NSF's Evolving Graduate Education Landscape: Preparing STEM professionals for the Science of the Future

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Workshop Today!!

- The CGS/NSF Dean-in-Residence Role
- The America Competes Act
- Trends in Graduate Education
- NSF's Focus
  - Ongoing Programs
  - DGE
  - HRD

  - CDI program

America Competes Act

- Highlights regarding graduate education

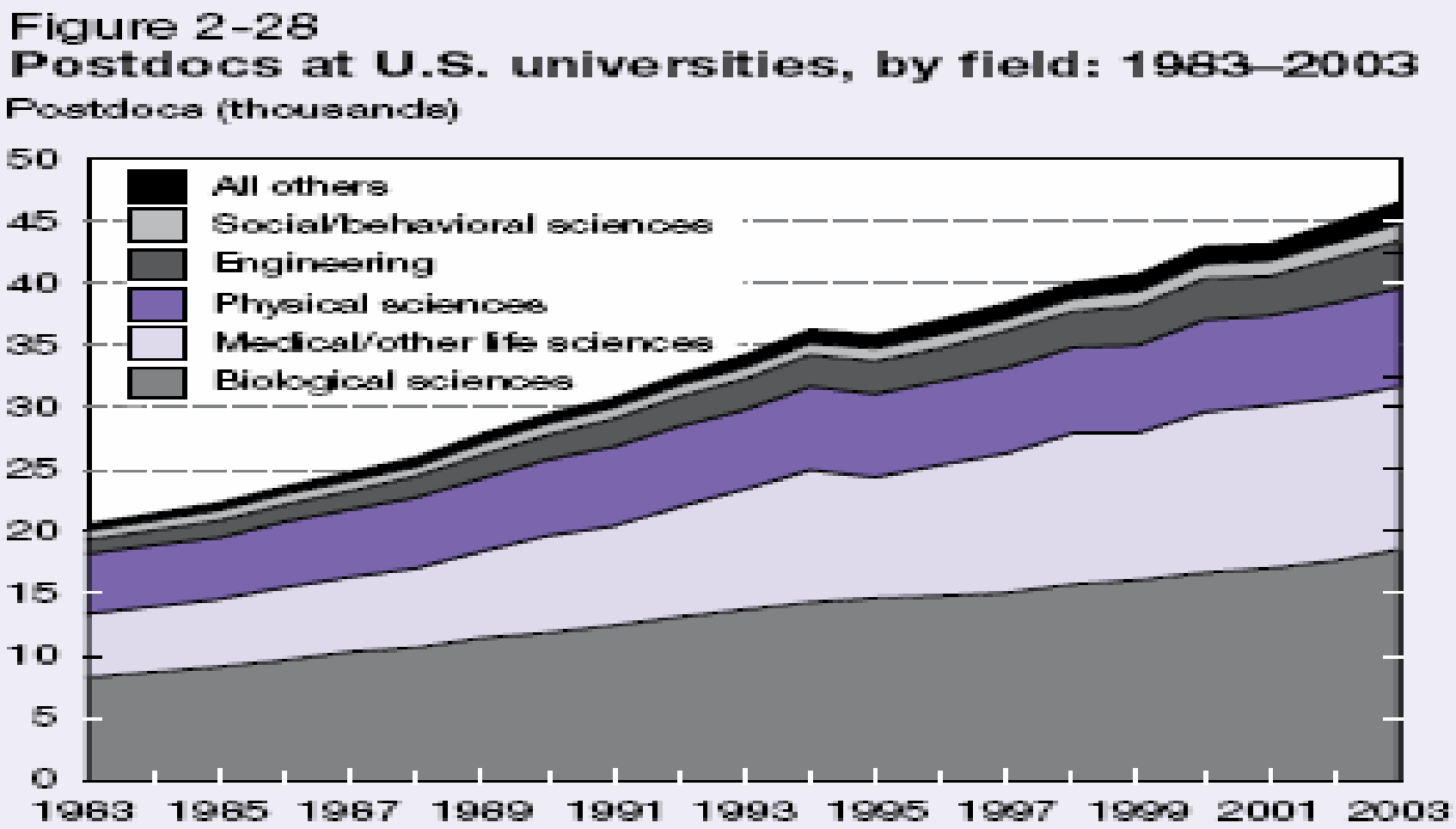
Overview: Graduate Education at NSF

- NSF in FY 2007 funded 32,900 graduate students
  - 5,000+ received fellowships and/or traineeships
  - 28,000+ are on research grants, and we don't know much about them
  - Growing concern about postdocs

Who are they?

- NSF Fellows and trainees: U.S. Citizens or permanent residents
- NSF Research associates—no citizenship limitation
- NSF Postdocs: no citizenship limitation

Figure 2-28
Postdocs at U.S. universities, by field: 1983–2003



SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Graduate Students and Postdoctorates in Science and Engineering, WebCASPAR database, http://webcaspar.nsf.gov. See appendix table 2-35.

Science and Engineering Indicators 2006

Who are they?

- 48,000 in science, engineering, health postdoctoral positions in 2005
- Over 50% are foreign students and more than a majority of them did not receive their doctorates in the US
- About 6,000 posstdocs funded by NSF in 2007

Key Issues in Graduate Education

- Long Periods of Training @ Great Expense
- The Need for Knowledge About Career Alternatives
- The Post-doc Experience
- Broadening participation for Workforce Development
- The Need for International Exposure

Why Broaden Participation?

"Women, minorities and persons with disabilities remain underrepresented in STEM professions while they are an increasing percentage of the overall U.S. workforce."

NSF Strategic Plan, 2006-2011

"…the number of native-born S&E graduates entering the workforce is likely to decline unless the Nation intervenes to improve success in educating S&E students from all demographic groups, *especially those that have been underrepresented in S&E careers*."

National Science Board, 2003

Division of Graduate Education (DGE)

DGE programs promote the early career development of scientists and engineers by providing support at critical junctures of their careers through fellowships and traineeships.

Division of Graduate Education

- NSF's Graduate Education laboratory
- Home to three large fellowship/traineeship programs
- Focus for research on graduate education
- Focal point for NSF's shared responsibility for graduate education
  - (Including the other 28,000 RAs?)

DGE Programs

- NSF Graduate Teaching Fellows in K-12 Education (GK-12)
- Graduate Research Fellowship Program (GRFP)
- Integrative Graduate Education and Research Traineeship (IGERT)
- Research on Graduate Education DCL

Graduate Teaching Fellowships in K-12 Education (GK-12)

- Program is in its 9th year
- Provides $30,000 stipend and $10,500 COE
- Current number of projects: 164
- Number of awards/year: 23-30
- Projects in 47 states and Puerto Rico
- Largest percentage of projects in urban setting schools
- Each year between 800-900 Fellows supported. Average 10 Fellows/site

Earthquake Simulator

- Northeastern University's GK12 Fellows introduce students from ACC (Another Course to College) to the university research facilities and university life.
- Graduate Fellows from civil engineering labs demonstrated the concept of resonance by using a shaker table to simulate various earthquakes. After the demonstration, students participated in a bridge design contest using “West Point Bridge” design software to simulate the strength of various trusts.

GRADUATE RESEARCH FELLOWSHIP (GRF) PROGRAM

- Purpose: To ensure the vitality of the human resource base of science and engineering in the United States and to reinforce its diversity. The program recognizes and supports outstanding graduate students in relevant science, technology, engineering, and mathematics (STEM) disciplines who are pursuing research-based master's and doctoral degrees, including women in engineering and computer and information science.
- Features
  - Portable (U.S. or foreign institution)
  - Flexible tenure options

NSF Graduate Research Fellowships

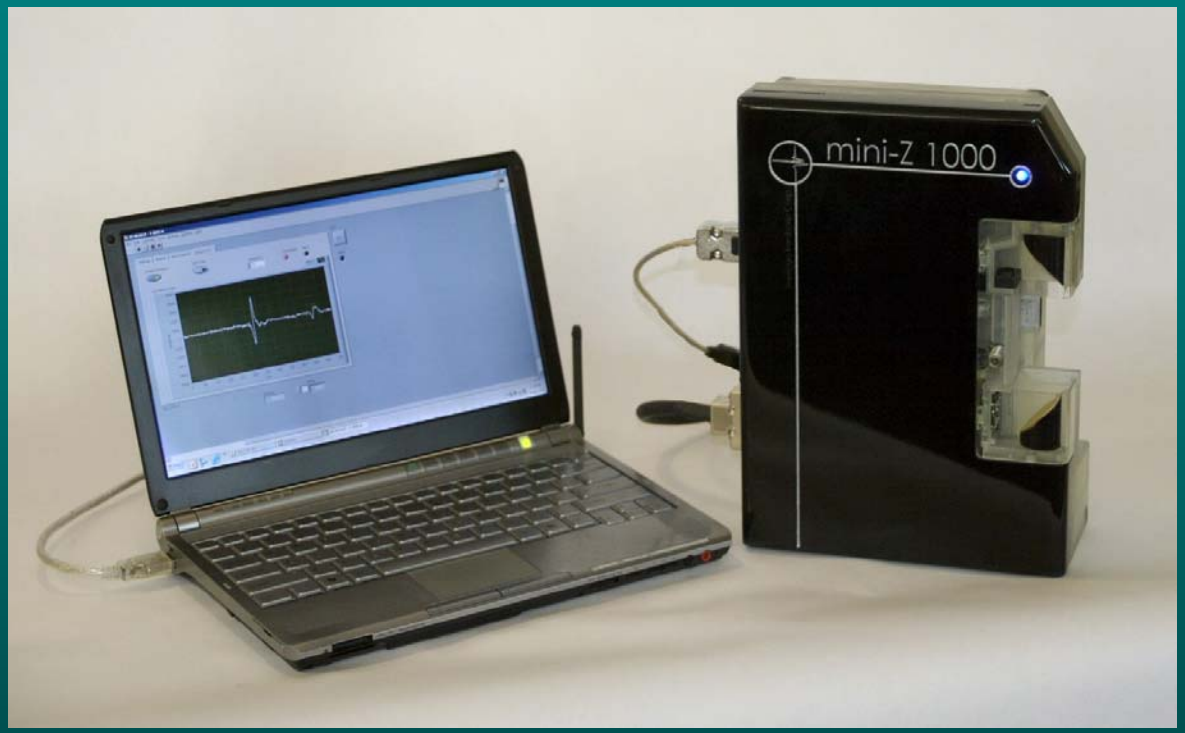
- Award Information
  - $30,000 stipend per year for three 12-month tenure periods over five years
  - $10,500 cost-of-education allowance per tenure year payable to the affiliated institution
  - $1,000 one-time international research travel allowance
  - Honorable Mention for meritorious applicants
  - Facilitation Awards for Scientists and Engineers with Disabilities
  - Women in Engineering and Computer and Information Science Awards
- Value Added
  - Supercomputer usage
  - Prestige

GRF Joe Brown, University of North Carolina at Chapel Hill
Field of Study: Environmental Sciences and Engineering
Patented a water filtration system for use in remote areas of developing countries.

NSF Graduate Research Fellowship Program

- Eligibility Requirements
  - U.S. citizen or permanent residents
  - Baccalaureate degree prior to Fall
  - Completion of fewer than twelve months of full-time graduate study
  - Graduate study in STEM disciplines supported by NSF
- Fellowship Applications
  - Personal profile
  - Personal essay
  - Previous research experience
  - Proposed research plan
  - Reference letters

“Young Inventor’s Research Transforms the Marketplace”



IGERT-funded researcher develops hand-held terahertz spectrometer. The device has applications in medical, aerospace, security and other fields. It has already proven its ability to detect cracks in space shuttle foam, image tumors in breast tissue, and spot counterfeit watermarks on paper currency!

Integrative Graduate Education and Research Traineeship Program (IGERT)

http://www.igert.org

Goal: **To provide training opportunities for U.S. Ph.D. students that feature**

- ✓ Interdisciplinary cutting-edge research
- ✓ Innovative educational programs
- ✓ Diversity

Unique IGERT Features

- Preparation for interdisciplinary research
  - Learning teamwork, crossing disciplines
- Preparation for a variety of careers
  - Academia, Industry, Entrepreneurship
- Preparation for a global future
  - International collaborative research and education

IGERT 1st Impact Evaluation

- The Impacts study employed a mixed methods design
- Data collection occurred in Fall 2004 and Spring 2005, and analysis is currently underway. Surveys were conducted with the following individuals:
- IGERT PIs
- IGERT and non-IGERT department chairs
- IGERT and non-IGERT faculty members
- IGERT and non-IGERT students
- Internship supervisors of current IGERT and non-IGERT students
- IGERT and non-IGERT recent graduates

The Comparison Sample

- The comparison sample consisted of departments identified by IGERT department chairs as their competitors.
- Each IGERT department included in the study was matched with an appropriate comparison department.
- Comparison faculty and students were randomly selected in equal numbers to the IGERT faculty and students already included in the sample.

Research Questions

- What has the IGERT program's impact been as compared to appropriate non-IGERT comparison data?
- Specifically, how has IGERT impacted recruitment, students, faculty, and institutions?

Preparation for Diverse Careers

- IGERT students (71%) are significantly more likely than non-IGERT students (47%) to receive opportunities to conduct research, work, or study off campus as part of their graduate program.
- IGERT students (29%) are twice as likely as non-IGERT students (15%) to have participated in an internship as part of their graduate program.
- As a result of these and other experiences, more IGERT students (63%) than non-IGERT students (44%) believe that they are being "prepared for a wide range of career possibilities."

Research on Graduate Education (DCL)

- REESE and DGE partnership to support research on Graduate Education
- Deadlines and general criteria same as REESE
- Dear Colleague Letter found on DGE web page

Division of Human Resource Development (HRD)

Two-fold Mission:

To increase the participation and advancement of underrepresented minorities and minority-serving institutions, women and girls, and persons with disabilities at every level of the science and engineering enterprise.

To serve as a focal point for NSF's agency-wide commitment to enhancing the quality and excellence of science, technology, engineering, and mathematics (STEM) education and research through broadening participation by underrepresented groups and institutions.

NRC/NSF Workshop Findings

- Independent research experience
- Robust research apprenticeships
- Learning to work productively as a member of an interdisciplinary team
- Development of pedagogical knowledge and skills
- Ability to communicate across disciplinary boundaries and with the lay community
- Career socialization, guidance, and counseling, including exposure to non-academic careers.

Cyber-Enabled Discovery and Innovation (CDI)

- Multi-disciplinary research seeking contributions to more than one area of science or engineering, by innovation in, or innovative use of computational thinking

- Computational thinking refers to computational...
  - ...Concepts
  - ...Methods
  - ...Models
  - ...Algorithms
  - ...Tools

Why CDI?

- *Enhance American competitiveness by enabling innovation through the use of computational thinking*

CDI is unique within NSF

- five-year initiative; minimum of $26M in FY 2008
- to create *revolutionary* science and engineering research outcomes
- made possible by innovations and advances in computational thinking
- emphasis on bold, multidisciplinary activities
- radical, paradigm-changing science and engineering outcomes through computational thinking

Long-term Funding for Cyber-enabled Discovery and Innovation

Request FY 2008	FY 2009	FY 2010	FY2011	FY 2012
$52M (min of $26M in the solicitation)	$100M	$150M	$200M	$250M

Three CDI Themes

CDI seeks transformative research in the following general themes, via innovations in, and/or innovative use of, computational thinking:

- **From Data to Knowledge:** *enhancing human cognition and generating new knowledge from a wealth of heterogeneous digital data;*
- **Understanding Complexity in Natural, Built, and Social Systems:** *deriving fundamental insights on systems comprising multiple interacting elements;* and
- **Building Virtual Organizations:** *enhancing discovery and innovation by bringing people and resources together across institutional, geographical and cultural boundaries*.

Important Dates and Addresses

- Letters of Intent (required) due: Nov 30, 07
- Preliminary Proposals due: Jan 8, 08
- Full proposals due: April 29, 08
  - Full proposals by invitation only!
- Awards: no later than October 2008

- For more information:
  - Solicitation: http://www.nsf.gov/pubs/2007/nsf07603/nsf07603.htm
  - FAQ, examples, resources: http://www.nsf.gov/crssprgm/cdi .