Rethinking Graduate Education for the 21st Century

Council of Graduate Schools Policy Forum
June 5, 2017

Never Discuss Floods With Noah In the Audience

- I'd like your input into a committee I'm chairing for the National Academies of Sciences, Engineering and Medicine

The National Academies of
SCIENCES • ENGINEERING • MEDICINE

Committee on Revitalizing Graduate STEM Education for the 21st Century

What's the issue?

- Over 60% of new Ph.D.'s do NOT go into academic research
  - But we train them the same way we have for 100 years

Doctorates in All SEH Fields in the workforce, 2013

5-9 years post-doctorate
70%
are engaged in R&D

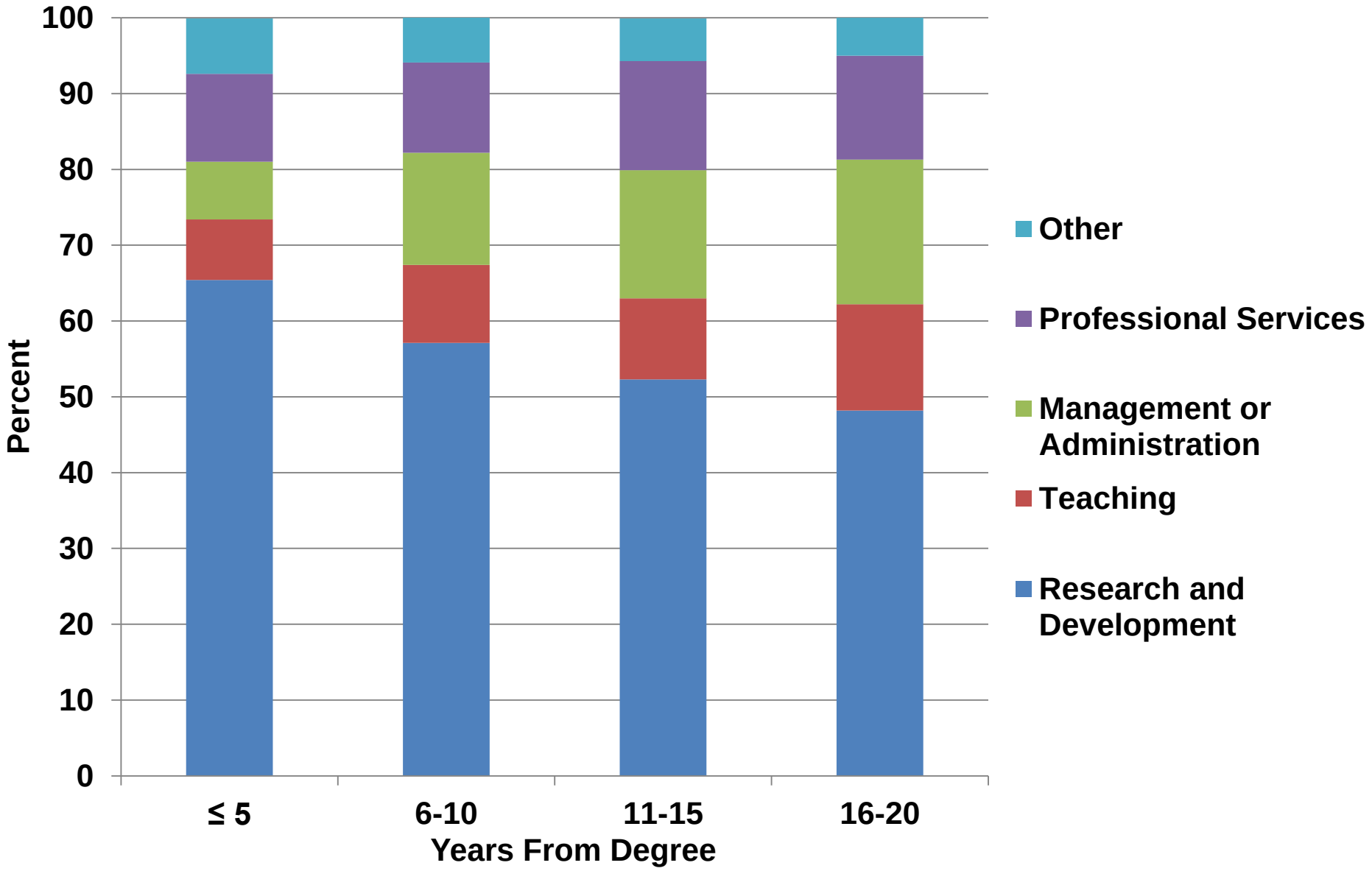
10-14 years post-doctorate
57%
are employed outside of 4-year academic institutions

15+ years post-doctorate
92%
are satisfied with their jobs across all employment sectors

Values are estimates and have associated standard errors. To directly compare two values, please see the downloadable data file for standard errors. Percentages may add up to > 100% due to rounding and the ability to select more than one answer. Data on job satisfaction and certain race and ethnicity categories were not collected on the 1993 survey. Some data may be suppressed due to data reliability or confidentiality concerns. Please see the About page for more information.

In some cases, non-numerical values are displayed due to data reliability, availability, or confidentiality concerns. Users should interpret non-numerical values as follows: * is where the value rounds to zero. **NA** is used when no information is available for that particular case. For example, the 1993 SDR did not ask respondents about Job Satisfaction. **S** is suppressed for reasons of confidentiality or reliability.

Work Activities of Former NRSA Trainees and Fellows with Biomedical Sciences Ph.D.s, 2013

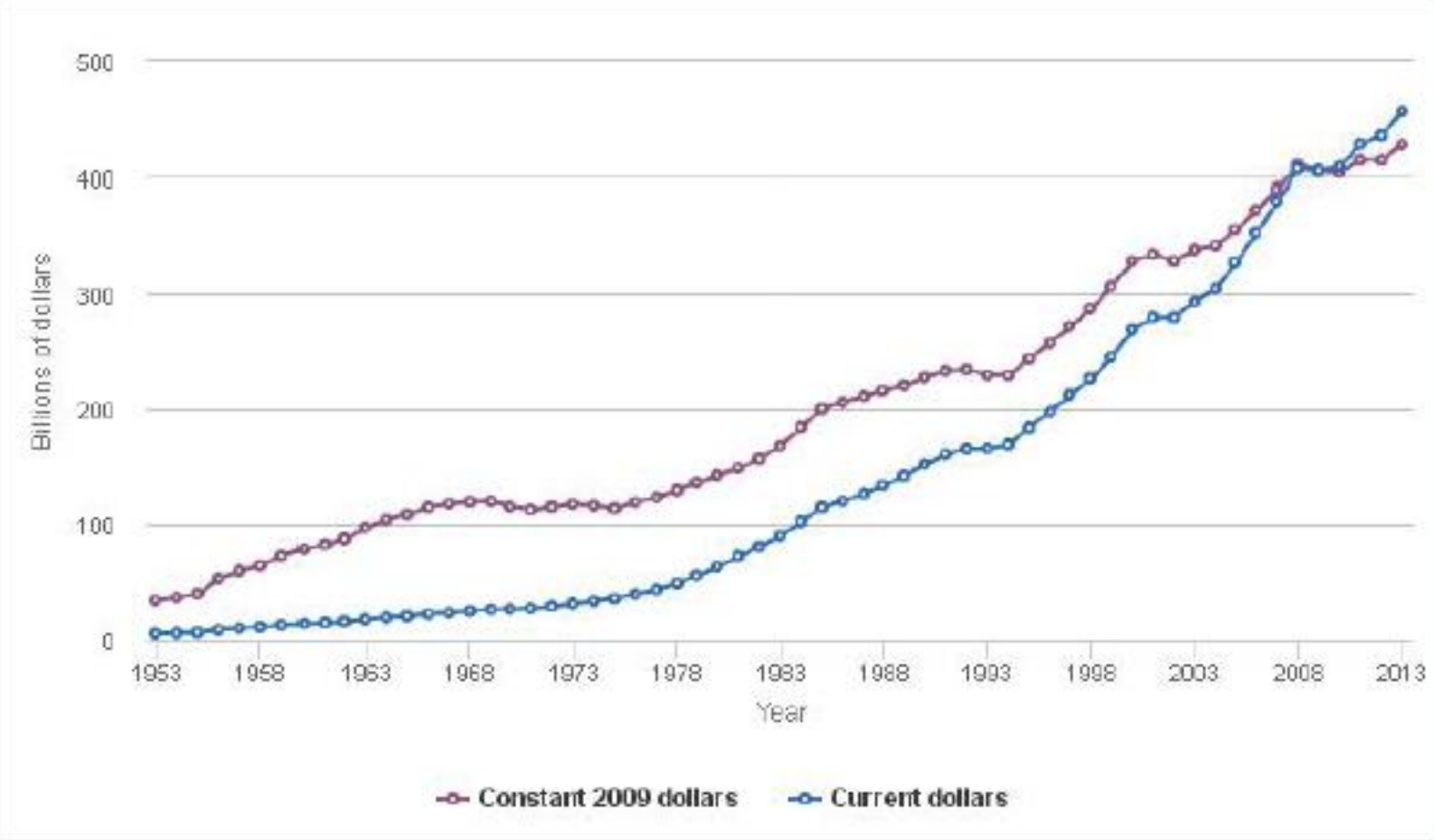


The world of science has changed substantially over the last 50-100 years

- The enterprise has grown tremendously
  - Funding

Figure 4-2

U.S. total R&D expenditures: 1953–2013



NOTE: Data for 2013 include some estimates and may later be revised.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, National Patterns of R&D Resources (annual series).

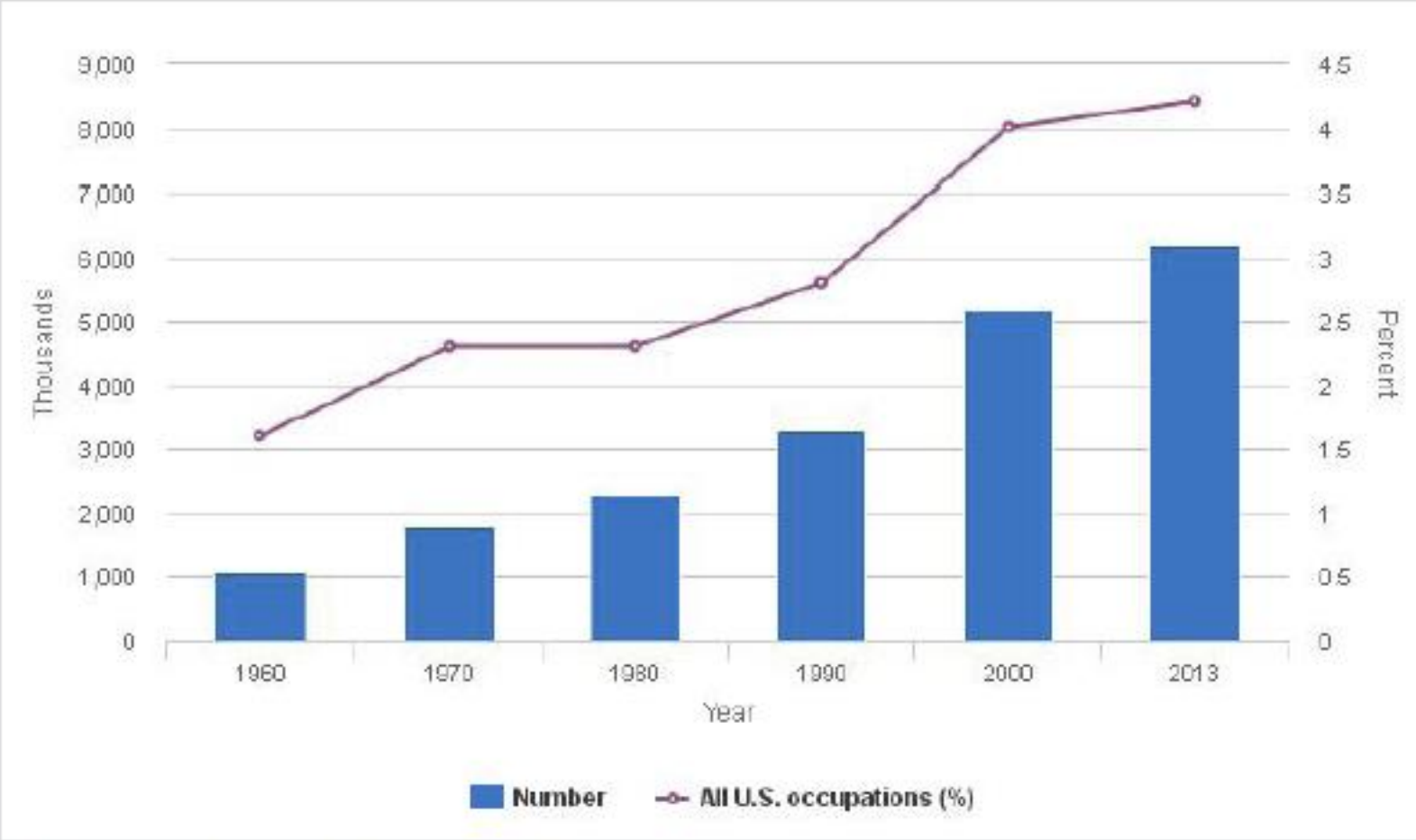
Science and Engineering Indicators 2016

The world of science has changed substantially over the last 50-100 years

- The enterprise has grown tremendously
  - Funding
  - The science and engineering workforce is growing

Figure 3-3

Individuals employed in S&E occupations in the United States: Selected years, 1960–2013

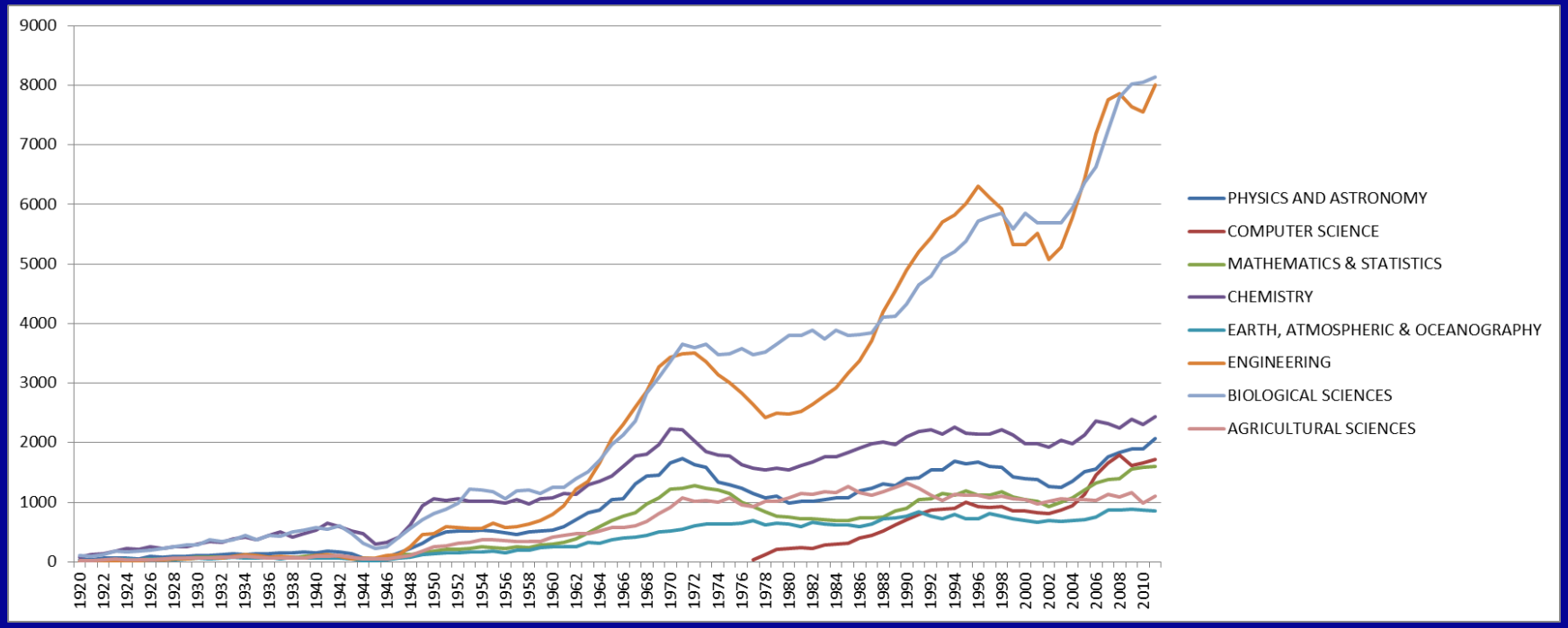


NOTE: Data include people at all education levels.

SOURCES: Census Bureau, Decennial Census (1960–2000) and American Community Survey (2013) microdata, downloaded from the Integrated Public Use Microdata Series (IPUMS), University of Minnesota (http://www.ipums.org).

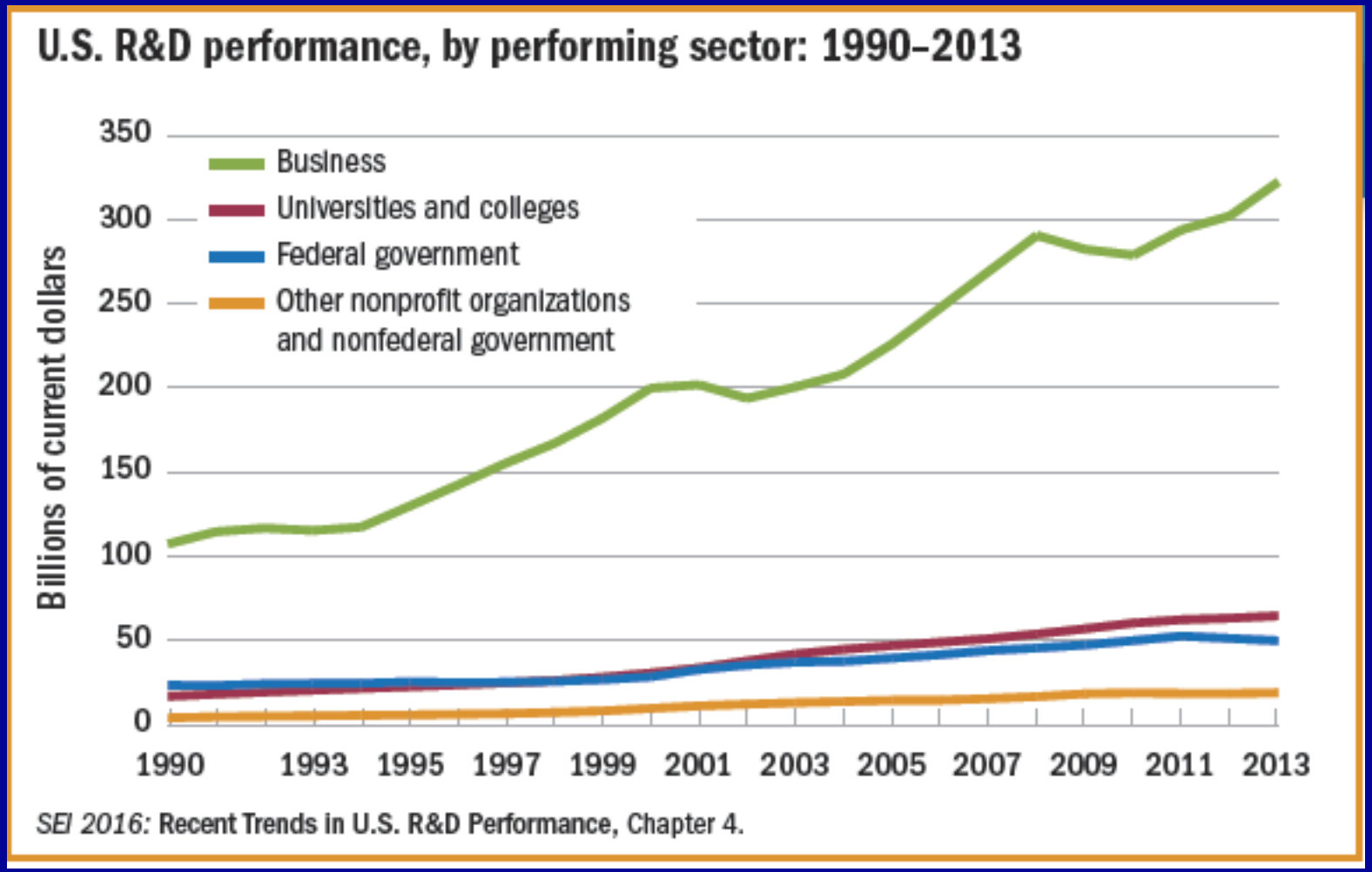
Science and Engineering Indicators 2016

PhD Production: 1920-2011



Compiled from administrative records and the SED

Research is being done in different settings


U.S. R&D performance, by performing sector: 1990–2013
Billions of current dollars
350
300
250
200
150
100
50
0
Business
Universities and colleges
Federal government
Other nonprofit organizations and nonfederal government
1990
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
SEI 2016: Recent Trends in U.S. R&D Performance, Chapter 4.

The nature of science has changed

- Science has become global
- Most problems are multi-disciplinary
- More and more scientists work in teams
- What makes a scientific career has changed
  - Variety has expanded greatly
  - Many are not linear

One likely will not follow a "traditional" route

- >60% of new Ph.D.'s go into non-academic careers
- Many people change jobs one or more times over their career

Current system works well for almost everyone

- Mentors/PIs
- Institutions
- Funding agencies

Except

- Some employers
- The STUDENTS

The Committee's task:

- A systems analysis of current state of graduate education and career paths
- Identify policies, programs and practices that could better meet the career needs of graduate students
- Identify strategies to improve the alignment of graduate education with the needs of prospective employers and students
- Identify possible changes to federal and state programs and funding priorities
- Identify how best to provide students and faculty with information about career paths
- Identify implications of the increasingly international nature of science
- Investigate the new models that are influencing graduate education

Committee Members

Chair: Alan I. Leshner
Chief Executive Officer Emeritus, AAAS

Sherilynn Black
Assistant Professor and Director of the Office of Biomedical Graduate Diversity
Duke University School of Medicine

Mary Sue Coleman
President
Association of American Universities (AAU)

Jaime Curtis-Fisk
STEM Program Leader and an R&D Scientist
Dow Chemical Company

Kenneth Gibbs, Jr.
Program Director
National Institute of General Medical Sciences

Maureen Grasso
Dean of the Graduate School
North Carolina State University

Sally Mason
President Emerita
University of Iowa

Mary Maxon
Biosciences Principal Deputy
Lawrence Berkeley National Laboratory

Suzanne Ortega
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Council of Graduate Schools

Christine Ortiz
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Henry Sauermann
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Scheller College of Business at the Georgia Institute of Technology

Barbara Anna Schaal
Dean of Arts and Sciences and Professor
Washington University in St. Louis

Subhash Singhal
Battelle Fellow and Fuel Cells Director
Pacific Northwest National Laboratory

Kate Stoll
Policy Advisor
MIT Washington

James M. Tien
Distinguished Professor and Dean Emeritus
University of Miami College of Engineering

Keith Yamamoto
Vice Chancellor for Science Policy & Strategy
Vice Dean for Research, School of Medicine
Professor of Cellular & Molecular Pharmacology
University of California, San Francisco

What do we hope to accomplish?

- Start a national conversation
- Distill overarching principles of where graduate education should be evolving
  - Without compromising what it means to be a Ph.D.
- Help figure out how to make changes in the system

What are we hearing?

- These are not our recommendations!!
  - They're things we're hearing

Deal with Master's degrees and Ph.D.'s separately

- Of all graduate students (non-health sciences)
  - > 75% master's
  - ~ 20% Ph.D.s
- Are typically very different curricula

Institutions should be transparent about career paths of their graduates

Engage a broader and more diverse cross section of population in STEM fields

Establish core competencies for master's and Ph.D.'s

Core competencies for all master's

- Disciplinary and interdisciplinary knowledge
- Professional competenceis
- Foundational and transferrable skills
  - E.g., communication
  - Leadership
  - Working in teams
- Research

Establish core competencies for all Ph.D.'s

- Add on other skills?
  - Required or optional?
- Expose to non-academic career options
  - Internships during Ph.D. training
  - Post-doc internships

Core competencies for all STEM Ph.D.'s

- Conduct of original research
- Broad science literacy
- Quantitative skills
- Science communication

Other skills needed for a STEM career:

- Research integrity
- Management and budgeting
- Working in teams
- Grant writing
- Communication with non-scientists

How to make change happen?

- Propagate model programs
- Incentives

Incentives

- How might the current incentive(s) system(s) for institutions, faculty and students be better aligned to the ways graduate education should evolve?
- Where are the most critical leverage points in the system?

Enough from me…

- What do you think?
- What are your experiences and ideas?