Modeling across the Curriculum II:
A SIAM-NSF Workshop*
January 12- 14, 2014

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Education and Human Resources Directorate

Major Goal

(Unchanged from MaC I)

Engage and Keep Young People in STEM Disciplines,
from K12 through Undergraduate (and Graduate) Studies,
and into the Workforce.

Background to the workshop proposal

- CCSS – call for more applications
  - But little specific content of applied nature
- National emphasis on STEM *and* STEM Education
  - Applied and computational math is at the heart
- Modeling (and then solution of those models) is a natural focus
- Applications over very wide range
  - Similarities of models is often missed

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Background to the workshop proposal

- College Prep, especially for STEM disciplines
  - Use Modeling/applied math in project-based modules to reinforce math and science education
  - Strengthen understanding rather than "new" topics
- **PCAST *Engage to Excel*** postdates our proposal by many months but makes the case for it
  - 1 million additional STEM graduates in next decade
  - The "math gap"
  - More relevant math and STEM experiences in K-12, especially HS

STEM

doesn't happen

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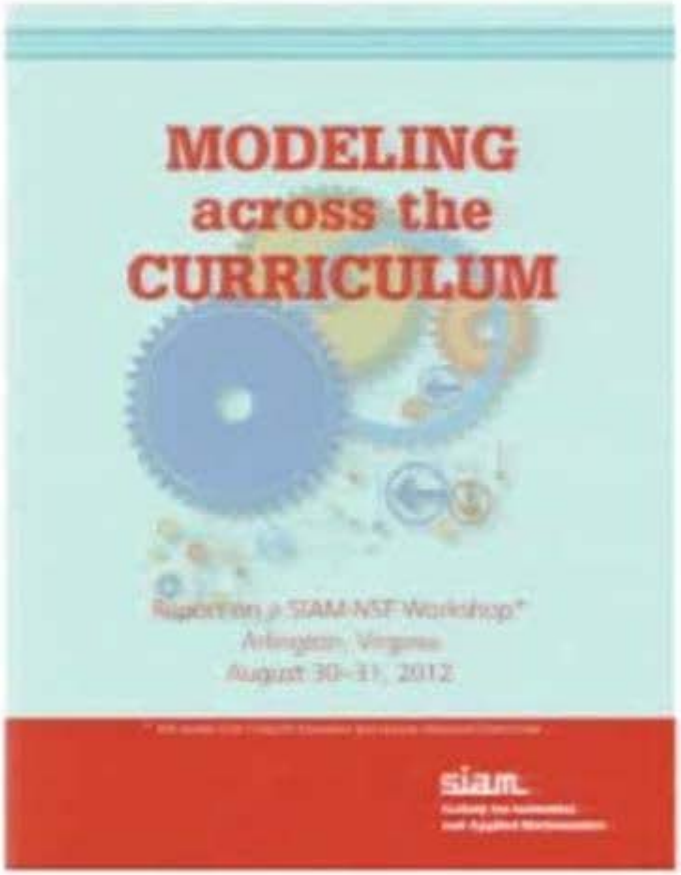
Workshop Objectives (again continuing from MaC I)

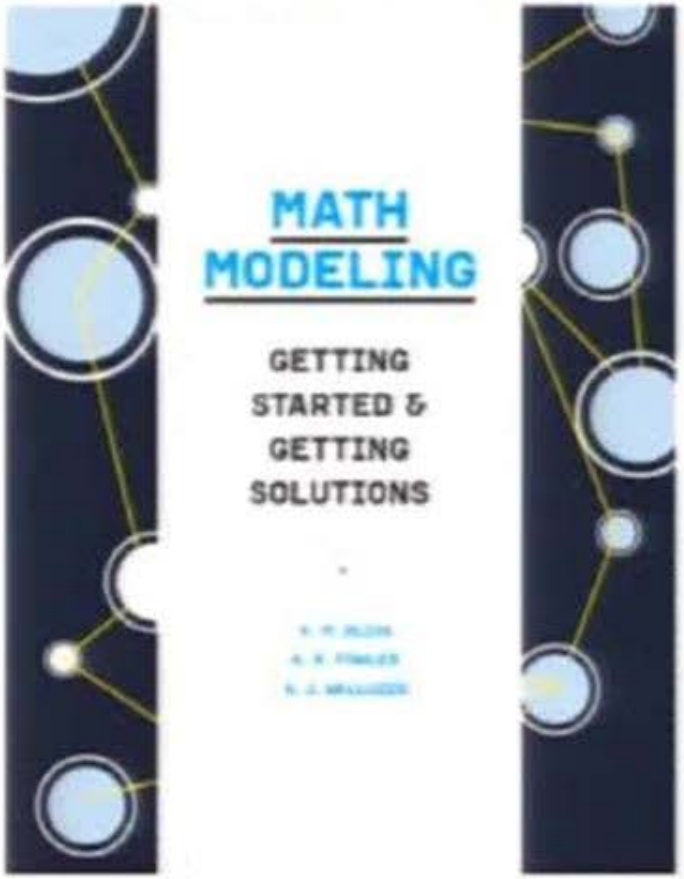
- *Engage to Excel* challenges us to develop new models for STEM education
- Opportunity to shape direction
- Coordinated approach to STEM
  - Not necessarily new fundamental content
  - Projects and research
  - Modeling and computation form a natural basis
  - Reinforcement of existing curricula

MaC I Recommendations

Four categories

- Expanding modeling in K-12
- Development of a high school one semester, or one year modeling course (with stratified content)
- Develop modeling-based undergraduate curricula
- Develop a repository of materials for math modeling instruction and understanding.





www.siam.org/reports/modeling_12.pdf

m3challenge.siam.org/about/mm/

Product of both MaC I and Moodys Mega Math Challenge

Synergistic Activities

- Math 2025
- INGenIOuS (ASA, MAA, SIAM, AMS)
- Common Vision Undergrad Math in 2025 (MAA, SIAM, AMATYC, ASA, AMS)
- JPBM presentation to PCAST (AMS, MAA, SIAM)
  - "led to" TPSE Math
- ISSUES (math, sciences and engineering)
- Future Directions in CSE Education (SIAM-EESI)
- CBMS Forum on Undergrad Programs

MaC II Acknowledgments

- NSF for MaC II award
  - EHR/DUE Award 1352973
  - Lee Zia, Mike Jacobson, Ron Buckmire/John Haddock
- SIAM
  - Strong support from Philadelphia HQ and from the entire leadership (President, Officers, Board and Council)
- ASA
  - Hosting, and providing important collaboration throughout

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Steering Committee

- Jim Crowley, ED of SIAM
- Peter Turner, SIAM VP for Education, 2009-2014
- Ron Wasserstein, ED of ASA
- Jeff Humpherys, BYU
- Rachel Levy, Harvey Mudd, new VP for Ed
- Katherine Socha, Math for America

Overview

- Three primary topic areas:
  - Early grades (Rachel Levy coordinating)
  - Middle/High School (Katherine Socha)
  - Undergrad curricula (Jeff Humpherys)
- "Current" process:
  - Developing clear list of deliverables
  - Panel first afternoon

Organization of meeting

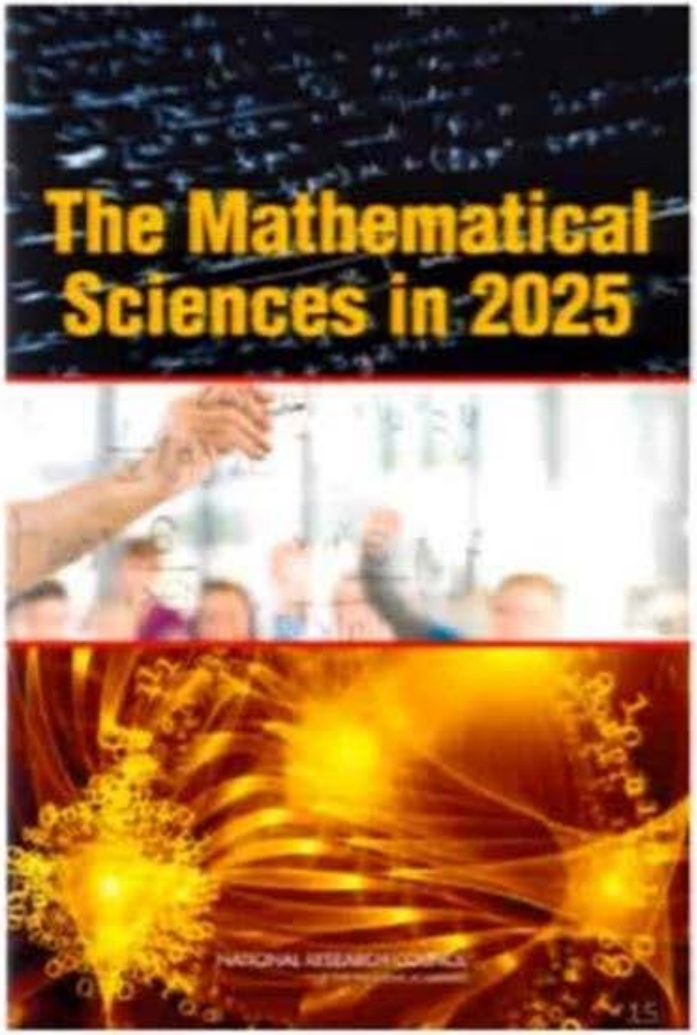
- Day 1: Plenary sessions
  - Welcome by Joan Ferrini- Mundy, NSF Assistant Director for EHR
  - Panel on the three themes
  - Getting Started on modeling
  - Keynote on Math2025 from Mark Green
- Days 2 & 3
  - Mostly break out group discussions

Panel Discussion

- Panel members: Humpherys, Levy, Socha
  Moderator: Turner
- Used to "set the scene" and review some of the discussions at MaC I:
  - Definition of modeling
  - Stand alone vs. infusion
- Setting goals for MaC II sessions
  - The role of algorithms
  - Modeling at different educational levels and in different disciplinary contexts
- Assessment

Keynote Address

- Math2025
- Mark Green, UCLA
  Former Director, IPAM
  Co-chair of report committee
- Emphasizing common themes in Math 2025 and MaC



Topics for Group Discussions

- Programs:
  - Courses, Programs, Degrees, Summer Experiences, Internships
  - "Infusion" or stand alone? ("Trojan mice")
- Materials:
  - Books, Videos, Software, Posters, Websites, MOOCs?
  - Informal education (MoMath?)
- Training:
  - Pre-service and in-service
  - Ways of interacting with teachers/ faculty/ TAs and students (and perhaps parents)

Outcomes and Recommendations

- The remaining three talks will add the details.
- Workshop was very productive
- Report is now complete
- Grant proposals
- Next steps include exploiting synergies

Summary Recommendations

Recommendation 1

- One of the u/g group's recommendations was that SIAM create an activity group on Applied Math Education.
  - To provide numerous opportunities for cooperation, collaboration, and recognition.
  - Examples include conferences, sessions at the annual meeting, email lists, SIAM-backed blogging, and even perhaps an online magazine.
  - Possibly also awards given to departments and individuals recognizing their contributions.

Summary
Recommendation 2

- Develop strong professional development and teacher training programs, materials and support networks to provide experience, understanding and skills in mathematical modeling at levels appropriate for use in early grades classrooms.
  - A major undertaking that probably requires the creation of specialist teachers in the early grades.

Summary

Recommendation 3

Develop professional development, curricular and assessment materials, and working groups for modeling in high school.

- Produce *Guidelines for Assessment and Instruction in Mathematical Modeling Education* (GAIMME) along the lines of ASA's GAISE Report.
- Propose and run a workshop focused on developing a high school mathematical modeling course and standards for modeling education.
- Create Working Groups to study different strategies
  - Infusion of Modeling into high school curricula,
  - Professional Development for teachers to improve or develop their expertise,
  - Assessment
- Develop a curated Repository of peer-reviewed and tested materials:
  - Projects, Curricular components, Career and Public awareness

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Summary
Recommendation 4

Two major reports (similar NAP reports):

- Connecting Mathematics to Reality,
  - Of value to educators, students and advisors at all levels
  - Answers to the "Why do I need to learn this?" or "When will I ever use this?"
- Modeling and the Pipeline
  - The vital role mathematical sciences play in developing an appropriately prepared and skilled workforce
  - Suggests an applications and modeling perspective to mathematical education.

NEWS FLASHES

- **SIAM Activity Group on Applied Math Education**
  - Started life January 2015
  - Officers: Turner, Humpherys, Seshaiyer, Galluzzo
  - First sponsored sessions at this meeting
  - Planning first SIAM Education Conference for 2016
  - Includes Modeling, CS&E, DESE, …
  - Career prep and pathways (in & out)
  - **Please join SIAG/ED**

NEWS FLASHES

- New joint **SIAM-NCTM Committee of Modeling across the Curriculum**
  - Peter Turner, Chair
  - SIAM representatives: Turner, Fowler, Levy and Socha
- **MaC II Report**
  - http://www.siam.org/reports/modeling_14.pdf
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