Public Policy Statement
2010-2013

SCIENCE EDUCATION POLICY

Well-educated scientists and engineers drive the technology development that allows the United States to maintain its competitive edge in the global marketplace and improve the well-being of all the world's citizens. Improvements in science, technology, engineering, and mathematics (STEM) education across all levels are critical to preparing current and future students with the skills to address these rapidly evolving technology needs. To achieve these STEM education improvements, policymakers should pursue the following objectives:

- Promoting lifelong, rigorous, inquiry-based, science education in both formal and informal settings to improve our citizens' understanding of science and the role it plays in our nation's economic and social well-being
- Ensuring adequate state and federal support for pre- and in-service teacher training to strengthen the quality of teaching and thus enhance student learning
- Nurturing students of all backgrounds—particularly those from under-represented groups—in the pursuit of further studies, and ultimately, careers in the science and engineering fields.

A systematic approach to improving science education is necessary to meet these objectives. Such an approach must recognize that U.S. students can enter and exit the educational system at many different grade levels. To succeed, all elements of the integrated educational system must be periodically monitored, evaluated, and improved.

This systematic approach is supported by research-based methods that yield measurable results and focus on the weakest areas of the science education system. The development and implementation of a national set of core science standards based upon desired learning outcomes are also necessary. These national standards must reflect the current body of research on teaching and learning and must emphasize the process and practice of science.

To improve the overall STEM education system, including alignment with workforce programs, we support

- Creating formal state coordinating councils to improve the alignment of K-12, higher education, and workforce training programs in the STEM subjects.
- Improving and aligning science standards and curricula by using systematic efforts within individual states, as well as between states.
- Pursuing initiatives at all educational levels to encourage partnerships between schools and appropriate STEM industries and/or businesses that would offer students a hands-on learning environment in cutting-edge, high-impact science in order to strengthen, expand, and diversify the STEM education system.

American Chemical Society, 1155 Sixteenth Street NW, Washington DC 20036, 202-872-4386, www.acs.org/policy

Improving K-12 Science Education

To prepare and nurture well-educated teachers, we support

- Recruiting, retaining, rewarding, and valuing teachers who are well prepared in their science and education backgrounds, and offering them lifelong professional-development opportunities to improve their content knowledge and pedagogical skills.
- Creating effective alternative pathways for science and technology professionals to become second-career, K-12 teachers.
- Providing opportunities for science and technology professionals to positively engage with K-12 teachers and students.

To foster a modern learning environment, we support

- Teaching science as core subject matter at every educational level and as an essential element of a well-rounded education with these goals in mind: all students should be proficient in science at the levels appropriate for their grade levels and all schools should be held accountable for their students' performance in science.
- Developing rigorous, high-quality science education standards based upon performance expectations and outcomes and providing adequate resources and facilities to support classroom and laboratory instruction towards these standards.
- Using both formative and summative assessments to provide feedback to both students and teachers in order to improve the overall learning experience.
- Choosing curricula that emphasize scientific reasoning, inquiry-based learning (as defined in the National Science Education Standards) and the most up-to-date scientific understanding of the physical world.
- Investing robustly in educational research in STEM subjects that guide the development of model programs, tools, and methods for improving the teaching and learning of science, and the means for assessing this.
- Adopting an expanded vision of scholarships that reward and promote discipline-based education research within STEM disciplinary departments.

Strengthening Higher Education In Science

To strengthen teacher education programs, we support

- Improving coordination, particularly in the area of teacher preparation, between teacher-education programs and STEM departments at higher education institutions.
- Making improvements in the rigor of, and standards for, existing STEM teacher education programs, especially in the area of increased and up-to-date science content knowledge.
- Creating and expanding dual-degree programs in teacher education designed to produce graduates with STEM degrees and concurrent teacher certification.

To enhance the higher education infrastructure, we support

- Making substantial investments to provide two- and four-year colleges and universities with modern science facilities, instrumentation, and world-class infrastructure.
- Carrying out targeted efforts to improve the capability of higher education institutions to recruit students into the STEM fields, especially those from under-represented groups.
- Expanding undergraduate research experiences by including support for summer and academic-year research projects and collaborations with industry, other academic institutions, government labs, and international collaborators.

APPENDIX: SPECIFIC POLICY RECOMMENDATIONS FOR SCIENCE EDUCATION

K-12 Education

1. Prepare and support well-educated teachers by

- Ensuring adequate funding for science teacher in-service professional development programs that use research-validated methods.
- Providing financial incentives to encourage high school teacher participation in summer research, workshops, and other external activities at higher education institutions, companies, and government laboratories.
- Requiring science teachers to take education courses that emphasize up-to-date content knowledge, peer-reviewed research in science education and human cognition, and use of technology.
- Promoting the use of appropriately certified teachers, at all levels, to teach science.
- Providing assistance to teachers through mentoring by master teachers, science specialists, or scientists.
- Ensuring that working conditions for science teachers are consistent with National Science Education Standards and ACS guidelines and that teachers have adequate time for class and laboratory planning and preparation.
- Evaluating teacher effectiveness in multiple ways to identify professional development needs.
- Supporting adjunct teacher programs that provide opportunities for experienced science and technology professionals to bring their expertise into the classrooms of K-12 teachers.

2. Implement high standards by

- Developing research-validated science curricula, based on content frameworks, such as those provided by the National Science Education Standards or AAAS Benchmarks, and including chemistry components at appropriate grade levels.
- Evaluating students' science achievement regularly with evaluation instruments that incorporate content knowledge, hands-on activities, scientific process skills, and higher-level cognitive skills.
- Holding schools accountable for student performance in science.
- Mandating at least three years of laboratory-based science for all secondary school students that is integrated across the disciplines and throughout the secondary school years and includes a scientific ethics component. This must be complemented by at least three years of mathematics instruction at the secondary school level, because a firm grounding in both mathematics and science is essential to prepare students for college-level science and engineering courses.
- Supporting the use of computers and web-based tools for appropriate purposes such as simulations, experimental investigations, and drills, but not as a complete replacement for hands-on laboratory experiences.
- Supporting the development of chemistry courses that present the broad scope of modern chemistry, including environmental protection and green chemistry.
- Supporting Advanced Placement, International Baccalaureate, or similar advanced programs as a second-year chemistry option.
- Supporting efforts to provide incentive grants to individual states to improve the quality of their science standards.

3. Facilitate inquiry-based learning by

- Ensuring that science teachers have adequate facilities (classrooms and laboratories) and other resources necessary for safe, hands-on, inquiry-based, science instruction that is supported by adequate budgets for supplies, equipment, equipment maintenance, and access to online resources.
- Providing support, such as scholarships, for high school student participation in science-focused experiential programs and activities during the school year and summer.
- Establishing school/business/government/professional society alliances for regular introduction of up-to-date STEM information into the classroom.
- Establishing tax incentives to encourage business involvement in K-12 science education.
- Developing school- and community-based, beyond-the-classroom science experiences for students and the general public.

4. Strengthen educational research by

- Supporting development of national assessment instruments to identify factors that lead to successful science learning and then working to strengthen those factors in every community.
- Supporting robust investments in educational research that provide the foundation for improved student achievement in the STEM subjects.

Higher Education

1. Invest in higher education capacity and infrastructure by

- Supporting a healthy balance of approaches for research support, including individual investigator grants, collaborative grants, research centers, and international alliances.
- Expanding funding for graduate student support through traineeships and fellowships, and supporting opportunities for graduate students to participate in external experiential programs.
- Ensuring that graduate teaching assistants and postdoctoral fellows are accorded appropriate compensation, benefits, and recognition.
- Encouraging graduate student education and faculty promotion policies that value both teaching and research activities.
- Supporting construction or remodeling of chemistry facilities and funding for modern instructional laboratory equipment and instrumentation, including maintenance and faculty training.
- Establishing and maintaining online library resources and information retrieval services to provide access to current developments.
- Providing preferential assistance to students studying in the STEM subjects through existing student aid programs such as Pell Grants and the GI Bill.
- Providing assistance to evaluate, update and generally improve the content and curricula of science education programs in higher education.
- Making scholarship information widely available to prospective STEM students.
- Addressing systemically the advancement of members of under-represented groups into academic careers.

2. Strengthen STEM teacher education programs by

- Supporting development of programs for pre-service teachers that include both pedagogy and appropriate science content so that future K-12 teachers can complete their teacher certification requirements within a typical four-year bachelor's degree program.
- Establishing scholarships to assist STEM majors in pursuing teaching careers.
- Supporting development of graduate degree programs designed to give teachers advanced content knowledge.
- Supporting teacher certification requirements that embody rigorous, inquiry-oriented, laboratory-based coursework.
- Modifying existing teacher certification programs to permit experienced scientists to begin teaching after completing a suitable internship—additional education credits would be required for permanent certification.

3. Improve the alignment and coordination of STEM-related K-12, higher education, and workforce programs by

- Establishing tax incentives to encourage individuals to enhance their technical competence through continuing education and support development of retraining programs for individuals whose careers have been impacted by changes in the global workforce.
- Providing funding for programs, projects, and activities designed to attract and retain students from under-represented groups in the scientific disciplines.
- Ensuring that students can transfer science course credits seamlessly from high schools, two- and four-year colleges, and universities.
- Establishing alliances among two- and four-year institutions, businesses, government, professional societies for curriculum revision, cooperative faculty activities, sharing of facilities, resources, and instrumentation.
- Supporting the improvement and alignment of workforce STEM training and education programs that are conducted outside institutions of higher education.

4. Encourage Student Research Opportunities

- Providing opportunities for sustained undergraduate research, including support for summer, academic-year, and international projects.
- Developing programs that allow majors in other sciences and non-science majors to experience chemical sciences research first-hand.