Maximizing the Biomedical Workforce: Promoting Change & Progress Through Program Development

Kansas, Oct. 2024

Presented by:

Andrew G. Campbell
Professor Emeritus of Medical Science
Dean of the Graduate School
Brown University, Providence, RI

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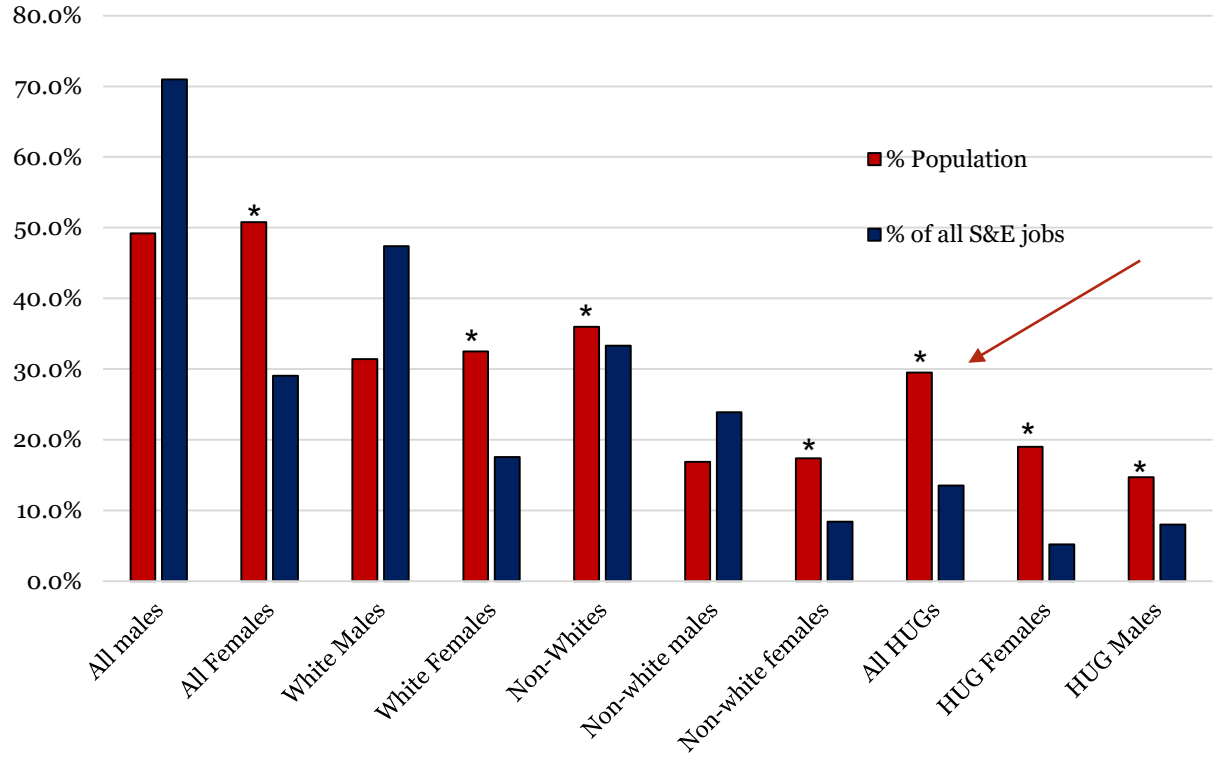
STEM and Underrepresented Groups

Employed S & E degree holders working in STEM



URM = HUG (Historically Underrepresented Group)

URM/HUG: Hispanics/Latin X, American Indian & Alaska Native, Black/African Americans and Native Hawaiian or Pacific Islanders. Non-Whites: All URMs/HUGS plus Asians

Data compiled from: National Science Foundation (NSF) 2017. Women, Minorities, and Persons with Disabilities in Science and Engineering. http://www.nsf.gov/statistics/wmpd/2013/tables.cfm Table 1-2 and Table 9-7. Last accessed: 6/6/19

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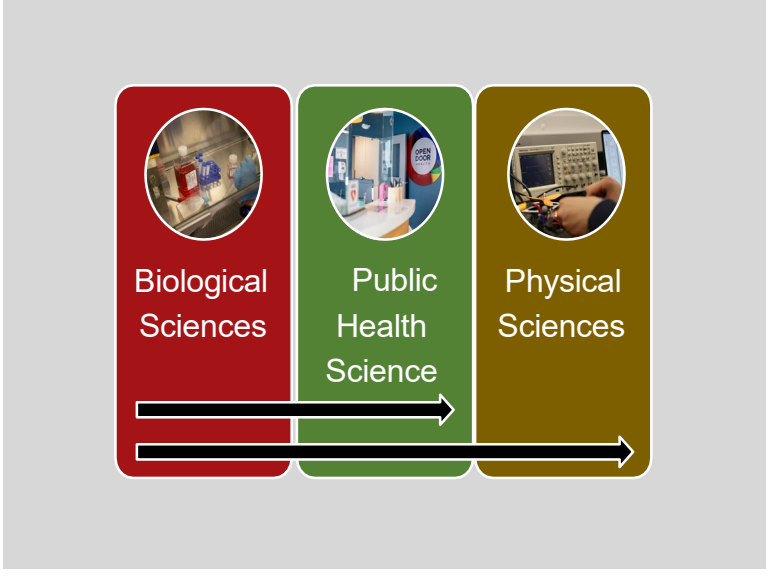
Programs & Practices that support Scientific/Biomedical Training & Workforce Diversity and Inclusion

1. IMSD@Brown: The Initiative to Maximize Student Development

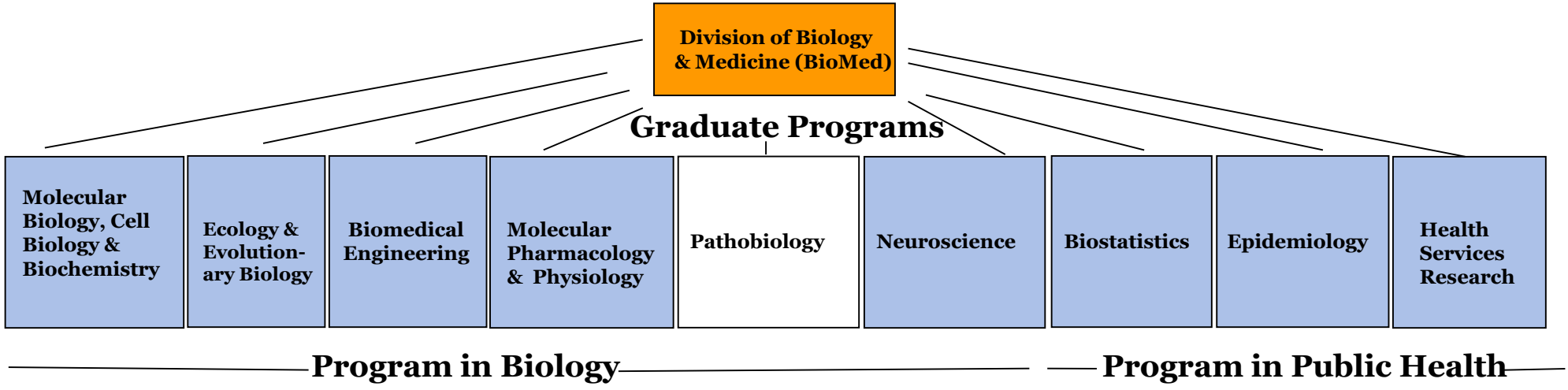


Outcomes measured over ~6 year intervals

2. ASCB Visiting Professors' Program

Outcomes measured over ~7-10 year intervals

The Brown BioMed IMSD Program



The Brown BioMed IMSD Program

PROGRAM: INITIATIVE TO MAXIMIZE STUDENT DEVELOPMENT (IMSD)

GOALS

Prepare a fully staffed STEM workforce that draws on and benefits from changing demographics to advance human health and national productivity, and is both relevant and globally competitive.

PROGRAM PRACTICES

1. **Enhance & Expand Strategic Partnerships**

2. **Implement a Multi-Faceted, Personalized Educational Program**

3. **Transform Institutional Climate & Culture**

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The Brown BioMed IMSD Program

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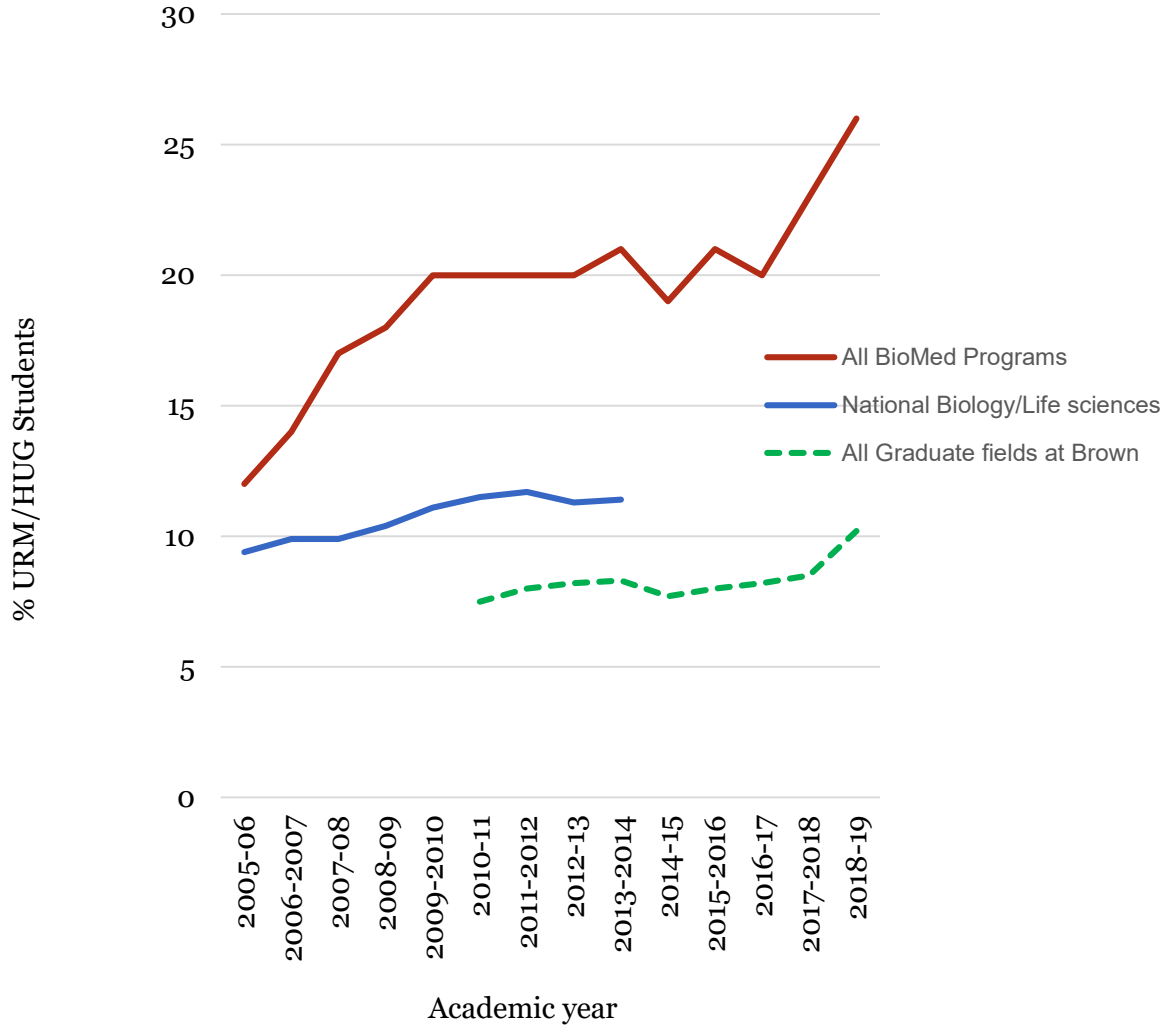
PROGRAM PRACTICES

1. **Enhance & Expand Strategic Partnerships**
   - Partner with MSIs, and organizations serving UR (HUG) students
   - Enables: Early cultivation of relationships with prospective trainees
     - Cooperative efforts to understand & support curricular needs and curricular mapping
     - Development and understanding of cultural competence

2. **Implement a Multi-Faceted, Personalized Educational Program**

3. **Transform Institutional Culture**

Change in BioMed students



URM/HUG: U.S. Under-represented racial& ethnic trainees (African-American, Hispanic or Latino/a, Native American, Native Hawaiians or Other Pacific Islanders
National URM/HUH source: nsf.gov/statistics/nsf12300/content.cfn?pub_id=4118&is=2. http://www.nsf.gov/statistics/wmpd/tables.cfm. Table 3 Biological, health and life science science disciplines. Last accessed 6-4-19. Values given are percent of U.S. citizens and PR. Figure adapted from Campbell, et. Al, 2020

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PROGRAM PRACTICES

1. **Enhance & Expand Strategic Partnerships**

2. **Implement a Multi-Faceted, Personalized Educational Program**

   Provides: Continuous advising and support structure
   Slate of Skill-based Training Modules
   Strengthened graduate student development & training
   Preparation for careers and career choices in the world beyond Brown
   Community building through: Seminars, Peer mentor networks, Community gatherings,
   Research presentations at local, regional & national meetings

3. **Transform Institutional Culture**

   Improves diversity and inclusion practices
   Engages faculty and staff as stakeholders and beneficiaries of diversity and inclusion investments

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IMSD Program Skills-based Training Modules*

"Demystifying the PhD Experience: Strategies for Academic & Personal Success in Grad School"
Become aware of and develop strategies to implement and integrate the academic & non-academic skills for success in Graduate School.

"Beyond the Hypothesis: Experimental Design & Critical Analysis":
Develop skills in mechanistic hypothesis setting and experimental design.

"Designing and Delivering Scientific Presentations":
Gain insight and practice in effective oral communications of scientific results.

"Scientific Writing: Key Principles":
Learn strategies to effectively communicate in writing the what, why, how, and outcomes of your work.

"Resources, Tools and Basic Techniques in Molecular Biology":
Insight into applying methods and resources for genomics/proteomics

"Scientific Presentation of Biological Data"
Constructing effective graphs that maximize meaningful content and interpretation while simultaneously minimizing distractions.

"Introduction to Statistical Analysis of Data":
Gain familiarity with statistical software and when to apply them in analyzing your data.

"Reading Scientific Publications":
Develop skills in interpreting, critiquing, understanding and appreciating journal articles in your field.

"Essential Laboratory Calculations"
Pointers on accuracy, following protocols, and making measurements that are critical to experimental success and reproducibility.

"Defending Your Research Proposal & Critiquing Those of Others":
Selecting a strong thesis topic; evaluating progress; giving & receiving advice.

Professionalism: Maximizing your Impact in Professional Settings": *Recognize & acquire behaviors that promote success health.*

* Taught by Faculty and Senior Scholars. 10 – 20 contact hours depending on module content. Non-credit-bearing.
Open to all BioMed graduate students , giving HUG students priority. Enrollment preference is given to BioMed PhD students
IMSD funded trainees must complete a minimum of 3 modules over the course of their graduate career.
Updated annually based on faculty and student survey responses

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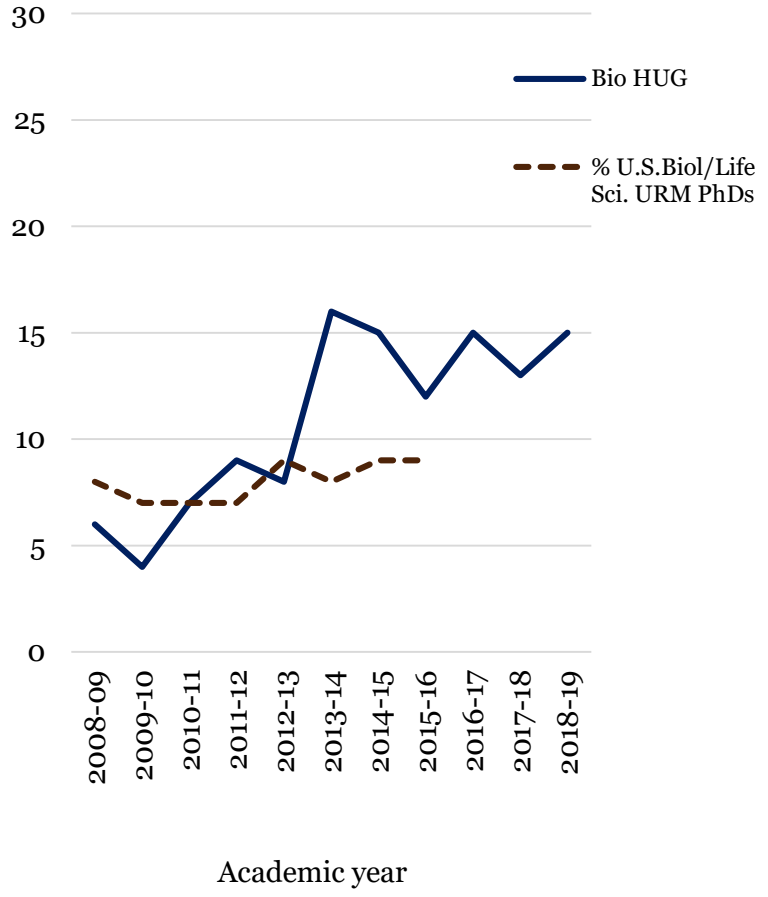
BioMed URM/HUG PhD degree Recipients: 10 year



Median Time to Degree

IMSD PhDs:	5.4yrs
Non-IMSD URMs	5.6 yrs
All BioMed & SPH PhDs:	5.3yrs
*National Life Sci PhDs:	6.7yrs

*Source:
National Science Foundation, National Center for Science and Engineering Statistics, special tabulations, Survey of Earned Doctorates (SED).
Science and Engineering Indicators

URM/HUG: U.S. Under-represented racial & ethnic trainees (African-American, Hispanic or Latin X, Native American, and Native Hawaiians
National URM/HUG source: https://ncses.nsf.gov/pubs/nsf19304/data Table 7-004.
Composite SED data shows national average of 12% for 2013-17

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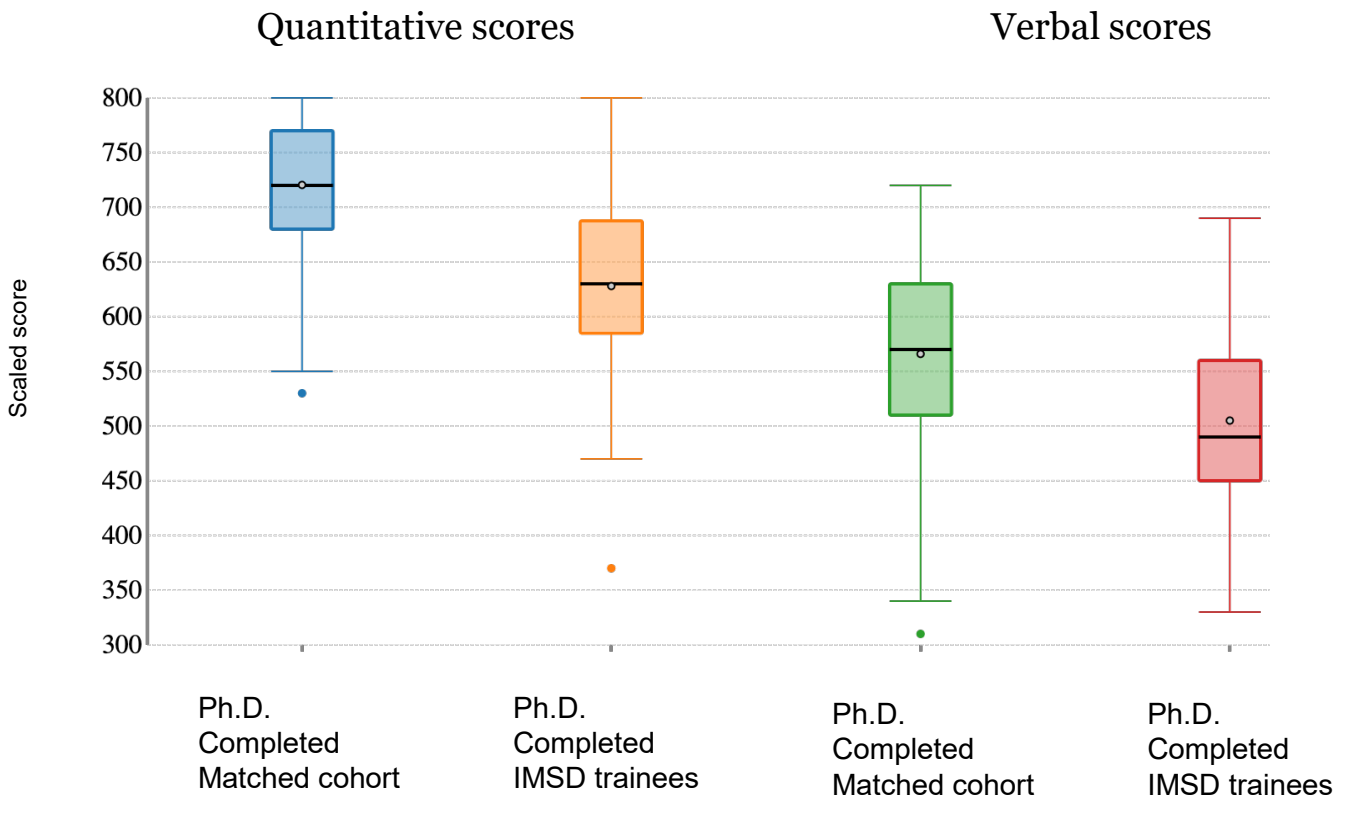
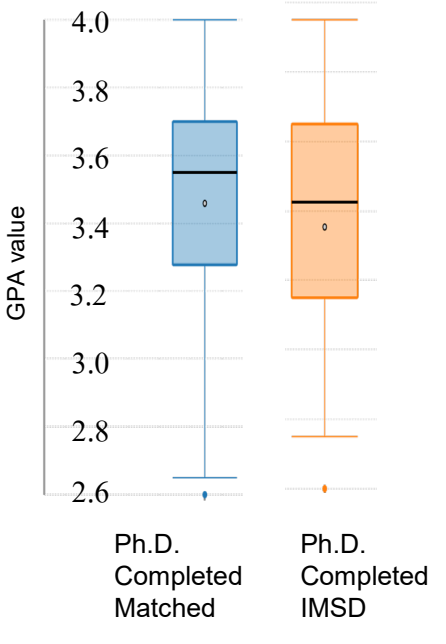
a. GRE scores



b. Undergraduate GPAs



Campbell, Thompson, Duncan and Harrington., 2020.

Attrition analysis of current and former PhD trainees, 2008 -18

10-Year Trainee Group	Active or completed PhD	Leaving with no degree	Leaving with Masters	Total % PhD attrition
BioMed IMSD Trainees N = 66	95.4%	0%	4.5%	4.5%
BioMed Non-IMSD URM Trainees N = 92	96.7%	1.1%	2.2%	3.3% p = >0.05
BioMed Non-IMSD Trainees N = 580	90.7%	5.0%	4.3%	9.3% p = >0.05
All University STEM Trainees N = 1705	86.2%	7.0%	6.1%	13.1% p = <0.05
All University Trainees N = 3175	86.1%	9.1%	4.7%	13.8% p = <0.05

Campbell, Thompson, Duncan and Harrington., 2020.

10-year, 2008 – 2018, analysis of trainee achievements

Trainee Group	Number of trainees	Time to PhD Degree (years	Ave. publication /trainee	Ave. 1st author public./trainee	% Federal Fellowships
IMSD	31	5.4	2.9	1.7	32.2
Matched BioMed Non-IMSD [1]	122	5.6 p = >0.05	2.9 p = >0.05	1.5 p = >0.05	23.7
BioMed Non-IMSD [2]	221	5.4 p = >0.05	N.D.	N.D.	N.D.
All University STEM[3]	616	5.4	N.D.	N.D.	N.D.
All University	1082	5.7	N.D.	N.D.	N.D.

Campbell, Thompson, Duncan and Harrington., 2020.

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Productivity outcomes measure:

Ranking among research intensive institutions[1] producing African American PhD holders in the Biological and Biomedical Sciences*

Year	Institution	Rank
2010	Brown	Unranked
2011	Brown	Unranked
2011	Brown	Unranked
2012	Brown	20 of 100
2013	Brown	11 of 100
2014	Brown	23 of 100
2015	Brown	11 of 100

* Source: Diverse Issues in Higher Education https://diverseeducation.com/top100/

[1] Non-Minority serving institutions

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*Trainee Placement Outcomes (as of 2024):

Tenured Associate Professors

Yale University
Skidmore College (Currently NFL Senior Director of Football Data & Analytics)

Tenure Track Assistant Professors (Research Track faculty not listed)

Bard College
Cal. State Univ.
Northwestern University
Rhode Island College
Boston University
Trinity College
University of Washington
Ohio State Univ.

Industry Biomedical Scientists (Senior scientists & Research Directors)

Bristol Myers Squibb
Biogen Inc.
Genomic Health Healthcare
IBM Inc.
Eli Lilly
Nirmidas Biotech, Inc.
Adidas Inc.
The L'Oreal Group
Beam Thera
Pioneering Med.

Postdoctoral Fellows (select)

Harvard University
UCLA
UMass Medical School
UC, Davis
Brown University
University of Colorado
Brandeis University
John Hopkins University
University of Rhode Island
Dana Farber Cancer Institute, Harvard Medical School

Regulatory Affairs/Legal Specialists

Oklahoma Med. Foundation
Cooley LLP
Wolf, Greenfield & Sacks P.C.

Other: Federation of American Societies for Experimental Biology

* Trainee identity publicly available via Linked In. Data as of 6/2024

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OUTCOMES:

104

Trainees supported by the program since 2008

Trainees awarded fellowships

26%

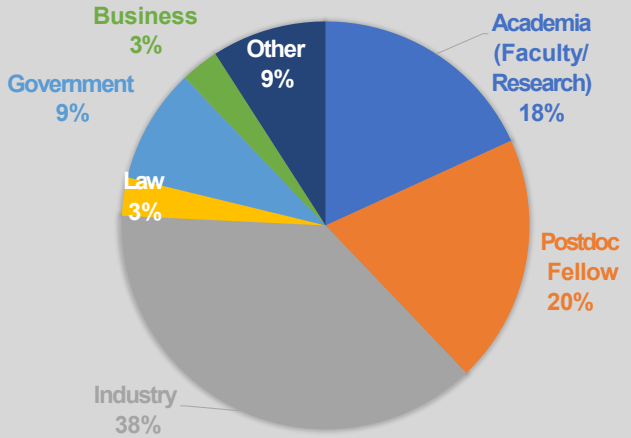
93%

Trainees who have obtained their PhD (56) or Master's (9) or are still in training (32), as of summer 2024

Time to degree (years)

5.5

OCCUPATION:



Academic Positions	
Faculty/ Research	Yale, UCLA, Northwestern, RIC, Trinity, Ohio State U, BU, Skidmore, U Wash, Brown
Postdoctoral Fellow	JHU, U Miami, Harvard, NYU, Brown, MIT
Industry Positions	
Scientist	Bristol Myers, Merck, Tango Therapeutics, Biogen, Pepper Bio, EpiVax, Vertex, Genentech, L'Oreal, Taconic, Nuvance, Astellas, Takeda, etc.

SUMMARY OF TRAINEE OUTCOMES AND JOB PLACEMENT. OUTCOMES: Breakdown of the trainee educational trajectory during their PhD studies. **OCCUPATION:** Current position breakdown of the 67 trainees who have earned a graduate degree (pie chart) and summary of institutions the trainees are employed (table).

* Trainee identity publicly available via Linked In. Data as of 5/30/24

The Brown BioMed IMSD Program

Who are our IMSD Trainees and Alums?:

Racial & Ethnic backgrounds

HUGs/URMs

52% African Americans
38% Hispanic/ Latin X
7% Native Americans

Non-HUGs/Non-URMs

1.5% Asian 1.5% White

Gender:

47% Men 51% Women

2% Transgender

Life status

5% graduate student parents

Prior Institutions

30% from MSIs

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The Brown Institutional IMSD Program

Expanded IMSD work coordinates with institutional work

1. Brown University Diversity and Inclusion Action Plan (DIAP)

a. Invested and committed institutional leadership
b. Supporting unit (departments, programs, centers & institutes) DIAP development

2. Brown Graduate School Programming

a. Preview Day (Early engagement and intervention)
b. Student of Color Orientation & 'Super Monday' (Enable early acclimation)
c. Fellowship Support (Strengthen recruitment & supporting academic excellence)
d. Co-curricular Programming: Writing Workshops, Career Panels *etc*.
e. Partnering with Brown IMSD and Post-Bacc (PREP) programs

3. Partnerships

a. Build strategic (internal and external) partnerships
b. Support Climate change: Transforming STEM departments 'microclimates' & 'microcultures'.

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The Brown Institutional IMSD Program

PROGRAM GOALS: Ensure the US has a fully staffed STEM workforce that draws on and benefits from changing demographics to advance human health and national productivity, and is both relevant and globally competitive.

Revised milestones to goals

1. Increase BioMed URM/HUG PhD population from a pre-IMSD era low of ~5% to 25%/26%-33% (Goal met)

2. Increase the non-BioMed STEM URM/HUG PhD population engaged in biomedically related training from its current level of ~4.2% to 15%

3. Institutionalize IMSD practices so that they are inherited broadly at Brown

4. Move to the top 10 in the nation in producing field-active URM/HUG PhD holders in all sciences

5. Elevate Brown to 'first among Ivies' in training diverse scholars

6. Become the desired destination for outstanding and promising scholars of all color, and an inclusive and rigorous training environment for all scholars

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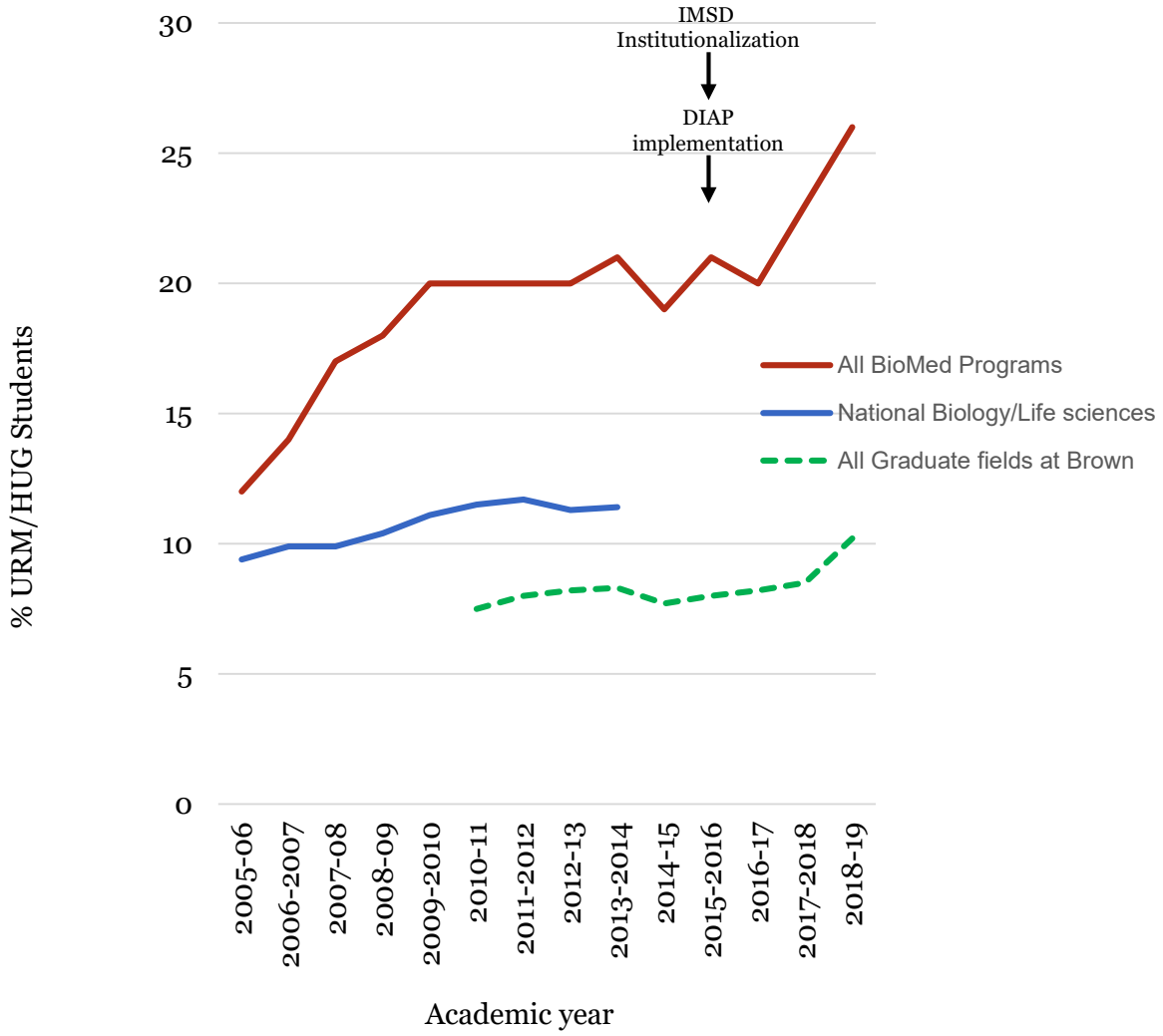
Brown IMSD & DIAP



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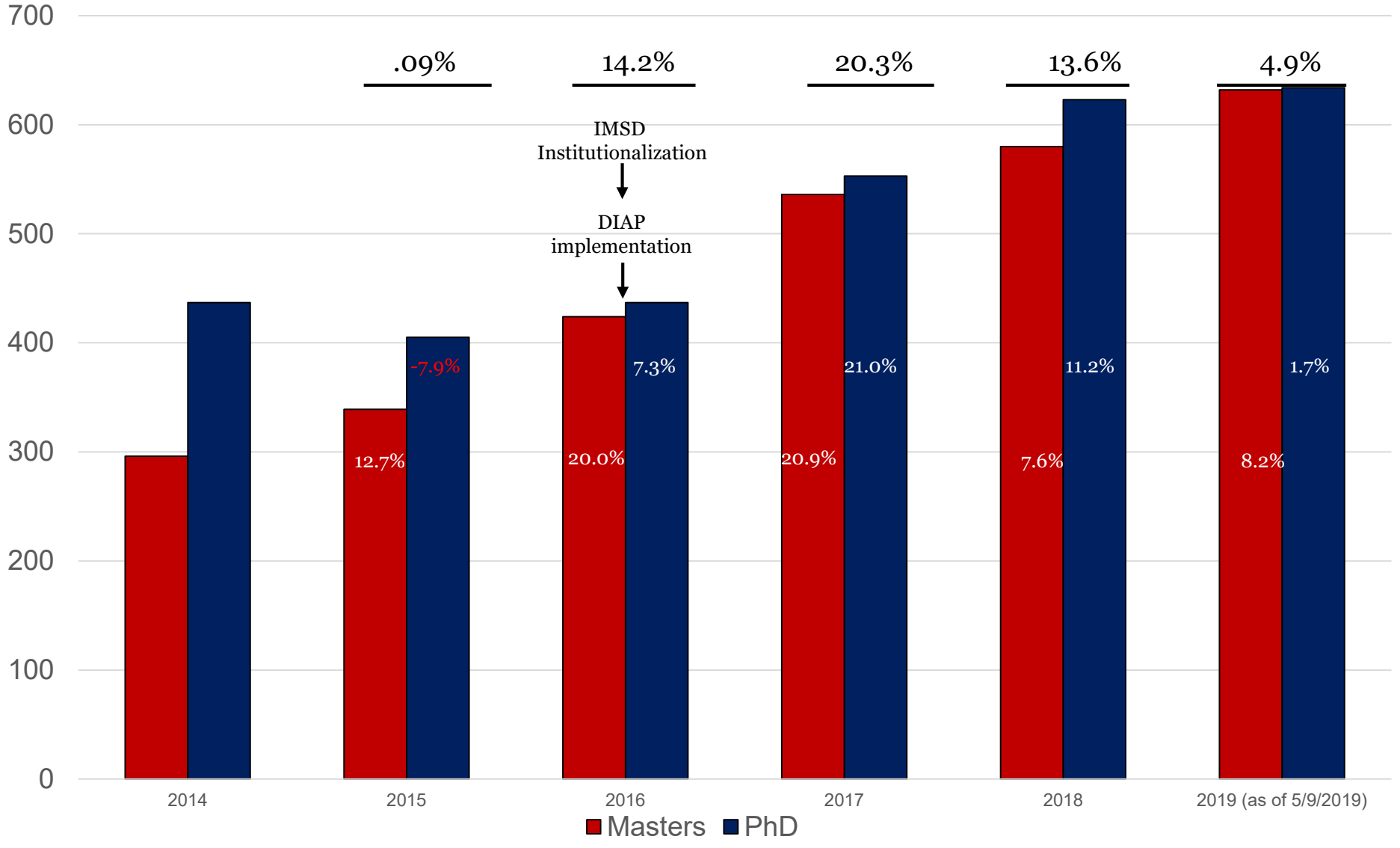
HUG/URM Applicants: 2014-2019



*Does not include non-degree applications

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IMSD-era 6-Year change in institutional HUG admits and matriculants

Absolute values of admitted and matriculating PhD students

Institution-wide IMSD and DIAP era →

Year	2014	2015	2016	2017	2018	2019
Apps	437	405	437	553	623	674
Admit	50	57	70	96	117	112
matrics	24	24	23	45	55	60

Percent change in matriculating PhD students

Institution-wide IMSD and DIAP era →

Year	2014	2015	2016	2017	2018	2019
% of all matrics	8.3%	8.4%	7.5%	14.8%	17%	21%

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Climate Survey outcomes

Lessons learned and challenges

A. Lessons

1. Reward faculty more for investments in diversity
2. Establish and sustain faculty-centric & student-centric programs

B. Challenges

1. Institutionalization vs. Siloes

2. Managing relationships:

a) Transactional Diversity (short-term, pressure-driven) and Transformational Diversity (long-term, principle driven)

b) Compositional Change and Climate Change

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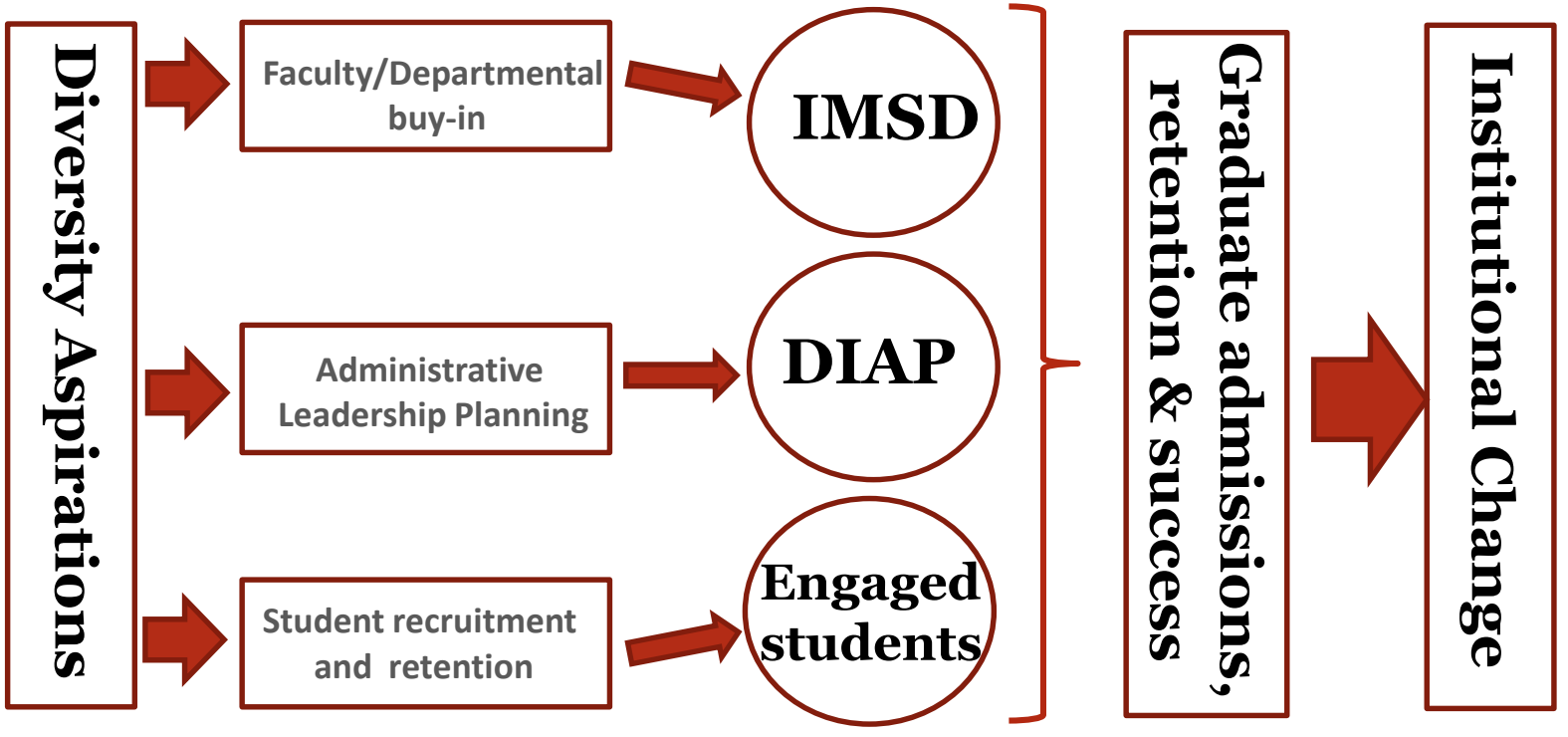
Institutional Change

Model for change



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Faculty Training & Professional Development

Partnered Research Experiences for Junior Faculty at Minority-Serving Institutions Enhance their Professional Success

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THE AMERICAN SOCIETY FOR CELL BIOLOGY

ascb
The American Society for Cell Biology

Faculty Training & Professional Development

THE ASCB Visiting Professorship Program

MSI Faculty work as Visiting Professors with faculty at research-intensive institutions

Develop collaborative projects taken back by MSI faculty home institutions

Projects used as teaching tools to engage students in the classroom and lab environment

Projects help to re-launch / sustain research careers and programs of MSI faculty

Authenticates MSI faculty scientific identity – defines faculty role model identity

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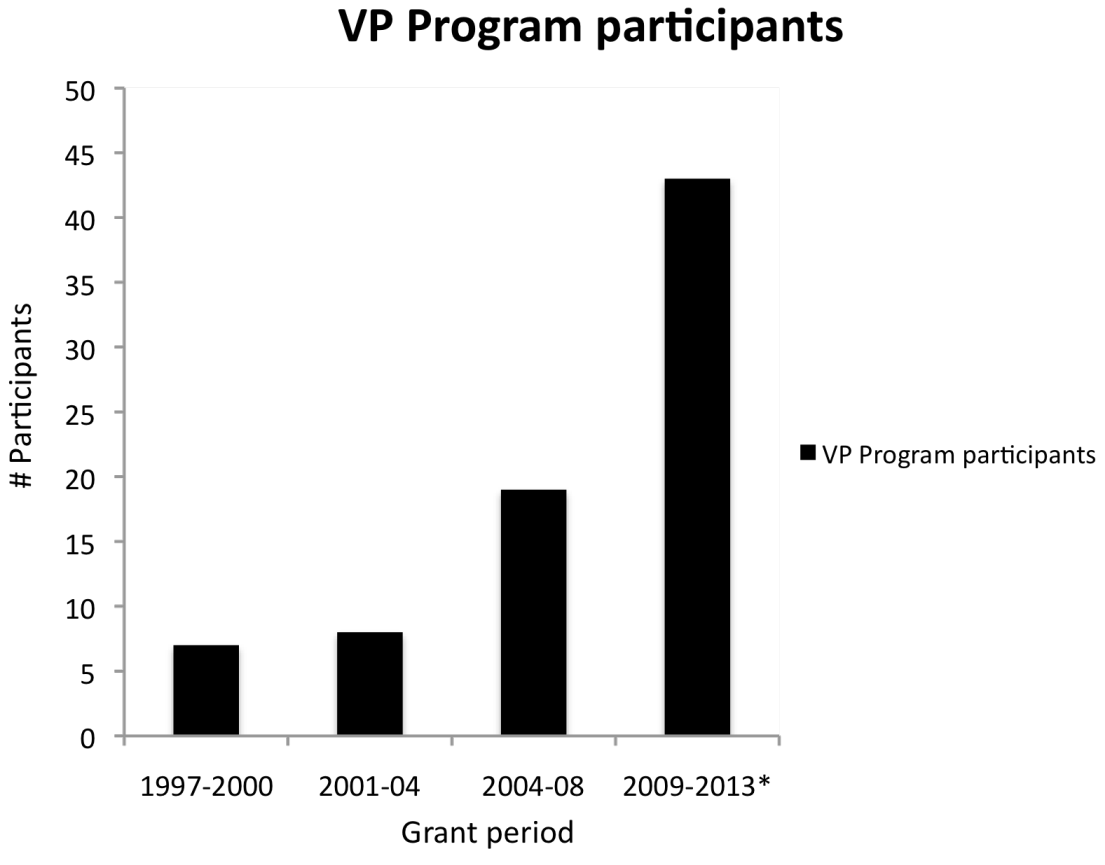
Faculty Training & Professional Development



Adapted from Campbell et al, 2013.
CBE Life Sciences Education

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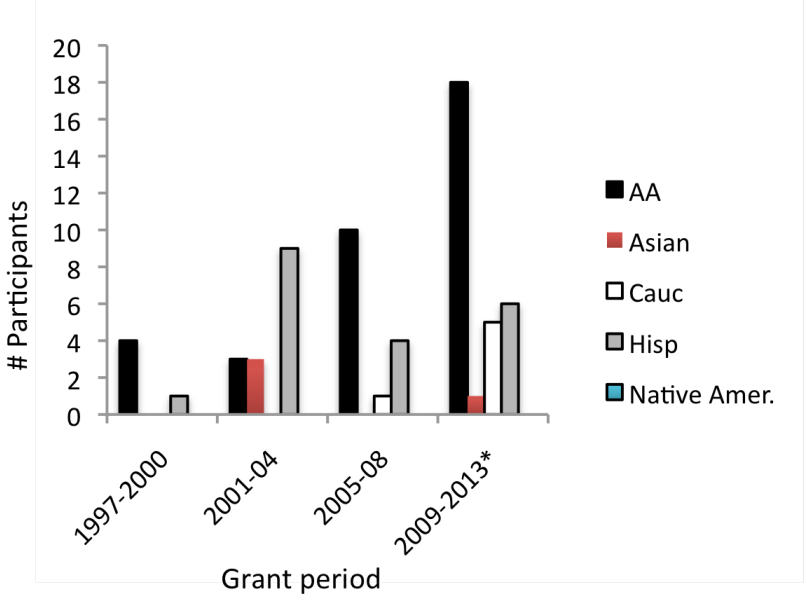
Faculty Training & Professional Development

Background of Program Participants



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Faculty Training & Professional Development

Questions

(1) Does the Visiting Professor's Program enhance MSI faculty scholarly practices?

(2) Does the program impact teaching, mentoring, and training practices in ways that benefit trainees?

Faculty Training & Professional Development

Participant Achievements

PUBLICATION RECORD		
Period	Average Number of Publications per Matched MSI Peer	Average Number of Publications Per program VP Participant
Pre-VP	0.85 σ =1.84	0.84 σ =1.93
Post-VP	0.82 σ =2.10	1.37 σ =2.37

p = 0.004

FEDERAL GRANT SUPPORT		
Period	Average Number of New Grants Per Matched MSI Peer	Average Number New Grants Per VP Program Participant
Pre-VP	0.3 σ =0.78	0.06 σ =0.24
Post-VP	0.16 σ =0.41	0.59 σ =1.38

p = 0.001

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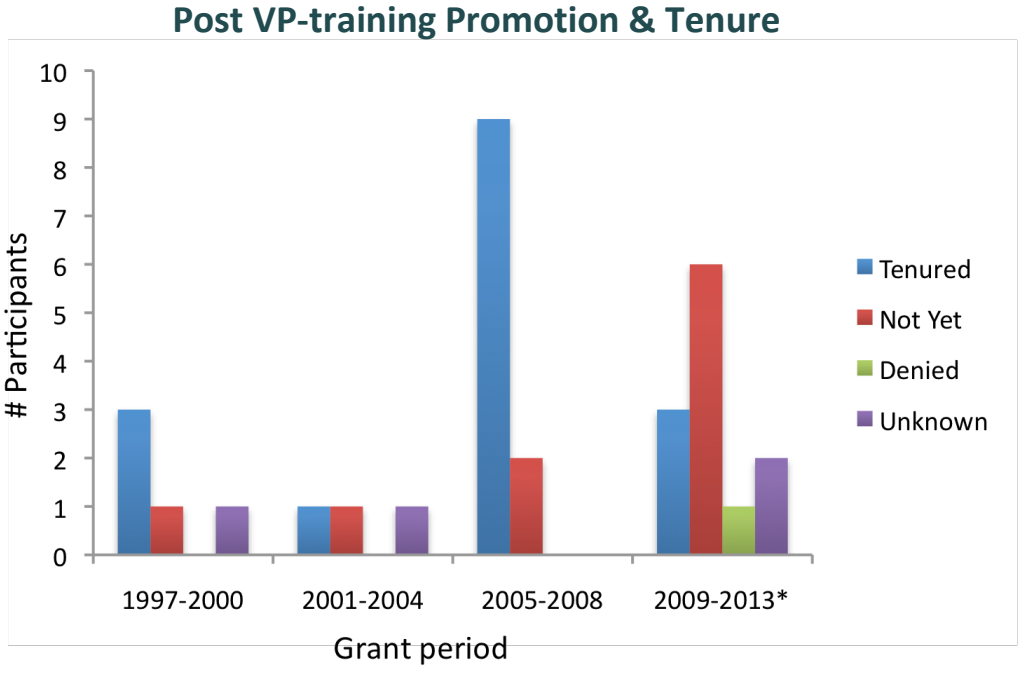
Faculty Training & Professional Development

Participant Achievements

SIZE OF GRANT SUPPORT		
Period	Average Grant Size Per Matched MSI Peer	Average Grant Size Per VP Program Participant
Pre-VP	202	17.53
Post-VP	124	117.18

In $1,000s

Faculty Training & Professional Development



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Faculty Training & Professional Development

Post-Training Activities

Activity	Number Participants
New Course Development or Curricular Improvements	22
Professional Society membership	21
Attendance at Professional Scientific Meeting	22
Student Research Training & Mentoring	31
Research Collaborations with host scientist	13
New Leadership Roles	15

Faculty Training & Professional Development

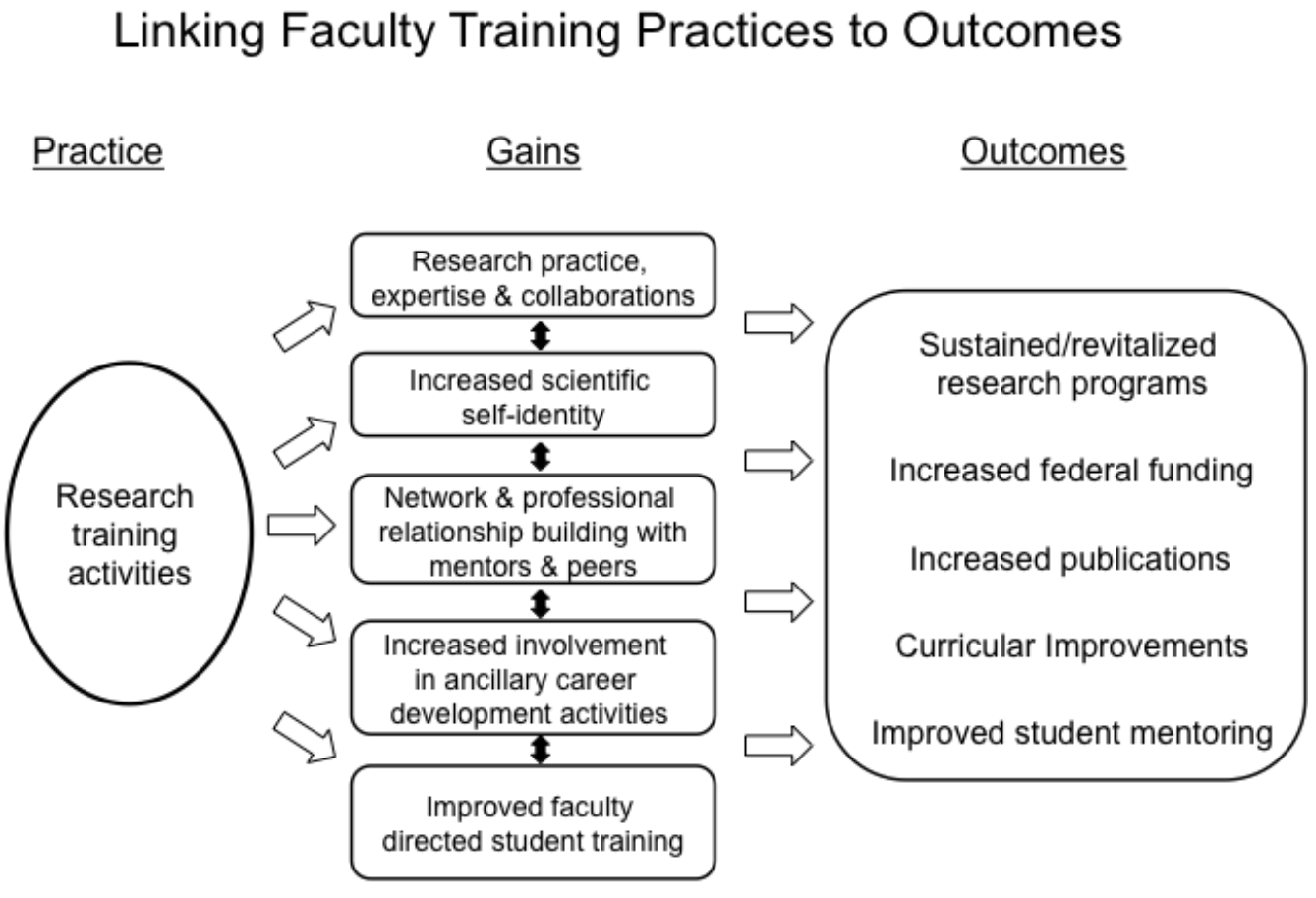
Challenges

Sustainability

Replication/Scaling & Advancement

Rewarding Faculty Investment / Valuing merit of work

Faculty Training & Professional Development



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Leadership & Support

IMSD Program :

Andrew G. Campbell	Brown University / ASCB MAC Co-Chair
Nancy Thompson	Assoc. Dean., Professor of Medicine
Elizabeth Harrington	Assoc. Dean., Professor of Medicine
Marlina Duncan	Assoc. Dean of the Graduate School., Asst. Vice-President
James Valles	Professor of Physics
Bjorn Sandstede	Professor of Applied Mathematics

Funding: NIGMS: R25 GM083270 (AGC) & R25 GM083270-S (AGC), T32

ASCB-MAC Program :

Andrew G. Campbell	Brown University / ASCB MAC CO-CHAIR
David Asai	Howard Hughes Medical Institute / ASCB MAC
Michael J. Leibowitz	University of California, Davis / ASCB MAC
Sandra A. Murray	University of Pittsburgh
David Burgess	Boston College / ASCB MAC
Wilfred F. Denetclaw	San Francisco State University / ASCB MAC
Franklin A. Carrero-Martinez	U.S. National Academy of Sciences / ASCB MAC

Funding: NIGMS: T36GM008622 (ASCB) & R25 GM083270 (AGC)

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