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ABSTRACT

The purpose of this guide is to offer suggestions for establishing different types of partnerships in math, science, and technology education and to suggest resources to make them successful. The first section describes materials to enhance learning that meet national science and mathematics education standards. The second section describes different types of K-12 partnerships in which engineers can add valuable insight. Types of partnerships, strategies for successful partnerships with educators, and examples of successful programs are also included. Contact information is provided throughout the guide. (WRM)

Volunteer Guide for Engineers

In Support of Educators

American Association of Engineering Societies

VOLUNTEER GUIDE *for* ENGINEERS

In Support Of Educators

American Association of Engineering Societies

The Engineers' Precollege Education Council

As a coordinating body representing more than 800,000 engineers, the Engineers' Precollege Education Council (EPEC) of the American Association of Engineering Societies (AAES) supports K-12 math, science and technology education in the United States. The EPEC seeks to enhance literacy in these areas and increase awareness of the engineering profession.

AAES is a multi-disciplinary organization of engineering societies dedicated to advancing the knowledge, understanding and practice of engineering in the public interest. AAES member societies represent the mainstream of U.S. engineering, with members in industry, government and education.

For more information on K-12 efforts in math, science and technology education, contact: Manager, Precollege Education Program, AAES, 1111 19th Street, N.W., #608, Washington, D.C., 20036. (202) 296-2237.

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This Volunteer Guide

There are many successful programs and partnerships in K-12 math, science and technology education, involving representatives from government, businesses, educational institutions and others. Engineers have played a powerful role as partners in many of these alliances and the roles for engineers in education are varied and numerous.

The purpose of this *Volunteer Guide for Engineers in Support of Educators* is to offer suggestions for establishing different types of partnerships in math, science and technology education and suggest resources needed to make them successful.

There are many resources available for volunteer activities, and those listed in this guide serve as just a sample of the possibilities for programs and partnerships. The appendix page following each section is included to provide references for additional educational resources developed by non-engineering organizations.

"In an ongoing partnership, engineers can lend their knowledge to help revise math, science and technology education from the bottom up. Our future as a nation depends upon the technical literacy of our population."

James E. Sawyer, P.E.
1995 Chair
AAES

MATERIALS TO ENHANCE MATH, SCIENCE AND TECHNOLOGY

Curriculum is the information that students are to learn and teachers are to teach. As a volunteer, often it is helpful to come to the classroom with materials that can enhance the existing curriculum in conjunction with a teacher's lesson plan. The materials listed in this guide were developed by engineering societies, meet national math and science education standards, and are available for use nationwide.

Math Education Standards ...

In 1989, the National Council of Teachers of Mathematics published its Curriculum and Evaluation Standards for School Mathematics. These standards define parameters for math competency across many areas, emphasizing students' ability to work collaboratively and to use mathematics to solve problems that arise in their everyday experiences.

Science Education Standards ...

In 1995, the National Academy of Sciences, through the National Research Council, released the National Science Education Standards. These benchmarks of what every student should know and be able to do in science emphasize that all students have the opportunity to learn science through hands-on activities and student-centered and cooperative learning.

ELEMENTARY SCHOOL

A World in Motion
Society of Automotive Engineers, International

A World in Motion is an elementary school physical science supplement for grades 4-6 that focuses on partnerships between teachers and engineers. The program involves professional engineers assisting elementary school teachers to motivate students, connecting physical science and mathematics with daily life.

Contact: Education Program Coordinator, SAE International, 400 Commonwealth Drive, Warrendale, PA 15096. (412)776-4841, fax: (412)776-5760.

Starting Out With National Engineers Week

Beginning a volunteer effort with a school can be made easy through the DiscoverE program of National Engineers Week (NEW), held in February of each year. DiscoverE activities are often the beginning of partnerships that continue throughout the school year and longer. During NEW, engineers visit classrooms to develop enthusiasm and interest in the applications of math, science and technology, often discussing the problems that they face and the work that they do. Materials can be provided by NEW Headquarters. **Contact:** National Engineers Week/DiscoverE, 1420 King Street, Alexandria, VA 22314. (703)684-2852, eweek@nspe.org.

Transformations
American Institute of Mining, Metallurgical and Petroleum Engineers

Transformations provides technical expertise and guidance to both teachers and students through two different programs. *Transformations: Science, Technology and Society* is an eight-part video and teacher guide series that is a collaboration of the knowledge and experience of engineers and teachers. The Transformations Project teams middle school teachers with practicing scientists and engineers who integrate experiences into daily classroom instruction, collaborate in team-to-team training, and interact with other teachers and technologists via the Internet.

Contact: Transformations, PO Box 1205, Jamaica Plain, MA 02130. (617)323-4514, transproj@aol.com.

MATHCOUNTS
National Society of Professional Engineers

MATHCOUNTS combines the efforts of education, business, government, and the technological community to promote math excellence among junior high school students. Teachers and volunteer engineers coach student "mathletes" on materials that emphasize team problem-solving and real-world solutions in preparation for local, state and national competition. Volunteers serve as scorers and hosts at competitions, serve on organizational committees, adopt teams, and sponsor programs.

Contact: MATHCOUNTS, 1420 King Street, Alexandria, VA 22314. (703)684-2828, mathcounts@nspe.org.

Tests of Engineering Aptitude, Mathematics and Science® (TEAMS®)

The TEAMS competition is an academic program in which teams of high school students work in an open book, open discussion environment to solve math- and science-based problems that engineers would face, often working with an engineering mentor. TEAMS combines academics with teamwork.

Contact: Junior Engineering Technical Society, Inc.®, 1420 King Street, Suite 405, Alexandria, VA 22314-2794. (703)548-5387, fax: (703)548-0769, jets@nas.edu.

National Engineering Design Challenge® (NEDC®)

The NEDC provides teams of students with the opportunity to design, fabricate, and demonstrate a working solution to a societal need. With the help of engineering mentors, students have developed solutions to replace a highway flagperson, help people with disabilities turn pages of printed materials, and retrieve and replace common household items from various locations.

Contact: Junior Engineering Technical Society, Inc.®, 1420 King Street, Suite 405, Alexandria, VA 22314-2794. (703)548-5387, fax: (703)548-0769, jets@nas.edu.

National Engineering Aptitude Search® (NEAS+®)

The NEAS is a self-administered academic survey that helps students determine their ability in pre-engineering and pre-technology basic skills, including mathematical understanding, scientific reading and reasoning, and practical understanding of physical phenomena. A "content map" enables students, either individually or with a teacher, tutor or mentor, to determine their ability level.

Contact: Junior Engineering Technical Society, Inc.®, 1420 King Street, Suite 405, Alexandria, VA 22314-2794. (703)548-5387, fax: (703)548-0769, jets@nas.edu.

"Approaching a teacher with materials that could enhance the set curriculum provided me with a constructive, reliable and exciting way to get started in my partnership with a local elementary school class."

Jon Darling
Volunteer
Institute of Electrical
and Electronics Engineers

Other Program Materials and Resources ...

American Association for the Advancement of Science, Project 2061/Resource Center, 1333 H Street, NW, Washington, DC 20005-4792. (202)326-6666, fax: (202)842-5196.

Project 2061 is a long-term initiative to reform K-12 education in natural and social sciences, mathematics and technology. Services include a resource data-base for curriculum and instruction.

Eisenhower National Clearinghouse, 1929 Kenny Road, Room 400, Columbus, OH 43210-1079. (614)292-9734 or (800)621-5785; fax - (614)292-2066; Internet - telnet enc.org or gopher enc.org; WWW - http://www.enc.org/; modem - (800)362-4448 or (614)292-2040.

ENC provides a national and international collection of curriculum materials in K-12 mathematics and science and also collects and disseminates information on federal math and science programs.

National Aeronautics and Space Administration NASA CORE, Lorain County JVS, 15181 Route 58 South, Oberlin, OH 44074. (216)774-1051, ext. 293 or 294.

NASA's Teacher Resource Center Network is used to enhance exisiting curriculum with information generated by NASA programs and technologies.

National Science Resources Center, 600 Maryland Avenue, SW, Suite 880, Washington, DC 20560. (202)287-2063, fax: (202)287-2070.

The NSRC collects and disseminates information about teaching resources and curriculum materials, and sponsors outreach activities, specifically for leadership development and technical assistance.

EDUCATION PARTNERSHIPS

Combining the forces of businesses or engineering societies and schools can bolster students' knowledge and teachers' preparation. There are various ways for an engineer to be involved in one of these education partnerships. Four of them are identified below by the National Association of Partners in Education, Inc. Contact: NAPE, 209 Madison Street, Suite 401, Alexandria, VA 22314. (703)836-4880.

- *Helping Hands* or "adopt-a-school" programs are those in which an individual company is paired with a school to support existing activities, providing tutors, speakers, equipment, and achievement incentives.

- In *Programmatic Initiatives*, individual companies work with school partners to develop programs that target specific curriculum or student and teacher needs, including technology skills, curriculum development, and school-to-work issues.

- Business leaders, educators and community organizations work together on *Policy Changes* to reduce bureaucracy, work for changes in legislation and regulations, and provide support through financing and programs.

- *Alliances, and Community Coalition Efforts* are joint efforts among businesses, community organizations and schools, designed to bring about fundamental changes, such as revision of curriculum and instruction, reorganization of school governance, and policy changes.

Other Tips for Creating Partnerships ...

National Research Council -- Project RISE
2101 Constitution Avenue, NW, Room HA 486, Washington, DC 20418. (202)334-2110, fax: (202)334-3159.

The NRC's Regional Initiatives in Science Education (Project RISE) aims to familiarize scientists with goals for science education reform through conferences, workshops, teacher training programs, and distribution of classroom materials.

Partners in K-12 Science Education Reform, Sigma Xi, The Scientific Research Society, PO Box 13975, Research Triangle Park, NC 27709. (800)243-6534, fax: (919)549-0090.

Handbook of effective strategies to creating partnerships in math, science and technology education.

Science Education Partnerships, Manual for Scientists and K-12 Teachers, San Francisco Science Press, PO Box 31188, San Francisco, CA 94131. $14.95 plus $4.00 shipping and handling. Fax orders to: (415)476-9926.

Thirty-five articles describe initiating partnerships, finding funding, implementing successful programs, and partnerships in the realm of systemic reform.

Triangle Coalition for Science and Technology Education, 5112 Berwyn Road, Third Floor, College Park, MD 20740-4129. (301)220-0870, fax: (301)474-4381.

The Triangle Coalition joins the forces of business and industry, science and engineering, and education, forming local alliances and partnerships to encourage reform in science, mathematics and technology education.

TYPES OF PARTNERS

Before you approach a school or a teacher in a partnership or other volunteer effort, become familiar with the type of activities in which you would like to be involved so you can offer suggestions or ask about your options. You could ...

- become a mentor or a tutor;
- work with a teacher to develop lesson plans or curriculum;
- help with clubs or science fairs;
- provide funds to buy equipment or help write fundraising proposals;
- organize internships or field trips;
- become an ongoing advisor to a teacher for lessons related to math, science and technology;
- work with administrators on strategic planning;
- assist with the professional development of teachers.

"Engineers are particularly goal-oriented and especially concerned about output as well as input. Classroom teachers can exploit this attribute for their students with hands-on demonstrations of physical principles."

Alfred Skolnick
Past-President
American Society of Naval Engineers

BECOMING A PARTNER

It may be helpful to consider the following strategies when entering into a partnership:

- **Contact the volunteer coordinator at the school district office first.** Each district will have its own process for matching partners and coordinating needs and objectives. If the district does not have a volunteer coordinator, contact the principal at a local school.

- **Contact members of existing school alliances or partnerships.** These can give you information about coordinating your efforts with an established network. See *Tips for Creating Partnerships* on page 9.

- **Respect your partner's needs.** Whether working with a teacher in the classroom or administrator on policy or curriculum revision, remember that educators must accomplish specific goals set by boards of education and administrators.

- **Prepare ahead of time.** If planning an activity, organize all of your materials and run through experiments or other activities at least once. *Use educational resources that emphasize hands-on discovery or real-world experiences.*

- **Make a long-term commitment** to your partnership. In this way, you can encourage both lasting change and the commitment of teachers and students.

More Steps to Volunteering...

These resources provide helpful suggestions to get you started in your volunteer effort:

A Guide to Volunteerism
National Society of Professional Engineers
1420 King Street
Alexandria, VA 22314
(703)684-2882, fax: (703)836-4875

Science Education in our Elementary and Secondary Schools: A Guide for Technical Professionals Who Want to Help
Sandia National Laboratories
Education Outreach Department
PO Box 5800
Albuquerque, NM 87185
(505)845-8680, fax: (505)844-7910

Sharing Science with Children: A Survival Guide for Scientists and Engineers; ***Sharing Science: Linking Students with Scientists and Engineers***; and ***Sharing Science with Children: A Guide for Parents***
North Carolina Museum of Life and Science
PO Box 15190
Durham, NC 27704
(919) 220-5429, fax: (919)220-5575

Volunteer Guide
Institute of Electrical and Electronics Engineers
1828 L Street, NW, Suite 1200
Washington, DC 20036
(202)785-0017, fax: (202)785-0835
a.hartfiel@ieee.org

PARTNERSHIP PROGRAMS ... EXAMPLES

Many engineering societies have become involved in partnership activities with local schools. These alliances range from one-on-one tutorial programs to systemic reform of entire districts. The following programs are *a sampling* of these successful efforts and can serve as prototypes to building your own volunteer programs.

Get SET
Society of Women Engineers

GetSET, (Get Science, Engineering and Technology) a four-year outreach program of the Society of Women Engineers Santa Clara Valley (California) section, encourages young underrepresented minority women in grades 9-12 to pursue careers in engineering based on hands-on learning exercises that emphasize technical, scientific and engineering concepts. The program encourages enrollment in math and science throughout high school; exposes students to concepts, material, and knowledge related to engineering; and shows how engineering relates to everyday life. Each summer involves a week-long engineering program followed by learning experiences throughout the school year.

Contact: Society of Women Engineers, Santa Clara Valley Section, GetSET Program, PO Box 61333, Sunnyvale, CA 94088-1333.

Salvadori Middle School Program
Salvadori Educational Center on the Built Environment

The Salvadori Educational Center on the Built Environment targets primarily inner-city public schools by using the concrete tools of architecture and engineering to teach the abstract concepts of math and science. Through a resource specialist staff of architects, the Salvadori Middle School Program provides training, curriculum materials and on-site technical assistance to teachers in eight New York City schools. SECBE conducts workshops and seminars during the school year and provides curriculum components and educational materials to educators nationwide.

Contact: SECBE, c/o City College, Harris Hall, #202, 138th St & Convent Ave, New York, NY 10031. (212)650-5497, fax: (212)650-5546.

"The Engineer's Precollege Education Council has identified the importance of partnerships between engineers and educators to strengthen K-12 education today. The practical and technical knowledge that engineers can offer to students and teachers is an invaluable resource."

Donald N. Zwiep
1995 Chair
EPEC

Brownsburg Partnership
PSI Energy

PSI Energy and the Brownsburg Community School Corporation in Brownsburg, Indiana, have formed a partnership between engineers and educators to develop activities to supplement curricular areas specific to fifth and sixth grade students in math and science. Activities include assisting in science fair projects, classroom science projects, computer learning, and setting up tours of business facilities. PSI is also involved in "Teach the Technology," a program for practicing engineers, educators and students in grades 5-12 that encourages an interest in science, math, manufacturing, and engineering.

Contact: CINERGY, 2437 East Main Street, Plainfield, IN 46168-2715. (317)838-1518, fax: (317)838-6746.

TRAC
American Association of State and Highway Transportation Officials

TRAC (TRansportation and Civil engineering) is a hands-on education program designed for use in science, math and social science classes. Volunteer engineers from state Departments of Transportation work with high school teachers and students using a computerized mobile laboratory and more than two dozen activities. By engaging students in real-world problems, TRAC connects students to the work world of transportation and engineering.

Contact: TRAC Program Director, PO Box 495, Ridgeland, MS 39158. (601)977-0209, fax: (601)977-8497.

Hughes K-12 Education Program Hughes Aircraft Company

The Hughes K-12 Education Program offers a support system for the improvement of math, science and computer education in Los Angeles area schools that lie in the Hughes local community. Volunteers tutor, give science demonstrations, perform science and engineering experiments, judge science fairs, and design and construct science and computer labs. The Hughes Teacher Center also supports teachers through teacher training and workshops, and each year Hughes also presents the Hughes Excellence in Teaching Math and Science Award to a local teacher.

Contact: Hughes K-12 Education Program, Bldg. C1, MS C129, PO Box 80028, Los Angeles, CA 90080. (310)568-6454, fax: (310)338-9459.

Westerville City School District Partnership Program American Ceramic Society

Through its partnership program with the local school district in Westerville, Ohio, the American Ceramic Society has developed an alliance to encourage student interest in science. Volunteers serve as technical experts to assist teachers with the application of ceramic science theories and principles, providing technical literature, technology updates and hands-on experiments. Activities also include field trips, internships, mentoring, access to ACerS facilities, scholarships, and teacher initiative grants.

Contact: American Ceramic Society, 735 Ceramic Place, Westerville, OH 43081-8720. (614)794-5898, fax: (614)899-6109.

School Partnership Program American Institute of Chemical Engineers/St. Louis Section

The St. Louis section of AIChE has partnered with the St. Louis Public Schools to enhance math, science and technology literacy and develop interest in engineering. Through the School Partnership Program of the St. Louis Public Schools, seven volunteers work with a high school class on a monthly basis, collaborating with the teacher's needs on activities including conducting experiments, discussing engineering, judging local science fairs, and National Engineers Week activities. The St. Louis chapter also sponsors two teachers each year to participate in a professional development workshop.

Contact: Cathy Zartman, AIChE, c/o Monsanto, 800 N. Lindbergh F4EC, St Louis, MO 63167. (314)694-4527, fax: (314)694-6595.

"Our School Partnership Program also involves a professional development workshop in which teachers incorporate real-world perspectives in their curriculum, which is critical to sustaining the interest and enthusiasm of students."

Cathy Zartman
Volunteer
American Institute of Chemical Engineers

Expanding Visions Program
Mobil Corporation

A Mobil Corporation grant to the Fairfax County Public Schools in Virginia sponsors the Expanding Visions program, which encourages middle school students to enroll in advanced math, science and technology courses, and works to increase awareness of the practical applications of these disciplines. The program includes classroom demonstrations and activities that introduce "hands-on" problem-solving, field trips including direct experience with equipment, tutoring sessions, and a year-end "Olympiad," in which student teams compete to solve academic challenges developed by business professionals.

Contact: Expanding Visions, Luther Jackson Middle School, 3020 Gallows Road, Falls Church, VA 22042. (703)204-8100, fax: (703)204-8197.

Partners in Education Program
Babcock & Wilcox

Babcock & Wilcox in Lynchburg, Virginia, is a Master Partner in the Partners in Education joint venture between the Lynchburg City Schools and the Greater Lynchburg Chamber of Commerce. The purpose of the partnership is to create linkages between the school system and area businesses, organizations and institutions. Activities include an Engineering Mentoring Program and participation in a Technology Education Advisory Committee, which develops technology-based modules for students.

Contact: Human Resources, Babcock & Wilcox, PO Box 785, Lynchburg, VA 24505. (804)522-6046, fax: (804)522-5922.

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