but fail to attend college and enter science and health professions. In 2006, the first of the baby boom generation reached age 60 years. By 2100, it is estimated that the United States will be home to 131 million individuals aged 65 years or older, and 5.3 million individuals aged 100 years or older.[7] An Institute of Medi-

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cine report emphasized that when the elderly population comprises up to 20% of the population by approximately 2050, "we will face a health care workforce that is too small and critically unprepared to meet their health needs."[8]

Along with the increase in US's elderly population is an increase in its ethnic minority populations. In 2005, California, New Mexico, Texas, and Hawaii became the first nonwhite majority states.[9] The rest of the United States will follow, with 50% of the US population expected to be ethnic "minority" by 2050.[9] Compared with white non-Hispanics, a larger proportion of ethnic minority groups, especially Hispanics and blacks, are concentrated in the youngest age groups. Although thousands of young people from these age groups will join the workforce in the next 25 years, without new, effective outreach programs, they will remain severely underrepresented in higher education and in science and health-related careers.

Universities as Interventionists in Precollege Science Education

The worsening state of science education combined with trends in demographics provide an opportunity for President Obama to enlist universities as active partners in promoting science education to young people outside public school classrooms. For example, a Stanford University medical sciences pipeline program, supported in part by grants from a National Institutes of Health Science Education Partnership Award and the Howard Hughes Medical Institute, serves as a case study of how universities and medical schools can promote science education. The Stanford Medical Youth Science Program offers a 5-week summer residential program for low-income, predominately black, Latino, and Native American high school students.[10] Priority is given to students who are first-generation college students, have faced personal hardships, and are from underresourced schools, communities, or both, including rural and inner-city schools, and agricultural labor camps.

Since 1988, the program has selected 24 students each summer to live on the Stanford University campus with 10 Stanford undergraduate staff, most of whom are from underrepresented ethnic minority groups and majoring in the sciences. Students are immersed in science and medicine through a broad curriculum that is based on scientific inquiry and includes anatomy practicums in the human cadaver laboratory (taught by medical students); hospital internships; group research projects; lectures by prominent scientists and physicians; college admissions and standardized test preparation; and long-term college and career guidance.

Five hundred students have completed the Stanford Medical Youth Science Program since 1988; 97% have been followed up for up to 21 years and 99% have been admitted to college. Of these, 78% of black, 81% of Latino, and 82% of Native American participants have earned a 4-year college degree (excluding those currently attending college).[10] In contrast, among 25- to 34-year-old US adults, only 15% of blacks, 10% of Latinos, and 10% of Native Americans earn a 4-year college degree.[10] Among the Stanford Medical Youth Science Program's college graduates, 47% are attending or have completed medical or graduate school and 43% are working as or training to become health professionals.[10] Based on these outcomes, if one university in each state in the United States would support such a program, in 20 years more than 10 000 diverse low-income students could potentially enter science and health professions.

Active participation of universities in precollege science education can complement traditional approaches to learning science in classroom settings, help elevate science education as a national priority, and create an expanded pipeline for an educated workforce in scientific and health professions.

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