Overview of the Current Knowledge Base on Broadening Participation (BP)

QEM NSF INCLUDES, March 7

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The STEM Pipeline

- 2001: 4.01 Million 9th Graders
- 2005: 2.8 Million High School Graduates
- Fall 2005: 1.9 Million College Plans
- Fall 2005: Only 1.3 Million College Ready
- Fall 2005: 278,000 Majoring in STEM
- 2009-11: 167,000 STEM Graduate
STEM Workforce: Race & Gender

Workers in science and engineering occupations

In 2015, women and some minority groups were represented less in science and engineering (S&E) occupations than they were in the U.S. general population.

<table>
<thead>
<tr>
<th>S&amp;E Occupations</th>
<th>U.S. Population</th>
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<tbody>
<tr>
<td>49%</td>
<td>31%</td>
</tr>
<tr>
<td>18% White men</td>
<td>31% White women</td>
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<tr>
<td>14% White women</td>
<td></td>
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<tr>
<td>7% Asian men</td>
<td>3% Asian women</td>
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<tr>
<td>3% Asian women</td>
<td></td>
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<tr>
<td>2% Black men</td>
<td>6% Black women</td>
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<tr>
<td>4% Black women</td>
<td></td>
</tr>
<tr>
<td>2% Hispanic men</td>
<td>9% Hispanic women</td>
</tr>
<tr>
<td>2% Hispanic women</td>
<td></td>
</tr>
<tr>
<td>2% Other men</td>
<td>8% Other women</td>
</tr>
<tr>
<td></td>
<td>3%</td>
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</tbody>
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Source: National Center for Science and Engineering Statistics, National Science Foundation
Women, Minorities, and Persons with Disabilities in Science and Engineering: 2017
https://nces.ed.gov/statistics/wmpdsi/
Rising Demand, Waning Supply

- Jobs in STEM fields will increase 17% between 2014 and 2024
- Size of the U.S. science and engineering labor force has declined since the turn of the 21st century
- White and Asian share of STEM workforce is currently higher than their share of the working age population
- The STEM workforce is no more diverse now than 14 years ago (Bidell 2015)
HBCUs produced 25 percent of all bachelor's degrees in STEM fields earned by African Americans in 2012.

While enrolling 9% of all black college students (Pew 2017)
NSF Broadening Participation

Broadening participation is embedded in its Strategic Plan through a variety of investment priorities related to the Learning and Stewardship strategic outcome goals, including:

• Preparing a diverse, globally engaged science, technology, engineering, and mathematics (STEM) workforce;

• Integrating research with education, and building capacity;

• Expanding efforts to broaden participation from underrepresented groups and diverse institutions across all geographical regions in all NSF activities; and

• Improving processes to recruit and select highly qualified reviewers and panelists.

To expand efforts to increase participation from underrepresented groups and diverse institutions throughout the United States in all NSF activities and programs.
DRK-12 Broadening Participation Topical Group Synthesis Project
2017 - 2018
Steering Committee

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Malcolm Butler, University of Central Florida
Cory Buxton, University of Georgia
Leanne Ketterlin Geller, Southern Methodist University
Odis Johnson, Washington University, St. Louis
Christopher Wright, Drexel University
Synthesis Products

- Policy Brief
  - Audiences: State, district, and school leaders
  - Goals: Draw on the unique strengths of DRK-12 research to provide insights about broadening participation and identify some potential policy levers

- Theory Paper
  - Audience: Prospective DRK-12 grantees
  - Goals: Provide guidance about using theory in research on broadening participation, highlight some currently used theories, and identify opportunities for the use of different theories
PROMINENT THEORIES RELATED TO BROADENING PARTICIPATION

Intersectionality (Collins 1990; Camacho and Lord 2011)
Culturally Relevant Pedagogy (Ladson-Billings 1995; Nasir and Hand 2008)
Micro-Aggressions/Trauma (Sue 2007; McGee and Pearman 2015)
Sociocultural Theory (Wertsch et al. 1995; Stinson 2008)
Stereotype-Threat (Steele and Aronson 1995; Good, Aronson and Harder 2008)
Labeling Theory/Self Fulfilling Prophesy (Rist 1970; Ferguson 2000)
Impostor Syndrome (Wenneras and Wold 1997; Kolligian and Sternberg 2010)
Cultural Capital (Bourdieu 1977; Carter 2003)
Cultural Ecological Model/Acting White (Ogbu 1987; Forham and Ogbu 1986)
Critical Race Theory (Ladson-Billings and Tate 1995; Villenal and Deyhle 1999)
Resiliency/Grit (Masten 1994; Duckworth 2016)
Social Capital (Loury 1977; Bourdieu 1986; Coleman 1988)
Social Cognitive Career Theory (Bandura 1986; Lent et al. 1994)
BP Theory & Change

It’s about...

• **CHANGE** in educational practices, institutional practices, communities of practice, the structure of OTLs, etc.,

• **CHANGE** in learning behaviors, and/or

• **CHANGE** in beliefs (socio-cultural, psycho-social, or attitudinal) about practices, learning and the environments in which both take place...

That will broaden the participation of traditionally underserved and underrepresented populations in STEM
Inclusive Science, Technology, Engineering, Mathematics, and Computer Science Learning Spaces Look and Sound Different

In inclusive classrooms:

- All students are having experiences with STEM-related phenomena: engaging with the content; talking; collaborating; and sharing their ideas, knowledge, work and understanding.

- Teachers view all students as capable of learning, thinking about, and knowing STEM. They are listening to students’ ideas, and finding different ways for students to express those ideas. They create an environment of trust and norms for collaboration that empowers students to share and participate.

- The learning of language and the learning of content are intertwined.

- Pacing might be different from expected norms.
Broadening Participation Requires a Different Set of Responses from the Education System

1. Articulating a clear vision for, and long-term commitment to, broadening participation in STEM.

2. Re-conceptualizing professional learning to more fully integrate strategies for broadening participation with science, mathematics, engineering, and computer science content.

3. Providing the specific types of tools, materials, and other supports that inclusive learning environments require.

4. Considering the effect of existing and prospective policies on students’ access to science mathematics, engineering, and computer science learning.

5. Being open to different conceptions of success, and sharing success stories.
QUESTIONS

1. Name two challenges that limit our nation’s ability to achieve a diverse workforce.

2. In what ways, if any, might the NSF Broadening Participation initiative enhance the diversity of the workforce?

3. What strategies are used on your campus to increase and retain the interest of historically underrepresented students in STEM?
THANK YOU

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CADRE strengthens the capacity, advances the research, and amplifies the influence of National Science Foundation DRK–12 projects and researchers, and the DRK–12 program.
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Other Theories

- Sociocultural and Sociolinguistic Theories
  - Communities of Practice
  - Systemic Functional Linguistics

- Agency and Resiliency
- Social and Cultural Capital
- Universal Design for Instruction & Assessment
- Critical Race Theory
- Social Control Theory
- Actor Network Theory
- Culturally Relevant Pedagogy
- Social Network Theory

- Constructivism
  - Learning adaptation theory
- Intersectionality
- Micro-Aggressions/Trauma
- Social Cognitive Career Theory
- Whole-child approaches to coordinating and integrating support systems
- Social Justice Leadership Theory
- Stereotype-Threat
- Impostor Syndrome
- Cultural Ecological Model/Acting White
- Bob Moses’ work of organizing young people around mathematics
Policy Brief

THE CHALLENGE

STEM-related skills, knowledge, and qualifications are highly valued and valuable in our society. Yet specific groups of students historically have had, and continue to have, unequal access to the kinds of learning opportunities that provide them with these skills, knowledge, and qualifications. This exclusion takes place at all levels of the K-12 education system and has led to well-documented disparities in high-prestige STEM majors and careers. Redressing these disparities is a moral imperative.

THE OPPORTUNITY

Broadening participation in K-12 STEM education to include students from all backgrounds equalizes access to experiences that can prepare students for participation and success in civic life and the workforce. In this way broadening participation has the potential to transform society by reducing social and economic inequalities. The shifts called for by many recent state mathematics and science standards, together with the emergence of engineering and computer science in the K-12 curriculum, provide an opportunity to reshape K-12 STEM education in ways that are more inclusive of females, Black and Hispanic students, English learners, and students with disabilities.