Part I: Trends in transforming postsecondary education in mathematics
Part II: What is going on in Washington?

Associated Colleges of the Midwest
Engaging the Community of ACM Mathematicians

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PART I
Trends in transforming postsecondary education in mathematics

Part I: Table of Contents

A brief history of the mathematical sciences in higher education

Calls for innovation and transformation of education in the mathematical sciences are not new

Until 1950

- During 1700s and 1800s, math played significant role in liberal arts undergraduate education in America. Also in the "new" scientific schools like Rensselaer (1824) and MIT (1861)
- Lincoln signed Morill Act in 1862 establishing the land-grant institutions
- In same year, the first math PhD in US was awarded (at Yale)

Until 1950 (continued)

- 1850-1900 college enrollments declined
  - "elective system" was instituted to boost enrollments
  - led to increasing enrollments college-wide, but dramatically decreasing enrollments in math
- Growing need for engineers and technically oriented professionals in industry and agriculture saved collegiate mathematics from being totally decimated
- In 1910 Harvard was first college to require students to have an academic major
- In 1915 Mathematical Association of America (MAA) born to focus on collegiate curricula

1950-1970

- In Cold War/Sputnik-era, science education become popular
- College enrollments quadrupled
- 1950s
  - calculus became the ultimate goal of HS math
  - AP calculus came into being
  - MAA *Committee on the Undergraduate Program in Mathematics (CUPM)* formed (1953)
- Related fields also grew – departments of computer science and statistics started splitting off from math departments

Trends since 1970

- University faculty turn to research
  - Reduced teaching for faculty
  - Freshman courses more often taught by grad students
- Liberal arts colleges have disproportionate success producing future PhDs
- 2-year colleges experience huge growth
  - Increasingly a starting point for 4-year degree seekers
  - Growth in developmental math enrollments (200,000 in 1970 to 1,100,000 in 2010, while enrollments in college credit-bearing math classes only doubled)

Trends since 1970 (continued)

- Focus on high school to college transition, the role of AP calculus, and "calculus reform."
- 1981 CUPM report encouraged broader scope for the mathematical sciences; led to proliferation of "tracks" in undergraduate curriculum, and advocated "interactive teaching" and "guided discovery."

Calls for innovation and transformation of education in the mathematical sciences are not new

Why change now?

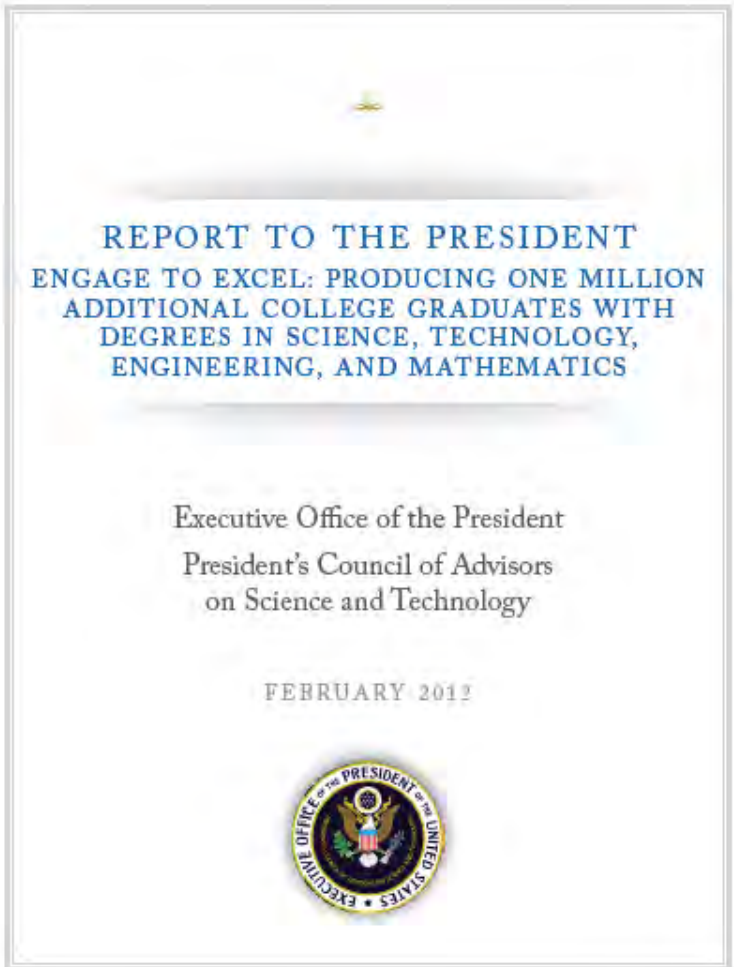
Answer 1

Discipline-based education research, which matured in 1980s and 90s, has produced significantly new ways of understanding knowledge, thinking, and learning.

Mathematicians are beginning to use this research to inform how they teach.

Answer 2

There is renewed federal interest in higher education in general, and undergraduate STEM education in particular. Two reports ...



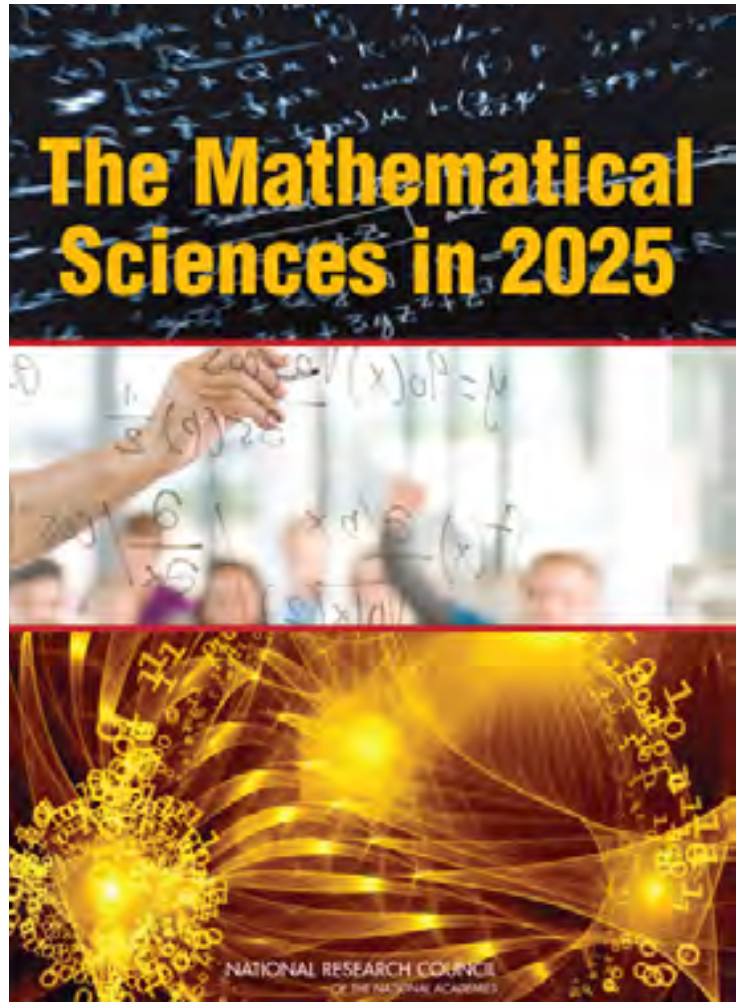
President Obama identified post-secondary education as key to a stronger economy and to 21st century success of the nation, and asked PCAST to prepare a report on producing one million more STEM graduates over the next decade.

PCAST's *Engage to Excel*

- points to a US Department of Commerce report projecting a 17% increase in the need for STEM-trained graduates over next decade, and
- suggests that "faculty from mathematics-intensive disciplines other than mathematics" should develop and teach courses in college-level mathematics, and that there should be a "new pathway for producing K-12 mathematics teachers from ... programs in mathematics-intensive fields other than mathematics."

National Research Council's
The Mathematical Sciences in 2025

- describes how mathematics has become essential to modern science
- recommends that undergraduate education in the mathematical sciences reflect this new stature
- highlights many up-to-date advances in mathematics



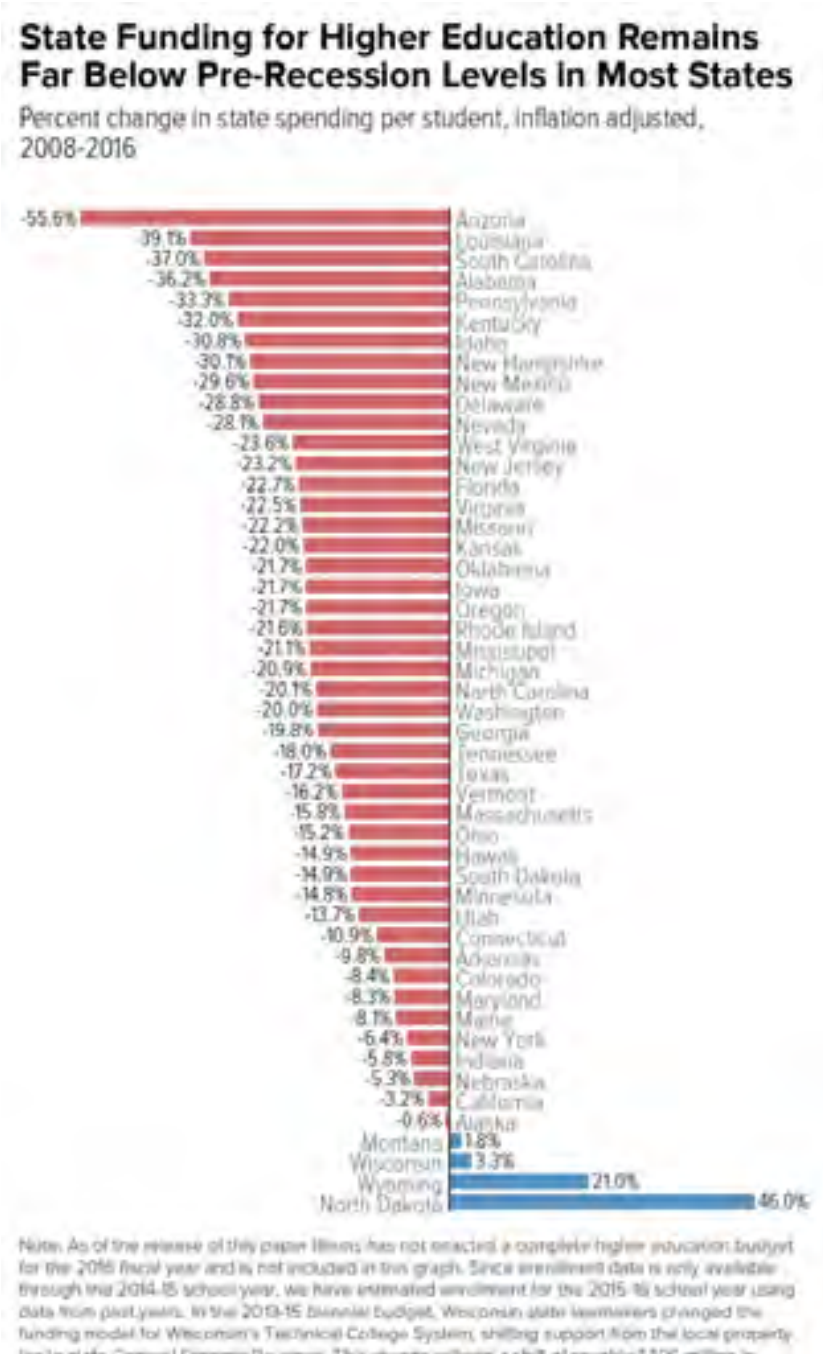
NAE GRAND CHALLENGES FOR ENGINEERING

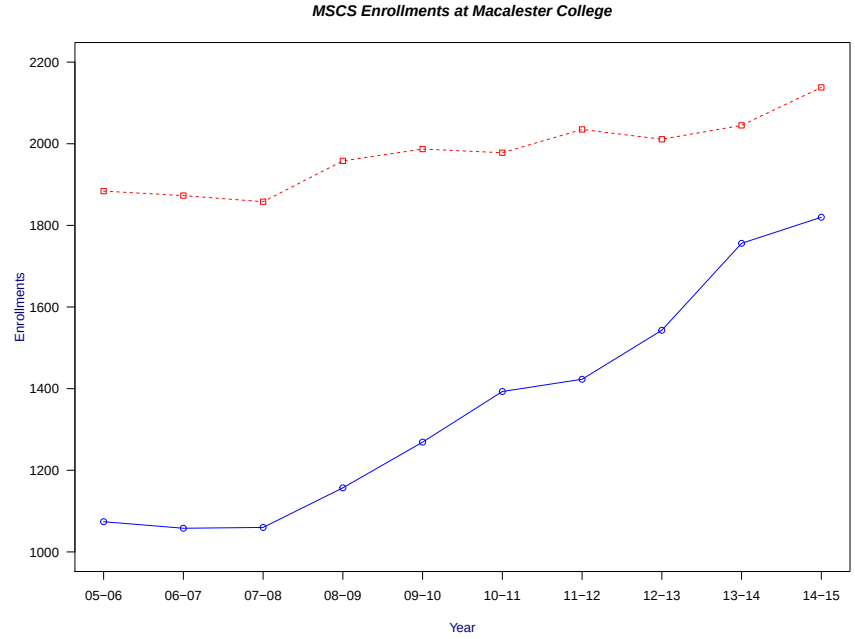
NATIONAL ACADEMY OF ENGINEERING

Develop Carbon Sequestration Methods
(modeling of porous media)

Prevent Nuclear Terror
(network analysis, data mining, cryptography)

Answers 3, 4, 5, ...





Mathematical sciences are dynamic. Our work is *never* done!!!

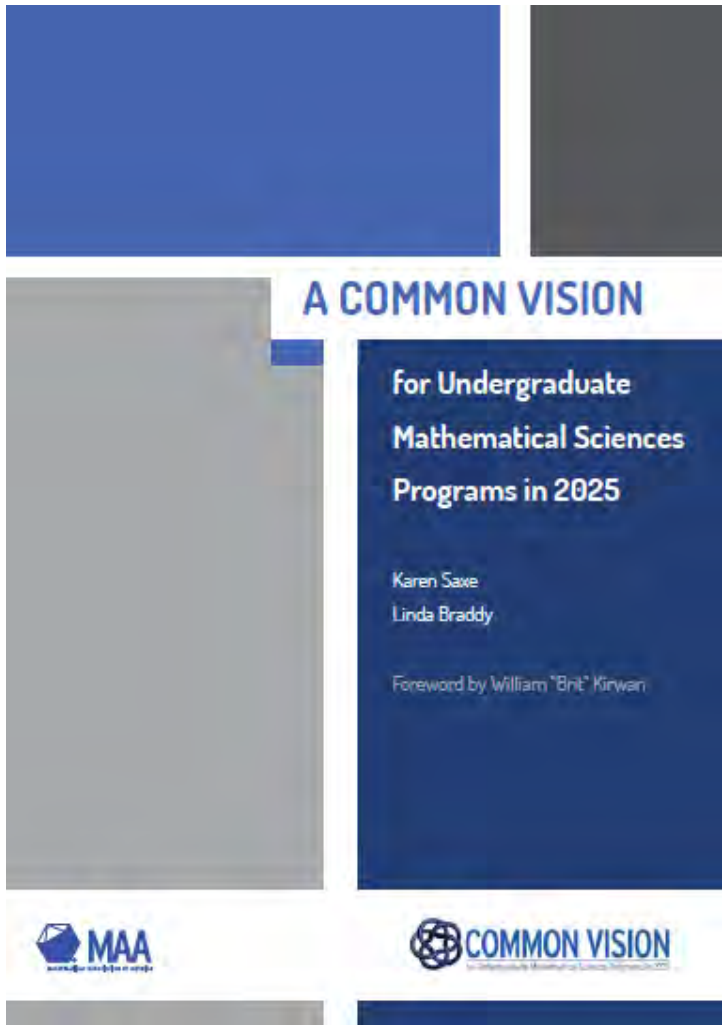
Two current initiatives *Common Vision* and *TPSE*

Common Vision for Undergraduate Mathematical Sciences Programs in 2025

Karen Saxe, PI
Linda Braddy, co-PI, MAA
John Bailer, ASA
Rob Farinelli, AMATYC
Tara Holm, AMS
Vilma Mesa, RUME
Uri Treisman, TPSE
Peter Turner, SIAM

NSF DUE-1446000

http://www.maa.org/common-vision



AMATYC	American Mathematical Association of Two-Year Colleges
AMS	American Mathematical Society
AMTE	Association of Mathematics Teacher Educators
ASA	American Statistical Association
ASL	Association for Symbolic Logic
AWM	Association for Women in Mathematics
ASSM	Association of State Supervisors of Mathematics
BBA	Benjamin Banneker Association
IMS	Institute of Mathematical Statistics
INFORMS	Inst. for Operations Research & the Management Sciences
MAA	Mathematical Association of America
NAM	National Association of Mathematicians
NCSM	National Council of Supervisors of Mathematics
NCTM	National Council of Teachers of Mathematics
SIAM	Society for Industrial & Applied Mathematics
SOA	Society of Actuaries
TODOS	TODOS: Mathematics for ALL

Conference Board of the Mathematical Sciences (CBMS)

Common Vision for Undergraduate Mathematical Sciences Programs in 2025

- Synthesis of the common themes from guides and leaders
  - The status quo is unacceptable
  - More statistics, modeling, simulation, and computation
  - Less traditional lecturing & more "active learning" techniques
  - Multiple pathways:
    - Through general education math/stat requirements
    - Into and through majors in the mathematical sciences
  - Increasing role of two-year colleges
  - Attention to student transitions & transfer between institutions
  - Technology to enhance student learning
  - Curricula development efforts with partner disciplines
  - Emphasis on developing students' communication skills
  - Faculty reward systems (e.g., tenure/promotion) are outdated
  - Sustainability of initiatives

Common themes from these existing curricular guides

- Beyond Crossroads, AMATYC, 2006 (update of Crossroads in Mathematics 1995)
- Guidelines for Assessment and Instruction in Statistics Education College Report, ASA, 2012
- Guidelines for Undergraduate Programs in Statistical Science, ASA, 2014
- 2015 CUPM Guide to Majors in the Mathematical Sciences, MAA, 2015 (CUPM guides published appr. every 10 years)
- Partner Discipline Recommendations for Introductory College Mathematics and the Implications for College Algebra, MAA, 2012
- Modeling across the Curriculum, SIAM, 2012
- Undergraduate Programs in Applied Mathematics, SIAM, 2014

What's happening since then?

- MAA working on an Instructional Practices Guide which will be the first of its kind; involves all five Common Vision associations
- AMATYC has begun its latest update of its curricular guide informed by the Common Vision report
- TPSE Math is focusing on policy efforts and engaging math department chairs & administrators, informed by Common Vision
- NCTM is working to build out from Common Vision into the K-12 arena
- AMS established Department of Education and Diversity

Transforming Post-Secondary Education in Mathematics

TPSEMath

Transforming Post-Secondary Education in Mathematics

About | Blog | Meetings | MAG | Links

Transforming Post-Secondary Education in Mathematics (TPSE Math), sponsored by Carnegie Corporation of New York and the Alfred P. Sloan Foundation, aims to effect constructive change in mathematics education at community colleges, 4-year colleges and research universities.

Spearheading the effort are:

- Eric Friedlander, University of Southern California
- S. James Gates, Jr., University of Maryland
- Mark Green, University of California - Los Angeles
- Phillip Griffiths, Institute for Advanced Study
- Tara Holm, Cornell University
- Karen Saxe, Macalester College
- Uri Treisman, University of Texas at Austin
- William (Brit) Kirwan, University System of Maryland, *Senior Advisor to TPSE Math*

Vision: Post-secondary education in mathematics will enable any student, regardless of his or her chosen program of study, to develop the mathematical knowledge and skills necessary for productive engagement in society and in the workplace.

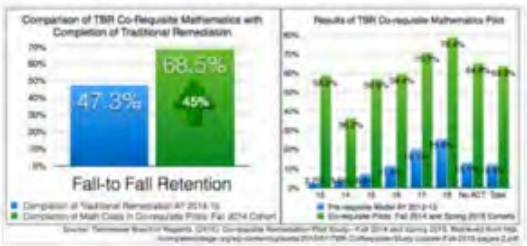
Mission: TPSE Math will facilitate an inclusive movement to strengthen post-secondary education in mathematics by working closely with--and mobilizing when necessary--faculty leaders, university

Tweets by @tpsemath

TPSE Math Retweeted

Philip Uri Treisman
@uritr

"2.Experiment in the classroom" @tpsemath to "study, catalog & promote" innovation. @DanBerett mentions @TNRegents

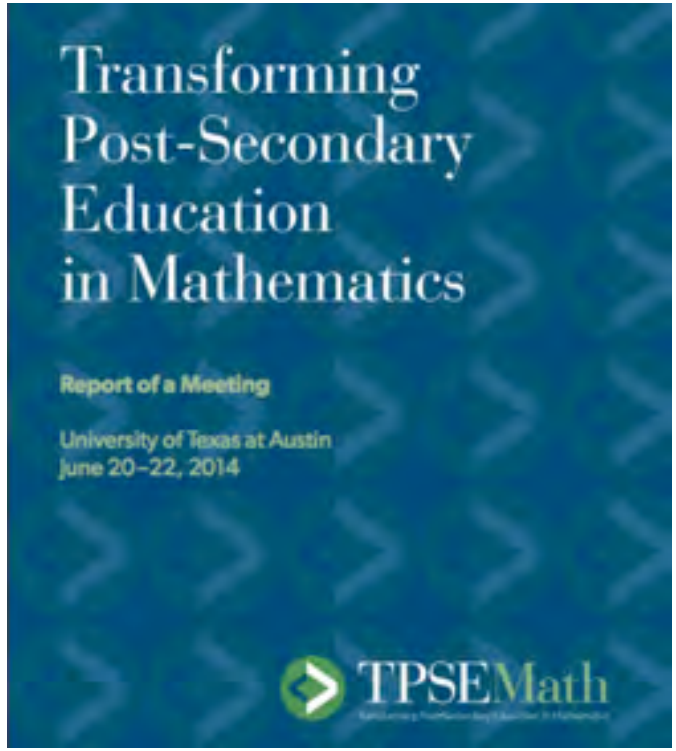


TPSE Math Retweeted

Philip Uri Treisman
@uritr

@tpsemath approach to transform #math #highered?


UNIVERSITY OF
18
56
MARYLAND


Transforming
Post-Secondary
Education
in Mathematics
Report of a Meeting
University of Texas at Austin
June 20–22, 2014
TPSEMath

TPSE – via alliances with state and federal agencies, the policy community, university administrators, higher education associations, and professional organizations – is securing the financial and structural support necessary to improve

- Curriculum pathways (lower & upper division, allowing students to reach the math relevant to their field of study)
- Graduate co-curricular training
- Leadership and capacity development

"Leadership matters – success in this area depends upon the value assigned to it by a department's leadership"

https://forum.tpsemath.org

PART II
What is going on in Washington?

The Budget

- How does the annual process work?
- Where are we this year in process?
- How is it looking for the things relevant to academic mathematicians?
  - NSF budget
    - Research and Related Activities
    - EHR
  - Immigration and visas
  - Higher education – college cost, indirect costs, ...

How does federal investment in science pay off for American tax-payers?

Farming Better

Farming, not an easy job in the first place, now requires more analytics and technology to meet the increasing demand for food. In one case, in California, mathematicians, hydrologists, and farmers met to design a plan that would minimize water used for crops but still make a profit for the farmers and meet consumer demand. The mathematical model that was created incorporated data such as plant growth properties and water requirements of different crops to identify which ones to plant, the best time to plant them, and which areas to leave unplanted. The farmers were happy to use their own resources and those of the community wisely, while the mathematicians were happy to work with experts in the field.

The application of math and high-tech approaches to farming is called *precision agriculture*. It involves collecting much more data than before, such as the weight of each hen in a chicken coop, and using models to find the best course of action to remedy any deficiencies in the production process. One aspect of farming that has become more efficient as a result is the use of fertilizer. Using GPS-equipped machines that sample the soil, farmers know exactly where more fertilizer is needed, thus overcoming the natural tendency to over-fertilize. As a result, more food is grown and less fertilizer is wasted, which means fewer nitrates in watershed run-off.

For More Information: "A Role for Modeling, Simulation, and Optimization in an Agricultural Water Crisis," Eleanor Jenkins and Kathleen Fowler, *SIAM News*, December 2014.

Listen Up!

MM/128

AMS American Mathematical Society

*The **Mathematical Moments** program promotes appreciation and understanding of the role mathematics plays in science, nature, technology, and human culture.*

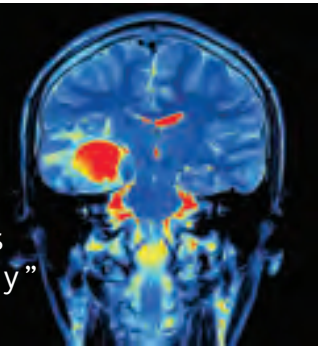
www.ams.org/mathmoments

MSRI Mathematical Sciences Research Institute

AMS American Mathematical Society

Cordially invites you to a lunch briefing on Capitol Hill entitled

"Blackboard to bedside: How high-dimensional geometry is transforming the MRI industry"



WEDNESDAY
6.28.17
12:00 pm – 1:30 pm

Room SR-188,
Russell Senate
Office Building

Introductions:
David Eisenbud
Director, Mathematical Sciences Research Institute (MSRI) &
Professor of Mathematics, University of California, Berkeley

Presenter:
David Donoho
Professor of Statistics
Stanford University

Recently the FDA approved a device for dynamic MRI incorporating a method that gathers data 15 times faster than before. The speedup will allow more patients to be served at a lower cost per patient, giving US taxpayers a better return on the tens of billions of dollars in annual MRI charges. The presentation will tell the story of how US investment in basic research in the mathematical sciences led to this breakthrough.

David Donoho is a MacArthur Fellow and National Academy of Sciences member. One of the world's leading mathematical statisticians, he is currently the Anne T. and Robert Bass Professor of Humanities and Sciences and professor of statistics, Stanford University. His patents on compressed sensing are incorporated in the latest generation of MRI machines from the Siemens Corporation.

LUNCH WILL BE SERVED. SPACE IS LIMITED AT THIS WIDELY ATTENDED PUBLIC EVENT.

RSVP by June 21st to
alb@ams.org

What else?

Science division of White House office left empty as last staffers depart

Comment / Share / Tweet / Stumble / Email

WASHINGTON -- The science division of the White House's Office of Science and Technology Policy (OSTP) was unstaffed as of Friday as the three remaining employees departed this week, sources tell CBS News.

All three employees were holdovers from the Obama administration. The

www.cbsnews.com/news/science-division-of-white-house-office-now-empty-as-last-staffers-depart/

AMS Washington Office resources

General information about the office and our programs[1]
www.ams.org/policy/policy

Capital Currents blog (post about every 2 weeks)
blogs.ams.org/capitalcurrents/

[1] Not in great shape, working on it!