



Initiating and sustaining improvements in
undergraduate education

AMS department chairs'
workshop

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INGenIOus threads

- Bridge gaps between business, industry, and government and academia
- Improve students' preparation for non-academic careers
- Increase public awareness of the role of mathematics and statistics in both STEM and non-STEM careers
- Diversity incentives, rewards, and methods of recognition in academia
- Develop alternative curricular pathways
- Build and sustain professional communities



Mathematics in 2025

Conclusion: The mathematical sciences have an exciting opportunity to solidify their role as a linchpin of twenty-first century research and technology while maintaining the strength of the core... The enterprise is qualitatively different from the one that prevailed during the latter half of the twentieth century, and a different model is emerging—one of a discipline with a much broader reach and greater potential impact. ...The value of the mathematical sciences to the overall science and engineering enterprise and to the nation would be heightened if the number of mathematical scientists who share the following characteristics could be increased:



Mathematics in 2025

- They are knowledgeable across a broad range of the discipline, beyond their own area(s) of expertise;
- They communicate well with researchers in other disciplines;
- They understand the role of the mathematical sciences in the wider world of science, engineering, medicine, defense, and business; and
- They have some experience with computation.



TPSE Math

- **Removing Barriers and Opening Pathways:** Institutions must create multiple pathways into and through the mathematical sciences curriculum,
- **Teaching and the Economic Model of Mathematics Departments:** Departments should enhance the status of teaching/pedagogy in the local culture, rewarding both tenure-track and non-tenure-track faculty in collaborative efforts at curriculum and teaching reform.
- **Enriching the Undergraduate Experience:** The undergraduate experience should be enriched by exposure to statistics, modeling, data science, and computation, as well as more experiential learning, effective use of technology, and career advice.
- **Enhancing the Graduate Training Experience** Because most graduate students find careers outside R1 universities, their training should include development of teaching, mentoring, and communication skills, and internships in the private or public sectors.



Some relevant activities at UIUC

- Career advisor
- ALEKS placement
- Engineering Calculus
- Active learning in large lecture courses
- First-year mathematics and statistics for life sciences
- Merit <http://merit.illinois.edu>
- PI⁴ <https://pi4.math.illinois.edu>
- Illinois Geometry Lab <http://www.math.illinois.edu/igl/>



Illinois Geometry Lab

- 3-4 undergraduates mentored by 1 PhD student and 1 faculty member
- Roughly a dozen projects so 40 students each semester
- Recruits new students to mathematics
- Connects students with internships
- Great vehicle for outreach
- 2013 Strategic Plan calls for every undergraduate major to have a research experience
- 1100 majors
- Work of IGL is almost all by volunteers



NC State

- Change major requirements to create space for undergraduate research
 - if it is a class you can give credit
 - Removing major requirements frees up faculty and student time
- Improved introductory and service courses
 - vigorous engagement with client disciplines
 - hired lecturers to teach them, freeing tenure-track faculty time to supervise undergraduate research
 - moved to large lectures, with substantial active learning and flipping; documented that success rates increased
- TT faculty get teaching credit for supervising undergraduate research



NC State

- NSF support helped get changes under way
- Online subscription-based course materials, created in-house, provide new source of revenue
- Persistence, optimism, negotiation



WPI

- By university policy, the curriculum includes two projects: a one-semester interdisciplinary project, and for seniors a year-long team-based project
- First 2 years: 4 seven-week terms, 3 courses per term, 5 days per week
- Projects with companies or labs on campus
- Funded projects: seek \$10K for a project; sometimes get less
- Example: a faculty member supervising 3 projects with 2 students each. University receives \$5K/project, and provides some summer support for students and discretionary funds for the faculty member. Discretionary funds sufficient to buy out a course



WPI

- Matchmaking with labs and companies is an important challenge
- Career development center and job fairs create opportunities for matchmaking
- Connections via existing internships
- <http://www.wpi.edu/academics/math/CIMS/>
- Active advisory board



NSF

- DUE/IUSE

http://nsf.gov/funding/pgm_summ.jsp?pims_id=505082&org=DUE&from=home

- Two tracks, two funding levels
- Must contribute to body of knowledge about STEM learning and teaching
- Webinar slides at <http://ehrweb01.aaas.org/stem-iwbw/iuse-webinars/>

- DMS Workforce

http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503233&org=DMS

- Two sessions at JMM:



NSF

NSF Funding Opportunities for the Learning and Teaching of the Mathematical Sciences, organized by John Haddock and Lee Zia, Division of Undergraduate Education, NSF; Karen King, Division of Research on Learning, NSF; Tasha Inniss, Division of Human Resource Development, NSF; Jennifer Slimowitz Pearl, Division of Mathematical Sciences, NSF. A number of NSF divisions offer a variety of grant programs that support innovations in learning and teaching in the mathematical sciences. These programs will be discussed along with examples of successful projects in two sessions. Anticipated budget highlights and other new initiatives for the next fiscal year, as appropriate, will also be presented. Sponsored by the MAA Committee on Professional Development.

Part I: Undergraduate/Graduate Education Programs, Workforce, and Broadening Participation (DUE/DGE/DMS, HRD) Saturday, 8:00 a.m.- 9:20 a.m., and

Part II: The K-16 Continuum: Learning Science & Research and Pre- and In-Service Teachers (DUE/DRL) Saturday, 9:35 a.m.-10:55 a.m.



For discussion

- Please share with your group some innovations you have tried or would like to try
- What are the challenges for getting them going, or for sustaining them: giving them a reasonable chance of succeeding?
- Discuss how you can plan in advance to know the extent of your success, and impress others when the extent is great
- Please help your colleagues solve their problems
- What resources or support would help you to overcome obstacles?

