

Opportunities and Strategies for Cross-Cutting Training Programs

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<http://www.nsf.gov>

Outline

- I. Introduction to NSF
- II. IGERT
Program, review, examples
- III. GOALI
Program, review, examples
- IV. Other cross cutting programs

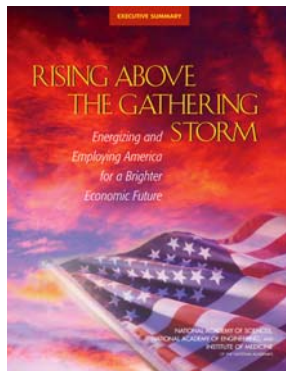
NSF Mission

Agency created by Congress in 1950 "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense..."

NSB 2020 Vision

- Strategic Priorities
 - Position of eminence at the global frontier of fundamental and transformative research; emphasize areas of greatest opportunity and potential benefit.
 - World-class S&E workforce; scientific literacy of all citizens.
 - Build basic research capacity through critical investments in infrastructure: advanced instrumentation, facilities, cyberinfrastructure, cutting edge experimental equipment

External Drivers



"Action B-4: Allocate at least 8% of the budgets of federal research agencies to discretionary funding that would be managed by technical program managers in the agencies and be focused on catalyzing high-risk, high-payoff research."

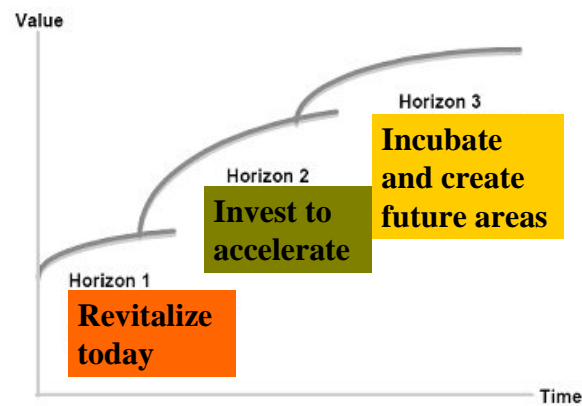
- American Competitiveness Initiative
- **Invest** in critical research, ensure the US continues to lead in opportunity and innovation, provide children with a strong foundation in math and science
- **Double** investment in key federal agencies that support **basic research** in the **physical sciences** over 10 years
- **ACI Partners** NSF, DOE & NIST



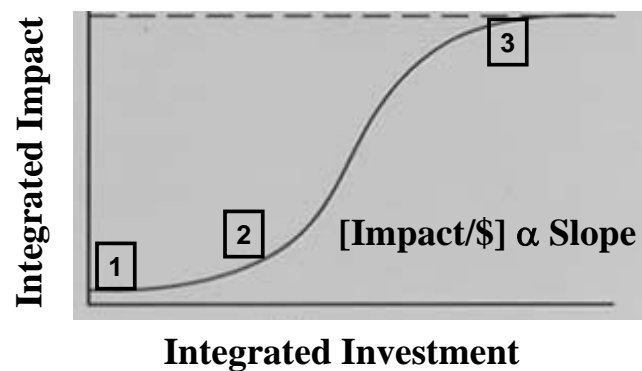
The Alchemy of Growth

Baghai, Coley and White

The growth challenge – *concurrent* management across 3 time horizons



Advancing the Frontier



“...if it's ‘safe science,’ NSF should not fund it.” A. Bement

NSF and the Physical Sciences

- **Largest Supporter of Basic Research in Physical Sciences Broadly Defined (~\$5B of \$6B)**
 - From Geoscience to Physics, from Computer Science to Chemistry, from Engineering to Mathematics
 - “Always at the Frontier, First at the Boundaries”
- **Special Roles**
 - University support (~80% of budget)
 - Steward for Math, Chemistry, Computer Science, and Ground-based Astronomy
 - Education, Broadening Participation, Public Understanding & Societal Implications
 - University-led facilities that are bold & transformational

NSF FY07 Priorities

- **Advancing the Frontier (grant support)**
- **Elementary Particle Physics (EPP)**, fundamental research across the energy frontier, the neutrino frontier and the cosmic frontier
- **Physics of the universe (POU)**, in partnership with DOE and NASA, exploring dark matter and dark energy; the fundamental nature of time, matter and space; and the role of gravitation.
- **Fundamental mathematical and statistical science**, strengthening the core of the Mathematical Sciences Priority Area and enable effective partnering across NSF as well as with NIH and DARPA.
- **Physical sciences at the nanoscale**, the foundation for innovative nanoscale technologies in partnership with other NSF organizations and the government-wide National Nanotechnology Initiative.
- **Cyberinfrastructure and the cyberscience it enables**, connecting with NSF's high priority activities in this area and the government-wide Networking and Information Technology R&D activities.
- **Molecular basis of life processes**, study of complex biological systems in areas such as self-assembly of disordered collections of molecules into the elements of living systems; protein folding; membranes; and emergence of physiological processes such as breathing and thinking out of complex, coupled arrays of individual reactions.
- **Sustainability**, areas that link the physical sciences with environmental sustainability, including green chemistry, water chemistry and energy.

FY07 Priorities, cont.

Facility Stewardship, Instrumentation and CyberInfrastructure

- »NB: \$50M in OCI toward a petascale capability
- CI track in the CRIF-CRF competition continues – NSF 06-512
- Cyber discovery embedded throughout CHE programs

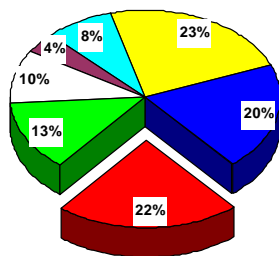
Broadening Participation, Education and Workforce Development

(cast in terms of dollars)

- Increases in NSF-wide Programs
 - » CAREER, GK-12, REU
- Expansion of existing MPS education and workforce activities
 - » EMSW21
 - » UBM, CSUMS
 - » URC
 - » IPSE
- Increased support for broadening participation
 - » PREM
 - » Partnering with professional societies
 - » Partnering with EHR/HRD
 - » Research Partnerships for Diversity
- Increases throughout MPS programs and projects that enhance education and workforce development and broaden participation

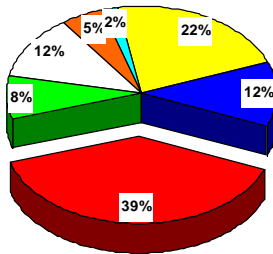
revitalizing

Analytical and Surface Chemistry Program



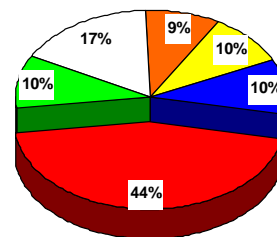
■ Electrochemistry
 ■ Atomic and Molecular Spec.
 ■ Surface Science
 ■ Separations
 □ Mass Spec.
 ■ Kinetic Methods and Analysis
 ■ Other

1984-85 avg.



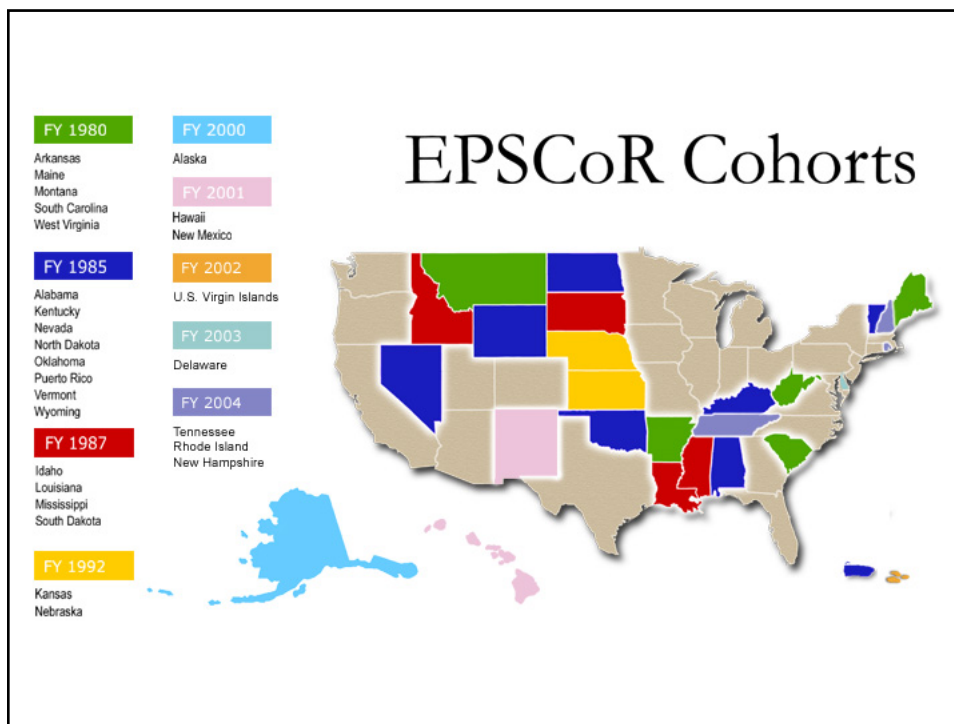
■ Electrochemistry
 ■ Atomic and Molecular Spec.
 ■ Surface Chem
 ■ Separations
 □ Mass Spec.
 ■ Sensors
 ■ Other

1994



■ Electrochemistry
 ■ Atomic and Molecular Spec.
 ■ Surface and Interface
 ■ Separations
 □ Mass Spec.
 ■ Sensors


2004-5 avg.



Review Criteria

- **Criterion 1: *intellectual merit?***
 - *Advancement of knowledge and understanding*
 - *How well qualified is the proposer?*
 - *Impact of prior work?*
 - *Exploration of creative and original concepts?*
 - *How well conceived and organized?*
 - *Resources?*

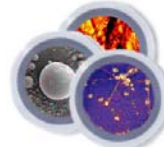
- **Criterion 2: *broader impacts?***
 - *Promotion of teaching, training, and learning?*
 - *Broadening participation?*
 - *Enhancement of infrastructure?*
 - *Dissemination?*
 - *Benefits to society?*



Dear colleague letters on broader impacts:
NSF 02-161 and 04-045

incubate and create new areas

Integrative Graduate and Education Research Traineeship (IGERT) Program NSF 06-525



- **Interdisciplinary theme plus disciplinary depth**
- **Emerging research area**
- **Innovative models for graduate education**
- **Broaden participation**
- **Catalyze a cultural change in graduate education**
 - For graduate students
 - For faculty
 - For institutions



- 5-year duration
- ~ \$3 M total funding
- ~12 trainees/year/award
- (\$30K/yr fellowship)

IGERT Students are Better Prepared For:

- Responsible conduct of research
- Learning about other disciplines
- Working across disciplines
- Collaboration and teamwork
- Communications inside and outside own field
- Communication with the general public

IGERT Goals

- Educate U.S. Ph.D. scientists and engineers for careers in research and education
- Establish new models for graduate education
- Facilitate diversity in student participation and preparation and contribute to a diverse globally engaged workforce

Merit Review Criteria

- **What is the intellectual merit of the proposed activity?**
- **What are the broader impacts of the proposed activity?**

Proposal Review Criterion: *Intellectual Merit*

- **Potential to advancing knowledge and understanding within and across fields**
- **Qualifications of investigators**
- **Creativity and originality**
- **Conceptualization and organization**
- **Access to resources**

Proposal Review Criterion: *Broader Impacts*

- **Advancement of discovery and understanding while promoting teaching, training and learning**
- **Participation of underrepresented groups**
- **Enhancement of infrastructure for research and education**
- **Dissemination of results to enhance scientific and technological understanding**
- **Benefits to society**

Intellectual Merit IGERT

- Vision, goals, thematic basis
- Major research efforts
 - Cutting edge aspects
 - Interdisciplinary theme
 - International component (if proposed)

IGERT Broader Impacts

- Integration of interdisciplinary research with graduate education and training
- Quality of educational plan
- Innovations and potential impact
- Recruitment and mentoring
- Career development
- Strategies for increasing diversity

IGERT Broader Impacts (continued)

- Benefits of international research experiences (if proposed)
- Emphasis on what is new and innovative

Management, Assessment, and Institutional Commitment

- Strategies for management
- Strategies for assessment using external expertise
- Institutional commitment to project goals
 - Supportive environment
 - Furthering diversity
 - IGERT interface with institutional programs

Renewals Additional Criteria

- Quality of outcomes of prior award
- Improvements and innovations for renewal period (value added)
- Plans for evaluating impact
- Documentation and dissemination
- Sustaining essential elements
- Progress on institutionalization

Examples of Successful IGERTS

(www.nsf.gov IGERT award search)

Astrobiology: Life in a Cosmic Context
Washington, 7/19/05 \$1,248,703

Sensor Science, Engineering, and Informatics
Maine, 6/27/05 \$603,147

Assessing the Implications of Emerging Technologies
MIT, 12/23/03 \$1,737,806

IGERT examples, continued

Graduate Training in Optical Sciences and Engineering
Colorado, 9/22/03 \$2,363,518

Vanderbilt-Fisk Interdisciplinary Program for
Research and Education in the Nanosciences
Vanderbilt, 10/15/03 \$1,548,193

Grant Opportunities for Academic Liaison with Industry

GOALI:

Collaborative Research Projects

- **Intellectual problem shared by industry and university; fundamental research (no routine development or short term work) with serious level of detail**
- **Industry co-PI; must present a real industry commitment**
- **Detailed plan for industry-university collaboration, w/ division of research tasks**
- **Industry technological relevance and commitment are essential evaluation criteria**
- **Proprietary issues – agreement on intellectual property is required**

GOALI:

The Mechanisms

- **Faculty and students in industry
NSF \$ support university participation**
- **Industry personnel in academe to catalyze research/curricula**
- **Shared use of instruments in either location or collaboration at a third location (e.g. center, beamline)**
- **International aspects welcome**
- **Inclusion of undergraduates (URC, REU)**

GOALI – how to

- **Submit to NSF 98-142:** university investigator (PI) submits under this number (as an unsolicited proposal, check target dates or deadlines on division website)
- Include co-PI from industry
(NSF funds for academic institution only)
- **IMPORTANT: benefit to student training and education**
- In kind contribution from industry (typically personnel time)
- Include letter from industry describing contribution and draft of intellectual property rights agreement
- Can be combined with other programs (NIRT, FRG, REU)

GOALI – practical advice

- **Start at**
http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf98142
- **Contact the program officer likely to handle your proposal**
- **Search Fastlane NSF Awards Database for similar areas –**
<http://www.nsf.gov/awardsearch/>
For proposals going to Engineering, call Don Senich 703-292-7082
- **For proposal going to Math and Physical Sciences, call Henry Blount 703-292-8803**
- **Dovetail with NSF themes, e.g. nanotechnology, environment, national security, cyberinfrastructure, miniaturization, workforce, education, etc.**

GOALI Industrial Partners 2002-2004

3M (2)	Chrysler	Hosokawa Micron Powder Systems	Motorola (5)	Tech-Assessment & Transfer (2)	
Alicia (7)	Conoco	Hughes Aircraft	Noecera, Inc.	Tektronix (2)	
Agilent	ConEd NY	Huntsman Corp	Novellus	Thixomat Inc.	
Air Liquide	Cummins Engine Co.	IBM Almaden (3)	Part Miner Inc	TIRE Solutions	
Amgen	CCVD Microcoating	IBM Watson (3)	Perkin Elmer	Texas Instruments	
Amoco	Daimler Chrysler	Imagine That!	Plasma Sol	United Airlines	
Applied Materials	Delphi Automotive (2)	Illinois Superconductor	Perot Systems	United Eng. Trustees	
Arena-flow	Dupont (3)	Intel (3)	Planar America	US Steel	
Aveka, Inc.	Dow (4)	JS Kanel & Assoc.	Pratt & Whitney (2)	Veeco	
Bechtel Power	Eastman Kodak (2)	Kimberly Clark	Promerus	Westvaco	
Becton Dickinson	Exxon	KMC	Praxair	Xerox-Webster	
Bethlehem Steel	Festp Corp	Hewlett Packard Caribe	Raytheon	Chemstations	
Black and Decker	Ford (5)	Lam Research	Rohm & Haas (4)	Chevron Texaco	
BMS Labs	GE (5)	Lucent (2)	Rockwell	Heinz	
Boeing Aerospace	General Motors (5)	Maxtor Corp	Rheometrics	Howmet Res. Corp.	
BP America	Genetronic (3)	Mallinckrodt	Schlumberger Doll	Materials Modification	
Caterpillar	GNS	MicroFabTech	Sima	Monsanto (2)	
Ceramco	Grumman Corp	Millenium Inorganic	SKF Condition Monitoring	Seagate	

Sample GOALI projects

- Wave forces on offshore submerged structures(CTS)
- Metabolic engineering/ethanol production in e.coli (BES)
- Cell culture (BES)
- Laser jet CVD (DMII)
- Phosphors/electroluminescent displays (DMR)
- Ni-based superalloy single crystals (DMR)
- Multidimensional NMR of polymers (DMR)
- Adsorption competition in soils (BES)
- Nanofibers by electrospinning (DMII)
- Wear of aluminum (DMR)
- Mathematical modeling of sensors for polymer characterization (DMS)
- Electro-poration mediated DNA delivery (BES)
- Aggregation of protein therapeutics in aqueous solution (BES)
- Chemical mechanical planarization process modeling (DMII)
- Fuel cell breathing in ground vehicle propulsion (CMS)
- Granular activated carbon for removing organic odorants (BES)
- Addressable multielectrode arrays (CHE)
- Single molecule spectroscopic imaging of photoresists (CHE)
- Molecular modeling of nanoporous materials (CTS)
- Simulations of retention processes in chromatography (CHE)
- Noble metal catalyst impregnation (CTS)
- Ocean electric energy extraction (ECS)
- Steels for next generation automobiles (DMR)
- Development of a seismic design methodology for precast floor diaphragms (CMS)
- 3D nanomanufacturing with rubber stamps (DMII)
- Structure and stability of gas hydrates (CTS)

Small Businesses

- independently owned and operated, American & in USA, <500 employees (full definition on www)
- Small Business Innovation Research (SBIR); Small Business Technology Transfer (STTR)
 - cross-cutting, managed in Engineering (ENG)
- SBIR Phase I (**NSF 04-551**) and Phase II
 - Phase II for previously NSF-funded Phase I businesses
- STTR for cooperation with industry
- Proposal submission and review criteria different than “regular” proposals



<http://www.eng.nsf.gov/sbir/>

incubate and create new areas

Small Business Innovation Research and Small Business Transfer Programs NSF 06-553

- stimulate technological innovation in the private sector, by strengthening the role of small business concerns in meeting Federal research and development needs, and increasing the commercial application of federally supported research results
- difference between the SBIR and STTR programs - STTR requires researchers at universities and other research institutions to play a significant intellectual role in the conduct of each STTR project. These university-based researchers, by joining forces with a small company, can spin-off their commercially promising ideas while they remain primarily employed at the research institution.

Successful proposers will conduct Research and Development (R&D) on projects that:

1. Provide evidence of a commercially viable product, process, device, or system; and
2. Meet an important social or economic need.

Projects should have the following:

- High potential commercial payback;
- High-risk efforts;
- Research tools which meet significant commercial market needs; and,
- Applications that result in multipurpose commercially viable functions.

- Topics: Advanced Materials (AM)
- Emerging Opportunities (EO)
- Information Technology (IT)
- Manufacturing Innovation (MI).

Industry/University Cooperative Research Centers (IUCRC)

a program in Engineering

(ENG): [NSF 01-116](#)

<http://www.eng.nsf.gov/iucrc/>

Hitachi S-5200 Nano SEM



- ~45 centers + several add-on's to centers
- develops long-term partnerships among industry, academe & government
- centers are catalyzed by a small investment from NSF
- primarily supported by center members, with NSF taking a supporting role in their development and evolution
- stimulate highly leveraged industry/ university cooperation by focusing on fundamental research recommended by Industrial Advisory Boards
- Ceramic and Composite Materials Center (CCMC):
University of New Mexico (lead), Rutgers, The State University of New Jersey & PA St. U.

Industrial Consortia in Academe

NSF Individual investigator awards sometimes contribute to “industrial consortia” associated with universities

- Carnegie Mellon University
- Arizona State Biodesign Institute
- Purdue Industrial Associates
- Center for U. Mass-Industry Research on Polymers (IUCRC)

Centers Involving Industry

Center awards sometimes have industrial partners

KINDS OF NSF CENTERS

Science and Technology Centers

<http://www.nsf.gov/od/oia/programs/stc/cid.htm>

Collaborative Research in Chemistry

<http://www.nsf.gov/pubsys/ods/getpub.cfm?nsf04601>

Chemical Bonding Centers (CBC)

<http://www.nsf.gov/pubsys/ods/getpub.cfm?nsf04612>

Materials Research Science and Engineering Centers (MRSEC), Division of Materials Research

http://www.nsf.gov/mps/divisions/dmr/about/c_facilities.htm#mrsec

Thank You!

