National Institute of General Medical Sciences

Catalyzing the Modernization of Graduate Biomedical Training

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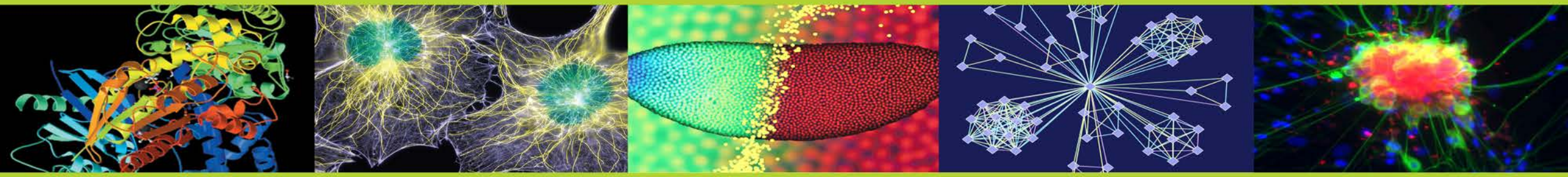


Biomedical Graduate Training: Calls for Revolution

EDITORIAL

Rethinking graduate education

All available evidence suggests that over 60% of new Ph.D.s in science in the United States will not have careers in academic research, yet graduate training in science has followed the same basic format for almost 100 years, heavily focused on producing academic researchers. Given that so many students will not join that community, the system is failing to meet the needs of the majority of its students.

Many academic, governmental, and professional leaders and organizations have lamented this disconnect and have suggested worthwhile adjustments, but most of these have been minor changes in graduate course offerings. It is time for the scientific and education communities to take a more fundamental look at how graduate education in science is structured and consider, given the current environment, whether a major reconfiguration of the entire system is needed.

"...a major reconfiguration of the entire system is needed."

Some relatively new government programs and curriculum supplements are positive steps that are likely to give students greater career flexibility. For example, the Strengthening the Biomedical Research Workforce Program from the U.S. National Institutes of Health supports innovative approaches to help biomedical graduate training better reflect the range of career options that students might pursue. Individual institutions are also working on the problem. As one example, the Massachusetts Institute of Technology offers a Global Entrepreneurship Bootcamp to help students learn innovation-driven entrepreneurship through hands-on learning experiences with successful entrepreneurs. However, these efforts are limited in scope and primarily take the form of adding offerings to an already overcrowded curriculum. What is needed is a fundamental system analysis and reconfiguration that results in graduate training programs that are better designed to meet the diverse career needs of today's students. One of the last system-level reviews was in 1995, when the U.S. National Academies' Committee on Science, Engineering, and Public Policy published a report* calling for a reshaping of graduate education to reflect the evolution of careers in science and science-dependent fields. Some experiments and much discussion, but not much real progress, ensued. It is time to do that scale of analysis again and include an action plan for making the recommended changes.

Making such fundamental change may encounter substantial resistance. After all, the current system does produce first-rate academic scientists and does meet the needs of faculty who depend on graduate students as research assistants. The system also works for the very best graduate students at the top research universities, whose career paths often do point toward academia. Indeed, because the current approach has generated one of the strongest academic scientific enterprises in the world, there will be understandable reluctance to tinker with success. "Do no harm while doing good" will have to be a mantra of any system redesign.

This scale of change has been tackled before, with substantial success, in related fields. The U.S. National Academy of Engineering's Educating the Engineer of 2020 project recommended dramatic changes in undergraduate engineering education, many of which have been implemented. The Vision and Change in Undergraduate Biology Education project organized by the U.S. National Science Foundation and the American Association for the Advancement of Science, and involving a large number of other scientific organizations, has similarly been directed toward major changes in the way biology is taught to undergraduate students, and many other initiatives are under way. The experiences of both projects are cause for optimism.

Leaders from the scientific, academic, industry, and government communities will have to work together to mount a project of this scope, develop an action plan, and monitor its progress. No group can do it alone. The benefits for the science students of the future will be well worth the collective effort.

– Alan I. Leshner

Alan I. Leshner is Chief Executive Officer, Emeritus, of the American Association for the Advancement of Science and former Executive Publisher of Science. *E-mail: alan.i.leshner@gmail.com*

WORLD VIEW *A personal take on events*

Reform the PhD system or close it down

MOST **DOCTORAL PROGRAMMES** CONFORM TO A MODEL DEFINED IN THE **MIDDLE AGES.**

Fix the PhD

No longer a guaranteed ticket to an academic career, the PhD system needs a serious rethink.

Future Of Bioscience Graduate And Postdoctoral Training Conference, Part 2

"Substantial changes in graduate education are recommended—not because the previous approaches were wrong—but because the technological leaders of this century must have skills crafted to meet its demands."

ADVANCING GRADUATE EDUCATION *IN THE* CHEMICAL SCIENCES

Summary Report of an ACS Presidential Commission

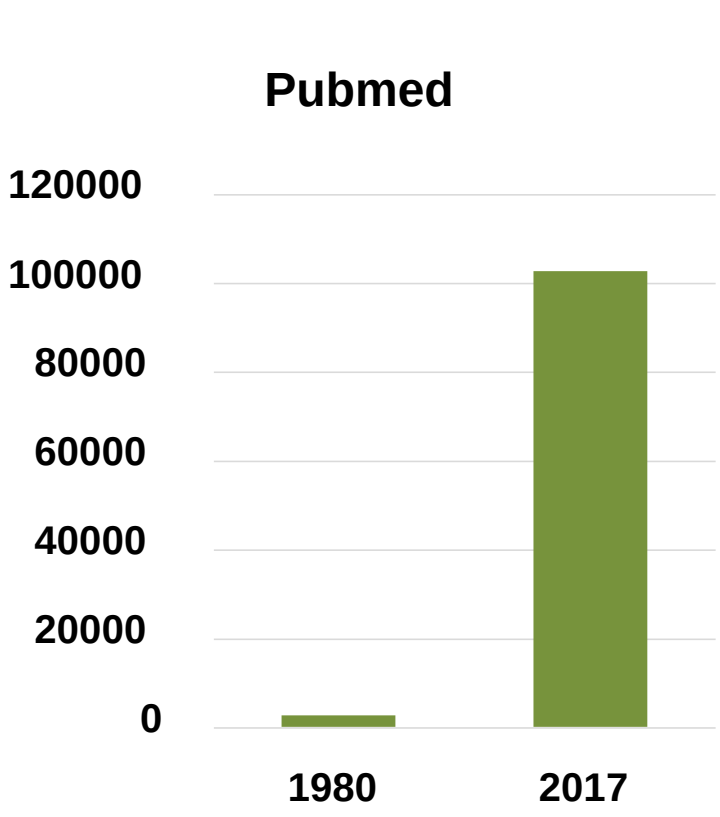
Submitted to ACS President Bassam Z. Shakhashiri on December 3, 2012

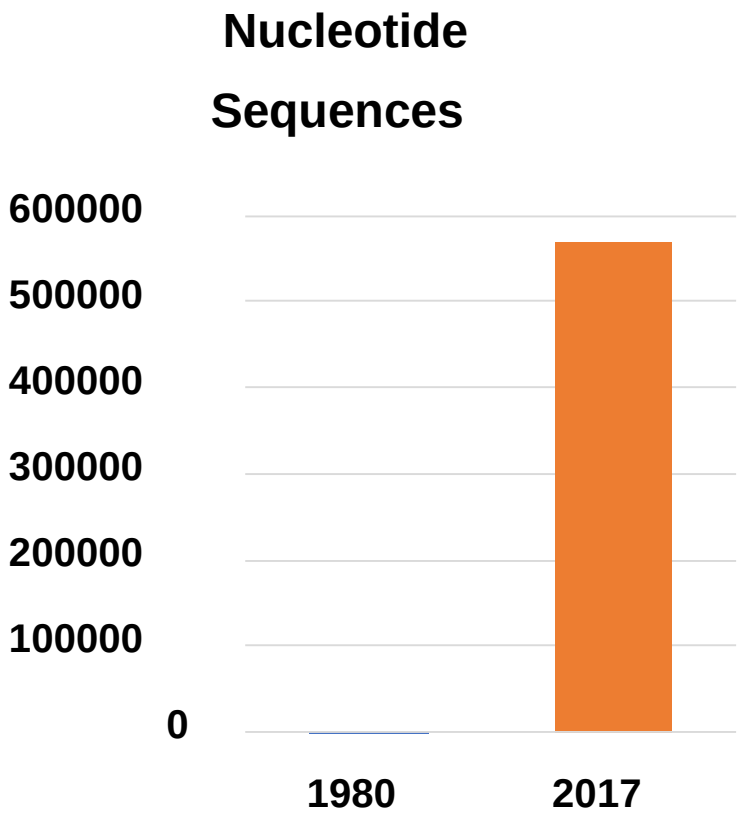
ACS Chemistry for Life®
AMERICAN CHEMICAL SOCIETY

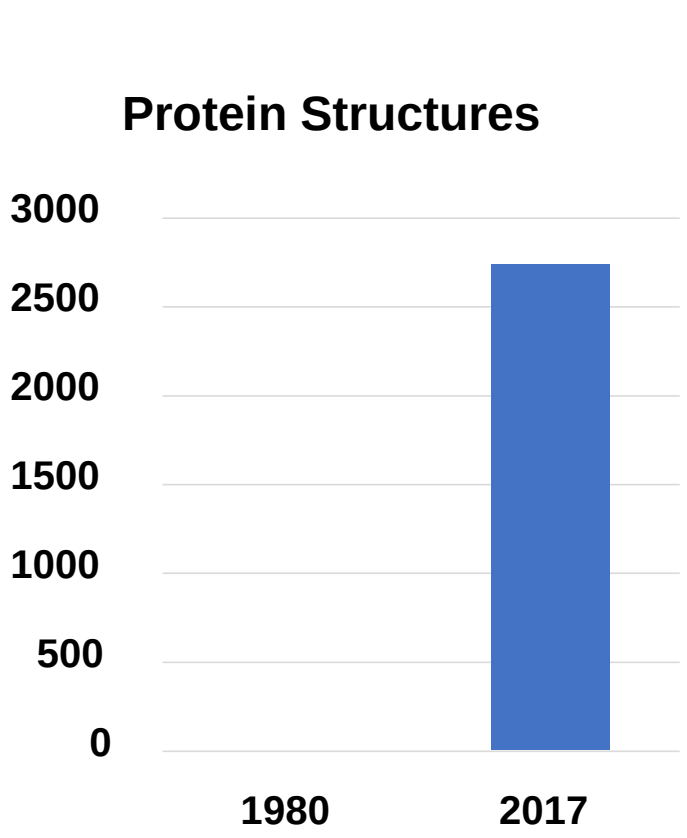
What are some of the major issues in training?

Biomedical science has changed significantly over the past decades – graduate education needs to keep up

It was easier to "know everything" there was to know about ACTIN in 1980





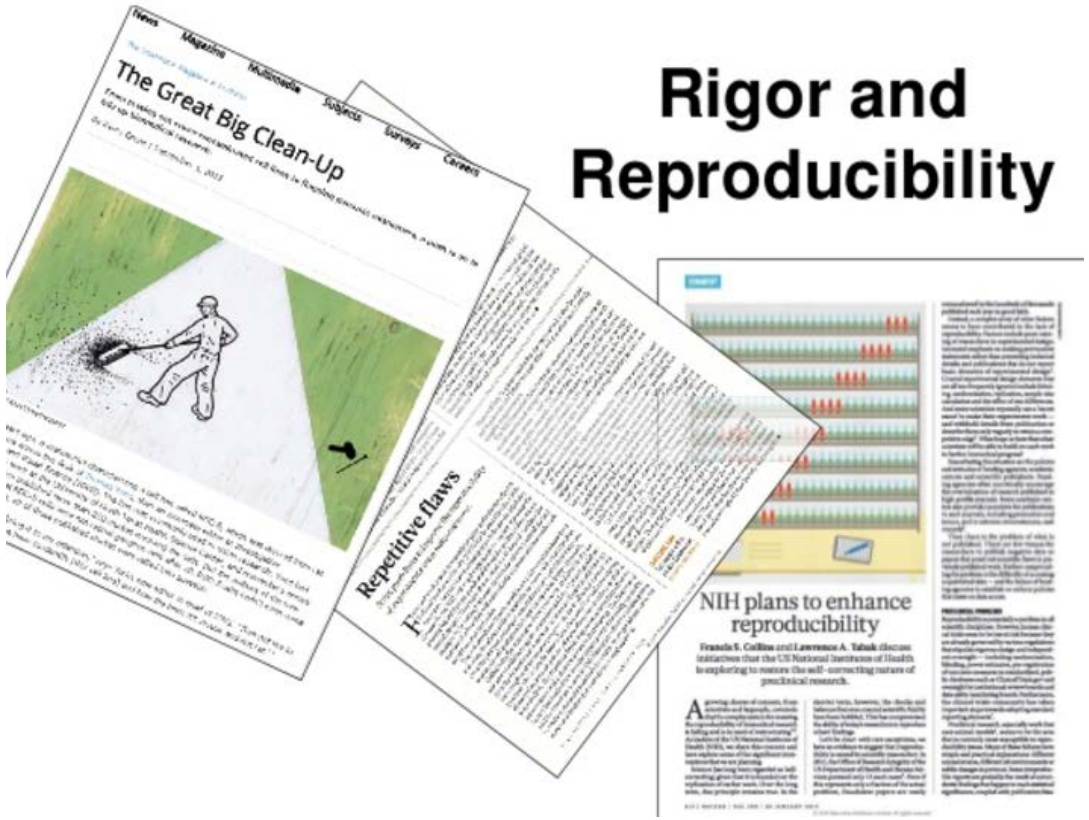


“Reproducibility” is a problem

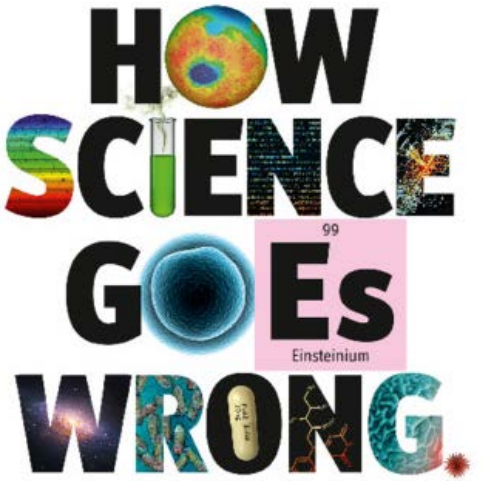
Science has lost its way, at a big cost to humanity

Researchers are rewarded for splashy findings, not for double-checking accuracy. So many scientists looking for cures to diseases have been building on ideas that aren't even true.

October 27, 2013 | Michael Hiltzik

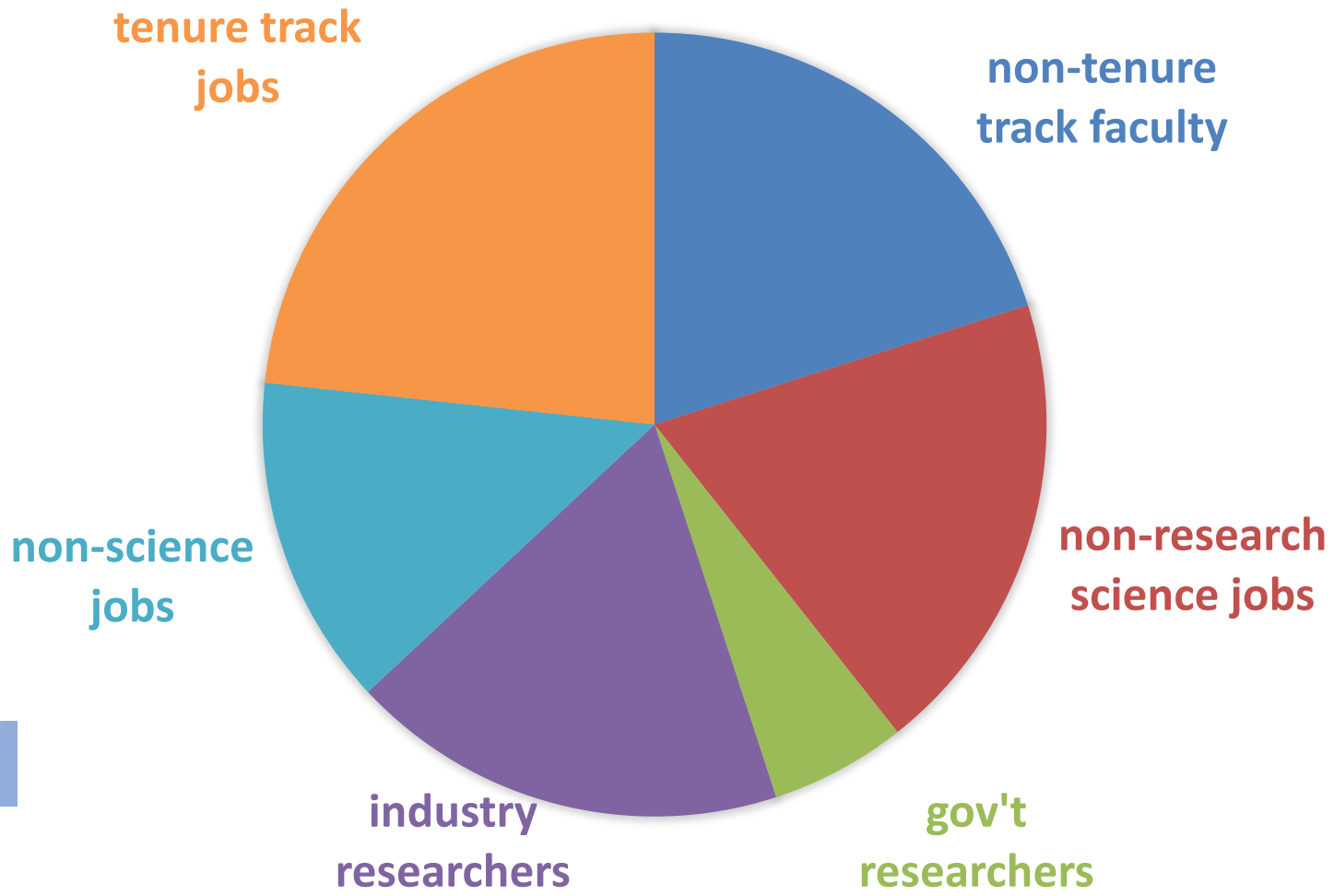


Rigor and Reproducibility



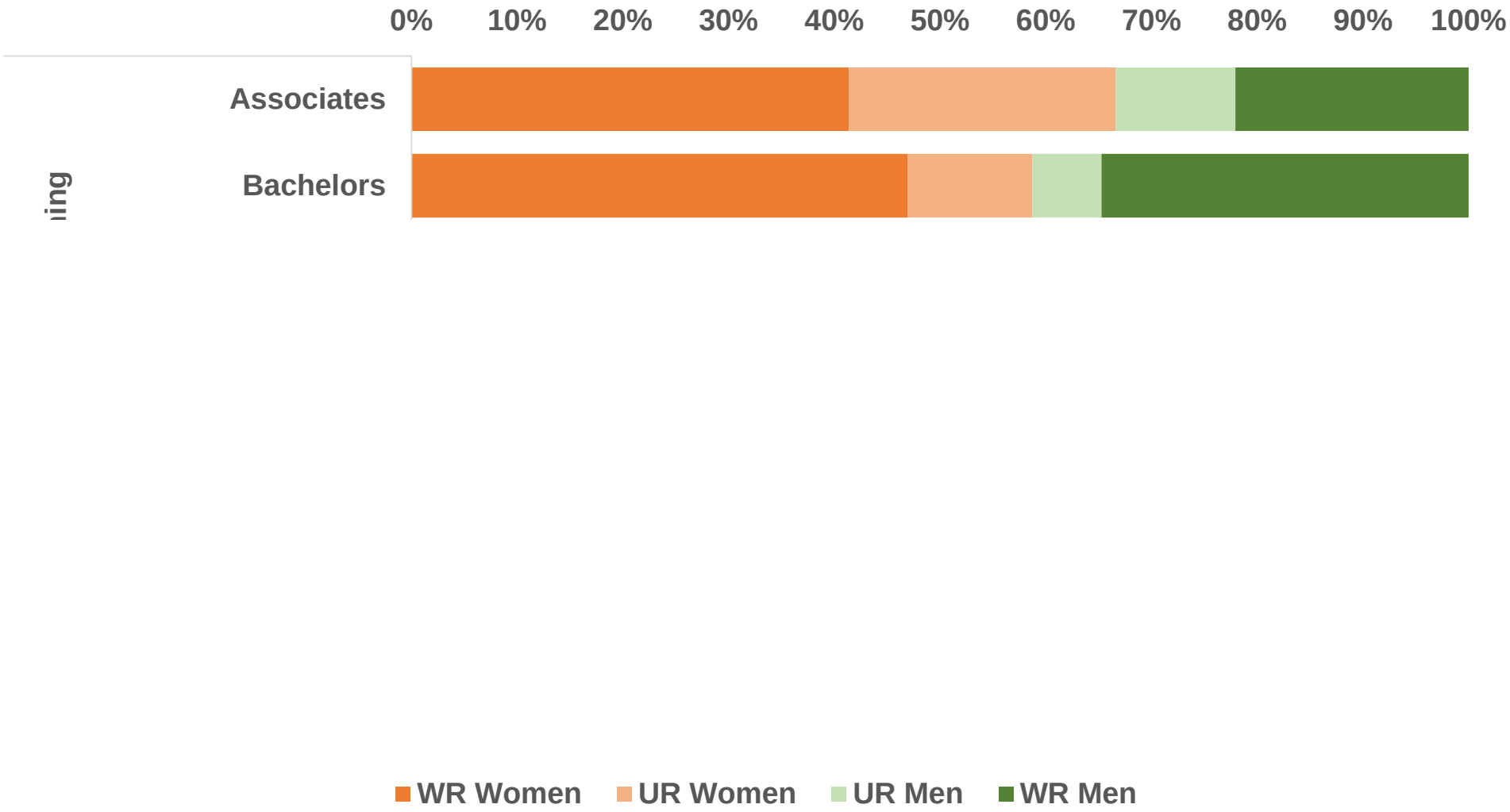
The research incentive structure is sometimes in conflict with training

The current careers in the biomedical workforce require training beyond academic research



ascb the american society for cell biology
COMPASS ASCB Committee for Postdocs and Students

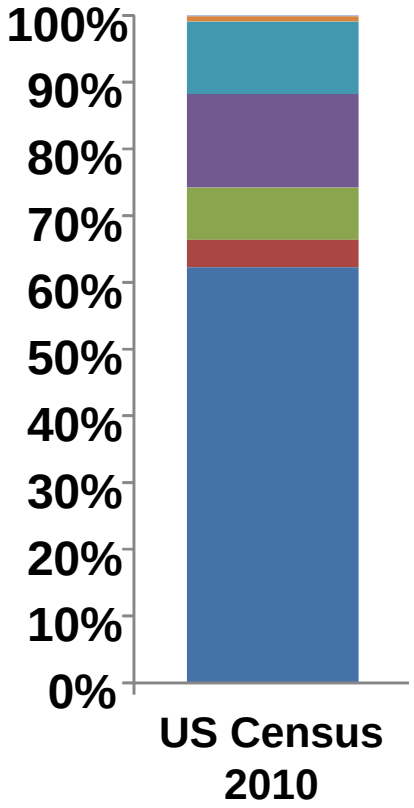
Underrepresented minorities and women are leaving the biomedical academic pathway



UR, underrepresented: Hispanic, African American/Black, Native American
WR, well represented: White, Asian

Valantine, Lund, Gammie 2016 CBE/LSE

The biomedical research community does not reflect the diversity in this country



- Native Hawaiian or Pacific Islander
- Native American or Native Alaskan
- Black or African American
- Hispanic - includes all races
- Other
- Asian
- White

TWD funding for graduate research training

Educator-Initiated Innovations

- **Training modules to enhance data reproducibility (R25)**

  NIH Rigor and Reproducibility Training Modules

  Introduction to the Modules [PDF, 110KB]

  Module 1: Lack of Transparency
  In order to reproduce someone else's findings adequately, the experimental methods, rationale and other pertinent information must be accessible and understandable. This module highlights the need to include all relevant details in publications to ensure that other studies are able to build upon the research appropriately and accurately.
  Lack of Transparency Discussion Material [PDF, 97.2KB]

- **Administrative supplements T32 predoctoral grants**
  - Rigor & Reproducibility
  - Career Development
  - Skills Development – technical, operational, professional
  - Safety in the Research Environment - *NEW*

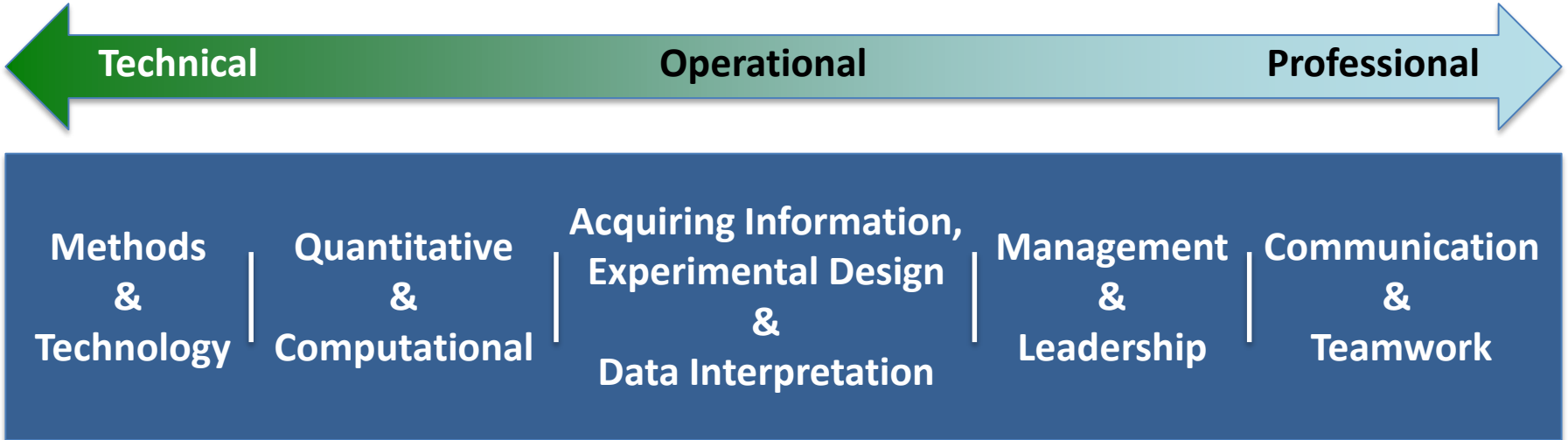
NIGMS Biomedical Graduate Training

While preserving the best elements, NIGMS would like to catalyze changes in biomedical graduate training to keep pace with the rapid evolution of biomedical research

NIGMS funds nearly half of the graduate level NRSA slots

Pilot NIGMS-specific funding announcement PAR-17-341

- Emphasize trainee development – providing the skills needed to transition into careers in the biomedical research workforce
- Focus on rigor & transparency, responsible & safe conduct of research, as well as diversity & inclusion throughout the training experience.
- Address conflicts in the incentive structure of the research enterprise
- Require mentor training and oversight of trainee/mentor matches.
- Require obtainable and measurable training objectives.



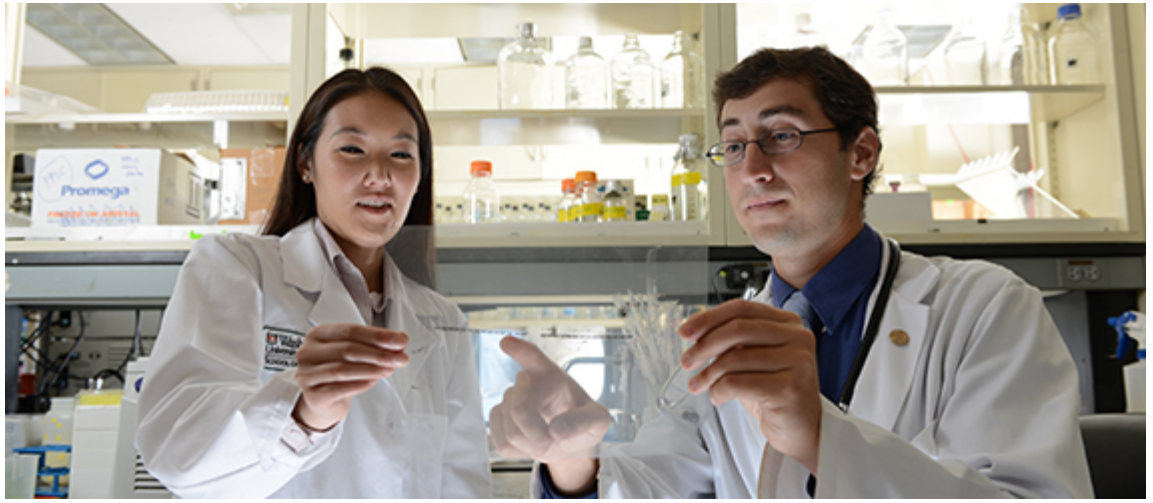
New Area - Transdisciplinary Basic Biomedical Sciences

Programs in this area should support training in two or more of the NIGMS funded areas and is designed to increase efficiencies and broaden the scope and geographic distribution of NIGMS training funds and is open only to:

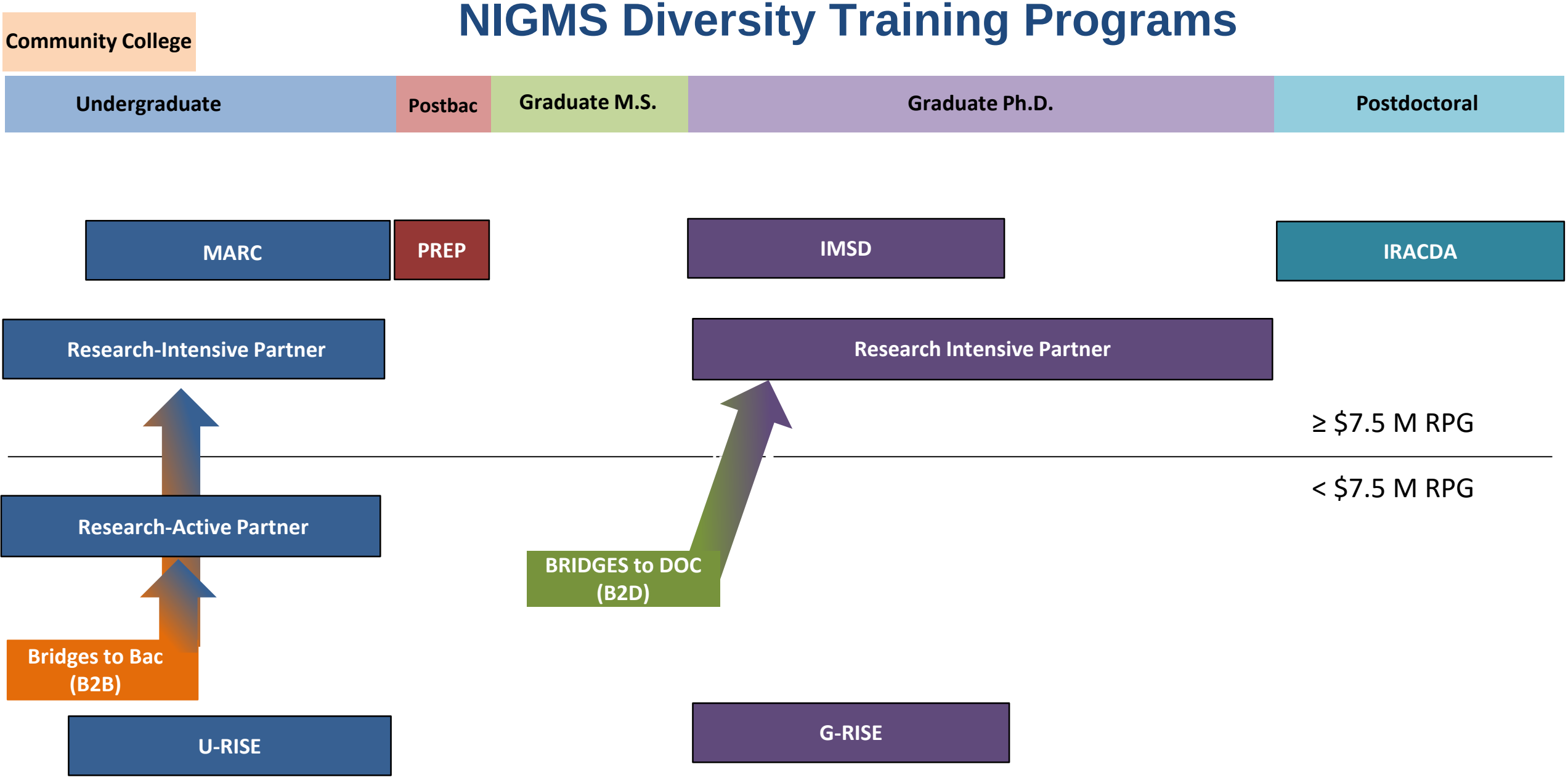
- institutions that currently do not have an NIGMS-funded institutional predoctoral T32 training program including a MSTP, or
- institutions with current NIGMS-funded predoctoral T32 training programs that propose to merge two or more of their existing NIGMS-funded predoctoral training programs in basic biomedical sciences disciplines into a single program.

Medical Science Training Program - New Funding Announcement Fall 2018

- Similar objectives to the Ph.D. T32 FOA
- Longitudinal mentoring with exposure to the spectrum of physician-scientist research areas
- Encourage career trajectories that utilize the dual degree



NIGMS Diversity Training Programs



Diversity Enhancing Programs Should -

Provide excellence in biomedical research training to individuals from diverse backgrounds, for example:

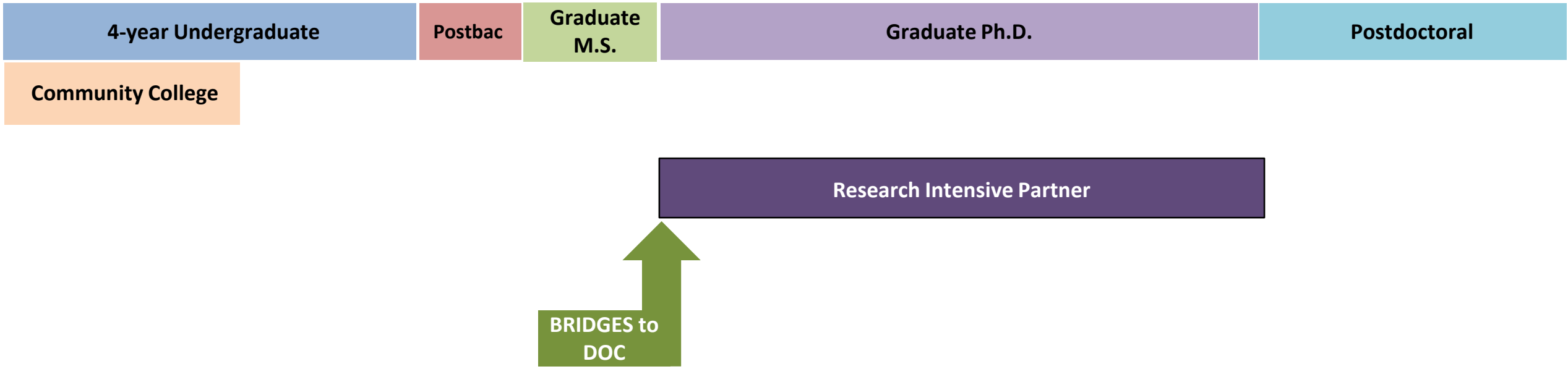
- Nationally underrepresented racial and ethnic minorities
  - African Americans, Hispanic Americans, American Indians, Alaska Natives, and other Pacific Islanders
  - Institutionally defined underrepresented groups
- Persons with disabilities
- Individuals from disadvantaged backgrounds
- Women at the later stages of the pathway (e.g., tenure-track faculty)

NIH's Interest in Diversity
NOT-OD-18-129

Bridges to the Doctorate

Contacts: Patrick Brown and Mercedes Rubio
Budget: ~$3.3 Million
Partnership: Master's and Ph.D. granting institutions
FY2017: NIGMS supported 15 institutions with 92 slots

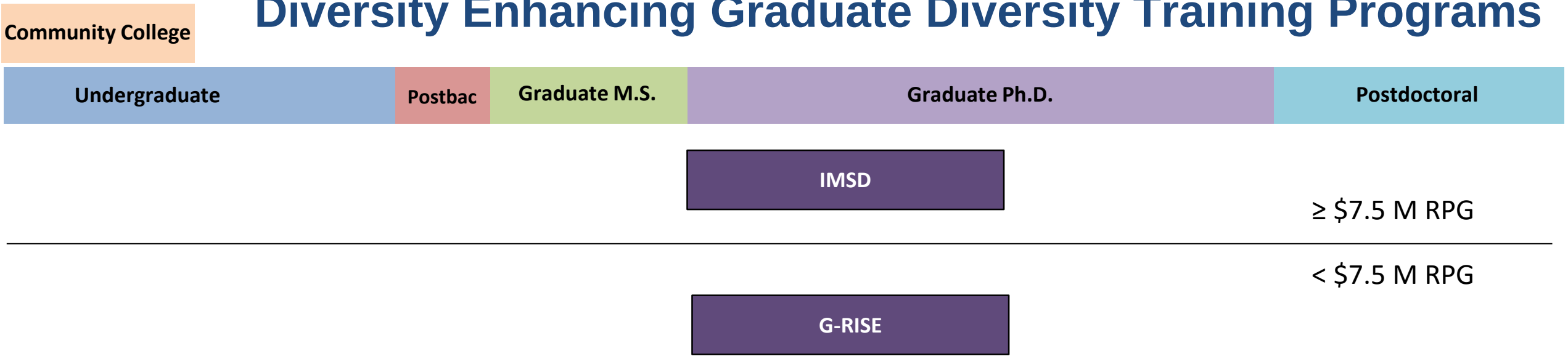
This program's goal is to enhance diversity in the biomedical research workforce. The strategy is to provide comprehensive research training, and mentoring interventions for M.S. degree students at institutions that do not offer Ph.D. degree programs. The primary objective is that the supported trainees will earn biomedical Ph.D. degrees from research-intensive partner institutions.



Upcoming FOA – Bridges to the Doc

- Emphasize strong partnerships to enhance bridging and reduce the time to degree (e.g., with effective skill-building activities and course credit articulation agreements).
- Focus on training and mentoring interventions before and after the bridge.
- Enhance the research efforts of the faculty at the master's degree granting institution through inter-institutional efforts (e.g., collaborations, shared resources, grant writing workshops and/or mentorship, and summer sabbaticals).
- When relevant, encourage the exploration of NIGMS Division of Research and Capacity Building (DRCB) programs (e.g., SCORE, IDeA, NARCH)

Diversity Enhancing Graduate Diversity Training Programs



- Emphasize the development of a diverse pool of scientists earning a Ph.D., who have the skills to successfully transition into careers in the biomedical research workforce.
- Support for 2-3 years (typically early years)
- Employ cohort-building activities and interventions that enhance the trainees' science identity and self-efficacy
- Provide individualized mentoring and oversight throughout the trainees' undergraduate or graduate career

Scientific Review

- Conducted at NIGMS in two panels
- Plan to add expertise to the panels in aspects of the FOA that may be less familiar to reviewers, such as:
  - program evaluation
  - evidence-based approaches to teaching and mentoring
  - non-academic career development

Reviewer Orientation

- Required Videoconference Orientation
  - Revising the materials and resources currently used to orient members of the review committees to ensure that reviewers understand and address the new review criteria.
  - All reviewers will be oriented (individually if they cannot make the videoconference)
- Additional orientation to guide the discussion at the start of the review meeting.

Questions?
Comments?