Maximizing the return on taxpayers’ investments in fundamental biomedical research

A core principle of both financial investment and biology is that diversity leads to strength. **Diversity at all levels**—from the kinds of science to the regions in which it is conducted to the backgrounds of the people conducting it—**strengthens the institute’s research portfolio** and should lead to the best returns on the taxpayers’ investments. Lorsch, *Molecular Biology of the Cell*, 2015

**National Institutes of Health addresses the science of diversity**

Lack of diversity “is limiting the promise of our biomedical enterprise” for building knowledge and improving the nation’s health...recruiting and retaining a diverse set of minds and approaches is vital to harnessing the complete intellectual capital of the nation.” Valantine & Collins, *PNAS*, 2015
What’s the Current Landscape?

Well Represented Groups (WR): White, Asian, Non-Resident

Underrepresented Minority (URM): Black, Hispanic/Latin@, American Indian, or Alaska Native

WR Men
URM Men
WR Women
URM Women

Valantine, Lund & Gammie
CBE Life Sciences Education (2016)
Won’t this all work out as demographics change?

**Mixed-methods approach**

Study population: US citizen/permanent resident biomedical Ph.D. graduates (2007-2012)

- Focus group (n=38)
- Survey (n=1500)
- In-depth interviews (n=70)

Career goals and knowledge, training experiences, career interests

Faculty (research-intensive), faculty-teaching intensive, research outside of academia, non-research career
Disparate Career Interests at Ph.D. Completion

(A) Likelihood of high interest in career path at Ph.D. completion

Controls
- Career interests at Ph.D. entry (+)
- Advisor relationship (+)
- Publication record (+)
- Ph.D. at “Top 50” university (-)
- Time-to-degree
- H-index
- Research self-efficacy (+)
- Departmental support for career development (+)
- Sense of belonging

WR Men (n=375)  URM Men (n=87)
WR Women (n=808)  URM Women (n=189)

Gibbs et al, PLOS ONE (2014)
RESEARCH

Decoupling of the minority PhD talent pool and assistant professor hiring in medical school basic science departments in the US

- System analysis: 1980-2014
  - NSF Survey of Earned Doctorates (FASEB)
  - AAMC Faculty Roster (Table 20) – assistant professors in basic science departments
Temporal Trends in Representation

(A) Under Represented Minority (URM) Participation: 1980-2013

(i) Annual Population

(ii) Population Growth (Relative to 1980)

(iii) Percentage Representation

(B) Well-Represented (WR) Participation: 1980-2013

(i) Annual Population

(ii) Population Growth (Relative to 1980)

(iii) Percentage Representation

Ph.D. Graduates

Assistant Professors

% Ph.D. Graduates

(US Citizens & Permanent Resident Only)
Temporal Trends in Representation

(A) Under Represented Minority (URM) Participation: 1980-2013

(i) Annual Population

(ii) Population Growth (Relative to 1980)

(iii) Percentage Representation

(B) Well-Represented (WR) Participation: 1980-2013

<table>
<thead>
<tr>
<th>Timeframe</th>
<th>Biomedical Ph.Ds.</th>
<th>Assistant Professors</th>
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<tr>
<td></td>
<td>URM</td>
<td>WR</td>
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<td>5122</td>
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<tr>
<td></td>
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</tbody>
</table>

% Change

URM: -1.70%

WR: +8.60%

Ph.D. Graduates

Assistant Professors

National Institute of General Medical Sciences

Gibbs et al, eLife (2016)
Enhancing Faculty Diversity

- Created system dynamics model of assistant professor hiring from 1980-2080 \( (R^2 = 0.79) \)
- Modeled impact of increasing
  - URM talent pool
  - Number of assistant professor positions
  - Transitions onto faculty job market and hiring
- Assume exponential URM population growth and no bias in hiring

% URM professors
A: < 25%
B: 25 – 50%
C: 50 – 75%
D: > 75%

Intervention: Number of Assistant Professor Positions

Intervention: URM Ph.D. Transition Rate

Ph.D. Graduates  Assistant Professor
New NIGMS Institutional Predoctoral Training Grant Funding Opportunity Announcement

BY DR. ALISON GAMMIE, DR. KENNETH GIBBS, AND DR. SHIVA SINGH

We’ve just released a new training funding opportunity announcement (FOA) specifically tailored for predoctoral graduate programs in the basic biomedical sciences. Through this FOA, we intend to encourage changes in biomedical graduate training that allow it to keep pace with the rapid evolution of the research enterprise, which is increasingly complex, quantitative, interdisciplinary, and collaborative.

The overarching objective of this new predoctoral T32 training program is to develop a diverse pool of well-trained scientists who have the following:

- 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.
- A strong foundation in scientific reasoning, rigorous research design, experimental methods, quantitative and computational 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.
- 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 (e.g., discipline-specific, across disciplines, and the public).
- The knowledge, professional skills, and experiences required to identify and transition into careers in the biomedical research workforce (i.e., the breadth of careers that sustain biomedical research in areas that are relevant to the NIH mission).

Goal is to equip trainees with the 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) skills required for careers in the biomedical research workforce.

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PAR-17-341

- **Strong disciplinary training**
- **Rigor & research integrity**
- 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 (e.g., discipline-specific, across disciplines, and the public); and
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New NIGMS Institutional Predoctoral Training Grant Funding Opportunity Announcement

OCTOBER 19, 2017

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Because diversity at all levels is integral to research and training excellence, this FOA is intended to support outstanding research training environments that focus on all trainees and enhance diversity in the biomedical enterprise by paying particular attention to groups underrepresented in the biomedical sciences.

Describe how applicants and trainees will be provided with information about the career outcomes of graduates of the program (including on publicly accessible websites) and about the overall biomedical research workforce employment landscape.
Faculty Diversity

**NOT-GM-19-019 & NOT-GM-19-020 Maximizing Opportunities for Scientific & Academic Independent Careers (MOSAIC) program** is designed to facilitate the transition of talented postdoctoral researchers from diverse backgrounds, for example individuals from groups underrepresented in the biomedical research workforce at the faculty level (see NIH's Interest in Diversity), into independent faculty careers in research-intensive institutions.

MOSAIC Institutionally-Focused Research Education Cooperative Agreement (UE5) NOT-GM-19-019

This program will support awards to independent organizations (e.g., scientific societies) with a membership of scientists conducting research within the NIH mission, an established record of providing professional development and networking activities for the next generation of biomedical researchers, and a demonstrated commitment to enhancing the diversity of the biomedical research workforce.


At the recent NIGMS Advisory Council meeting, the Division of Training, Workforce Development, and Diversity received approval to write two new funding opportunity announcements as part of our efforts to **enhance postdoctoral career transitions to promote faculty diversity** in the biomedical research workforce.

**The Maximizing Opportunities for Scientific and Academic Independent Careers (MOSAIC) program** is designed to facilitate the transition of talented postdoctoral researchers from diverse backgrounds into independent faculty careers in research-intensive institutions. The program has two components: an institutionally-focused research education cooperative agreement (UE5) and postdoctoral career transition award (K99/R00) to enhance diversity.

Dr. Alison Gammie

Alison directs the NIGMS division that supports a variety of research training, career development and diversity-building activities at the undergraduate through faculty levels.

Dr. Kenneth Gibbs

Kenny directs the Postdoctoral Research Associate Training (PRAT) program and oversees the Faculty Professional Development Program.

[Watch the MOSAIC presentation at the January Advisory Council meeting.](https://loop.nigms.nih.gov/2019/03/early-notice-concept-clearance-for-the-maximizing-opportunities-for-scientific-and-academic-independent-careers-mosaic-program-ue5-and-k99-r00-to-promote-diversity-in-the-biomedical-research-work/)

**March 4, 2019**

Early Notice: Concept Clearance for the Maximizing Opportunities for Scientific and Academic Independent Careers (MOSAIC) Program (UE5 and K99/R00) to Promote Diversity in the Biomedical Research Workforce

By Dr. Alison Gammie, Dr. Kenneth Gibbs, and Dr. Michael Sesma

The Maximizing Opportunities for Scientific and Academic Independent Careers (MOSAIC) program is designed to facilitate the transition of talented postdoctoral researchers from diverse backgrounds, for example individuals from groups underrepresented in the biomedical research workforce at the faculty level (see NIH's Interest in Diversity), into independent faculty careers in research-intensive institutions.
Maximizing Opportunities for Scientific and Academic Independent Careers (MOSAIC)

K99/R00 to enhance diversity (15 per year – 75 at steady state in 5 years)
• Independent funding & path to professoriate (5 years of funding in 2 phases)
  • Mentored research experience as postdoctoral fellow (K99) 1-2 years
  • Independent research support as faculty (R00) (up to 3 years)
• Research focus – within the mission of NIGMS
• US citizens/permanent residents
• Enhance the diversity of the biomedical research professoriate (e.g., individuals from underrepresented groups – certain racial/ethnic groups, women, persons with disabilities, institutionally defined, see NOT-OD-18-210)
• Commitment to enhancing diversity, equity and inclusion
Maximizing Opportunities for Scientific and Academic Independent Careers (MOSAIC)

For the MOSAIC UE5, NIGMS intends to fund independent organizations other than institutions of higher education (e.g., scientific societies) with:

• A membership of scientists conducting research within the mission of NIGMS
• Experience serving as a centralized entity to enhance scientific communication and networking among scientists conducting research within the mission of NIGMS
• Established record of providing professional development and networking activities for the next generation of biomedical researchers.
• A demonstrated commitment to enhancing the diversity of the biomedical research workforce.
Maximizing Opportunities for Scientific and Academic Independent Careers (MOSAIC):
Postdoctoral Career Transition Award to Promote Diversity (K99/R00)
Institutionally Focused Research Education Cooperative Agreement to Promote Diversity (UE5)

- Award UE5’s to “neutral” organization such as scientific societies

- Competition for K99/R00

- Cohort 1 assembles (~15 K99/R00)
  organized by scientific areas within
  the mission of NIGMS
MOSAIC Overview Cohorts 1 and 2

Cohorts 1 & 2 (~30 K99/R00)
Maximizing Opportunities for Scientific and Academic Independent Careers (MOSAIC)

UE5 – Research Education Cooperative Agreement (up to 3 awards). Fund independent scientific organizations composed of NIGMS scientists (e.g. scientific societies) to:

• Assemble cohorts of MOSAIC K99/R00 fellows based on scientific areas
• Facilitate the development of strengths-based individual development plans for MOSAIC fellows that will allow them to progress toward academic and research independence
• Provide courses for skills development around topics such as job search strategies, proposal preparation, scientific publishing, enhancing laboratory management, budgeting, hiring, managing career challenges and expectations, academic advancement, and balancing teaching, research, and service.
• Enhance the scientific and professional networks of MOSAIC fellows beyond their local institutions
• Identify and connect fellows with additional mentors who can facilitate appropriate career advancement
• Convene regular meetings with appropriate leaders at the institutions where MOSAIC fellows conduct research (e.g., postdoctoral research advisors during the mentored phase; department chairs, deans, or provosts during the independent phase) to exchange ideas, and employ evidence-based approaches to mitigate bias and enhance equity
• Enhance institutional accountability for the fellows’ career advancement
• Track and publicize outcomes (e.g. publicly available websites)
Summary

• The pool of Ph.D. trained scientists from URM groups is growing

• Disconnect between URM talent pool and faculty hiring; disparate career interests & institutional/systemic factors

• NIGMS initiatives to enhance biomedical training (T32; PAR-17-341) and workforce diversity (MOSAIC; forthcoming) responsive to evidence
Parting Thoughts

- The scientific workforce represents a system (not pipeline)—intervention must consider system architecture
- Increasing the number of URM Ph.Ds. will only affect faculty diversity to the extent that these scientists enter the job market as candidates (are hired and retained)
- Thought experiment
  - AAMC institutions hire ~1000 assistant professors per year
  - To get to 10% URM representation = 100 URM faculty
  - There are ~150 institutions
  - If 2/3rd of AAMC institutions, hired (and retained) one URM faculty member per year for six-years, there would be parity in the assistant professor pool in one tenure cycle

References

- Griffin KA, Gibbs KD Jr., et al, “Respect me for my science’: A Bourdieuan analysis of women scientists’ interactions with faculty and socialization into science.” *Journal of Women and Minorities in Science and Engineering* 2015; 21 (2): 159
- Gibbs KD Jr., Basson JJ, Xierali I, Broniatowski DA. “Decoupling of the Minority Ph.D. Talent Pool & Assistant Professor Hiring in Basic Science Departments.” *eLife* 2016 Nov 17;5. pii: e21393
- NIGMS Feedback Loop: [https://loop.nigms.nih.gov/](https://loop.nigms.nih.gov/)  
  E: kenneth.gibbs@nih.gov @NIGMSTraining
If you have students interested in postdocing at the NIH

NIGMS Postdoctoral Research Associate Training (PRAT) program: https://www.nigms.nih.gov/Training/Pages/PRAT.aspx

Next application deadline ~October 2019 to start ~September 2020
Thanks for listening!
Kenneth.gibbs@nih.gov