



*How Does Science Funding Affect
Career Pathways?
Developing a Research Agenda*

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The University of Kansas

Thank You to the Alfred P. Sloan Foundation

- The Alfred P. Sloan Foundation Funded three workshops:
 - Investments in Early Career Scientists: Research and Data Gaps.
 - Early Career Scientists: The Impact of Graduate Training and Postdoctoral Research on Career Outcomes.
 - How Does Research Funding Affect Career Outcomes?
- Our goal is to strengthen ties with the Research on Research Institute (RoRI).



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To the support the Research on Research (RoR) field, Wellcome Trust, Digital Science and the Universities of Sheffield and Leiden have joined forces to establish the Research on Research Institute (RoRI), and to build an international consortium of funders, academics and technologists committed to transformative & translational RoR.

RoRI includes 21 partners, drawn from 13 countries or regions.



RoRI Goals

- To Expand Research on Research (RoR)
- Connect academic RoR capabilities to the data and analytical resources of Wellcome, Digital Science and our other strategic partners
- To experiment, coproduce and test new tools, indicators, funding modes and evaluation frameworks
- To critically evaluate RoR methods and support engagement with RoR data and evidence by decision makers and wider society
- To create an independent space for RoR learning, networking and collaboration between researchers, policymakers, funders & technologists

The National Bureau of Economic Research

National Bureau of Economic Research

Conducting and disseminating non-partisan economic research

- NBER affiliated researchers have the research interests and methodological capabilities to further the goals of Research on Research.



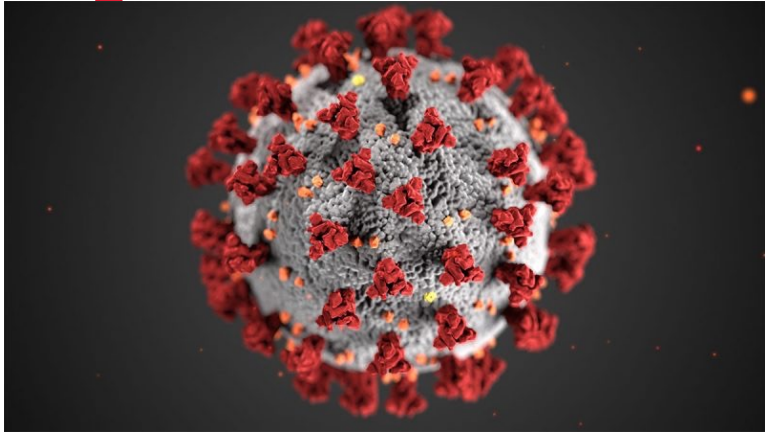
Developing A Research Agenda
on Career Pathways:
Research and Data Gaps on
Early Career Scientists

The National Institutes of Health



- NIH is the largest science funding agency in the world
- FY2020 Budget – \$42 billion
- 21 Separate Institutes focused on different aspects of health. (e.g. NCI, NICHD, NIGMS). Each is a separate line item in the federal budget.
- 80% of budget funds 50,000 competitive grants to 2,500 universities

Scientific Funding of Basic Research Resulted in COVID Vaccines



Basic research conducted by Graham and others at the National Institutes of Health (NIH), Defense Department and **federally funded academic laboratories** has been the essential ingredient in the rapid development of vaccines in response to COVID-19.

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MEDICINE

For Billion-Dollar COVID Vaccines, Basic Government-Funded Science Laid the Groundwork

Much of the pioneering work on mRNA vaccines was done with government money, though drugmakers could walk away with big profits

By Arthur Allen, Kaiser Health News on November 18, 2020

Source: Scientific American, November 18, 2020

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Funding Also Shapes Scientific Careers

- Science funding subsidizes graduate students, postdoctoral researchers, staff scientists, and principal investigators.
- In US medical schools, over one-third of faculty salaries are derived from research grants as of 2009.
- How does research funding (or lack of it) affect early career scientists?
 - In graduate school and the postdoc?

The Scientific Workforce is Complicated

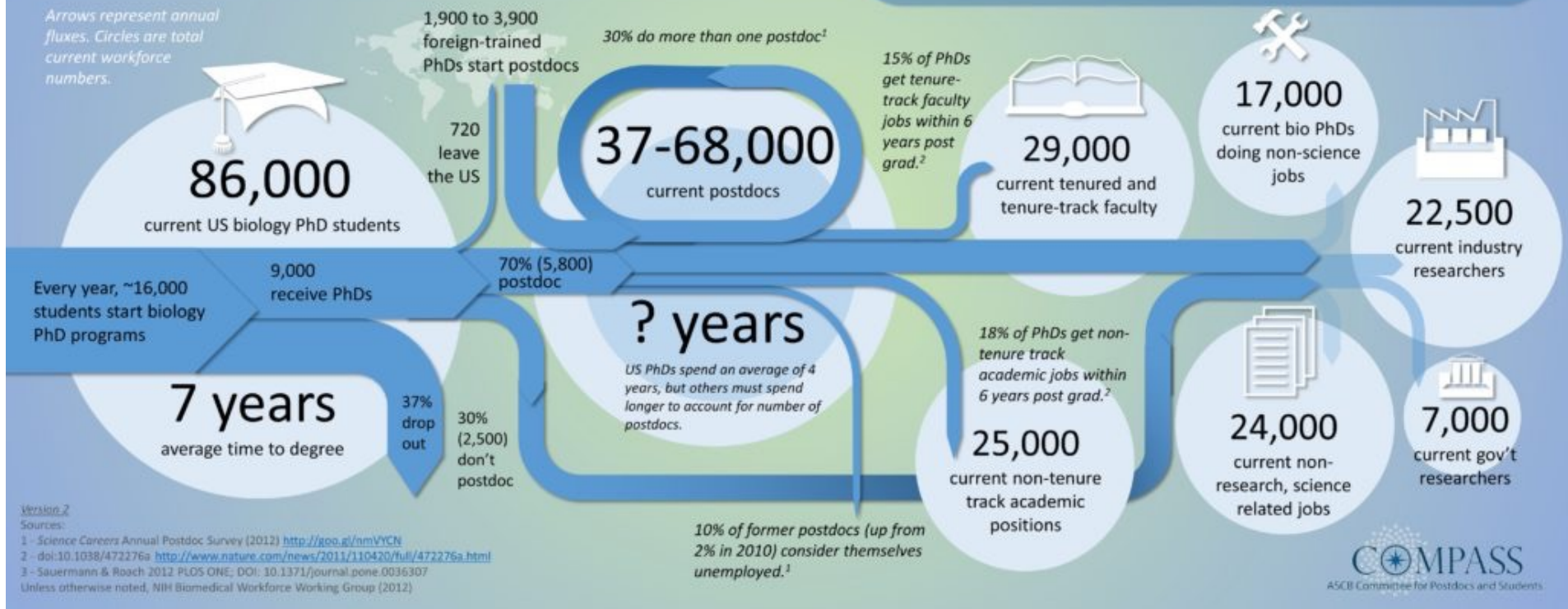
Where will a biology PhD take you?

Arrows represent annual fluxes. Circles are total current workforce numbers.

A faculty job is an "alternative" career.



At this rate, <10% of entering PhD students will become tenure-track faculty. Yet, 53% rank research professorships as their most desired career.³



Version 2

Sources:

1 - Science Careers Annual Postdoc Survey (2012) <http://goo.gl/nmVYCN>

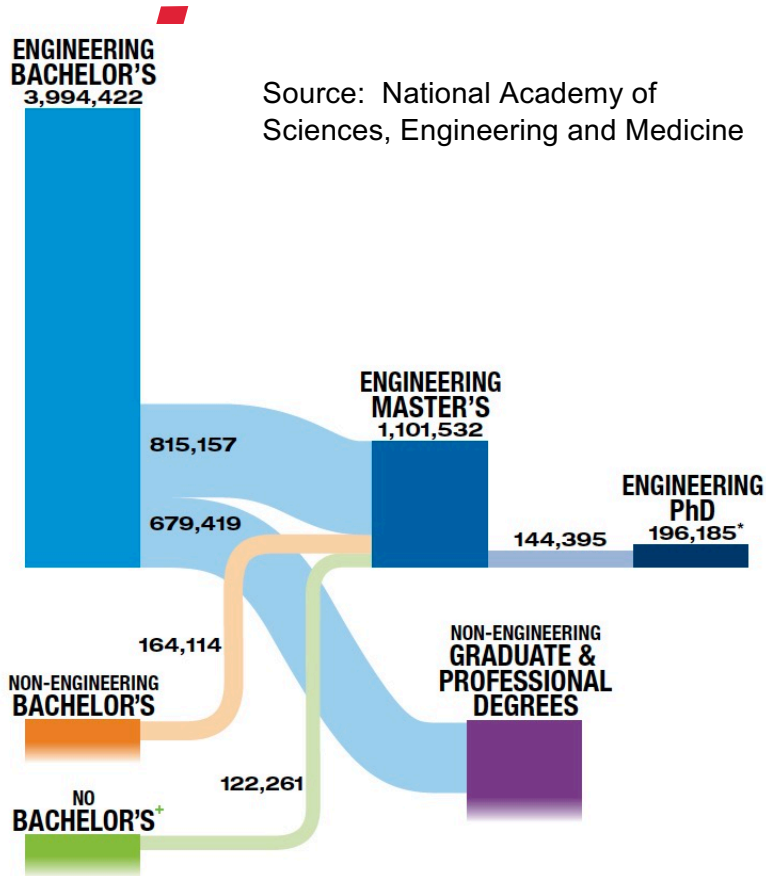
2 - doi:10.1038/472276a <http://www.nature.com/news/2011/110420/full/472276a.html>

3 - Sauermann & Roach 2012 PLOS ONE; DOI: 10.1371/journal.pone.0036307

Unless otherwise noted, NIH Biomedical Workforce Working Group (2012)

Engineering Looks Different

Source: National Academy of Sciences, Engineering and Medicine



- Each field of science is a different labor market.
- Engineering has shorter postdoctoral appointments and much higher salaries than in biomedical fields.
- Scientific training and science labor markets also differ across countries.

* This figure shows the advanced educational pathways of BS engineering graduates and the pathways to advanced engineering education of students lacking a BS engineering degree as measured in 2013 by the National Survey of College Graduates.

⁺ This number includes those who earned an engineering PhD via a less common degree pathway: straight from a BS in engineering; combined with a non-engineering degree at the bachelor's, master's, or PhD level; or with no reported bachelor's degree.

This group may be explained as a measurement error due in part to the complexity of collecting an individual's complete degree history, but it may also include those who do not in fact hold a bachelor's degree, such as people who have worked in occupations in or related to engineering and then pursued a master's in engineering from a program that does not require a bachelor's degree, or people working in the US who received an engineering education in Europe where a bachelor's degree equivalent does not exist and their degree is most similar to a master's degree in the US.



There are Data Gaps in Tracking the Scientific Workforce

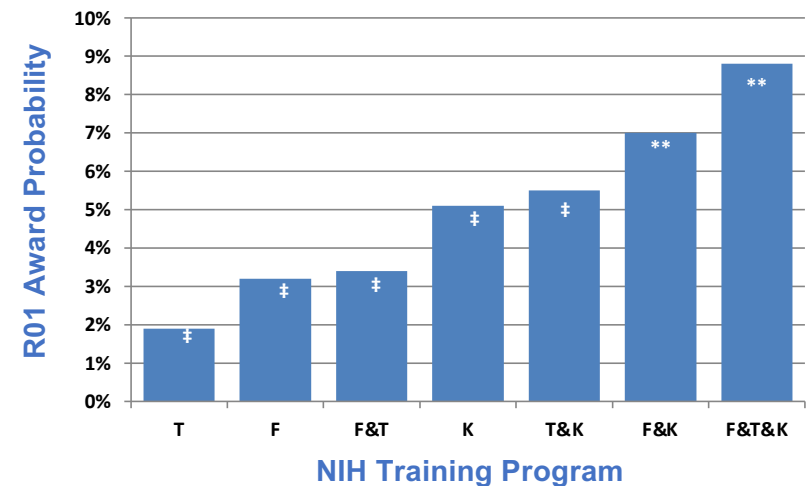
US Survey Data to Study Scientists

- No perfect data exists to study postdocs
- NSF's Survey of Earned Doctorates: Census of all US doctorates
 - Postdoc intentions
- NSF's Survey of Doctorate Recipients: biennial survey based on SED.
 - Longitudinal sample was significantly diminished in a sample redesign
- NSF's Early Career Doctorates Survey
 - A potential new source for research on postdocs

Administrative Data to Study Careers

- More challenging to use but offers important insights.
- IRIS—Institute for Research on Innovation & Science, University of Michigan has administrative data on grants, students and postdocs from 26 universities.
- NIH administrative data--IMPAC II is linked to the SED

Impact of Multiple NIH Training Programs on R01 Award Probability: 2000-2006



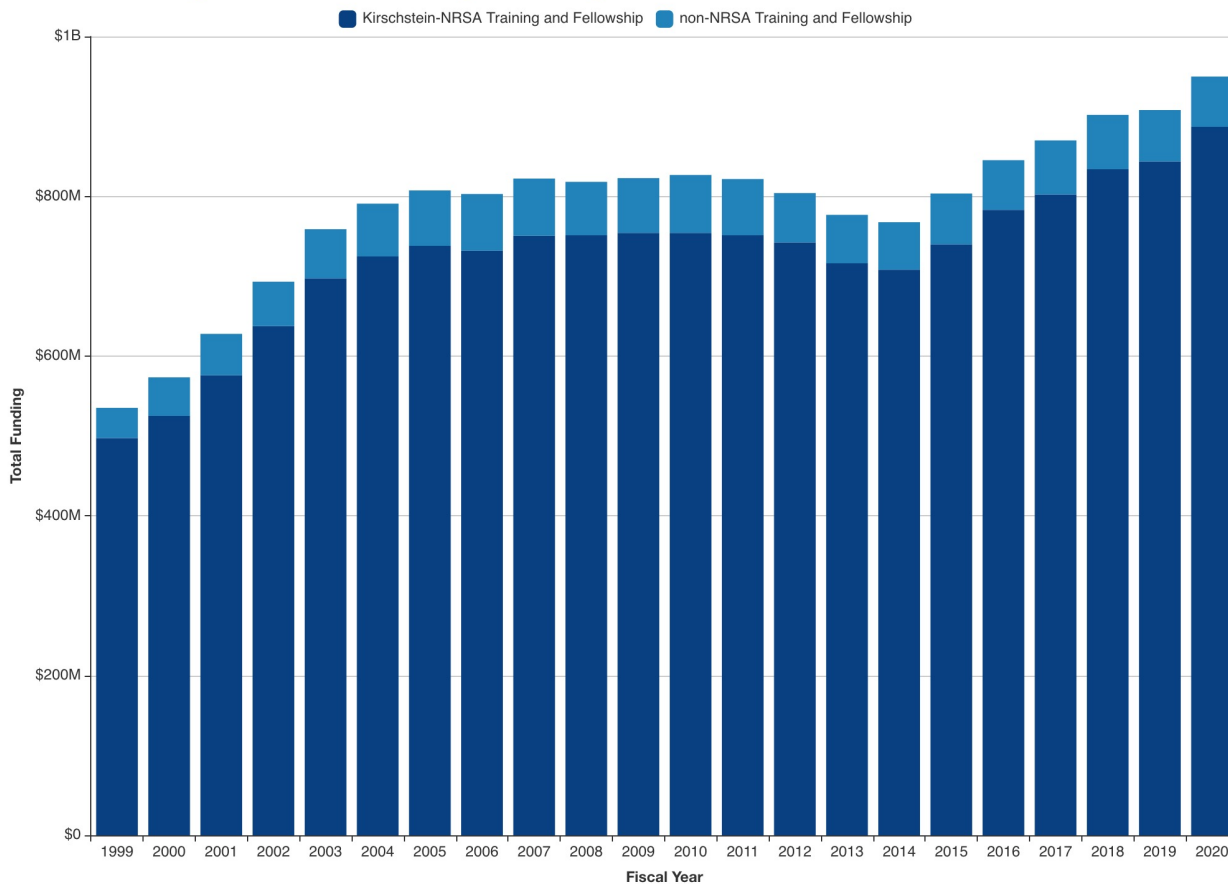
Analysis from Ginther et al (2011): Race, Ethnicity & NIH Research Awards. *Science*.



Funding Affects Training and Careers: A Case Study of NIH

Follow the Money: NIH Training

Research Training Grants and Fellowships: Funding of Kirschstein-NRSA and Non-NRSA Awards



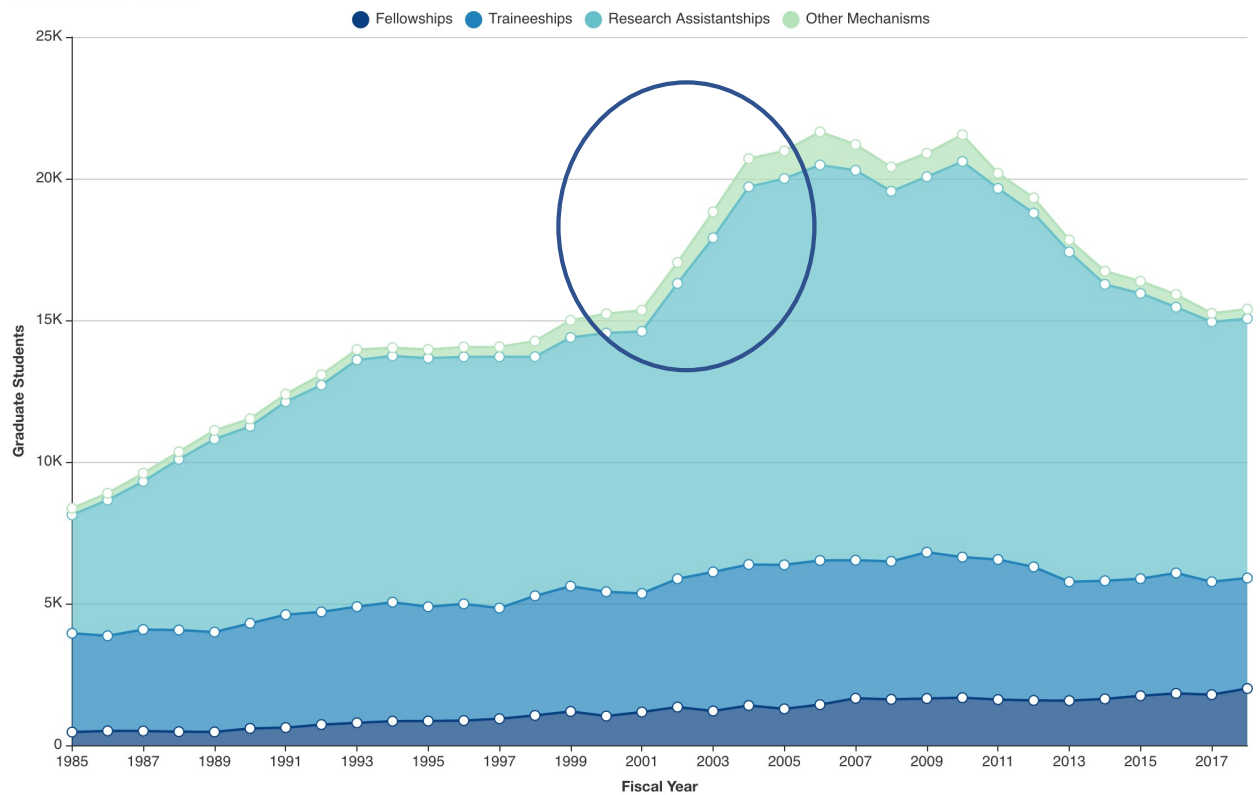
Data for this report are available at NIH Data Book - <https://report.nih.gov/nihdatabook/report/49>

- NIH spent \$887 million dollars in research training for graduate students and postdocs in FY 2020.
- Source: NIH Data Book
- <https://report.nih.gov/nihdatabook/report/49>

Follow the Money: Graduate Students

National Statistics: Primary Mechanisms of National Institutes of Health (NIH) Support for Full-Time Graduate Students

All Fields of Study

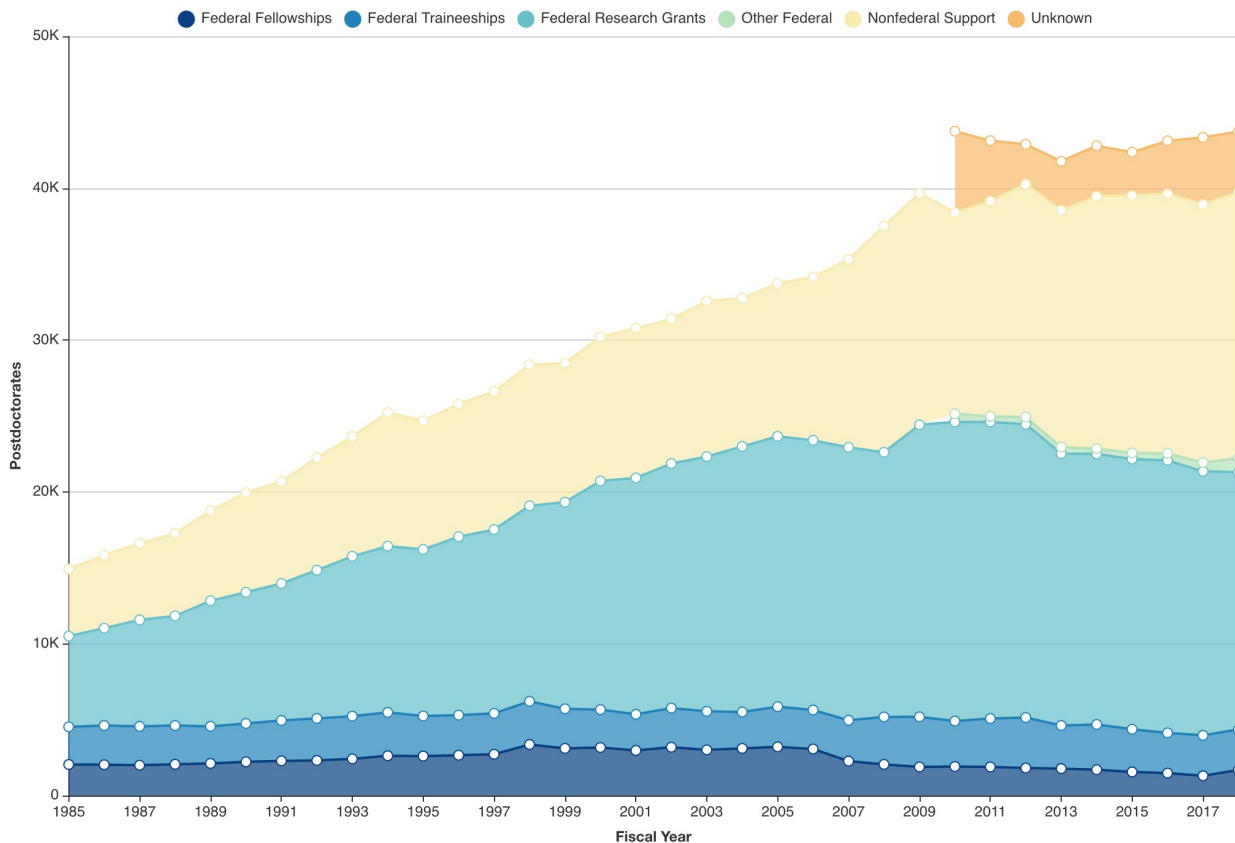


Data for this report are available at NIH Data Book - <https://report.nih.gov/nihdatabook/report/243>

- During the NIH Doubling, more graduate students were funded.
- By 2018:
 - Two-thirds were research assistants on grants.
 - One-third were trainees or fellows.

Follow the Money: Postdocs

National Statistics: Primary Source of Support for Postdoctorates All Fields of Study



Data for this report are available at NIH Data Book - <https://report.nih.gov/nihdatabook/report/263>

- Only 1600 postdocs were trainees or fellows in 2018
- In 2009 there over 39,672 postdocs
 - The majority--19,231 working on research grants

How Many Postdocs Are There?

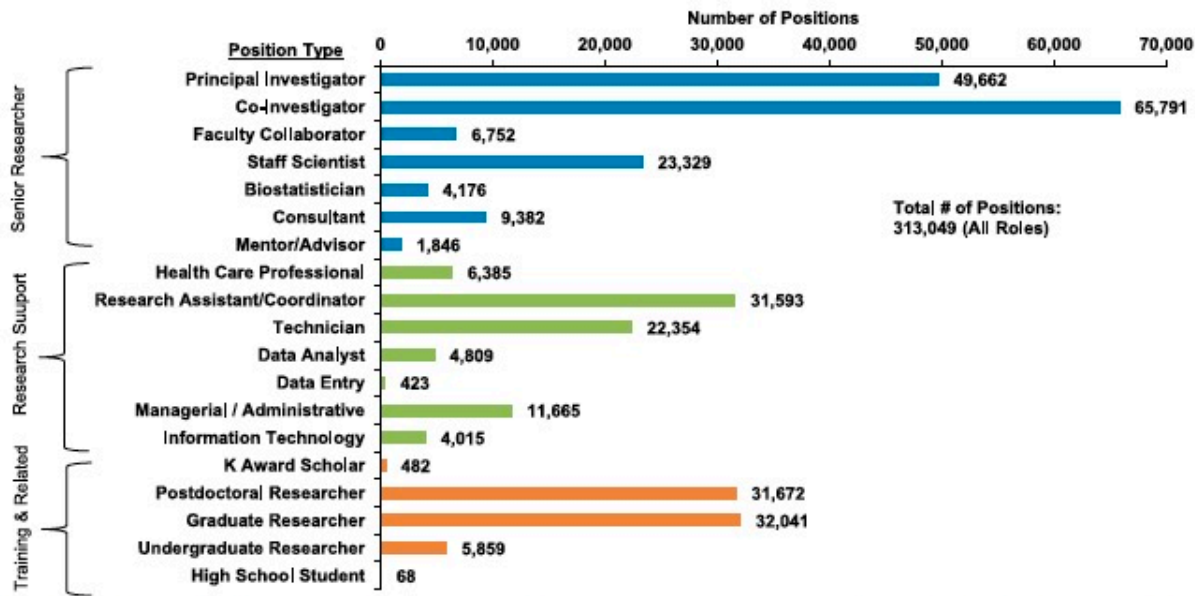


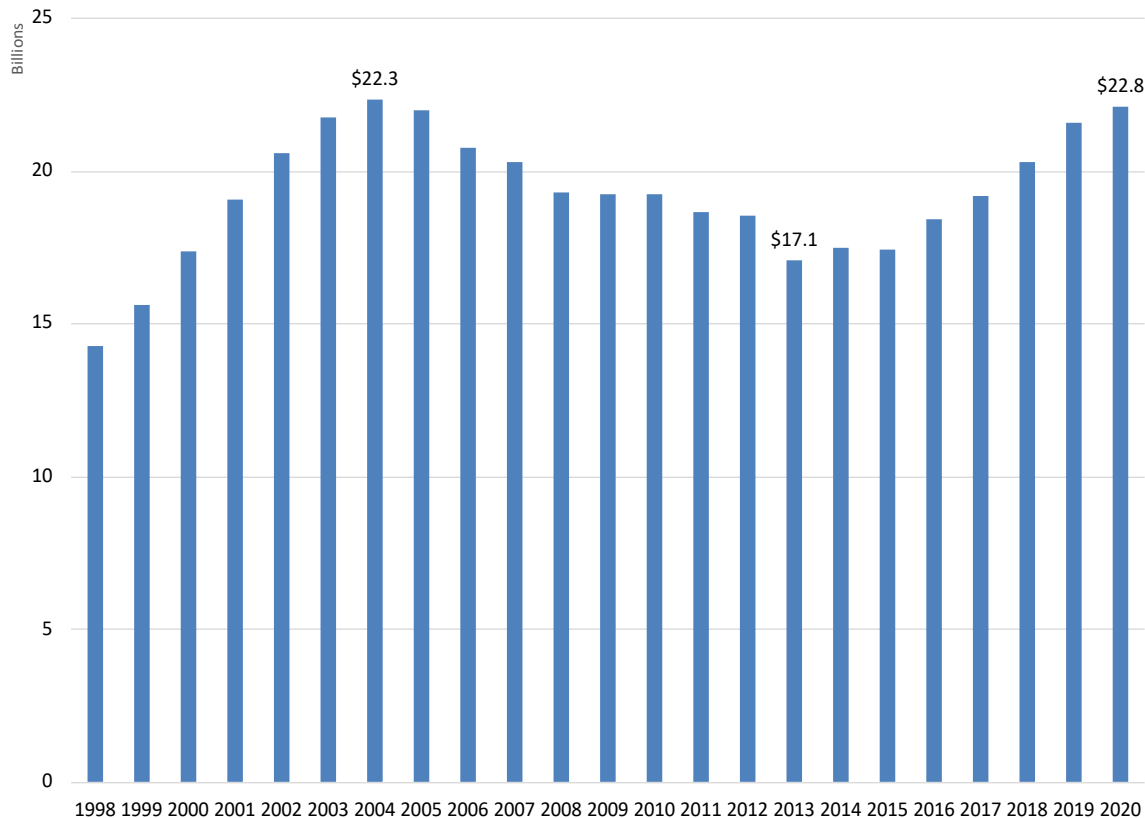
Figure 1. Number of FY 2009 extramural grant positions by position type. PI position type includes MPIs officially indicated on an NIH Grant Application. Excludes positions funded through the ARRA.

- In 2009 an NIH Census of Extramural Research Projects identified
 - 32,000 postdocs on grants NIH grants alone.
 - We do not know how many postdocs work in the US.

Pool et al, 2016 FASEB Journal

NIH Has Experienced Booms and Busts

NIH Funding for Research Project Grants, 2019 Billions of Dollars

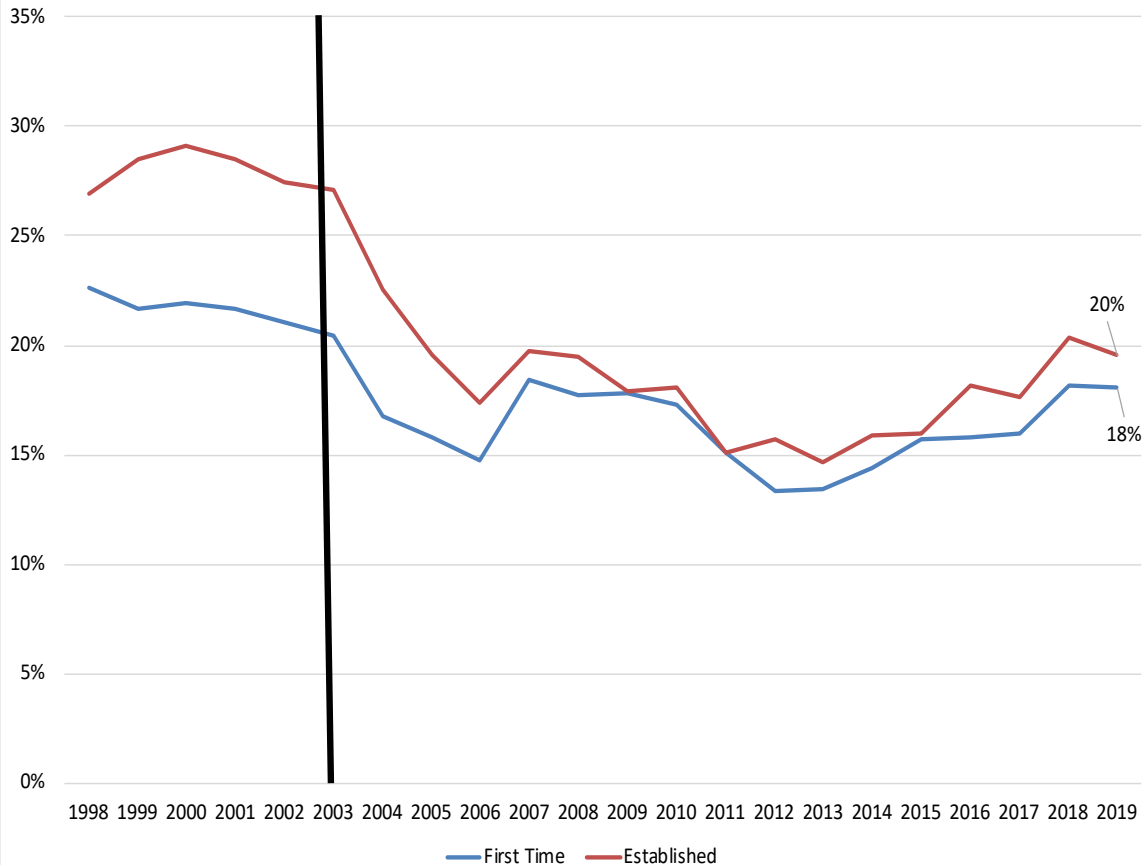


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- The NIH Budget Doubled between 1998-2003.
 - That money went into Research Project Grants.
- However, it fell in real terms for the next decade.
- In FY 2020, the NIH budget reached the FY 2004 level.

Connecting Funding to Careers is Challenging

NIH Type 1 R01 Success Rates by Investigator Status



- When NIH Doubled the budget between 1998-2003, established investigators benefited more than first-time investigators.
- Aggregate data tell us about trends, but individual-level data can tell us a lot more.

Connecting Funding to Careers is Challenging

- Longitudinal data on graduate training, postdoc appointment, and career outcomes including:
 - Employment Sector, research funding, publications, lab size, etc
- Economists are very interested in the causal effect of funding
 - Ideally, we would observe applications for funding and those who received funding.
 - By comparing outcomes of those who did and did not get funded we can identify the causal effect of funding on careers.

Research Agenda for Studying Early Career Scientists

- Does Postdoctoral Training Raise the Likelihood of a scientific research career?
 - So far, the answer is yes.
- What determines the length and compensation structure of postdoctoral training?
 - What determines postdoc pay?
 - What is the impact of postdoc pay on demand for postdocs?
- How do postdocs contribute to the research & development system?
 - Do institutions with more postdocs receive more R&D funding?
- What is the effect of team size on science careers and scientific discovery?

Research Agenda for Studying Postdocs

- How do different types of postdoc funding affect career outcomes?
 - Does working on a PI's project have the same career impact as an F32 fellowship?
- How do postdocs compare across fields? Across countries?
 - Most research on postdocs have focused on biomedicine. However, each science field is a very different market.
- What role, if any, does the postdoc play in promoting diversity in science?
 - My research and that of Hamilton & Ley (2008) shows that women leave science during the postdoc. Is this still the case?
 - How does the postdoc affect underrepresented minority science careers?

Overview of Today's Conference

- Keynote Address: Paula Stephan--The Economics of the Postdoc
- Research on Early Career Scientists:
 - The Impact of NIH Postdoctoral Fellowships on a Future Independent Career in Federally Funded Biomedical Research
 - Publish and Train or Perish? Valuing the Early Career Outcomes of STEM Ph.D. Recipients
 - The Color of Money: Federal vs. Industry Funding of University Research

Overview of Today's Conference

- Data Gaps in Studying Early Career Scientists
 - Jaquilina Falkenheim—National Science Foundation
 - Jason Owen-Smith—Institute for Research on Innovation & Science, University of Michigan
 - Anne-Marie Coriat--Head of UK and Europe Research Landscape, Wellcome Trust

Paula Stephan

- Paula Stephan is professor of economics, Georgia State University and a research associate, National Bureau of Economic Research. Her research focuses on the economics of science and the careers of scientists and engineers. Author of *How Economics Shapes Science*, she has served on the National Academies Committee on the Next Generation of Researchers. She is a Fellow of the American Association for the Advancement of Science and member of the Board of Reviewing Editors, *Science*. She was named *ScienceCareers*' first Person of the Year in 2012. Stephan was a Phi Beta Kappa Visiting Scholar for the 2018-2019 academic year.



Thank You!

Thank You *Mahalo*
Kiitos
Tack
Grazie **Thanks**
Toda
Obrigado
Takk **Gracias** *Merci*
Danke