Published in final edited form as:
JAMA. 2010 March 10; 303(10): 983–984. doi:10.1001/jama.2010.249.

Promoting Science Education [Commentary]

Marilyn Winkleby, Ph.D., MPH[1] and **Judith Ned, M.Ed., Ed.D.**[1]

[1]Stanford University School of Medicine, Stanford Prevention Research Center, Stanford Medical Youth Science Program Stanford, CA, USA CA 94305-5411

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 of public school classrooms. The President's campaign encourages a broad sector of organizations and companies to champion science education, including public television, private businesses, and foundations. However, this campaign will be limited unless another vital sector is included—private and public universities.

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 lab 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 as opposed to learning outcomes that promote stimulating, experiential, and cooperative learning. 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 science report that their passion for science was first sparked in non-school environments.[2] Furthermore, science activities that take place outside of 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]

The 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 US and lack of personnel from the scientific, technical, engineering, and mathematics (STEM) 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 one hour each week teaching science, and 16% spent no time doing so.5 Over 40% of the 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

Corresponding author: Marilyn A. Winkleby, Ph.D., MPH, Professor of Medicine, Faculty Director, Office of Community Health, Stanford Prevention Research Center, Medical School Office Building (MSOB), 251 Campus Drive MC 5411, Room 318, Stanford, CA 94305-5411, Phone: (650) 723-7055, Fax: (650) 725-6247 winkleby@stanford.edu.

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 labs; inadequate technology; and outdated science textbooks.

Taking advantage of changing demographics

The increasing number of older Americans illustrates the urgent 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. By 2100, it is estimated that the US will be home to 131 million individuals aged 65 and older, and 5.3 million individuals aged 100 years and older.[7] An Institute of Medicine report "Retooling for an Aging America: Building the Health Care Workforce," 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 America's elderly population is an increase in its ethnic minority populations. In 2005, California along with New Mexico, Texas, and Hawaii became the first non-white majority states.[9] The rest of the US 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 African Americans, 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 pre-college 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 of public school classrooms. A Stanford University medical sciences pipeline program, supported in part by grants from an NIH 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 (SMYSP) offers a 5-week summer residential program for low-income, predominately African American, 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 under-resourced schools and/or communities 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 lab (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 SMYSP since 1988; 97% have been followed for up to 21 years and 99% have been admitted to college. Of these, 78% of African American, 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 African Americans, 10% of Latinos, and 10% of Native Americans earn a 4-year college degree.10 Among SMYSP'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 US would support such a program, in 20 years more than 10,000 diverse low-income students could potentially enter science and health professions.

Conclusion

Active participation of universities in pre-college 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.

Acknowledgments

Additional Contributions: We thank Drs. Don Barr, Gabe Garcia, Charles Prober, Randy Stafford, Barry Starr, Hannah Valantine, and PJ Utz, and Ms. Nell Curran, Ms. Cindy Limb, and Ms. Alana Koehler from the Stanford School of Medicine; Dr. Michael Lichtenstein from the University of Texas Medicine at San Antonio; Ms. Debra Felix from the Howard Hughes Medical Institute, and Dr. Chris Perumalla from the University of Toronto for their critical reading of the manuscript. None received remuneration for their contributions. Disclaimer: The content of this commentary is solely the responsibility of the authors and does not necessarily represent the official views of the funding agencies.

Funding Support: Drs. Winkleby and Ned are supported in part by grants from the Science Educational Partnership Award (SEPA) from the National Center for Research Resources, a component of the National Institutes of Health (R25RR026011); the Howard Hughes Medical Institute, Grants for Precollege Science Education (51006099); The HealthTrust, San Jose, California; and the Stanford NIH/NCRR CTSA Award (UL1 RR025744).

References

1. The White House. Educate to Innovate. [Accessed 1/5/10]. [webpage] http://www.whitehouse.gov/issues/education/educate-innovate
2. Yager, RE.; Falk, JH., editors. Exemplary Science in Informal Education Settings. Standards-Based Success Stories. Arlington, VA: National Science Teachers Association Press; 2008.
3. Friedman LN, Quinn J. Science by stealth. How after-school programs can nurture young scientists and boost the country's scientific literacy. Educ Week 2006;25(24) 45,48,49.
4. U.S. Department of Education. Report of the Academic Competitiveness Council. [Accessed 1/22/08]. [PDF] http://www.ed.gov/about/inits/ed/index.html
5. Dorph, R.; Goldstein, D.; Lee, S.; Lepori, K.; Schneider, S.; Venkatesan, S. The status of science education in the Bay Area: Research brief. Berkeley, CA: Lawrence Hall of Science, University of California; 2007.
6. Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future. Washington, DC: National Academies Press; 2007. Committee on Prospering in the Global Economy of the 21st Century, National Academy of Science.
7. Department of Health and Human Services. Statistics. A Profile of Older Americans: 2007. The Older Population. 2008 Feb 11 [Accessed 4/7/08]. [Web page] http://www.aoa.gov/prof/statistics/profile/2007/3.asp

8. Institute of Medicine. Retooling for an Aging America: Building the Health Care Workforce. Washington, DC: National Academies of Science; 2008 Apr 11. 2008

9. U.S. Census Bureau. Census 2000 Summary File 4—United States. [Accessed 2/1/10]. http://www.census.gov/prod/cen2000/doc/sf4.pdf

10. Winkleby MA, Ned J, Ahn D, Koehler AR, Kennedy J. Increasing diversity in science and health professions: A 21-year longitudinal study documenting college and career success. J Sci Educ Technol 2009;18:535–545.