### Sunday, June 18, 2017

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<tbody>
<tr>
<td>1:00P – 7:00P</td>
<td>Advance Registration Check-in</td>
<td>Grand Ballroom Lobby Level</td>
</tr>
<tr>
<td>3:00P – 4:30P</td>
<td>Posters Installation (BUILD, NRMN, IPERT, and T32)</td>
<td>Grand Foyer West</td>
</tr>
</tbody>
</table>
| 3:00P – 4:00P| Welcome & Meeting Objectives
Speaker: Alison Gammie, Ph.D.                                                      | Grand Ballroom Salon V/VI         |
| 4:00P – 5:00P| Presentations
Highlighting Outcomes of NRMN/BUILD/ IPERT/CEC/UI                               | Grand Ballroom Salon V/VI         |
| 5:00P – 5:30P| Baltimore Marriott Waterfront-Sponsored Coffee Break                              | Grand Foyer West                  |
| 5:00P – 7:00P| Poster Session A                                                                  | Grand Foyer West                  |
| 7:00P – until| “Charm City Dining” – Dinner On Your Own                                          | Baltimore, MD                     |

### Monday, June 19, 2017

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<td>Poster Session B</td>
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<td>9:00A – 10:00A</td>
<td>“Next Gen Ph.D.s and Careers” Speaker: Melanie V. Sinche, NCC</td>
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<td>Baltimore Marriott Waterfront-Sponsored Coffee Break</td>
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| 10:30A – 12:00P| PANEL: Career Panel Discussion
Speaker: Kenny Gibbs, Jr., Ph.D., M.P.H.; Klarissa Jackson
Hardy, Ph.D.; Lisa Parker Smith, Ph.D.; Odaine Gordon, Ph.D. | Grand Ballroom Salon V/VI         |
| 12:00P – 1:30P| “Charm City Dining” - Lunch On Your Own                                           | Baltimore, MD                     |
| 1:30P – 2:30P| Presentation/Workshop
“NRMNet and MyNRMN: Tools for mentoring and networking”
Speakers: Jamboo K. Vishwanatha, Ph.D. | Grand Ballroom Salon V/VI         |
| 2:30P – 3:00P| Baltimore Marriott Waterfront-Sponsored Coffee Break                              | Grand Foyer West                  |
| 3:00P – 4:00P| Breakout Session: IRACDA
Chair: Jessica Faupel-Badger, Ph.D.                                                   | Contact Dr. Faupel-Badger
badgerje@nigms.nih.gov | Grand Ballroom Salon IX/X |
| 3:00P – 4:00P| Breakout Session: MARC
Chair: Sailaja Koduri, Ph.D.                                                           | Grand Ballroom Salon IX/X         |
| 3:00P – 5:00P (concurrent sessions)| Breakout Session: Bridges to Baccalaureate
Chairs: Mercedes Rubio, Ph.D.                                                          | Grand Ballroom Salon I/II         |
| | Breakout Session: Bridges to Doctorate
Chairs: Patrick H. Brown, Ph.D.                                                        | Grand Ballroom Salon III/IV       |
| | Breakout Session: RISE
Chair: Luis Cubano, Ph.D.                                                              | Grand Ballroom Salon VII/IV       |
| | Breakout Session: IMSD
Chair: Veerasamy Ravichandran, Ph.D.                                                  | Chasseur                          |
| | Breakout Session: PREP
Chair: Michael Bender, Ph.D. and Kenny Gibbs, Jr., Ph.D., M.P.H.                     | Dover A                           |
| | Breakout Session: BUILD
Co-Chairs: Anissa Brown, Ph.D., Richard Okita, Ph.D., and Desiree Salazar, Ph.D.   | Dover B                           |
| | Breakout Session: IPERT/MARC T36/CEC
Chair: Michael Sesma, Ph.D.                                                            | Dover C                           |
| | Breakout Session: T32
Chair: Shiva Singh, Ph.D.                                                              | Grand Ballroom Salon V/VI         |
| 5:00P – 6:00P| TWD Program Directors’ Steering Committee Meeting
Chair: Barry Komisaruk, Ph.D., Rutgers University                                         | Grand Ballroom Salon V/VI         |
| 6:00P – Until...| “Charm City Dining” - Dinner On Your Own                                           | Baltimore, MD                     |
### Tuesday, June 20, 2017

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<td>5:00P – 6:30P</td>
<td>Breakout Session: T32 Training Grant Tables</td>
<td>Grand Ballroom Salon VII/VIII</td>
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<td>Poster Viewing (unattended)</td>
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<td>Baltimore Marriott Waterfront-Sponsored Coffee Break</td>
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<tr>
<td>9:45A – 10:45A</td>
<td>Message from The Director</td>
<td>Grand Ballroom Salon V/VI</td>
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<td>10:45A – 11:45A</td>
<td>TWD Listens/Feedback Session (TWD Staff Panel)</td>
<td>Grand Ballroom Salon V/VI</td>
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<tr>
<td>11:45A</td>
<td>TWD Program Directors’ 2017 Meeting Adjourned</td>
<td></td>
</tr>
</tbody>
</table>

2017 TWD Program Directors’ Meeting is funded in part by grants from the National Institute of General Medical Sciences of the National Institutes of Health. [T36 GM0008059-32; T36 GM0008637-21]
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<tr>
<td>Abstracts: Poster Session B</td>
<td>40</td>
</tr>
<tr>
<td>Abstracts: Poster Session C</td>
<td>77</td>
</tr>
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</table>
Dear Colleagues,

On behalf of the FASEB Office of Sponsored Programs, Diversity and Grants Administration staff and the 2017 Training, Workforce Development and Diversity (TWD) Program Planning Committee, I want to welcome you to the 2017 TWD Program Directors’ Meeting.

As we reflect on our successes in preparing the outstanding and diverse biomedical workforce for tomorrow, we recognize that the careful and stage-appropriate development – from exploration to degree attainment to career development and beyond – rests upon your continued commitment, dedication and expertise.

This meeting represents an important networking and partnership opportunity in itself, and we look forward to interacting with each of you, exchanging ideas, formulating new strategies, and considering new ways to keep the conversations alive year round.

Welcome and thanks again for your engagement.

Jacquelyn Roberts
Director
Federation of American Societies for Experimental Biology (FASEB)
Office of Sponsored Programs, Diversity and Grants Administration
FASEB MARC Program

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**2017 TWD Program Planning Committee**

- Joey Barnett, Ph.D. (Vanderbilt University School of Medicine)
- Kelly Cox (Federation of American Societies for Experimental Biology)
- Stephen Dewhurst, Ph.D. (University of Rochester Medical Center)
- Jessica Faupel-Badger, Ph.D. (National Institutes of Health, National Institute of General Medical Sciences)
- Kenneth Gibbs, Jr., Ph.D., M.P.H. (National Institutes of Health, National Institute of General Medical Sciences)
- Barry Komisaruk, Ph.D. (Rutgers University)
- Joyce Lloyd, Ph.D. (Virginia Commonwealth University Medical Center)
- Jacquelyn Roberts (Federation of American Societies for Experimental Biology)
- Mercedes Rubio, Ph.D. (National Institutes of Health, National Institute of General Medical Sciences)
- Michael Sesma, Ph.D. (National Institutes of Health, National Institute of General Medical Sciences)

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**2017 TWD Program Directors’ Meeting Management**

- Kelly Cox (Federation of American Societies for Experimental Biology)
- Jacquelyn Roberts (Federation of American Societies for Experimental Biology)
General Information

**TWD Registration Desk Hours**
Location: Convention Registration Desk  
Sunday  1:00P – 7:00P  
Monday  7:30A – 6:00P  
Tuesday  7:30A – 6:30P  
Wednesday  7:30A – 12:00P  
Managers-on-Duty: Kelly Cox and Cordelia Smith

**FASEB Emergency Contact Info**
Jacquie Roberts – 240.281.8294 (text or call)

**Internet Access**
Guest rooms Wireless  
- Complimentary for Marriott Rewards members; *TWD 2017 attendees can enroll free-of-charge.*  
- High Speed: $12.95/day; Enhanced High Speed: $15.95/day  
- Lobby and public areas: Complimentary Wireless

**Audio/Visual Support provided by:**  Atlantic Images & Sound Event Services, LLC  
Location: Atlantic Room (Grand Ballroom Level)  
Managers-on-Duty: Eric Berry, William Slater, C.L. Rando and Carl Rando

**Hotel Parking**
- On-site parking, fee: $8.50 hourly, $26 daily  
- Valet parking, fee: $45 daily  
- *Parking garage does not accommodate oversized vehicles-height clearance 6 feet 8 inches.*
## 2017 TWD Program Directors' Meeting
Baltimore Marriott Waterfront, Maryland
Daily Schedule

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| 4:00P – 5:00P | Presentations  
Highlighting Outcomes of NRMN/BUILD/ IPERT /CEC/UI:  
- UTEP BUILDing SCHOLARS, Lourdes Echegoyen, Ph.D.  
- STEM BUILD @UMBC, William (Bill) LaCourse, Ph.D.  
- CSUN BUILD PODER, Crist Khachikhian, Ph.D.  
- CSULB BUILD, Laura Kingsford, Ph.D.  
- NRMN, Rafael Luna, Ph.D.  
- CEC, Keith Norris, MD, Ph.D./Teresa Seeman, Ph.D.  
- IPERT, Giovanna Guerrero-Medina, Ph.D.  
- IPERT, Christine Pribbenow, Ph.D.  
Moderator: Mercedes Rubio, Ph.D. | Grand Ballroom Salon V/VI                                    |
| 5:00P – 5:30P | Baltimore Marriott Waterfront-Sponsored Coffee Break                | Grand Foyer West                   |
| 5:00P – 7:00P | Poster Session A (BUILD, NRMN, IPERT, and T32)                     | Grand Foyer West                   |
| 7:00P – until | “Charm City Dining” – Dinner On Your Own                           | Baltimore, MD                      |

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| 9:00A – 10:00A | “Next Gen Ph.D.s and Careers”  
Speaker: Melanie V. Sinche, NCC  
Moderator: Jessica Faupel-Badger, Ph.D. | Grand Ballroom Salon V/VI            |
| 10:00A – 10:30A | Baltimore Marriott Waterfront-Sponsored Coffee Break                | Grand Foyer West                   |
| 10:30A – 12:00P | PANEL: Career Panel Discussion  
Speaker: Kenny Gibbs, Jr., Ph.D., M.P.H.; Klarissa Jackson Hardy, Ph.D.; Lisan Parker Smith, Ph.D.; Odaine Gordon, Ph.D.  
Moderator: Kenny Gibbs, Jr., Ph.D., M.P.H. | Grand Ballroom Salon V/VI                                    |
| 12:00P – 1:30P | “Charm City Dining” - Lunch On Your Own                             | Baltimore, MD                      |
| 1:30P – 2:30P | Presentation/Workshop  
“NRMNet and MyNRMN: Tools for mentoring and networking”  
Speakers: Jamboor K. Vishwanatha, Ph.D.  
Moderator: Mercedes Rubio, Ph.D. | Grand Ballroom Salon V/VI                                    |
| 2:30P – 3:00P | Baltimore Marriott Waterfront-Sponsored Coffee Break                | Grand Foyer West                   |
| 3:00P – 4:00P | Breakout Session: IRACDA  
Chair: Jessica Faupel-Badger, Ph.D. | Contact Dr. Faupel-Badger for information  
badgerje@nigms.nih.gov |
| 3:00P – 4:00P | Breakout Session: MARC  
Chair: Sailaja Koduri, Ph.D. | Grand Ballroom Salon IX/X            |
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| 3:00P – 5:00P | Breakout Session: Bridges to Baccalaureate  
  *Chairs: Mercedes Rubio, Ph.D.*  
  *Co-organizers: Linda Gutierrez Tunstad, Ph.D. and Joe Skrivanek, Ph.D.* | Grand Ballroom Salon I/II          |
|               | Breakout Session: Bridges to Doctorate  
  *Chairs: Patrick H. Brown, Ph.D.*  
  *Co-organizers: Linda Gutierrez Tunstad, Ph.D. and Joe Skrivanek, Ph.D.* | Grand Ballroom Salon III/IV        |
|               | Breakout Session: RISE  
  *Chair: Luis Cubano, Ph.D.* | Grand Ballroom Salon VII/VIII      |
|               | Breakout Session: IMSD  
  *Chair: Veerasamy Ravichandran, Ph.D.* | Chasseur                           |
|               | Breakout Session: PREP  
  *Chair: Michael Bender, Ph.D. and Kenny Gibbs, Jr., Ph.D., M.P.H.* | Dover A                            |
|               | Breakout Session: BUILD  
  *Co-Chairs: Anissa Brown, Ph.D., Richard Okita, Ph.D., and Desiree Salazar, Ph.D.* | Dover B                            |
|               | Breakout Session: IPERT/MARC T36/CEC  
  *Chair: Michael Sesma, Ph.D.* | Dover C                            |
|               | Breakout Session: T32  
  *Chair: Shiva Singh, Ph.D.* | Grand Ballroom Salon V/VI          |
| 5:00P – 6:00P | TWD Program Directors’ Steering Committee Meeting  
  *Chair: Barry Komisaruk, Ph.D., Rutgers University* | Grand Ballroom Salon V/VI          |
| 6:00P – Until | “Charm City Dining” - Dinner On Your Own | Baltimore, MD                      |
| 7:00P – 9:30P | BUILD Team Networking Session  
  *Organizer: Anissa Brown, Ph.D.* | Contact Dr. Anissa Brown for more information anissa.brown@nih.gov |

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| 9:00A – 10:00A| Panel Discussion with T32 PIs  
  **“T32 Supplements”:**  
  - R25 Reproducibility: Vivian Siegel, Ph.D.  
  - T32 Rigor: Donna Korzick, Ph.D.  
  - T32 Career: Philip R. Mayeux, Ph.D.; Gordon Laurie, Ph.D.; Stefan Strack, Ph.D.  
  - T32 Research Curriculum Skills Development: Miguel Garcia-Diaz, Ph.D.; Thi Nguyen, Ph.D.; William Atkins, Ph.D.  
  *Moderator: Shiva Singh, Ph.D.* | Grand Ballroom Salon V/VI          |
| 10:00A – 10:30A| Baltimore Marriott Waterfront-Sponsored Coffee Break | Grand Foyer West                   |
| 10:00A – 11:00A| Poster Session C  
  **T32 Supplements, R25 Rigor & Reproducibility PIs** | Grand Foyer West                   |
| 11:00A – 12:00P| Science Education Session  
  *Speaker: Erin L. Dolan, Ph.D.*  
  *Moderator: Kenny Gibbs, Jr., Ph.D., M.P.H.* | Grand Ballroom Salon V/VI          |
| 12:00P – 1:30P | “Charm City Dining” - Lunch On Your Own | Baltimore, MD                      |
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<td>1:30P – 2:30P</td>
<td><strong>Breakout Session: Unique Opportunities...Working with Deaf Trainees</strong>&lt;br&gt;Speakers: Peter Hauser, Ph.D. and Steven Barnett, M.D.&lt;br&gt;Moderator: Mercedes Rubio, Ph.D.</td>
<td>Grand Ballroom Salon VII/VIII</td>
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<td><strong>Breakout Session: NIH BEST Program Idea Exchange</strong>&lt;br&gt;Speakers: Stephanie Watts, Ph.D.; Avery August, Ph.D.; Victoria (Vicky) Prince, Ph.D.&lt;br&gt;Moderator: Jessica Faupel-Badger, Ph.D.</td>
<td>Grand Ballroom Salon IX/X</td>
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<td>2:30P – 3:00P</td>
<td><strong>Baltimore Marriott Waterfront-Sponsored Coffee Break</strong></td>
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<td>3:00P – 5:00P</td>
<td><strong>Evaluation Workshop</strong> (an interactive workshop on evaluating your program and disseminating information)&lt;br&gt;Conducted by Keith Norris, M.D., Ph.D.&lt;br&gt;Moderator: Kenny Gibbs, Jr., Ph.D., M.P.H.</td>
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<td>5:00P – 6:00P</td>
<td><strong>Breakout Session: CareerTrac</strong>&lt;br&gt;Speaker: Christina (Christie) Drew, Ph.D.&lt;br&gt;Moderator: Mercedes Rubio, Ph.D.</td>
<td>Grand Ballroom Salon IX/X</td>
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<td><strong>Breakout Session: T32 Training Grant Tables</strong>&lt;br&gt;Speaker: Richard Okita, Ph.D.</td>
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<tr>
<td>5:00P – 6:30P</td>
<td><strong>Do You Play Fair? A Workshop about Bias in Academia</strong>&lt;br&gt;Conducted by: Christine M. Pribbenow, Ph.D.</td>
<td>Grand Ballroom Salon III/IV</td>
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<td>6:00P – 8:00P</td>
<td><strong>Poster Viewing</strong> (unattended)</td>
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<td>9:45A – 10:45A</td>
<td><strong>Keynote Address</strong>&lt;br&gt;Message from The Director&lt;br&gt;Jon Lorsch, Ph.D.</td>
<td>Grand Ballroom Salon V/VI</td>
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<td>10:45A – 11:45A</td>
<td><strong>TWD Listens/Feedback Session</strong>&lt;br&gt;(TWD Staff Panel)</td>
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*2017 TWD Program Directors’ Meeting is funded in part by grants from the National Institute of General Medical Sciences of the National Institutes of Health.*

*[T36 GM0008059-32; T36 GM0008637-21]*
## 2017 TWD Program Directors’ Meeting Abstracts

### POSTER SESSION A: Sunday, June 18, 5:00P - 6:30P

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### POSTER SESSION C: Tuesday, June 20, 10:00A -11:00A

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ABSTRACTS – POSTER SESSION A
BUILD POSTER A1

BUILDing SCHOLARS: Combining Asset Bundles with High Impact Practices

Lourdes E. Echegoyen¹,², PhD; Stephen B. Aley³,⁴, PhD; Thomas Boland⁵, PhD; Timothy Collins⁶, PhD; Guadalupe Corral³,⁵, PhD; Marc B. Cox, PhD⁴,⁸; Sara Grineski⁶, PhD; Osvaldo Morera⁸, PhD; Amy Wagler¹⁰, PhD

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NIGMS/NIH TWD Program: Diversity Program Consortium/BUILD

Keywords: BUILD; Boot Camp; Course-based Undergraduate Research Experiences; Summer Research Experiences

Abstract: In order to train the next generation of biomedical researchers and contribute to a diversified biomedical research workforce, the student development activities of our NIGMS-funded BUILDing SCHOLARS¹ project are based on the premise that progress in recruiting and retaining the most talented minority students in the sciences requires institutional investment in five types of asset bundles: 1) educational endowments, 2) science socialization, 3) network development, 4) family expectations, and 5) material resources.² This presentation will focus on just three of the multiple interventions associated with the first three bundles, which are addressed through a rigorous training sequence that engages our students in various dimensions of undergraduate research and other high impact practices.³ The summer prior to their first semester, incoming BUILD freshmen participate in a 3-week boot camp that prepares them to transition to the rigors of a university environment. Then, as entering freshmen students enroll in a 3-course research intensive sequence that is open to all students on campus. Through the duration of the program, BUILD fellows spend their summers conducting research with faculty at one of 12 research partner institutions or at UTEP. Results of post-boot camp subject tests show a significant increase in preparation relative to pre-boot camp tests. Data also demonstrate a sizable increase in freshman to sophomore year retention for all students who enroll in the research intensive course sequence relative to students who take the traditional courses. Additionally, answers to survey questions intended to gauge the impact of the summer research experience, such as those measuring development/increase of science identity and self-efficacy, and intent to pursue PhDs and biomedical research careers, resulted in over 78% agreement/strong agreement. This indicates that BUILDing SCHOLARS is on track to increase the overall percentage of UTEP students who will eventually join the biomedical research workforce. 5UL1GM118970-03

References
Project Pathways, BUILD Program at Xavier University of Louisiana

Maryam Foroozesh, PhD, Xavier University of Louisiana, New Orleans, LA; Kathleen Morgan, PhD, Xavier University of Louisiana, New Orleans, LA; Marguerite Giguettte, PhD, Xavier University of Louisiana, New Orleans, LA; Kelly Johanson, PhD, Xavier University of Louisiana, New Orleans, LA

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Keywords: Biomedical Research; Student Training; Academic Support.

Xavier University of Louisiana is a historically Black and Catholic institution whose mission is to “promote a just and humane society” by educating students in a diverse learning environment. Even though Xavier’s reputation in the sciences attracts many of the best and brightest students, the University also continues to provide an excellent educational opportunity to many students who, due to socioeconomic disparities, lack the appropriate preparation for college, and thus are not welcomed by many other institutions of higher education.

The ultimate goal of Project Pathways, the BUILD Program at Xavier, is to increase the number of students who actively consider biomedical research careers and ultimately enter graduate programs in biomedical disciplines, successfully earn terminal degrees, and enter the biomedical research workforce. Xavier's plan to meet this challenge is based on a holistic approach, providing an integrated and coordinated student support and research skills training network. This coordinated effort cuts across academic departments in biomedical disciplines, academic support offices that include the Student Academic Success Office (SASO), the Office of Career Services (OCS), and the Center for Undergraduate Research and Graduate Opportunity (CURGO), as well as the Center for the Advancement of Teaching and Faculty Development (CAT+FD) for faculty support and mentor training. This work seeks to counter the regular practice at higher education institutions that have yet to address the importance of integrated programming across academic programs, student support programs, and research programs, lack of which often leads to duplication of efforts and ineffective use of resources. Xavier's BUILD program intentionally provides mechanisms and safeguards to ensure that coordination and integration occur at all levels.

Through Project Pathways, the students are provided with academic support, career information and counseling, research training, and opportunities for networking and developing their scientific communication skills. In addition, they receive hands-on mentoring by faculty and program staff. BUILD provides faculty with pedagogical and mentor training workshops as well as research funding through pilot grants. In addition, the Program provides post-baccalaureate research skills training in form of one-year BUILD Technician positions. Project Pathways is now in its third year. Early stage assessment results are very encouraging; however, full longitudinal assessment of the various program initiatives is required to determine final program outcomes. The Project Pathways’ initiatives can be replicated at institutions whose goal is to have a positive impact on the matriculation of individuals from underrepresented populations into and through biomedical doctoral programs and eventually into the biomedical workforce.

Funding: NIH NIGMS grants numbers 5UL1GM118967, RL5GM118966, and 5TL4GM118968
BUILD EXITO: Partnering for Undergraduate Research Training in Biomedical Fields

Cynthia Morris, Dawn Richardson, Thomas Keller, De'Sha Wolf and Carlos Crespo

Oregon Clinical & Translational Research Institute, Oregon Health & Science University, Joint School of Public Health, Portland State University- Oregon Health & Science University, Center for Interdisciplinary Mentoring Research, Portland State University.

Abstract:

As part of the NIH BUILD initiative to diversify the scientific workforce, the EXITO project is a large multi-institutional providing comprehensive support and training for undergraduates from traditionally underrepresented student populations who aspire to health-related research careers. Portland State University (PSU), a major public urban university, and Oregon Health & Science University, a research-intensive academic health center, lead the EXITO network of eleven 2-year and 4-year institutions of higher education spanning Oregon, Washington, Alaska, Hawaii, Guam, American Samoa, and the Northern Mariana Islands. The EXITO project is a multi-level intervention offering a three-year research training pathway for scholars across multiple disciplines in the biomedical, behavioral, health, and social sciences. Fundamental components of the model include student outreach and engagement, integrated curricular enhancements, intensive research experiences, three tiers of developmental mentoring, supportive community and services, and rigorous evaluation and quality improvement. EXITO features several innovative approaches to research training, including supported summer entry into research placements, incorporation of responsible conduct of research content into general education curriculum, and intentional matching of scholars with three types of mentors (e.g., peer, career, research). EXITO also addresses the sustainability of undergraduate research training by addressing faculty and institutional development that includes holding curriculum development conferences, creating research learning communities, awarding pilot project research funding, providing mentor training and ongoing support, collaborating with other research equity programs, and developing campus infrastructure and services to support scholars with diverse backgrounds and needs. The EXITO project involves inter-institutional coordination to accommodate students transferring from 2-year partner institutions to PSU, as well as inter-institutional replication to deliver the program model in its entirety at partnering 4-year institutions. Preliminary findings and insights are reported from evaluation of consortium-wide and site-specific outcomes reflecting student success, faculty development, and institutional development. 5RL5GM118963-03, 5UL1GM118964-03, 5TL4GM118965-03
Finding the Best Match: Managing a Multi-Institutional Mentoring Program using an Online Mentoring Interface

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¹Department of Sociology and Anthropology; ²Research Evaluation & Assessment Services, ³Office of Research & Sponsored Projects & Department of Biological Sciences; ⁴Department of Metallurgical, Materials and Biomedical Engineering; ⁵Center for Faculty Leadership and Development & Department of Biological Sciences; ⁶Campus Office of Undergraduate Research Initiatives & Department of Chemistry; ⁷Department of Psychology; ⁸Department of Mathematics.
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NIGMS/NIH TWD Program: Diversity Program Consortium/BUILD

Key words: mentoring, undergraduate research, BUILD

Abstract: Our NIGMS-funded BUILDing SCHOLARS program involves 100+ undergraduate students from over 20 majors, faculty mentors from the primary institution, and faculty mentors from 12 research partner institutions. The need to effectively coordinate a faculty-mentored research program across the 13 institutions motivated us to experiment with an on-line mentoring software program from Chronus™. We customized the software for our program needs with help from Chronus™ technicians. Each user is invited to complete a profile form, which includes their basic information, CV, and research interests. Students are matched to faculty by program personnel, with the help of a matching algorithm. Once the pairs are matched, faculty nominate a ‘second mentor’ (e.g., graduate student), who is linked into the connection. The connected students and mentors then access a tailored connection plan, which is also distributed via email. They are prompted to schedule meetings, to complete a mentor-mentee compact and individual development plan, and to meet deadlines (e.g., turn in research poster). We use the profile forms to match students for summer research, but also for academic year research and with peer mentors in our peer mentoring program. On a survey of academic year mentoring program participants (n=~80), users rated the system as approximately a 5 on a 7-point scale, in terms of ease of use, satisfaction, and functionality. They rated the mentoring content received as a 4 on a 7-point scale. The best aspects of the system, as reported by users, were the reminders of due dates and the accessibility of mentor profiles, which can be easily browsed by students. The worst aspects related to user perceptions of excessive email volume and information overload. In terms of lessons learned, the system can be an effective tool for managing a dispersed mentoring program, even though users may express skepticism regarding its utility.

References:
http://chronus.com/
https://buildingscholars.chronus.com
An Entrepreneurial Training Model to Enhance Undergraduate Training in Biomedical Research

Farin Kamangar\textsuperscript{1,2}, Gillian Silver\textsuperscript{1}, Christine Hohmann\textsuperscript{1,2}, Cleo Hughes-Darden\textsuperscript{1,3}, Jocelyn Turner-Musa\textsuperscript{1,4}, R. Trent Haines\textsuperscript{1,4}, Michael Koban\textsuperscript{1,3}, Gloria Hoffman\textsuperscript{1,3}, Avis Jackson\textsuperscript{1}, Payam Sheikhattari\textsuperscript{1,5}

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\textsuperscript{5}Department of Behavioral Health Sciences, School of Community Health and Policy, Morgan State University, Baltimore, MD, USA

The NIH Building Infrastructure Leading to Diversity (BUILD) Initiative was established to fund innovative undergraduate research training programs and support institutional and faculty development of the recipient university. The training model at Morgan State University (MSU), namely “A Student-Centered Entrepreneurship Development training model” (ASCEND), is one of the 10 NIH BUILD-funded programs, and offers a novel, experimental “entrepreneurial” training approach. In the ASCEND training model, the students take the lead. They own the research, understand the big picture, and experience the entire scope of the research process, which we hypothesize will lead to a greater sense of self-efficacy and research competency, as well as an enhanced sense of science identity. They are also immersed in environments with substantial peer support, where they can exchange research ideas and share experiences. This is important for underrepresented minority students who might have fewer role models and less peer support in conducting research.

We will describe the MSU ASCEND entrepreneurial training model’s components, rationale, and history, and how it may enhance undergraduate training in biomedical research. We also discuss evaluation methods, possible sustainability solutions, and programmatic challenges.

Morgan State’s ASCEND program is supported by the National Institute of General Medical Sciences, National Institutes of Health, under Award Numbers UL1GM118973, 8RL5GM118972, and 8TL4GM118974.
Engaging Rural Students in Biomedical Research Through One Health Focused Undergraduate Research Experiences

Karsten Hueffer, Arleigh J. Reynolds, Paul Cotter

BLaST (Biomedical Learning and Student Training), Department of Veterinary Medicine, College of Natural Science and Mathematics, University of Alaska Fairbanks, Fairbanks AK 99775

Abstract: The large size of Alaska and resulting subsistence lifestyle is a challenge for traditional western-based approaches to student engagement. By presenting biomedicine in the context of the One Health Paradigm, which explicitly links animal, environmental and human health, we hypothesize to be able to specifically engage and retain underrepresented students into this program that synergistically integrates research and teaching and aligns more closely with indigenous patterns of learning and teaching. Our Biomedical Learning and Student Training program (BLaST) provides undergraduate research experience in a One Health context to train students in a meaningful way.

Initial quantitative and qualitative data from students and faculty indicate high levels of engagement and satisfaction with mentored research experiences. Undergraduate researchers report significantly increased interest, comfort, and competency in laboratory research, and improved understanding of science and of laboratory research methods (p<0.01 in all cases; Wilcoxon Paired Sample Tests). Trends suggest undergraduate researchers from rural backgrounds are especially interested in connections between animal/environmental health and human health.

Together our research suggest that the One Health concept which includes zoonotic diseases is a valuable tool to engage students in research and make this research more meaningful especially for students from a rural background that are underrepresented in biomedical research.
BUILD POSTER A7

Transitioning From an Emerging to Established Research Institution

Paul Buonora, Enri’que Flores, Kim Vu, Arturo Zavala, Jesse Dillon, Selena Nuygen-Rodriguez, Guido Urizar, Laura Kingsford; California State University, Long Beach

Keywords: Physical Infrastructure, Research Curriculum, Institutionalization

Abstract: The NIH’s Building Infrastructure Leading to Diversity (BUILD) program gave Long Beach State the opportunity to expand the scale of training programs, and to leverage institutional change supporting the transition from an “emerging” to an “established” research institution. This poster focuses on two key components of the effort: the campus physical and curricular infrastructure.

In partnership with the university, physical infrastructure investments include renovations of campus spaces, purchase of state-of-the-art major and mid-sized research equipment targeted to needs of the four colleges participating in BUILD. Hundreds of CSULB students and faculty have utilized these resources to advance the number of research projects and level of research on the campus.

More than a physical infrastructure, strengthening a research culture requires a motivated community of scholars. Keeping with the goals of enhancing the number and diversity of researchers and addressing institutional goals of enhancing completion rates and time to completion, we added a curricular solution in our Research Career Exploration course which brings aspects of freshmen advising and individual development plan creation with an emphasis on exploring the potential of research careers to serve the values and community focused interests of our students. The logistics of this have delayed the inauguration of the course until Spring 2018.

Once engaged by the prospect of a research career, students can now participate in the BUILD developed CSULB Research Curriculum, which provides research skills training through courses in Interdisciplinary Approaches to Health Disparities, Scientific Research Communication and Introductory and Advanced Research Methods. Providing General Education credit ensure we had minimal impact on time to degree and support introduction into degree plans. Course development and general education certification slowed offering courses, but all have been offered and enrollment pressure from two already supports optimism about institutionalization.

Funding: 8RL5GM118978
NIGMS Workforce Diversity Programs at Xavier University of Louisiana

Teresa Birdwhistell, PhD, MARC U*STAR Program, Xavier University of Louisiana, New Orleans, LA; Maryam Foroozesh, PhD, RISE and BUILD Programs, Xavier University of Louisiana, New Orleans, LA; Marguerite Giguette, PhD, Associate Vice President of Academic Affairs, Xavier University of Louisiana, New Orleans, LA; Kathleen Morgan, PhD, BUILD Program, Xavier University of Louisiana, New Orleans, LA; Kelly Johanson, PhD, BUILD Program, Xavier University of Louisiana, New Orleans, LA; Ja’Wanda Grant, PhD, Center for Undergraduate Research and Graduate Opportunity, Xavier University of Louisiana, New Orleans, LA

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Keywords: Biomedical Research; Student Training; Academic Support; Synergy.

Xavier University of Louisiana is a historically Black and Catholic university nationally recognized for its STEM curriculum. Seventy-nine percent of current Xavier undergraduates are majoring in biomedically related disciplines. According to the US Department of Education, during the past decade, Xavier has ranked first nationally in the number of African American students earning undergraduate degrees in Biology, Chemistry, Physics, and the Physical Sciences overall. The University is also first nationally in the number of Black graduates who go on to earn doctorates in the Life Sciences and fifth in producing African American students who earn their PhDs in Science and Engineering. Despite these accomplishments, the average percentage of Xavier Biomedical graduates entering graduate programs directly after graduation is only 16%. On average, 41% of Xavier’s new freshmen annually enter a premed curriculum; however, only 4% of Xavier’s annual graduating class actually enter medical schools. Also, despite a significant proportion of students entering Xavier as Pre-pharmacy majors, only about 28% of these students are accepted into Pharmacy School. Xavier thus has a large number of Biomedical majors who with additional research exposure, support, and career counselling could potentially choose careers in Biomedical research.

Training, Workforce Development, and Diversity programs at Xavier (Building Infrastructure Leading to Diversity (BUILD), Maximizing Access to Research Careers (MARC), and Research Initiative for Scientific Enhancement (RISE)) work together to try to reach these students and increase the number of graduates who pursue careers in biomedical research. Through close collaboration the three programs are able to work synergistically to increase effectiveness, reduce duplication of efforts, and leverage all funding to promote programmatic goals. The programs coordinate with Xavier’s Center for Undergraduate Research and Graduate Opportunity (CURGO) in recruiting and selecting students for the programs. The mechanisms of this collaboration and the impacts on the programs will be presented.

Funding: NIH NIGMS award numbers 5UL1GM118967, RL5GM118966, 5TL4GM118968 (BUILD), 5T34GM07716 (MARC), and 5R25GM060926 (RISE)
“Do You Play Fair?” is an NIH-sponsored training (IPERT-GM114002) that explores and addresses biases that impede student success in STEMM fields. *Fair Play* is a video game designed to raise awareness about stereotypes, microaggressions, and other racial biases in academia (NIH-GM08352). In the game, players step into the shoes of Jamal, an African-American graduate student who experiences bias incidents as he navigates through his academic career and interacts with faculty, staff, and students on a college campus. *Fair Play* enables players to experience and learn about many forms of racial bias firsthand, providing an engaging and dynamic environment for perspective-taking and increasing bias literacy, which helps to reduce bias and afford Black students equal opportunities to excel in science (Kaatz et al., 2017). The training is modeled after other evidence-based bias literacy workshops (Carnes et al., 2015). The first module presents research on unintentional racial bias (i.e., “implicit bias”) and how it functions as a “habit of mind.” In module 2, participants play through *Fair Play*. Following game play (module 3), participants reflect on their experiences as Jamal and learn about a variety of evidence-based techniques that have been shown to yield long-term change in implicit bias. Besides conducting this training at national venues, the team is invited to different institutions of higher education. As this program begins its third year, training of workshop facilitators across this country is a priority for its dissemination.

Funding: NIH-GM08352, IPERT-GM114002
Research and Educational Career Development Program for Cell Biologists: An Integrated Approach

Latanya Hammonds-Odie, Ph.D., School of Science and Technology, Georgia Gwinnett College, Lawrenceville, Georgia 30043, USA, Michael Leibowitz, M.D., Ph.D., Department of Medical Microbiology and Immunology, University of California Davis School of Medicine, Davis, CA 95616, USA, and MariaElena Zavala, Ph.D., Department of Biology, College of Science and Math, California State University, Northridge, Northridge, CA 91330, USA

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Keywords: Professional Development, Diversity, Mentoring, Career-Stage Appropriate

The American Society for Cell Biology (ASCB), the Minorities Affairs Committee (MAC) Research and Educational Career Development Program for Cell Biologists: An Integrated Approach was built on the success of our previous career-stage appropriate programming for junior scientists and postdoctoral fellows who are members of underrepresented groups and for faculty members at under-resourced colleges and universities. This project revolved around five activities developed and directed by the ASCB MAC.

- Mentoring Academy: This activity provided professional development workshop sessions for over 100 undergraduate and graduate students, postdoctoral fellows and junior faculty members at the Mentoring Symposium and Academy at the 2016 ASCB Annual Meeting.
- Outreach Activities: The ASCB MAC provided travel awards to 14 undergraduate students, 35 graduate students, 13 postdoctoral fellows, and 23 junior faculty members to attend and present at the 2016 ASCB Annual Meeting. In addition, MAC members coordinated sessions at ABRCMS and SACNAS meeting and disseminated information about MAC programming, other ASCB activities, and other professional development opportunities via email distribution lists and social media posts.
- Visiting Professors Program (VP): Four faculty members from MSIs or PUIs were supported for mentored training experiences at research-intensive universities. These experiences should have significant impacts on their career trajectories and on the research capabilities at the VPs’ home institutions.
- Junior Faculty and Postdoctoral Fellows Career Development Workshop: The 2016 Workshop in Raleigh, NC was attended by 12 postdoctoral fellows, 11 junior faculty members, and 4 at others career stages. The 3-day workshop included 27 sessions on topics ranging from grantsmanship to networking to how to mentor students.
- Linkage Fellows Program (LF): Seven faculty members at under-resourced campuses were supported to engage students in activities centered on Cell Biology. These context-relevant programs implemented by the LF impacted hundreds of students.
- Supported by NIH NIGMS TWD 5R25GM116707 awarded to the ASCB
The Leadership Alliance Synergistic Network to Enhance Research that Grows Innovation (SYNERGI)

Medeva Ghee, Ph.D.¹, Micere Keels, Ph.D.², Chloe Poston, Ph.D.¹, Dolores Bradley, Ph.D.³, Brian M. Lawrence, Ph.D.⁴, Regina Dixon Reeves, Ph.D.⁵, Nancy Schwartz, Ph.D.⁶, Don C. Brunson, Ph.D.⁷
¹The Leadership Alliance, Brown University, Providence, RI; ²Department of Comparative Human Development, University of Chicago, Chicago, IL; ³Department of Psychology, Spelman College, Atlanta, GA; ⁴Department of Chemistry, Morehouse College, Atlanta, GA; ⁵Office of the Provost, University of Chicago, Chicago, IL; ⁶Department of Pediatrics, Department of Biochemistry and Molecular Biology, University of Chicago, Chicago, IL; ⁷Graduate School, Vanderbilt University, Nashville, TN

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Keywords: Undergraduate skill-building; Professional development; Mentoring; Career training

The Leadership Alliance is a national partnership among 36 institutions and private industry. The Alliance flagship programs include the Summer Research Early Identification Program (Ghee et al., 2016) and the Leadership Alliance National Symposium. To expand training and mentoring activities, a collaborative effort, SYNERGI, SYnergistic Network to Enhance Research that Grows Innovation, was formed among Brown University, Morehouse College, Spelman College, University of Chicago, and Vanderbilt University. The goal is to increase the readiness and competitiveness of underrepresented scholars as they train for and enter careers in the research workforce. Informed by the social cognitive career theory (Bandura, 1986), we propose that the provision of programmatic interventions at each stage of the academic pathway results in positive changes in trainees’ knowledge of careers, plans to pursue doctoral programs and research careers.

SYNERGI partners developed and implemented the Creating a Collaborative Learning Group and What is Research workshops for first year undergraduates. Post-workshop surveys revealed an increased understanding of the skills needed to effectively work within a collaborative learning group and the benefits of participating in undergraduate research opportunities. A career development workshop for graduate students and postdoctoral scholars incorporated the expertise of the NIH Broadening Experiences in Scientific Training consortium. Pre and post survey results revealed that participants demonstrated sizeable increases in their knowledge of research and non-research careers and acknowledged considerable gains on how to market themselves for research careers. A Faculty Retreat on Mentoring Diverse Scholars had an impact on participants’ heightened awareness of culturally sensitive issues in mentoring and emphasized the need for self-reflection and continued mentor training. Our results provide preliminary evidence of effective programmatic interventions that have the potential to increase trainees’ self-efficacy as they progress through the academic pathway.

The SYNERGI project is supported by an R25 IPERT award from the NIGMS.

References:

Leading Diverse and Emerging Scientists to Success (LEADS)

Authors: Doris Rubio, PhD, Lourdes E. Soto de Laurio, EdD, MPHE, Stephanie Bailey, MD, George Perry, PhD, Magda Shaheen, PhD, MPH, MS, Alex Quarshie, MD, MS, Todd Seto, MD, MS.

Motivation: To diversify the biomedical research workforce by training post doctoral scholars and junior faculty from six Minority Serving Institutions (MSIs) (University of Puerto Rico, University of Hawaii, Morehouse School of Medicine, Meharry College of Medicine, Charles Drew University, and University of Texas San Antonio) on practical research skills such as Critical and Creative Thinking, Grant Writing, and Team Science.

Approach: In collaboration with our partners, we identified 9 areas where trainees lacked training. We created innovative online modules for each area using Moodle as the content management system. Scholars complete readings, videos, self assessments and participate in discussion board each week. In addition, we have weekly synchronous sessions for each module. All scholars are required to take the grant writing module and 8 other modules. After each module, trainees complete a brief survey to evaluate the module. The leaders at the MSI participated in an intensive face-to-face training session on how to be a career coach so that they can be career coaches for the LEADS Scholars at their home institutions. Travel awards are available to Scholars for them to attend a national conference to present their work or receive specialized training.

Results: In the first year, we selected 13 LEADS Scholars from 5 of the MSIs. Scholars value each of the modules and rated them very highly. One scholar already received a grant. Another scholar was accepted into NRMN Grant Writing Coaching Groups, and another scholar was accepted into the Early Career Reviewer program for NIH.

Discussion: Post doctoral scholars and junior faculty from MSI need practical research training to help launch their research career. We suspect that this is true of many institutions and plan to develop these modules so that they can be widely disseminated to other institutions.
NRMN POSTER A13

NRMN-CAN: Model of Multi-Institutional Cooperation in ESI Career Advancement

Nancy B. Schwartz¹, Laurie E. Risner¹, Rick McGee², Aman Yadav³, Xenia Morin⁴, Peter Hitchcock⁵, Evelyn Erenrich⁴, Philip Clifford⁶, Jeffrey Franke⁷

¹University of Chicago, ²Northwestern University, ³Michigan State University, ⁴Rutgers University, ⁵University of Michigan, ⁶University of Illinois at Chicago, ⁷University of Maryland

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Abstract

The absence of supportive mentoring practices may have a significant impact on the training environments and career trajectories of STEM trainees at all levels. These deficiencies are especially impactful on aspiring scientists from underrepresented (UR) populations who may be acutely sensitive to training environments that do not provide adequate mentored support, and in particular may lead to fewer UR postdocs entering the professoriate. Educators and scientists have recognized the need for enhanced professional skill development and grantsmanship training to address the lower success rates for postdocs and junior faculty in obtaining NIH funding. Unfortunately, with constricting institutional budgets and increased pressure on faculty time, it is often difficult for individual institutions to muster the resources and instructional talent to provide adequate training in all the areas needed to launch an academic career.

Through a National Research Mentoring Network (NRMN) Supplement, the Big Ten Academic Alliance (15 institutions) has 1) leveraged its individual institutional resources, 2) built multi-institutional cooperatives, 3) created inter-institutional mentoring and grantsmanship training teams, 4) and is continuing to track outcomes to measure the effect of evidence-based interventions on changing institutional culture to benefit the careers of postdocs and faculty.

This extensive program has provided professional development and grantwriting experiences to aspiring scientists, especially underrepresented populations, and assisted faculty and administrators in developing core competencies for mentoring and grantwriting. Our results indicate that these programmatic interventions have enhanced the career potential for diverse mentees, as well as improved the training climate and built capacity for sustaining and disseminating these activities at our partner institutions.
Training Curricula For Improving Mentoring Relationships Through the National Research Mentoring Network (NRMN)

Richard McGee, PhD Associate Dean for Professional Development, Northwestern University Feinberg School of Medicine, Chicago, USA; Angela Byars-Winston, PhD Associate Professor, Department of Medicine, School of Medicine and Public Health and Director of Research and Evaluation, Center for Women’s Health Research; University of Wisconsin-Madison, Madison, Wisconsin, USA; Janet Branchaw, PhD Assistant Professor, Department of Kinesiology; Director, Wisconsin Institute for Science Education and Community Engagement (WISCIENCE); University of Wisconsin-Madison, Madison, Wisconsin, USA; Christine Pfund, PhD Director, Mentor Training Core, National Research Mentoring Network; Associate Director, Institute for Clinical and Translational Research, Department of Medicine, School of Medicine and Public Health, and Associate Scientist, Wisconsin Center for Education Research, University of Wisconsin-Madison, Madison, Wisconsin, USA

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Keywords: mentor; mentee; training; cultural diversity; curricula

NIGMS/NIH TWD Program: NRMN

Abstract:
Research indicates that mentoring relationships play a critical role in the retention and success of trainees across the career spectrum. Despite its importance, mentors and mentees do not often have the skills needed to optimize their relationships. The National Research Mentoring Network is working to provide all trainees across the health sciences with evidence-based mentorship and professional development programming that emphasizes the benefits and challenges of diversity, inclusivity, and culture within mentoring relationships, and more broadly the research workforce.

NRMN’s Mentor Training Core provides career-stage appropriate training for mentors and trainees with a focus on broadening and deepening impact of mentoring relationships on the persistence and success of diverse biomedical research trainees. This is achieved through implementation of in-person training at institutions and organizations across the nation, in addition to synchronous and asynchronous online training. Evaluation data are being collected from all training events, with a particular focus on the high dosage events and include: participation; satisfaction with elements of training; self-reported knowledge and skill gains from training; and intent to apply/actual application of knowledge and skills gained from training. The Mentor Training Core has developed training interventions for mentors and mentees that are evidence-based, culturally-tailored, innovative, and can be implemented in a variety of formats and venues.

This poster will provide an overview of training with particular focus on descriptions and preliminary data of new mentor training modules focused on: 1) cultural aware mentorship; 2) mentee research self-efficacy; 3) a library of >80 mentee training activities. Aligned with the mission of NIGMS/TWD, NRMN is committed to working with the broader community of trainers and educators dedicated to developing a well-prepared, diverse biomedical research workforce.

This work was supported through the National Research Mentoring Network (NRMN) funded by NIH/NIGMS Award Number U54GM119023.
Addressing STEM persistence by training undergraduates to communicate science, navigate scientific culture and build effective mentoring relationships

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Abstract: Career advancement for scientists from underrepresented (UR) groups can be impeded by the transmission of cultural norms and development of crucial skills occurring outside standardized classroom learning and instead relies upon informal relationships with colleagues and mentors. Learning how to communicate one’s research to a variety of audiences and understanding how to get the most out of mentoring relationships are examples of keys to STEM success that are rarely explicitly taught. Similarly, the impact of social factors such as Implicit Bias are often not openly addressed by institutions and leaders responsible for training STEM students and yet have disproportionate impact on engagement and success of UR trainees. We have created and institutionalized a semester-long course for STEM undergraduates engaged in research to strengthen scientific communication, demystify social aspects of the culture of science and strengthen mentoring relationships. The course utilizes a “flipped” model in which classroom time is used to reinforce skills and concepts encountered in readings and assigned work out of the classroom. Class meetings include work on scientific communication and exploring the culture of scientific research. Multiple methods were employed to evaluate student learning, including pre- and post-course surveys, regular student feedback, and graded performance in assigned tasks such as written work and oral presentations. These quantitative and qualitative data describe strong improvement in a range of student’s scientific communication skills and the ways in which mentoring and social factors contribute to success in STEM careers. Similarly, we found a shift in the topics students associate with the inhibition of communicating science to include curriculum topics, such as impostor syndrome and communication styles. As mastery of the range of concepts covered is both hard to gain and critical to persistence in scientific careers, the approach is a valuable addition to attempts towards increasing diversity of the STEM workforce.

Reference: https://nrmnet.net/collaborate/rfa/2015-pilot-4-of-7/
T32 POSTER A16

Development of Graduate Course “Science Communication in the Digital Age”

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Keywords: communicating science; diverse audience; digital media; equipping scientists; alternative careers

Abstract: To enhance the training of our graduate students in communicating research to diverse scientific and lay audiences, three NIGMS-funded training programs at the University of Iowa collaborated to develop a new course “Science Communication in the Digital Age” (RHET:7500). Development of this course was supported by an administrative supplement by NIGMS (PA-15-136) as well as matching internal funds. Directed by senior lecturer Matthew Gilchrist of the Department of Rhetoric, this 2-credit course is offered every spring semester and features guest lectures by faculty from several biomedical departments as well as the School of Journalism and Mass Communication. The course aims to develop direct and succinct communication skills in order to convey science to both lay and peer audiences, and to build skills in audio/video production, basic website design, and the suite of Adobe presentation software. The major goal is to make trainees more competitive in scientific careers both in and outside of academia. The course is part of the core curriculum of the Genetics (Eberl, PD) and Pharmacological Sciences (Strack, PD) training programs, and an elective for the Psychological and Brain Sciences (Lutgendorf, PD) program. A portion of the award was used to organize and support an annual, all-day graduate career fair/workshop, the first one of which was held April 23, 2016, entitled “Careers outside the Academy: Science Communication”. This poster showcases several student projects, presents comprehensive before-after skill surveys, as well as plans to enhance and expand “Science Communication in the Digital Age” in coming semesters. The authors are grateful for start-up support by NIGMS (T32 GM08629-19S1) and continued support of this course and career workshop by the Graduate College, the Department of Rhetoric, and the Office of the Vice President for Research and Economic Development at the University of Iowa.
Curricular Innovation toward Integration of Bioscience and 21st-Century Careers

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NIGMS/NIH TWD Program: T32 Supplements

Keywords: Careers; Curriculum; Ethics; IDP

Abstract:

Our project at Washington University in St. Louis integrates career exploration and planning into the second and third years of bioscience Ph.D. curriculum, encouraging students to consider career paths early in their graduate training. Students commonly avoid career development opportunities, or very lightly engage very late in their Ph.D. program. To jump-start career planning, we conducted two pilot courses that expose Ph.D. students in the Division of Biology and Biomedical Sciences (DBBS) to a broad range of science careers: Ethics, Bioscience, and Society, designed by Dr. Kurt Thoroughman; and Career Planning and Professionalism, designed and taught by Dr. Jessica Hutchins.

- DBBS students take a required course in responsible conduct of research in their second year; this required course considers laboratory bioscience within the academic research environment. The pilot section, Ethics, Bioscience, and Society, extends consideration to responsible conduct of research across the many workplace sectors engaging in bioscience: academia, industry, entrepreneurial ventures, nonprofits, and government. We recorded videos, in which student leaders in those areas interviewed most relevant national experts and scholars. These videos became source material for in-class discussion.

- Career Planning and Professionalism builds upon the initial exposure to broad research careers in Ethics, Bioscience, and Society. This course for third-year Ph.D. students formalizes the IDP process by facilitating self-assessments, career exploration, and goal-setting. Students worked in peer-led groups to conduct focused research projects on the career area of their choice, culminating in group presentations to the full class. Discussion topics included work-life balance, weighing interests and values in choosing a career, identifying transferable skills and filling skills gaps, conducting informational interviews, reading job ads, and searching for positions.

We will report on the successes of these pilots, in terms of faculty buy-in, institutional investment, integration into curriculum, and student outcomes.
Augmenting Ethics Training with Scientific Rigor and Reproducibility Concepts

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Keywords: reproducibility, rigor, research ethics, ethics training

All Berkeley MCF Graduate Program students are required to take MCB 293C (responsible conduct in research and research ethics) during their 1st year. To address training in rigor and reproducibility, we expanded this 5 week required course to 10 weeks in the Spring of 2017. Students were first polled for the interest and ability level on multiple topics. In response, we introduced curricula covering data management, experimental design, data collection and recording, and image analysis. A set of three interactive sessions discussing statistical data analysis and reporting was also developed. In addition to these lectures, the students were required to attend weekly discussion sections for the first 5 weeks in groups of 10-15 trainees with MCF faculty who led case studies and shared personal experiences. We developed an instructor course website with training materials for faculty discussion leaders to use in their discussion sections. The materials included recommended case studies, as well as guides for the faculty discussion leader to present the particular case studies to the students. All materials consulted during curricula development were recorded on an OSF project site. Lectures were recorded via course capture and have been made available along with all course materials on the course website. Regular in-class student evaluations were collected. The OSF project website, course website, instructor website, and digitized student evaluations are being made available to the curriculum advisory board, comprising faculty who are currently training grant PIs at UC Berkeley, for their evaluations and recommendations. Potential improvements already identified include expanding the new curricula in the areas of experimental design and statistical analysis, a broader use of multimedia training tools, and increased guidance for PIs who are new to the discussion sessions.

University of California Berkeley Chemistry-Biology Interface Training Grant Program
Project Number: 3T32GM066698-13S1
At UT Southwestern, we attract graduate students interested in biomedical sciences from across the United States and from many foreign countries. These students pursue scientific careers encompassing many disciplines and with a variety of goals. The challenge has been to provide career development that is of broad value no matter the considered career path. Therefore, our goal has been identifying and providing information that will be of significant benefit to all of our students in obtaining suitable positions in the scientific direction they have selected. We established a year-long program that covered two main professional development topics all scientists need – project management and communication (both in general and with a particular focus on science). This year-long development training program was comprised of didactic seminars including case studies, complemented by seminars presented by alumni and other professionals who shared career path stories and gave examples of how professional development skills manifest in day-to-day work in each of their current careers.

The Project Management program is described here. Project management is an important facet of professional development for graduate students in the biomedical sciences. While teaching these skills may often be implicit in doctoral training, our supplemental training course, Fundamentals of Project Management, allows graduate students the explicit opportunity to learn about and develop project management skills. Students concurrently learn how these skills are used in different biomedical careers – both in academia and ‘beyond the bench’. Training includes: 1. Interactive workshops with external speakers from a variety of biomedical professions who will discuss project management in their daily settings; 2. Self-assessment tools that will allow students to inventory their skills, with workshop sessions providing guidance on using the results to reflect on potential career paths and strengthening needed skills; 3. How to plan, manage, and present an individual project, in or out of the lab. Assessment of the program was conducted throughout the year via online survey tools, as well as unique measurements of the individual student. Students met individually with facilitators to discuss their project ideas and projected learning outcomes. Outcomes of the assessments were used to determine the program’s usefulness to the students, as well as to determine general student interest in this course as an elective part of the curriculum.
T32 POSTER A20

T32 Supplement at Stony Brook University: Enhancing Quantitative Training and Career Development Opportunities for T32 trainees.

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Keywords: quantitative skills; career development; electronic lab notebook; python; rigor and reproducibility

Abstract

The Training Program in Pharmacological Sciences requested a supplement in order to enhance the training received by trainees at Stony Brook University, focusing on Reproducibility and Rigor as well as Exposure of Students to Multiple Career Paths.

Reproducibility and rigor. The supplement catalyzed numerous modification to our first-year curriculum: Stony Brook trainees in the Life Sciences now universally receive training in computational methods and statistics; seminars and faculty-directed sessions address issues of reproducibility; we have initiated a program to implement and encourage the use of electronic lab notebooks; hands-on modules have been introduced throughout the curriculum to teach trainees modern approaches to data processing and analysis.

Central to our effort was a program to provide trainees with ultraportable computing devices (Surface Pro). These enabled us to provide hands-on training in computational approaches, including a Python bootcamp, statistical analysis using R, image processing, a Structural Biology tutorial, big data analysis, plotting, compartmental analysis, etc. Furthermore, trainees were encouraged to use the devices to document their work during research rotations, leading to most of our trainees continuing to take advantage of electronic lab notebooks for their thesis work.

Exposure to Career Paths. The supplement funded the initial iteration of “Facilitating Awareness and Career Exploration for Scientists” (FACES). FACES is a trainee-organized event that brings together professionals with Stony Brook trainees to facilitate career exploration and networking. The initial FACES was extremely successful, took place again in 2017 and will become an annual event.

Summary. The T32 supplement resulted in the implementation of multiple new training elements, a new program to expand the use of electronic lab notebooks and a yearly career development event that is widely attended by trainees in the Life Sciences. The supplement has impacted several Graduate Programs and T32 programs at Stony Brook.
Rigor and Reproducibility Curriculum Development at Northwestern University

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NIGMS/NIH TWD Program

Keywords: Rigor; Reproducibility; Curriculum; Experiential

A supplement to the T32GM008061 training grant was used to develop two new graduate courses in scientific rigor and reproducibility (R&R) at Northwestern University. Both courses were launched in the Spring Quarter (March-June) of 2017. One course, \textit{IBiS 421}, is called \textit{Rigor and Reproducibility in Research}. Experimental design and data analysis is discussed through analysis of case studies on the topics of rigorous statistical analysis, transparency in reporting, data and material verification, and sharing. The course also establishes best practice guidelines for image based data and description of biological materials to uniquely identify the reagents (in particular antibodies, cell lines and animal models). Lectures include: Experimental design; Transparency in reporting; Data and material sharing; Statistical analysis; Description and authentication of materials; Image based data; Presentation of data. Students demonstrate knowledge and use of the techniques discussed by presenting experimental design and data analysis of their own doctoral research.

The other course, \textit{IBiS 416}, is called \textit{Practical Training in Chemical Biology Methods and Experimental Design}. It features two weeks of classroom and lab-based instruction on experimental design and analysis, supplemented by R&R training modules using case studies. Lectures and labs include: Data organization; Reproducible research; Github; Lab notebooks; Study design; Statistical analysis; Processing data; Plotting data; Data presentation. This is followed by a combination of lectures and labs addressing a broad range of analytical techniques. These lessons are then applied to inquiry based learning in six of Northwestern’s advanced instrumentation cores. For both courses, the curriculum and assessment tools were developed in consultation with NIGMS training program directors across Northwestern. Both courses were piloted with a small number of trainees this spring using team instruction approaches. Student reviews indicated that they found this training to be a valuable addition to traditional coursework.
T32 POSTER A22

Advanced Training in Business Entrepreneurship or Research Reproducibility: A Value Added Boot Camp Approach

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Motivation: To expand and augment curricular activities associated with two NIGMS-sponsored training programs at Penn State University through a supplemental award (T32GM108563-02S1). Each training program addressed key components of PA-15-136; i.e. either promoting a strong foundation in research design and rigorous statistical and bioinformatic analyses (GM102057), or training to better prepare students for varied research careers in the biomedical sciences (GM108563). As such, we were positioned to build upon existing curricula to enhance and intensify each training program and widen the training audience at our institution. Approach: Streamlined training in the form of unique interdisciplinary 1-week executive style boot camps was used and specifically developed for graduate students and postdoctoral fellows across units in the biological and life sciences. For camp 1 (The Business of Science), we partnered with the Smeal College of Business and others to address key business, legal and regulatory aspects specific to the biotechnology enterprise, including Market Analysis, Finance and Valuation, Entrepreneurship, Business Plans, and Intellectual Property. For camp 2 (Biological Data: the Right Way), data reproducibility was addressed by faculty in Bioinformatics, Statistics and Biochemistry and Molecular Biology. As such, some content which was previously optional was now delivered through a compact, efficient and effective medium for both GM102057 and GM108563. Outcomes: A total of 60 students participated in 2016, and we anticipate an additional 60 students will participate in 2017. Lessons Learned: Students will register and not attend. We need to develop a mechanism which involves supervisor/mentor approval prior to registration confirmation. Sustainability and Dissemination: We will sustain our effort for at least four years through institutional matching commitments from the Colleges of Agricultural Sciences, Engineering, Health and Human Development, Medicine, and Science. We have used our website and press releases to disseminate results and impact.
Narrative Text:

We developed a new curriculum for NIGMS T32 students with the title “Hypothesis, Design and Biostatistics”. The goal of this course is to train students in principles of rigor and reproducibility, ethics, and decision-making in science. This curriculum was developed with NIGMS T32 Supplement funds to Dr. Trudeau. As laid out in the TPIMB T32 Supplement proposal, we combined elements from a course and a proseminar that covered hypothesis testing and experimental design and biostatics at Maryland. Faculty members worked with the new Academic Innovation and Distance Education (AIDE) Center on campus who helped design and develop student centered, engaging, learning experiences. Since the teaching materials are now recorded and on-line the course is sustainable. The modular nature of the course means that new topics can be easily integrated as the need arises. The course can be scaled to meet the needs of all NIGMS T32 students at Maryland (including the MSTP). The course can be extended to other T32 programs at Maryland and our system campuses and to other NIGMS T32 programs at other sites. We have already trained 25 students in this course, and the course is now very popular and is in high demand. The course is best described as a hybrid course with a modular structure. It features recorded videos and on-line problem sets and quizzes for the students to complete prior to class or outside of class. In-class time is spent in small groups reviewing problems and problem sets with the guidance of the instructor. Each module is self-contained and features a similar format so that the students gain familiarity with the teaching style and course expectations. The goal is for principles from the course to inform the trainees’ laboratory research and enhance rigor and reproducibility.
Career Development for Biomedical Graduate Studies: Making It Count

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The mission of NIGMS-sponsored training programs is to provide discipline-specific educational and research opportunities that help us to foster the next generation of scientific leaders. In the past, this mission squarely targeted academic research positions as the ultimate career goal of our trainees. Recently, however, career goals have become increasingly diverse, as changes in federal funding levels for basic research, the availability of academic research, and the growth of biotechnology-related industries, among other factors, have dramatically altered the landscape of scientific careers. Currently a majority of graduate students report an interest in pursuing careers outside of academic research and some feel 1) they are not adequately informed of all the career options available to PhD students in biomedical sciences and 2) the training received is not sufficient to prepare them for such a career choice. With supplemental funding to our NIGMS T32 we developed two distinct resources to inform students about career opportunities: a “Learn to Lead” seminar series and a Career Development Website.

The “Learn to Lead” seminar series brought individuals from various careers in science to the University of Pennsylvania for a lunchtime seminar where students heard about the trajectory of the individual from completing his or her PhD to their current position, and provided ample time for Q and A. One or both of the following criteria were considered when selecting the speakers: (1) they received their PhD in the last 5-10 years and (2) they were Penn Alumni. Meeting speakers who received their PhD in the recent past allows our students to see the trajectory of PhD students that completed their training under similar training conditions, and allows them to imagine a trajectory that has relevance to them in the current work climate.

The Career Development web site organized and improved the visibility of existing and novel career-development resources at Penn. An overarching objective for the development of the site as to convey to students that competencies developed through pre-doctoral training in the biomedical sciences are valued in a variety of professions. Students often feel that they are not prepared for “other careers” outside academia, but in fact competencies in, for example, critical thinking, mathematical and computational practices, or management and communication are invaluable to any career. We specifically wanted to remind our students that all these skills are intrinsic to their training in a PhD program at Penn, hence the rationale for the byline of the site “Making It Count!” In addition the website navigates students through Career Paths, which provides descriptions of types of careers for which PhD training is attractive. It also hosts videos from individuals in each of the career paths, some of which participated in the Learn to Lead seminars. There is also a Career Blog, which provides a schedule of current seminars workshops and other events relevant to career exploration and development that occur on Penn’s campus. Lastly, an Alumni Outcomes is provided as an additional source of identifying specific career paths as well as a networking source.

The career development seminar series and website align with the goals of NIH and NIGMS training by enhancing the impact of our training programs to deliver well trained scientists to the workforce at large. The influence of having more visible career options available to our PhD students will be measured in outcome tables collected over the next 15 years.

Key Words: Career, competencies, graduate education

T32 GM008076
New Course: Skill Development for Diverse Scientific Careers B&BS 550b

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Keywords: biotechnology, entrepreneurship, resume writing, research residency, post-doctoral fellowship, productivity

The 2012 Biomedical Workforce Report concluded that our traditional graduate school training programs in the biological sciences do little to prepare our students for the wide variety of scientific and biomedical career options open to them. As one remedy, we have offered a new semester-long course that has addressed topics that are not currently covered in any curriculum at Yale: biotechnology entrepreneurship; how to run clinical trials; the business and scientific sides of biotech; strategies for optimal professional productivity; how to convert a CV into a resume; and how to find a post-doctoral fellowship or research residency. Speakers were chosen from our own successful graduates, when possible, to expose our current students to role models as well. The course was given an official course number through the BBS so that students with an 80% attendance record would receive credit on their transcripts. The Qualtrics survey done after each session confirmed that the course has served as a valuable new resource for all of our students as they transition into the biomedical workforce. Next year we plan to add a session on careers in publishing and science writing based on student feedback.

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Post-Baccalaureate Technician Program (PTP) at Xavier University of Louisiana

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Keywords: Biomedical Research; Post-baccalaureate Training; Research Skills.

Xavier University of Louisiana is the only historically Black, Catholic institution of higher education in the United States. The University is nationally recognized for its Science, Technology, Engineering and Mathematics (STEM) curricula. 79% of Xavier undergraduates are majoring in Biomedical disciplines. While Hispanics, African-Americans and Native Americans make up more than 30% of the US population, they earn fewer than 9% of all STEM PhDs. Bridge and post-baccalaureate programs have been viewed as effective interventions to dissuade attrition from the biomedical research workforce pipeline. The program described here is an initiative funded under the Research Enrichment Core of Project Pathways, the Building Infrastructure Leading to Diversity (BUILD) Program at Xavier. The BUILD Post-baccalaureate Technician Program (PTP) was modeled after a previously informal practice at Xavier in which recent Xavier graduates with great potential for graduate studies who lack full preparedness and/or competitiveness are offered one-year, full-time research staff positions. The Program provides these graduates with research training and opportunities for networking and developing their scientific communication skills. In addition to being mentored by faculty and program staff, Technicians also receive mentor training and act as mentors to undergraduate research students. The seven technicians in the first cohort completed their one-year training in summer 2016 and all have entered into graduate programs. The nine cohort two technicians are now completing their training and graduate school application process. The selection process for cohort 3 technicians is in progress. PTP, which provides Xavier graduates with post-baccalaureate research training at Xavier, has been very successful in its early stages. This program can be replicated at other institutions whose goal is to have a positive impact on the matriculation of individuals from underrepresented populations into and through biomedical doctoral programs and eventually into the biomedical workforce.

Funding: NIH NIGMS grants number RL5GM118966
Developing a Science Identity: Using Developmental and Critical Race Theoretical Lenses in an Undergraduate Research Training Program

Gabriela Chavira, Carrie Saetermoe, Crist Khachikian

While current efforts in diversifying NIH-funded research have been successful in developing opportunities for a wide variety of scholars from traditionally underserved communities, including people with disabilities and people from disadvantaged backgrounds, there remains a cultural lag in socialization to graduate programs, faculty positions, and NIH-funded research programs (Ginther et al., 2011). Specifically, African Americans and Latinos earned 6.0% and 6.8%, respectively, of all the doctorates in science fields, which is significantly less than their 50% representation in the general US population (NSF, 2015), and a similar pattern is seen for science and health doctorate holders employed by US universities and 4-year colleges.

BUILD PODER at CSU Northridge is part of the NIH-Diversity Program Consortium. *Poder* means “power” and “to be able to” in Spanish. BUILD PODER aims to build a biomedical workforce that thinks creatively and holistically about health disparities issues. To draw in and motivate student scholars, we employ developmental and Critical Race Theory (CRT) approaches to identifying and resolving social problems such as health disparities.

Two components of the student training were examined - the Summer JumpStart program, a four-week intensive entering to research experience and the year-long faculty mentored research. First, students’ research skills, self-efficacy, and research ethics knowledge significantly increased in four weeks. Qualitative analyses of students’ self-reflection essays describe themes focused on excitement beginning research, worries of not succeeding, and increased confidence. For example, one male student said, “I learned that I have the capacity to learn how to do research. I am more capable than I believed myself to be.” Second, qualitative analyses of students’ mentored research experiences highlight increased confidence and growth in their science identities. One female student wrote, “I now identify myself as a smart woman who’s a scholar and a researcher at CSUN.”

Our findings illuminate the importance of developing a science identity in undergraduate students’ interest, entry and retention in biomedical science majors.
Promising undergraduates, especially pre-transfer community college students, often have difficulty obtaining authentic research experiences, putting them at risk of not persisting in the science, technology, engineering, and mathematics (STEM) fields. To increase their preparedness and competitiveness, we developed the BUILD a Bridge to STEM Internship, a six-week summer internship for pre-transfer community college students that is supported by the NIH-funded STEM BUILD at UMBC Initiative. The internship involves students from five community colleges (Anne Arundel Community College, Community College of Baltimore County, Howard Community College, Montgomery College, and Prince George’s Community College) and Gallaudet University. A unique aspect of the internship is the BUILD Group Research (BGR) experience, where students work in teams of three to four members on authentic research experiences mentored by UMBC faculty or industry researchers. Participants in the BUILD a Bridge to STEM Internship are nominated by institutional representatives, are financially compensated, and participate in various enrichment activities in addition to working on biomedically-focused research projects. To date, two cohorts of students have participated in the study: 13 students in the summer of 2015 and 15 students in the summer of 2016. An evaluation of the internship has revealed that participants achieve significant gains in their science identity and research self-efficacy. Further, students report that this internship helps to clarify their career paths and inspires some students to continue in research careers. Further, this internship has provided UMBC an opportunity to pilot and refine the BUILD Group Research (BGR) model and explore other strategies to expand the benefits and capacity of authentic research experiences to more students with an interest in STEM disciplines through the creation of a short-term group research program.
Curriculum Development to Improve Training in Rigor and Reproducibility in the Albert Einstein College of Medicine Graduate Program

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Concerns about the rigor and reproducibility of biomedical research have arisen in the past decade. Causes include contaminated cell lines, mouse strain and source/housing on phenotype, antibody specificity, fundamental issues of experimental design, and invalid data analytic methods. While the first three are more technical, the fourth and fifth are problems in the graduate training process. Students must learn about experimental design and essential statistical principles, along with their implications for scientific rigor, before starting thesis research. This will ensure dissemination of best practices to their thesis laboratories. To achieve this goal at Einstein, existing courses and workshops were modified to emphasize experimental design (blinding, power, replicates, measurement error, variability); avoid pitfalls in data analysis (p-value hacking; multiple testing; missing data); transparent programming (debugging; clearly commented code); and proper reporting of results. To demonstrate the importance of these issues, four half-day sessions were added to the incoming PhD student boot camp. These introduce essential statistical concepts, quantitative and computational skills using the R programming language, principles of study design, best laboratory practices, and accounting for sources of biological variability and measurement error in an experiment. Students now must take the course “Quantitative Skills for the Biomedical Researcher” revised to cover current reproducibility issues and statistical theory for research reproducibility. Finally, we are launching our inaugural hackathon “Can We Hack the Fountain of Youth?” this July which will promote skills in reproducibility research as student teams compete to solve innovative questions centered on the science of aging by analyzing big datasets. By incorporating these activities into required courses, we ensure that all trainees are exposed to these important concepts. It is difficult to assess whether this will improve the quality of their scientific research, but one thing is certain, ignorance will not be an excuse for poor quality work.
ABSTRACTS – POSTER SESSION B
**Title:** Successful Bridges Program at LaGuardia Community College

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**Abstract:** The LaGuardia Bridges program has formed a consortium with three four year colleges, the City College of New York, Hunter College, and Queens College, to provide challenging research experiences in the biomedical and behavioral sciences for the underrepresented college students (women, minorities, the disabled, and those from disadvantaged backgrounds) that LaGuardia serves.

During the academic year, our Bridges students are engaged in preparatory research under the tutelage of the LaGuardia Faculty Research Mentors. This experience prepares them to engage in intensive research at our three linking colleges, Brookhaven National Laboratories, and the Hospital for Special Surgery during the summer.

In addition to the core research experiences, our Bridges program features the following activities designed to support the students’ academic preparation and for successful transfer endeavors. These activities include: monthly research student seminars, tutoring, transfer counseling, opportunities to present their research results at local and national conferences, instruction in the Responsible Conduct of Research, instructional workshops on bio-statistics, leadership and management skills, bioinstrumentation, research paper critique, library research, research design and poster presentation and the use of ePortfolios.

We have successfully carried out this program since 1993. The average graduation rate is 96% and the transfer rate is 88%. Bridges students move on and earn higher degrees in biomedical and behavioral sciences fields.

What makes our program successful is the well-designed activities that help our Bridges students develop their potential and build their confidence in pursuing their aspirations.

Our College has incorporated research in major science courses. That will ensure the dissemination and sustainability of these educational activities.
Implementing Authentic Research-based Introductory Laboratory Courses at Bridge Scholars’ Home Institution.

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Abstract:

Miami Dade College (MDC) and the University of Miami (UM) have offered a Bridge to the Baccalaureate Program since 1994 to encourage underrepresented students to enter biomedical research careers. A key component of the program are special courses at UM, such as the introductory authentic research-based laboratory courses, but accessibility to these courses has been challenging for Bridge students. Thus, we 1) implemented authentic research-based introductory biology and chemistry labs at MDC and 2) investigated if these courses had a positive impact on student learning in science.

Through our NIGMS and HHMI bridge program between MDC and UM, MDC faculty mentored by UM faculty, UM graduate TAs, and MDC undergraduate peer facilitators led teams of MDC students to develop and conduct authentic research investigations. At the beginning and end of each semester, we surveyed students in research-based and traditional laboratory courses with the Classroom Undergraduate Research Experience survey.

Research-based lab students were 2-3 times more likely than traditional students to report gains in research skills, such as scientific communication and laboratory techniques. Students also benefited from research-based labs in personal achievements, such as increased self-confidence, significantly more than students nationally. Research-based lab students more strongly agreed that their course was good exposure to research compared to traditional lab students, which likely led to them being 8 times more likely than traditional students to obtain subsequent research experiences.

These self-perceived benefits of research experiences in introductory courses may increase student persistence in science. We will be comparing student participants’ transfer rates to four-year institutions, graduation rates, and entrance into graduate programs or STEM workforce. Sustainability plans include training MDC faculty to translate their research expertise into their courses and training MDC students to help faculty teach these labs. We disseminate our model to faculty at both institutions and at education conferences.
Southern Illinois Bridges to Baccalaureate Program utilizes Arabidopsis resources for training community college students

Jessica R Lucas and Karen Renzaglia

The Southern Illinois Bridges to Baccalaureate Program (SIB) is designed to help Southern Illinois community college students interested in biomedical and behavioral science (BBS) disciplines, persevere at 4-year universities and complete BBS bachelor’s degrees. It is estimated that half of all college students in the United States attend community colleges, and that only a third of those students matriculate to four-year universities. Half of the community college students who progress to universities graduate with bachelor’s degrees. The high attrition in STEM majors nationwide combined with the difficulties of transitioning to a university means that community college students are underrepresented in the STEM workforce. SIB is an NIH-funded program that provides underserved students in rural, southern Illinois the mentorship and learning-experiences that will help them succeed in STEM majors at universities.

A centerpiece of the SIB program is an eight-week Summer Research Institute (SRI) where students learn molecular biology through an intensive inquiry-based research experience while still attending community college. Here we present the pedagogy and results the SRI. Our pedagogy including active-learning exercises, inclusive teaching practices, and student-driven research projects. Students proposed and began molecular genetic research projects in Arabidopsis thaliana. Students build hypotheses based upon available primary literature and gene expression databases. Self-assessment indicates that self-confidence and interest in graduate school increased over the summer research institute. Students also improved their problem-solving, scientific literacy and collaborative skills.
Scaffolding Learning Experiences to Enhance Student Research

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Keywords: pre-research; course-embedded; enrichment

Queensborough Community College is an open-admission minority institution that enrolls more than 13,000 degree students (30% Hispanic and 26% black). The majority are low-income, first generation students who come from educationally disadvantaged backgrounds. Our students often have low self-efficacy and misconceptions about research. The project’s goal was to address these issues and enhance student participation in research. Students are inspired and prepared to complete meaningful research projects by a carefully designed scaffold of inquiry and problem-based experiences. General Biology lab facilities were updated with networked digital microscopes and computer-based sensors to support a revised curriculum emphasizing inquiry-based exercises with written reports. During Enrichment Workshops, General Biology I students work in groups on challenging problems that build content knowledge and cognitive skills. They also attend research seminars by visiting scientists. Workshop students outperform non-Workshop students in combined % A, B, C and mean final grades. A pre-research program consisting of interactive workshops and hypothesis driven hands-on research is offered during intersession. General Biology II students participate in authentic genomics research as part of the SEA National Genomics Research Initiative. A 3 credit Research Laboratory Internship places students in research labs on or off campus. Both courses require research reports and offer the opportunity to give presentations. NIH and University supported faculty-mentored research is a capstone experience for many students. The College recognizes student research as a high impact practice and the position of campus Research Coordinator has been institutionalized. Since 2010, the total number of students engaged in course-embedded research and research programs and has increased from 47 to over 300 per year. This research has resulted in the publication of papers co-authored by students as well as awards at regional and national conferences. Support was provided by the QCC NIH Bridges to the Baccalaureate Program 4R25GM065096-15.
The Use of ePortfolios to Support and Document Academic Self-Efficacy and Goals in Bridges to the Baccalaureate Students.

Karen Singer-Freeman, Linda Bastone, and Joseph Skrivanek; Purchase College, State University of New York

Abstract: ePortfolio creation is a high impact practice that might amplify the effects of other high impact practices such as science research experience. In the current work, we describe our use of ePortfolios to support reflection and assess changes in students’ identity during a summer research program. The constructs of academic self-efficacy and academic goals have been found to be moderately related to academic persistence (Robbins, Lauver, Davis, Langley, & Carlstrom, 2004). We hypothesize that the development of a sense of academic self-efficacy and goals will support students’ identity as a member of a community of scholars and will support persistence in the pursuit of a college degree. We used ePortfolios to promote and assess identity change during our Bridges to the Baccalaureate summer research program. Students participated in weekly ePortfolio workshops. Students created ePortfolios documenting and reflecting on their summer experiences and creating long-term plans and goals. Program staff held weekly workshops in which students contributed at least one journal entry, one image, and one piece of writing that documented learning. Students provided a caption for each image that explained how the image documented learning. Additionally, students responded to a reflective writing prompt that was designed to stimulate academic self-efficacy, goals, or a sense of being part of a community of scholars. We found that as the summer progressed ePortfolio entries included increasing references to future goals, academic self-efficacy, and a sense of belonging to a scholarly community. Students enjoyed creating the ePortfolios and felt that they provided lasting documentation of their summer experience. We hypothesize that the inclusion of reflective ePortfolios enhances students’ experience in our program. An enhanced sense of academic identity and future goals may buffer students against the challenges they are likely to face upon transfer to four-year institutions.

References:
IMSD POSTER B6

Peer Mentoring as an Intervention to Increase Student Success Among URM STEM Majors

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Keywords: Peer Mentoring; Intervention; Retention; Training

Abstract:

This poster will outline an effective peer mentoring model for the mentorship of underrepresented STEM majors participating in the University of Missouri’s NIGMS IMSD program. This innovative peer mentoring program has resulted in the growth and success of our IMSD participants, as well as yielding significant learning outcomes for the peer mentors. In the past eight years, our program has grown from 20 to more than 100 underrepresented undergraduates. We now have a cadre of 10 trained peer mentors who work with our approximately 80 incoming freshmen, sophomores and transfer participants. Training peers to be effective coaches is key the success of the program. The specifics of the peer mentor training will be discussed including selection, responsibilities, a three-day training retreat, and on-going weekly professional development workshops. Our peer mentors assist underclassmen with acclimating to the university, achieving academic success, identifying and interviewing for research lab positions, as well as maximizing one’s undergraduate research experience. Peer mentors also participate in our comprehensive IMSD program that integrates research, faculty mentoring, academic and social support, and professional development to prepare students to matriculate into graduate doctoral and medical/doctoral programs. Evidence of this successful intervention has been shown from qualitative focus group data and external evaluator reports, student feedback, and success of our students entering summer research and graduate programs. Additionally, the IMSD program’s retention rate and graduation date is significantly above the comparison data for URM STEM majors not receiving the IMSD Peer Mentor intervention. With limited funding available to support professional program staff and varying demands of faculty at a research university, we have leveraged our peer mentors to expand, strengthen, and enhance our IMSD program for STEM undergraduates, while making the professional development a defining leadership experience for the peer mentors.
Survey of Checkpoints Along the Pathway to Diverse Biomedical Research Faculty

Lindsay C. Meyers, Abigail Brown, and Roger Chalkley

Given the persistent shortage of underrepresented minority (URM) faculty at medical schools who do research in basic biomedical research, we wanted to examine the entire training pathway of potential candidates to identify the points of greatest loss. Using a range of recent national data sources, including the National Science Foundation’s Survey of Earned Doctorates and Survey of Doctorate Recipients, we analyzed the size and demographics of the population of interest, specifically those from URM backgrounds with an interest in biomedical sciences. We examined the URM population in undergraduate, graduate, and postdoctoral training as well as the URM population with basic science tenure-track faculty appointments at medical schools. We find that URM trainees are just as likely to transition into doctoral programs, to receive their doctoral degree, and to secure a postdoctoral position as any non-URM student, likely a consequence of the many successful NIGMS programs to increase minority participation in Basic Biomedical Research. However, the analysis reveals that the diversions from a goal of developing a faculty career are found primarily at two highly identifiable places, specifically during undergraduate education and in transition from postdoctoral fellowship to tenure-track faculty in the basic sciences at medical schools. These finding are consistent with previous studies which focused more broadly on URM participation in STEM (Science, Technology, Engineering, and Mathematics) fields.
IMSD POSTER B8

Accelerated Training of Non-Traditional Students in Computational Math for Biomedical Research

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When compared to other groups, underrepresented student populations advance in early math and science courses in fewer numbers and leave STEM majors at a higher rate. At the same time, there is an increasing need to incorporate mathematics and statistics into biomedical research and to use them in innovative ways to decipher life processes. For the past three semesters we have been developing and teaching an interdisciplinary Math in Biomedical Research course that addresses these issues. The primary focus of our course is to develop students' abilities to learn and apply advanced computational mathematics in the context of interdisciplinary research projects. The emphasis is on helping students to independently acquire mathematical skills motivated by a biological or biomedical research question and achieving this in a shorter timeframe than the traditional math curriculum.

In this poster, we also report an assessment of the students' cognitive development related to their conceptual understanding of mathematical topics during the course. Using graph theoretic learning assessment tools, we present analyses of the changes in organizational indicators of students' cognitive structures during the semester as represented by their concept maps. These results show how this type of cognitive assessment could be used to modify instruction to improve and adapt advanced mathematics training according to the students learning.

This work is being supportive by the University of Kansas (KU) College of Liberal Arts and Sciences, KU Office of Research, and KU Initiative for Maximizing Student Development (IMSD -- NIH/NIGMS R25GM062232) to ensure its long-term sustainability. We have presented these results at several conferences and we have publication plans that will encourage the replication of similar models of accelerated adaptive training in advanced mathematics topics in biomedical research.
Multi-Level Culturally Aware Mentoring Programs Engage a Broad Community of Unfunded Participants

Amanda Marie James, Edward T. Morgan, Anita H. Corbett, Malú G. Tansey, Shayla Shorter, Patricia Marsteller, Keith D. Wilkinson; Emory University, Atlanta, GA, US

Keywords: near-peer mentoring, campus-wide participation

Emory’s Initiative to Maximize Student Development (IMSD) program is a campus community that is welcoming and accessible to all research-focused STEM students who seek mentorship and guidance for their professional, personal, and career development. This dual program brings together undergraduate scholars and graduate fellows allowing vertical integration. Students are encouraged to identify multiple mentors from the IMSD leadership and the broader scientific community. The primary mechanism for content delivery, networking, and mentoring is a weekly for-credit class that is attended by all IMSD trainees. In optimizing our program in response to trainee feedback, we have implemented five major initiatives; 1) every student participates in an orientation hosted by both IMSD leadership and senior IMSD trainees; 2) the IMSD class includes a mixture of academic status-specific and community-wide sessions; 3) a near-peer mentoring scheme, with student groups (PODS) containing 1-2 graduate students and 3-5 undergraduates; 4) presentations given by speakers with diverse backgrounds, careers and education; and 5) all students focused on research careers but are not funded by the grant are welcomed as Associate Scholars or Fellows.

Feedback on our modified program has been positive. The mandatory orientation was evaluated as helpful for all and IMSD-designed Orientation Success Guides were deemed to have ongoing utility. The modifications to the class schedule were cited as effective. Specifically, the graduate students felt fulfilled and more engaged when they were mentoring undergraduates in PODS. Undergraduates value having graduate student role models whom they can emulate and relate to. Finally, enrollment has more than tripled (22 in Spring 2014 to 74 in Spring 2017; only 18 funded). Thus, we leverage resources that fund 18 trainees to impact a group of 74 trainees. Our ability to effectively evaluate our program, identify deficiencies, and implement reasonable change are key to our success thus far.
IMSD POSTER B10


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Abstract: The ASOM is an initiative of Emory’s IMSD and the joint Emory-Georgia Tech BEST programs with the goal of strengthening mentoring and diversity awareness at Emory University and in the Atlanta STEM community. ASOM coordinates the efforts of local chapters to evaluate and implement innovative mentoring practices and leverages and shares ongoing and new mentoring practices at the member institutions. The Emory chapter has met regularly for two years, and we are in discussions with Georgia State University’s IMSD program and Georgia Tech to form new chapters. Achievements at Emory include a 6-part mentoring workshop series attended by more than 30 faculty in the Fall of 2016. Sessions were led by the IMSD Team, augmented by other experienced mentors, and were designed and facilitated by two faculty who underwent training at the University of Wisconsin. It became apparent that graduate students could offer important insights and contributions to ASOM, so we invited students from IMSD programs and from the broader student population to join. Student leaders worked with ASOM to create a series for students based on the faculty workshop series. 21 graduate students and 5 postdocs attended, and 9 participants received a certificate for attending at least 5 sessions. Feedback was very positive, and all respondents urged us to continue these workshops. Importantly, the student leaders communicated that it would be very useful for students to have information about which faculty mentors had participated in the faculty workshops. Thus, faculty who participated and those who completed the entire series are recognized on the ASOM web site. ASOM is working to establish criteria for mentor certification for other faculty members with a demonstrated excellence in mentoring or formal training through other mechanisms. Future initiatives at Emory include a research project to evaluate new uses of established mentor training assessment tools.

Keywords: mentoring strategies, student mentor training
IMSD POSTER B11

The IMSD Meyerhoff Graduate Fellows Program

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The IMSD Meyerhoff Graduate Fellows Program has had a dramatic impact on PhD-level training of Underrepresented (UR) doctoral students at the University of Maryland, Baltimore County (UMBC) and the University of Maryland, Baltimore (UMB). Since its inception in 1997, UR participation in IMSD supported departments has increased significantly from 5% (UMBC) and 4% (UMB) to 13% and 12% respectively in 2015. Expansion to the Graduate Program in Life Science (GPILS) at UMB, in 2007 triggered a 50% increase in UR GPILS enrollment at UMB over the past 4 years. IMSD enrollment has increased linearly since 1997, with 102 PhD students enrolled in the IMSD Meyerhoff Graduate Program in the Fall 2016. Retention (91% in the most recent funding period, 2013-2017) has reached an all-time high, and UR PhD production has increased dramatically, from 6 URM PhD degrees awarded over the 15 years preceding IMSD to 92 PhDs awarded to IMSD Fellows since our first IMSD Fellow graduated in 2001 (a 16 year period). Preparation of IMSD Graduate Fellows for academic positions will remain a high priority for our IMSD program. Activities that benefit academic-track students will also benefit students interested in research careers in government and industry. New activities to better prepare IMSD students to be nationally competitive for quality postdoc positions and an leadership positions in the Biomedical Workforce include: (a) publishing workshops to increase publication records; (b) development of Independent Development Plans (IDPs) to improve IMSD-level mentorship; (c) requirement for all 2nd and 3rd year students to submit federal pre-doctoral grant (supported by mock study sections and grantsmanship workshops); (d) expansion of our Speaker Exchange Program (Fellows visit and give seminars at Research-Intensive partner institutions); (e) establishment of 3-tier summer program that will focus on the needs of (i) incoming Fellows, (ii) mid-level Fellows preparing for examinations, grant submissions, and publications, and (iii) senior Fellows applying for postdocs or jobs.
IMSD POSTER B12

Strengthening the Pipeline and Reducing the Gap: Activities and Outcomes from the IMSD Program at Louisiana State University

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The Initiative for Maximizing Student Development Program at Louisiana State University (LSU) is substantially increasing the number and science motivation of underrepresented minority students enrolling in and completing baccalaureate degrees in STEM and subsequently going on to pursue graduate studies in biomedical related disciplines. Through a systematic mentoring approach utilizing comprehensive intervention strategies, including faculty and peer mentoring, undergraduate research, professional development opportunities, and individual counseling and academic advising, the LSU IMSD program creates a professional culture and learning environment promoting student success. The LSU IMSD program continuously identifies, monitors and follows scholars from the time they enter the program to graduation and beyond. Since 2004, the program has supported a total of 96 undergraduate scholar participants, achieved a substantial increase of scholars’ overall GPA, maintained a graduation rate well above university average, and substantially increased the number of underrepresented minority students attending conferences, publishing peer-reviewed scientific articles and entering graduate school compared with non-IMSD scholars. In order to achieve optimal success, the IMSD program seeks to increase student enrollment into graduate programs and reduce the length of gap years. Through annual program assessments, the IMSD Program improved and refined program activities and practices aimed at increasing direct matriculation into graduate programs, including increased collaborations with other institutions, campus site visits, and continued communication with recent graduates. In a recent pilot study utilizing a qualitative multiple case narrative, emerged themes from the cross case analyses indicate the familial home and laboratory environment as two influential factors on science career and academic trajectory among underrepresented minority students. The shared commonalities support social cognitive career theory (Lent et al., 1994) in which cognitive and contextual factors influence STEM career development and persistence into advanced levels of education among underrepresented minority students. Continued research in this area will provide the LSU IMSD and other programs with future, innovative strategies to foster and promote the success of URM students in the science pipeline.

References:

IRACDA POSTER B13

The INSPIRE NIH/IRACDA Program – a Win for Both Post-Docs and PUI Partner Institutions

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IRACDA is a career development program facilitating progress of postdocs towards biomedical research and teaching careers. It promotes consortia between research-intensive and partner institutions having a historical mission and commitment to providing training, encouragement and assistance to underrepresented students in the biomedical research enterprise. Medgar Evers College (MEC) is a MSI in Central Brooklyn, NY. MEC is a partner institutions of the INSPIRE IRACDA Program with Rutgers-RWJMS. Thus far twelve INSPIRE fellows received training in MEC science classrooms under the mentorship of five MEC faculty. Before coming to MEC, fellows spend their first year in a scientific teaching workshop at Rutgers where they participate in sessions that include setting learning goals, diversity and learning styles, instructional technology, active learning techniques, and assessing learning outcomes. INSPIRE fellows bring fresh and novel teaching approaches to MEC undergraduate courses. They have been effective at incorporating their postdoctoral research interests and techniques into various lecture and lab topics to enhance science learning and emphasizing how important being a researcher is to the advancement of medical science. INSPIRE is providing valuable career development for post-docs interested in advancing their research and teaching training, and proving to have a positive impact at MEC in science curriculum, research and undergraduate career development. INSPIRE fellows have worked with MEC faculty to develop new undergraduate courses and research collaborations. The Postdocs are provided formal mentoring sessions and mock interviews to assist them in seeking professional employment. Having INSPIRE fellows on our campus allows for interactions with MEC students in and out of the classroom. By relating their own experiences and how to prepare for and navigate graduate school, the fellows served as excellent role models, effectively motivating our students about graduate school and building up their self-confidence about research and research careers.
IRACDA POSTER B14

“This is What a Scientist Looks Like” Changing Perceptions through San Diego IRACDA Partnerships with Minority-serving Institutions

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A major goal of the San Diego IRACDA program is to improve retention and success of underrepresented minority (URM) students pursuing careers in STEM. We have taken a comprehensive approach whereby IRACDA postdoctoral fellows provide research oriented workshops, research symposiums, and one-on-one mentoring to SDSU and SDCC undergraduates. We hypothesize that mentor-mentee dyads with shared experiences, understanding and backgrounds will have an enhanced and positive effect on URM student success in STEM. We address this hypothesis as follows: 1) For early URM student engagement, IRACDA fellows direct an 8-week SURF Program for City College, which provides a unique opportunity to interact with community college students, 2) To expose students who have successfully started a 4-year university to science careers, we have developed a strong collaboration with SDSU’s MARC program, and 3) To enhance URM student interest in becoming scientists, cutting-edge research and to foster research collaborations we have created an annual scientific research symposium. The SURF and SDSU Pre-MARC Programs were specifically developed for early college students to reinforce awareness, interest and motivation in STEM. Both programs have been successful in building strong mentoring relationships and engaging URM students in research. Our goals were to increase the number of students engaged in authentic research, increase scientific self-identity, and increase the number of transfer students and interest in pursuing graduate studies. Yearly evaluations show increases in student confidence of scientific skills and plans to pursue graduate school. Several undergraduates have transferred to 4-year institutions, attended national conferences, and been accepted to graduate programs. We conclude that the existence of multiple and diverse mentors enhances URM student interest and success in STEM. The MARC and IRACDA programs are successful in providing such mentoring opportunities and are valuable when available to students at every stage of their career.
Early Immersion in Research Experience: The MARC Molecular Biology Summer Boot Camp

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Undergraduate students in the natural sciences are encouraged to seek laboratory experience but are often unsure how to proceed. This lack of awareness in laboratory culture is exacerbated in biology majors who often take their first biology courses only in their fourth or fifth semester of college. To engage students’ early interest in research as well as foster mentorship with research faculty who do not frequently teach lower division biology courses, we have started a pilot program in 2015 called the MARC Molecular Biology Summer Boot Camp. Students are invited to apply to this program based on their completion of a first semester biology course (BIOL106; BIOL101), high grade point average, and belonging to an under-represented group in biomedical research, including economically disadvantaged. This 4-week program contains experimental modules using environmental microbial samples to train participants in basic molecular biology techniques as well as data collection and analysis, and culminates in a poster presentation. In the last two cohorts, 16 out of 33 Boot Camp participants have joined faculty research labs, among them are current RISE, MARC, and BUILD scholars. Our aim is to train students over five summers and monitor their application and entry rates into graduate programs, and compare them with similarly qualified cohorts, including those who were offered but choose not to participate in the program. (Supported by Provost’s Funds and MARC U*STAR 5T34GM008395-27 to M. E. Zavala)
Winston-Salem State University’s Maximizing Access to Research Careers Undergraduate Student Training in Academic Research (MARC U*STAR) Program

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Winston-Salem State University’s (WSSU) MARC program is designed to maximize biomedical/biobehavioral research training and to have a broader impact at the institution. The aims are to 1) introduce students to biomedical research through hands-on participation; 2) provide experience in scientific writing; 3) foster a career commitment through an experience that exemplifies the excitement and challenges of clinically relevant investigations; 4) teach critical thinking associated with biological techniques via a 3-part series of an Investigation & Research course as a supplement to a rigorous curriculum; and 5) establish an Internet-based tracking tool to maintain contact with program alumni whose success can inspire others. The program has over 20 mentors who have primary academic appointments in ten different Departments at WSSU and Wake Forest University Health Sciences, and draws trainees who support STEM education from WSSU departments. In the current cycle, 7 of 8 (88%) trainees directly matriculated into PhD programs in biomedical/biobehavioral sciences. We leveraged funding to include a parallel cohort of MARC Affiliates per year. The Affiliates participate in activities without direct financial support but benefit from mentorship in funded research labs, and placement in research programs at our T32 partner institutions. Two of four Affiliates matriculated into MS degree programs leading to PhD degrees at a success rate of 60%. The programmatic goal is to increase the institutional number of students who gain admission into PhD programs by 10. This involves a cohort of 4 upperclassmen (2 juniors and 2 seniors) per year with a goal to matriculate 90% of the MARC Scholars into competitive PhD programs. We collaborate with the NIGMS-RISE program to increase the number of MARC-eligible students via the “RISE to MARC” activities with the lowerclassman who successfully complete program activities and become eligible for the MARC program and/or pursue graduate degree in STEM fields.
The Use of Program Seminars to Support Academic, Economic, and Social Capital in MARC U*STAR Scholars

Karen Singer-Freeman and Linda Bastone; Purchase College, State University of New York

According to Donahoo (2011), students’ success in higher education depends on the acquisition of academic, economic, and social capital. In order to assess the extent to which capital barriers prevent students from actualizing careers in biomedical research, we surveyed 68 students in Biology II and Chemistry II asking them to report up to three obstacles that could prevent them from reaching their career goals. Of the 33 UR students who responded, many described concerns that related to forms of capital: 52% economic (e.g., money and tuition); 52% academic (e.g., difficult courses, admissions requirements, competition, and standardized tests); and 15% social (e.g., mentoring, society, friends, and family). We designed biweekly program seminars to help MARC trainees develop improved capital. Topics included: Learning about Capital; Identifying Personal Strengths and Weaknesses; Academic Roadmaps; Research Ethics; Research and Personal Statements; Resume Development; Conference Skills; Networking Skills; and Presentation Skills. At the beginning and end of the academic year, trainees provided self-reports about the extent to which they possess economic (e.g., “I have sufficient economic resources to complete college.”), academic (“I possess the knowledge I need to do well in graduate school”), and social (“I will feel comfortable in a doctoral degree program”) capital. We report how participation in program seminars influenced each area of capital and summarize key elements of the program seminars that impacted capital.

References:

Cristin F Gavin, Jeffery Engler, Michelle Naffziger-Hirsch, and Daniel C. Bullard

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The UAB PREP Scholars Program aims to increase competitiveness of individuals from underrepresented groups for entry into biomedical-related doctoral graduate programs at top-tier research institutions and ensure success in completing their Ph.D. degrees. Our program provides financial support for PREP scholars for the duration of the program, creates individual development plans to prepare them for the rigors of doctoral research and education, and places each scholar with a mentor for research experience. In addition, we provide training to strengthen written and verbal communication, quantitative skills, critical thinking, and build a strong foundation in scientific literacy and biomedical research ethics. We facilitate interactions with graduate minority student groups and faculty, and assist scholars in building a career network through workshop participation and national meetings of minority biomedical students to incorporate scholars into the broader scientific community. UAB is a rich environment for PREP scholar success, as >70% of scholars from the previous funding period are now enrolled in established doctoral graduate programs. Our program evaluation consists of extensive surveys and interviews by an external evaluator with both current and past PREP scholars to assess the effectiveness of the program curriculum. This assessment process is unique among PREP programs and provides a rich source of data about what interventions are most effective for this population of future scientists. While early iterations of the program consisted of primarily remedial components (academic coursework and basic professional skills), the program has evolved to include more activities that focus on the application of skills needed in early graduate training. These activities include grant and paper writing workshops, in-depth training for responsible conduct of research, mock interviews, presentation of primary scientific literature, and high volume presentation of their current research projects. Ultimately, we have learned that interactive preparation for the future is more beneficial than remediation for our PREP scholars.
Can Applications Predict Biomedical Graduate Student Productivity?

Joshua Hall, Anna O’Connell, and Jean Cook; Office of Graduation, University of North Carolina School of Medicine

**Motivation:** Biomedical PhD programs in the United States often receive many more applications than they can accept each year, leading to a competitive admissions process. Historically, programs have relied heavily on quantitative measures such as the GRE and GPA to select students for admission into their graduate programs. Admissions committees have operated under the assumption that these metrics correlate with an individual’s potential for success while in graduate school, but these assumptions have not been rigorously tested. **Approach:** To increase our understanding of whether common application components such as GRE scores, GPA, previous research experience, recommendation letters, and in-person interviews can predict biomedical graduate student success, we retrospectively examined whether these metrics correlated with measures of student productivity in graduate school, namely publication number and time-to-degree. We collected publication and graduation data for 280 graduate students in 14 biomedical PhD programs who entered graduate school between 2008-2010. **Outcomes:** There were no significant differences in GRE scores, GPA, amount of previous research experience, or in-person interview scores between the most (3+ first author publications) and least (0 publications) productive students or between students who completed their PhD versus those who withdrew or left the program early with a terminal Master’s degree. Interestingly, recommendation letter strength differentiated the most and least productive students; those with the strongest recommender scores published more papers in graduate school than students with the weakest letter scores. **Lessons learned:** These data have important considerations for faculty and administrators involved in the biomedical PhD admissions process. Sharing these findings with admissions committee faculty has impacted biomedical graduate admissions practices at UNC School of Medicine and has correlated with increased admissions offers for promising UR applicants.

**References:**


Objective: To determine whether participation in an optional, stipend supported, pre-matriculation summer review and wet lab course improved PhD student outcomes. Methods: From 2007-2015, the College of Graduate Studies at MUSC offered a free, pass/fail, 1 credit hour summer review course for incoming PhD students which was optional for all matriculating students. The course covered basic biochemistry and cell biology in didactic as well as hands-on wet lab sessions. Student outcomes of success in the PhD program were measured, including graduate grade point average in a common first semester curriculum, degree completion rate, time to graduation, and number of publications from graduate research within 1 year of graduation. Student satisfaction and perceived value of the review course were collected by anonymous survey and focus group. Results: In the 9 year study period, 189 students matriculated into the PhD in Biomedical Sciences common first year curriculum program at our institution, and of those, 119 (63% overall and 85% of matriculating URM) participated in the summer review course. Focus group feedback sessions found that the summer review course was popular with those who chose to participate. Student perceptions were that its primary benefit was decreased stress associated with adjusting to a new city and school and forming relationships with other students. Participation increased over time, and URM students participated at a higher rate than non-URM. Current objective outcomes are provided in the table:

<table>
<thead>
<tr>
<th>Summer Review</th>
<th>Total 2007-2015</th>
<th>URM Total</th>
<th>Number earning the PhD as of April 2017 (%)</th>
<th>Total leaving program w/o PhD (%)</th>
<th>URM leaving without PhD</th>
<th>GPA in first year common core</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants</td>
<td>119</td>
<td>17 (14.3%)</td>
<td>48 (40%)</td>
<td>18 (15%)</td>
<td>2 (12%)</td>
<td>3.58 ±.27</td>
</tr>
<tr>
<td>Nonparticipants</td>
<td>70</td>
<td>3 (4.3%)</td>
<td>35 (50%)</td>
<td>9 (13%)</td>
<td>1 (33%)</td>
<td>3.57 ±.27</td>
</tr>
</tbody>
</table>

Statement of the conclusions: A period of stipend supported, structured, but low-stakes acclimatization to a new institution prior to formal classes increases self-reported student assessments of confidence and well-being. Didactic content during this period did not have a significant impact on objective academic outcomes to date. However, increased participation rates in later years may confound current results, as more than half of participants are still in their PhD program. Self-selection for the summer review course may also have resulted in course participants starting with different skill levels than nonparticipants.

Source of support: R25GM072643 (Wright, PI) and R25GM113278 (Kasman and Wright, Co-PIs)
Postbaccalaureate Research Education Program (PREP) at the University of Rochester School of Medicine and Dentistry

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The long-term goal of the Postbaccalaureate Research Education Program (PREP) at the University of Rochester School of Medicine and Dentistry (URSMD) is to prepare predoctoral students from underrepresented groups (URGs) to matriculate into accredited graduate schools and pursue meaningful scientific careers. Over the past 12 years we have preserved the numerous successful aspects of our program, but have continuously sought ways to grow and fit the changing needs of our students. We have included important modifications to better prepare our students for the challenges in building scientific careers. Notably, we have developed innovative elements including new courses, skills developing programs, and more involvement with the UR Office of Diversity and Inclusion to enhance our relationship with the URG community. New to our PREP, trainees will be introduced to current basic laboratory, management and mathematical skills during a two-week workshop in early July at the start of PREP to accelerate laboratory integration and facilitate a smoother transition into graduate school level work. We have built in peer supported learning and encouraged our students to engage in community outreach to share the benefits of their scientific endeavors. Additionally, our PREP now includes a co-director approach designed to enrich our students’ PREP experiences by promoting and integrating scientific research development and scholarly mentorship. In summary, our PREP training plan will maintain the framework focused on developing trainee autonomy in the laboratory setting, critical thinking, writing, communication, leadership and management skills. Our PREP Research Strategy has been carefully designed - two-arcing focus: Research Development and Scholarly Mentoring - to create a valuable experience for the PREP trainees to succeed in graduate school and beyond and for mentors who will benefit greatly from shared and group activities.

References: [https://www.urmc.rochester.edu/education/graduate/prep-program.aspx](https://www.urmc.rochester.edu/education/graduate/prep-program.aspx)
Best Practices for a Novel Toxicology Mentoring and Training Program Targeting Underrepresented Undergraduate Students in STEM Disciplines

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Keywords: Toxicology; undergraduate; mentoring; online modules; underrepresented

The US toxicology workforce lacks diversity. Unfortunately there is a gap in exposure of undergraduate students with interest in STEM careers to toxicology. This is because an undergraduate toxicology major is rare across US colleges and universities. Thus the pool of undergraduates entering the pipeline for toxicology graduate programs may be limited because students who are otherwise interested may not be exposed to toxicology as a career option. This is particularly true for underrepresented students who are critical to a more diverse and representative future workforce. The Toxicology Mentoring and Skills Development Training Program (ToxMSDT) is a unique collaboration amongst educators at Iowa State University, Tuskegee University and Ohio State University with trained mentors from government and the private sector – acquainting promising undergraduates with toxicology careers and providing training that prepares them with toxicology fundamentals and skills to aid their entry into graduate programs. The public face of this program is the ToxMSDT web resource comprised of learning modules and supplemental resources targeted to student learning that also introduces the general public to toxicology. The online learning modules and associated activities reflect key core competencies for training toxicologists as identified through the 2012 SOT Toxicology Education Summit, namely (1) toxicology fundamentals; (2) pathophysiology; (3) applied systems biology; (4) biochemistry; (5) molecular genetics; (6) regulatory frameworks; (7) communication; and (8) critical thinking. We recruited 15 mentees and 15 mentors with wide racial and ethnic backgrounds. The first cohort of students will complete all required elements of the course by June 30th 2017. We have learned that recruitment of qualified students and mentors is a challenge, hence the importance of networking with other programs. This program advances the goals of NIGMS of creating an inclusive workforce to achieve the NIH mission. Funding was provided by an NIH R25 IPERT grant# 1R25GM113989-01A1.
RISE POSTER B23

RISE Program-Integration of Research, Mentoring, Role Modeling and Professional Skill-Building

Jill Adler-Moore, California State Polytechnic University, Pomona (CPP)

With a professional Evaluator, we developed a logic model that helped us plan and execute the program. This has kept us on track to achieve our objectives. The program has focused on four critical objectives: 1) to increase research skills, students participate in a 2 year research project at CPP, with one summer at an ROI institution; 2) to increase student confidence about completing a doctoral degree, we have utilized faculty and peer mentoring; 3) to deepen student and family awareness of the commitment needed to pursue a doctoral degree and the career options with a PhD, we have family potluck sessions and invite former RISE and non-RISE students who are succeeding in PhD programs to give research seminars; 4) to gain competency in professional skills, we have workshops for grant writing, time management, manuscript writing, presentations, ethics, and journal reading. Students have consistently reported in surveys and focus groups that these workshops improved their writing, presentation and reading skills and time management. The Program includes 1) RISE Invitation undergraduates to cultivate their interest in research; 2) RISE Intensive undergraduates with a strong desire to pursue a research career; 3) RISE Intensive Master's students with a definite commitment to pursue a research career. The initial CPP summer session with its accompanying workshops has created strong bonds amongst the students that have grown throughout their time in the program. Given the strong need to mobilize family support, we have organized quarterly, family potluck dinners and family members have been encouraged to visit the laboratories in which their students do research. In this way, the families have been folded into the RISE activities in a non-threatening, supportive environment. Through these integrated activities, the Program has helped students successfully transition into PhD programs or into a Master’s and then PhD program in biomedical research.
RISE POSTER B24

Contributing to Increasing the Number of Students from Underrepresented Groups Completing Ph.D. Degrees at the University of Puerto Rico Medical Sciences Campus

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Keywords: Publications, scholarly activity, postdoctoral

The University of Puerto Rico Medical Sciences Campus (UPR MSC) offers associate degrees, undergraduate degrees, professional and research doctoral degrees as well as Master level degrees. The Division of Graduate Studies and Biomedical Sciences (DBS) of the School of Medicine is the only one in Puerto Rico offering both Master in Science (M.S.) and Doctor in Philosophy (Ph.D.) degree programs in Anatomy, Biochemistry, Microbiology, Pharmacology, Toxicology and Physiology. Even though almost all of the students in the DBS are Hispanics of Puerto Rican ancestry, they come from a very diverse genetic pool, where close to one third come from households with low income and 63% are females. We believe the academic environment at the UPR MSC provides unique opportunities to students wishing to pursue graduate degrees in biomedical sciences and careers in science. Attrition for RISE supported students was only 2% during the past three cycles, while that of the DBS was only 7.5%. The DBS faculty wanted to enhance scholarly activity of graduate students in order to better compete for external funds for their research projects. A combination of institutional and RISE Program activities have focused on increasing scholarly activity and promoting that Ph.D. students continue on to postdoctoral training. Many of the research training activities included in the RISE Education Program aim to improve the students' scientific writing skills and English proficiency, as well as their oral presentation skills. In the case of Puerto Ricans, language is a barrier to writing and communicating research results since for the majority of our students their first language is Spanish. Of note, the DBS has awarded 165 Ph.D. degrees in Biomedical Science disciplines in the last ten years, as well as 86 MS degrees. The UPR MSC RISE Program has focused in the DBS Ph.D students during the past two funding cycles and provided opportunities to its participants that have helped them secure postdoctoral and other types of positions. In the past three grant cycles the RISE program supported 131 PhD students, 93 of which (71%) completed their doctoral degree, while 35 (27%) persist in graduate school. These 93 doctoral degrees were in the following biomedical sciences disciplines: 5 (5%) Pharmacology, 13 (14%) Anatomy, 29 (31%) Biochemistry, 29 (31%) Microbiology, and 17 (18%) Physiology. Out of the 93 Ph.D. graduates, 46 (49.5%) continued to postdoctoral positions, the majority went to leading research institutions in the mainland US. During the past three grant cycles, RISE students have published a total of 158 unique publications in peer review journals, an increasing trend in the number of publications that can be observed per cycle. The UPR MSC RISE program has contributed to the overarching national program goal which is to significantly increase the number of students from UR groups who successfully complete Ph.D. Biomedical Degrees. The UPR MSC RISE Program is supported by NIGMS grant R25GM061838.
The focus of Winston-Salem State University’s (WSSU) NIGMS-RISE program is to strengthen the credentials of undergraduate students from underrepresented (UR) populations, to facilitate their entry directly into competitive PhD programs. Through career exposure, academic enhancement, research training and professional development in biomedical/biobehavioral sciences, the 4-stage program approach is designed for maximal institutional impact. All entering students in the STEM disciplines participated and a regimen of training and development were designed for these aims: 1) build a supportive learning community with the undergraduate freshman class to foster academic success, career exploration and professional development; 2) facilitate formal training in research skills for a self-selected sophomore cohort through an intense elective laboratory research methods course; 3) engage a competitively selected cohort of juniors (RISE Fellows) to function as a Learning Community through their participation in paid mentored research activities by providing exposure to research faculty in both basic and clinical sciences; and 4) strengthen undergraduate senior participants’ critical thinking skills by providing an Investigation and Research course associated with biomedical/biobehavioral research techniques to enhance the understanding of basic STEM research and graduate education. In this current cycle, 25/25 (100%) students participated in summer research internships, and 17/25 (68%) gained experience at presenting at national scientific meetings. The program offers additional professional development activities such as Graduate Record Examination preparation, publication of students’ research findings in scientific journals, and career exploration seminars. The training program has over 20 mentors who have primary academic appointments in ten different Departments, Centers and Programs at WSSU and Wake Forest University Health Sciences and draws trainees from three WSSU participating departments in the College of Arts and Sciences: life sciences, chemistry, and behavioral sciences. The RISE program is guided by an advisory committee consisting of both internal and external members and reviewed by an independent program evaluator.
Xavier University of Louisiana is the only historically Black, Catholic institution of higher education in the nation. According to the US Department of Education, Xavier, during the past decade, has ranked first nationally in the number of African American students earning undergraduate degrees in biology, chemistry, physics, and in the physical sciences overall. Xavier is the number one undergraduate source of African Americans who complete their medical degrees or who go on to earn doctorates in the life sciences, and fifth in the nation in producing African American students who earn their PhDs in science and engineering.

Despite these accomplishments, the retention and graduation rates at Xavier are not satisfactory, and the success stories from Xavier do little to ameliorate the national problem of low number of underrepresented minorities in research careers. Xavier’s reputation in sciences attracts many pre-medical and pre-pharmacy students who often influenced by their families/cultures, have selected their path based on familiarity with and social status of physicians and pharmacists. Xavier freshmen are rarely aware of research careers, and often by the time they change career goals as juniors or seniors, have come too far to start research skills training in time for graduation and successful application to graduate programs. RISE Program at Xavier focuses on career advising, and research training to assist these students in successfully transitioning to graduate programs in biomedical sciences.

The Program is currently in the fifth year of its third cycle with the renewal application pending. Over the last three cycles, 43% of RISE Students who have successfully completed the Program have entered graduate programs in Biomedical disciplines and another 32% have entered professional schools. The RISE Program’s initiatives can be replicated at other institutions with similar mission and goals.

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Transforming Students from Consumers to Creators of Knowledge with Curriculum Reform

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A primary objective in training PhD-bound students is transforming young scholars from consumers of knowledge to creators. Curriculum reform is a promising, systematic, sustainable method for addressing this objective. This paper will discuss CHEM 5100: Introduction to Research, which is a new course in the Masters in Chemistry program at Cal State LA. Introduction to Research (CHEM 5100) is the first part of a three-course sequence designed to provide students with the basic skills required to design research studies and communicate the results in writing, on posters and in formal research talks. Introduction to Research explores the structure of research studies, multiple genres within the chemical literature, research ethics, and various career pathways. The focal point of CHEM 5100 is the development of a written research plan for the Masters thesis. Upon completion of this course, students will become proficient in many skills required for research, including: defining a research question or hypothesis; evaluating relevant literature; designing experiments; connecting research studies to socially relevant issues; and effectively communicating research plans. First instructed in Fall 2016, this 15-week course resulted in 100% of enrolled students producing 1st drafts of their research plans. Students made substantial progress towards becoming creators of scientific knowledge, and are better prepared to become successful PhD students if they so choose. This course helped to inspire a multi-department expansion and redesign of research courses with the support of Cal State LA RISE (R25). Plans to further assess CHEM 5100 will be discussed. Merits of developing research courses for the training of research scholars include institutional sustainability and the potential to inspire others to develop similar courses at other institutions.
RISE POSTER B28

Building Biomedical Research Workforce Capacity by Aligning Training, Education and Institutional Goals

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¹ Morehouse School of Medicine

Motivation: Successful biomedical research relies on the talent and dedication of the scientific workforce, and a continued supply of highly trained people of the best quality who can bring new insights to our understanding of biology and advance the translation of these insights into improved health for all (NIH Biomedical Workforce Report 2012). However, D.K. Ginther et al. reported that scientists from racial minority groups are less likely than white applicants to receive research funding from the US National Institute of Health thus limiting the diversity of the workforce. This deficiency has been attributed to the lack of adequate mentoring, participation and persistence/resilience of individuals from diverse backgrounds in the biomedical research pipeline.

Approach: Morehouse School of Medicine (MSM) addressed this deficiency by enhancing training efforts to engage a more diverse group of learners in biomedical research careers through structured engagement, training and mentoring of learners; establishing of student learning communities; supporting pre-doctoral graduate students with competitive "skill/knowledge sets"; establishing an Office of Career Connections (OCC) and introducing the 3 minute thesis challenge; establishing a Mentoring Academy and faculty development program; and strengthening institutional research training infrastructure (Research Cores).

Outcomes: Efforts towards diversification of the workforce has yielded remarkable results based on metrics indicating increased number and quality of applicant pool of trainees, improved curricula, increased offerings in research training programs at MSM (PhD, MSBR, MSMS, MSNS, MSBT, MSCR), increased number and impact of research publications, increased matriculation rates and increased number of graduates entering research-based postdoctoral opportunities.

Lessons learned: Outreach, advertising and recruitment in URM communities inadequate. Need increased numbers of funded faculty mentors to support program size. Modification needed to increase numbers of URM matriculating males. Expose learners to traditional and non-traditional workforce career options; opening-up diverse job opportunities. Institutionalization helps to sustain educational innovations.

References:
1. NIH Biomedical Workforce Report (2012)
RISE at Morgan State University: Critical Thinking – Transdisciplinary Training

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Keywords: critical thinking; science process skills; writing skills;

RISE at Morgan State University focusses on preparing undergraduate students for graduate training and biomedical research careers. Individual, year-round faculty-mentored research training has been central to the program since inception in 1999. Based on formative and summative evaluations, our Program has evolved to scaffold hands-on mentored research with specific learning goals (science process skills, soft skills, and critical thinking skills) and strategically placed annual group activities. RISE at Morgan has increasingly been able to attract students from across the STEM and Social/Behavioral Science who share an interest in health relevant research, making it expedient to devise training activities which draw upon the strength of diverse disciplinary backgrounds. Our poster will introduce the learning goals central to current RISE activities and focus on a series of transdisciplinary training activities rated as highly effective, based on Program Evaluation as well as research conducted by the authors.

Specifically, in their first summer in RISE students are introduced to concepts put forward by the Foundation for Critical Thinking and then use these concepts to engage in collaborative problem solving regarding real life scientific questions. Skills developed in this weeklong workshop are reiterated throughout the summer, as students gather to develop abstracts and poster presentations based on their mentored research projects. As juniors and seniors students further hone these skills by participating in Critical Analysis of the Research Literature and Senior Thesis Seminar, the capstone of their training.

Both courses, originally developed for RISE participants, have become part of the curriculum in the School of Computer, Mathematics and Natural Sciences at Morgan, open to all qualified students. Our poster will present the gains in both science and writing efficacy, experienced by students as they complete these training experiences.

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RISE at Claflin University through Collaborative Interdisciplinary Mentoring in Biomedical and Behavioral Sciences

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- Motivation: Improve and expand the science curriculum to broaden participation in STEM and Behavioral Science research at Claflin University.
- Approach: In order to improve and expand participation in our science curriculum and also broaden participation in Research, we introduced RISE Program to approximately 400 entering freshmen in August 2016 by presenting RISE marketing material through direct face-to-face presentations and through informational flyers developed by RISE Staff members. RISE Participants served as Ambassadors to share experiences in RISE Program with sophomores and juniors in seminar classes to enhance recruitment.
- Outcomes: Seventy-five percent of RISE participants entered graduate school, 25% entered a PhD Program and 25% went directly into the job market (computer science/industry). This exceeds the institutional level at 20% of graduates being PhD seekers in the School of Natural Sciences and Mathematics (SNSM). RISE Participants have been accepted into several graduate schools in Public Health/Epidemiology as well as into the workforce with training and preparation to enter PhD program after one year. Increase PhD seekers from 14.5% to 25% of those entering graduate/professional programs. Twenty-five percent of students in SNSM, both graduate students (M.S. Biotechnology) and RISE Participants, who entered graduate school in 2016 are Ph.D. seekers. Only 8.6% of all SNSM undergraduates entered graduate school as Ph.D. seekers in 2016. Of students completing the newly designed Psychology major, 30.8% of the 26 graduates entered Master’s Programs.
- Lessons learned: Interdisciplinary concept has been broadened by including Geography and Sociology. The Program Manager’s position is critical to maintaining stability, continuity, and sustainability in the Claflin University RISE across disciplines. A well-structured summer program is important. The website is adding visibility to the project and will be linked to the institution and to the agency. A CU-RISE flyer has been developed.
RISE POSTER B31

RIT-RISE Scientists-In-Training Program for Deaf and Hard-of-Hearing Undergraduates

Scott R. Smith, MD, MPH and the RIT-RISE Team (TBD)

Office of the Associate Dean for Research, National Technical Institute for the Deaf, Rochester Institute of Technology

The RIT-RISE Scientists-In-Training Program for Deaf and Hard-of-Hearing Undergraduates (RIT-RISE) is a new training program funded by NIH/NIGMS to increase the number of deaf and hard-of-hearing biomedical, behavioral health, and clinical research scientists. The RIT-RISE program will reinforce and supplement Scholars’ academic and professional preparation with undergraduate research experiences essential for entry into PhD programs. RIT-RISE Scholars will benefit from a network of more than 40 research faculty mentors at RIT as well as more than 15 research faculty mentors outside of RIT supplemented by salary support, laboratory supplies, communication access support, and faculty mentoring programs. These supports will ensure that Scholars are able to access meaningful and successful research experiences over 3 academic years and 2 summers with eventual conference presentations and publications. RIT-RISE Scholars will also receive an Individualized Development Plan, career advice and support, professional development workshops and presentations, and specialized research classes and camps to ensure their success.
Welcoming Future Scientists: Engaging Puerto Rican High School Students in STEM through Community-Based Learning and Outreach

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University of Puerto Rico in Ponce, RISE Program

Key words: Community-Based Learning, Hands-On-Experiences, STEM

Welcoming Future Scientists (WFS) is an annual one-day community outreach event that exposes STEM topics to high school students and teachers. Currently in its 5th year, WFS brings together high school students and teachers from local public and private high schools in Puerto Rico to participate in interactive hands-on scientific experiments, live demonstrations, and workshops. **Motivation/Aim:** to promote awareness of STEM research and the role of biomedical scientists, to encourage college-level studies in science, to provide community-based learning and leadership skills among our current PRISE students, to evaluate the outcome of introducing science and research topics to high school students in interactive hands-on sessions during WFS. **Approach:** A team of UPR PRISE and non-PRISE students designed, organized, and conducted a full day of concurrent sessions in STEM. In each session, the UPR Ponce students explained the purpose of the activity, performed an interactive demonstration or experiment and answered questions. This year, 147 high school students and 16 teachers from 14 high schools of 5 municipalities participated. All activities were conducted in Spanish. Pre- and post-tests evaluated student learning in STEM topics. Data was analyzed using an independent t-test and chi-square test. **Outcomes:** We determined that this activity had a positive impact in the high school students. We observed significant increases in the number of correct answers among 11th (p=0.02) and 12th grade (p=0.00) students. Students also reported gaining a better understanding of STEM, graduate studies, and a research career. **Lessons learned:** Introducing science and research topics to high school students through interactive hands-on activities in their native language helped to improve student learning and increase interest in selecting science as a career. Teachers regard WFS as a form of continued-education. In the future, we need to assess the impact of WFS in the professional and scientific training of our PRISE students.
Preparing Incoming Freshmen to Succeed in College

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Keywords: Freshmen; achievement gap; math; language arts

URM and economically challenged students have an achievement gap in STEM at CSUN, limiting their participation in targeted STEM programs. For seven years we have provided opportunities for entering freshmen to help prepare them for success in college. Most students in the program are both underrepresented minorities and economically disadvantaged while others are economically disadvantaged but not members of historically underrepresented groups. Admission to the program is based on an application from prospective science and math majors accepted to CSUN and registered by the time the program starts. 40 students are selected for this program and 20 are usually funded by CSUN. The program consists of 5 weeks with 3 days a week for math enhancement, one day a week for English enhancement and one day a week for an educational field trip to local museums and marine areas. Throughout the program, pep talks on going for a Ph.D. degree in biomedical research were also presented.

A comparison was made of the college pass rates in 12 math courses taken during the first freshman semester at CSUN of students that completed the program (Group 1; pass rate 91%), those accepted into the program but did not attend (Group 2; pass rate 60%), those not accepted (Group 3; pass rate 76%), other students in biology/chemistry/biochemistry, physics and astronomy, psychology (Group 4; pass rate 72%) and other health science and kinesiology students (Group 5 pass rate 77% ) in the Summer of 2016 program. At the start of the program 20% of the students were possibly interested in pursuing a Ph.D. degree in biomedical research. At the end of the program, the percentage was 48%. The data indicate that those students who completed our program had a substantially better pass rate than students in any other group; closing the achievement gap. (Supported by R25GM063787, T34GM08395, and CSUN Provost’s Fund to M.E. Zavala)
PREP POSTER B34

PREP@UGA: Post-baccalaureate Training in Infectious Diseases Research, the First Three Years

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University of Georgia's “Post-baccalaureate Training in Infectious Diseases Research” (PREP@UGA) program is entering its fourth year, with a total of 20 scholars trained to date. PREP@UGA is unique among PREP programs in its focus on infectious diseases research. This focus supports a cohesive environment for training and the development of community within the scholar cohorts, despite drawing faculty mentors from 12 departments and 6 colleges/schools. PREP@UGA uses a mentoring triad model, in which each scholar is paired with a faculty mentor and a research mentor, the latter a senior graduate student or postdoc, who supports the day to day activities of the scholars and ensures scholar integration into routine professional and scientific development activities appropriate for aspiring graduate students. A major metric of success for the program is scholar acceptance into competitive PhD programs; to date, 17 of 20 PREP@UGA scholars have been accepted into or are currently enrolled in PhD programs at Carnegie Foundation classification “Doctoral University - Highest Research Activity” institutions. A combination of scholar self-assessments and scholar assessments completed by research mentors and faculty mentors are used to assess improvements in technical skills, communication skills, and measures of confidence. Analysis of PREP@UGA’s first two cohorts shows significant improvement in a number of metrics from program beginning to end, including “project understanding”, communication skills, self-advocacy and participation. Weaker performance in “command of the literature” and “anticipated next steps in the research project” has guided implementation or planning for new approaches to focus specifically on developing these areas, including a move toward a PREP scholar-centric intensive literature review course. PREP@UGA intends to continue to serve deserving and motivated scholars with increased focus going forward on individualized development plans, with scholar guidance and support provided by the mentoring team (faculty and research mentors) as well as near peers, personal mentors, and the National Research Mentoring Network.
Addressing STEM persistence by training undergraduates to communicate science, navigate scientific culture and build effective mentoring relationships

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Career advancement for scientists from underrepresented (UR) groups can be impeded by the transmission of cultural norms and development of crucial skills occurring outside standardized classroom learning and instead relies upon informal relationships with colleagues and mentors. Learning how to communicate one’s research to a variety of audiences and understanding how to get the most out of mentoring relationships are examples of keys to STEM success that are rarely explicitly taught. Similarly, the impact of social factors such as Implicit Bias are often not openly addressed by institutions and leaders responsible for training STEM students and yet have disproportionate impact on engagement and success of UR trainees. We have created and institutionalized a semester-long course for STEM undergraduates engaged in research to strengthen scientific communication, demystify social aspects of the culture of science and strengthen mentoring relationships. The course utilizes a “flipped” model in which classroom time is used to reinforce skills and concepts encountered in readings and assigned work out of the classroom. Class meetings include work on scientific communication and exploring the culture of scientific research. Multiple methods were employed to evaluate student learning, including pre- and post-course surveys, regular student feedback, and graded performance in assigned tasks such as written work and oral presentations. These quantitative and qualitative data describe strong improvement in a range of student’s scientific communication skills and the ways in which mentoring and social factors contribute to success in STEM careers. Similarly, we found a shift in the topics students associate with the inhibition of communicating science to include curriculum topics, such as impostor syndrome and communication styles. As mastery of the range of concepts covered is both hard to gain and critical to persistence in scientific careers, the approach is a valuable addition to attempts towards increasing diversity of the STEM workforce.

Reference: https://nrmnet.net/collaborate/rfa/2015-pilot-4-of-7/
Increasing Access to Training for Reproducible Research Tools: R and git

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Motivation: As the importance of, and demand for, reproducible research (RR) skills grows, the need to reach a wider audience is acute. The major challenge is that Weill Cornell's current educational offerings in RR are delivered in hands-on, small-group, interactive settings that mix lectures with guided, in-class exercises. These require a high ratio of professional level (PhD or equivalent) teaching assistants to students, in addition to a lead instructor, and are thus labor-intensive to deliver. Approach: Here, we leverage emerging tools for on-line learning so students may acquire the basic concepts and practical skills independently, and at their own pace. The self-paced, on-line portion of each course is implemented using DataCamp (http://www.datacamp.com); using this system, students have access to the tool they are learning (i.e., R or git) from within the browser. One of the main advantages of this platform is the ability to require the student to solve a computational task and finely assess the result, giving feedback tailored to specific errors (i.e., not just inform the learner if he/she is correct or not). Outcomes: Students can avail themselves of the on-line materials when they need them most, and not have to wait until a workshop is scheduled. Ultimately, this will allow the presentation of higher-level and domain-specific problem sets in a classroom setting that assumes facility with the basics conveyed in the on-line portion of the course. Lessons learned: Preliminary feedback from beta testers indicates that because there is no real-time Q&A, complicated concepts have to be explained more incrementally. This approach seems to be most useful for teaching new skills but may not be as effective for complex problem-solving exercises. Dissemination: To benefit the wider biomedical research community, the on-line portion of each course has been made publicly available.
ABSTRACTS – POSTER SESSION C
Enhancing Graduate Training to Bolster Success on the Non-Academic Job Market

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Keywords: technical skills short-courses; career development workshops; pre-doctoral training

Graduate training in the biosciences has traditionally focused on preparing students for careers in academia and basic research. As opportunities of this nature are decreasing, there is a need to expand training to prepare students to make meaningful contributions in other professional settings. We developed and implemented the following activities to ensure that our programs continue to produce scientists poised to respond to an employment environment that includes a diverse array of career paths.

• Technical Skills Short Courses. These courses are intended to expand the toolkit that students can apply to their thesis research, and to increase their marketability as they enter the workforce.
  (i) A 2-day workshop in the theory and practice of flow cytometry and cell sorting (January 2017); (ii) a 2-day workshop in the theory and practice of Advanced Biological Imaging (June 2017); (iii) a 1-day course in genome-editing (March 2017).

All three courses were heavily subscribed. These workshops will be offered on an annual basis in the future, to be taught by our Core Facility personnel who received training from the visiting professionals this year.

• Professional Development Workshops. We hosted a 1-day workshop in scientific writing taught by a professional science writer (September, 2017). Student feedback will guide development of a new writing course to be taught by UO faculty each fall. Workshops in identifying strengths, preparing resumes, interviewing and networking skills were offered in May, 2017, timed to precede the Career Symposium where students practiced these skills.

• Career Symposium. A Career Symposium brought bioscience professionals representing diverse careers to campus (June 2017). Visitors participated in panel discussions to share practical advice, and were available for a networking session.

• Online Internship Portal. We developed an online portal and a network of contacts to connect students with opportunities for non-academic internships toward the end of PhD training.

Source of support: NIGMS T32 Supplement
Training in Rigor and Reproducibility

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We piloted a training program to enhance rigor and transparency in biomedical research in response to PA-16-060. The motivation is to provide trainees with a didactic and participatory learning experience to develop a strong foundation of knowledge about experimental design and methods and learn how to apply this knowledge and adopt best practices to conduct rigorous and reproducible research. The initiative is led by Dr. Oswald Steward, who has been directly involved in projects that brought the “replication crisis” to light, and Dr. John Billimek, who is the lead biostatistical resource for UCI’s Health Policy Research Institute. The approach was to pilot a 5 day training session in September 2016 involving 12 students and postdocs, which allowed us to test teaching approaches and strategies and obtain feedback. This was followed by an 8 day class for 9 MSTP students that alternated sessions on reproducibility led by Dr. Steward with sessions on statistical approaches led by Dr. Billimek. Outcome was assessed by a survey on student satisfaction and opinions regarding balance between in person discussion vs. independent study. Quality outcomes will include assessment of how the students prepare fellowship proposals with respect to the standards for rigor and transparency of reporting, the reviewers’ comments of those proposals, and an internal review of publications resulting from trainee research. The lessons learned thus far are: 1) Students felt that an initial in person session was required to emphasize the issues in rigor and replication; 2) Group discussion of published papers for rigor was important; 3) Combining statistics with instruction in rigor was useful; 4) Instruction in rigor should include more aspects of professional development; 5) Outcome could be assessed by having students focus on a product, such as a fellowship proposal, IRB or IACUC protocol.
Mastering the Art of Reproducible Science

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Keywords: reproducible science, case reports, best-practice procedure, experimental design

The problem of non-reproducible outcomes in the scientific literature is rapidly eroding the credibility of biomedical research. The motivation of this course was to advance the visibility and awareness of this critical issue and to equip students to better recognize and eliminate sources of irreproducible data. The course explored the fundamental causes and consequence of data irreproducibility, discussed best-practice procedures to minimize data irreproducibility, and discussed the responsibility of the scientific community to confront the irreproducibility crisis. Our approach included independent reading and assessments; literature based case reports and team scenario demonstrations in a flipped classroom format. Our outcomes were active discussions and debates on the causes of irreproducibility and ways to effectively address these issues, as well as student-designed and acted scenario movies portraying reproducibility problems commonly found in research laboratories, in publications, and during grant review. Lessons we learned from student evaluations of the course were: 1) that real life examples of reproducibility that they experienced in their research and were able to discuss with the class were very practical and changed the way they now design experiments and interpret outcomes; 2) that the course would be most effective if offered early in their curriculum; 3) that the case studies and lecture/discussion groups were effective, and 4) while the scenario videos were fun, they were viewed as focusing more toward teaching than on practical ways to address the reproducibility problem.
Improving Student Statistical Skills Via An Interactive Web-based Portal

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A general lack of statistical awareness is one of the major challenges facing the scientific workforce. Consequently, developing better ways to train graduate students in the sciences is crucial to helping them reach their potential in their future careers. Moreover, it is clear that this training must reach beyond the classroom in order to help students apply the lessons directly to their research. Accordingly, we have created a statistics and data analysis web portal to allow students to learn the best ways to handle their data. Our approach is three-pronged: 1) Answer common questions in clear, non-specialist language, while providing links to more rigorous treatments for those with specialized interests; 2) Provide interactive demonstrations of key concepts to help students build intuition by “playing” with data; 3) Encourage users to take ownership by facilitating student comments and authorship on the site. Finally, we recognize that certain disciplines (e.g. proteomics) have very specific data-handling requirements; for these cases, we will recruit local experts to create articles and link to authoritative external sites.

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Optimizing Programmatic Components of the Molecular Medicine PhD Training Program at Cleveland Clinic/Case Western Reserve University
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Motivation: To modify curricular and graduation requirements for our 10-year old translational research program that effectively meet our students needs and deliver appropriate courses and research training to meet programmatic goals of training the next generation of translational researchers in a reasonable period of time.

Approach: The Executive and Curriculum Committees are reflective and meet regularly to fine tune course offerings and graduation requirements. Every course offered has an anonymous online course evaluation that each student fills out. In addition, an annual Curriculum Retreat is held with student representatives from the first 3 years. The Curriculum Committee has reorganized courses, removed courses, and added new courses over the past 10 years to address student feedback. The Executive Committee addressed the exiting publication requirement (1 accepted and 1 submitted first author paper) so as to be more flexible to individual circumstances.

Outcomes: Examples of new courses include: 1) Molecular Mechanisms of Human Disease, a second year course focusing on 3 diseases in a bedside to bench approach, and which includes grant writing instruction and practice to prepare students for their Qualifying Exam Proposal; and, 2) Student Seminar Series, a weekly class attended by all students of all years where students orally present their research progress in a safe environment, participate in Q & A about their research, and get feedback on their presentation style from peers and course instructors. This format also serves for occasional clinical presentations by Clinical Co-Mentors, and small group discussions for continual RCR and reproducibility and rigor case studies. The Executive Committee amended the student petition process for exceptions to the graduation publication requirement, and decided that each petition must be approved by a majority vote of the committee.

Lessons Learned: Listening to student feedback has been very useful for evolving our curriculum to meet both student and programmatic needs. Having flexibility in our publication requirement will help with reasonable time to degree for students who have completed a body of work deemed deserving of a PhD by the thesis committee, but may be otherwise delayed by choices of the thesis advisor or journal editors that are beyond the student’s control.
Survey of Student Knowledge and Behaviors Related to Experimental Design

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Concerns around the reproducibility of published biomedical research studies have seeded conversations about the state of knowledge of today’s biomedical science trainees and how best to educate them in the principles and practices of rigorous experimental design. We assessed the sources of knowledge, behaviors, and state of knowledge of 28 2nd year biomedical science graduate students who had not yet been exposed to a formal course in experimental design. Some aspects of experimental design, such as hypothesis formation, were discussed frequently in journal clubs, other classes, and as part of the mentor-student interaction. However, other topics, such as internal and external validity, were discussed less frequently, with 29% reporting that they either did not know how to define these terms or had never discussed them. Regarding behaviors related to experimental reproducibility, randomization and blinded were infrequently used in the students’ most recent publication (56% and 18%, respectively). While most (80%) reported that all members of the study team could access all of the project data, 18% reported that they had never backed up their data and another 18% reported that they had not backed up their data in the previous month. Regarding knowledge of experimental design principles, respondents scored below chance in areas such as the philosophical foundations of science, sampling practices and principles, and properties of measurements; but they were better able to recognize the confounding variables and forms of experimental control present in hypothetical experimental designs. Overall, these data describe a group of biomedical science graduate students who have not been exposed to comprehensive and systematic instruction in experimental design. As a likely consequence of this lack of systematic instruction and the reliance on ad hoc methods, their knowledge of experimental design principles is incomplete and their practice of behaviors that promote reproducibility is sporadic.
Quantitative Measurement and Analysis to Enhance Rigor and Reproducibility

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Keywords: Measurements, error analysis, assumptions

One goal of the Systems Biology Graduate Program is to train students in quantitative approaches to experimental design and problem solving. This begins with experimental strategy, through to assay characterization, and statistical data analysis. The Systems Biology student cohort is extremely diverse, with backgrounds ranging from pure mathematics to biochemistry to organismal biology. This diversity presents a core strength of the program but also a challenge. With the goal of preparing students for a well-rounded, multi-disciplinary PhD, we developed a course, Quantitative Measurement and Analysis, to better prepare our G1 students in quantitative empirical science. The course was piloted in the Systems Biology program, and will be open to all Harvard graduate students. The class has a modular design to allow other PhD programs to substitute experimental methods most suited to their students, while retaining overall goals and approaches. Our goals are to provide students with the tools to understand sources of measurement error in biological assays, the assumptions being made in gathering and interpreting data, and statistical intuition for data analysis. In its first year, we delivered a quarter course to allow us to test key concepts; next year we are extending the course to a full term. The course introduced physicochemical foundations of several measurement techniques, and guided students in how to characterize the performance of assays, assess statistical significance, and avoid pitfalls. Emphasis was placed on recurring principles across measurement methods. We commissioned feedback from the students during the course and at its completion. We learnt that students found the material challenging, but that they appreciated its importance. The students and faculty felt that, with more in class time for exercises, they would gain a better mastery of the material. We expect to measure long term retention through the student’s use of class concepts in their qualifying exams.
Computational and Professional Skills for Biomedical Trainees

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Keywords: Pharmacology; Career Skills; Computational Skills; Reproducibility

The Harvard Pharmacological Sciences training program offers training in the sciences relevant to discovering and developing novel therapeutics, including the study of drugs in preclinical and clinical settings to improve disease treatment. A major aim is to link training to industrial, clinical, and regulatory activities by requiring students to participate in hands-on, real-world internships in non-academic settings.

A second major aim is to provide students with the toolkit and practical skills necessary for therapeutic discovery and development, including experimental design and quantitative and computational skills. We were awarded supplements to create two new courses to (1) address rigor and reproducibility through quantitative and computational skills and (2) develop professional skills to foster success in diverse career paths. The Statistical Modeling using MATLAB course was motivated by our students’ need for a strong foundation in computation; because of students’ widely varying levels of background expertise, this foundation could not be integrated into existing courses. We engaged content experts and seasoned instructors from Applied BioMath to help design, develop, and teach this course, which assumes no prior knowledge of either MATLAB or statistical analysis and which complements our existing core curriculum. The Fundamentals of Entrepreneurship course was motivated by our students’ need for professional skills to complement the internship experience and by feedback from industry partners about key skills important for trainees. Together we identified the need for didactic training in leadership, management, communication, and entrepreneurship. We are collaborating with Harvard Business School faculty to develop case-based modules, with the Alan Alda Center for Scientific Communication to create units on oral and written communication for scientific and non-scientific audiences, and with entrepreneurs at Harvard and in industry to participate in group-project work. We look forward to reporting on outcomes and lessons learned as these courses are implemented in the Fall semester.
Empowering the Next Generation of Discovery Pharmacologists

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Since its inception in 1991, the university-wide predoctoral training program in Biomolecular Pharmacology at BU has integrated core principles and cutting edge technologies of pharmacology and Biomedical Engineering, with industrial research training in Big Pharma. The NIGMS T32 was awarded in 1997. Two decades later, this program is a cornerstone of predoctoral training at BU across multiple departments and campuses of the university and with Pfizer and Biogen industrial partners.

Motivation and Approach:
To develop a dynamic training program that graduates the next generation of thought leaders in academic biomedical research and drug discovery. The curriculum ensures quality training in basic principles of pharmacology while providing the essential tools for advanced careers in academic or industrial settings. Thus, the rapidly accelerating technological advances across the breadth of this discipline must be aligned with the research and career goals of our students.

Outcomes and Lessons Learned:
We redesigned, consolidated, and streamlined the curriculum and qualifying exam structure to eliminate redundancy, focus on rigorous experimental design, statistical approaches, and reproducibility as a core thread through the entire curriculum (1). This NIGMS initiative accelerated the previous 10 years of effort, reducing time-to-degree to 5.2 years with a 92% graduation rate. Students critically review experimental design in selected high profile publications with identified pitfalls. After 3-4 rotations, students match with mentors and then rotate at Pfizer or Biogen. Student teams form entrepreneurial companies in a “role-playing” exercise where a discovery project is pitched to Pfizer executives in an oral presentation. We have learned that to effect change, striving for an innovative curriculum is a continuous effort. Interdisciplinary laboratory rotations, industry rotations, and a diverse array of research opportunities is essential. Most importantly, students are a valuable resource for guidance and each student’s needs must be carefully monitored using multiple methods of frequent mentoring.

(1) Supported by NIH/NIGMS 3T32GM008541-18S1
Management Matters for Scientists

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Motivation: Young investigators running independent labs in today’s scientific market face many obstacles. In addition to writing proposals, publishing papers, teaching and service to their school/field, they are also faced with the day to day business of running a lab. More than ever, an understanding of how to lead a lab as a successful organization is essential for young investigators’ career and productivity.

Approach: In collaboration with faculty members of the MCO program and Harvard Business School (HBS), we designed an interactive nanocourse called “Management Matters” to cover the following: basic elements of business strategy (Module 1), improving leadership, teamwork, and team management (Module 2), developing effective science communication skills (Module 3), and gaining a deeper understanding of research management and practice in industry through field trips (Module 4).

Outcomes: The 4 modules were scheduled to take place throughout the academic year. We measured the effectiveness of each of the training modules through a detailed evaluation via an online survey instrument. Overall, students found Module 1 very useful and expressed satisfaction with the in-class case study, effectiveness of the instructor, and duration of the module (3-hrs). Module 3 was held in two separate sessions. The long duration and instructor dynamics presented a challenge to some of the students in session 1 (science writing). However, many of the components (duration, in-class assignments, instructor) in session 2 which covered science presentation skills was well received by students. So far, we are finding students are reasonably able to articulate important take-away lessons from each of the modules. Modules 2 and 4 are still in progress.

Sustainability: In order to accommodate more students to attend these important workshops and sustain it in the long run, our plan is to offer a half-day management matters mini conference each year comprised of interactive workshops that would cover important topics in the area.
Improving Reproducibility in Bioinformatics through a Course in Data Mining with Visual Programming

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Motivation: Bioinformatics presents several challenges in the areas of reproducibility and rigor. One problem is that many biologists lack technical expertise to analyze and evaluate large data sets. Therefore, they rely on collaborators to analyze their own data and their ability to critically evaluate the data of others is limited. We wanted to provide students with training that will address these issues.

Approach: Data mining provides approaches and tools that allow biologists to analyze and understand their data. We developed a course focused on data mining essentials such as clustering, classification, regression and model selection, along with techniques such as gene-set enrichment analysis. We teach these methods through a visual programming platform, Orangeᵃᵇ, that requires no training in programming. The course provides an introduction to the inner workings and mathematics, helping students to intuitively understand the data analysis algorithms without having to understand deep mathematical concepts.

Outcomes: We taught the course in 2015 (39 students) and in 2016 (47 students). The course is taught over two weeks, through seven two-hour sessions that include lectures in which the students use the Orange software on their laptop computers to analyze data and learn concepts in a hands-on manner. The students receive a homework assignment after each class. The course is a major success, as assessed by a standardized evaluation administered by the Graduate School. We also observed that students are using Orange to analyze data after the course and we are receiving requests from staff and faculty who want to use the software. Moreover, Orange has been incorporated into a new course at BCM.

Lessons learned: The course materials and the method of instruction seem to be useful. We plan to continue teaching this course while emphasizing the use of visual programming to improve rigor and reproducibility in bioinformatics.

References:


Software: Orange: Data Mining Fruitful & Fun, http://orange.biolab.si. The software is free of charge to all and can be downloaded and installed by anyone who has basic computer skills (i.e. point and click).
Collaboration with the Center for Open Science: A New Model for Enhanced Reproducibility Training Coupled with Evolving Electronic Notebook-Like Data Framework

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Introduction We collaborated with the Center for Open Science (COS), a Charlottesville Virginia non-profit whose mission is 'to increase openness, integrity, and reproducibility of research'. A key tool of COS is their free, open-source ‘Open Science Framework’1, a cloud-based data organization and sharing platform recognized by a growing number of journals including eLIFE, Springer Nature, Biomed Central, and many others2 as well as institutions as a scholarly web tool that enhances transparency, fosters collaboration, and increases visibility of research outputs at the institutional level3. Our goals were to: (i) involve COS staff and UVa faculty in the restructuring of our core 'Essentials of Translational Science' course, and to (ii) help evolve the Open Science Framework as a graduate student electronic notebook. Results (i) The course now begins with key presentations from COS' Tim Errington and Courtney Soderberg respectively on the Open Science Framework as a tool to enhance rigor and reproducibility and integration of the Open Science Framework with daily research workflow. Topics that follow include: ethics, design thinking, entrepreneurship, intellectual property, regulatory science and translational science. (ii) COS planners interacted with a committee of UVA graduate students inclusive of one postdoc and one senior technician. The committee proposed twenty-nine improvements. Eight were prioritized, and to date two have been completed. School of Medicine funding is being sought to sustain this process and the course. Outlook The COS Open Science Framework facilitates idea development, study design, acquisition of materials and data, storage, analysis and interpretation of data; and writing and publishing articles. Further Framework evolution will seek input from at least 100 UVa and other graduate students and postdocs towards introduction very early in graduate education. Through this mechanism all graduate students should become proponents of transparency in science.

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The “Mechanisms of Disease & Translational Science” (MoDTS) Graduate Track [1] is a PhD training track that will provide students with unique opportunities to study human diseases at the interface between basic and clinical sciences. MoDTS students will be empowered to spearhead the bidirectional translation of discoveries between the bench and bedside to harness the explosion of scientific knowledge to improve human health. The approach combines experiential and didactic learning to increase student exposure to clinicians and clinical and translational research through immersion experiences that are supplemented by courses in human physiology and pathology. We leveraged institutional resources including those from the Center of Translational Medicine [2] that administers the NIH supported Clinical and Translational Award (CTSA). We have obtained continuous extramural support for MoDTS, first from the HHMI Med into Grad program and currently by the NIH GM Molecular Medicine T32 Training Program and the CTSA TL1 component. Admissions to the MoDTS program is competitive, and we have successfully trained ~8 PhD students per year for the past 8 years. Despite the additional curriculum, mean time to PhD degree for MoDTS is less than that of our overall graduate school. The majority of graduates pursue postdoctoral fellowships in preparation for diverse careers in the translational biomedical workforce. PhD dissertation mentors accept their students’ participation in the supplemental track, and MoDTS is embraced by clinicians and clinical investigators who serve as preceptors. Challenges include difficulty of scaling up due to funding constraints and the limited pool of clinical preceptors. Sustainability and dissemination are achievable, with continued institutional and extramural grant support as well as campus-wide appreciation of the importance of translational research for advancing human health.

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1. MoDTS website: http://www.utsouthwestern.edu/education/graduate-school/programs/phd-degrees/specialized-supplemental-phd/mechanisms-of-disease/
2. Center for Translational Medicine website: http://www.utsouthwestern.edu/research/translational-medicine/
Principles, Statistical and Computational Tools for Reproducible Science Abstract for the FASEB TWD Program Directors’ Meeting

Heather Mattie1, Curtis Huttenhower1, John Quackenbush1, Lorenzo Trippa1, Christine Choirat1 and Xihong Lin1  
Harvard T. H. Chan School of Public Health

The bioscience community recognizes reproducibility as a growing challenge in basic, clinical and population sciences. Indeed, experimental design, data provenance, analytic methods and tools, and reporting science play a critical role in the biomedical research ecosystem to ensure scientific rigor, robustness and transparency (1). To meet these scientific needs, we are creating a reproducible research curriculum for a series of six online modules that can stand alone or be used in a blended classroom setting to cover the following topics: Fundamentals of Reproducible Science; Case Studies; Data Provenance; Statistical Methods for Reproducible Science; Computational Tools for Reproducible Science; Reproducible Reporting Science.

We are releasing the modules in Fall 2017 on the edX platform as a free Massive Open Online Course available to the whole research community. We will also teach the course as a blended residential course using a flipped classroom for all trainees of our NIGMS T32 training grant. Students will be asked to do data analysis class projects that use reproducible research tools taught in class by reanalyzing the data of their first year summer projects. Students’ performance in the course will be graded. We will encourage the trainees’ dissertations to adhere to standards of reproducibility and data access learned from this class. The dissertation committee of a student will examine the student on his/her plan on reproducibility research in his/her dissertation work in their oral exams.

In collaboration with the Harvard Bok Center for Teaching and Learning, we have developed a comprehensive protocol to evaluate students’ knowledge and abilities gained from this course using several short-term and long-term mechanisms. Multiple methods of data gathering at multiple time points will allow for validation of study results. In this evaluation, outcomes for program participants will be compared using a pre-post design.

References:

The major goal of the TBMM program at BCM is to train biomedical scientists to work at the interface of basic and clinical research for the improvement of human health. The program matriculated its first class of students in 2005 and is now in its 12th year. Its development was motivated by the need to train a new cadre of translational researchers equipped with the scientific expertise, translational and clinical research knowledge, and leadership skills, to bridge the gap between bench and bedside. To achieve this goal, we have developed an innovative curriculum that includes rigorous basic science courses, as well as courses focused on pathophysiology of diseases, regulatory and ethical aspects of clinical research and leadership. A unique feature of our Program is dual mentorship: students have a basic science mentor and a clinical mentor who guides them through a semi-structured exposure to clinical care and clinical research. Our outcomes data, including publications in high impact journals, begin to show that we have successfully recruited and educated students with a solid education in basic science, pathophysiology and clinical translational research, who are prepared to become independent investigators at the interface between basic and clinical medicine. The program also promotes interdisciplinary translational research through student-driven collaborations between their basic and clinical mentors. Our NIGMS T32 training grant supports students in their second and third years when they are involved in both clinical and translational research projects. Our graduates are currently employed in a wide range of science related careers. A majority remain within academia and medicine, but many are in industry and several have taken a regulatory or licensing route.
Integrated early-stage training in computer programming and biostatistics

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Critical analysis of quantitative, large-scale data sets is increasingly important in all fields of biology, and fluency in basic programming and statistical skills is becoming essential for all biomedical researchers. Many entering biomedical PhD students lack training in programming and statistics, and essentially none have been trained to integrate these approaches to guide experimental design and data analysis. To address these deficiencies, we developed a course that provides an integrated introduction to biostatistics and computation. The 10-week course interleaves lectures on Python programming and statistics. Programming lectures focus on introducing basic concepts in programming, e.g. loops, a building block of reading data and simulation analysis, rather than providing a comprehensive understanding of “computer programming”. Statistics lectures focus on providing a conceptual understanding of statistical principles via simulation- and resampling-based approaches. Students complete homework using the Jupyter Notebook tool, which provides a permanent “lab notebook” in which notes, Python computations, and results, including graphs, can be co-mingled, an output often unavailable in standard computational workflows. In pre-/post-test surveys, students self-reported knowledge of statistics and programming increased by 1.33 points and 1.25 points, respectively, on a 5-point Likert scale. Student feedback indicated support for integrated training in simulation-based statistics and programming, enthusiasm for a concepts-first introduction to statistical hypothesis testing powered by computer simulations, and an increased understanding of what p-values and statistical testing mean. Many students reported implementation of acquired programming and statistics skills in their research. We found that teaching general programming strategies was as important as teaching specific Python syntax: When students first created a road-map to solve a multistep programming problem in plain language, “pseudocode”, and then translated the pseudocode into correct Python, they more effectively and efficiently solved complex problems. Future plans include expanding the course into a full-semester class and adding an “applied biostats” module.
New Curriculum in Rigor and Transparency in the Division of Biology & Medicine at Brown University

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We designed and implemented seven new training modules in Rigor and Transparency (R&T). Topics featured include: experimental design, variability, technical and biological replicates, implicit and confirmation bias, record keeping, investigation using "big data", team science and collaboration, critique of methods published in peer-reviewed journal articles, and biostatistics. Trainees participated in the R&T modules during their first year of graduate study, with the goal of acquiring foundational knowledge that will benefit them throughout their careers. Using the Canvas learning management system, the R&T modules employed web-based discussions and background materials to engage the trainees prior to in-class discussions. We incorporated videos of our instructors explaining content that often confuses students and designed exercises that required the students to apply new or sharpened skills and perspectives to their concurrent laboratory research projects. Assignments such as writing data management plans and resource authentication plans were designed to prime components of the students' future thesis work and funding proposals. Training and assessment are ongoing. Thus far, students have asked for increased in-person discussions, fewer options for background readings and case studies, and for some training exercises to be carried out later during graduate training, i.e., after they have joined their thesis laboratories. It is planned that, in future years, the R&T program will be permanently incorporated into the core training curriculum, along with the Responsible Conduct of Research and Individual Development Plans, for all PhD students in the Division of Biology & Medicine at Brown University.
Ensuring Rigor and Reproducibility: A Team Based Approach

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Jillian Harvey, PhD and Betsy Hill, PhD
Colleges of Graduate Studies and Medicine

Reproducibility is the cornerstone of scientific research. Replication of one’s own or someone else’s research provides the momentum for forward progress within the scientific community. Unfortunately, the literature is replete with cases of failure to reproduce published research. We designed a course that addresses the issues of rigor and reproducibility. The objectives of the course were: Identify and describe essentials for maintaining a comprehensive and legal laboratory notebook; Identify biologic variables that can compromise reproducibility; describe and implement principles of rigorous study design to reduce sources of error (systematic and random); understand appropriate statistical methods for the analysis of different data types; describe considerations specific to the processing and analysis of ‘big data’ and subsequent inference; understand requirements for transparent reporting, including those for publication and authorship; understand, describe and identify scientific misconduct. The course includes lectures, reading assignments and interactive sessions. A unique component to the course is the following. Students will be given a short background for a research proposal at the first lecture and will be given 2 weeks to write a mini research proposal. This will be minimally graded and returned to them. Towards the end of the course, they will be asked to revise their proposal based on what they have learned from the course about ensuring rigor and reproducibility. It is presumed that they have learned how to design more rigorous experiments as a result of the course. The rewritten proposal will count for 60% of their grade. The course is scheduled for 15 weeks and will start in the Fall, 2017.
A new hands-on paradigm for teaching experimental and analytical methods in biomedical sciences

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Motivation. Modern research in biomedical sciences requires considerable expertise in computational, quantitative, statistical, and experimental analysis. For many years, the graduate Program in Molecular Biophysics (PMB) has offered a lecture-based course in biophysical methods to its first year graduate students. Although the targeted group takes away a broad awareness of topics covered by this survey course, second year graduate board oral (GBO) examinations have revealed that important concepts and particulars need to be better assimilated and retained.

Approach. To train students effectively in both “hard” skills (i.e., methods and technology) and “operational” skills (i.e., experimental design and data interpretation), PMB is organizing modules that provide direct, hands-on immersion experiences with computation (Unix, Python, Mathematica) and key techniques (e.g., single-molecule measurements, NMR spectroscopy). The enhanced active learning approach concentrates module instruction in a one- or two-week period during which students progress from concepts to experimental design to measurement to analysis, as appropriate.

Outcomes. With an administrative supplement awarded in August 2016, PMB delivered three computational modules in September. Modules in optical spectroscopy, X-ray diffraction, NMR spectroscopy, and statistical analysis followed over spring semester. The computational skills have been immediately useful in coursework, laboratory rotations, and other modules. Experimental modules have improved appreciation of the literature and understanding of seminar material.

Lessons learned. Students appear engaged. As expected, the closely monitored mode of instruction with practicum exposes misconceptions and insufficiencies in background that can be immediately addressed. Whether intellectual independence and knowledge retention have improved will be assessed during next year’s GBOs.

Sustainability and Dissemination. The support of the supplement is essential for establishing course material and purchasing necessary supplies and equipment. After a first year run-through, the modules will be ready for repeated offering and opening to other training programs.
Introducing the Program in Enhance Research Training (PERT)

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Keywords: Predoctoral Fellowships, Enhanced Training in Biomedical Research, Career Development

The Program in Enhanced Research Training (PERT) at OHSU is an ancillary pre-doctoral training program designed to provide students with training that is not usually incorporated into traditional graduate curricula. Although graduate programs provide outstanding training in scientific content, there is generally a lack of formal training in other skills critical to success. Our goals are to position these trainees to be competitive for individual predoctoral fellowships, shorten the time to degree completion, and enhance the likelihood of a successful research career. PERT is a year-long program targeted to 2nd year PhD students. It consists of workshop modules that include: Tools for Professional Writing, Data Presentation and Efficient Information Mining; Data Rigor and Reproducibility; Navigating Your Relationship with Your Mentor, Program Director and Dissertation Advisory Committee; Constructing a Successful Fellowship Application; Fine Tuning Your Scientific Presentations; and participation in a Computational Biology Data Jamboree. Additional didactic coursework requirements include one term courses in Molecular and Cellular Approaches to Disease and Training in Professional Scientific Writing. Trainees also attend two career development sessions to initiate and evaluate their Individual Development Plan. Trainees are required to participate in one national level research conference, compete to give an oral presentation during OHSU Research Week. There is a one-year commitment to the PERT Peer-to-Peer Mentoring program where they engage with the next PERT cohort. PERT trainees must also submit a NRSA or similar predoctoral fellowship application at the end of the PERT training period. We are nearing completion of the first year of PERT. All five PERT trainees were selected to give oral presentations during Research Week. We conducted a survey to evaluate trainee satisfaction with the content of the program. The program was generally viewed as success and the detailed feedback will be used to make improvements. PERT is supported by NIGMS T32-GM071338.
The Institute of Medicine’s (IOM) 2014 report on graduate medical education noted the need “to advance innovative education and training models with a focus on team science, leadership and entrepreneurship”, so that new discoveries can quickly benefit patients. To assess interest in entrepreneurship training, we surveyed pre- and postdoctoral fellows in a partnership effort between our T32 GM106999 Systems Pharmacology and Toxicology Training Program and our Translational Research Institute. Only 53% of trainees indicated the goal of securing a position in an academic health care setting. Nearly an equal number desired jobs in the private sector, government agencies, or other nonacademic settings. Fully 65% of trainees believed that training in entrepreneurship would advance their careers. Accordingly, we used a T32 GM106999 Supplement (PA-15-136) to design a new curriculum in entrepreneurship for T32 Scholars and other trainees called the Health Sciences Entrepreneurship (HSE) Boot Camp. The goals of the intensive 4.5-day HSE Boot Camp, offered before graduate classes begin in the Fall, are to: (1) enhance the breadth of career development activities that prepare graduate students for the biomedical research workforce by introducing trainees to principles of business and entrepreneurship, (2) support educational activities that complement traditional graduate research by increasing awareness of entrepreneurial activity and the potential to commercialize discoveries to improve health outcomes, and (3) reinforce the principles and practice of team science as a mechanism for health science innovation. Fourteen trainees attended the inaugural HSE Boot Camp in 2016, which included classes on business principles, showcasing of health science entrepreneurs, and incubator teams that evaluated ideas for potential commercialization. A survey of participants indicates that the HSE Boot Camp will be a valuable addition to our curriculum as we seek to train future innovators to translate discoveries into improved health care in academic and nonacademic settings.
Using an NIH Training Grant to Support Real Team Science Training

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Keywords: predoctoral; team science; interdisciplinary

In our era of team science in which institutions and funding agencies expect research to be increasingly interdisciplinary, translational, and collaborative, considerable attention is paid to the challenges of team science for faculty members, e.g., promotion and tenure policies and multi-PI funding mechanisms. The problem we seek to address is how better to prepare research trainees for team science. We developed a Clinical & Translational Science co-major for PhD students engaged in health research. A unique feature of our program is using the TL1 training grant mechanism to support not individual trainees, but teams of trainees. PhD students propose collaborative research as “TL1 Teams” comprised of two or more PhD students from different degree programs in different colleges. Teams collaborate to develop new team specific aims that expand the scope of their individual dissertation projects based on a common research interest, e.g., a human disease being investigated at different levels (molecular to population), with different experimental approaches or data analysis methods, and/or at different parts of the T0-T4 continuum. Team training is supported by a didactic “Team Science” course, in which teams practice hands-on skills for team assembly, management, and performance monitoring. Lessons learned to date revolve around the needs to redesign the entire application process, from providing networking opportunities for interested applicants, revising the application format, requiring joint letters of support by co-mentors, conducting team interviews, and scoring teams rather than individual applicants. Outcomes are being assessed quantitatively and qualitatively. We propose that the team training model may be especially suited for interdisciplinary training programs supported by the T32 and other grant support mechanisms. We believe that team science can help to transform biomedical science doctoral training, and we welcome opportunities to expand this training model and collaborate to assess its impact on research and career outcomes. TL1TR001428, UL1TR001427
Open Source Training in Computational Competence and Hands-on Data Analysis

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This project is implementing a set of career development activities for Cellular and Molecular Biology trainees at Stanford University to enhance their training in data analysis and computational competence. Activities include creation of hands-on data analysis sections for three existing mini-courses and partnering with non-profit educational organizations, Software and Data Carpentry \url{https://software-carpentry.org} to build skills in computational competence, data management and data analysis. A new workshop focused on the analysis of digital images was created in the Data Carpentry format. Because all Carpentry materials are freely distributed, they can be widely adopted to develop a resource for the entire biomedical community. This project also offers a new professional development opportunity for trainees, to become a licensed carpentry instructor. Our goal is to develop a self-sustaining Data/Software Carpentry community at Stanford so that these workshops can be offered on a continuing basis to provide ‘just in time’ training to trainees at multiple stages of their training. Preliminary findings indicate that this training improves trainee confidence in data analysis practices and dissemination, which are anticipated to promote increased rigor and reproducibility. This project was funded under PA-16-060 as a supplement to parent award 2T32GM007276.
An Advanced Seminar on Data Analytics

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Keywords: reproducibility, bioinformatics, biostatistics, experimental planning

We offer a new statistics course to biomedical PhD candidates from all of our T32-supported programs with four broad learning objectives: To work with increasingly sophisticated experimental and exploratory data analysis and data visualization relevant to biomedical research, using R software. To gain deeper experience in planning and performing appropriate statistical analysis given a variety of experimental design scenarios. To understand the philosophical and historical underpinnings of the scientific method and their relationship to data exploration and statistical inference. To be positioned to undertake an advanced bioinformatics course. The course was structured using two pedagogic practices within each class meetup elements (guided discussion and practicum). A highlight of the term was a session on forensic bioinformatics and the notorious Anil Potti case by Kevin Coombs as guest lecturer. Dr. Coombs also gave well-attended open lecture entitled, “Cell lines, chemotherapy response and the need for reproducible research”. The students were surprised to learn the degree by which sloppy handling of the primary data underpinned that case. Although the course offered a variety of conceptually sophisticated biostatistical and computational concepts that are foundational for bioinformatics, including multivariate regression, permutation analysis, GLM and network analysis, the class discussions frequently returned to the fundamental problems of finding unbiased ways to approach experimental planning, data handling and its visualization. One outcome was realizing the difficulty by which students view traditional statistical power analysis as a pre-planning tool. A solution derived from the class joins statistical tests most commonly used in biomedical research (eg, t-tests and ANOVA) with more sophisticated permutation analysis (Monte Carlo) as used in bioinformatics. The resulting hybrid calculations yields both important experimental previsualization and a power calculation. Together, these allow for a more realistic assessment of experimental feasibility a priori. If widely adopted, this approach can arrest the proliferation of underpowered experiments.

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Development and Impact of a Practical Statistics course tailored to Graduate Biomedical Scientists

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Keywords: Curriculum development; interdisciplinary training; practical statistics; data processing; data analysis

The Predoctoral Pharmacological Sciences Training Program at the University of Michigan is a unique interdisciplinary effort between the Medical School and the College of Pharmacy with the goal of preparing graduates for a successful career in experimental therapeutics both in the academy or the private sector. To achieve these goals, we strive to develop a responsive curriculum that prepares trainees for success in the program and adds value to their education by providing broadly applicable tools and expertise. A critical component of this mission is to develop skills in effective experimental design and rigorous data analysis coupled with clear presentation and visualization tools. Although formal statistics courses are available at our institution, the offerings are not tailored to the needs and approaches that biomedical scientists encounter on a daily basis. We have therefore developed a novel graduate level course to address this important unmet need. The course is comprised of weekly sessions in a computer laboratory and student engagement is through a combination of didactic lectures, online learning, exercises, hands-on data manipulation with multiple software tools, and critical analysis and discussion of the primary literature. Formal evaluation of the first year of the course was carried out by consultants from the Center for Research on Learning and Teaching at the University of Michigan and involved in-class observations, a mid-course survey, and interviews with the students. Initial results indicate that the students found the course helpful, interesting and liked the format. Importantly, the students indicated that the course changed the way they interpret data and read scientific papers. Detailed feedback from the students is being incorporated to modify the curriculum for the next iteration this coming fall term. We will gauge the long term impact of the course by surveying the students and their mentors as they progress to candidacy.

NIGMS T32 Predoctoral Training Grant GM007767 and Supplement
Development of Didactic Content and Practical Exercises for a Course in Reagent Validation

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Supported by administrative supplement (PA-16-060) to T32-GM077229-08 (Mirmira, PI)

Keywords: reproducibility, reagent, validation, authentication

Based on guidelines and recommendations from the National Institutes of Health regarding policy guidelines for rigor and transparency in research, we aimed to standardize and enhance the education of pre-doctoral students in the area of appropriate reagent utilization and validation. To address this goal, we developed a novel course, “Reagent Validation as a Means for Enhanced research Reproducibility”. The objectives of the course were to teach pre-doctoral students to query experimental reagents with healthy skepticism, to anticipate commonly encountered reagent errors, to design reagent validation methods, to prioritize biological variables in the design and analysis of vertebrate animal studies and to structure manuscripts using recommended practices and established guidelines for publication of studies using vertebrate animals, cell lines, plasmids, and antibodies. We implemented the course with a series of 7 lectures that covered topics of transgenic mouse validation, murine strain identification, murine study design, cell line provenance and authentication of –omic data. For the transgenic mouse validation and murine strain identification, students executed practical exercises using Ensembl (http://www.ensembl.org/mus_musculus/info/index) and the Mouse Phenome Database (http://phenome.jax.org). We are in the process of formally surveying the students regarding course content applicability and quality of course delivery; however, based on anecdotal comments, the course was well-received. As an institution, we are anticipating making this course required for all pre-doctoral students. For the future offerings of this course, we will expand content on appropriate software utilization, antibody specificity verification, and best practices for manuscript preparation and reporting.
QuARCC: The Quality Assurance Research Reproducibility Collaborative

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Key words: Research; Quality Assurance; Rigor; Training

Scientists and the institutions that support them have been encouraged to develop strategies to ensure and demonstrate the quality of the critical work they do. This call to action, in response to research reproducibility concerns, provides an excellent opportunity to develop science-centered and risk-based strategies to complement (and meet) the requirements already proposed by concerned stakeholders such as funding and publication entities.

We hypothesize that a reasonable approach for improving research practice (while simultaneously generating evidence of research quality) is to integrate Research Quality Assurance (RQA) best practices into research training programs. We formed the Quality Assurance Research Reproducibility Collaborative to develop and deliver educational activities aimed at providing foundational training in RQA. This program includes lecture, interactive workshops, and individual support within the trainee research environment.

Twelve predoctoral trainees volunteered to participate in the pilot program, which includes 8 workshops, 2 Data Carpentry workshops, laboratory meetings (2-4 meetings per trainee) and trainee RQA audits at the completion of the course.

To date, all trainees attended a QuARCC Kick-Off event and ten trainees have attended and/or completed all assignments for the first four workshops. Nine of the ten have committed to lab-based consultation. One of the twelve trainees attended the Kick-Off event and the first workshop, and one trainee only attended the Kick-Off.

Pre-and post-training assessments, workshop evaluations, and audit results will be used to evaluate the program. Future strategies for training dissemination will be based on training outcomes and sustainability considerations. Challenges include scheduling difficulties and the occasional perception that QA is a defensive strategy put in place to identify (or in response to) poor work, rather than a proactive strategy to demonstrate research quality and encourage continuous improvement.

Funding was provided by an Administrative Supplement to Medical Scientist Training Program NIGMS T32 grant [T32 GM008244-29S2].
Rigor and Reproducibility in Biomedical Research

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We have integrated the concepts of rigor, repeatability and reproducibility into our current curriculum and have developed a new curriculum that combines both “wet” and “dry” lab components focused on teaching these concepts and laboratory skills. We strive to make these concepts routine considerations during the design and execution of any type of experiment. We have implemented the supplement at many levels as proposed and described below.

Students are required to write sections in their preliminary and comprehensive examinations on Rigor, Repeatability and Reproducibility similar to that required in NIH grant applications. We created a new course for our 2nd year students in both the Molecular Biology and Pharmacology Programs called MOLB/PHCL7801 “Rigor and Reproducibility in Biomedical Research”. The class is 1 hr/week in the Spring semester (17 weeks).

The results have been excellent at several levels. Several students have commented that “this is the most useful class they have ever taken”. In addition to lectures, readings and discussions, they have submitted cell lines for authentication to our NCI-funded UCCC (University of Colorado Cancer Center) Shared Resource, which is headed by Dr. Steven Anderson of our program. The results have been revealing as some cell lines are incorrect and/or contaminated with mycoplasma. We discuss the results with them and plan future corrective measures.

With regards to Quality Control (QC), we have purchased antibodies and reagents for students to test the quality of their antibodies. We have discussions of these results with the students presenting their data to the class for discussion. For rigor in biostatistics, we have setup the appropriate lectures, discussions and have purchased the appropriate software for rigorous statistical and bioinformatic analyses. We have also had a visiting lecture on “big data” analysis by Dr. Keith Baggerly of MD Anderson Cancer Center. To address Rigor and Reproducibility requirements by peer-edited, peer-reviewed scientific journals, Dr. Mark Johnston, Editor in Chief of Genetics led the discussion (supported by NIH GM008730-17S to R. Sclafani).
Enhanced Career Planning in Molecular, Cell and Development Biology

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Keywords: Careers, IDPs, Skills, Interests, Databases

The T32 Training Grant in MCD Biology at UC Santa Cruz received an administrative supplement to better prepare students in our Molecular, Cell and Developmental (MCD) Biology PhD program for diverse career paths.

Motivation: The career outcomes of our trainees resemble national trends: 52% in biotechnology, 17% in staff research positions at universities, 12% in academic tenure-track positions, and 19% in other positions. A responsibility of graduate programs is to inform students about the diversity of careers that PhDs can pursue and to provide training in the skills needed for those careers.

Approach: We developed a Career Planning course for mid-3rd-year graduate students. This course includes two panel discussions, one on academic careers and one on non-academic careers; guidance from experts in diverse careers on typical paths to those careers and developing the appropriate skill sets; a visit to a start-up company; training students to give effective short "elevator" talks; and working on Individual Development Plans (IDPs) to target each student’s training to her/his selected career goal(s). To facilitate students learning about different job options, arranging informational interviews, networking with employees, and considering internship opportunities, we developed a database of contacts and information about Bay Area biotechnology companies and a database of UC Santa Cruz PhD alumni who have pursued different careers.

Outcomes: We used an anonymous survey tool to assess how helpful our 10 Career Planning sessions were for students and to seek their recommendations for improvements in future years.

Lessons: The students were very enthusiastic about having a Career Planning course available to them and about the sessions we designed. The most appreciated sessions were the panel discussions, visiting a start-up company, and learning how to give short "elevator" talks. The least appreciated sessions were 2 invited guests discussing transitioning to industry and careers in public policy.
Improving Rigor and Reproducibility in Big Data Research

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Keywords: big data; reproducibility; biomedical research; machine learning; data science;

The supplemental project for the Pre-doctoral Training in Statistical Genetics program at the University of Washington, titled “Improving Rigor and Reproducibility in Big Data Research”, was motivated by the need to enhance existing training in bioinformatics and machine learning to provide trainees with quantitative expertise necessary to extract knowledge from biomedical big data. To this end, we developed a new data science curriculum for biomedical sciences at the University of Washington (UW), consisting of the following introductory (Masters-levels) courses:

1. Introduction to Biomedical Data Science: this course covers data wrangling, data visualization, exploratory data analysis and tools for reproducible research. The course also introduces basic computing and statistical tools that are prerequisites for more advanced classes in data science;

2. Bioinformatics for Big Omics Data: this course equips students with bioinformatics and computational biology tools necessary for analyzing various Omics data types, from whole genome sequencing to mass-spectrometry-based proteomics and metabolomics. Tools for reproducible research, including interactive reporting and version control are emphasized throughout the course;

3. Machine Learning for Biomedical and Public Health Data: this course introduces students to statistical machine learning tools for analysis of biomedical Big Data, with an emphasis on challenges and pitfalls of obtaining generalizable and reproducible results in light of the IOM report on the analysis of Omics Data [1].

The above courses have been developed as part of the Data Science curriculum at UW and can be used by students in various departments within the School of Public Health and the School of Medicine to complete the coursework for the university-wide Data Science Option, which is being adopted by many departments across UW. All three courses have been offered and have received favorable reviews from the students. The students’ reviews and the enrollment in classes will be used as criteria to assess and improve the above courses, and make additional adjustments in the curriculum, if necessary.

References:
"Business Strategies for Scientists: A Flipped Classroom Learning Experience"

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Keywords: business; flipped learning; podcast; strategy; videos

The objective for this project was to develop and evaluate a novel course, Strategy4Scientists, that teaches predoctoral research students basic business strategy skills that can be applied in both academic and non-academic settings. This project endeavored to fill a gap in graduate education that currently lacks the formal training in the strategic basis of running research programs either in academic or industry settings.

Methodology: The course was tailored to life sciences trainees, and utilized a flipped classroom model in which students participated in interactive, small group discussions after first watching online videos and listening to podcasts. The podcast (Strategy4Scientists on iTunes) included interviews with faculty and PhD professionals in industry and consulting. In-class discussions centered on real cases provided by academic faculty and UCSF alumni in industry and consulting. This curriculum comprised the following topics:
- Introduction to Business Strategy
- Academic-Biopharma Partnering
- Frameworks for Strategic Collaborations
- Developing a Strategy
- Strategy tools

Summary: This program provided exposure to the business strategy language and tools used by faculty and industry professionals to analyze their respective competitive landscapes and engage in strategic collaborations. Assessment data indicate that the content was applicable for trainees seeking science careers in multiple career areas. Participation in the course increased knowledge of basic business concepts, and increased the ability to apply these concepts to practical business cases. Furthermore, students reported they felt more competent to use this new knowledge in networking and interview settings, which shows impact in their professional development.

Conclusion: The course, Strategy4Scientists, was well-received at UCSF, and several peer institutions have implemented portions of this course. This project advanced the goals of NIGMS by creating and implementing a novel course that helps students build the professional skills and confidence necessary to make structured, strategic decisions that will impact their research and career success.

Source of Support: NIH NIGMS T32 Administrative Supplement grant (PA-16-142)
Predoctoral T32 Training Program in Biomolecular Science and Engineering at Rensselaer Polytechnic Institute in Collaboration with the University at Albany

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Fully exploring linkages between biology and engineering and identifying new opportunities requires the bridging of disciplines in specific target areas that are central to biotechnology. One such area is biomolecular science and engineering, where engineering principles are used to understand, design, manipulate, and apply biological macromolecules in a range of contexts. Biomolecular science and engineering needs to accommodate the increased interactions of engineers and life scientists in order to spur growth in areas including but not limited to synthetic biology, stem cell biotechnology and data-driven therapeutics discovery.

To address the above need, the Biomolecular Science and Engineering Training Program at Rensselaer Polytechnic Institute (Prof. Deepak Vashishth, Director), in collaboration with University at Albany (Prof. Marlene Belfort, Associate Director), is dedicated to the education of a broad cadre of predoctoral students spanning both life sciences and engineering. The program’s mission is to provide an integrated and multidisciplinary platform to broadly train predoctoral students at the interface of biology and engineering, focusing on the quantitative linkages that define this interface and preparing trainees for careers in biotechnology. In this manner, biomolecular science and engineering becomes a central focus of a broad component of biotechnology; namely, that which operates at the subcellular level, yet with applications over a wide range of length, volume, and time scales.

Key outcomes of the program include a well-balanced interdisciplinary predoctoral training program in biotechnology that also includes course work and training in data science/analytics, technological entrepreneurship and a strong public-private partnership based on strong relationships with industry and healthcare providers. More importantly, graduates of our program have gone on to an equal degree of success in both academic (41%) and non-academic (59%) careers in broad areas within biomolecular science and engineering including pharmaceuticals, environmental engineering, semiconductors research and/or created new companies (http://biotech.rpi.edu/students/nih-training-program/career-outcomes).

References: None

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A Laboratory Course in Biophysical Analyses of Protein Therapeutics

William M. Atkins, John P. Sumida, Mikklos Guttman

University of Washington Pharmacological Sciences Training Program

The Pharmacological Sciences Training Program at The University of Washington (PSTPUW) spans the Graduate Programs in Medicinal Chemistry, Pharmaceutics, and Pharmacology, as well as the umbrella programs in Biological Physics, Structure and Design and Pathobiology. Based on student feedback and requests, we aimed to provide a graduate level hands-on laboratory course to provide basics skills in the analysis of protein therapeutics. Protein therapeutics, or 'biologics,' dominate the pipelines of Biotech and Pharmaceutical companies, yet there is a striking lack of training in biologics in academic environments. In order to address this we developed a laboratory course to expose students to antibody structure and function with an emphasis on analytical aspects that are used in their commercial development. As part of the strategic planning for the course, we consulted with industry representatives to identify skills that would be valued. The course was offered for the first time in spring 2017, and was oversubscribed at 13 students. Nearly all (12 of 13) students will apply for T32 support in either the PSTP or the Molecular Biophysics Training Program (MBT). The specific laboratory activities included surface plasmon resonance of IgG binding to the FcRn receptor, comparison of native IgG1 and deglycosylated IgG1 thermal stability and binding to Fc receptors by differential scanning calorimetry and isothermal titration calorimetry, and peptide mapping mass spectrometry to determine the sites of glycosylation. These experiments were conducted in two 'cost centers' at UW. In addition speakers from industry were invited to talk about the use of these analyses in the commercial development process. Student feedback suggests a high need to offer the course on a regular basis. Due to significant costs, it will only be offered in alternate years and creative mechanisms will be required to ensure sustainability.
Interdisciplinary Biostatistics Research Training for Molecular and Cellular Sciences: Enhancing Rigor and Reproducibility

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Keywords: biostatistics, molecular and cellular level analysis, rigor and reproducibility

Graduate students in life and engineering sciences are increasingly tasked with analyzing complex quantitative experimental data while lacking a strong foundation in statistical approaches. General statistics courses focus largely on theoretical considerations of how the statistical tests are derived rather than on application, and tend to be taught by statisticians who rarely have a solid foundation in biological and engineering principles. Accordingly, students sometimes find it difficult to connect statistical concepts to the specific statistical tests that they need in order to analyze their data.

A T32 supplement through NIGMS/NIH provided us with the opportunity to develop a modern and relevant biostatistics course with a strong foundation in data analysis specifically tailored to the molecular, cellular, and tissue biotechnology and bioengineering. The course is taught by bench scientists with a solid grasp of statistical methodology and experience of teaching statistics to wide audiences. The course was launched in January 2017. Twenty-seven graduate students from the Rutgers Biomedical Engineering and RWJMS Molecular Biosciences programs completed the course. The syllabus combined didactic instruction in lock-step with experiential training and included a spectrum of biostatistics concepts reinforced by specific and practical examples. Topics ranged from basic concepts such as sampling distributions and how p-values are generated to more advanced topics such as logistic regression and survival analysis. Several labs were conducted in which students generated data sets that they analyzed either by hand or by various statistics software packages such as Prism, Excel, MatLab, and SPSS. Focus here was placed on how to interpret output tables. At the end of the semester, students presented a statistical analysis plan for their thesis projects. The course will be offered as a permanent component of the NIH Biotechnology Training Program and the BME graduate program. Course evaluation in process.
Professional Preparedness in Biotechnology

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Keywords: professional skills, process management, quality assurance, case studies, finance, communication

The NIGMS aspires to “provide leadership in training the next generation of scientists.” Although current courses in the typical graduate curriculum deliver strategic discipline-based learning for life science and engineering graduate students, the broader biotech and health science industry further demands that scientists be prepared to serve a variety of distinct functions and to understand broader developmental aspects of the business of science and engineering in a professional environment. Many scientific professionals, while experts in their respective fields, have little academic/professional background in business management; i.e. skills that ensure that scientific projects and research are implementable, feasible and sustainable. A T32 supplement through the NIGMS/NIH TWD mechanism allowed us to establish a graduate course entitled, “Professional Preparedness in Biotechnology,” providing practical and professional context for the Biotechnology curriculum and available to a diverse group of students enrolled in various NIH, NSF and DOE programs focused in biotechnology and life sciences. The course works to enhance students’ competitive skills and introduce additional layers of specialized competence enabling immediate contribution within diverse organizations in the life and biomedical sciences commercial sector. The course, launched in the first academic summer session of 2017, is taught by experts in the fields of communications, business management, financial analysis, quality assurance, process management and other areas directly applicable to these fields. The syllabus combines didactic instruction with expository case studies, reinforcing key learnings, as they review and analyze case studies specific to various professional environments and challenges and present recommendations to the class to seed group discussions and further roleplay. At the end of the semester, students present a case study based upon their area of professional interest with analysis of the actions and inactions relative to the concepts taught in class. The course is offered as a permanent component of the BME graduate program.
T32 POSTER C36

MD-PhD, Is It Right for Me?

Ruth Gotian, EdD (Tri-Institutional MD-PhD Program), Maggie Krall (UPenn-MSTP), Sandra Lemmon, PhD (UMiami MD-PhD Program), Robin Lorenz, M.D., PhD (UAB-MSTP), Brian Sullivan (WashU-St. Louis), and Joe Barbieri, PhD (MCW-MSTP)

Members of the Communications Committee for the MD-PhD Group of the Graduate Research, Education, and Training (GREAT) Section at the Association of American Medical Colleges (AAMC).

To extend opportunities to present information about MD-PhD training, the Communications Committee for the MD-PhD Group of the GREAT Section prepared a poster to provide talking points a director or administrator can use to overview the major features of MD-PhD training. The poster will reside on the MD-PhD page within the AAMC website. During the TWD meeting, Medical Scientist Training Program (MSTP) T32 Directors will staff the poster to present the strengths and challenges our MSTPs have towards identifying qualified students to pursue careers as physician scientists, and present how MSTPs train students for the dual degree. Presenting this poster at the 2017 TWD may facilitate additional communications between MSTP-T32 directors and directors of other training programs sponsored by NIGMS.
Jumping in: the Biotechnology Practicum as an Innovative Vehicle for Student-Driven Learning at the Cutting Edge of Research

Joshua N. Leonard (Co-Director), William M. Miller (Director)

Northwestern University Biotechnology Training Program (GM 008449)

This poster introduces a unique training innovation developed at Northwestern University – the Biotechnology Practicum. The central objective of the practicum is to provide hands-on training in current and emerging biotechnologies. In particular, this program is designed to empower students to learn about cutting-edge technologies and to catalyze the integration of these methodologies into their own research projects and laboratories. The practicum was initiated in response to feedback from the Biotechnology Training Program (BTP) trainees during an evaluation run by Dr. Denise Drane, Director of Research and Evaluation at the Searle Center for Advancing Learning and Teaching at Northwestern. During the discussion, in which faculty are not allowed, the trainees discussed the activities of the training program. While the trainees commented positively on all aspects of the program, a discussion identified that opportunities for greater hands-on training would be valuable. With this objective in mind, we began organizing an annual Biotechnology Practicum, beginning in August 2011.

The Practicum is a full day event divided into introductory and experiential pedagogical components. In the morning, domain experts from industry and academia provide background introductions to methodologies, theory, and applications pertaining to the topic of the practicum. In the afternoon, students receive hands-on training in associated technologies and methods. In this latter session, students are also encouraged to discuss their own research goals and interests with these experts, in order to obtain real-time feedback and guidance as to how such methodologies may be integrated into their own research. The morning lectures are open to all interested members of the biotechnology community at Northwestern. In the afternoon, BTP trainees and select additional students from the community participate in hands-on training with the technology. Topics are selected by the trainees and are generally chosen to dovetail with local expertise and core facilities. Importantly, these events are also organized by trainees, providing a unique opportunity to invite and network with faculty and industrial contacts from the Northwestern community and beyond. Topics covered to date include High-Throughput Technologies (2011), Imaging Strategies and Capabilities (2012), Bionanotechnology (2013), From Bench to Bedside – Small Molecule and Protein Production in Molecular Hosts (2014), A Practical Guide for Designing and Implementing CRISPR Experiments (2015), and Next Generation Sequencing (2016). The 2015 and 2016 offerings each attracted more than 100 participants, including industrial representatives as well as postdocs, graduate students, and faculty from multiple institutions. This event highlights a way in which the BTP serves to foster and grow the biotechnology community at Northwestern and beyond.
CMM OPTIONS: Cellular and Molecular Medicine Opportunities for Professional Training in Occupations for Scientists

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Graduate Education; Professional Development; Career Awareness; Cohort Model

A plethora of career development opportunities are now available to Johns Hopkins School of Medicine graduate students, yet only a fraction of our graduate students participate in them. The OPTIONS program integrates mandatory career development training into the PhD curriculum in order to transform PhD career development training. OPTIONS’ goal is that every Ph.D. student graduates with 1) a thorough understanding of career options, 2) critical career skills and job search tools, and 3) experiential training that enhances competitiveness in the job market.

OPTIONS offers an array of workshops and experiential opportunities timed to align with existing milestones in the graduate curriculum. For example, we will offer instruction and practice on oral presentations immediately prior to students’ first rotation talks. This will allow students to practice key career skills in an existing context.

In their third year, students will sort themselves into one of six cohorts by career interests, forming a peer community focused on career preparation. Monthly cohort meetings led by subject experts will establish a professional network for our students. Students will develop a portfolio of individual and group projects that will build skills and experience in their chosen fields. We are assembling steering committees of leading professionals for each cohort and partnering with existing student groups and external organizations for each family of careers.

The OPTIONS curriculum will be evaluated with evaluations, focus groups and reported satisfaction with career outcomes. Communication skills will be assessed by a common rubric used across all coursework. We are working with the JHSOM Office of Evaluation and Assessment (OAE) to develop evaluation tools. Pilot tests of OPTIONS courses have shown improvement in career skills and confidence and have been well-received by students. OPTIONS will transform graduate student career development by requiring career development education throughout graduate training.
A supplement to the T32GM008061 training grant was used to develop two new graduate courses in scientific rigor and reproducibility (R&R) at Northwestern University. Both courses were launched in the Spring Quarter (March-June) of 2017. One course, IBiS 421, is called Rigor and Reproducibility in Research. Experimental design and data analysis is discussed through analysis of case studies on the topics of rigorous statistical analysis, transparency in reporting, data and material verification, and sharing. The course also establishes best practice guidelines for image based data and description of biological materials to uniquely identify the reagents (in particular antibodies, cell lines and animal models). Lectures include: Experimental design; Transparency in reporting; Data and material sharing; Statistical analysis; Description and authentication of materials; Image based data; Presentation of data. Students demonstrate knowledge and use of the techniques discussed by presenting experimental design and data analysis of their own doctoral research. The other course, IBiS 416, is called Practical Training in Chemical Biology Methods and Experimental Design. It features two weeks of classroom and lab-based instruction on experimental design and analysis, supplemented by R&R training modules using case studies. Lectures and labs include: Data organization; Reproducible research; Github; Lab notebooks; Study design; Statistical analysis; Processing data; Plotting data; Data presentation. This is followed by a combination of lectures and labs addressing a broad range of analytical techniques. These lessons are then applied to inquiry based learning in six of Northwestern’s advanced instrumentation cores. For both courses, the curriculum and assessment tools were developed in consultation with NIGMS training program directors across Northwestern. Both courses were piloted with a small number of trainees this spring using team instruction approaches. Student reviews indicated that they found this training to be a valuable addition to traditional coursework.
Increasing Graduate Program Diversity and Improving the Student Experience

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Our program sought to increase the diversity and cohesion among its students. Our goal was to create a learning environment in which students feel connected, supported, and able to accomplish their career aspirations. In order to increase diversity, our program made a concerted effort to promote our program and our vibrant campus at in-person and virtual conferences, universities, poster sessions, and online/print advertising. Additionally, applicant interview weekends have added a focus on diversity and inclusion programs and resources available at our university and within our program. In order to create a more cohesive group of students, the program hosts an annual student retreat, facilitates camaraderie among students with a weekly student-led seminar series and lunch, and the program director meets individually with students each year.

Our student body has become more diverse. In our previous T32 funding period from 2008-2013, we had 5 URM students, comprising approximately 9% of our student body. Over the past 5 years, our percentage of URM students has increased to 14% and by fall 2017 will be 17%. Additionally, our applicant pool diversity over the past 5 years has increased from 6.5% to 17.5%. This speaks well of our efforts, as the state of Wisconsin is less racially diverse than the Midwest and much less racially diverse than the nation. (Data: 2013: 6 (93) = 6.5%; 2014: 9 (91) = 9.9%; 2015: 9 (89) = 10.1%; 2016: 11 (87) = 12.6%; 2017: 11 (63) = 17.5%)

Our student body has also become more cohesive, as evidenced by exit survey data from program graduates. Data show high satisfaction with program support, faculty helpfulness, career advice and more. Graduates also reported a strong social and intellectual climate in the program, as well as a very collegial environment. It takes time and faculty buy-in to work to improve the diversity and cohesion of a student body. It takes collaboration, creativity, and time among multiple individuals and programs, as well as funding to support the efforts. The work is never done, and programs should always continue working to improve.
Design and Implementation of a Short Course in Best Practices for Rigor and Reproducibility in Research

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Motivation: Training in Best Practices for rigorous and reproducible research was not available to our students in any organized manner. We sought to formally introduce these topics early in students’ careers in a campus-wide and consistent format to ensure that each trainee would contribute positively to the integrity of UNC research culture.

Approach: To provide our graduate students with a strong foundation in research design and methods, we organized a course called “Best Practices for Reproducibility and Rigor in Research” which was comprised of seven 2.5-hour workshops led by UNC faculty. The workshops were a mixture of didactic lecture, class discussion, and in-class exercises. The following topics were covered: Session 1: “Best Practices from an Industry Perspective”; Session 2: “Experimental Design”; Session 3: “Experimental Rigor”; Session 4: “Recognizing Biological Diversity and Potential Artifacts”; Session 5: “Record Keeping and Standard Operating Procedure (SOP)”; Session 6: “Data Acquisition and Archiving”; Session 7: “Data Analysis and Reporting”.

Outcomes: Overall, the course was considered successful and covered what was thought to be the most important topics for conducting rigorous and reproducible research. Forty students signed up for the course, and these students came from a broad range of research interests and departments/curricula at UNC. End-of-course evaluations were positive (average score: 2.05; scale 1-5, with 1 being the highest), with many students offering suggestions in content/approach for subsequent years.

Lessons Learned: Teaching faculty attended other sessions and learned different ways of communicating to a large diverse group of students. Students in the computational sciences were less engaged during the discussions focused on wet-bench research. Forty students is probably maximum due to classroom limitations and conducting effective class discussions. We plan to offer the course each year at the end of the Summer.
We wish to express sincere appreciation to the following for their time, effort, support and commitment to making this meeting possible:

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- Dr. Mercedes Rubio
- Dr. Shiva Singh

**Keynote Speakers**
- Dr. Alison Gammie
- Dr. Jon Lorsch

**Speakers**
- Dr. William Atkins
- Dr. Avery August
- Dr. Steven Barnett
- Dr. Erin L. Dolan
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