Promoting Engineering, Science and Technological Literacy: Pre-College Educator Resources

Douglas Gorham
Manager, Pre-college Education
IEEE Educational Activities

Abstract
In an ever increasing technical society the need for a technologically literate citizenry who possesses the ability to use, manage, assess, and understand technology, science and engineering is becoming a basic necessity. Pre-college students must be educated to make informed decisions in our technological world. IEEE and ASME have developed resources that promote these areas of study at the pre-college level. Engineers and engineering educators are encouraged to share these resources with their local pre-college schools and school districts to enhance the level of science and technological literacy and to promote engineering as a future area of study and as a career option.

Introduction
The engineering profession is concerned with the Engineering Workforce Commission of the American Association of Engineering Societies report indicating an overall US decline in B.S. degrees in engineering awarded between 1996-2000.[1] Federal Reserve Chairman Alan Greenspan, testifying before the Committee on Education and the Workforce regarding the economic importance of improving math-science education, reinforced the need for a more technologically literate society and workforce when he stated, "The proportion of our workforce that created value through intellectual endeavors, rather than predominantly through manual labor, began a century-long climb. In 1900, only one out of every ten workers was in a professional, technical, or managerial occupation. By 1970, that proportion had doubled, and today those jobs account for nearly one-third of the work force."[2]

The growing importance of technology on our society means that the engineering profession can have an increasingly significant influence on teachers and their students. As the need for a technologically literate populace increases pre-college institutions are being held accountable for producing graduates who possess basic technical knowledge and skills. Typically, schools are not able to keep up with the rapid pace of technological innovations. In addition, educators, like other segments of society, possess varying degrees of technical expertise.

IEEE and ASME have developed resources for pre-college educators that promote engineering, science, and technological literacy. Engineers and engineering educators are encouraged to share these resources with their local pre-college schools and school

districts to enhance the level of science and technological literacy in their local community and to promote engineering as a future area of study and as a career option.

IEEE and ASME Resources

IEEE and ASME promote enhanced technological literacy through a collaborative outreach effort. Both have established an outreach program that impacts the pre-college community. Each organization has addressed a variety of needs of pre-college educators through a diversity of programs and products. And, while IEEE and ASME have differing approaches, both organizations agree that the engineering profession, working with pre-college educators, can strengthen efforts to advance science, mathematics and technological literacy in elementary and secondary schools.

IEEE Resources

PEERS (Pre-College Educator/Engineer Resource Site), (www.ieee.org/eab/peers), is a resource to help engineers and educators work together to make technical subjects and technology come alive. PEERS offers a recommended process designed to help engineers effectively contribute to the local school system. A goal of PEERS is to develop a broad network of engineers of all disciplines who will become science, mathematics, and technology resources for the pre-college education community. Educators can utilize PEERS to discover how engineers can enhance their level of technological literacy and how to infuse technical subject matter in their classroom instruction.

The Teacher In-service Program, (www.ieee.org/organizations/EAB/precollege/tipst), features engineers developing and presenting technologically oriented subject matter to pre-college educators in an in-service/professional development setting. This program was piloted by the Florida West Coast Section in 2001 and now boasts participation by fourteen IEEE Sections. Sample presentation topics include: “Everything You Wanted to Know About Electric Motors But Were Afraid to Ask”; “Rocket Cars and Newton’s Laws”; “Light Waves and Spectroscopes”; and “Build Working Models from Household Items.” Over 160 pre-college science, technology and mathematics educators have participated in this program. These teachers represent over 20,000 students.

The IEEE Virtual Museum, (www.ieee.org/museum), is designed for educators, students ages 10-18, and the general public to enhance their understanding of the principles of electrical and information sciences and technologies within a historical context. It explores the global social impact of technology and demonstrates the relevance of engineering and engineers to society.

IEEE is planning a future two-day conference titled: **LEADERSHIP FOR TECHNOLOGICAL LITERACY: Collaborations in Science, Mathematics, Engineering, and Technology Education (SMET)**. The central themes of the conference are leadership, technological literacy, and collaborations among mathematics, science, and technology educators.

The primary attendees at the conference will be pre-college educators from all over the world. However, engineers, scientists and other technical professionals may have an interest in attending. Sessions will describe programs and projects that feature the

integration of the SMET disciplines and will focus on collaborations between engineers and educators, both in and outside the classroom. The emphasis of all the sessions will be hands-on, demonstrated activities that provide attendees with useful teaching tools or practical ideas for program implementation.

ASME Resources

"The Integrated Design Engineering Activity Series" (IDEAS), available in both web and booklet formats. IDEAS (www.asme.org/education/precoll/ideas/) provides ten low cost, hands-on project activities for middle grade teachers and students, with connections to science, technology and mathematics. Teachers and engineers developed each activity within IDEAS. Sample project activities include: "Toothpick Bridges and Other Structures"; "Solar Collector"; "Alternative Energy-Wind Powered Machines"; "Geodesic Domes And Sheltering Structures"; and "Amusement Park and Playground Physics."

"Engineers Solve Problems" web site link, (www.asme.org/education/precoll/esp/), features lesson activities aimed at the middle school audience. The activities include a lesson rationale, lesson objectives, a lesson plan and enrichment activities. Sample activities include: "Why Do Planes Fly"; "How Tall Is That Flagpole Anyway?"; "The Wonderful World of Gears"; and "Amusement Park Roller Coaster."

Teacher and student workshops are available. The teacher workshop focuses on science, technology and mathematics educators engaged in a 5-6 hour program. This hands-on presentation is connected to the science and technology standards and features teachers working in small groups. One example of a workshop focus is to have teachers examine, sketch, and construct common household mechanisms. The student workshop provides students the opportunity to work with engineers to investigate how common household mechanisms function and to construct cardboard mechanisms to "rescue" a figure from a simulated roller coaster during a mechanical design competition.

The opportunity for local Sections to apply for "Pre-college Action Grants" is available. These grants are designed to encourage engineers and student Sections to partner with teachers and schools to: initiate new programs, enhance existing programs and develop professional development activities for teachers.

A variety of electronic and print material, geared to pre-college educators, including guidance counselors has been produced. Sample electronic materials include: "The Mothers of Invention"; "Engineering is For Everyone"; "Water Wheels, Structures, Tops, and Yo-Yos"; "CareerPath: Mechanical Engineering"; "Careers for Mechanical Engineers"; and "Career Encounters: Mechanical Engineering." A diversity of print material is available for pre-college educators including: "What is a Mechanical Engineer?", "Mechanical Engineering and Mechanical Engineering Technology: Which Path Will You Take?"; and "Mechanical Engineering A-Z."

What Can Engineering Education Do?

Engineering educators and engineering departments can act as catalysts to support and encourage schools and school districts to offer an array of practical and applicable science, mathematics and technology activities for pre-college students that promotes an increase in technological literacy.

Engineering educators and engineering departments can join pre-college educators in contributing to this venture in a variety of ways including:

- Initiating interdisciplinary collaborations with pre-college technology and science faculty.
- Developing partnerships with schools and assist in developing technologically oriented curricula, including engineering projects and laboratory activities.
- Sharing the pre-college resources available from the IEEE and the ASME.
- Assisting in the curricular articulation with community colleges.
- Serving as a member of a school or district technology committee.
- Becoming a member of a school or district curricular review team to assess science or technology curriculum, textbooks, workbooks or equipment.
- Developing collaborations with school districts to develop practical, applicable engineering activities for pre-college teachers.
- Partnering with a school for local, state, and national competitions in science, technology or mathematics.

Bibliography

[1] "Engineering and Technology Degrees: 2000", Engineering Workforce Commission of the American Association of Engineering Societies, Inc., pp. 10-13.

[2] Greenspan, A. (September 21, 2000). The economic importance of improving math-science education. Testimony before the Committee on Education and the Workforce, U.S. House of Representatives. Washington, D.C.

DOUGLAS GORHAM

Douglas Gorham is currently responsible for pre-college education programs for the IEEE Educational Activities Board. He taught high school science for 8 years in Illinois and served as a high school administrator for 18 years, including 12 years as a high school principal. As a principal Dr. Gorham: coordinated the planning and implementation of an electronics engineering program, was highly involved in the design and building of a new high school, added Advanced Placement programs, and developed and implemented interdisciplinary programs combining pre-calculus with physics and American Literature with American History.