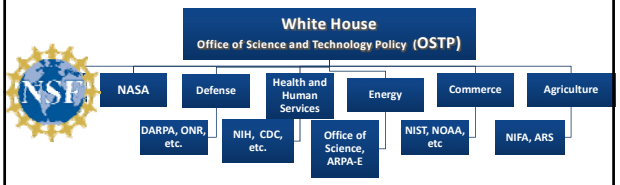
U.S. National Science Foundation: Cultivating the Next Generation of Innovators

Nancy Sung
Director, NSF Beijing Office
International Conference on Science, Technology and Education Policy (ICSTEP)
November 18, 2014

Outline

- What is NSF?
- What is NSF doing for the next generation of innovators?
- How does NSF collaborate internationally?

S&T Funding in US

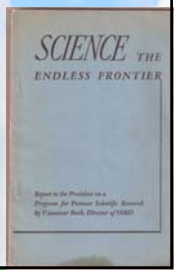


National Science Foundation

- Is an Independent Agency established by Congress in 1950 with two core missions:
- Supports basic science and promotes discovery
- Prepares science and engineering workforce through providing research and educational experience for U. S. Students

On Basic Research: (1945)

- "without scientific progress no amount of achievement in other directions can insure our health, prosperity, and security as a nation in the modern world".
- "The most important ways in which the Government can promote industrial research are to increase the flow of new scientific knowledge through support of basic research, and to aid in the development of scientific talent."



Engineering at NSF

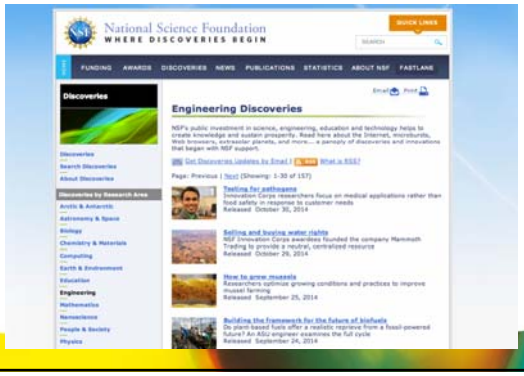
- 1964: Division > 1981: Directorate
- ~15% of NSF's allocation

R&RA Funding
(Dollars in Millions)

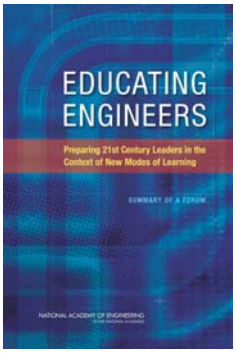
	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	Change over FY 2014 Estimate Amount	Percent
Biological Sciences	$679.21	$721.27	$708.52	-$12.75	-1.8%
Computer & Information Science & Engineering	858.13	894.00	893.35	-0.65	-0.1%
Engineering	820.18	851.07	858.17	7.10	0.8%
Geosciences	1,273.77	1,303.03	1,304.39	1.36	0.1%
Mathematical & Physical Sciences	1,249.54	1,299.80	1,295.56	-4.24	-0.3%
Social, Behavioral & Economic Sciences	242.62	256.85	272.20	15.35	6.0%
International and Integrative Activities	434.28	481.59	473.86	-7.73	-1.6%
U.S. Arctic Research Commission	1.39	1.30	1.41	0.11	8.1%
Total, R&RA	$5,556.88	$5,808.92	$5,807.46	-$1.46	-

Totals may not add due to rounding.

NSF-supported engineering discoveries belong to the public: http://www.nsf.gov/discoveries/



NSF listens to the community: bottom-up



What is an engineer?

A definition I like:

"An engineer is a person who envisions what has never been and does whatever it takes to make it happen."

Founders, Franklin W. Olin College of Engineering

Olin College of Engineering

A few key issues emerged:

- Gap between education and practice
- Diversity in workforce/broadening participation

Which qualifications do we seek for engineers?

Traditional values of educational institutions	Values of companies/practitioners
Technical competence	Teamwork, social and communications skills
High test scores	Problem solving ability. What have they built?
Academic rigor	Creativity
"Seat time"- credit hours	Continuing Education
Classroom learning	Real-world, holistic practice

Building a collaborative community of scholars and practitioners

"Valley of Death?"

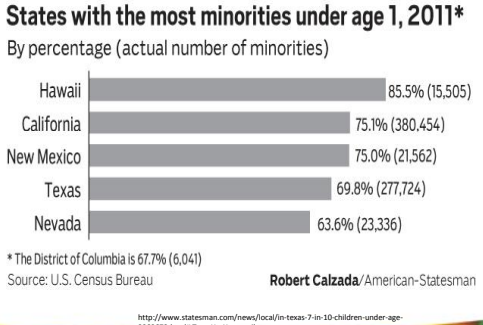
How do we bridge the divide?

Engineering education researchers

Engineering education practitioners

By Al Soyster

DIVERSITY in the United States: The minority is becoming/has become the majority.



http://www.statesman.com/news/local/in-texas-7-in-10-children-under-age-2360672.html#.T-psxHtnVtg.email

12

The rapid growth rate of underrepresented group demographics is undeniable.

- In Texas **70%** of children under the age of one are minorities (2011).
- Nation-wide **50.4%** of children under the age of 1 are minorities (2011).
- 2011 was the tipping point.

Minority: Anyone who is not single race-white

http://www.texasmonthly.com/2012-09-01
http://www.statesman.com/news/local/in-texas-7-in-10-children-under-age-2360672.html?printArticle=y

Beyond its ongoing support for development of engineers (see www.nsf.gov)

- CAREER
- Research Experiences for Undergraduates (REU)
  - Supports the involvement undergraduates in ongoing research
  - Deadline for site proposals in Aug. each year
  - Supplements
- Research Initiation Grants in Engineering Education (RIGEE)
- Research in Engineering Education (REE)
- Research Experiences for Teachers (RET) in Engineering
  - Supports the active involvement of K-12 teachers and community college faculty in engineering research to bring knowledge of engineering and technological innovation into their classrooms

What is NSF doing now?

Professional Formation* of Engineers

- a multi-year initiative *to create and support an innovative and inclusive engineering profession for the 21st Century.*
- *Includes formal and informal processes and value systems by which people become engineers.*
- *ethical responsibility of practicing engineers to sustain and grow the profession.*
- *The engineering profession must be responsive to national priorities, grand challenges, and dynamic workforce needs; it must be equally open and accessible to all.*
- ** Not limited to education*

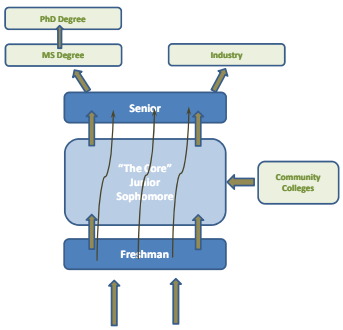
STEP 1: REVOLUTIONIZE ENGINEERING DEPARTMENTS (RED)

Seeking ground-breaking, scalable, sustainable ideas

REFORM vs. REVOLUTION

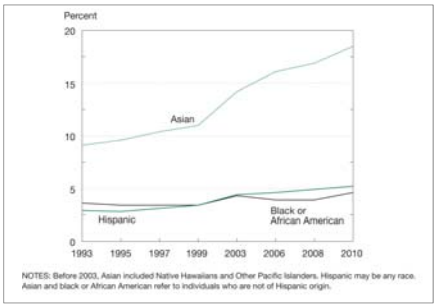
- In last ten years- department-level reform
  - 20 grants over three years, up to $1.5 M
  - Multidisciplinary-systems thinking
  - Emerging technologies
  - Project-based/teams
- NOW:
  - Radically, suddenly, completely new
  - Producing fundamental structural change
  - Outside or beyond existing norms

RED Target Point: The Core



18

Share of workers in S&E occupations, by selected race and ethnicity: Selected years, 1993–2010



Attention to: Broadening Participation in Engineering

- the *understanding* of how a diverse engineering student body, professional workforce, and faculty impact engineering innovation and productivity.
- the *underlying issues* affecting the differential participation rates in engineering, particularly those that can be addressed by engineering faculty members.
- *the experiences and interactions* that enhance or inhibit underrepresented groups' persistence to degree and career interest in the professoriate.

How does NSF engage internationally?

- **Supports U.S. participants ONLY**
- International collaborations can be:
  - An integral component of proposals submitted to NSF disciplinary programs
  - Supplements to existing awards
  - Proposals to International Office

NSF-wide Criteria
- Intellectual Merit
- Broader Impacts

According to NSF's international office, what makes a good international collaboration?

- True Intellectual Collaboration
- New partnerships
- Mutual Benefits for U.S. and Foreign Partners
- Involvement of U.S. Junior Researchers & Students
- Access to unique resources
- Leveraging

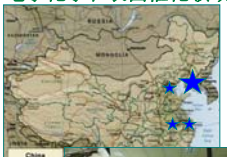
Other NSF-wide Considerations
- Integration of Research and Education
- Broaden Participation

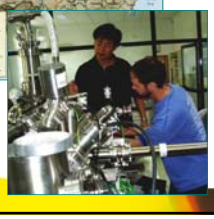
A good partnership requires courtship, patience, and trust

Some examples of NSF-supported US-China collaborations in engineering education:

PIRE: Electron Chemistry and Catalysis at Interfaces (ECCI) for sustainable energy applications

电子化学和表面催化领域研究 -- 国际研究和教育合作团队





China

Dalian Institute for Chemical Physics, CAS

Tsinghua University

Institute of Chemistry, CAS

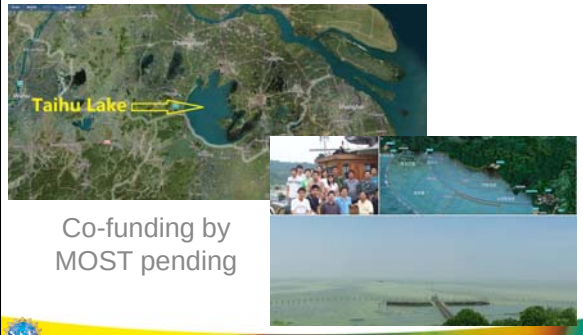
Institute for Nanotech & Nanobionics (SINANO)

University of Science and Technology of China

U.S.

University of California-Santa Barbara

#1230543 An Ecologically-Driven Strategy for Ensuring Sustainability of Anthropogenic ally and Climatically Impacted Lakes



Co-funding by MOST pending

Partnerships for International Research and Education (PIRE)

Developing Low Carbon Cities in US, China & India.

This interdisciplinary project brings together **six U.S. institutions and eight Asian institutions** to design low-carbon, sustainable cities in the U.S., India and China. Researchers are exploring how to best reduce greenhouse gas emissions, linking this with broader sustainability goals, including **economic development, pollution, and public health**. The project is **training nearly 100 students** – across all **three countries** – and partnering with NGOs to translate research into action.

Research Experiences for Students (IREU)

- Advanced Materials : Clarkson Univ./ Tsinghua Univ., Nanjing Univ./and CAS
- Chemistry/Chemical Eng: U.C. SB/Dalian Univ. of Technology and Dalian Institute of Chemical Physics, CAS
- Aerodynamics: Shanghai Jiaotong/Iowa State

27

There are many more. NSF supports 200-300 new projects per year that include collaborations with Chinese researchers.

Cross-cultural and international collaboration is good for science

Collaborating With People Like Me: Ethnic co-authorship within the US

Richard B. Freeman, Wei Huang
National Bureau of Economic Research Working Paper No. 19905
Issued in February 2014

This study examines the ethnic identify of the authors of over **1.5 million scientific papers** written solely in the US from 1985 to 2008. In this period the proportion of US-based authors with English and European names fell while **the proportion of US-based authors with names from China and other developing countries increased**. The evidence shows that persons of similar ethnicity co-author together more frequently than can be explained by chance given their proportions in the population of authors. This homophily in research collaborations is associated with weaker scientific contributions. Researchers with weaker past publication records are more likely to write with members of ethnicity than other researchers. **Papers with greater homophily tend to be published in lower impact journals and to receive fewer citations than others,** even holding fixed the previous publishing performance of the authors. Going beyond ethnic homophily, we find that papers with more authors in more locations and with longer lists of references tend to be published in relatively high impact journals and to receive more citations than other papers**. These findings and those on homophily suggest that diversity in inputs into papers leads to greater contributions to science, as measured by impact factors and citations.**

Details: www.nsf.gov, search for 14-602

Applications due November 26

NSF China Team:
Beijing: Nancy Sung nsung@nsf.gov
Sun Bo
Shen Yu
Arlington VA: Bill Chang
Sonia Ortega