Under Construction: Next Generation Leadership for STEM

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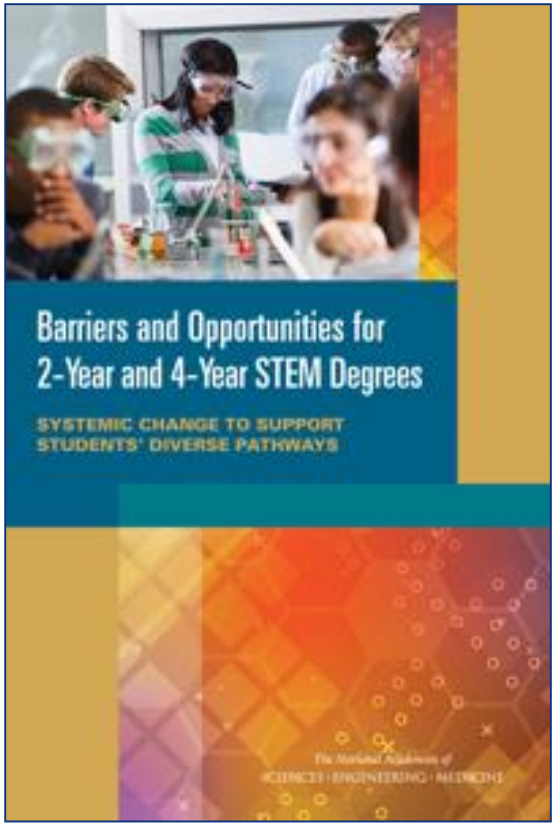
“Round up the usual suspects”

The “Unusual” Suspects

Shifting demographics of college and university students

- Stable numbers of high school graduates
- Increased numbers of non-white students
- Women are a higher percentage of college going students
- Increased significance of two-year institutions
- Larger percentages of part-time, working and older students

Barriers and Opportunities



The Educational and Research Values of Diversity

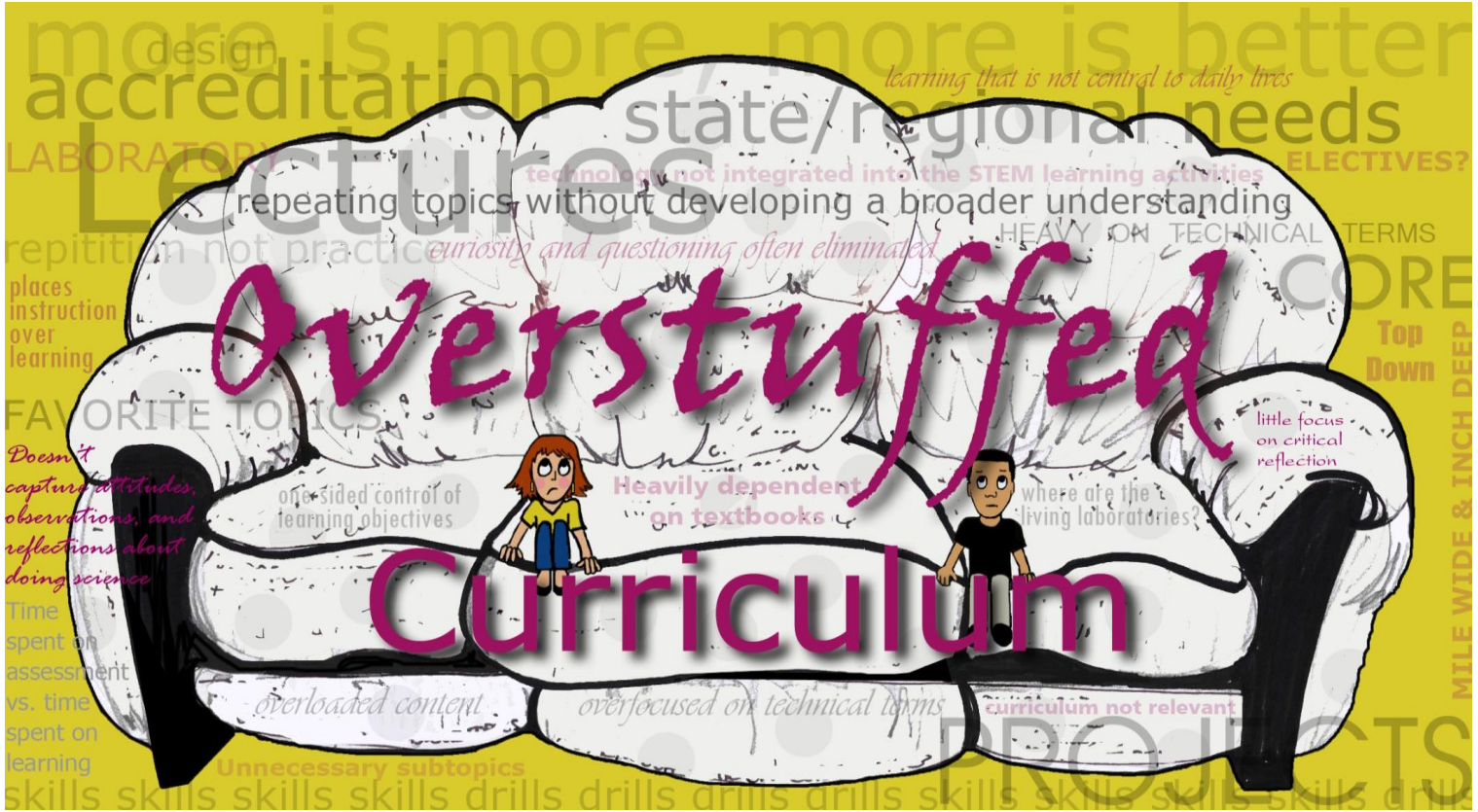
- Why is diversity a “game changer?”
  - Changing the available perspectives?
  - Changing the problems we choose?
  - Providing new routes to innovation?
  - Introducing new research performers?
  - Compelling/inspiring innovations in education?

Changing Needs in STEM

Today's problems and our ability to address these into the future require new skills for leadership

- Working across fields
- Working in diverse teams and collaborating across stakeholder groups
- Developing and sharing compelling stories
- Communicating with non-technical audiences
- Different management styles that inspire the best from others
- Understanding the larger policy and contextual issues of the problems we seek to address

Content? Can't Squeeze in Anything More!



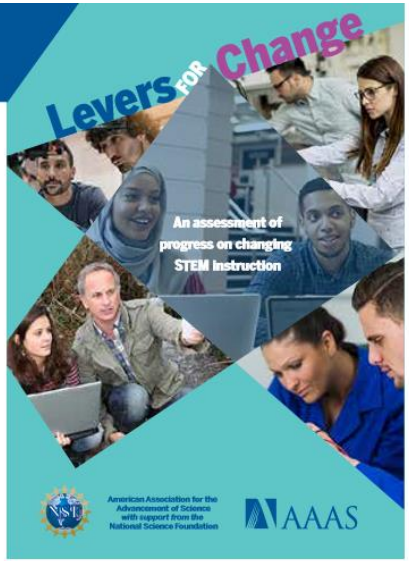
The Conundrum

- When and how will you be able to help students and faculty acquire these skills? (Curricular? Co-curricular? Blended? Professional development?)

- Where will they be valued?

Levers for Change

An assessment of progress on changing STEM instruction



A report from AAAS, with support from NSF and HHMI

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EXECUTIVE SUMMARY

Education research demonstrates that pedagogical approaches that foster active and collaborative learning can enhance student learning, attitudes, and persistence in science, technology, engineering, and mathematics (STEM) educational paths. Yet most students do not experience these engaging pedagogies, with students from underrepresented groups (e.g., nonwhite racial and ethnic groups and low-income students) least likely to experience these approaches despite being more likely to benefit from them. It is crucial that we learn how to actively lower barriers to and promote instructor adoption of effective evidence-based teaching practices.

We consider this problem in terms of a metaphor — "levers for change." Why levers? In mechanics, a lever is a simple machine used to move an object at one location by applying a force somewhere else. When we try something and see that it is working, we have gained *leverage* on the problem. Here, we consider how systems, structures, and cultures can work as levers to accomplish change in STEM instruction, recognizing the complex and multilevel nature of the environment in which such levers operate.

We set out to assess the state of reform in STEM undergraduate instruction and to identify effective levers for change on STEM undergraduate teaching and learning, both within and across six STEM disciplinary clusters: life sciences; chemistry and

or situation of any single instructor. We sought scholarship- and community-based answers to the following questions:

- What is the current state of research-based reform in undergraduate instruction within these six clusters of STEM disciplines?
- How did each arrive there? What levers for change — activities, events, influences, movements, groups, documents, contexts — have been important in reaching this state? And how are these levers similar or different for each discipline?
- What provides evidence for these trajectories of change, and why?
- What can be learned from this evidence about how to expand and deepen the impact of these changes in the next decade?

We commissioned scholarly

Opportunities and Challenges of Co-Curricular Approaches

- While perhaps effective in developing skills, may not be accessible to all
- What opportunities to build community that supports retention?
- Real life connections often prized by students from diverse populations
- Time (for everyone) and added cost
- Compatibility with the life demands of today's students?

The Integration of Teaching, Research and Skills Development

Can changes in course delivery, assessment, research topics or structure support this?

- Blending/flipped
- Projects/problems
- Tackling “real world” issues
- Peer teaching/peer mentors
- Research presentations
- Outreach
- Presentations to community audiences

A View from the Field

The World from 30,000 Feet

Down in the Weeds

The Integration of Research and Education

The integration of research and education

- How to accomplish this? Implementing a strategic plan
- Changing the criteria
- Interpreting the criteria
- The emergence of “Broader Impacts” and the opportunities that provides

Professional Development to Support Faculty and Postdoctoral Scholars

What specific skills?

- Networking
- Mentoring
- Writing for different audiences
- Speaking to different audiences
- Effective teaching
- Policy and context

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- **COACh** career building workshop topics: effective negotiation, communication techniques, successful mentoring, leadership skills, publishing in peer reviewed journals, grantsmanship, memorable scientific presentations and launching a career in science and engineering.
- **COACh** provides a forum for networking and mentoring of scientists and engineers at all levels to assist them in their research, teaching and career advancement.

Professional Development

Programs that put the pieces together

- Science and Technology Policy Fellowships
- Mass Media Science and Engineering Fellows
- Agency rotators
- Professional society committee service
- Service as reviewers
- Editorial board service

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PROGRAMS

Science & Technology Policy Fellowships

Transforming Education in STEM and Building Skills

- Enlisting students as peer tutors and peer mentors
- Students' engagement in community-based programs
- Use of paid internships in the community (e.g., nonprofits, foundations, industry)
- Do authentic experiences raise the value to skill-building?

What experiences should students have?

Both Targeting and Mainstreaming

Centers had different human resources development requirements than single investigator grants.

Centers have different human resources outcomes than parent departments.

T-shaped Skills, Pi-shaped Skills and Comb-Shaped Skills