EDUCATING THE NEXT GENERATION

Graduate Education in the Plant Sciences Supported by NSF

William Hahn
Division of Graduate Education, NSF

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S&E Graduate Education - Structure and Funding

"The real ceiling on our productivity of new scientific knowledge …is the number of trained scientists available."

"The Government should provide a reasonable number of undergraduate scholarships and graduate fellowships in order to develop scientific talent in American youth."

Science: The Endless Frontier, Vannevar Bush, 1945

"There is no clear human-resources policy for advanced scientists and engineers, so their education is largely a byproduct of policies that support research."

Reshaping Graduate Education in Science and Engineering, COSEPUP, NAS, 1995

1° Support for S&E Doctoral (non-MD) Recipients 2005

	Total	RA	Fellow / Trainee	TA	Grant / Stipend
Non US citizen, temporary resident	10792	49.1%	13.2%	17.6%	5.6%
US citizen, national, permanent resident	17307	21.6%	22.5%	13.8%	14.4%
Total Doctoral	29751*	31.2%	23.5%	14.5%	15.6%

*1652 of unknown citizenship
Totals do not equal 100% due to unknown and use of personal funds
Grant/Stipend may include some traineeships
Source: NSF/SRS, Survey of Earned Doctorates, 2008, WebCASPAR

NSF-supported Graduate Students

Program	GRFP Fellow	IGERT Trainee	GK12 Trainee	Bridge to the Doctorate Trainee	Other NSF RA Etc.	Total US S&E Grad Student	US Citizen S&E Grad Student
Total #	2454	1570	799	ca. 250	ca. 25,000	583,226	436,530
US citizen	100%	100%	100%	100%	?	74.8%	100%
Female	53.6%	42.4%	53.3%	45.5%	?	47%	49.3%
URM	14.3%	13.9%	18.6%	100%	?	N/A	11%
Disabled	3.4%	2.2%	3%	?	?	?	?
PhD in 10 yrs	83%	Eval in prog	Eval in prog	Eval in prog	?	60%	56%

"Other NSF" includes RAs and other graduate student participants funded by R&RA directorates such as Science and Technology Centers
URM = Underrepresented Minorities in S&E; NSF numbers = 2008; US = 2006
Source: NSF/SRS; Survey of Earned Doctorates, 2008; WebCASPAR; DGE

Funding models for S&E Graduate Education

Most students received mixed sources of support

Implications of different models

- RAship - research enterprise, apprenticeship
- Traineeship - curricular focus
- Fellowships - flexibility and independence

Cost/benefit - indirect costs, “time” costs, RA as “cost” of research, Fellow/Trainee as education

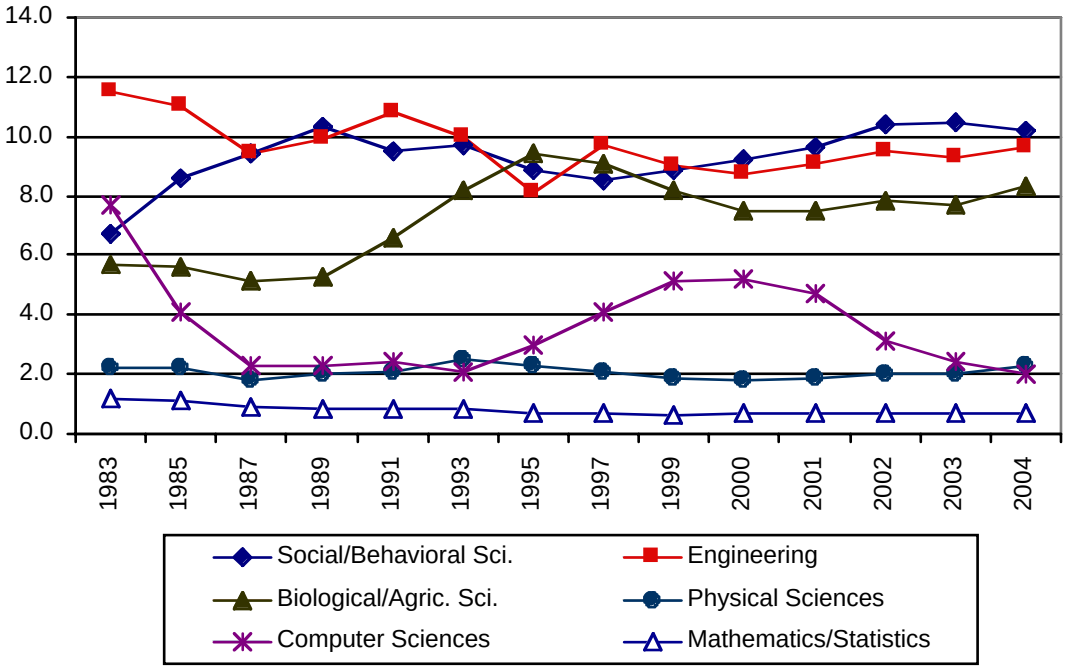
Critical stages of first and last years of degree

Undergraduate S&E Profile

Data Matters

Percentage of Freshmen Planning to Major in Science & Engineering, by Broad Field, Selected Years, 1983 to 2004

Freshmen interest in majoring in the physical sciences and mathematics/statistics has remained relatively constant over the past two decades, while interest in other fields, particularly the computer sciences, has fluctuated widely.



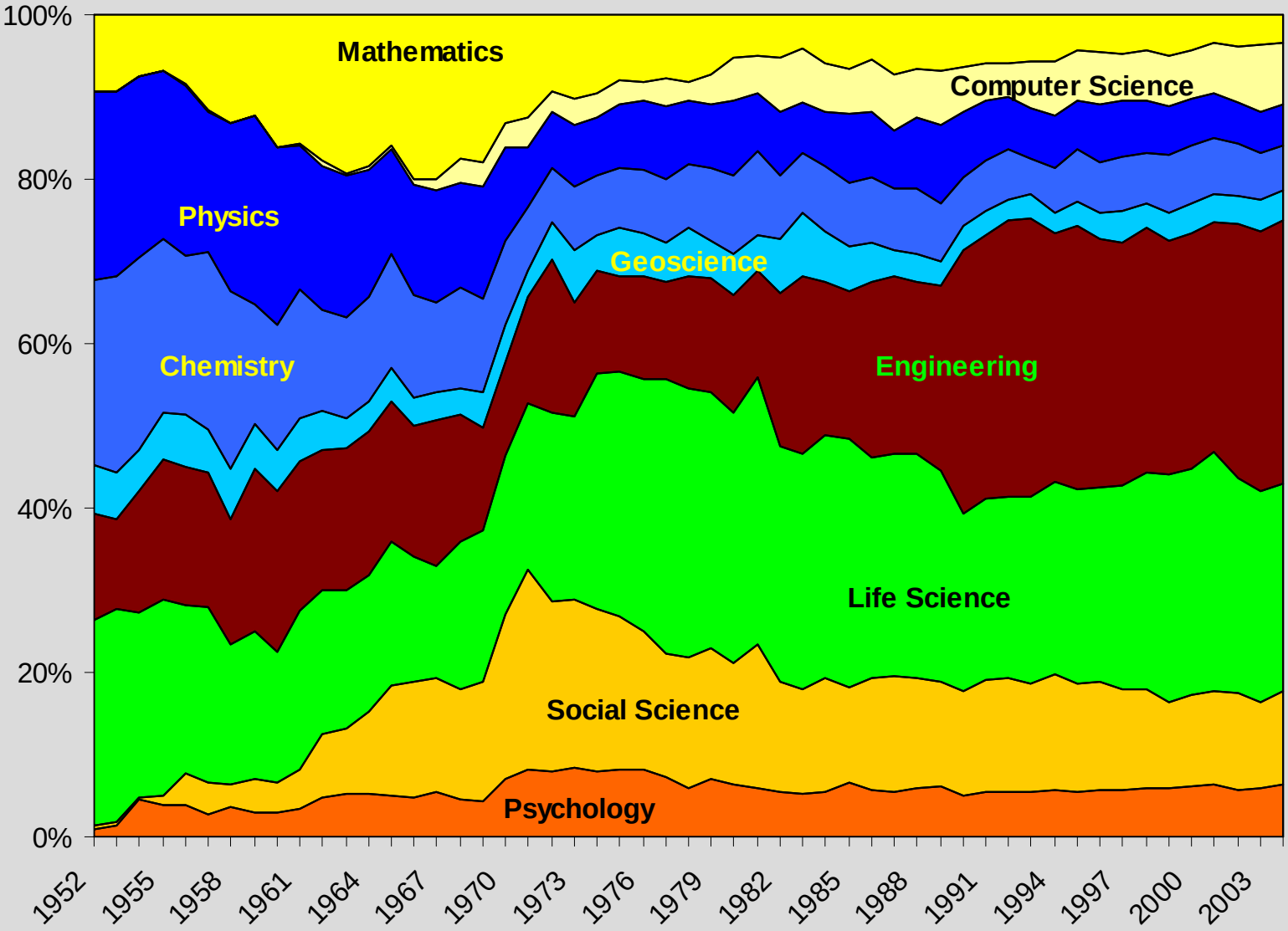
Source: CPST, data derived from National Science Foundation,*Science & Engineering Indicators* , based on data from the Higher Education Research Institute,*Survey of the American Freshman*

Some fields vary in numbers over time.

Many students change fields within the sciences.

Undergraduate research opportunities demonstrate possibilities.

NSF Graduate Research Fellowship - Disciplinary Profile



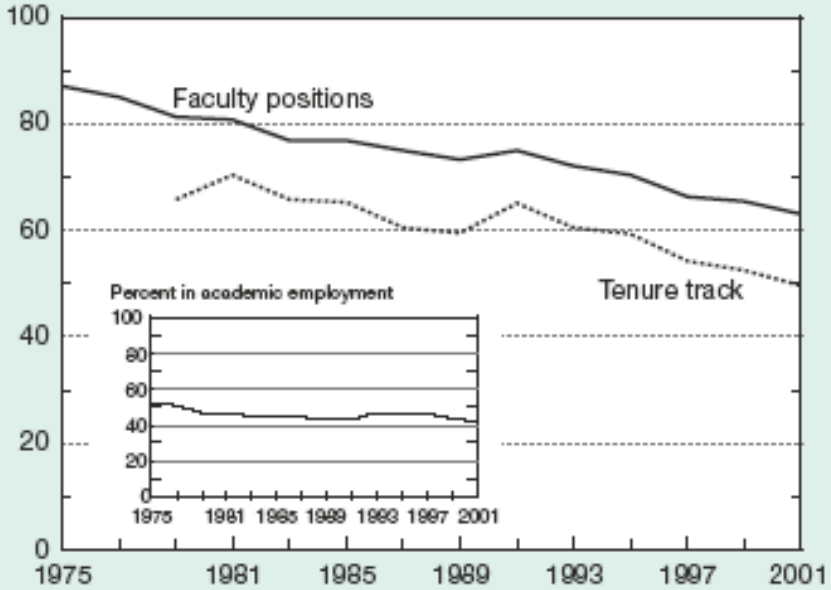
Agricultural Sciences in the 2009 GRFP Competition

FIELD	APPLICATIONS
Agriculture	12
Agronomy	4
Plant Physiology	51
Agricultural Ecology	1
Forestry	10
Horticulture	3
Other Agriculture	26
Plant Pathology	25
Soil Science	6
TOTAL "PLANT SCIENCE"	138
ALL	9012

One of 32 panels - only 1.5% of all applications. Other panels (e.g., Ecology, Physiology, Genetics, Environmental Biology) may have reviewed other "agricultural" applications but the majority are here.

Changes in the Professoriate

Figure O-29
Faculty and tenure-track status of young academic S&E doctorate holders: 1975–2001

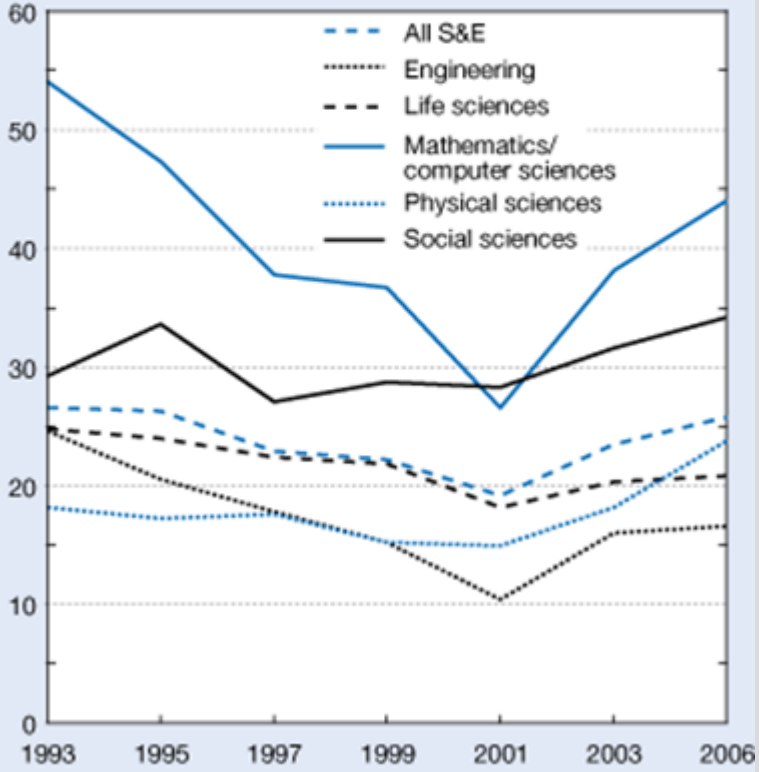


NOTE: Data are for individuals whose doctorates were earned 4–7 years earlier.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Doctorate Recipients, special tabulations.

Science & Engineering Indicators – 2004

Figure 3-33
Doctorate recipients holding tenure and tenure-track appointments at academic institutions 4–6 years after degree, by field: 1993–2006



S&E Indicators - 2006

Elements of 21st century STEM Graduate Education

Research is central to PhD education

Masters curricula more varied

Broader scientific training - fundamentals of science and discipline, interdisciplinary work, fieldwork, theory and application

“practical things” - communication, teamwork,, management, entrepreneurship, cross-cultural training, ethics, internships, other skill sets

Suggested Action Items

Recruit via undergraduate research activities

Encourage application to the GRFP

Consider traineeships through whatever mechanism

Explore all areas of NSF for support

Focus on graduate education, not “apprenticeship”
- provide for alternate career pathways

Is 30-40% PhD attrition a cost to graduate enterprise?