Catalyzing the Modernization of Graduate Biomedical Training

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Biomedical Graduate Training: Calls for Revolution

Rethinking graduate education

A substantial reconfiguration of the entire system is needed.

“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.”

Fix the PhD

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

Reform the PhD system or close it down

Summary Report of an ACS Presidential Commission

Submitted to ACS President Basam Z. Shashashiv on December 3, 2013

American Chemical Society
What are some of the major issues in training?
Science has changed dramatically in the past two decades – graduate education needs to keep up.
“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
The research incentive structure is sometimes in conflict with training - trainees vs. workforce?
The career landscape has changed

- Tenure track jobs
- Non-tenure track faculty
- Non-science jobs
- Industry researchers
- Government researchers
- Non-research science jobs
Underrepresented minorities and women are leaving the biomedical academic pathway

Training

- Associates
- Bachelors
- Masters
- Doctoral

Early Career

- Lecturer/Instructor
- Assistant Professor

Tenured Faculty

- Associate Professor
- Full Professor

UR, underrepresented: Hispanic, African American/Black, Native American
WR, well represented: White, Asian
The biomedical research community does not reflect the diversity in this country.
What is NIH doing to address these issues?
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 (26)
  ○ Career development (16)
  ○ Graduate Education - Skills (10)
Career Preparation

BEST

NIH

PHARMA • BIOTECH
ENTREPRENEURSHIP • CONSULTING
GOVERNMENT • PUBLIC POLICY
TECHNOLOGY TRANSFER • I.P. • LAW
VENTURE CAPITAL • FINANCE
BASIC RESEARCH • TEACHING
Information about how NIH promotes a diverse scientific research workforce

Learn how diversity supports our mission, find opportunities to participate in diversity programs, meet researchers, and more. Whether you are a science student, trainee, faculty member, or someone who is interested in diversity programs, you can find what you are looking for here.

Questions, comments, and suggested resources should be directed to extramuraldiversity@mail.nih.gov, or use the Contact Us link below.
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.
Pilot NIGMS-specific funding announcement PAR-17-341

- Emphasize trainee skill development, i.e., the technical, operational, and professional skills needed to transition into the range of 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 (treat individuals as trainees, rather than workforce).

- Select faculty based on research excellence and training commitment. Take diversity into consideration when building a team. Require mentor training and oversight.

- Require obtainable and measurable training objectives. Require the collection of data on the success/failure of educational interventions. Encourage the dissemination of training intervention outcomes. Require programs post career outcomes on publicly available sites.
The Objective of the Institutional Research Training Grant Program is to:

• **Parent:** develop and/or enhance research training opportunities for individuals interested in careers in biomedical, behavioral and clinical research that are relevant to the NIH mission. The training program should provide… (a set of experiences)

• **Pilot:** develop a diverse pool of well-trained scientists who have ….. (a set of skills, described in the next slides)
Proposed *Trainee* Focused Objectives: Technical/Operational Skills

- A broad understanding across biomedical disciplines and the skills to independently acquire the knowledge needed to advance their chosen field
- The ability to think critically, independently and to identify important biomedical research questions and approaches that push forward the boundaries of their areas of study
Proposed *Trainee* Focused Objectives: Technical/Operational Skills

- A strong foundation in scientific reasoning, rigorous research design, experimental methods, quantitative approaches, as well as data analysis and interpretation
- A commitment to approaching and conducting biomedical research responsibly and with integrity
- Experience initiating, conducting, interpreting, and presenting rigorous and reproducible biomedical research with increasing self-direction

### Technical
- Methods & Technology
- Quantitative & Computational
- Acquiring Information, Experimental Design & Data Interpretation

### Operational
- Management & Leadership
- Communication & Teamwork
Proposed *Trainee* Focused Objectives: Professional Skills

- The ability to work effectively in teams with colleagues from a variety of cultural and scientific backgrounds, and to promote inclusive and supportive scientific research environments.
- The skills to teach and communicate scientific research methodologies and findings to a wide variety of audiences.
- The knowledge, professional skills and experiences required to identify and transition into careers in the biomedical research workforce.
Program Plan – Rationale, Mission, Objectives and Overall Training Plan

• Rationale and training record
• Training mission, objectives (specific, measurable)
• How the training activities will build skills and attain objectives
• Plans for using evidence-based training activities
• Explain how differences in backgrounds will be accommodated
• Should enhance the training environment beyond the supported trainees
• For multidisciplinary programs- how does the training program integrate across the various departments.
• Distinctions/synergies with other NIGMS funded T32 programs
Program Plan - Career Preparation

• Post outcomes

• Introduce trainees to a range of careers in the biomedical research workforce

• Provide opportunities to develop needed skills and for experiential learning (internships, shadowing, informational interviews)
Program Plan - Program Oversight

• Oversight throughout the training process is essential
• Select faculty based on commitment to training and mentoring
• Provide mentor training
• Ensure that trainees are in research environments that promote responsible conduct as well as rigor and transparency
• Mechanism for
  o Matching mentors/mentees
  o Monitoring mentee/mentor relationships and plans for removing faculty showing poor mentorship qualities from the program
Program Plan – Institutional Commitment

- Rigor and responsible conduct in research is valued
- Start up and bridging funds are available to ensure training continuity
- Provide staff support and research infrastructure
- Give protected time for training and mentoring
- Consider training and mentoring in tenure and promotion
- Provide safe and accessible facilities
- Support trainees throughout their time in graduate school
- Support evaluation of training and mentoring activities
- Ensure there is no overlap in training mechanisms
Principal Investigator(s)

- Expertise, leadership, *record of rigorous research*, time commitment, *trained in mentoring, diversity, and inclusion*
- Encourage multiple PI’s with complementary expertise in training
Program Faculty

• Sufficient numbers, funding and expertise
• Bandwidth and commitment to training
• Must provide opportunities for trainees to initiate, conduct, interpret, and present rigorous, reproducible and responsible biomedical research with increasing self-direction
• Demonstrate a commitment to effective mentoring and to promoting inclusive and supportive scientific and training environments
• Actively promote career development
• Should consider diversity when building the faculty mentor team and select faculty who cooperate, interact, and collaborate.
Trainees

• Justify slots – explain appointment process

• Encourages recruiting and appointing trainees from diverse backgrounds (broadly defined) with the potential to become outstanding scientists (e.g., a holistic review process when accepting and appointing students)

• Emphasizes a retention plan with oversight throughout the entire time in graduate training
Training Record - Outcomes

• Completion and time to degree (well- vs under-represented similar)
• Demonstrate rigorous research activity that advanced scientific knowledge and/or technologies (e.g., peer-reviewed papers, presentations at scientific meetings, etc.)
• Plans for career tracking
Training Record - Evaluation

• Evaluation plans to assess whether the training activities are effective in meeting the objectives and whether the training environment is inclusive.
• Describe how the program has been or will be responsive to feedback from assessments.
• Plans for career tracking
Review Criteria – Overall Impact Score

Will the training program produce a diverse pool of well-trained scientists with the skills necessary to conduct rigorous and reproducible research, and transition into careers in the biomedical research workforce?

Skills include:

• technical (e.g., appropriate methods, technologies, and quantitative/computational approaches),

• operational (e.g., independent knowledge acquisition, rigorous experimental design, and interpretation of data), and

• professional (e.g. management, leadership, communication, and teamwork)
Timeline

• First application receipt: May 2018
• Initial review: Oct/Nov 2018
• NAGMS Council review: January 2019
• Earliest award date: July 2019
Group Discussions

1. Developing Achievable and Measurable Training Objectives
2. Employing Evidence-Based Practices for Training and Mentoring
3. Teaching Rigor and Transparency as well as Responsible Conduct of Research Throughout
4. Focusing on Trainee Skills Development
5. Emphasizing that Diversity and Inclusion is Essential for Training Excellence
6. Preparing Trainees for a Broad Range of Careers in the Biomedical Research Workforce