

# TSPE-MAG Panel: Lessons from Postsecondary Reform in Other STEM Disciplines

Moderator: Susan Singer, NSF

Physics: Bob Hilborn, AAPT

Geosciences: Kim Kastens, Columbia University

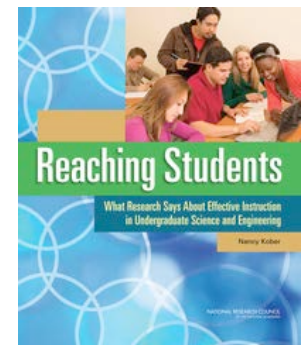
Biology: John Jungck, University of Delaware

Engineering: Karl Smith, University of Minnesota

# Approach

- Goals:
  - Share lessons learned about improving practice and role of discipline-based education research in other STEM field: physics, geosciences, biology, engineering
  - Encourage research and practice integration (rich history of RUME)

- Approach:
  - 10 minute overviews
  - Discussion

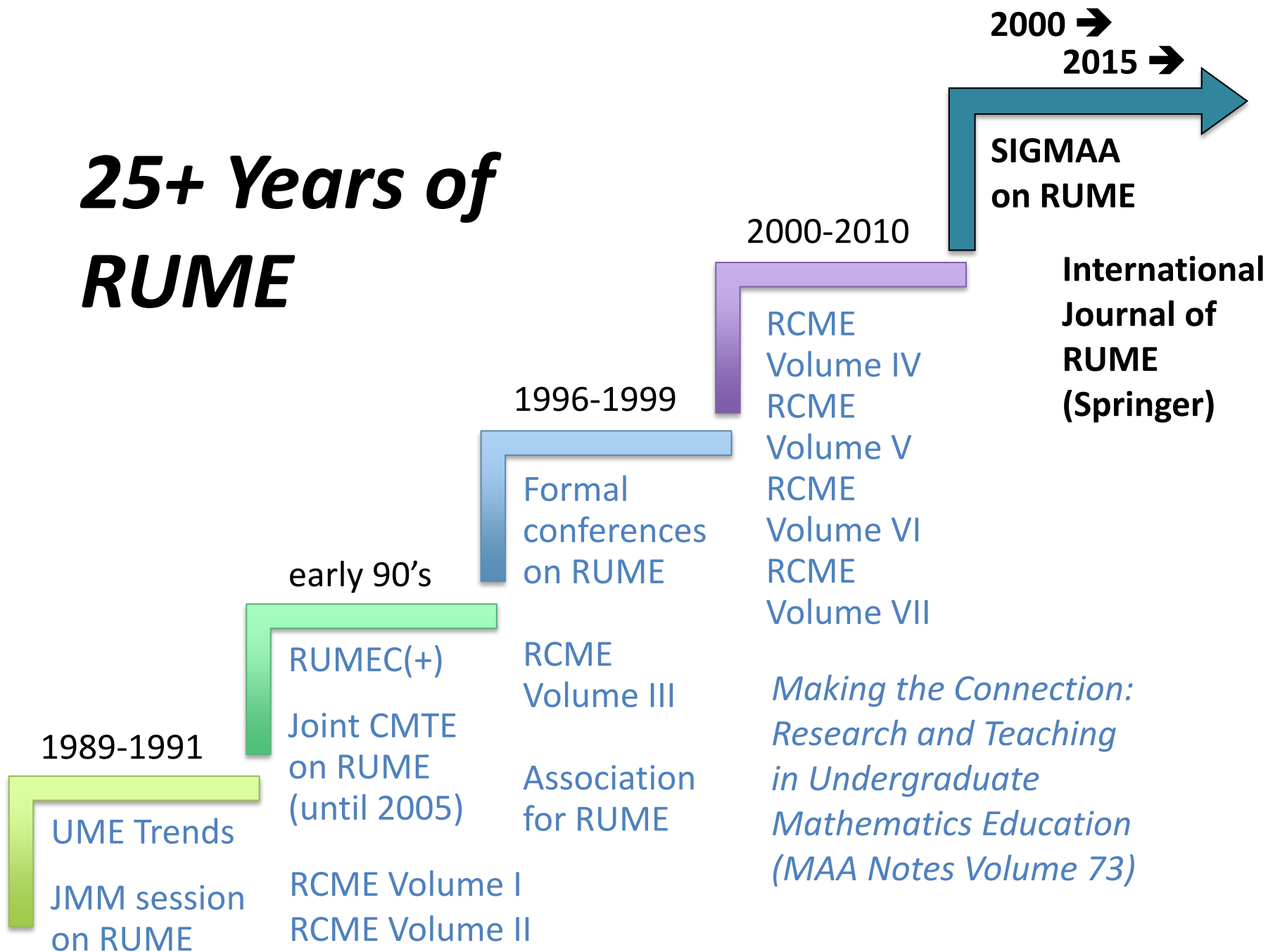


- Resources posted to TPSE website

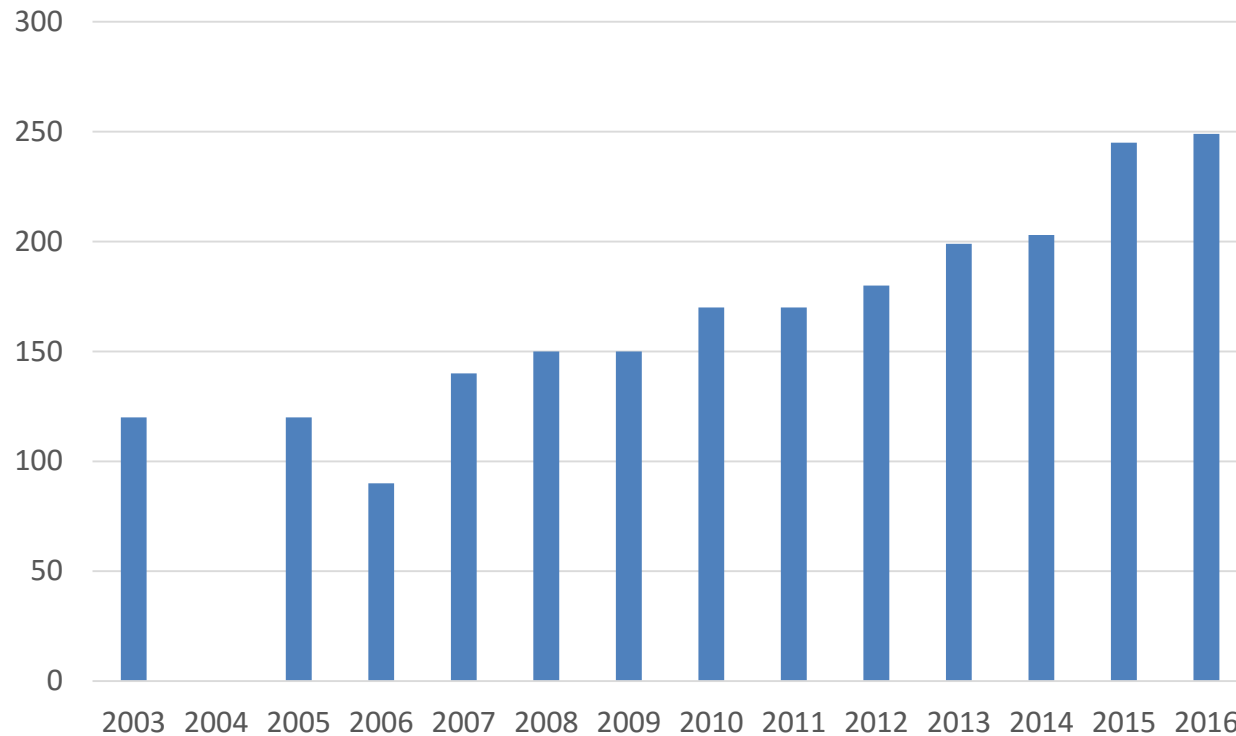
# Some Notes on the History of RUME

Compiled by Jack Bookman, Lloyd Douglas,  
Tim Fukawa-Connelly, Shandy Hauk, Eric  
Hsu, Karen Marrongelle, TJ Murphy, Chris  
Rasmussen, Annie Selden, Natasha Speer,  
Aaron Weinberg

# 25+ Years of RUME



## RUME Conference Attendance



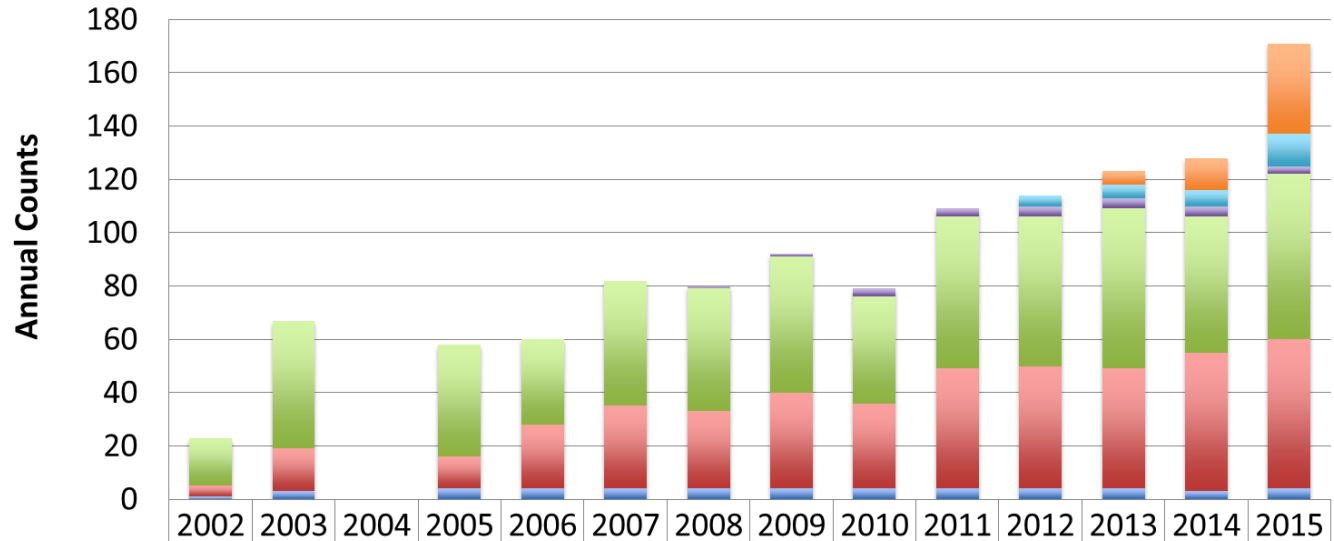
### Notes:

2001: September conference cancelled because of 9/11

2002: Pre-session to MAA MathFest instead of stand-alone conference

2004: No conference because shifting annual date (October 2003 to February 2005)

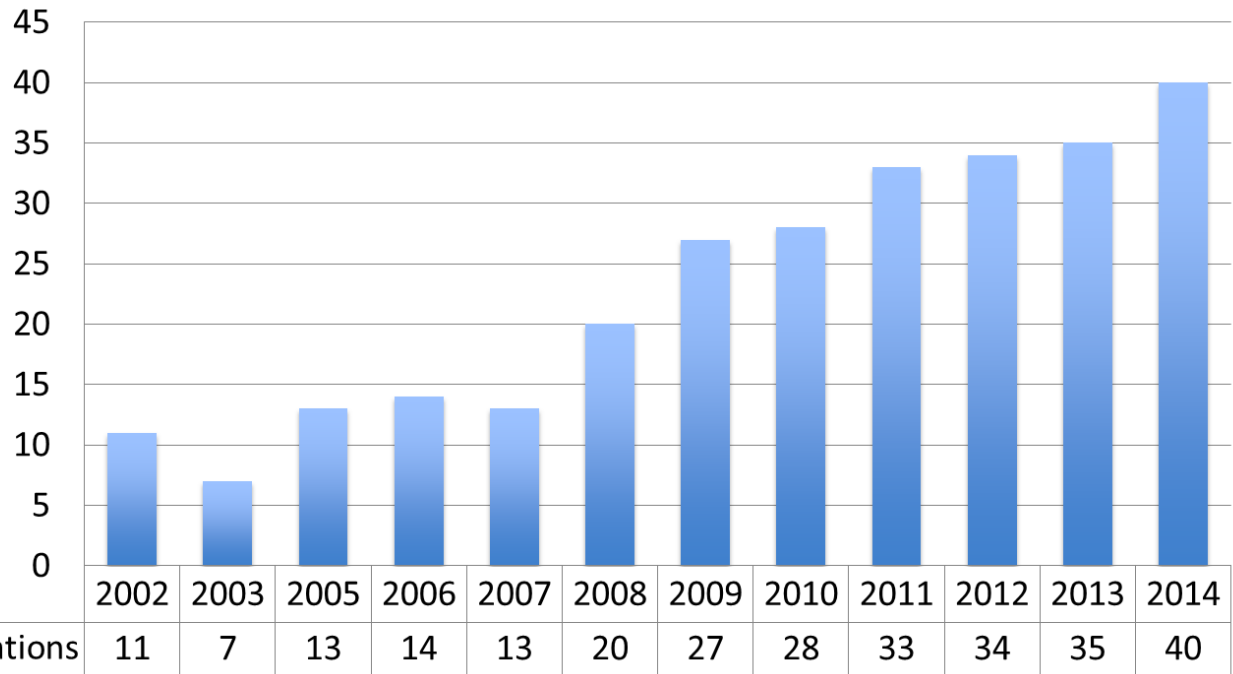
## RUME Conference Research Reporting



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Posters												5	12	34
Theoretical Reports											4	5	6	12
Presessions							1	1	3	3	4	4	4	3
Preliminary Reports	18	48		42	32	47	46	51	40	57	56	60	51	62
Contributed Papers	4	16		12	24	31	29	36	32	45	46	45	52	56
Plenary Sesions	1	3		4	4	4	4	4	4	4	4	4	3	4

Note: The RUME Conference began a *Proceedings* in 2007.

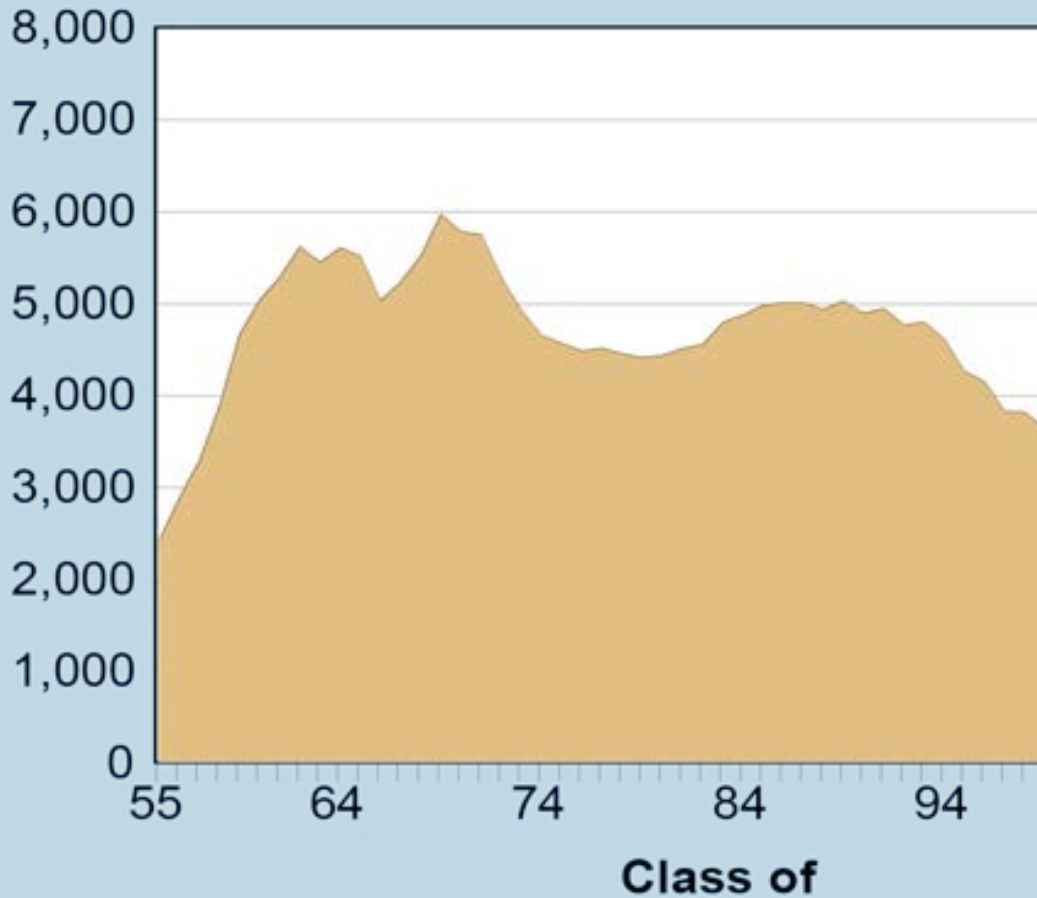
### RUME Research in Peer-Reviewed Journals, 2002-2014



Note: From a systematic but not exhaustive search in Academic Search Premier (ASP). 2014 is the most recent full year for which ASP promises complete data for a journal. Search terms "peer-reviewed" "mathematics" "undergraduate or college" resulted in about 1800 hits. A review of titles (and abstracts when needed) identified which were RUME. Selection criteria: research about undergraduates learning mathematics and/or college faculty teaching mathematics (e.g., some papers that appeared in JMTE are included because they are about pre-service teachers learning mathematics in college mathematics classes).

## Physics Bachelor's Degrees Awarded in the US, Classes of 1955 through 2014.

Number



<http://www.aip.org/statistics>

(1) The Department (2) The Department (3) The Department



# Lessons from Physics

- Long tradition of physics education research
  - PhysPort.org: user-friendly resources for interactive engagement teaching and assessment
- 1990s presented strong incentives for change
- 1999-2003 SPIN-UP –
  - Departments are the crucial units for change.
  - The PROGRAM is more than the courses.
  - Increasing # of majors  $\leftrightarrow$  improved “service” courses
  - Time scale for significant change is 5-10 years
- 1996-present: Physics and Astronomy New and Experienced Faculty Workshops – over 1800 alumni
  - Now reaching 50% of new tenure-track hires
  - TYC New Faculty Experience
- AAPT/APS Joint Task Force on Undergraduate Physics Programs – preparing students for diverse careers
- APS/AAPT Physics Teacher Education Coalition – engaging physics departments to meet the strong demand for highly qualified physics teachers
- All programs have enhancing diversity efforts

# Suggestions from Geoscience Education Reform

- Build a community of practice of faculty who share a passion for improving education
- “...simple clear messages repeated often by a variety of trusted sources...” Edward Maibach on climate communication
- Build a library or portal of peer-recommended teaching resources
- Learn from social scientists and K-12 education researchers
- Reflect on what cognitive processes and intellectual approaches are characteristic of your discipline
- Learn more about what employers value
- Learn more about what critical incidents entrain, retain or repel students from your field, especially under-represented minorities

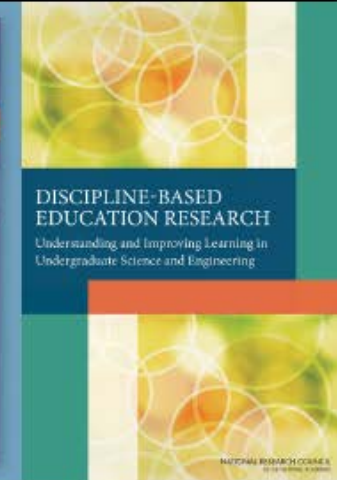
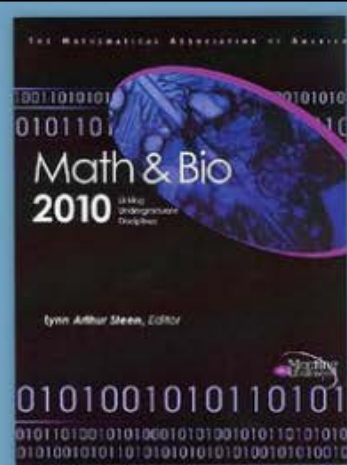
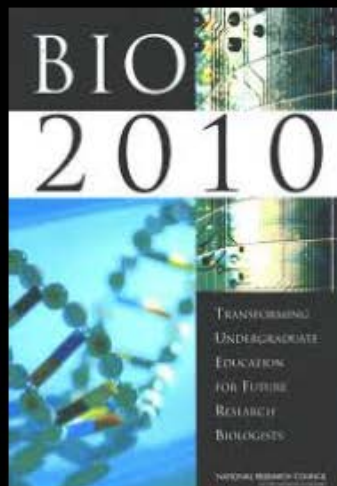
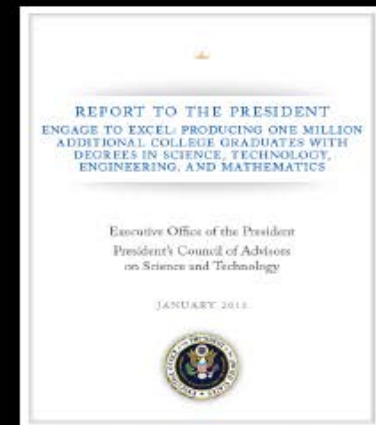


Kim Kastens  
Lamont-Doherty  
Earth Observatory  
of Columbia  
University

From 1966 -2016

CUEBS → GRC TMB → SMB → BioQUEST → NRC Bio 2010 → cbeLSE/MMNP/BI → QUBES

# Supporting Sustainable Student Success in Biology



# QUBES

The Power of Biology × Math × Community

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## Two Engineering Education Reform Examples

Cooperative Learning in Engineering Education and beyond 1974 - present



Engineering Education Research & Innovation 2004 - present

**Karl A. Smith**

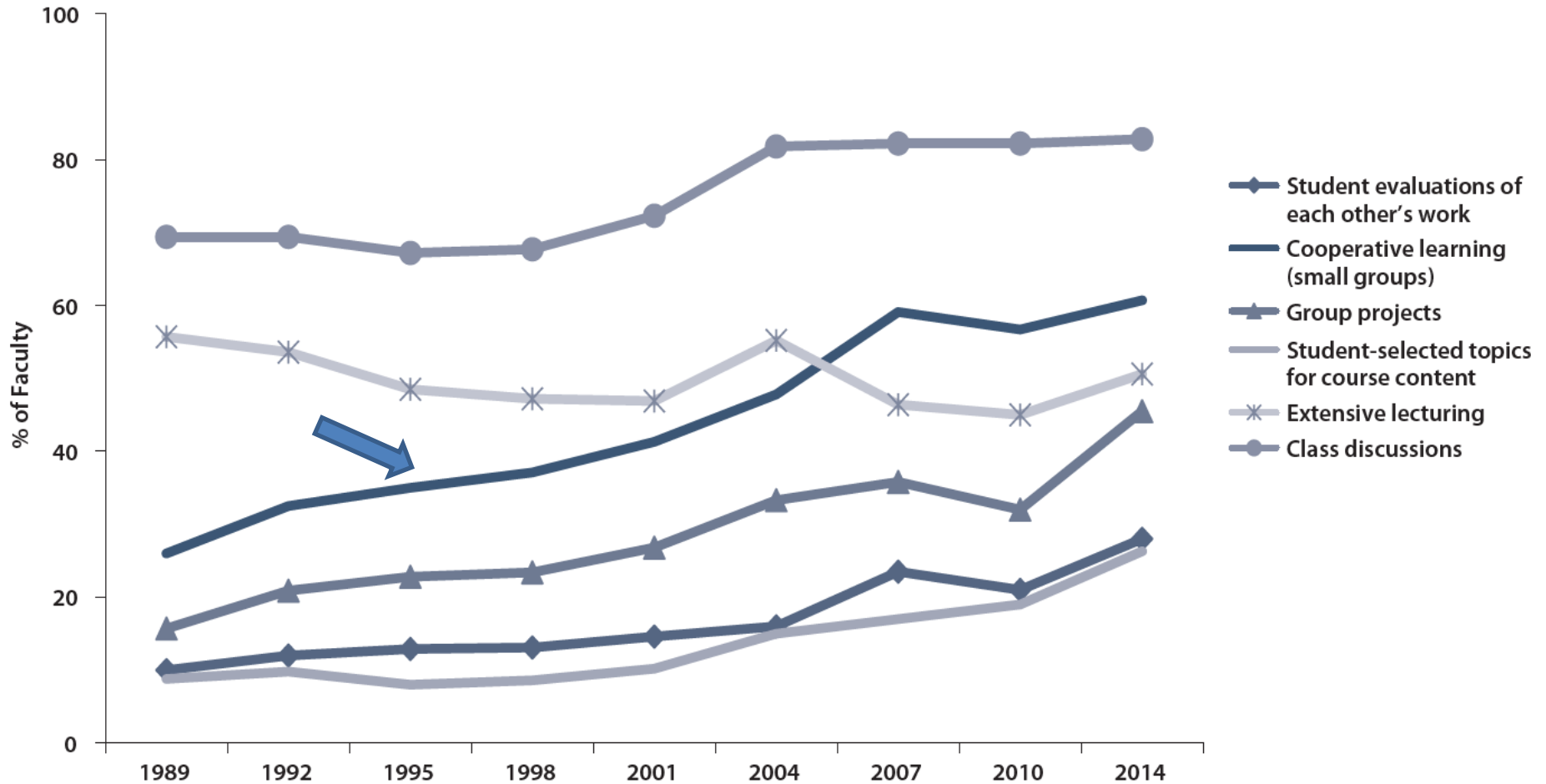
Civil Engineering/STEM Education Center –  
University of Minnesota &  
Engineering Education – Purdue University

[ksmith@umn.edu](mailto:ksmith@umn.edu)

<http://personal.cege.umn.edu/~smith/links.htm>

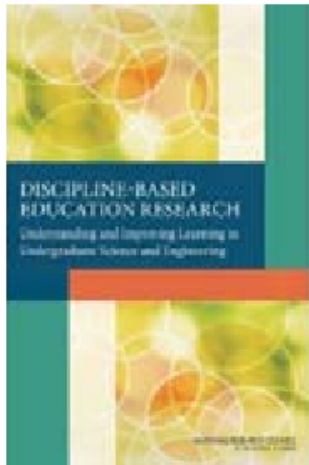
# Undergraduate Teaching Faculty: The 2013–2014 HERI Faculty Survey

Figure 2. Changes in Faculty Teaching Practices, 1989 to 2014  
(% Marking "All" or "Most" Courses)

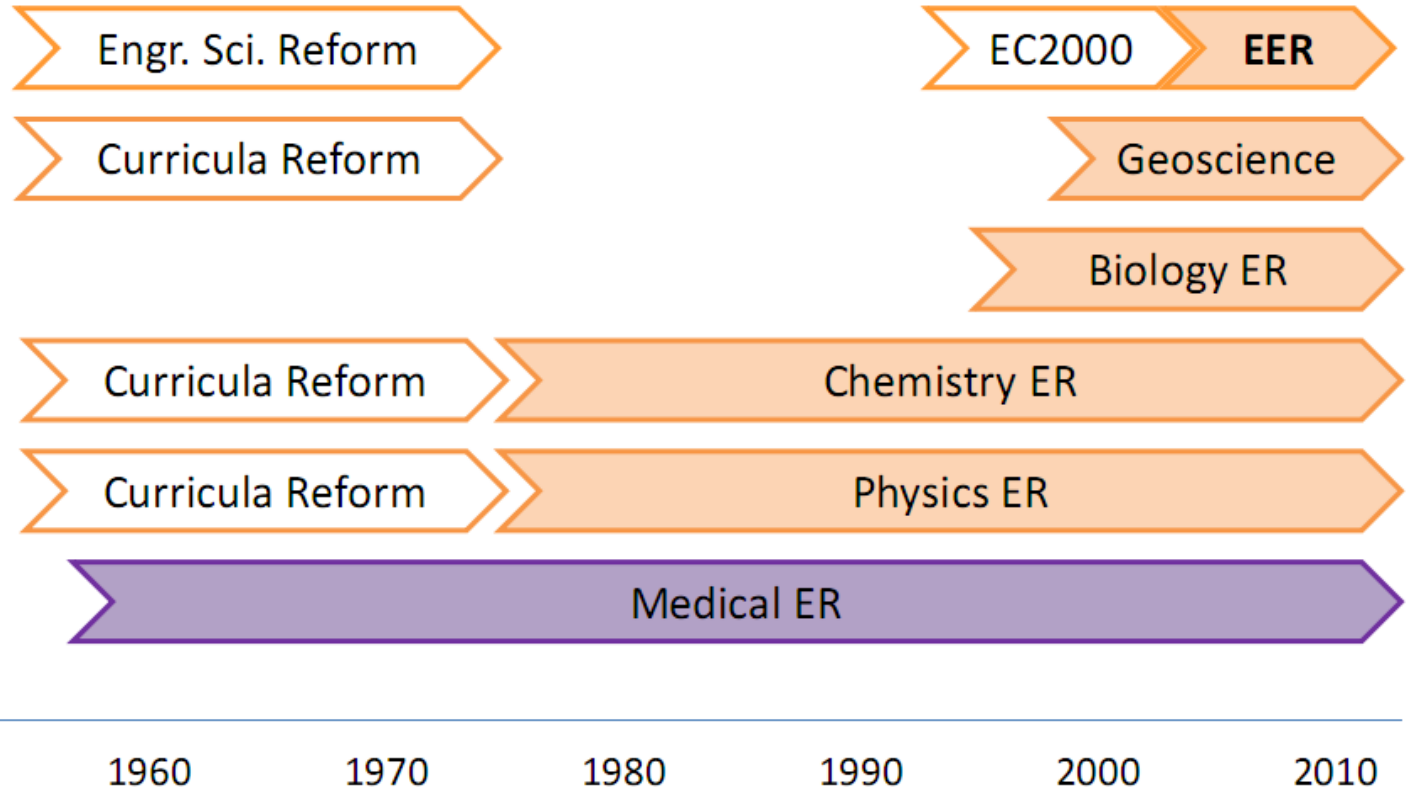


# Discipline-Based Education Research Timeline

DBER PhD Programs (xER)



National Research Council  
2012



DBER is **located** in the relevant disciplinary school, e.g. medicine, physics.

# Reflection and Dialogue

- Individually reflect on your insights, take aways, questions, etc. from the panel so far. Write for about 1 minute.
- Turn to a neighbor, introduce yourself, and share your ideas, listen carefully to your neighbors ideas. Discuss with your neighbor for about 2 minutes
  - Select/create a response to present to the whole group if you are randomly selected