



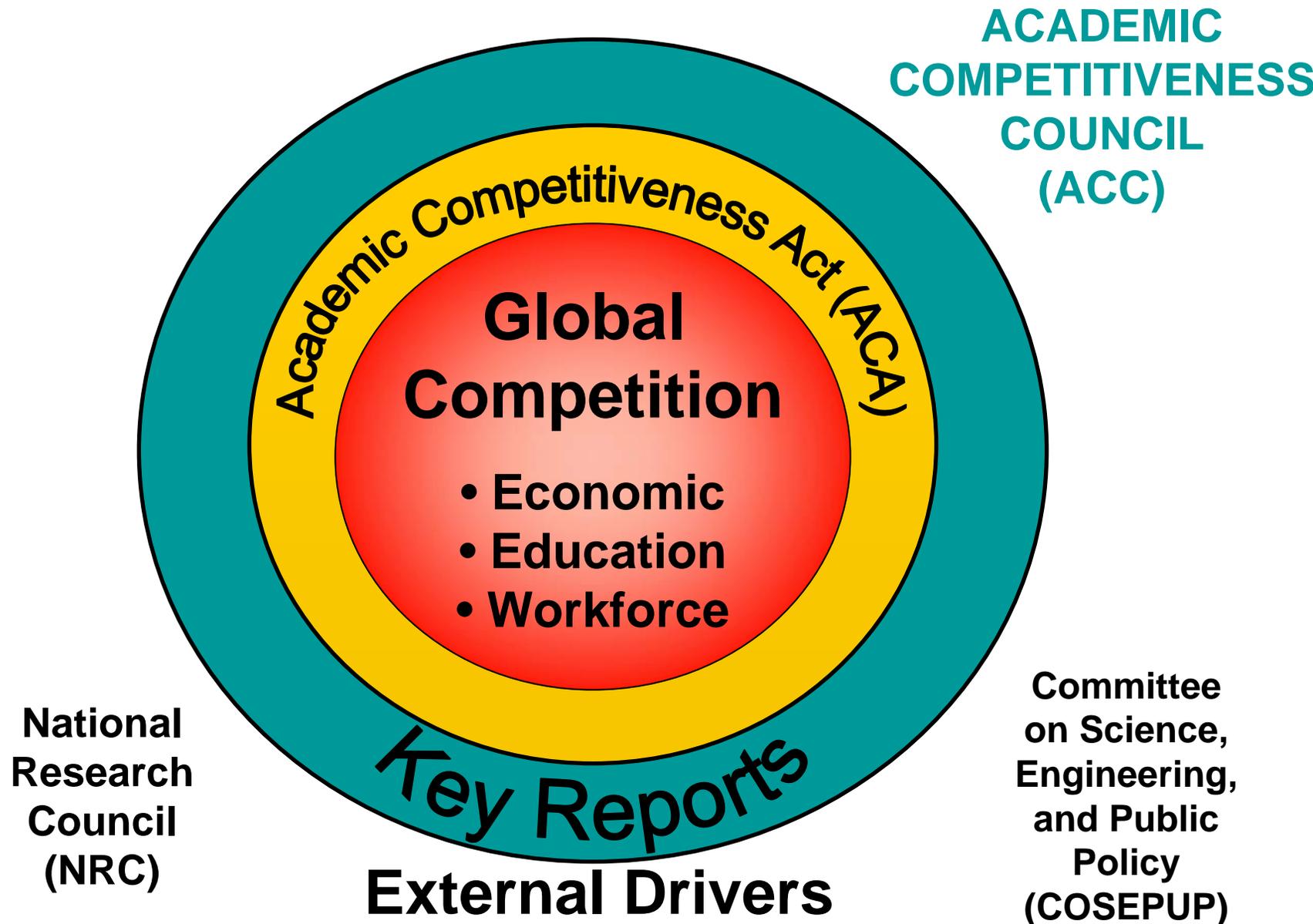
Broadening Participation of STEM Talent

Wanda E. Ward, Ph.D.

**Meeting of the Advisory Committee
Directorate for Engineering**

October 16, 2008

Drivers Shaping the Future





Internal Drivers



- *National Science Foundation Investing in America's Future: Strategic Plan FY 2006-2011*
- *National Science Board 2020 Vision for the National Science Foundation*
- *Broadening Participation at the National Science Foundation: A Framework for Action*

NSF Strategies

Focused Programs Examples

BIO: Research Initiation Grants and Career Advancement Awards to Broaden Participation in the Biological Sciences (RIG CAA BP)

CISE: Broadening Participation in Computing (BPC)

EHR: Centers for Research Excellence in Science and Technology (CREST)

GEO: Opportunities for Enhancement of Diversity in the Geosciences (OEDG)

MPS: Partnerships in Astronomy and Astrophysics Research and Education (PAARE)

Embedded Programs Examples

ALL: Research Experiences for Undergraduate (REU) Sites

CISE: CISE Pathways to Revitalized Undergraduate Computing Education (C-PATH)

EHR: Informal Science Education (ISE)

MPS: Enhancing the Mathematical Sciences Workforce in the 21st Century (EMSW21)

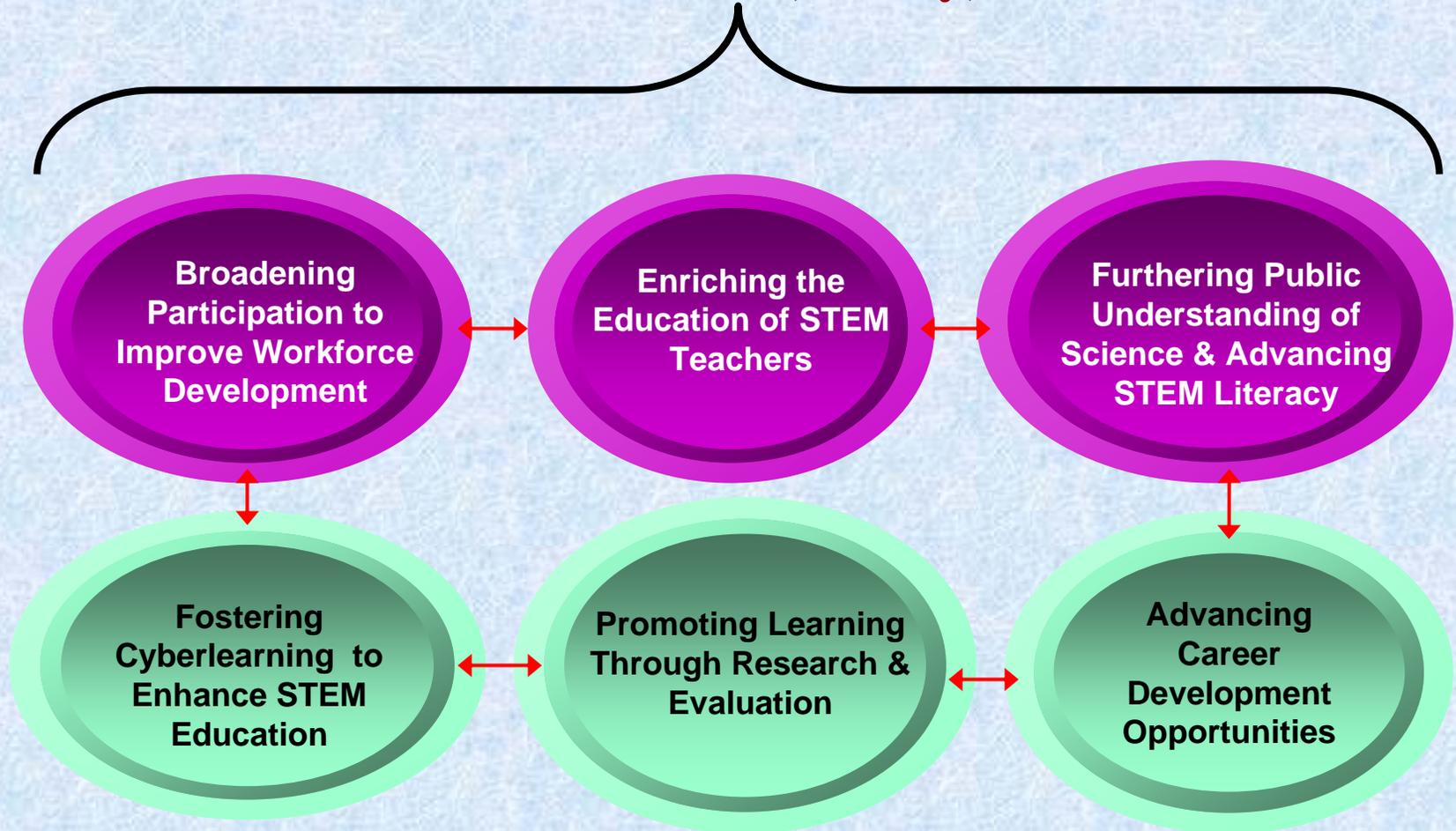
OD: Science and Technology Centers (STC)

**Broadening
Participation**



Thematic Framework for Directorate-Wide Coordination/Connections

STEM Education Research, Policy, and Practice



EHR Manages 31 of NSF's 59 Programmatic Efforts to Broaden Participation

Examples

MSP

ATE

LSAMP

IGERT

CREST



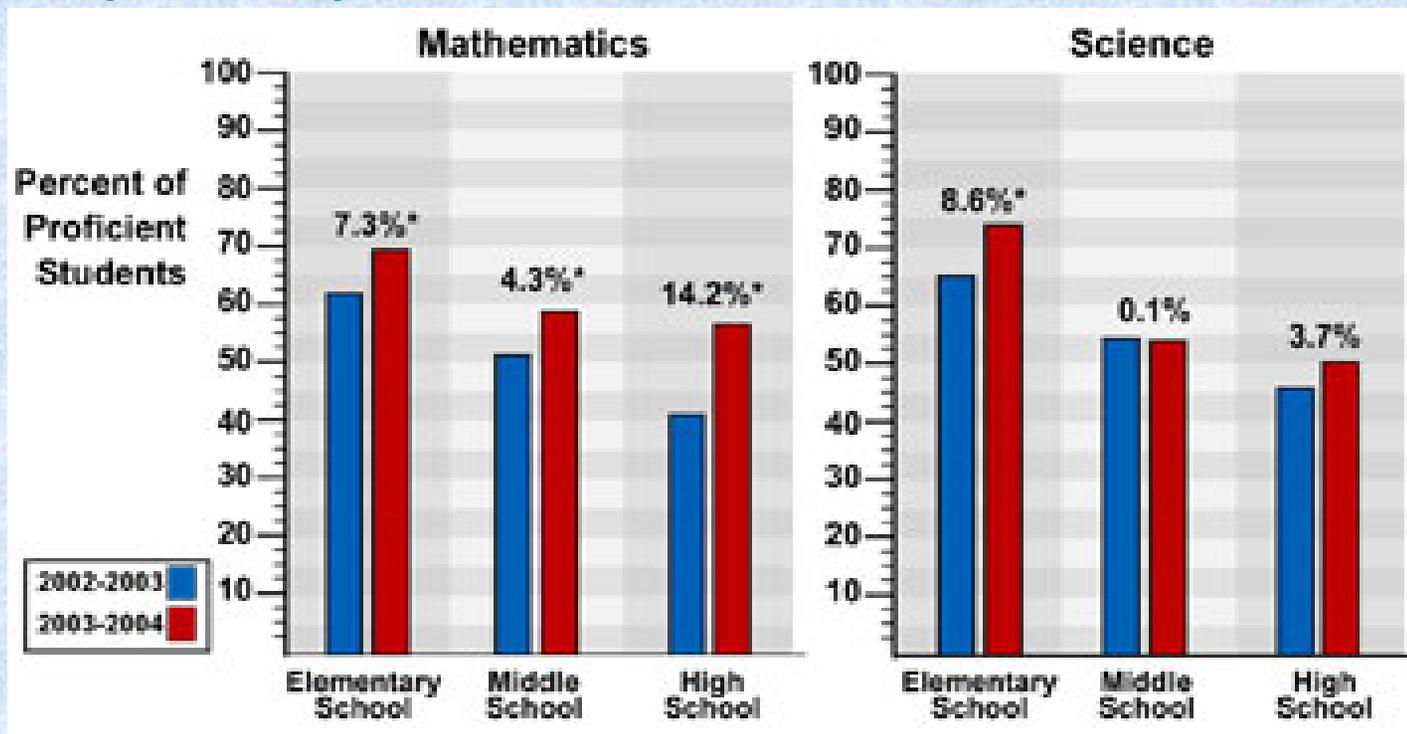
Math Science Partnership (MSP) Program Description

- Supports innovative partnerships between institutions of higher education and local school districts
- Seeks to improve learning in math and science for all students at all grade levels
- Aims to increase the number, quality, and diversity of mathematics and science teachers
- Enhances schools' capacity to provide more challenging curricula for all students, and promotes organizational change in education system



Attracting Higher-Ed Disciplinary Faculty in Helping to Improve K-12 Teacher Quality and Student Outcomes: Math Science Partnership (MSP) Program

In a first *analysis of student data*, elementary, middle and high school students showed significant improvements in mathematics proficiency test scores during the 2002-2003 and 2003-2004 school years. During the same period, MSP elementary school students showed significant gains in science proficiency.



Advanced Technological Education (ATE) Program Description

- Focuses on the education of technicians for high-technology fields, with an emphasis on two-year colleges
- Involves partnerships between academic institutions and employers to improve the education of science and engineering technicians at the undergraduate and secondary school levels
- Provides development and training opportunities for prospective teachers in technological education



Two-Year Colleges' Leadership Role in Developing Best Practices in Technician Education: Advanced Technological Education (ATE) Program



- ATE instruction and student experiences are tailored to industry and company requirements
- ATE-trained technicians are highly qualified and need little additional training other than company specific training provided to all employees

•ATE centers and projects have collaborated with over 7,800 business and industry partners, and 2,200 educational institutions





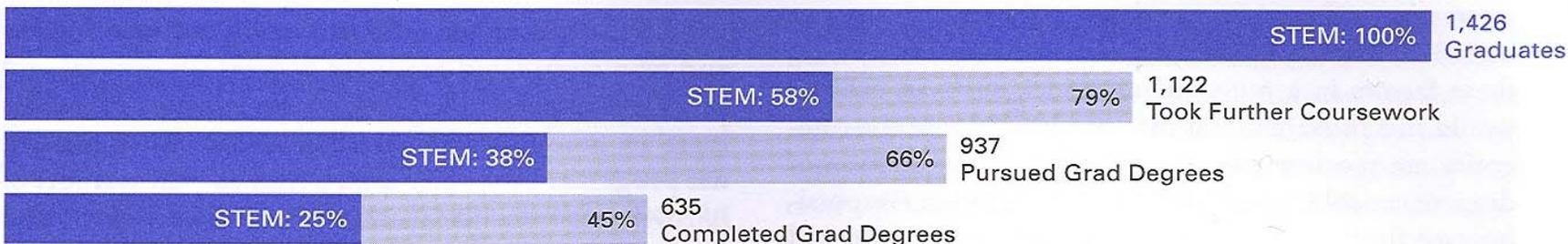
Louis Stokes Alliances for Minority Participation (LSAMP) Program

Seeks to increase the quality and quantity of students receiving baccalaureate degrees in STEM fields

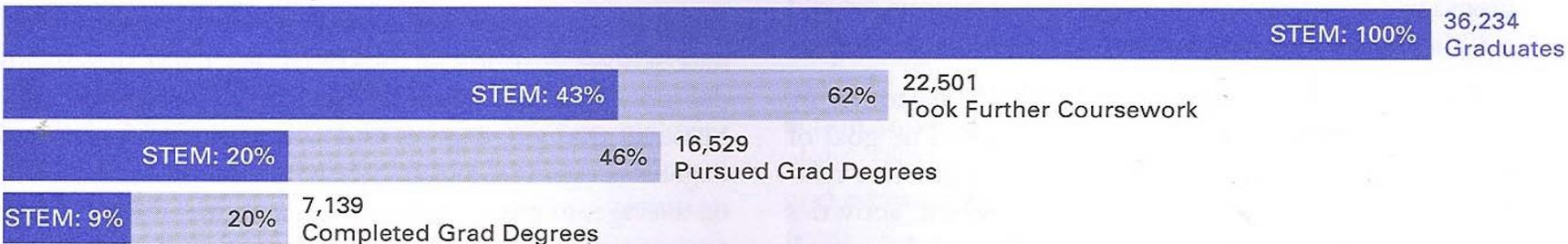
Measuring Effectiveness and National Impact: LSAMP

FIGURE 6. Graduate Coursework, Degrees Pursued, and Degrees Complete

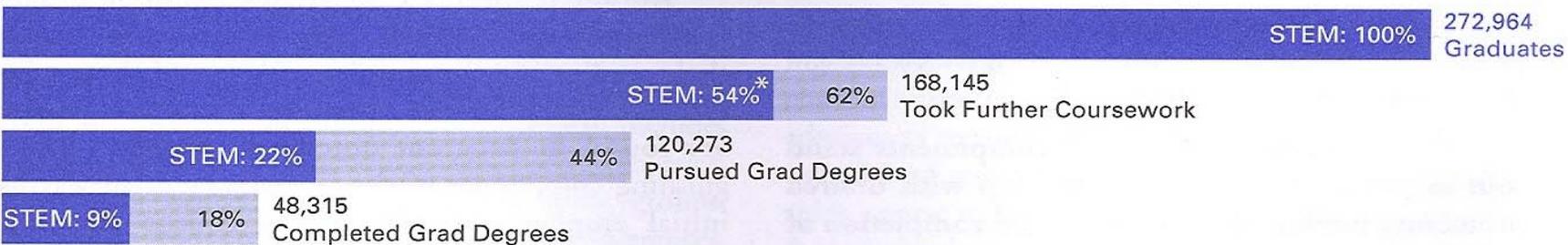
LSAMP Participants



National Underrepresented Minority



National White and Asian



Sources: UI LSAMP Graduate Survey and NSF NSRCG Longitudinal File.

*National comparison group statistic is not significantly different from LSAMP.

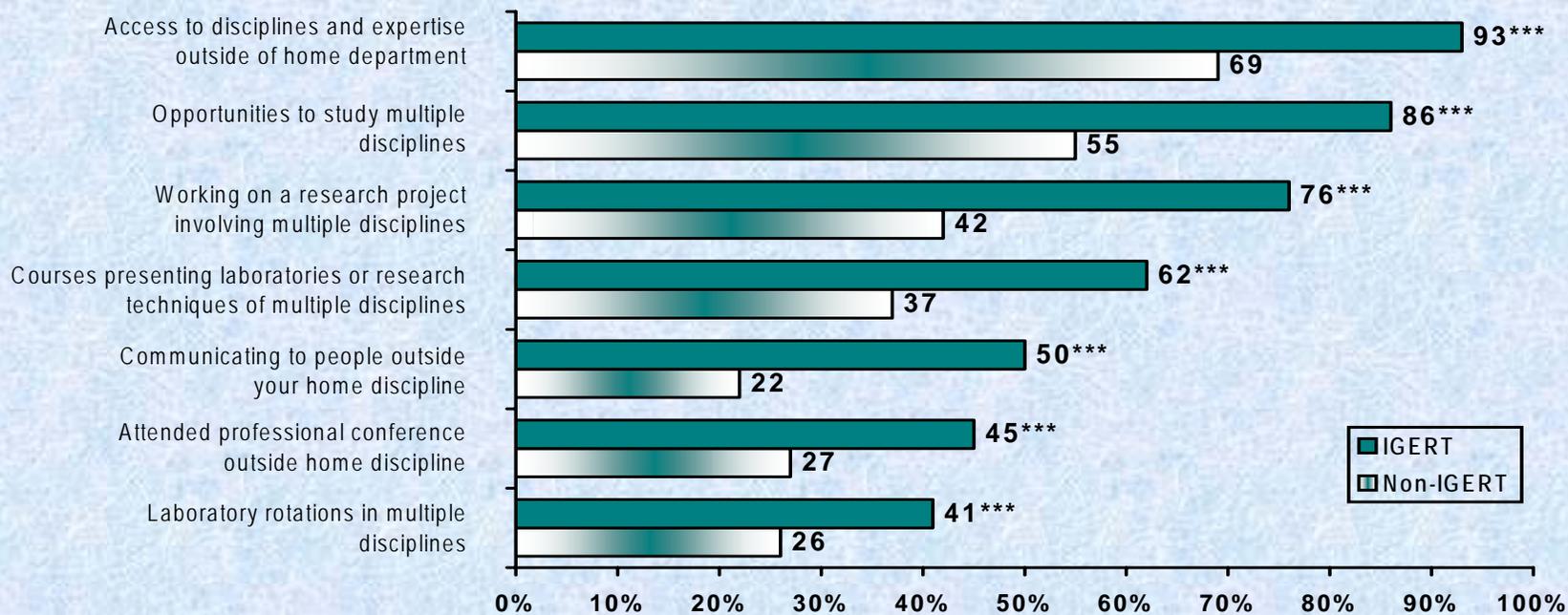


Integrated Graduate Education and Research Traineeship Program (IGERT) Program

- Supports education of U.S. Ph.D scientists and engineers with interdisciplinary backgrounds and subject expertise
- Promotes innovative and collaborative interdisciplinary research
- Catalyzes a culture change in graduate education
- Prepares a world-class, broadly- inclusive and globally-engaged science and engineering workforce



Framing Interdisciplinary and International Experiences for Global Competitiveness: Integrated Graduate Education and Research Traineeship Program (IGERT)



IGERT N ranges from 303-306. Non-IGERT N ranges from 559-566. Range is due to missing responses.

Significance denoted as: *** ($p < .0001$)

Source: *Initial Impacts Survey of Students 2004.*

Questions: “Which of the following benefits or opportunities have you received as part of your graduate program?” “Have the following *interactions* been part of your graduate program?” “Have the following *research experiences* been part of your graduate training?” “Have you ever attended a professional conference in a field outside your home discipline?”



Centers of Research Excellence in Science and Technology (CREST)

- Designed to strengthen the research and education capacity in MSIs and increase student graduation in STEM disciplines.
- Notably, this program has supported:
 - the establishment of 8 new Ph.D. programs at MSIs
 - more than 450 students and 160 faculty and the production of 470 publications and 450 research presentations in 2005 alone.
- EHR and the Directorate for Mathematics and Physical Sciences have also forged a collaboration with CREST, through Partnership for Research and Education in Mathematics (PREM), thereby expanding NSF efforts to broaden participation Foundation-wide.



CREST Engineering Research Center (ERC)

- North Carolina Agricultural and Technical State University and its partners are establishing a new NSF ERC.
- The ERC will develop interdisciplinary research and education programs that address important issues in health care and provide the foundation for new industries through innovation.
- NSF will invest \$18.5 million in the Center over the next five years.



Credit: Division of Research and Economic Development, North Carolina A&T State University

Tribal Colleges & Universities Program TCUP/ENG Collaboration

Engineering Education in the Nation's Tribal Colleges and Universities

- Workshop, December 2005:
 - 42 Faculty members, representing various TCUP institutions, provided expertise in formulating recommendations and strategies aimed at increasing the number of Native American graduates in the engineering disciplines
- A Small Grant for Exploratory Research to Oglala Lakota College supports preliminary work on a “cohort model” to provide a common experience for pre-engineering students at the tribally controlled college in South Dakota on the Pine Ridge Indian Reservation
- A forthcoming workshop targets TCUs and potential mainstream partners with the goal of finalizing best practices and strategies for transfer student success.



Newer Directions in EHR

A More Integrated
Approach: I³

International
Engagement of
Underrepresented Groups

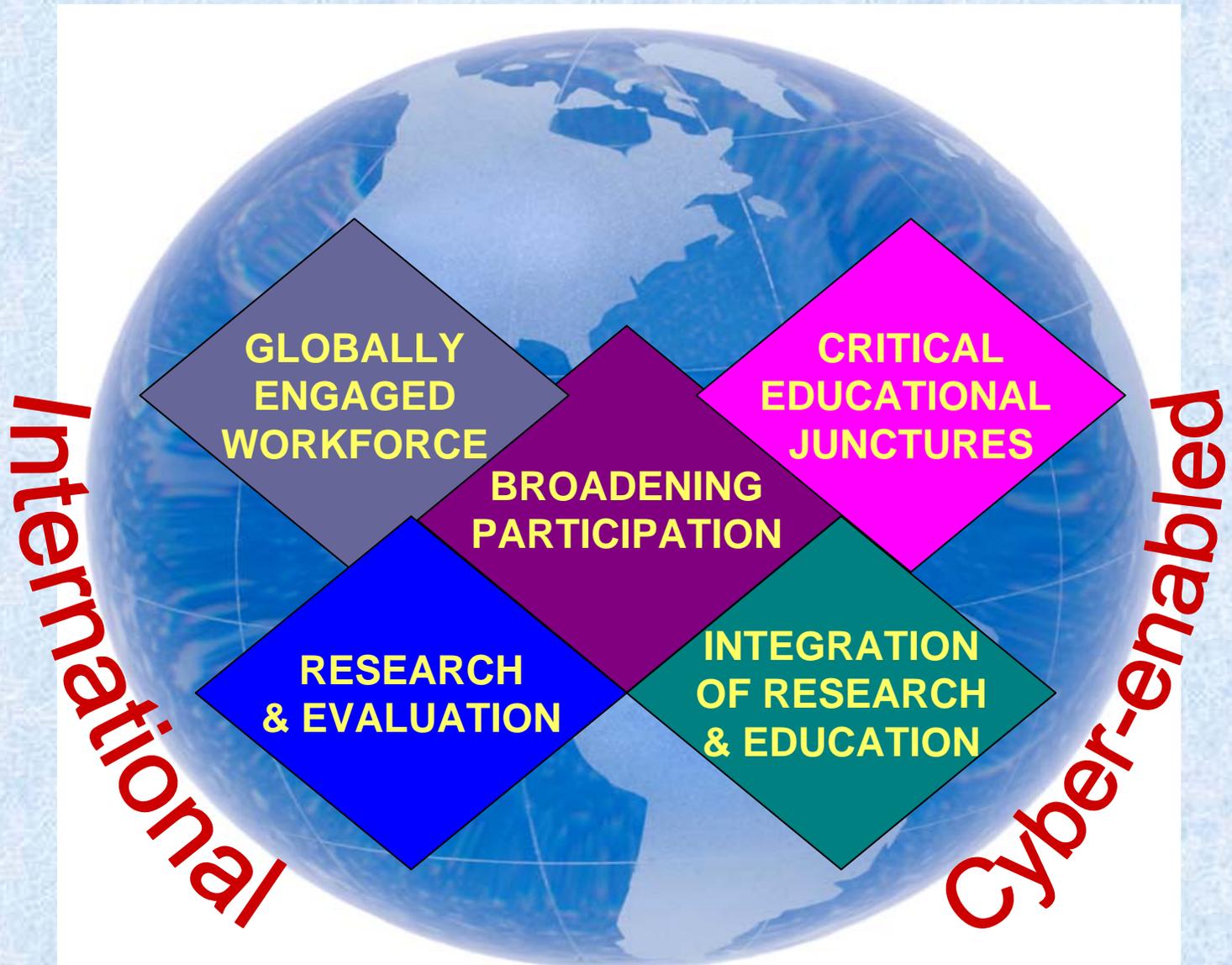


Innovation through Institutional Integration (I³)

- Challenges faculty and administrators in institutions of higher education to think strategically about the creative integration of NSF-funded awards towards a whole that exceeds the sum of its parts
- Focus can be:
 - Intra-Institutional
 - Inter-Institutional



Innovation Through Institutional Integration (I³)



2008 I³ Examples

Six awards were made in 2008

- **University of Colorado at Boulder**
 - CCLI, Noyce, TPC, Reese, REU, other NSF awards from ENG, EEC
- **University of Florida**
 - AGEP, GK-12, IGERT, REUs, other NSF awards from ENG, SBE, etc.
- **University of Washington**
 - STEP, CCLI, RDE, ADVANCE
- **Kapiolani Community College of the University of Hawaii**
 - TCUP, STEP, LSAMP subaward, EPSCOR subaward
- **Louisiana State University**
 - GK-12, LSAMP, S-STEM, AGEP, Noyce, other awards from MPS
- **Georgia Institute of Technology**
 - GK-12, AGEP, IGERT, RET, Noyce, ADVANCE, REU



Cross-Divisional Effort In EHR

Proposals were solicited in six programs for 2008

- Centers of Research Excellence in Science and Technology (CREST)
- Information Technology Experiences for Students and Teachers (ITEST)
- Math Science Partnership (MSP)
- Robert Noyce Teacher Scholarship Program (Noyce)
- Research in Disabilities Education (RDE)
- Tribal Colleges and Universities Program (TCUP)



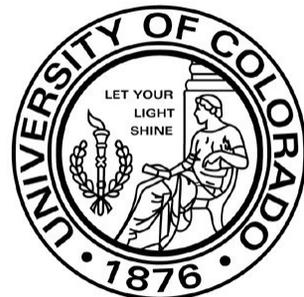


2008 I³ Examples: University of Colorado at Boulder

Builds on:

- CCLI
- Noyce
- TPC
- REESE
- REU
- Other NSF awards from ENG, EEC

- The Center for STEM Education, Research, and Transformation addresses three themes of the National Academy of Science's report *Rising above the Gathering Storm*: (1) K-12 education, (2) research, and (3) higher education
- It is a distributed center that retains disciplinary departmental identity





2008 I³ Examples: University of Florida

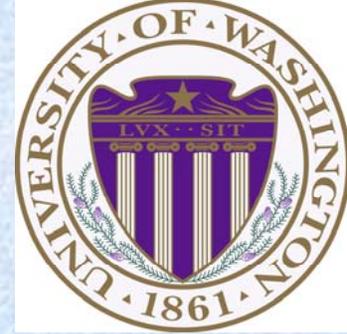
Builds on:

- AGEP
- GK-12
- IGERT
- REUs
- Other NSF awards from ENG, SBE, etc.

- Brings together existing NSF projects for underrepresented groups and engages more students from those groups to broaden participation and foster atmosphere of collaboration and peer support among students
- The project encourages youth and incoming college students to consider STEM disciplines and careers



2008 I³ Examples: University of Washington



Builds on:

- STEP
- CCLI
- RDE
- ADVANCE
(finished, but
created Center for
Institutional
Change)

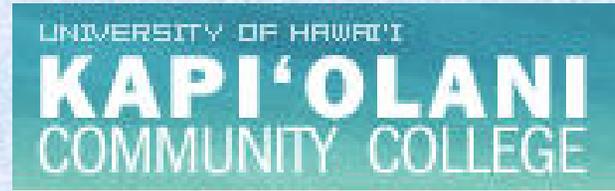
- PEERS (Promoting Equity in Engineering Relationships) undertakes both student-centered and engineering transformation interventions and creates new tools and resources
- The project addresses issues relevant to students who identify with more than one underrepresented group.

2008 I³ Examples:

Kapiolani Community College of the University of Hawaii

Builds on:

- TCUP
- STEP
- LSAMP Subaward
- EPSCoR Subaward



Develops new Associate of Science in Natural Science degree and engages in faculty development needed to increase quantity and quality of STEM faculty, thus supporting a pipeline for more Native Hawaiian and other students to complete STEM degrees





2008 I³ Examples: Louisiana State University

Builds on:

- GK-12
- LSAMP
- S-STEM
- AGEP
- Noyce
- Other NSF awards from MPS



Assists students in their professional development towards advanced degrees, creates an interdisciplinary curriculum in materials engineering and science, and develops Hierarchical Mentoring Ladder system involving faculty members, graduate/undergraduate students, and high school teachers/students



2008 I³ Examples: Georgia Institute of Technology

Builds on:

- GK-12
- AGEP
- IGERT
- RET
- Noyce
- ADVANCE
- REU

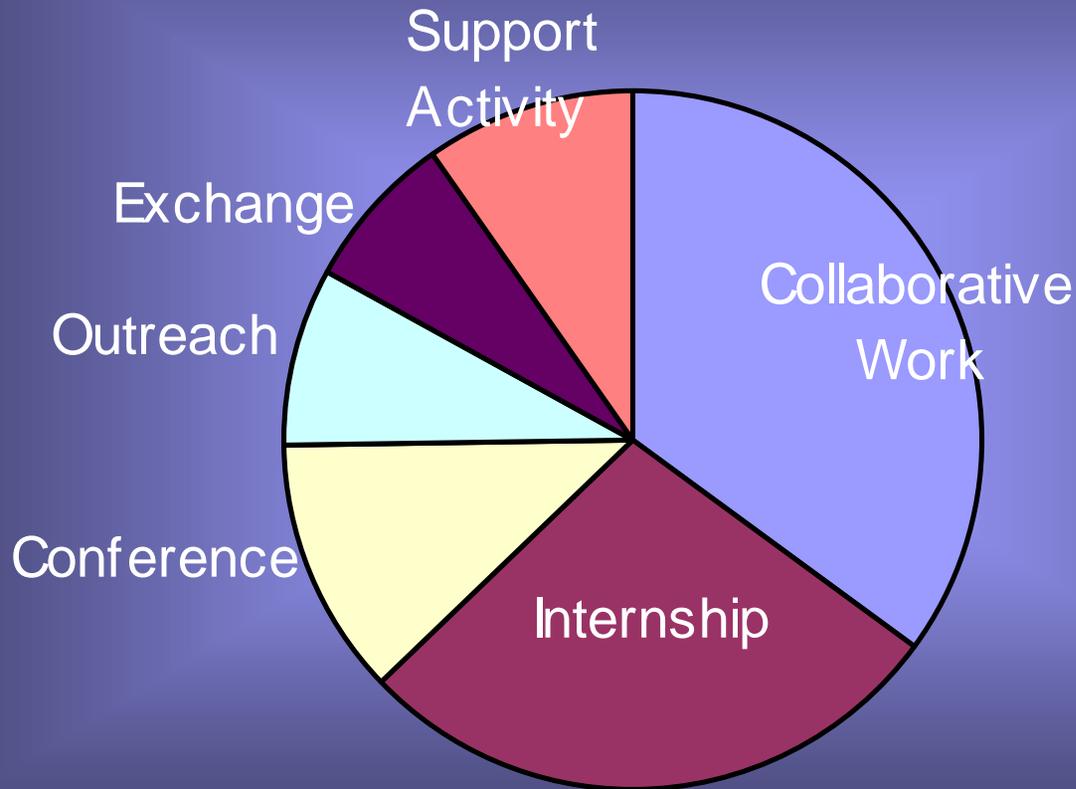
- *Tech to Teaching* includes pathways towards state teacher certification through cooperation with Kennesaw State University's Master of Arts in Teaching program.

- Increases collaboration with partners Spelman College and Georgia Perimeter College through engagement of Tech's graduate students as instructors in partner classrooms



EHR International Activity

International Activity by Type





International Activity by Type

- **Collaborative Work**
 - Draws on international resources, and supports international activity and research with a high global impact.
 - Exemplary programs: *IGERT*, *GRF*, *GSE*
- **Conference, Seminar & Workshop**
 - Supports international conferences participation and fosters international dialogue through workshops and scholarly meetings.
 - Exemplary programs: *ITEST*, *LSAMP*
- **Internship & Study Abroad**
 - Prepares a vibrant, engaged workforce by offering academic and industrial experiences abroad.
 - Exemplary programs: *IGERT*, *LSAMP*

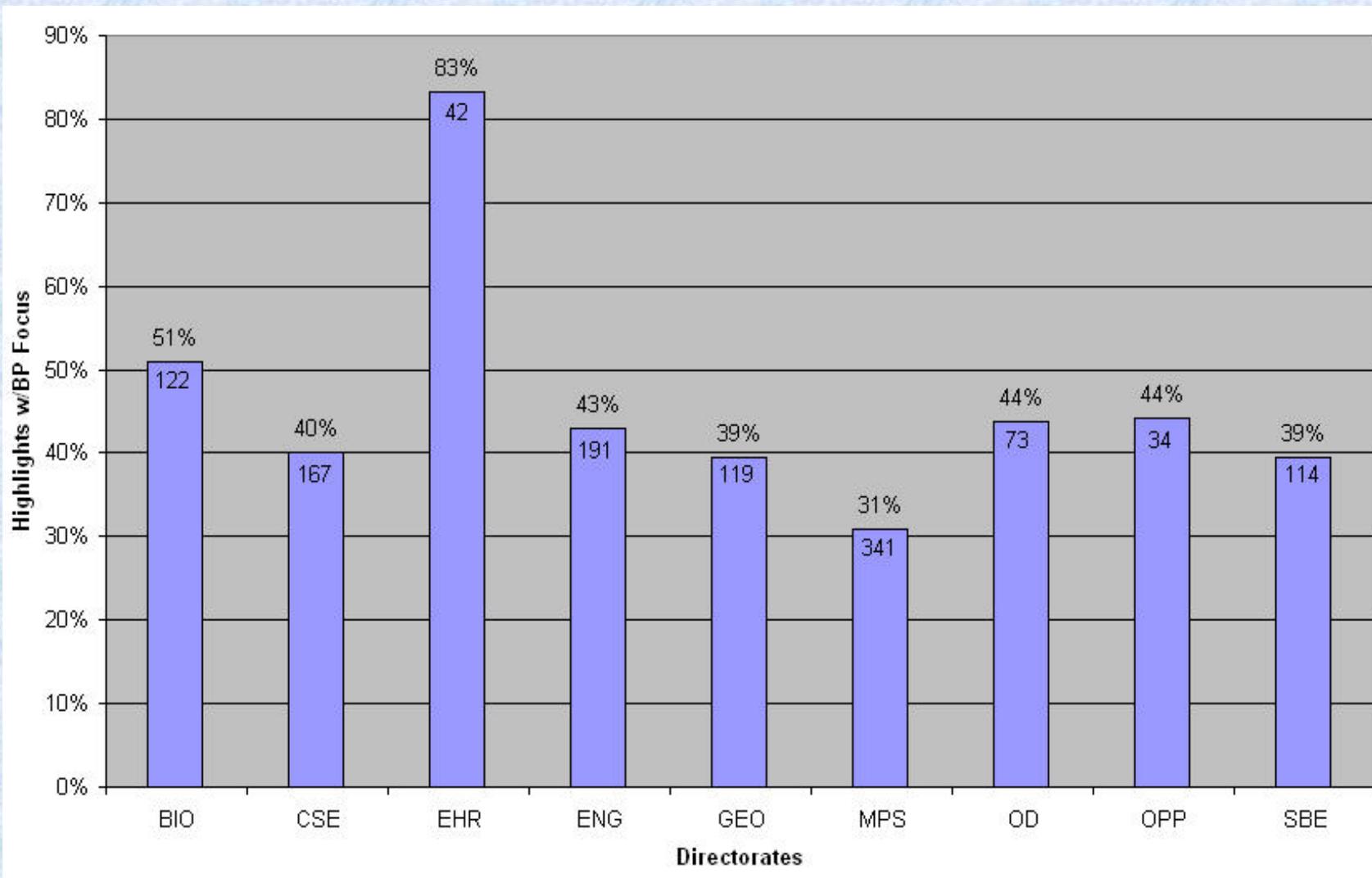


International Activity by Type

- **Outreach & Dissemination**
 - Promotes high-impact projects and facilitates informal science learning in international settings.
 - Exemplary programs: *IGERT*, *RDE*
- **International Exchange**
 - Promotes academic exchange and collaboration, and provides cross-cultural learning experiences.
 - Exemplary programs: *CREST*, *IGERT*, *LSAMP*
- **Other Support Activity**
 - Provides a range of support in the areas of human resources, facilities, and instrumentation to facilitate international endeavors and help students gain international perspective in learning and research.
 - Exemplary programs: *IGERT*, *ATE*



2008 NSF Directorate-Approved Highlights with a Broadening Participation Focus



*These numbers represent those highlights for which it was determined that there was a broadening participation focus and only includes Directorate-approved highlights for the year 2008, as submitted by individual projects.



Future Directions

Broadening Participation across Seamless Transitions (BPaST) including the engagement of professional associations

A more expanded NSF-wide emphasis on broadening participation across critical transitions, including explicit attention to HSIs



NSF Focused Broadening Participation Programs*

- RAHSS - BIO supplements
- RIG CAA BP
- URM
- Minority Postdoctoral Research Fellowships (BIO and SBE)
- BPC
- ADVANCE
- AGEP
- CREST
- HBCU-UP
- LSAMP
- PAESMEM
- RDE
- GSE
- S-STEM
- TCUP
- GRS Dear Colleague Letter
- BRIGE
- RAHSS - SBIR/STTR Phase II Supplements
- George E. Brown, Jr. Network for Earthquake Engineering Simulation Research (NEESR Payload Proposals only)
- SBIR/STTR & EHR Dear Colleague Letter: Minority-Serving Community College Research Teams
- SBIR/STTR & EHR Dear Colleague Letter: Diversity Collaborations
- GeoEd - Track 2
- OEDG
- PREM
- PAARE
- CI-TEAM
- EPSCoR Research Infrastructure Improvement Grant Program
- EPSCoR: Workshop Opportunities
- EPSCoR
- FASED
- SBIR/STTR Supplemental Funding for Community College Research Teams

*as of August 2008

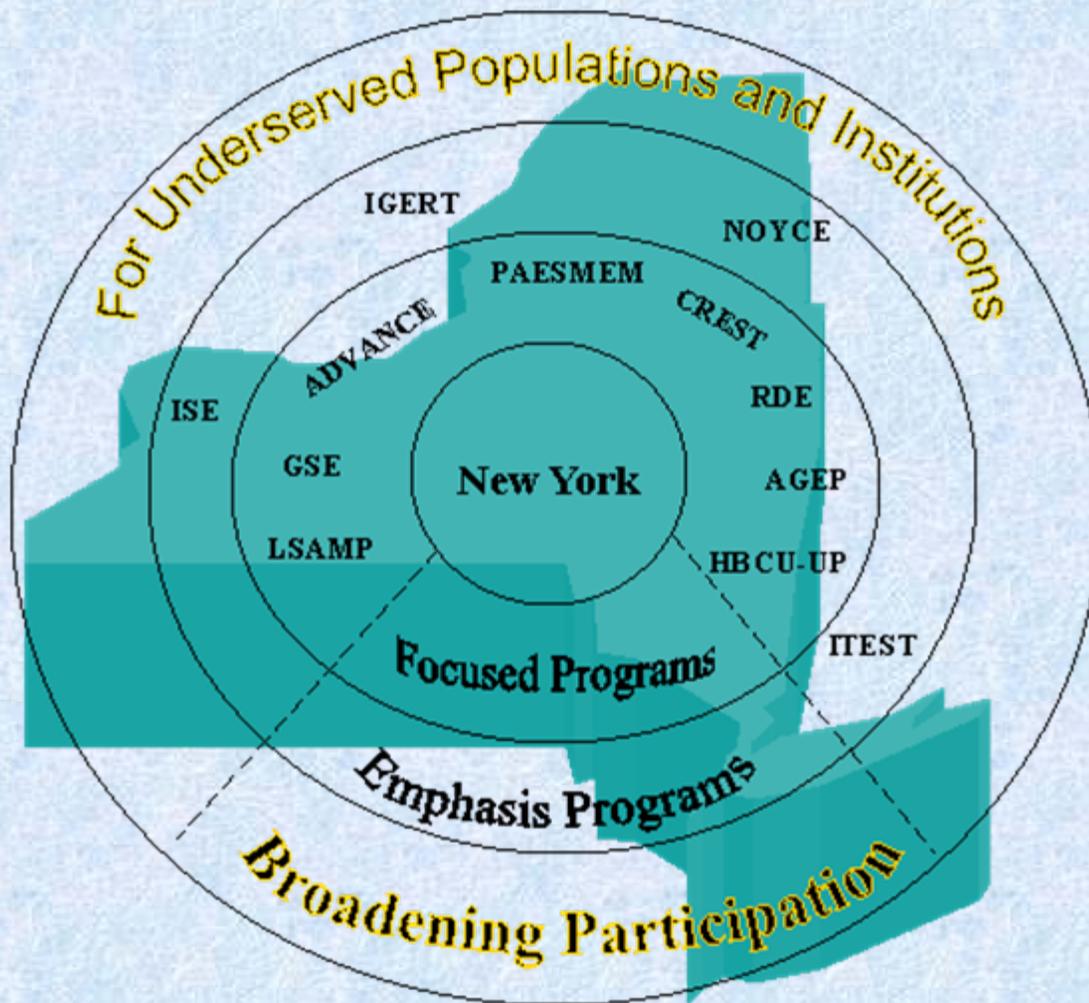


NSF Embedded Broadening Participation Programs*

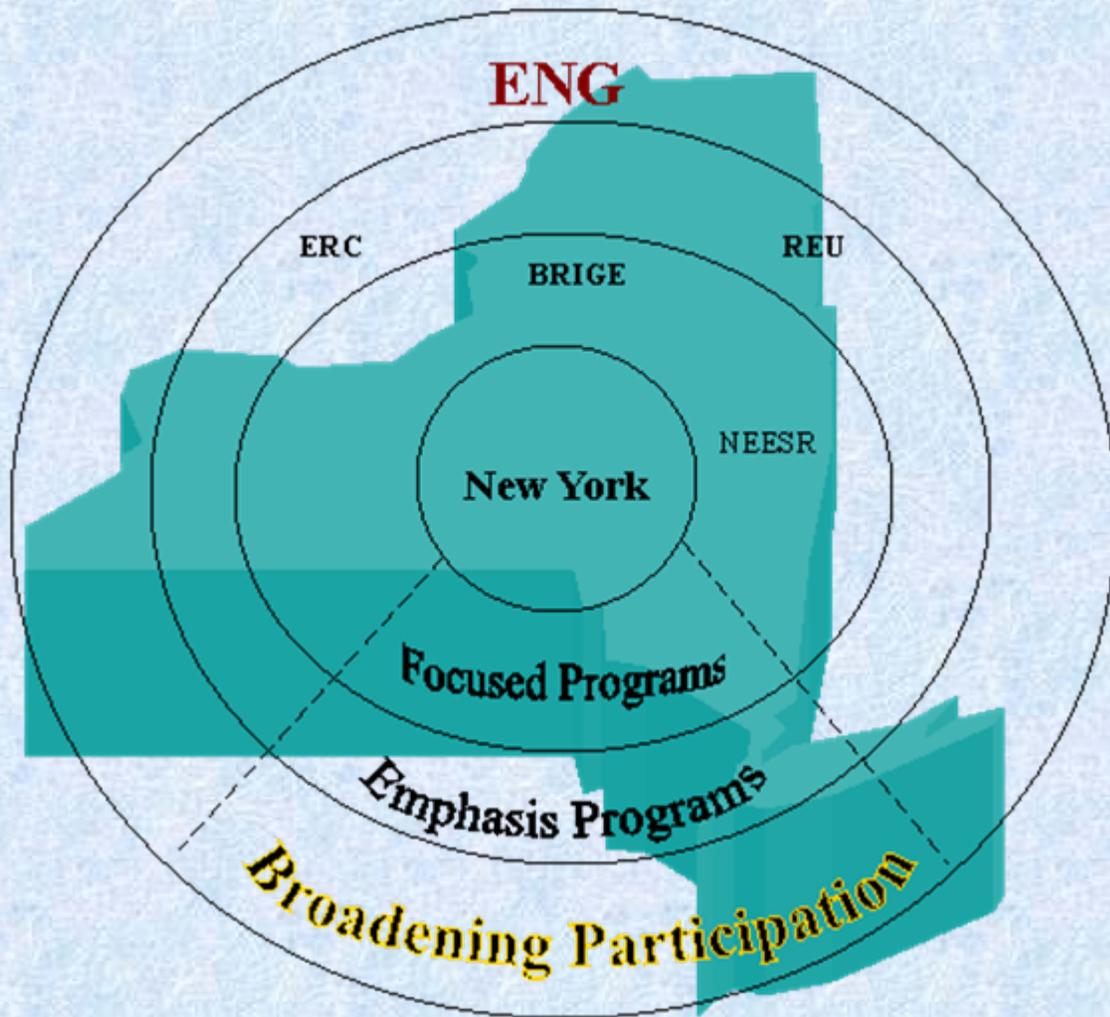
- REU Sites
- PFI
- C-PATH
- ISE
- ITEST
- IGERT
- NSFAYS
- NOYCE
- STC
- ACC-F
- ERC
- Chemical Bonding Centers-Phase 2
- Undergraduate Research Collaboratives
- CRIF
- EMSW21
- MRSEC
- Physics Frontiers Centers
- NSE (NSEC only)



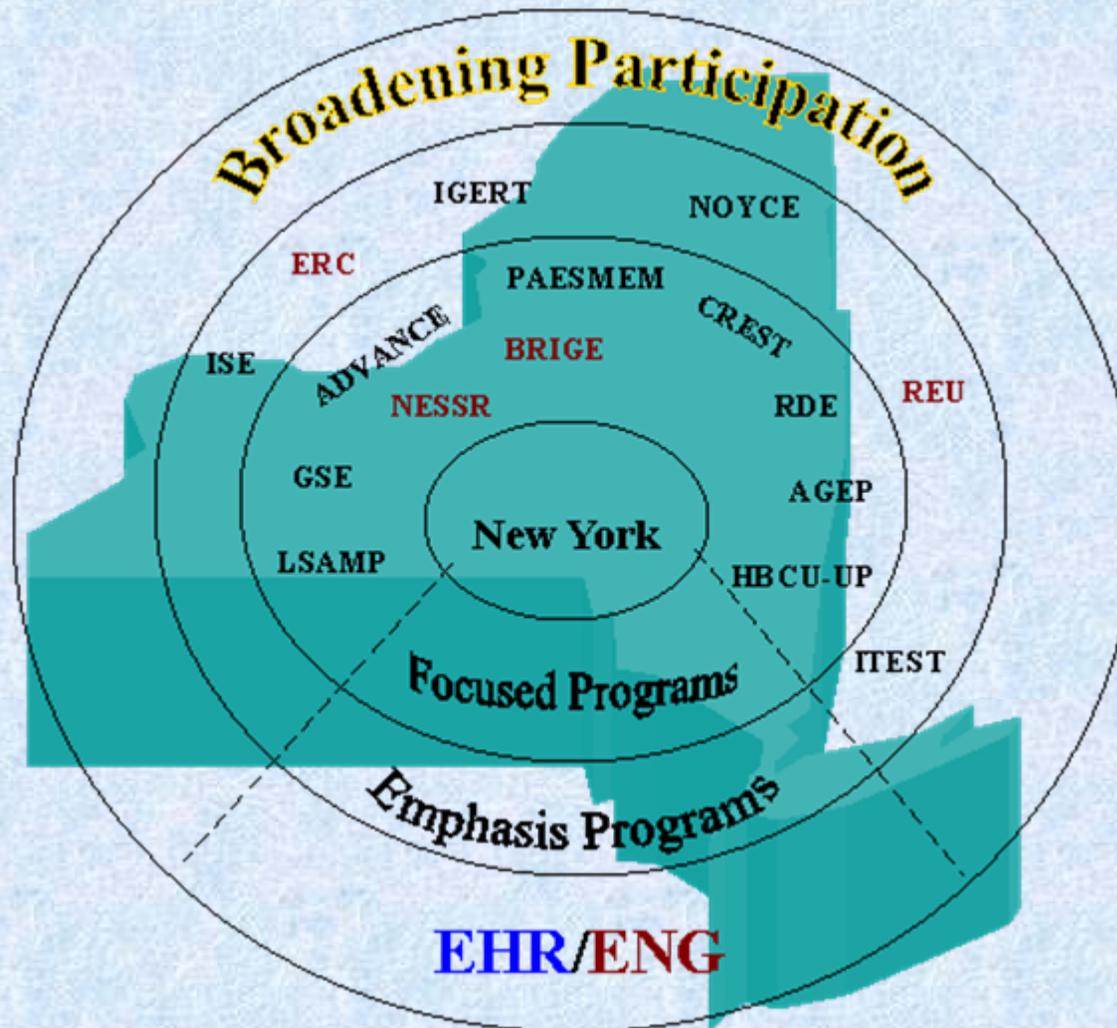
EHR Broadening Participation Programs in New York



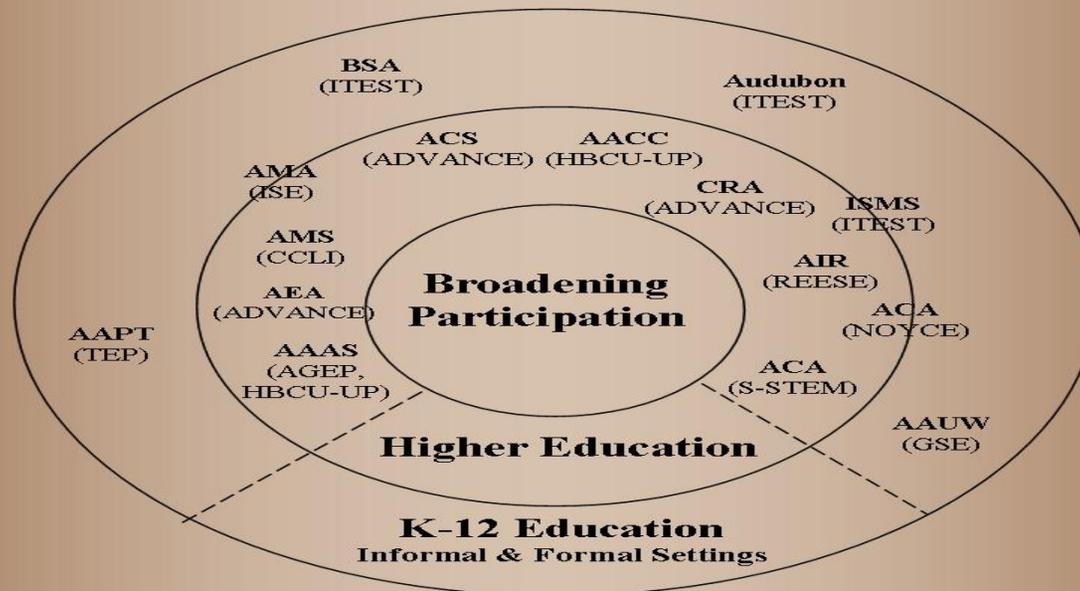
ENG Broadening Participation Programs in New York



EHR/ENG Broadening Participation Programs in New York



Professional Associations Leading EHR Broadening Participation Efforts in STEM Education



Source: NSF Fastlane Database, Feb 4, 2008

AMA: Anchorage Museum Association
AAAS: American Association for the Advancement of Science
AACC: American Association of Community Colleges
AAPT: American Association of Physics Teachers
AAUW: American Association of University Women
ACS: American Chemical Society
AEA: American Economic Association

AMS: American Meteorological Society
ACA: Appalachian College Association
AIR: Association for Institutional Research
BSA: Botanical Society of America
CRA: Computing Research Association
ISMS: Illinois State Museum Society
Audubon: National Audubon Society

Promoting a Diverse Scientific Workforce: Hispanic Serving Institutions (HSIs)

Career

ADVANCE Institutional
Transformation Award

New Mexico State University

High School

Computer Science,
Engineering, and
Mathematics Scholarships

*Florida International
University*

Graduate Engineering
Education To Serve the
Aerospace Industry in Urban
Los Angeles and the
Antelope Valley

*California State LA
University Auxiliary
Services, Inc.*

TAMUK STEP: A Model for
Student Success and
Persistence

*Texas Engineering Experiment
Station*

Graduate

Undergraduate



Critical Transition Examples Led by Hispanic Serving Institutions (HSIs)

- **Alliances Among Higher Ed Institutions**

Institution: Texas Engineering Experiment Station with Texas A&M University-Corpus Christi, other 4-year institutions, and HSI Community Colleges

Program: LSAMP

Project: Texas LSAMP Phase IV (LSAMP)

- **Pre-College/Post-Secondary Partnerships**

Institution: San Mateo County Community College District

Program: ATE

Project: Chemistry: A Pipeline to 21st Century Careers



Critical Transition Examples Led by Hispanic Serving Institutions (HSIs)

- **Community College Articulation with Feeder High Schools and 4-year Transfer Institutions**

Institution: Southwestern College

Program: ATE

Project: Biotechnology Education and Training Sequence Investment

- **Bridging to Doctoral Programs**

Institution: Northeastern Illinois University

Program: S-STEM

Project: A Mathematics and Physical Sciences (MaPS) Cohort of Scholars Program





“NSF will focus on broadening participation in STEM disciplines...[working] with academic and industry partners to ensure that STEM education and workforce preparation are broadly available, for the technical workforce as well as for future scientists and engineers, and provide the skills and knowledge needed to flourish in a global knowledge economy.”

