Bridging the STEM Gap for Underrepresented Minorities through Undergraduate Research

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Council of Undergraduate Research
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Session Overview

- Review of National Data on Underrepresented Minority (URM) participation and persistence in STEM
- AAAS Research Competitiveness Program STEM Program Assessment Findings Dr. Irene Aninye
- Research Initiative for Scientific Enhancement (RISE) at Morgan State University Dr. Christine Hohmann
- Maximizing Access to Research Careers (MARC) at the University of Maryland Baltimore County Dr. Jackie King
- Discussion of tools and approaches to engage URMs in STEM undergraduate research
Racial/Ethnic Distribution of S&E Degree Recipients, 2012
(U.S. Citizens and Permanent Residents)

National Science Board, STEM Education Data and Trends, 2014
Factors that Effect URM Persistence in STEM

**Challenges**
- Negative stereotypes and experiences
- Cultural and academic isolation
- Disparities in academic preparation

**Interventions**
- Social support and community building
- Academic services
Factors that Effect URM Persistence in STEM

**Challenges**
- Negative stereotypes and experiences
- Cultural and academic isolation
- Disparities in academic preparation

**Interventions**
- Financial support
- Social support and community building
- Academic services

**Undergrad Research Experiences**
Benefits of Undergraduate Research (UGR) Experiences

- Builds confidence in research and professional skills
- Increases preparation for and commitment to pursue graduate program in STEM
- Clarifies future career pathways in STEM

ALL Student participation in UGR (NSSE, 2017)  
STEM Student participation in UGR (Russell, 2006)

Black student participation in UGR compared to White students (Delta-P) (Figueroa, 2013)

16.27%
URM students who participated in UGR experiences were **17.4% more likely** to persist in STEM than those who did not. *(Chang et al., 2014)*

**Effect of Research Participation on STEM Graduate/Professional School Enrollment**

Hurtado, 2014
Bridging the STEM Gap for URMs through UGR

Racial/Ethnic Distribution of S&E Degree Recipients, 2012

Effect of Research Participation on STEM Graduate/Professional School Enrollment

National Data & Trends
AAAS Research Competitiveness Program

- Provides support to individual researchers, academic institutions, funding agencies, and governments in four program areas:
  - Peer Review of Research Proposals
  - STEM Program Assessments
  - Innovation and Entrepreneurship programs
  - Capacity-building and Competitiveness short courses
AAAS STEM Program Assessments

- 250+ strategic assessments (> $1 billion in programs)
  - Independent, external assessment to institutions and awardees
  - Large-scale multi-institutional initiatives
    - Established Program to Stimulate Competitive Research (EPSCoR – NSF, NASA, DoE)
    - IDeA Network for Biomedical Research Excellence (NIH INBRE)
  - Expert panel provides scientific and administrative assessment and guidance
    - Research infrastructure
    - Program design and leadership development
    - Student training and research

- Summary report of panel’s findings and recommendations

RCP Assessment Portfolio

- NIH INBRE, 33%
- NSF EPSCoR, 46%
- Other, 20%
AAAS STEM Program Assessments: A Retrospective Analysis

- RCP assessments from 2010 to 2017
  - Reports on programs assessed at least 3 times over 5 years
  - 15 reports, including 48 institutions

No. of Institutions Represented in AAAS Study

- Research-intensive
- Primarily Undergraduate
- Minority Serving Institutions
- Tribal Colleges
- Community Colleges
- Healthcare Centers/Hospitals
- Other (e.g., National Labs, NFP)
Retrospective Analysis: Approaches to Engage URMs in UGR

Areas of Focus

- Students/Training
- Faculty/Mentoring
- Outreach
- Leadership
- Communication
- Research/Program Cores
- Funding
- M&E
- Sustainability

- Broadening Access and Participation
- Addressing Student Preparedness
- Developing Mentors
- Institutionalizing Support for UGR
Approaches to Broaden Access and Participation

- Offer challenging projects that students can take ownership of
- Ensure research opportunity is accessible to students (travel and lodging), summer and academic year UGR
- Engage students after the summer program; utilize alumni networks
- Highlight non-PhD career options in STEM

- **Community-based participatory research and service learning opportunities**
  - Potential public health or clinical research focus
  - Partnered with community organizations, clinics, centers
  - Engaged and serviced students’ local or home community
Approaches to Address Student Preparedness

- Expose students to sophisticated equipment
- Utilize small group discussions and working groups

**Intensive boot camp orientation (1-2 weeks) at the beginning of the summer**

- *Provided training in basic lab techniques, research ethics, and field methods*
- *Offered specialty training and certifications (e.g., phlebotomy, CPR, cultural competency)*
- *Assessed knowledge acquisition with pre- and post-testing*
Approaches to Develop Mentors

- Require mentor training/orientation
- Incorporate teaching and mentoring opportunities for post-docs and graduate students

**Active matching process to place students with a faculty mentor**

- Promoted direct faculty engagement with student during program
- Exposed students to a diverse pool of mentors

Strong faculty-student relationships is a strong predictor of choosing STEM graduate study \((\text{Hurtado, 2014})\)
Approaches to Institutionalize Support for UGR

- Enable course credit for UGR throughout the year
- Provide gap funds when grant cycle is misaligned to internship schedule
- Incentivize and recognize faculty for participation in UGR
- Sponsor internal competition for students to continue summer research during the academic year (awards <$10,000)

**Multi-program symposia and seminars**

- Allowed students to communicate science and exposed them to the larger scientific community
- Maximized individual program resources
- Incentivized the institutions to provide additional support to event
- Attracted attention of the surrounding non-STEM community
References and Resources


- National Science Board’s STEM Education Data: https://www.nsf.gov/nsb/sei/edTool/

- National Survey of Student Engagement: http://nsse.indiana.edu/
Morgan State University
Christine F. Hohmann,
Professor of Biology, P.I. NIH RISE
MSU DEMOGRAPHICS

BA/BS DEGREES IN > 40 DISCIPLINES
15 DOCTORAL PROGRAMS
>30 MS/MA PROGRAMS

Graduate  1,307  16.8%
Undergraduate  6,440  83.2%
Total  7,747  100%

RISE Relevant majors – approximately 1,200

> 85% URM (mostly African American)
> 60% Pell grant recipients
> 40 First Generation in STEM
Average SAT 885
> 45% place in developmental Math and Reading

Ranking 5th in the production of AA BA/BS graduates who complete a PhD in STEM/Life Sciences (NSF 2014)
Overview

- 4 cycles of RISE since with a total of 122 graduates since 1998.
- >97% retention in science major to graduation
- >95% alumni in science professions
- On average 70% of participants eventually transitioned into graduate school
- 11 PhDs completed to date
- 16 PhDs still in progress

Admissions Requirements:
- True passion for research
- Desire to attend graduate school
- Minimum GPA of 2.8
% of RISE Graduates Entering Graduate Training

<table>
<thead>
<tr>
<th>Period</th>
<th>% graduate programs</th>
<th>% PhD entered</th>
<th>% PhD stayed</th>
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<tr>
<td>1998-2001</td>
<td>90</td>
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<td>2007-2012</td>
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<tr>
<td>2013-2018</td>
<td>72</td>
<td>45</td>
<td>41</td>
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</tbody>
</table>

RISE at Morgan State University
% of RISE Graduates Entering Graduate Training

How do we improve PhD program entry and retention?

<table>
<thead>
<tr>
<th>Period</th>
<th>% of Graduate Programs</th>
<th>% PhD Entered</th>
<th>% PhD Stayed</th>
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<td>1998-2001</td>
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<td>39</td>
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<td>2002-2006</td>
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<td>2007-2012</td>
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<tr>
<td>2013-2018</td>
<td>72</td>
<td>45</td>
<td>41</td>
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RISE at Morgan State University
Constructing RISE at MSU

Since Inception: Foundational
- Faculty mentored research
- Oral and poster presentations
- (GRE workshops)
- Assistance with graduate applications

Building Science Identity/Self-efficacy
- Intentional Cohort building (retreats and joint activities such as conferences, workshops)
- Interdisciplinary communications

Building Process Skills
- Critical thinking skill workshops
- Writing workshops
- Career workshops
- Survival skills workshops
- Mock interviews

Institutional Impact
- Course redesign
- Scientific Teaching Institute

Developing the Instructional Environment
NIH RISE

Cohort 1
Year-round research on and off campus
Regional & national conference presentations
MSU Research Symposium
Graduate application support
Interdisciplinary research seminars (Alumni!)
Responsible conduct training
Critical Thinking Boot Camp
Quantitative skills workshop
Mock grad school interviews
Career Workshop (Alumni!)
Annual Retreat
Survival Skills workshop

Cohort 2
Senior Thesis class (Biol 451)
Critical analysis of the research literature (BIOL 450)

Cohort 3
Faculty training & instructional development

Cohort 4

RISE at Morgan State University
% of students who rated the activity highly effective in the relevant domain

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<td>82</td>
<td>79</td>
<td>90</td>
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<td>BIOL 450 (Lit analysis)</td>
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<td>Career Workshop</td>
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<td>83</td>
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<td>88</td>
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<td>ABCRMS Conference</td>
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<td>100</td>
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<td>100</td>
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<tr>
<td>Survival Skills Workshop</td>
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<td>63</td>
<td>89</td>
<td>85</td>
<td>77</td>
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<td>Mock Interviews</td>
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<td>100</td>
<td>88</td>
<td>86</td>
<td>88</td>
<td>100</td>
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<tr>
<td>BIOL 451 (thesis)</td>
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<td>86</td>
<td>85</td>
<td>71</td>
<td>85</td>
<td>72</td>
<td>82</td>
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<td>Retreat</td>
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<tr>
<td>Research Symposium</td>
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<td>86</td>
<td>75</td>
<td>50</td>
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Activities benefitting the entire Morgan Community
Activities that have become institutionalized

NIH RISE

Year-round research on and off campus
Regional & national conference presentations
MSU Research Symposium
Graduate application support
Interdisciplinary research seminars (Alumni!)
Responsible conduct training
Critical Thinking Boot Camp
Quantitative skills workshop
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Cohort 1
Cohort 2
Cohort 3
Cohort 4

Senior Thesis class (Biol 451)
Critical analysis of the research literature (BIOL 450)
Faculty training & instructional development

Activities that have become institutionalized
MARC U* STAR at UMBC

Jackie King, PhD - Associate Director MARC Program
UMBC Demographics

- Mid-size public research university
- Student Body – Fall 2017 = 13,662
  - Undergraduate – 11,234 (82.2%)  Graduate – 2,428 (17.8%)
  - 55% Majority; 23% Asian; 22% Minority
  - Avg. SAT = 1216 (2-part)
  - Pell Grant 25%
  - 60% STEM majors (22% URM)
- Academic Programs
  - 48 BS/BA programs
  - 36 MS/MA programs
  - 26 Doctoral programs
- **MD-PhDs awarded to AA (N=413); more than 10% UMBC AA alumni** (AAMC, 2017)
MARC U*STAR at UMBC

**Early Years, 1997-2000**
- Meyerhoff Program model
- 40 trainee slots
- Faculty mentored research
- Poster/oral presentations
- Grad school application prep

**Building Program Identity**
- Program Evaluation
- GPA requirement
- Recruitment
- Cohort building

**Academic and Skill Development**
- Sustained and summer research
- Scientific writing course
- Quantitative methods workshop
- Career workshops

**Motivation and Support**
- High expectations
- Seminar series
- Conferences
- Campus visitations

**Advising and Monitoring**
- Grade reports
- Academic coaching
- Time management

**Academic and Social Integration**
- Study groups
- TA
- Community service

**Program Outcomes**
MARC Trainees 1997 – 2018
(N = 443)
Major Distribution

Successful applicant:
- >3.2 GPA
- “Fire in the belly”
- Pursue PhD, MD/PhD
- Coachable

- BIOL 34%
- BIOC 30%
- CENG 11%
- CHEM 4%
- CMPE 2%
- CMSC 2%
- ENVS 1%
- INDS 1%
- MATH 5%
- MENG 7%
MARC Academic Outcomes

- > 400 MARC Trainees
- 95% Graduates in STEM
- 243 enrolled in PhD or MD/PhD programs (60%)
- 135 completed a PhD or MD/PhD degrees (74%)
Grad School Entry Outcomes

Entrance into Graduate and Professional Schools for MARC Trainees and Comparison Sample Graduating Spring 2016 through Spring 2017

<table>
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<tr>
<th>Graduate Program Entered</th>
<th>PHD</th>
<th>MD/PHD</th>
<th>MD</th>
<th>MS</th>
<th>TOTAL</th>
<th>NGSS**</th>
<th>TOTAL</th>
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<tr>
<td>MARC</td>
<td>18</td>
<td>7</td>
<td>2</td>
<td>2</td>
<td>29</td>
<td>13</td>
<td>42</td>
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<tr>
<td></td>
<td>(42.9%)</td>
<td>(16.7%)</td>
<td>(4.8%)</td>
<td>(4.8%)</td>
<td>(69.2%)</td>
<td>(31.0%)</td>
<td>(100%)</td>
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<td>COMPARISON</td>
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<td>0</td>
<td>2</td>
<td>1</td>
<td>6</td>
<td>36</td>
<td>42</td>
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<tr>
<td></td>
<td>(7.1%)</td>
<td>(0.0%)</td>
<td>(4.8%)</td>
<td>(2.4%)</td>
<td>(14.3%)</td>
<td>(85.7%)</td>
<td>(100%)</td>
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</table>

* Total entering graduate or professional school
** NGSS: No graduate school for science

1 Included are all students who entered the MARC program and subsequently graduated from college, including those who did not remain in the program.
Institutional Support and Impact

Supporters
- STEM Program Departments
- STEM-BUILD, Transfer Student Alliance
- Student Support Services

Impact
- Culture of academic excellence
- URM participation in research
- URM completing PhD, MD/PhDs
- Funding
Open Discussion

- Broadening access and URM participation in UGR
- Addressing student preparedness
- Engagement of faculty and program alumni
- UGR Program evolution
- Institutionalizing support