

The Future of High School Mathematics: New Priorities and Promising Innovations **September 25-27, 2008**

Concern about the condition of school mathematics has been expressed with renewed urgency in many recent advisory reports and policy recommendations. As a result, national attention is once again focused on questions about curriculum, teaching, and assessment in high school mathematics and on the challenges of teacher professional development required to achieve improved results.

To address these timely questions and to showcase progressive ideas about curriculum, teaching, assessment, and technology in high school mathematics, the Center for Mathematics Education at the University of Maryland, along with "Math Is More" and a group of progressive curriculum development projects, will host a conference of leaders in high school and collegiate mathematics education to be held at the Renaissance M Street Hotel in Washington, DC on September 25 – 27, 2008.

The conference will include presentations and examples of promising innovations produced by extensive research and development programs, and it will provide a forum for shaping the national, state, and local policy debates about appropriate directions for progress in high school mathematics.

The target audience includes high school mathematics teachers, leaders of state and local mathematics programs, mathematics teacher educators, collegiate mathematics faculty with special interest in curriculum 9 -14, developers and publishers of high school mathematics curriculum materials and tests, as well as other STEM professionals, government, and foundation officials with policy responsibilities/interests related to school mathematics.

Conference Context

October 4, 2007 was the fiftieth anniversary of the Sputnik launch that led immediately to deep concern about the quality of U. S. mathematics education and recommendations for reform. Not surprisingly, reactions to Sputnik focused on the importance of mathematics education to national defense and on the need to prepare our most capable high school students for careers in mathematics, science, and engineering. By the time of the 1983 Nation at Risk and Educating Americans for the 21st Century reports, the rationale for reform of mathematics education had changed to focus on its importance for international economic competitiveness—a concern that has persisted to the present day.

At each critical juncture, mathematics education researchers and curriculum developers have responded to concerns by exploring new approaches to teaching and by preparing curriculum and assessment materials that reflect changing content objectives and priorities. **Leaders of school mathematics programs have then faced the challenge of choosing among competing proposals for change and of implementing new curriculum frameworks, teaching strategies, and tests.**

For example, in response to publication of the 1989 Curriculum and Evaluation Standards for School Mathematics, the 1991 Professional Standards for Teaching Mathematics, and the 1995 Assessment Standards for School Mathematics, five major NSF-funded curriculum projects and several other projects funded by private foundation grants developed and field-tested materials to support high school mathematics instruction that reflects the recommendations of those advisory documents. At the same time, innovative curriculum projects focused on middle school mathematics developed materials that provide students with enhanced preparation for success in high school mathematics. Activities at the collegiate level—like the MAA Curriculum Foundations project, the MAA CUPM Curriculum Guide, the various calculus reform curriculum materials projects, and the AMATYC Crossroads recommendations—encouraged reconsideration of the mathematics curriculum content and teaching that students experience when they leave high school.

In the past eight years, concern about the condition of high school mathematics has been expressed with renewed urgency in reports from the Glenn Commission (Before It's Too Late), the National Commission on Prospering in the Global Economy of the 21st Century (Rising Above the Gathering Storm), the American Diploma Project, the College Board Mathematics and Statistics Advisory Committee, the American Statistical Association GAISE project, the President's National Mathematics Panel, the NCTM High School Mathematics Curriculum Project, and the Carnegie-IAS Commission on Mathematics and Science Education. Concurrent with those spirited national discussions about the future of school and collegiate mathematics, the most widely used innovative curricula at the high school level have completed major revisions of their programs, to reflect learning from use of first edition student and teacher materials. Those revised curriculum materials are complemented by emergence of other new approaches to high school mathematics whose development is also funded by NSF.

Once again, teachers and leaders of school mathematics programs face the challenge of choosing among competing proposals for curriculum content, teaching approach, and assessment strategies and the challenge of effectively implementing change.

Conference Goals

To introduce results of recent theoretical and development work to key mathematics educators and educational policy professionals and to place those developments in a broader context of mathematics education innovation. the plenary and workshop sessions of the 2.5-day conference will address four central questions:

- What are the most important mathematical concepts, skills, and reasoning methods that students of different interests and prior achievement should master in the high school years so that they are well prepared for college, the world of work, and effective citizenship in the 21st century?
- What instructional practices hold greatest promise for effective teaching of mathematics to the diverse student population in U. S. high schools?
- What practices in assessment of student understanding and skills most effectively advance teaching and learning and provide an evidence base for important educational policy decisions?
- What practices in teacher professional development and school change hold greatest promise for meeting the challenge of implementing best practices in mathematics education curriculum, teaching, and assessment?

The goal of the conference is to bring together leaders of state and local school system mathematics programs, mathematicians and other STEM professionals, curriculum developers, educational researchers, and education policy-makers for in-depth discussion of the challenges and opportunities for innovation in high school mathematics. Participation in this conference will provide school system leaders with information and perspectives about future directions of high school mathematics that they can carry back to their state and local work on curriculum, teaching, and assessment. Participation by curriculum developers, teacher educators, and education policy-makers will provide them with insights into their own work developing future mathematics programs, teachers, and policies. Participation by mathematics education researchers will help in framing an agenda of important evaluation and research projects required to inform and evaluate the various ideas for innovation. Working together, these professionals can also begin to establish community action plans for developing and implementing promising innovations in high school mathematics.

Conference Organizers

Planning and operation of Future of the High School Mathematics conference is a collaborative effort of partners who are active in designing, developing, and implementing cutting-edge practices in high school mathematics education.

[Math Is More](#) is a discussion forum for work toward a national consensus on improving U. S. mathematics education. Leaders of the group will coordinate planning of the issues forum on the first 1.5 days of the conference.

Leaders of the following curriculum projects have been involved in planning the conference, and their most recent work will be featured in showcase sessions:

- [Core-Plus Mathematics Project](#)
- [Interactive Mathematics Program](#)
- [The CME Project at EDC](#)
- [Math Connections](#)
- [SIMMS](#)
- [University of Chicago School Mathematics Project](#)

Faculty and staff of the University of Maryland Center for Mathematics Education are engaged in research, teaching, and service designed to build the national capacity for improving the mathematical education of all students, especially those from ethnic and racial minorities in urban settings. The Center coordinates planning and provides logistical support for conference operations.

In addition to the core organizing group, insights for planning the Future of High School Mathematics conference have been gained from conversations and correspondence with representatives of a variety of professional education and mathematics organizations.

The conference organizers have obtained National Science Foundation support for conference operations and participant expenses

Meeting Agenda

Conference activity will occur in plenary and workshop sessions that address important aspects of mathematics curriculum, teaching, assessment, and teacher development at the high school level. *All sessions will be designed to provide informative reviews of the case for new directions in high school mathematics **and** significant opportunities for participants to critique the new ideas and analyze prospects for their implementation.*

Thursday Evening, September 25 — The Case for Innovation in High School Mathematics

The opening session will include plenary presentations about the challenges confronting those who seek to prepare high school students well for future work and post-secondary study and to transform innovative ideas into standard practice of schools nationwide.

5:00 – 7:00 pm Conference Check-in and Reception with Light Buffet

Supper 7:00 – 9:00 pm Welcome and Conference Keynote Addresses:

Overview of Conference Goals by Sol Garfunkel

Garfunkel is Executive Director of COMAP where he has been active in a series of projects to develop curriculum and professional development materials for high school and collegiate mathematics that emphasize applications of the subject to scientific, technical, business, and everyday problem solving. He is convener of *Math Is More* and a member of the conference core planning group.

Keynote Address by David Mumford

Mumford is University Professor in Brown University's Division of Applied Mathematics. His research has made fundamental contributions in algebraic geometry, computer vision, pattern theory, and neurobiology. That work has been recognized by award of the Fields Medal, a MacArthur "genius" grant, the 2008 Wolf Foundation Prize in Mathematics, and numerous other prizes. In addition to his research contributions, he has developed and taught a Brown course *Modeling the World with Mathematics* that seeks to bridge the gap between a mathematically literate minority of physical, computer and mathematical scientists, engineers and economists and an alienated majority with a sense that mathematics is abstruse, too hard to use, or just plain "fuzzy".

Keynote Address by Suzanne Wilson

Wilson is a Professor and Chair of the Michigan State University Department of Teacher Education and Director of the College of Education's Center for the Scholarship of Teaching. Her work spans several domains, including teacher learning, teacher knowledge, and the connection between educational policy and teachers' practice. She has conducted research on mathematics teaching and authored the 2003 book *California Dreaming: Reforming Mathematics Education* that examines the myths used to explain the failure of reforms, the actual reasons for failure, and the importance of taking multiple perspectives into account when planning and implementing reform.

Friday, September 26 — Critical Issues

Forum The Critical Issues Forum has two overarching objectives:

- *To identify curriculum, teaching, and assessment practices that offer greatest promise of improving the high school mathematics learning by all students.*
- *To formulate strategies for collaborative action by K-12 educators, collegiate mathematicians, curriculum developers and researchers, teacher educators, and leaders of education policy that will lead to implementation of desirable changes in high school mathematics.*

The day's activities will include three breakout sessions focused on content, teaching, and assessment issues and a closing plenary session focused on strategies for collaborative work on innovative research, development, and implementation activities. Discussions in the breakout and plenary sessions will address specific questions like these:

1. What curricular and instructional practices enable successful entry to high school study for students with diverse prior learning experiences, achievement, aptitudes, and interests in mathematics?
2. How can high school mathematics effectively prepare students for transition to the diverse challenges of post- secondary study and work?
3. What are the potential advantages of organizing topics in the high school mathematics curriculum into integrated courses rather than the U. S. tradition of separate years for algebra, geometry, and advanced algebra?
4. What curriculum materials and teaching methods have proven effective in school settings with large numbers of students from groups that are poorly served by traditional approaches to mathematics and what is appropriate content and teaching for highly talented students?
5. How do the high-stakes tests for school accountability, college admission, and college placement advance

- and/or constrain innovation in high school mathematics curricula and teaching?
6. What have the past two decades of curriculum research and development taught us about what works in high school mathematics and what are the most important questions for further study?
 7. What is the appropriate role for topics from probability, statistics, and discrete mathematics in the high school curriculum?
 8. How should available calculator and computer technologies be used to enhance mathematics teaching and how does nearly universal access to those tools change curriculum content priorities?
 9. What changes in teacher preparation and professional development are required to support needed innovation in high school mathematics curricula, teaching, and assessment?

7:00 – 8:30 am Continental breakfast

8:30 – 8:50 am Overview of Goals and Schedule for the Day by Dan Chazan

Chazan is Director of the University of Maryland Center for Mathematics Education and a member of the faculty in the Department of Curriculum & Instruction at the University. He is Co-Director of the THEMAT research project investigating challenges in algebra teaching and a principal investigator in the Mid-Atlantic Center for Mathematics Teaching and Learning leading a research group investigating algebra teaching in urban school settings.

9:00 – 10:30 am Breakout Session 1

The Future of High School Mathematics Curricula

Traditional conceptions of high school mathematics reflected expectations that a relatively small number of students should be prepared for mathematics-intensive collegiate study in physical science or engineering and that most students needed only modest mathematical preparation for the limited demands of work and daily life. However, the rapid mathematization of work in almost all areas of business, industry, personal decision-making, and the social and life sciences has made the case that all high school students need to learn more and possibly different mathematics than what traditional curricula provide.

The question is: *‘What mathematical content will best serve the diverse talents and interests of contemporary high school students?’* The first major breakout session of the Critical Issues Forum will address recent thinking about and experimentation with the content and organization of high school mathematics, including prominent proposals for change in curriculum practice.

Session leaders will
be:

- Karen King, New York University
- Joseph Malkevitch, York College of
- CUNY Mike Shaughnessy, Portland State
University
- Dan Teague, North Carolina School of Science and

Mathematics 10:30 – 11:00 am Break

11:00 – 12:30 pm Breakout Session 2

The Future of High School Mathematics Teaching

Reflecting widespread belief in the proposition that what you learn depends in important ways on how you are taught, the history of mathematics education has included a persistent strand of proposals to change the common paradigm of U. S. mathematics teaching. Most development projects in the *Standards*-based era have designed student and teacher curriculum materials to support specific changes in the well-known classroom routine of teacher explanation and demonstration followed by student practice.

The second major breakout session of the Critical Issues Forum will focus on recent thinking about and experimentation with alternative approaches to high school mathematics teaching. Numerous advisory and research reports have expressed a variety of proposals for transformation of standard teaching practice, and those proposals will be analyzed in session discussions.

Session leaders will
be:

- Lawrence Clark, University of Maryland
- Bill Haver, Virginia Commonwealth
- University Gary Martin, Auburn University
- Faith Muirhead, Hunter College and MSPinNYC

12:30 – 2:00 pm Buffet Lunch

2:00 – 3:30 pm Breakout Session 3

The Future of High School Mathematics Assessment

The best laid plans for transformation of curriculum content and teaching will make little headway in schools unless success of innovations is evaluated using data from assessments that are aligned with the new goals. Most of the curriculum materials produced by projects in the *Standards*-based era have included specific proposals for change in traditional strategies for assessing student learning.

The third major breakout session of the Critical Issues Forum will focus on new thinking about and experimentation with alternative approaches to assessment in high school mathematics. Numerous recent advisory and research reports have expressed a variety of proposals for change in assessment practice.

Session leaders will
be:

- Jere Confrey, North Carolina State
- University Christine Franklin, University of Georgia
- Bernie Madison, University of Arkansas
- Kathleen Snook, U. S. Military Academy at West Point

(retired) **3:30 – 4:00 pm Break**

4:00 – 5:30 pm Plenary Session on Strategies for Organizing Research, Development, and Policy Action to Support Promising Innovations.

This plenary session will feature presentations by two leaders from the school and collegiate mathematics communities who will analyze, from their perspectives, the actions that are required to develop and implement high priority innovations in high school mathematics. Their remarks will reflect their experiences in dealing with educational policy and practice issues and the ideas that will have been expressed in the breakout sessions

during the day.

The expert commentators in this session will be Cathy Seeley and David Bressoud.

Seeley is a senior fellow at the Charles A. Dana Center working on state and national policy and improvement efforts in mathematics education. A past-president of the National Council of Teachers of Mathematics, she is a veteran mathematics educator and change facilitator with 35 years of experience at the local, state, and national levels, including teaching mathematics at the middle school and high school levels, working as a K-12 district mathematics supervisor, and serving for eight years as Director of Mathematics for the Texas Education Agency.

Bressoud is DeWitt Wallace Professor of Mathematics and Computer Science at Macalester College and president-elect of the Mathematical Association of America. An expert in analytic number theory, he is co-author of *A Course in Computational Number Theory*. He is also the author of *Proofs and Confirmations: The Story of the Alternating Sign Matrix Conjecture* and *A Radical Approach to Real Analysis* and is widely recognized for his work in improving secondary and undergraduate mathematics education.

Saturday (8 am – 2:00 pm) — Showcase of Promising Programs

The third major segment of the meeting will feature presentations and in-depth discussion of the ways that innovative curriculum, instruction, and assessment principles are embodied in materials produced by active curriculum development projects and the evidence about effects of those programs in school trials.

7:00 – 8:30 am Continental Breakfast

8:30 – 8:45 am Overview of Goals and Schedule for the Day by Eric Robinson

Robinson is Professor of Mathematics at Ithaca College. In addition to his mathematical research in topology, he has been active in developing and promoting innovative approaches to mathematics curriculum and teaching at the high school and collegiate levels. Since 1997 he has been Director of the COMPASS Center for dissemination of innovative curriculum ideas and materials. He is a member of the core planning group for this conference.

9:00 – 10:30 am Breakout Session 1 will feature presentations by four innovative curriculum projects. Meeting participants will choose one presentation to attend from among:

Core-Plus Mathematics Project (CPMP)

University of Chicago School Mathematics Project (UCSMP)

MATH Connections: A Secondary Mathematics Core

Curriculum Mathematics: Modeling Our World (ARISE)

10:30 – 11:00 am Break

11:00 – 12:30 pm Breakout Session 2 will feature presentations by three innovative curriculum projects. Meeting participants will choose one presentation to attend from among:

Interactive Mathematics Project (IMP)

Center for Mathematics Education Project from EDC (CME)

Integrated Mathematics: An Approach Using Technology (SIMMS IM)

12:30 – 2:00 pm Buffet Lunch and Closing plenary session Remarks by Steve Rasmussen on Future Prospects for Curriculum Materials

Rasmussen is the co-founder and Chief Executive Officer of Key Curriculum Press, a major publisher of innovative curriculum materials and teaching/learning software like the Geometer's Sketchpad, Fathom, and Tinkerplots. In 2007 the California Mathematics Council recognized Rasmussen's contributions to mathematics education with the Walter Denham Memorial Award for Advocacy for Mathematics Education. His remarks at the close of the Future of High School Mathematics conference will address emerging developments in production and delivery of curriculum materials and software tools for teaching and learning.

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