Graduate Research Fellowship Program

Fields of Study

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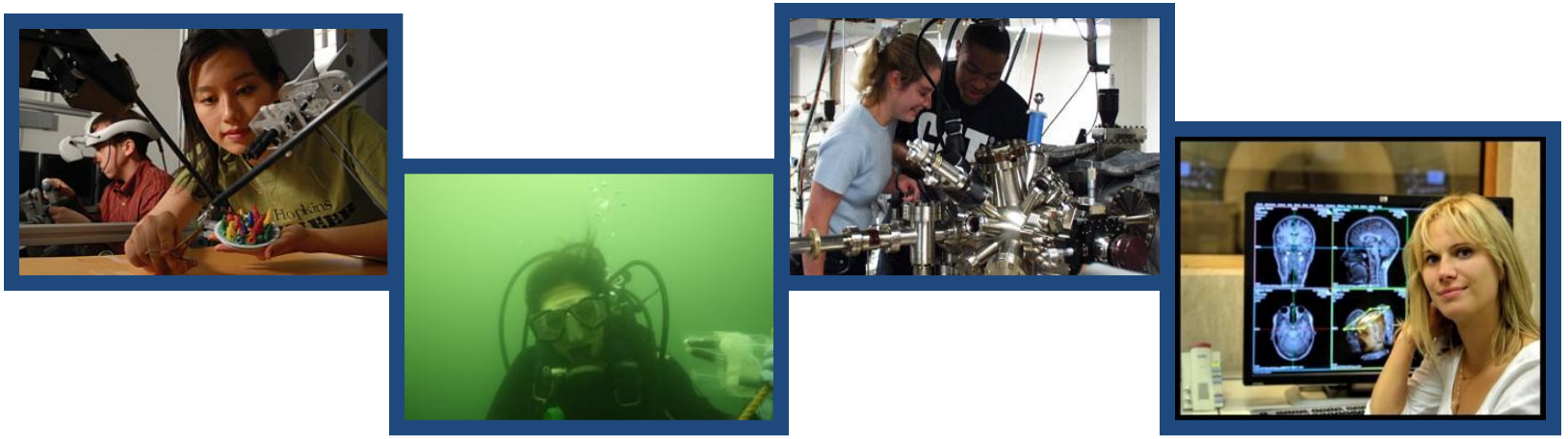
GRFP Overview

- Initiated 1952
- Identifies Nation's future STEM leaders
- Focuses on the individual
- Promotes diversity in the STEM workforce
- Adheres to the NSF Merit Review Criteria



GRFP Key Elements

- **Applicants** – undergraduates, beg. graduate students

- **Five Year Award – $121,500**

  Three years of support
  - $30,000 Stipend per year
  - $10,500 Educational allowance to institution

- International research opportunities; supercomputer access

GRFP Unique Features

- **Choice** of project, research advisor & program
- No service requirement
- Portability
  - Any accredited institution
  - MS → PhD
- Flexibility
  - "On Reserve"
  - "On Tenure"

GRFP Success Rate

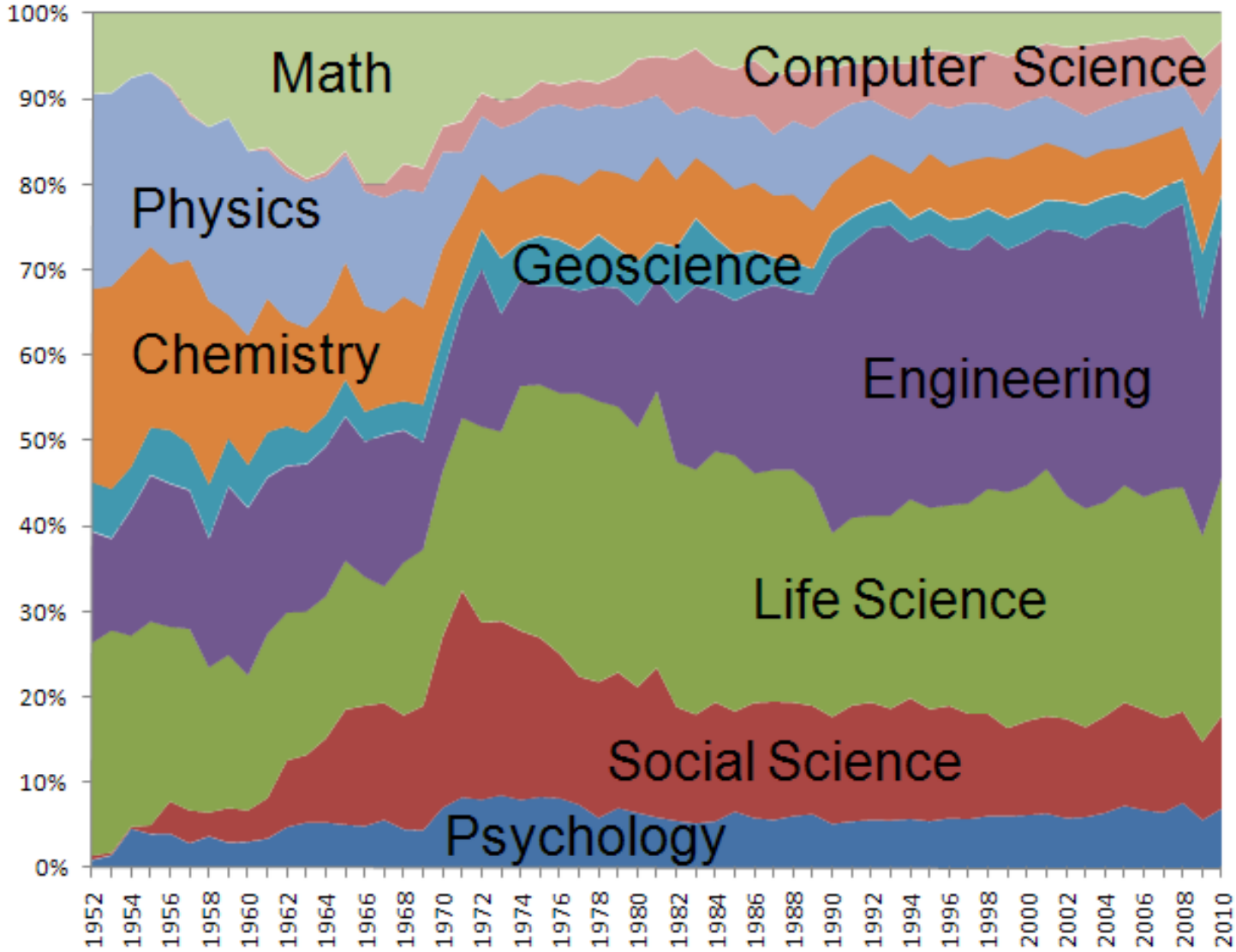
2008

- 1,000 Awards
- 10,000 Applications
- ~ 10% Success

2010

- 2,000 Awards
- 12,000 Applications
- ~ 17% Success

GRFP Funding History



~20% Physical sciences & mathematics

~30% Engineering

~30% Life sciences

~20% Social sciences

1952: Announcement of Fellowships

NATIONAL SCIENCE FOUNDATION
FELLOWSHIPS
in the
BIOLOGICAL, ENGINEERING, MATHEMATICAL, MEDICAL AND PHYSICAL SCIENCES

The National Science Foundation is authorized by the National Science Foundation Act of 1950 to award Fellowships to promote the progress of science by increasing the nation's supply of trained scientists. Selection of persons for fellowships will be made from among citizens of the United States solely on the basis of ability.

Basic stipends range from $1400 to $3400 per year. The fellowships will also provide payment of tuition and fees, dependency allowances for married Fellows and limited travel allowances.

Appointments are for one year. The closing date for receipt of applications for 1953-54 will be January 5, 1953. Awards will be made on April 1, 1953.

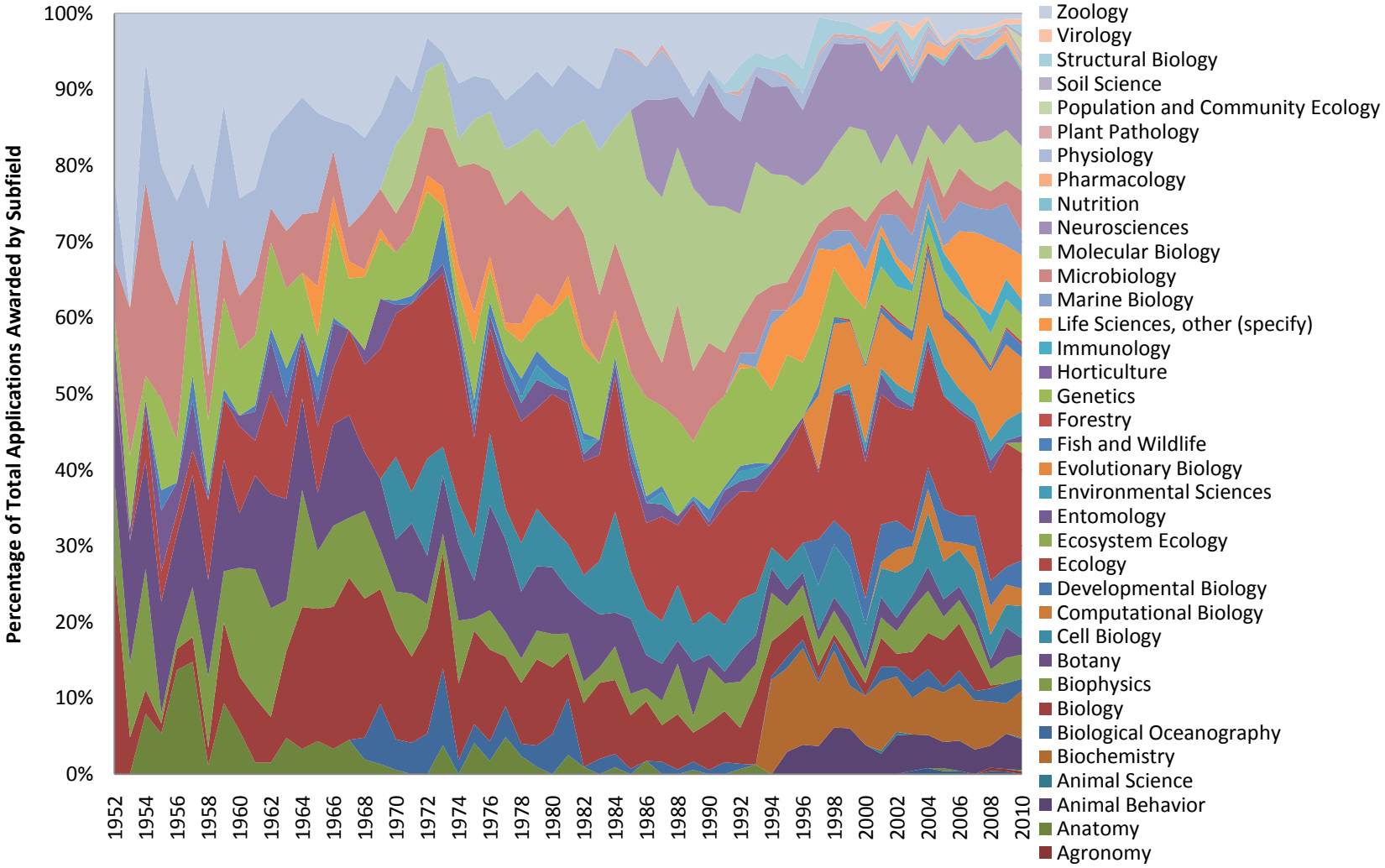
Applicants for predoctoral fellowships will be required to take an examination designed to test scientific aptitude and achievement.

Applications will be evaluated by committees of scientists appointed by the National Research Council; final selection of Fellows will be made by the National Science Foundation.

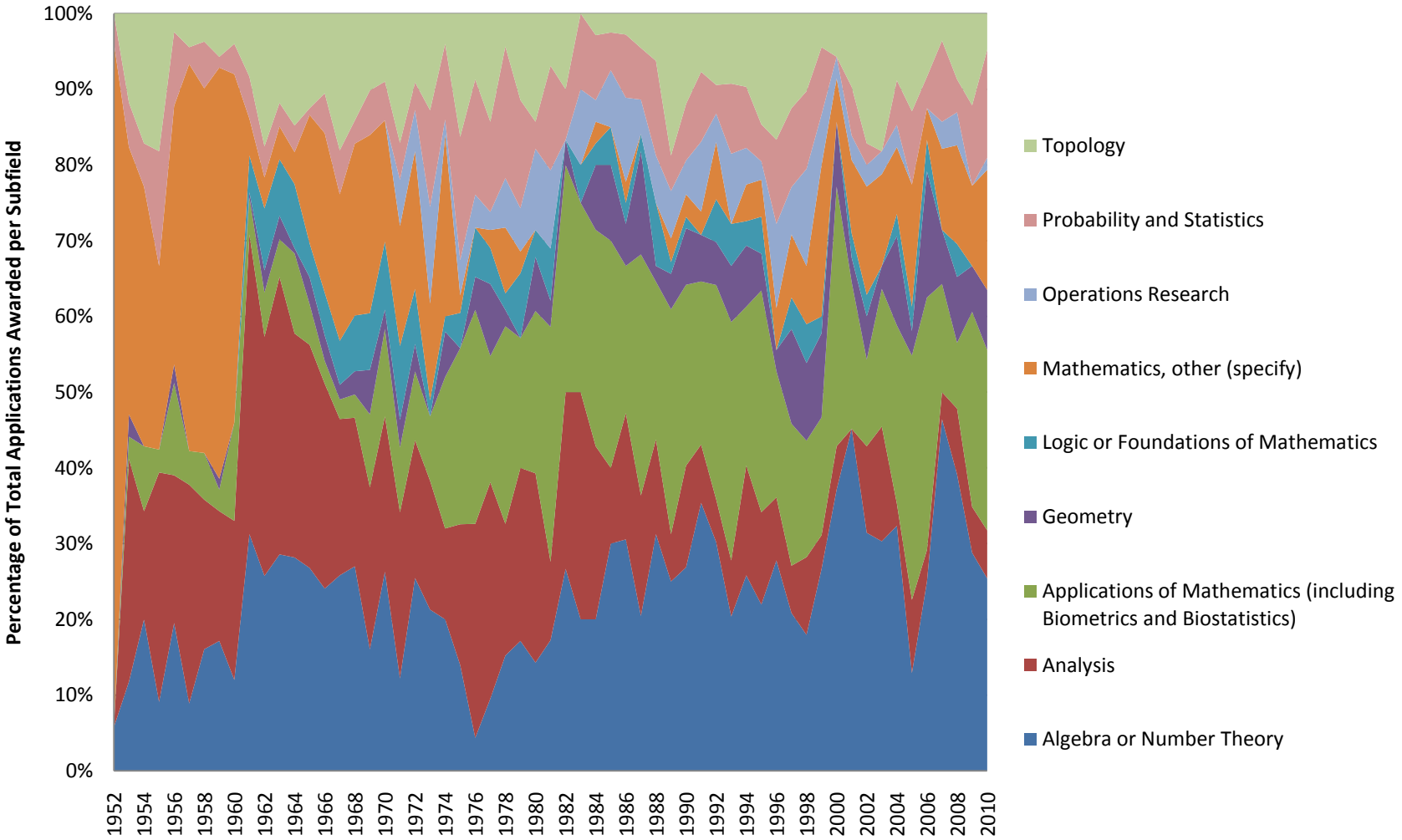
PRIMARY FIELD OF STUDY

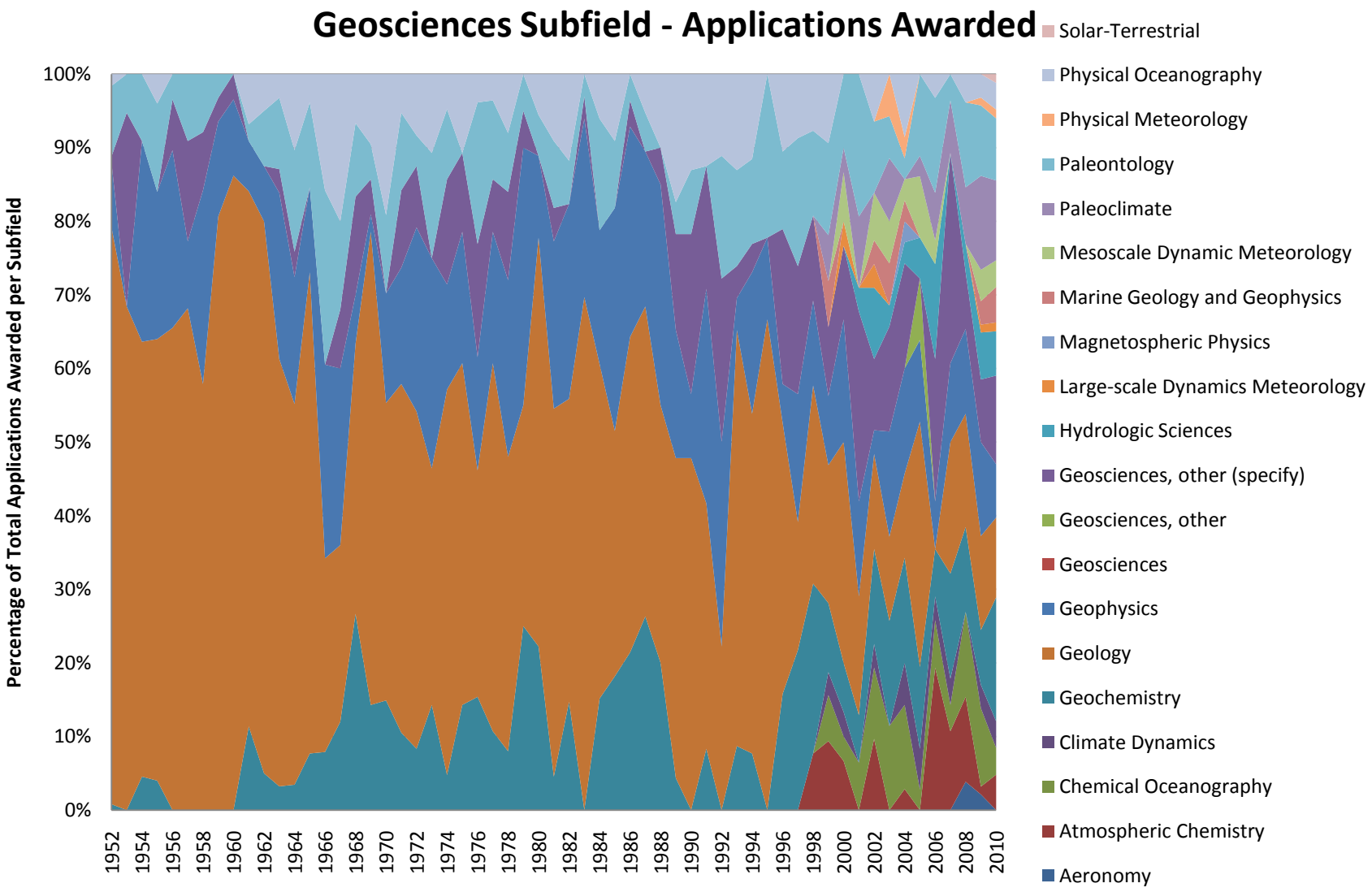
Original Fields 1952	1965 - 1973	1984 - 1989	1990 - 1993	1994 - 1997	1998 - 2009	2010
Engineering	Engineering					
Biological Sciences	Life and Medical Sciences	Life Sciences				
Medical						
	Psychology					
	Social Sciences					
Mathematical Sciences	Mathematical Sciences					
			Computer Science	Computer & Information Science and Engineering		
Physical Sciences	Physical Sciences					
		Chemistry				
		Earth Sciences			Geosciences	
		Physics	Physics & Astronomy			
						STEM Educ & Learning Res

Life Sciences Subfield - Applications Awarded

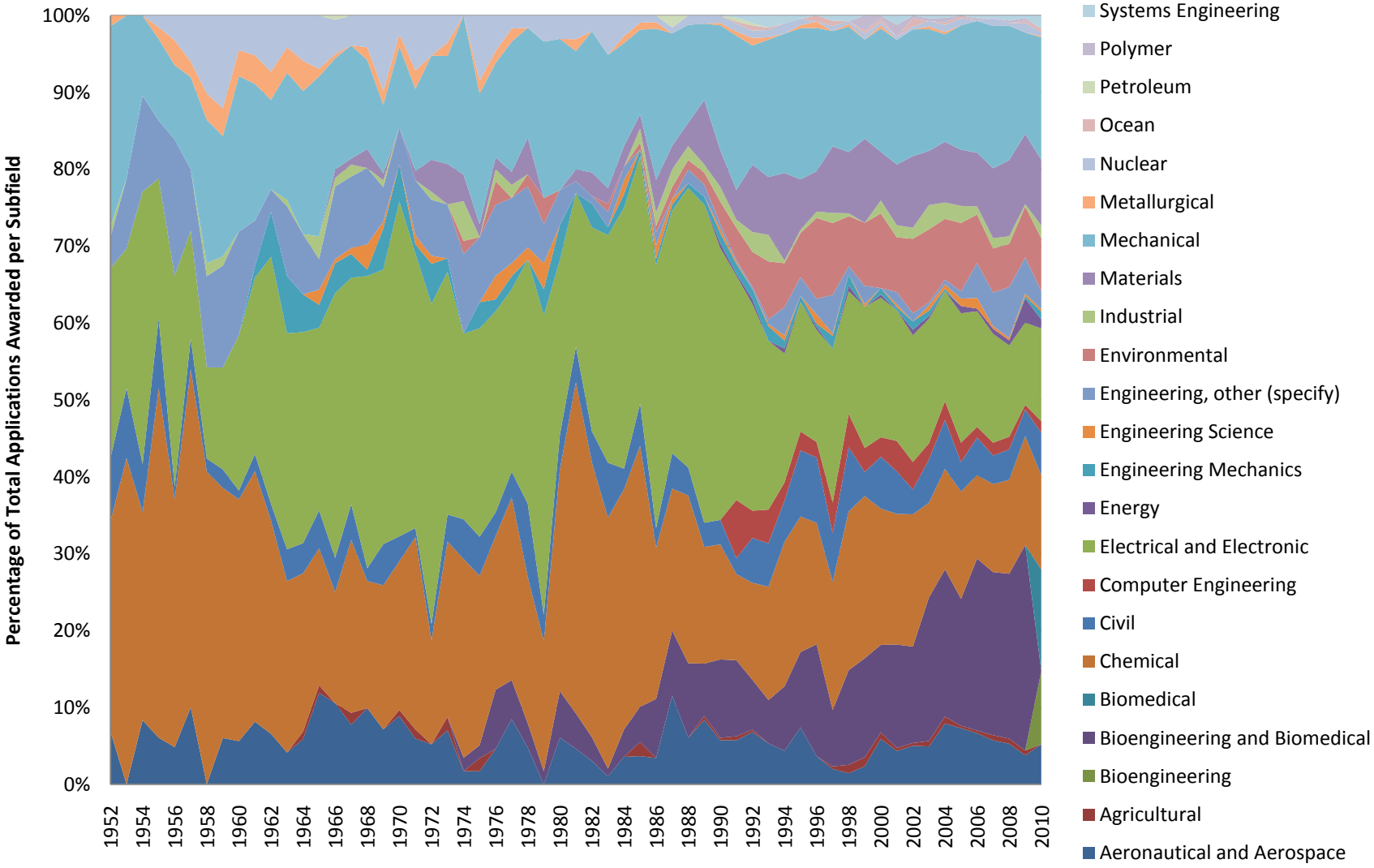


Mathematical Sciences per Subfield - Applications Awarded



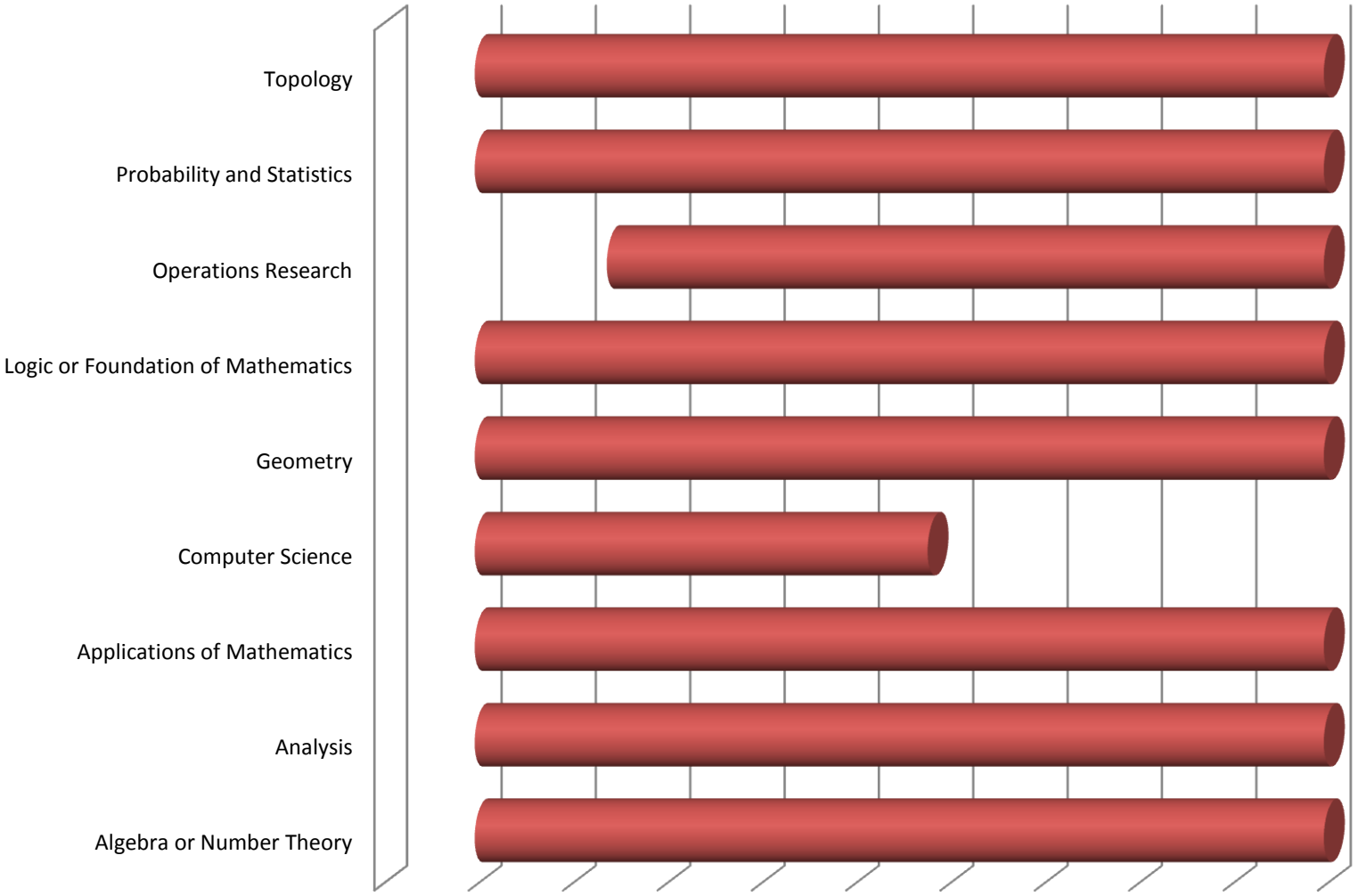

Geosciences Subfield - Applications Awarded
Percentage of Total Applications Awarded per Subfield
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1952
1954
1956
1958
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Solar-Terrestrial
Physical Oceanography
Physical Meteorology
Paleontology
Paleoclimate
Mesoscale Dynamic Meteorology
Marine Geology and Geophysics
Magnetospheric Physics
Large-scale Dynamics Meteorology
Hydrologic Sciences
Geosciences, other (specify)
Geosciences, other
Geosciences
Geophysics
Geology
Geochemistry
Climate Dynamics
Chemical Oceanography
Atmospheric Chemistry
Aeronomy

Engineering Subfield by Applications Awarded



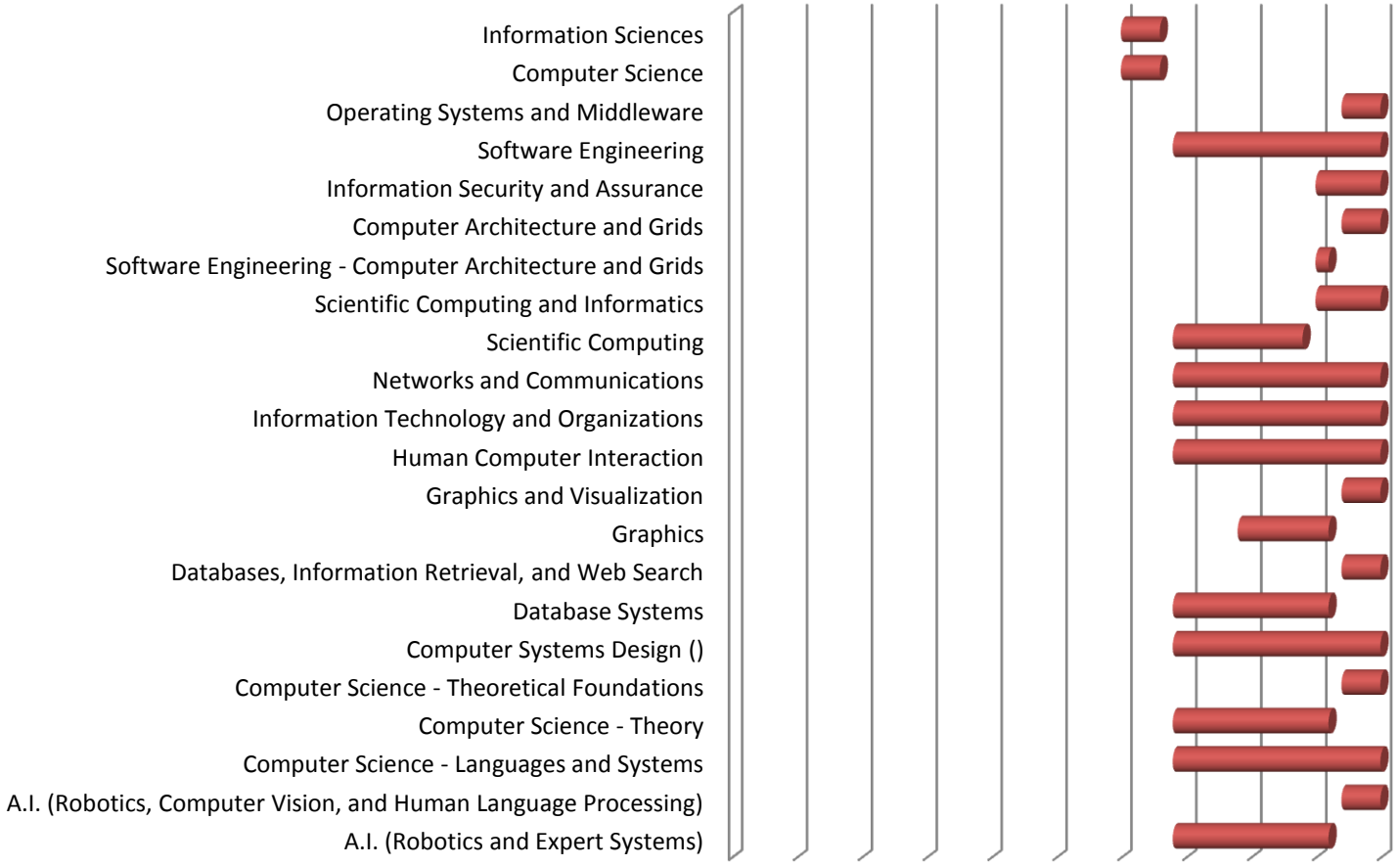
MATHEMATICAL SCIENCES SUBFIELD	START YEAR	END YEAR
Algebra or Number Theory	1965	
Analysis	1965	
Applications of Mathematics	1965	
Computer Science	1965	1989
Geometry	1965	
Logic or Foundation of Mathematics	1965	
Probability and Statistics	1965	
Topology	1965	
Operations Research	1972	

Mathematical Sciences



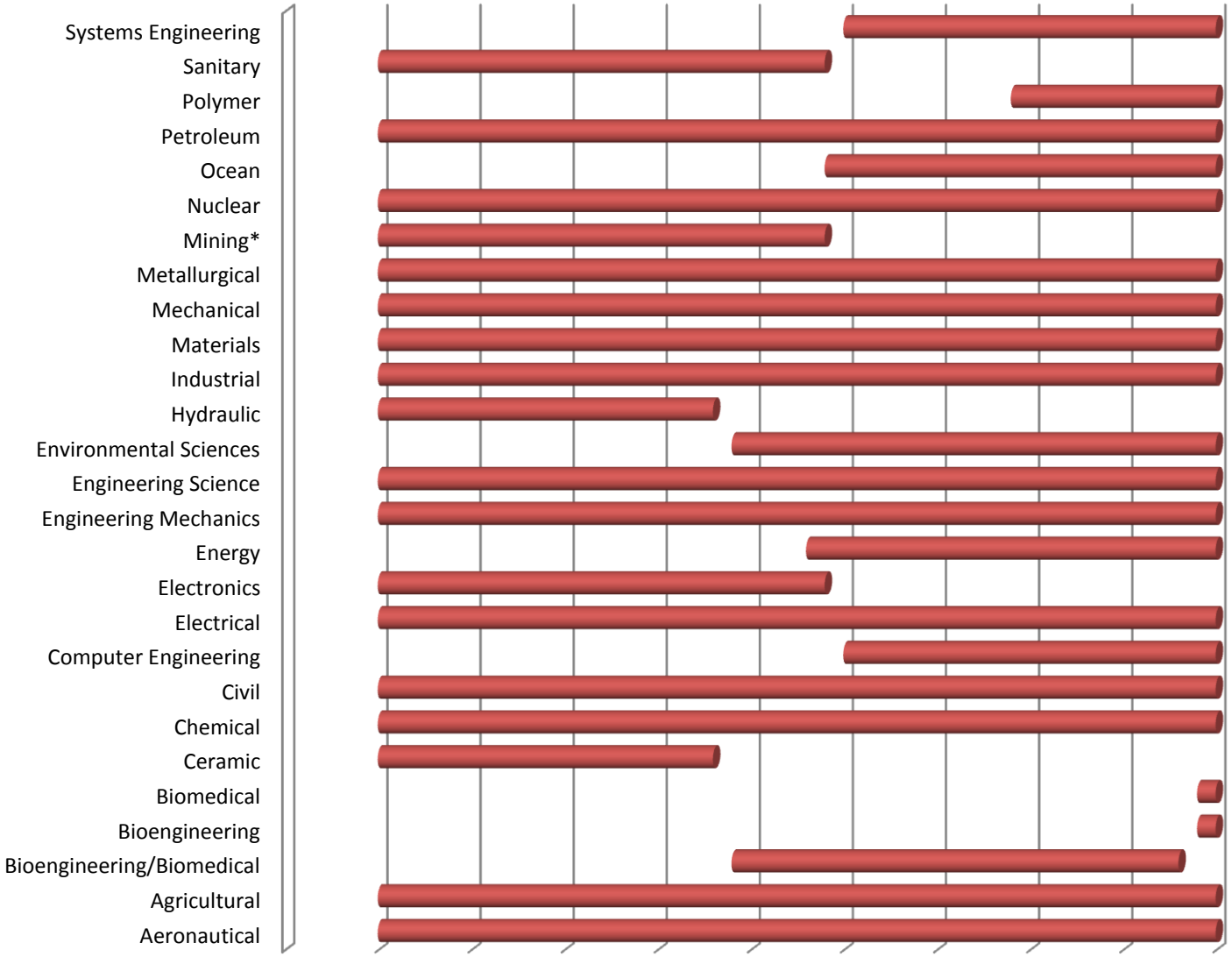
COMPUTER SCIENCE SUBFIELD	START YEAR	END YEAR
Computer Science	1990	1993
Information Sciences	1990	1993
A.I. (Robotics and Expert Systems)	1994	2006
Computer Science - Languages and Systems	1994	
Computer Science - Theory	1994	2006
Computer Systems Design ()	1994	
Database Systems	1994	2006
Human Computer Interaction	1994	
Information Technology and Organizations	1994	
Networks and Communications	1994	
Scientific Computing	1994	2004
Software Engineering	1994	
Graphics	1999	2006
Scientific Computing and Informatics	2005	
Software Engineering - Computer Architecture and Grids	2005	2006
Information Security and Assurance	2005	
A.I. (Robotics, Computer Vision, and Human Language Processing)	2007	
Computer Science - Theoretical Foundations	2007	
Databases, Information Retrieval, and Web Search	2007	
Graphics and Visualization	2007	
Computer Architecture and Grids	2007	
Operating Systems and Middleware	2007	

CISE


Information Sciences
Computer Science
Operating Systems and Middleware
Software Engineering
Information Security and Assurance
Computer Architecture and Grids
Software Engineering - Computer Architecture and Grids
Scientific Computing and Informatics
Scientific Computing
Networks and Communications
Information Technology and Organizations
Human Computer Interaction
Graphics and Visualization
Graphics
Databases, Information Retrieval, and Web Search
Database Systems
Computer Systems Design ()
Computer Science - Theoretical Foundations
Computer Science - Theory
Computer Science - Languages and Systems
A.I. (Robotics, Computer Vision, and Human Language Processing)
A.I. (Robotics and Expert Systems)

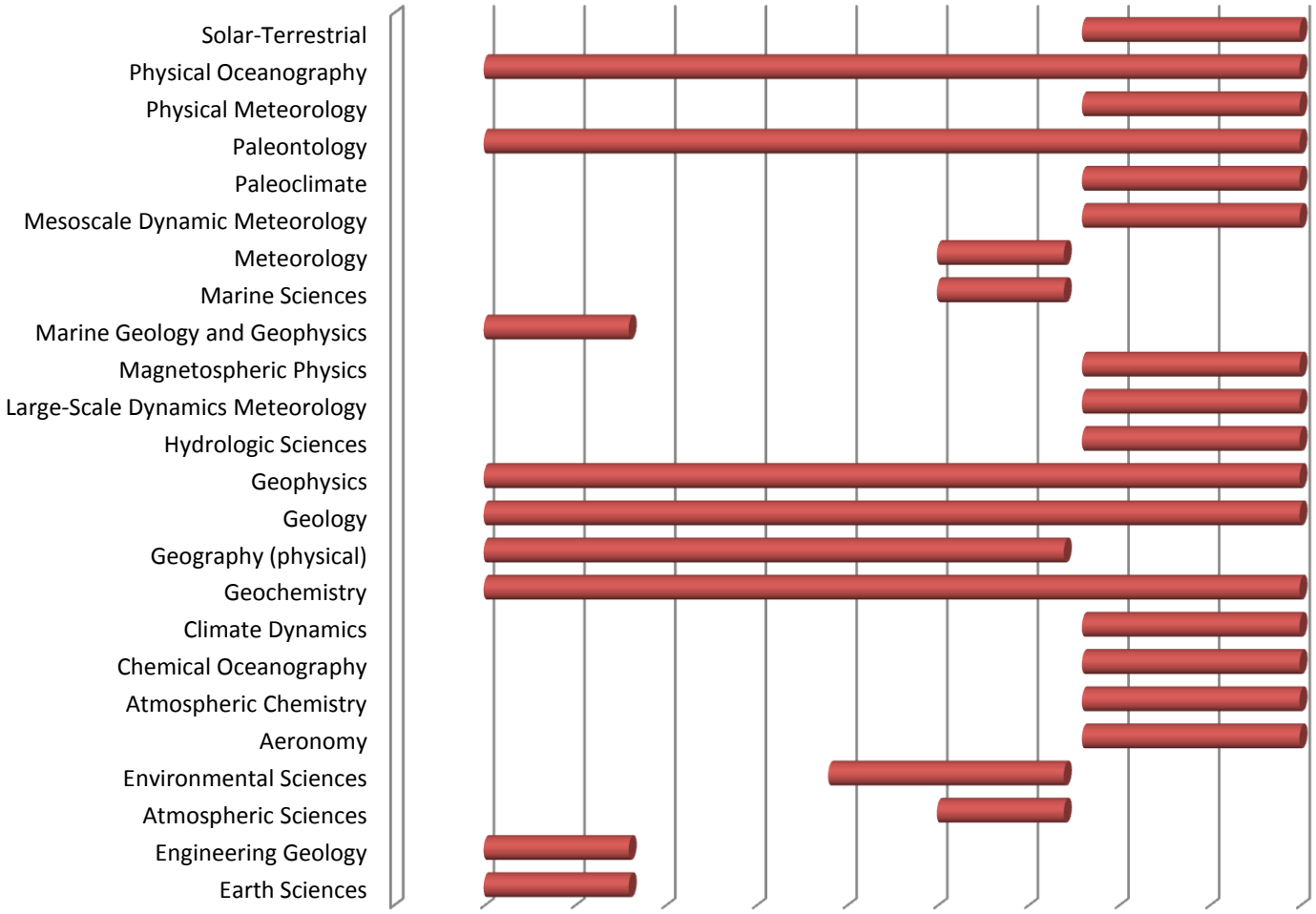
ENGINEERING SUBFIELD	START YEAR	END YEAR
Aeronautical	1965	
Agricultural	1965	
Ceramic	1965	1983
Chemical	1965	
Civil	1965	
Electrical	1965	
Electronics	1965	1989
Engineering Mechanics	1965	
Engineering Science	1965	
Hydraulic	1965	1983
Industrial	1965	
Materials	1965	
Mechanical	1965	
Metallurgical	1965	
Mining	1965	1989
Nuclear	1965	
Petroleum	1965	
Sanitary	1965	1989
Bioengineering/Biomedical	1984	
Environmental Sciences	1984	
Energy	1988	
Ocean	1989	
Computer Engineering	1990	
Systems Engineering	1990	
Polymer	1999	

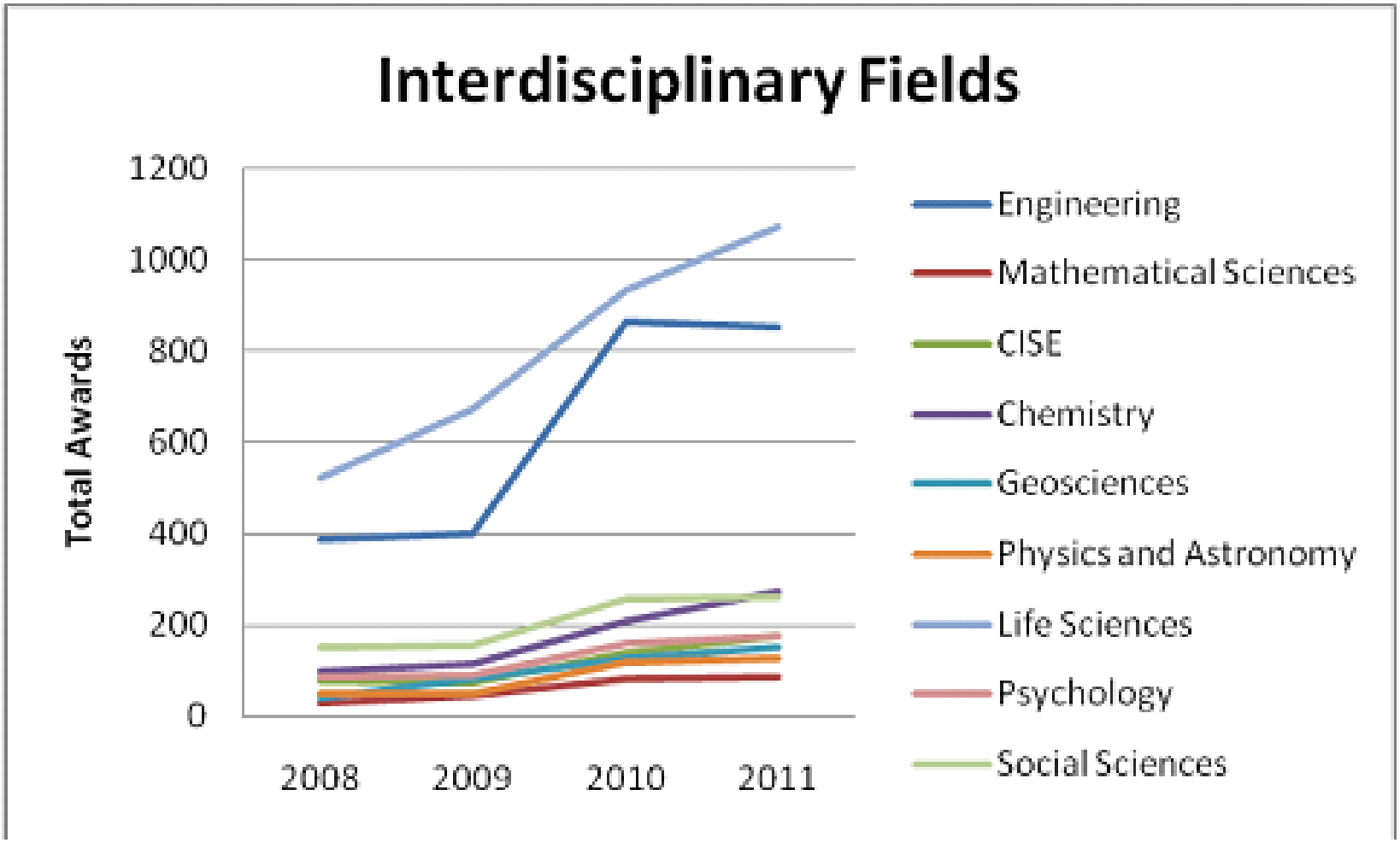
Engineering

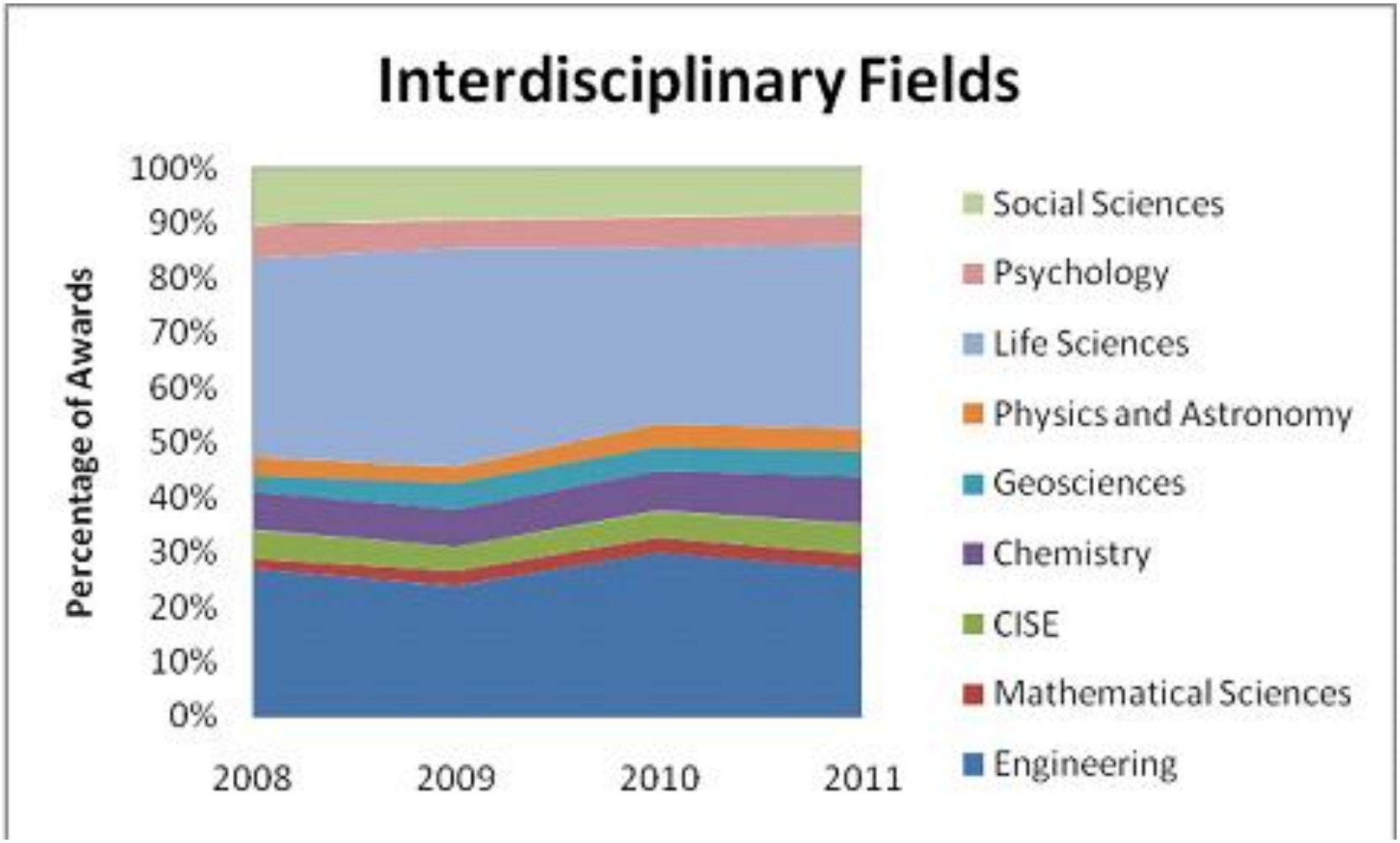


GEOSCIENCES SUBFIELD	START YEAR	END YEAR
Earth Sciences	1965	1973
Engineering Geology	1965	1973
Geochemistry	1965	
Geography (physical)	1965	1997
Geology	1965	
Geophysics	1965	
Marine Geology and Geophysics	1965	1973
Paleontology	1965	
Physical Oceanography	1965	
Environmental Sciences	1984	1997
Atmospheric Sciences	1990	1997
Marine Sciences	1990	1997
Meteorology	1990	1997
Aeronomy	1998	
Atmospheric Chemistry	1998	
Chemical Oceanography	1998	
Climate Dynamics	1998	
Hydrologic Sciences	1998	
Large-Scale Dynamics Meteorology	1998	
Magnetospheric Physics	1998	
Mesoscale Dynamic Meteorology	1998	
Paleoclimate	1998	
Physical Meteorology	1998	
Solar-Terrestrial	1998	

Geosciences




Interdisciplinary Fields
Total Awards
1200
1000
800
600
400
200
0
2008
2009
2010
2011
Engineering
Mathematical Sciences
CISE
Chemistry
Geosciences
Physics and Astronomy
Life Sciences
Psychology
Social Sciences


Interdisciplinary Fields
Percentage of Awards
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2008
2009
2010
2011
Social Sciences
Psychology
Life Sciences
Physics and Astronomy
Geosciences
Chemistry
CISE
Mathematical Sciences
Engineering

Integrative Graduate Education and Research Traineeship (IGERT)

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Grand Challenges-NAE Report

Engineering's Grand Challenges

WHAT DO YOU THINK?

Voting Results:

Make solar energy economical

Votes: 12779

Provide energy from fusion

Votes: 7512

Provide access to clean water

Votes: 7213

Reverse-engineer the brain

Votes: 4640

Advance personalized learning

Votes: 3670

Restore and improve urban infrastructure

Votes: 3483

Engineer the tools of scientific discovery

Votes: 3396

Develop carbon sequestration methods

Votes: 2743

Engineer better medicines

Votes: 2563

Prevent nuclear terror

Votes: 2309

Advance health informatics

Votes: 2283

Secure cyberspace

Votes: 2240

Enhance virtual reality

Votes: 2106

Manage the nitrogen cycle

Votes: 1864

Addressing Grand Challenges

- Grand Challenges are inherently
  - Interdisciplinary, complex
  - Involves not just science and engineering, but also policy, government, and geopolitics
- Plans to tackle grand challenges should include:
  - Systematic training for future scientists and engineers to take on these challenges
  - Strategic support for research
  - Building an innovation ecosystem

Disciplinary Thinking and Grand Challenges

- Energy
- Climate change
- Water
- Food
- Health care
- Infrastructure
- Safety
- . . .

"I'm on the verge of a major breakthrough, but I'm also at that point where chemistry leaves off and physics begins, so I'll have to drop the whole thing."

http://www.engineeringchallenges.org

NSF and Interdisciplinary Research

- NSF has a long history of encouraging interdisciplinary research at all levels of the organization.
- This includes support for proposals that are submitted in response to targeted IDR solicitations and for unsolicited proposals

NSF interdisciplinary support

- Single vs. multiple investigator awards:
  - 1987: 18%
  - 2007: 46%
- Co-funding in 2008 at 8%
- Use of the term “interdisciplinary”:
  - 118 of 342 (35%) active solicitations in 2008

IGERT Vision

- IGERT envisions that the next generation of U.S. PhDs is diverse, globally competitive with the training and skills necessary to work in an interdisciplinary collaborative research environment in emerging and critical areas of science and engineering, and contribute to innovative solutions that address societal needs and grand challenges for the 21st Century.

IGERT Goals

- Support interdisciplinary STEM research themes
- Support novel research-based graduate education and training mechanisms to help students transcend disciplinary boundaries and work in a collaborative and innovative environment
- Support novel strategies and plans for recruitment, mentoring, retention, and graduation of U.S. Ph.D. students in NSF-supported STEM fields, including efforts aimed at members of groups under-represented in science and engineering

IGERT Goals

- Support institutional plans to establish a supportive environment for innovation and for learning.
- Support activities that foster the development of professional and personal skills, skills for communicating at all levels, development of an international perspective, develop an awareness of ethics and responsible conduct of research
- Support institutionalizing best practices in education and training of PhD students.

Integrative Graduate Education and Research Traineeship (IGERT)

- Awards to institutions ($3-3.2M/5 years); senior PIs
- Recent competitions have > 400 pre-proposals, ~20 awards (5%)
- Since 1997:
  - 240 awards
  - 110 different lead institutions
  - 43 states, DC, and Puerto Rico
  - ~25 trainees/award, typically supported 2 years/each
  - ~5,200 PhD students have been supported

Support Level-Details

- 5-year awards
- Up to $600K per year
- Up to $200K additional in the first year for equipment, special materials, or methodologies, part of the total $600K
- Additional International Training Component $50K per year for years 2-5
- Indirect limitation: 8% of total direct costs excluding equipment and COE
- Graduate student stipend $30,000, Cost of education expenses $10,500
- 20 new awarded for the 2010 competition.

Some IGERT Interdisciplinary Themes

- Smart sensors and integrated devices
- Biosphere-atmosphere research
- Molecularly designed materials
- Assistive technology
- Sequential decision-making
- Urban ecology
- Astrobiology
- Alternate Energy
- Nanotechnology

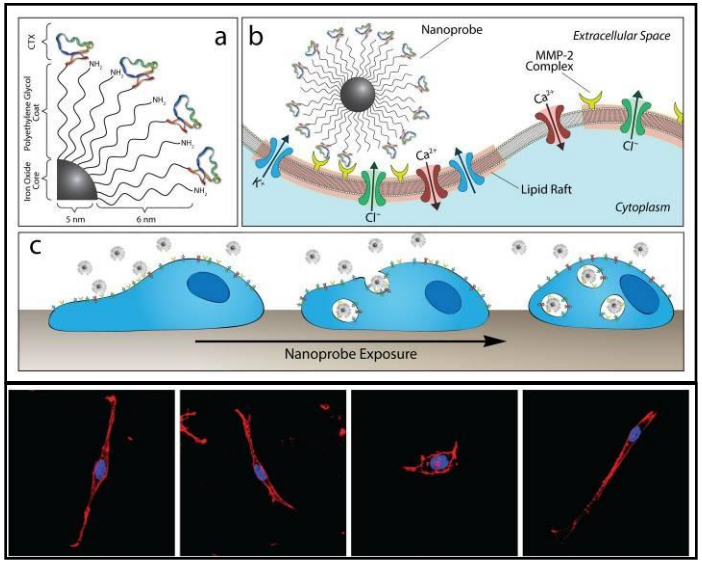
IGERT Examples

IGERT: Marine Sustainability
University of Alaska
PI: Ginny Eckert

Goal: Double the # of Alaskan Native PhD Graduates from UAF

IGERT: Nanotechnology
University of Washington
PI: Marjorie Olmstead

Education achievement: America's first PhD program in Nanotechnology



Theme: Environmental Change and Implications for Humanity

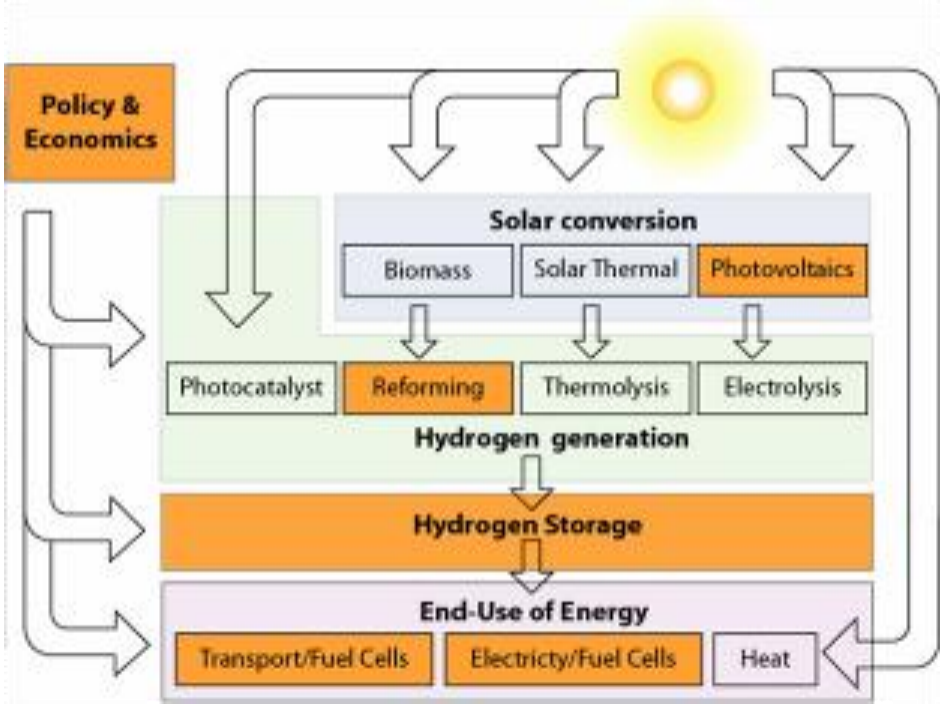
Dartmouth: Polar Environmental Change

George Washington University: Dynamics of Behavioral Shifts in Human Evolution: Brains, Bodies, and Ecology

UCSD: Marine Biodiversity: Understanding Threats and Providing Solutions

Theme: Clean Energy and Engineering Processes

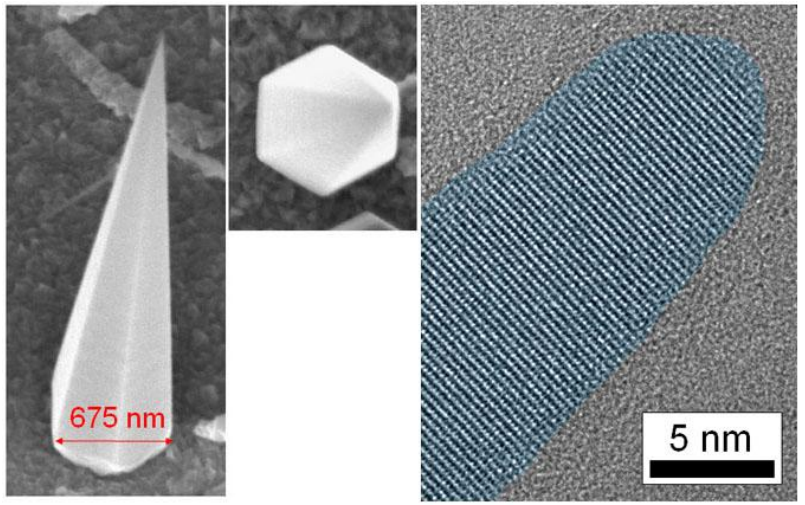
- Texas Tech University: Wind Science and Engineering

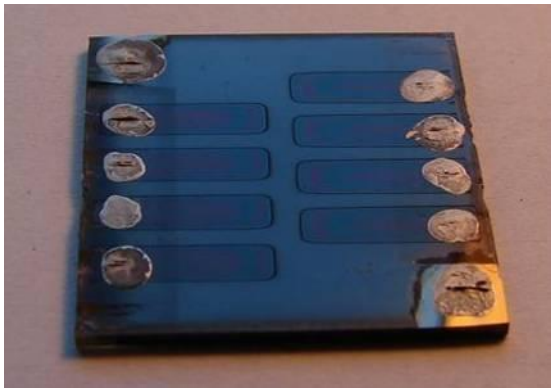


University of Delaware: Sustainable Energy from Solar Hydrogen

Nanoscale Science in IGERT

- 24 active awards including 4 renewals directly focused on Nanoscale Science
- Nanoscale Science in
  - Biology
  - Devices and machines
  - Electronics
  - Fabrication
  - Laminates
  - Materials; Biomaterials
  - Medical
  - Particles
  - Pharmaceutical
  - Photonics
  - Probes





2010 Portfolio by Theme

	THEMES													
Title	sustain, env, eco	Comp & applied math	human and social	nano	energy	materials	infrastructure	entrep	climate	evo/dev	Imaging	sensing, signal procesing	water	Life sciences
IGERT: Sustainable Grid Integration of Distributed and Renewable Resources	x	x			x		x							
NSF IGERT: Training the Next Generation of Researchers in Cellular & Molecular Mechanics and Bionanotechnology				x		x								x
Integrative Graduate Education and Research Traineeship in Magnetic and Nanostructured Materials	x			x		x								
IGERT: Geoinformatics for Environmental and Energy Modeling and Prediction (GEEMaP)		x	x				x		x					
IGERT: Complex Scene Perception		x	x											
IGERT--Interdisciplinary Evolutionary Primatology: Conservation and Human Evolution join Behavior, Bones and Genes			x							x	x			x
IGERT: Sustaining Ecosystem Services to Support Rapidly Urbanizing Areas	x		x											
IGERT: Distributed Renewable Energy: From Science and Technology to Entrepreneurship and Policy	x			x	x	x								
IGERT: Returning the Radio to Chemistry: Integrating Radiochemistry into a Chemistry Ph.D. Program	x					x					x			
IGERT Linking Individuals, Families and Environments in An Aging Society			x											x
IGERT: Water Across Boundaries - Integration of Science, Engineering, and Diplomacy	x		x				x						x	
IGERT: Training, Research and Education in Engineering for Cultural Heritage Diagnostics		x	x			x				x	x			
IGERT: INSPIRE: Information Security and Privacy: An Interdisciplinary, Research and Education Program		x	x				x							
IGERT: Stem Cell BIomanufacturing						x		x						x
IGERT: WATER - Integrated Water Atmosphere and Ecosystem Education and Research	x		x						x				x	
IGERT: Reverse Ecology: Computational Integration of Genomes, Organisms, and Environments	x	x				x								x
IGERT Nanomedicine Science and Technology				x		x		x			x	x		x
IGERT: MultiScale Transport in Environmental and Physiological Systems (MultiSTEPS)		x		x	x	x								x
IGERT: Training Program in Sustainable Energy Recovery from the Earth -- Educational Innovation at the Intersection of Geosciences and Engineering	x	x	x		x	x								
IGERT: Educating and the Interface: Nanomaterial Environmental Impacts and Policy (EI-NEIP)			x	x		x								x
	9	8	11	6	4	11	4	2	2	2	4	1	2	8
	45%	40%	55%	30%	20%	55%	20%	10%	10%	10%	20%	5%	10%	40%

www.igert.org