

THE COUNCIL'S CHARGE

Taking challenging courses and mastering high-level mathematics and science are the gateway to success in college, careers and citizenship. Similarly, for Ohio business and industry, a well-trained workforce with knowledge and skills in these subjects is the key to competitiveness in the global economy – the road to economic growth and prosperity.

In this context, the Ohio Board of Regents, Ohio Department of Education and the Governor's Office created the Science and Mathematics Education Policy Advisory Council and directed it to recommend changes in public policy and educational practices that will allow Ohio to become a leader in developing world-class talent, particularly in the disciplines of science and mathematics. Specifically, the Council's charge was to ***develop findings and make policy recommendations to the Governor, to the Chancellor of the Board of Regents, and to the State Superintendent of Public Instruction respecting improvements in the P-16+ education system for mathematics and science education.***

Mathematics and Science – The Keys to Success in Today's World

To attract and retain 21st century businesses – and to create and sustain high-skill, high-wage jobs – Ohio must meet its talent challenge. It must produce more workers with advanced knowledge and skills in science, technology, engineering and mathematics – the so-called STEM disciplines. Not meeting this challenge will have devastating consequences for the state's economy, just as it will limit Ohioans' opportunities in a fiercely competitive, global economy.

To be sure, the state of Ohio has made substantial progress in preparing its students to succeed in the 21st century economy, but there are growing indications that the gap between *workplace readiness* and *employers' expectations* for entry-level workers is growing. Also, there is substantial evidence that foreign advances in the fields of mathematics and science are leaving Ohio and other states at a competitive disadvantage.

This is the reality that all Ohioans – and specifically, the state's education policy leaders – must confront. Today, Ohio is not producing enough workers educated in the STEM disciplines. Our supply of qualified workers is not keeping pace with the demands of an innovation and technology-driven economy. Yet, it will not be easy to dramatically increase the number of students who acquire greater thinking, reasoning and problem solving skills in the fields of mathematics and science.

Facing this challenge, the Council concluded *New York Times* columnist Thomas Friedman is right – that ***“math and science are the keys to innovation and power in today's world.”*** It also agreed with those who see a direct link between improving mathematics and science education and enhancing Ohio's ability to prosper in a global economy. Therefore, the Council's recommendations focus on those actions that will support economic growth, strengthen the system of mathematics and science education, build upon existing programs and make high-level mathematics and science courses available to all Ohio students.

To be sure, everything can't happen at once. There will be fiscal restraints and some of the proposed actions must be phased in over time. Council members hope that the intent and design of their recommendations will be respected and that serious efforts will be made to implement their proposals in ways that expand Ohioans' interest and achievement in science and mathematics, and to strengthen the technological expertise that will shape Ohio's success in the 21st century.

Sustaining Ohio's Science and Mathematics Policy Agenda

Research confirms that investments in knowledge building – through education and research – are the key to Ohio's success in the 21st century's innovation-based global economy. It supports the conviction that Ohio's future prosperity will be shaped by its citizens' success in acquiring the high-level knowledge and skills in science and mathematics that are associated with the development and commercialization of new technologies and with advancements in the STEM-based industries that are driving economic growth today.

Early in their deliberations, Council members agreed that Ohio's students must improve their performance in mathematics and science. For this purpose, the Council focused on the factors that encourage young people to pursue STEM careers and take higher level mathematics and science courses. Students need exposure to excellent mathematics and science teaching at an early age so they can determine their interest and aptitude in these areas. Then, in order to continue, students need support and encouragement as well as rigorous coursework and superior teachers.

The Council agreed that K-12 students in urban and rural high-poverty schools should have the same access to high-quality mathematics and science courses – and to opportunities to pursue STEM careers – as students in higher wealth suburban schools. Finally, the Council acknowledged that the education community – acting alone – cannot meet these and other objectives. Instead, success demands the building of a full and active partnership among the education and business communities and state government.

From the start, Council members agreed that their recommendations should be carried out by leveraging existing resources wherever possible and by drawing from both public and private sources when new

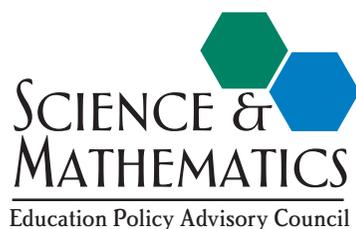
funding is required. Yet, they also understood that funding issues ultimately will have to be resolved by Ohio's education policy leaders in collaboration with key decision makers in the state's education and business communities.

Where should the work begin? The Council believes this question has already been answered – that the job of executing Ohio's agenda for improving science and mathematics education has already begun.

In recent years, state and local leaders – both in and outside the education community – have worked to improve the performance of Ohio schools and the students they serve. Important steps have been taken in many areas, particularly to strengthen the state's academic content standards, assessments and accountability system. Progress also can be seen in the areas of teacher preparation, teacher standards and school facilities, just to mention a few.

All of these reforms have important implications for mathematics and science education, and Ohioans should take pride in the fact that their children achieve at higher levels than those in most states. But Ohio still has a long way to go if its children and youth are to have the knowledge and skills they will need to succeed in the 21st century economy.

The time to move forward uncompromisingly to turn Ohio's science and mathematics education policy agenda into action – to achieve this vision – is now.



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The Science and Mathematics Education Policy Advisory Council consisted of 23 Ohioans who came from a variety of professional backgrounds and was chaired by Julian M. Earls, Executive in Residence at Cleveland State University Nance College of Business Administration, and Karen A. Holbrook, President of The Ohio State University.

For more information about the Council or to download its final report, visit www.regents.ohio.gov/samepac/. For a printed copy of the report, call 614/247-6342.

Science and Mathematics

A Formula for 21st Century Success

The future prosperity and well-being of our state and its citizens depend on how well we educate our children and youth. The success of Ohio businesses in the innovation-based global economy demands that they have workers with advanced thinking, reasoning and problem-solving skills. In simple terms, Ohio's future will be defined by *its citizens' ability to think for a living*.

More than ever before, knowledge and skills in science and mathematics will be linked to success in the 21st century economy.

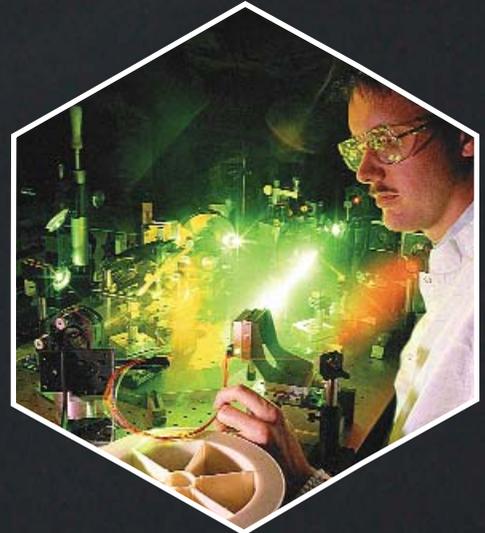
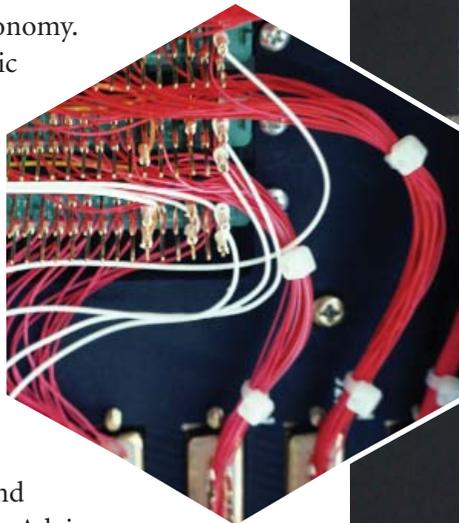
No longer will basic arithmetic and a familiarity with a limited number of scientific facts be enough to get ahead – and to stay ahead – either in college or in the workplace. They will not be sufficient for Ohioans to become productive and informed citizens.

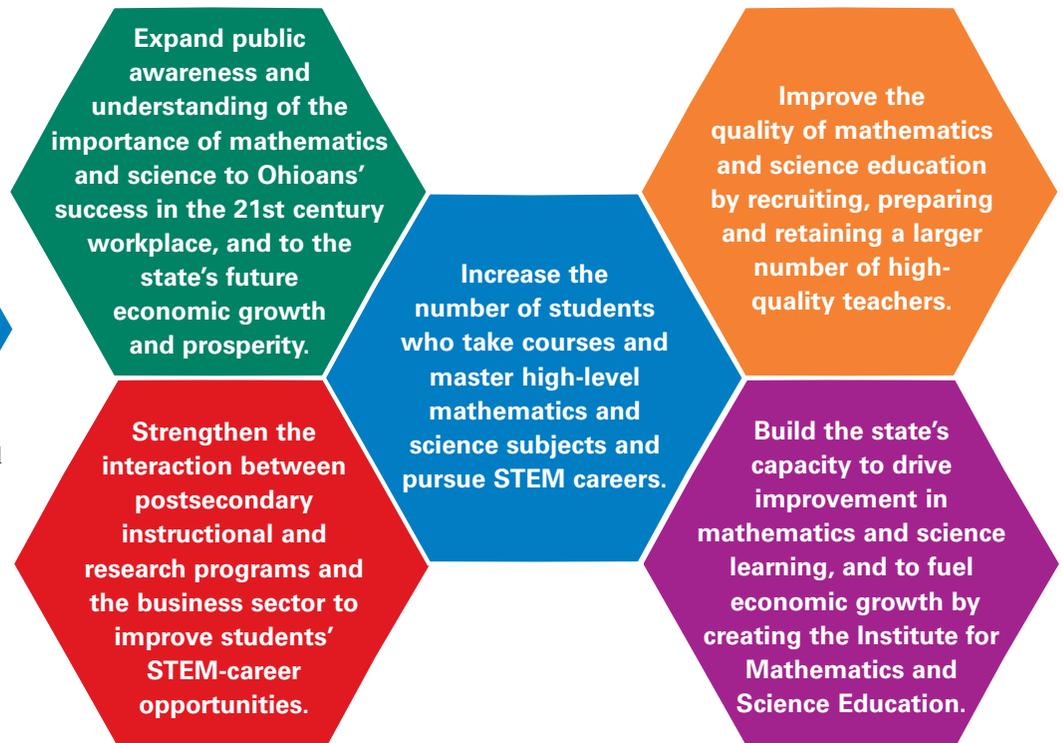
For this reason, the Science and Mathematics Education Policy Advisory Council's vision is clear:

VISION

Ohio will be a leader in the innovation-based global economy, and its citizens will have the high-level knowledge and skills in science and mathematics they will need for success.

January 2007





The Council's Recommendations: Expanding Ohioans' Interest and Achievement in Science and Mathematics

The Council chose to focus on a limited set of goal-based recommendations structured around five specific strategies that members believe will have a positive impact – both in the short- and long-term – on educational outcomes. It is not recommending additional studies, nor have members allowed the Council's mission to “creep” into subjects beyond their charge.

The Council's 13 recommendations reflect the following core strategies:



STRATEGY #1
Expand public awareness and understanding of the importance of mathematics and science to Ohioans' success in the 21st century workplace, and to the state's future economic growth and prosperity.

Recommendation 1: Develop and carry out a multi-year, research-based public awareness campaign focused on the importance of mathematics and science education to Ohio's citizens, as well as the state's future economic growth and prosperity.

Recommendation 2: Identify, coordinate, integrate and sustain community-based and statewide partnerships (i.e., advocacy networks) to improve mathematics and science education.



STRATEGY #2
Increase the number of students who take courses and master high-level mathematics and science subjects, and pursue STEM careers.

Recommendation 3: Expand and improve opportunities for students to participate in high-quality mathematics and science programs.

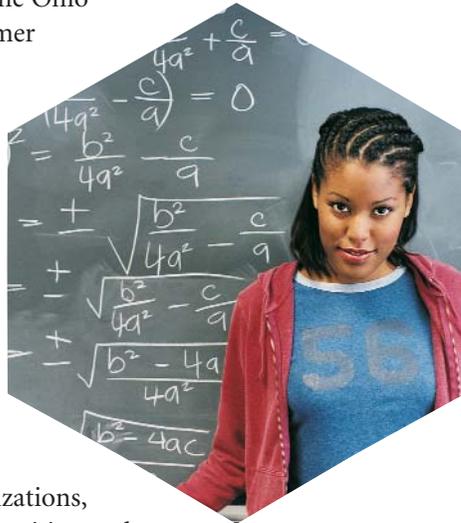
- Offer early intervention programs and extra supports in the elementary- and middle-school grades, particularly for low-income and minority students in both urban and rural communities, to prepare them for higher level STEM courses and careers.
- Create special-focus schools linked to public and private colleges and universities or other STEM organizations that provide interested students with concentrated learning opportunities in STEM disciplines.
- Use technology – such as online course delivery – to expand access to upper-level courses in high-school mathematics and science, including Advanced Placement (AP) courses, to small, rural school districts that lack financial or human resources to make such courses available in their school buildings.
- Refine and clarify the Ohio academic content standards in mathematics and science to help schools and school

districts develop a more focused and coherent curriculum compatible with the preparation needed to enter college and the workforce.

- Encourage the redesign of entry-level postsecondary STEM courses based on models of exemplary postsecondary teaching that attract and retain undergraduate students in STEM disciplines.

Recommendation 4: Expand school-based and extracurricular resources and programs to attract students to higher-level mathematics and science learning opportunities and STEM careers.

- Continue and expand the Ohio Board of Regents' summer academies that attract students to STEM careers and mathematics and science teaching.
- Advocate for and support validated extracurricular programs that emphasize STEM subject areas provided through informal science organizations, public and private universities, and other non-profit groups.
- Build partnerships that give professionals in STEM careers opportunities to interact with and mentor students, beginning with the middle-school grades and continuing through postsecondary education.
- Create and promote a statewide database of non-classroom options and opportunities for informing and mentoring students for STEM careers, including model mentoring programs for middle- and high-school students.



Recommendation 5: Eliminate barriers that prevent or discourage college-level students from taking and successfully completing STEM courses, or from pursuing STEM majors.

- Increase financial support, including scholarships, loans and loan forgiveness programs, for college students pursuing STEM careers or high-school teaching careers in STEM disciplines, to enable these individuals to study full-time.
- Identify, expand and replicate exemplary programs in Ohio's public and private two- and four-year colleges and universities that have shown to be effective in attracting, preparing and retaining students, paying special attention to proven strategies for reducing attendance barriers and raising success rates for low-income, minority, adult and other underrepresented students.

- Support local programs that help and encourage students who have left school to return and to earn high-school diplomas and postsecondary degrees in STEM fields.



STRATEGY #3

Improve the quality of mathematics and science education by recruiting, preparing and retaining a larger number of high-quality teachers.

Recommendation 6: Improve the quality and effectiveness of teacher education and the transition of teacher candidates into careers through incentives and improved accountability.

- Provide higher subsidies or other incentives to teacher education programs that produce high-quality middle- and high-school mathematics and science teachers who enter the profession and teach in Ohio.
- Monitor and report on teacher education programs that successfully retain high-quality teacher education candidates through licensure and make the transition into the teaching profession.

Recommendation 7: Provide greater incentives and create improved working conditions for mathematics and science teachers and teacher candidates to enter and continue in the teaching profession.

- Develop financial and other incentives for school districts to pilot and evaluate differentiated compensation programs for teachers in hard-to-staff schools and subject areas.
- Develop financial and other supports such as sustained mentoring that bolster the effort of hard-to-staff schools to retain experienced, effective mathematics and science teachers.

Recommendation 8: Strengthen middle-grade licensure programs and middle- and high-school re-licensure requirements for mathematics and science teachers.

- Assure uniformly high standards for middle-grade mathematics and high-school science teacher preparation programs.
- Require that teacher re-licensure requirements for middle and high school address the need for teachers to deepen their understanding of the subject matter taught and effective ways to teach it.

Recommendation 9: Improve program supports for teachers' continuing professional education so that school districts have access to highly effective teachers.

- Provide statewide online and on-site courses in state-targeted mathematics and science content needed for teaching for elementary-, middle- and high-school mathematics and science teachers.

- Help school districts identify professional development needs, expand technical assistance for the analysis of student assessment data and create services to meet other documented professional development needs of individual teachers.
- Offer incentives to businesses and non-profit organizations that provide summer employment opportunities for teachers that enrich their mathematics or science content and real-world application knowledge.

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STRATEGY #4
Strengthen the interaction between postsecondary instructional and research programs and the business sector to improve students' STEM-career opportunities, and to improve the education community's ability to meet the workforce needs of Ohio's technology- and innovation-driven businesses.

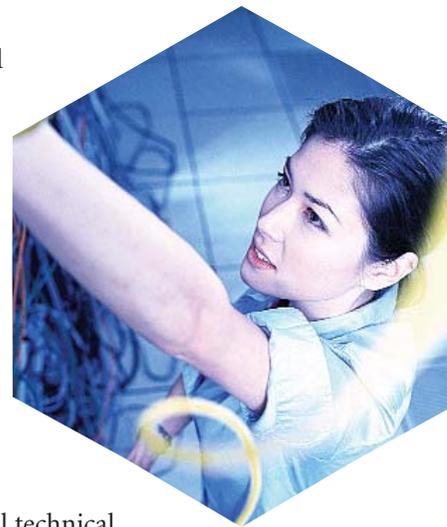
Recommendation 10: Establish university-business advisory councils to develop and promote research goals and graduate study programs that are mutually beneficial to higher education and the state's employers, and provide internships and other nontraditional learning experiences for university and college students and teachers in STEM-related disciplines.

Recommendation 11: Develop a Web-based clearinghouse for regional and statewide internship and externship opportunities to ensure that students in STEM academic programs acquire the requisite skills for entry into and for successful careers in Ohio's job market.

- Encourage STEM-related departments in Ohio's research universities to create business advisory councils and internships, both of which will enable educators and employers to better understand each others' needs and capabilities.
- Establish a Web-based clearinghouse for regional and statewide internship and externship opportunities, which will serve as a one-stop shopping center for employers, students and teachers.
- Broaden the Third Frontier Internship Program to include support for graduate students majoring in science, engineering and mathematics disciplines to encourage them to enter into careers involving technology commercialization.



- Align STEM instructional programs and create new courses at Ohio's colleges and universities to ensure that students develop the skills needed by the state's employers.
- Emphasize high school and two-year college programs that improve the education-business pipeline through the development of high-level technical skills to support Ohio employers.



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STRATEGY #5
Build the state's capacity to drive improvement in mathematics and science learning, and to fuel economic growth, by creating the Institute for Mathematics and Science Education (IMSE).

Recommendation 12: Establish the Institute for Mathematics and Science Education by linking the Ohio Resource Center with other data and policy study entities.

- Direct IMSE to prepare and issue periodic data analyses, needs assessments and other policy reports on the condition of mathematics and science education, including a supply and demand study on mathematics and science teachers, to the state's education policy leaders.
- Commission IMSE to work with appropriate state agencies to create instructional products and other resources needed to make strategic mathematics and science education improvements statewide.
- Authorize IMSE to provide input to the mathematics and science advocacy network and marketing campaign to build public awareness, understanding and support for mathematics and science education and STEM careers.

Recommendation 13: Connect the Institute for Mathematics and Science Education with regional delivery and support systems to drive strategic improvements in P-12 STEM education across the state.

- Coordinate an ongoing professional development delivery network staffed with mathematics and science professionals to provide continuing technical assistance for P-12 school improvement, and to implement teacher training packages and other tools developed through the state structure.
- Develop and circulate validated, field-tested products that support professional practice and standards.
- Support regional university collaboratives and/or school districts' participation in these delivery networks.