

The STEM Promise: Recognizing and Developing Talent and Expanding Opportunities for Promising Students of Science, Technology, Engineering, and Mathematics

Executive Summary

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Science, Technology, Engineering, and Mathematics (STEM) are critical to our economy, our national security, and our global leadership in innovation and research. Our key resource lies in students with mathematical and scientific promise, those with potential to become leaders in STEM fields. This includes students who traditionally have been identified as gifted, talented, bright or precocious in mathematics or science as well as those students with potential who may have missed out on the rich opportunities that have accompanied this recognition. Many of our students with the greatest aptitude are underachieving, languishing in repetitive, unchallenging classes. As with all students, these special needs students deserve a learning environment that lifts the ceiling to currently unknown heights and allows them to make continuous progress throughout their academic careers. In this competitive, technological world, we cannot afford to waste the talents of students with the greatest potential to lead us to creative and productive futures in mathematics, science, technology, and engineering.

What does the research tell us?

A number of recent studies have shown that U. S. students scoring above the 90th percentile in mathematics and science are among those making the least progress in school. At the same time, the percentage of U. S. students majoring in STEM disciplines in college and choosing STEM careers is decreasing while the percentage of foreign students in these fields is increasing. International studies including the Trends in International Mathematics and Science Study (TIMSS) and the Program for International Student Assessment (PISA) indicate that top U. S. students continue to perform below the level of top students in other countries in the areas of mathematics, science and problem solving.

What are the implications for action?

Given the need to recognize and develop promising and already accomplished students, to provide them with significant opportunities in all the STEM fields and provide a pipeline of talent in the United States, the following steps are recommended.

- ***Discover the potential.***
 - **Maximize numbers and levels of students and celebrate their successes.** The goal and purpose of discovering potential in the STEM areas should be to maximize the number and levels of promising students and not to limit the numbers of students in specialized programs. We must recognize that ability, motivation, beliefs, and experiences are not fixed and must be developed, supported and celebrated.
 - **Seek out and identify diverse students.** Aptitudes and abilities of students, regardless of gender, ethnicity, language or socio-economic background, can and should be recognized in order to help them achieve their full potential.
 - **Use a variety of identification measures.** Identification measures might include observations of students during the problem-solving process; portfolios of research, problems and projects in the STEM disciplines; teacher, parent and/or peer recommendations; standardized tests, especially when used off-level; spatial and other non-verbal ability tests, self-selection; affective measures; measures of creativity; and/or grades in mathematics and science classes.

- ***Develop talent and strengthen opportunities at all grade levels.***
 - **Ensure continuous progress.** All students with STEM potential should be provided powerful and rigorous STEM experiences and held accountable to the highest world-class standards. Students need access to systematic, timely, continuous progression through a challenging and creative curriculum. All students should take appropriate, rigorous mathematics and science classes every year from elementary through high school. Technology and engineering curriculum should be an integral part of the K-12 continuum. Students of any age should progress freely to greater rigor and complexity and/or higher-level classes once they demonstrate depth of understanding of course content. Every high school should offer in-house or online access to high-level STEM classes such as Advanced Placement and International Baccalaureate.
 - **Strengthen and create a variety of challenging experiences.** Opportunities and materials for learning high-level, innovative mathematics, science, technology and engineering should be readily available where students can work with peers of similar interests and abilities. Opportunities should include the investigation of rich, complex problems, conducting authentic scientific research, undertaking engineering design challenges, joining STEM clubs, entering STEM contests, and accessing mentors.
 - **Prepare and support teachers.** Teachers should have ongoing professional development experiences beginning in their undergraduate courses to assist them in recognizing and developing students with STEM promise, differentiating instruction and providing for continuous progress. They should also acquire a background in the depth and complexity behind the STEM content appropriate for the students with whom they work. Fellowships, scholarships, internships and mentorships as well as print, electronic, and human resources and support should be readily accessible for these teachers. Vertical teams of teachers from elementary, middle, high school, and postsecondary education should work together to prepare students for continuous progress and deep understanding and reasoning.
 - **Align and lift the ceiling on assessment.** State and national content standards and assessment must lift the ceiling, encourage creativity, identify growth and continuous progress, and provide opportunities for students to go beyond current levels of proficiency.
- ***To enhance school accommodations/services, create out-of-school programs to develop STEM talent and interest.***
 - **Develop community support.** A wide range of community stakeholders should support, mentor, fund, and promote students with promise in STEM fields for the improvement of society and the development of world class citizens.
 - **Collaborate.** The education community should collaborate with mathematicians, scientists, engineers, and technology experts in such efforts as mentoring, apprenticeships and lab programs, the development of challenging summer, after-school, and online programs and materials, and support of competitions.

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