

## Symposia Abstracts

### **S01: Strengths-based STEM Interventions for Underrepresented Students: Understanding Strong Program Elements and Student Barriers**

*Chair: Phillip Bowman—University of Michigan*

Strengths-Based STEM Interventions: Meyerhoff Scholars Program and Beyond  
*Kenneth Maton, Mariano R. Sto, Domingo, Patricia Esparza, Rukiya Widerman, and Freeman A. Hrabowski, III—all of University of Maryland, Baltimore County*

Increasing the academic success of underrepresented students (URS) in the STEM fields is a pressing national priority. Progress in this area both contributes to national competitiveness in the global economy and promotes our country's social justice agenda. The Meyerhoff Scholars Program at the University of Maryland, Baltimore County (UMBC) is an evidence-based and highly successful strengths-based intervention program that contributes to these priorities. As a national model, the Meyerhoff Program's radiating influence at UMBC and on campuses around the country can help to further clarify core supportive elements of an exemplary strengths-based STEM intervention for URS. Kenneth Maton et al.'s presentation summarizes key aspects of the Meyerhoff Program model, and then to move beyond the program per se, depicts its radiating effect on the UMBC campus more generally, and on strengths-based interventions around the county.

Formal Organizational Support and STEM Intervention Outcomes: A Strengths-Based Approach  
*TaShara Bailey—University of Maryland, Baltimore County*

This strengths-based study provides new insight into the social organization of strong pipeline interventions for URS. TaShara Bailey's presentation summarizes recent findings on how strong Formal Organizational Support may help to explain overall program satisfaction and successful STEM career plans among URS. This NIH-NIGMS supported study revealed that URS in strong pipeline interventions with multiple program components had higher scores on strong formal organizational support scale items than URS in pipeline interventions with fewer formal program components. In summary, (1) URS with higher formal organizational support had significantly higher informal support from program peers than from either faculty mentors or program staff sources; (2) strong formal organizational support was related to program satisfaction, and (3) program satisfaction was linked to STEM research career plans. Theory-driven findings have implications for refining a strengths-based model of successful STEM outcomes, guiding future research as well as implications for program practice and policy.

Financial and Academic Barriers to STEM Intervention Success  
*Krystal Williams—Educational Testing Service*

Although strengths-based interventions can promote STEM success, it is also important to understand how barriers faced by URS in intervention settings also influence STEM outcomes. Krystal Williams' Presentation focuses on the importance of strengths-based elements to overcome pivotal financial and academic barriers that often impede URS in intervention settings. This NIH-NIGMS supported study further clarifies social psychological mechanisms through which financial and academic barriers impede STEM outcomes. Multivariate analyses of longitudinal data on 376 URS in summer research interventions found that STEM research career plans were enhanced by

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strengths-based interventions, but impeded by financial and academic barriers (both objective barriers and subjective threats). Study findings also suggest that personal resiliency, a measure of adaptive cultural strength, can promote successful STEM outcomes despite barriers. These theory-driven findings can help program administrators and policy-makers better determine not only if, but how, strengths-based interventions promote STEM success.

**S02: Promising Models to Promote STEM Research Careers by Multi-Institution, Multi-Disciplinary Alliances Funded by the NSF AGEP-T Program**

*Chair: Mohammed A. Qazi—Tuskegee University*

The AGEP-T program has been established by the NSF to encourage institutions of higher education and other stakeholders to form strategic alliances and propose innovative models to increase the quality and quantity of underrepresented minorities (URMs) in STEM graduate education, STEM postdoctoral studies and the STEM Professoriate (URMs include African Americans, Hispanic Americans, American Indians, Alaska Natives, Native Hawaiians and other Pacific Islanders). The focus of the proposed symposium is to have active AGEP-T alliances engage in dialogues on the development, implementation, study and evaluation of their respective models for URM STEM graduate education and transitions to careers in academia. The dialogue will consist of presentations by three AGEP-T alliances (led by Tuskegee University, Stony Brook University and Texas A&M University) to describe their models and associated research and evaluation activities, followed by a discussion with the audience. These research and evaluative components are critical to investigate the effectiveness of each model. They are driven by strategically formulated research or evaluation questions that are studied by using qualitative and quantitative techniques from education and the social sciences.

Each AGEP-T Alliance will describe features that make their models unique and their potential to contribute to preparing URMs that are better motivated to pursue STEM research careers. For example, the innovative aspect of the Tuskegee AGEP-T Alliance lies in the virtual nature project interventions. The uniqueness of the Stony Brook AGEP-T model is based on a strategic alliance that includes a national laboratory (Brookhaven National Laboratory) to facilitate the research productivity of their advanced URM doctoral students in STEM by providing them with a series of opportunities to learn technical competencies, develop research collaborations, and broaden their scientific networks. Finally, the originality of the Texas A&M AGEP-T model lies in the engagement of students in performing peer reviews, identifying and subsequently applying for competitive fellowship program and providing professional development to acquire skills for teaching at all levels.

The proposed symposium is organized by the “Tuskegee Alliance to Forge Pathways to Academic Careers in STEM (T-PAC)”, which is the only one amongst the eight AGEP-T Alliances currently in operation that is led by a Historically Black University – Tuskegee University. All AGEP-T Alliances are spearheaded by faculty members in key disciplinary areas who are the Principal Investigators, including STEM, behavioral sciences, education and diversity. These individuals will lead the proposed dialogue during this session.

The symposium dialogue will shed light on the factors that may adversely impact the academic success of URMs, and will illuminate positive practices leading to promising strategies that can be widely adopted to gradually increase URM representation in STEM research careers.

The Tuskegee Alliance to Forge Pathways to Academic Careers in STEM (T-PAC)  
*Melody L. Russell—Auburn University; Shaik Jeelani and Mohammed A. Qazi—both of Tuskegee University; and B. K. Robertson—Alabama State University*

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T-PAC is an AGEP-T collaborative effort among three doctoral granting institutions in the state of Alabama consisting of two Historically Black Universities, Tuskegee University (TU), and Alabama State University (ASU), and a Traditionally White Institution, Auburn University (AU). The focus of T-PAC is to recruit 18 first year URM doctoral students (T-PAC Scholars) at the three T-PAC Alliance institutions and assist them in their preparation through a promising novel model for STEM doctoral education. The novelty of the T-PAC model lies in the joint mentorship that is provided by engaging Scholars in interventions that are characterized by their *virtual* nature. These strategic interventions assist T-PAC Scholars to successfully progress through the various critical phases of their doctoral programs of study, such as passing graduate course work, preparation for qualifying examinations, carrying-out research and writing a publishable thesis.

The effectiveness of T-PAC's interventions is investigated through comprehensive research and evaluative components. Our research is grounded in the theory of Social Cognitive Career Theory and STEM Identity and is guided by the following strategically formulated research questions:

1. What factors impact STEM URMs decision to pursue careers as STEM faculty at Historically Black Colleges and Universities (HBCUs) and Traditionally White Institutions (TWIs)?
2. What factors determine STEM identity development for URM STEM graduate students?
3. Does STEM identity impact career choice and academic outcomes for URM in graduate programs across STEM disciplines?

Our presentation will start with a description of the T-PAC model and will be followed by a detailed discussion of the research that is being carried out to assess and understand the model's effectiveness. Results-to-date will be shared.

AGEP-T Frontiers of Research and Academic Models of Excellence (FRAME): Bridging Research and Practice to Promote Academic Engagement of Underrepresented Minorities in STEM Fields  
*Sheri Clark—Stony Brook University*

Despite growing recognition that advancement of innovations in STEM fields in the U.S. is often stymied by a lack of diversity among advanced STEM professionals, members of underrepresented groups continue to encounter considerable barriers to their success in STEM fields. In addition to barriers such as reduced access to resources and fewer opportunities for mentoring, research on social identity threat highlights the prevalence of messages in the academic environment that convey low value for underrepresented groups in STEM. To address these issues, we will describe a programmatic intervention (AGEP-T FRAME) that was designed to support the development of advanced URM STEM graduate students and postdoctoral trainees in the critical areas of research productivity, professional development, and postsecondary teaching. AGEP-T FRAME supplements doctoral training by focusing on the quality of degrees, and by providing professional preparation that will permit underrepresented minority graduate students and postdoctoral trainees in the STEM disciplines to compete and succeed in the Professoriate. Our recruitment, graduate and postdoctoral training components are designed to maximize professional outcomes in highly competitive research environments, with the aim of increasing URM representation in the Professoriate at all levels. To do this, Stony Brook University has formed an alliance with Brookhaven National Laboratory to provide comprehensive training for underrepresented postdoctoral fellows in key competencies that will enhance the trainee's likelihood of successful placement in faculty positions in research-intensive institutions. Additionally, this strategic alliance provides academic integration for advanced underrepresented doctoral students in STEM to increase their research productivity by providing them with a series of opportunities to learn

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technical competencies, develop research collaborations, and broaden their scientific network. Combined, these activities support our goal to increase quantity and quality of research publications produced by AGEP-T students.

Finally, we will describe results of a longitudinal social science research study that builds on this programmatic intervention by examining whether one's academic environment provides a threatening context for URM students (vs. non-URM students) in STEM that undermines URM students' persistence in their STEM fields over time. Specifically, this study examines implicit theories of intelligence, confidence, and sense of belonging, to see if these psychosocial variables predict persistence in STEM fields over time. Supporting this possibility, preliminary results demonstrate that graduate students' beliefs that their STEM colleagues believe intelligence is a fixed (versus malleable) entity may create a context of threat – particularly for members of an underrepresented group in STEM (i.e. women), impacting confidence and sense of belonging among women and leading women to consider dropping out of their STEM career pathway. A description of the AGEP-T FRAME model as well as the rationale, methods, and results of the research study that builds on this model will be discussed.

The Next Generation of Scholars: Recruiting and Retaining URM STEM Graduate Students  
*Rhonda Fowler—Texas A&M University*

The Texas A&M University System (TAMUS) AGEP-T entitled “Collaborative Research: Advancing Interdisciplinary STEM Graduate Education in Energy and Sustainability Disciplines program” is designed to open multiple paths to the doctorate and professoriate for URM populations by successfully developing and sustaining large-scale, distributed, yet interconnected STEM communities among the diverse alliance institutions that increase participation, reduce barriers, and promote success of URM doctoral students preparing for careers in the professoriate. The alliance is led by five institutions granting Ph.D.'s in Science, Technology, Engineering and Mathematics (STEM) that include Texas A&M University, Prairie View A&M University, Texas A&M University-Corpus Christi, Texas A&M University-Kingsville, and West Texas A&M University.

The programmatic interventions that are being implemented by this multi-institutional, multi-disciplinary alliance are centered on Energy and Sustainability. These interventions will enable us to more effectively recruit URMs into the Alliance and provide the community, training, research experiences, and mentoring to promote their success and interest in pursuing careers in the professoriate. The outcomes of the interventions are being investigated through comprehensive research and evaluative components.

The conceptual framework that is used to guide the alliance's research plan is anchored around Social Cognitive Theory. The social science research study designed to gain an understanding of the effectiveness of the proposed interventions is guided by the following questions related to feelings of inclusion of URM STEM graduate students at each of the Alliance institutions in both experimental and applied settings:

1. What effect does experiencing isolation or ostracism have on the productivity and progress of URM STEM graduate students and their intentions to continue to the professoriate?
2. What factors (e.g., institutional, interpersonal, individual) promote or mediate against URM STEM students' experiencing feelings of isolation or ostracism?
3. How effectively are project activities impacting students' educational and career plans, their sense of community, and their attitudes, beliefs, confidence, and skills related to successful completion of URM STEM PhDs and continuation into faculty/post doc positions?
4. Do URM STEM students at all TAMUS AGEP-T institutions have a sense of community?

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5. Are the collaborative research efforts across TAMUS AGEP-T programs and institutions impacting the success of URM STEM students?

The presentation will start with a description of the TAMUS AGEP and will be followed with discussion of the research that is being carried out to assess and understand the effectiveness of the program. Types of data collected will be described. Results-to-date will be discussed.

### **S03: The 2- to 4-Year College Transition**

*Chair: Kelly Mack—Project Kaleidoscope/ST*

Factors Influencing the Persistence of Students Enrolled in S.T.E.M. Programs at Historically Black Community Colleges

*Latitia D. McCane—Bishop State Community College*

The majority of the research on African American students in STEM has focused on four-year institutions, even though they comprised 15% of the enrollees at two-year colleges in fall 2009, compared with 14% at four-year colleges (Snyder & Dillow, 2010). Sadly, this demonstrates that too little is understood regarding the role community colleges play in the production of STEM graduates, particularly African Americans. More tragically, is the fact that little or no quality research exists on Historically Black Two-Year Colleges' production of STEM graduates, although, research shows the largest portion of STEM degrees earned by African Americans is awarded by four-year Historically Black Colleges and Universities (HBCUs), that which has been produced tends to focus on STEM persistence at four-year HBCUs.

This presentation will discuss findings on how African American STEM students' academic and social integration on campus; interaction with other STEM students and faculty; influence their persistence in STEM at two-year Historically Black Community Colleges. The study sought to understand the experiences of African American with an associate degree through the eyes of those who completed their first year in a STEM at two-year historically black community colleges and how their lived experience might influence the academic success of future STEM participants. Utilizing Tinto's theoretical model of persistence, the study examined the experiences students' encountered through participation in STEM after the completion of their first year. The study was conducted to achieve the following two goals: (a) to determine what academic and social integration looks like for African American students in STEM at historically black colleges. (b) to assess how interactions with faculty and peers positively impact the African-American student experience in STEM pathways.

To achieve these two goals, this study examined the particular experience of African American students enrolled in STEM pathways across 5 two-year HBCUs in Alabama. The method of inquiry was a phenomenological approach designed to elicit a clear and complete understanding of how African American students attending historically black two-year colleges experience STEM. The intent of the study is to assist community colleges and universities in developing stronger recruitment and retention strategies that may yield positive results in improving African American persistence in STEM.

This study was guided by the following research questions:

1. What kind of college experiences did students acquire as a result of having participated in STEM courses?
2. How did academic integration influence persistence toward degree completion?
3. In what ways did social integration influence persistence toward degree completion?

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4. What was the influence of faculty mentoring on adaptation to the academic environment of the college?
  5. How did interacting with other students influence student persistence toward degree completion in STEM pathways?

Tinto's (1975) model of persistence was the theoretical framework applied to this phenomenological study to document the experiences, perspectives, and recommendations of African American students who were currently enrolled in STEM pathways at historically black community colleges in Alabama. Many studies on student persistence have utilized Tinto's theory because social integration, academic integration, student interaction, and faculty interaction are strong indicators of student success. This study proved that Community Colleges have a traditional age talent pool in STEM that is college ready. Students in this study were traditional age college students and the results of the findings indicated that they were academically and socially integrated into their college environment. Participants credit their institution, faculty, peers, and themselves working collaboratively to achieve their educational goals. All students in this study will earn their two-year degree and transfer to a four-year college or university in STEM.

URM Students are the Majority in a Hybrid Online B.S. Degree Program from a Research-intensive University

*Jennifer C. Drew and Eric W. Triplett—both of University of Florida*

The Microbiology and Cell Science Department in the College of Agricultural and Life Sciences at the University of Florida has developed an innovative model of a 2+2 degree program that increases participation of underrepresented minority students in a STEM degree programs. Although many two-year students have a desire to pursue a B.S. degree, due to a myriad of factors, these students do not complete the 2-year to 4-year transition, and this transfer gap is wider for URM students. Many universities in the United States, particularly research-intensive land-grant universities, are located in rural regions that are distantly located from their respective states' highly populated urban centers. This geographical and cultural distance reduces participation of otherwise highly qualified and diverse students in the STEM degree pipeline. In response to these challenges, we developed a new model of a 2+2 program that uses distance education as the vehicle to bring a university's life sciences curriculum to students rather than the oft-tried model of a university attempting to recruit URM students to its location. In this paradigm, community college graduates transfer into the Microbiology and Cell Science (MCS) program as distance education students to complete their Bachelor of Science degree. The program was established in 2011 and is the first of its kind in a STEM field, and as such serves as a model for other universities seeking to broaden the reach of their STEM programs.

The program was established in close collaboration with the 2-year institution Miami Dade College – North Campus. This strategic partnership with a large minority-serving institution allowed us to integrate one of our primary objectives from the very start: increasing URM participation in the STEM pipeline. The experience of the students in the Distance Education Microbiology and Cell Science program (DE MCS) is very similar to the on-campus students' experiences in that both groups of students take the same departmental courses taught by the same instructors, take required laboratory courses in a face-to-face format, take only proctored exams, and have the same availability to instructors. To test the hypothesis that this hybrid online approach can increase participation and diversity in the STEM pipeline, the outcomes of the DE MCS were assessed and compared to the on-campus MCS program after three full academic years. The enrollment of DE MCS majors has climbed steadily each year from the initial cohort of 11 students to a current enrollment of 79 DE MCS majors, and has contributed to an overall increase in the number of Microbiology and Cell Science majors. As of the Fall 2014 semester, over half (51%) of the DE MCS students are from underrepresented minority backgrounds. Statistical analysis of the

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data indicate that this level of URM participation is significantly higher than the URM participation levels in corresponding on-campus cohorts, which vary from 21-33% (p values < 0.05). The DE MCS program has comparable graduation and retention rates as their corresponding on-campus programs. Academically, the DE MCS students perform as well as, or better than their on-campus cohorts with a mean graduation GPA of 3.50. Overall, these data indicate a hybrid online 2+2 approach is successful in increasing URM participation and strengthening the STEM pipeline. The data represents an update on the results in press in the journal PLOS ONE.

#### **S04: Taking the Next Step: Examining Obstacles and Opportunities in STEM Career Pathways**

*Chair: Clifton Poodry—Howard Hughes Medical Institute*

##### **Taking the Next Step: Examining Obstacles and Opportunities in STEM Career Pathways**

*Christopher B. Newman, Kimberly Griffin, Kenneth Gibbs, and Tonisha B. Lane—all of University of San Diego*

In this symposium, the researchers will present three empirical studies that focus on STEM career pathways. The purpose of this session is to provide the audience with a better understanding of factors contributing to underrepresented populations' educational choices and career decision-making. The presenters will focus on multiple time points in the training trajectory, addressing the early postsecondary entry points for undergraduates, students engaging in undergraduate research and/or internships with corporate industry, and postdoctoral scholars as they decide between faculty, researcher, or non-academic career roles.

Tonisha Lane will focus on the role of undergraduate research in developing a STEM identity among women scientists of color. Using interview data collected from 15 Black females and Latinas, she explores the advantages of engaging in undergraduate research. Participants reported that building relationships with faculty, engaging in scientific practices, strengthening their technical skills, preparing materials for conference presentations, and being recognized for their work solidified their identities as future scientists and engineers. These opportunities also demonstrated to the students their aptitude for graduate education and academic careers. Furthermore, this presentation will utilize social and cultural capital as analytical lenses to elucidate how participation in undergraduate research creates critical pathways to graduate education and academic careers for women of color.

Dr. Christopher Newman will present research based on a multiple case study of two predominantly White public research universities. Interviews were conducted with 70 individuals including undergraduate engineering and computer science majors, faculty, senior administrators, and baccalaureate recipients who completed their degree within 3-5 years at the time of the study. His research investigates how undergraduate experiences with corporate internships and individual's financial circumstances inform students' consideration of pursuing careers in industry. Personal finances as well as the allure of lucrative employment within corporate industry appeared to play a considerable role in participants' intent to enter the labor market instead of pursuing graduate degrees. An econometric model of investing in human capital, tempered with a social capital framework, is employed to help interpret students' decision-making processes. Drawing from multiple perspectives from students, faculty, and administrators, the presenter will discuss important implications for the future of STEM fields and the possible systematic diversion from graduate education and, subsequent, academic/research careers.

The research presented by Drs. Kimberly Griffin and Kenneth Gibbs will address career development during graduate and postdoctoral training. They will present survey data collected from 1,000 American postdocs, assessing their current level of interest in four career paths: faculty at a research university; faculty at a teaching university; researcher outside of academia; and non-academic careers. Participants were also asked to reflect on and indicate their interest in each career path before graduate school and after completing their PhDs. Analyses examined how career

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interests changed over time, the factors that may be shaping career interest development, and whether there were differences in patterns by social identity. Regression analyses showed that group differences in interest in faculty careers were explained by career interest differences formed during graduate school, but not by differences in research productivity, self-efficacy or advisor relationships. This work highlights the need to attend to graduate experiences and training, and suggests scientists must be provided with career information early to have greater influence on development.

This symposium will conclude with time for questions and discussion regarding the various pathways to STEM careers, and factors that influence decision-making. Further, we will generate discussion regarding strategies and programs that could be implemented to increase diversity in various STEM career paths.

### **S05: Strategies with Undergraduates I**

*Chair: Shiva Singh*

#### **Integrated Programs Support Success and Graduation**

*Patricia A. Marsteller, Drew Kohlhorst, Molly Embree, Jacob Shreckengost, and Andrea Neal—all of Emory University*

Integrated programs of academic support and early research are essential to developing identity as a scientist and increasing persistence of underrepresented students. Integrated undergraduate development programs are organized and conducted by the Emory College Center for Science Education (ECCSE). ECCSE promotes access, interest and participation in STEM careers, by supporting and enhancing programs in the college, the graduate school, and in the health sciences. ECCSE programs supported by Emory College and grants from HHMI and NSF have enhanced the success of over 1500 UR undergraduate students. Since 1995 the Hughes Undergraduates Excelling in Science (HUES) Program has provided guidance and support for under-represented minorities interested in science and science careers. HUES has two components: a week-long Summer Institute preceding the freshman year, followed by various activities to support participants throughout their years at Emory. During the 2013-2014 academic year, there were a total of 84 UR incoming freshmen along with 56 upper-class peer mentors that participated in HUES. More than 60% of HUES alumni continued to graduate or professional school. HUES participants have significantly higher GPAs and persistence compared to matched Emory students.

ECCSE supports collaborations between Oxford and Emory, providing faculty development of best practices in course design, assessment, and inclusive instruction. We support a pre-freshman bridge program, Getting a Leg Up at Emory (GLUE) that has served 198 prospective STEM students since 2012 (60% UR), building key critical thinking, campus resource discovery and learning community skills. Participants are evaluated and interviewed by Emory/Oxford faculty to determine scientific ability and fit for various disciplines. To date, 22% of GLUE participants have participated in our “Introduction to Research” course, semester and summer research experiences, our HUES program and our NIH funded Initiative to Maximize Student Development (IMSD) program. Approximately 75% of GLUE UR participants are interest in Ph.D. programs in biomedical sciences. Of our 2012 cohort (n=32) over 50% of program participants have declared a STEM major and our 2013 and 2014 cohorts are active in extracurricular research opportunities and continue to act as mentors to new cohorts.

Emory College students have multiple opportunities for research and many departments sponsor research for credit or work-study opportunities. The Scholarly Inquiry and Research at Emory (SIRE) Program since 2004 has placed 986 first and second year students (13% UR) in research projects in all disciplines, 70% of these in the sciences. This year the SIRE/HHMI Partners



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program assisted 121 (19.8% UR) students in selecting a lab, reading relevant literature and developing lab, analytical and communication skills (graduate fellows receive an additional stipend for conducting these sessions). Undergraduates then developed a proposal for semester or summer research with the lab they choose as part of the program.

Finally, the Summer Undergraduate Research Program at Emory (SURE), established in 1990, has served over 1660 students (30% UR). SURE program participants reported significant learning gains in scientific-focused ethics and laboratory skills and increases in their interest in pursuing an MD/PhD degree or PhD in a scientific field.

In conclusion, we report on the use of early interventions and research programs to aid students in successfully completing a degree in the STEM disciplines. In a recent survey of alumni who have completed their undergraduate academic degree and participated in one or more of these early interventions report 81% are employed in a STEM career (n=145), with 58% of respondents currently participating in scientific research, 81% are satisfied with their position and over 80% plan to remain in a STEM career over the next 10 years. These data show the clear value of these early academic and research events that fosters identity student as a scientist, academic success and graduate school entry.

#### Closing the Social Class Achievement Gap in Undergraduate Biology Courses with Values Affirmation Interventions

*Yoi Tibbetts, Elizabeth Canning, and Judith Harackiewicz—all of University of Wisconsin-Madison*

**Objective:** We will discuss intervention research designed to improve performance and persistence for first-generation students who typically struggle in undergraduate biology courses. We investigate the mechanisms through which values affirmation interventions may help first-generation college students achieve a greater sense of belonging in college courses, perform better, and continue in the field of biology.

**Theoretical framework:** Achievement gaps for underrepresented ethnic minority and low SES students are prevalent in American education, and it is critically important to develop interventions to close these gaps. Recently, a series of randomized field experiments has produced striking effects on student motivation and achievement. The values affirmation intervention, in which students reflect on important personal values, is a brief exercise integrated into classroom curriculum that has led to significant effects on academic performance (Cohen et al., 2006; Miyake et al., 2010). This social psychological intervention has proven to be particularly effective for minority students and for women in physics, but no prior research has attempted to close the gap for first-generation students, a population that accounts for nearly a fifth of college students. When first-generation students write about their most important values, they may bolster themselves against perceived identity threats, whether those threats are due to stereotypes about their group or a mismatch between personal and institutional norms/values. Indeed, recent research suggests that values-affirmation interventions promote a sense of social belonging or academic fit and this may be particularly effective for first-generation students who endorse more interdependent motives for attending college and who may experience a lower sense of academic belonging. Focusing on important values may help first-generation students cope with stress and uncertainty about their background, and promote more effective performance in classes.

**Methods and results:** We tested a values-affirmation intervention in a double-blind randomized experiment with 798 U.S. students (154 first-generation) in an introductory biology course for majors. The brief writing exercise was administered in laboratory sections of the course, early in the semester, and again in the 5th week of the course. For first-generation students, values affirmation significantly improved final course grades and retention in the second course in the biology sequence, as well as overall GPA for the semester. This brief intervention narrowed the

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achievement gap between first-generation and continuing generation students for course grades by 50% and increased retention in a critical gateway course by 20%. A three-year follow-up revealed that first-generation students in the VA condition continued to earn higher grades in classes taken after the semester in which values-affirmation was implemented. In our ongoing research, we are examining the mechanisms through which this intervention worked, focusing on the content of students' writing.

Significance: Our results indicate that the values affirmation intervention can be scaled up to large enrollment science classes and can help first-generation students. Our results suggest that educators can expand the pipeline for first-generation students to continue studying in the biosciences with psychological interventions.

### Closing Achievement Gaps with Utility Value Interventions

*Judith Harackiewicz, Stacy Priniski, Elizabeth Canning, and Yoi Tibbetts—all of University of Wisconsin-Madison*

Objective: Many students start college intending to pursue a career in biosciences, but too many minority and first-generation students abandon this goal because they struggle in introductory biology. Keeping students interested in college science courses is crucial to keeping them on track for careers in biomedical science.

Theoretical background: One way to develop interest in activities is to find meaning and value in those activities, and one type of task value that has proven to be a powerful predictor of interest and performance is utility value (UV). Recent research indicates that it is possible to promote perceived utility value with simple interventions that ask students to write about the relevance of course topics to their own life or to the life of a family member or close friend. These interventions work best for students with a history of poor performance. For example, Hulleman et al. (2010) found that a UV intervention promoted interest in a psychology class for students who had performed poorly on early exams, relative to a control group. We hypothesized that UV interventions might be particularly effective with minority and first-generation students who are uncertain about their background and preparation for college science courses.

Method and results: The utility value intervention was administered in a randomized field experiment in four semesters of an introductory college biology course. A total of 1040 students participated; 423 were majority continuing-generation students (Caucasian/Asian), 126 were minority continuing-generation (African-American/Hispanic/Native American), 427 were majority first-generation students, and 64 were minority first-generation students. This sample allowed us to evaluate the independent and interactive effects of generational and ethnic minority status. The achievement gap in this course was significant for both first-generation and minority students, and greatest for the minority first-generation students (compared to all other groups).

The experimental intervention consisted of three 500-word paper assignments, for credit, assigned during the second week of each of three 5-week units of the course. Students in the control condition wrote a summary of course material. Students in the UV conditions wrote essays describing the relevance of course material to their own lives and/or a letter describing the relevance of the material to the life of a close friend or family member. We found that the UV intervention significantly improved grades for all students, but had a particularly strong effect for minority first-generation students, relative to all other groups. These students have the “double challenge” of contending with both minority and first-generation status, and our results suggest that the UV intervention was most effective for the most challenged group.

Significance: Our results highlight the importance of supporting task values for at-risk students and further suggest the importance of considering the separate and combined effects of generational and ethnic minority status in designing effective interventions.

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## **S06: Enhancing Success for Post Baccalaureates and Graduate Students**

*Chair: Richard McGee—Northwestern University, Feinberg School of Medicine*

### **Transforming PREP Outcomes through Changes in Mentoring Approach**

*John David and Michael L. Garcia—both of University of Missouri-Columbia; and Anthony L. DePass—  
Long Island University*

The University of Missouri-Columbia post-baccalaureate research education program (MU PREP) is now in its 12<sup>th</sup> year of operation. With its strong emphasis on the development of students who would not otherwise be in the upper levels of the biomedical career track, successful applicants to the program are required to demonstrate high motivation to pursue doctoral study, but lacking in the requisite skill sets to be considered for admission into a competitive doctoral program in the biomedical sciences. Once admitted, MU PREP Scholars participate in a program regimen that addresses weaknesses in preparation, usually through enrollment in first year graduate course(s) and participation in a meaningful research experience. MU PREP Scholars also participate in a weekly course designed to enhance professional communication skills as well as targeted preparation for the graduate school application process. While the program is designed to be successfully completed in one year, it is not uncommon for MU PREP Scholars to appeal for a second year of study.

In 2009, the MU PREP program leaders decided, as part of the application renewal process, to implement a more intense mentoring approach. The rationale for this shift was twofold: 1) while cultural sensitivity and solid support structures are critical components of the program, the leaders of the program were also sensitive to the unintended consequence of dependence on such supports by trainees; 2) professional success at the doctoral level is often predicted by “degree quality” as is often measured by levels of productivity, quality of networking circles, and training pedigree. As such, the program was modified to have an intense mentoring structure that prioritized rigor in training and an emphasis on developing cultural capital and identity as a successful scientist. During their first year, MU PREP Scholars receive very critical real-time feedback on their performance in venues such as journal clubs and snap research presentations within PREP group meetings. This critical feedback extends to regular individual meetings with a research mentoring committee and program leaders where all aspects of their performance in the program are discussed. Program expectations are mapped to Scholar performance with an emphasis on the development and performance consistent with maturity in scientific thought, behavior and performance. MU PREP Scholars expressed being overwhelmed in the first year, but scholars were in agreement with research mentors and program leaders that by the second year they had gained experience and confidence.

MU PREP Scholars reported in evaluation interviews and focus groups about being pushed almost to their limit in the journal club, and often being recipients of “tough love” in one-on-one and committee meetings. In hindsight (during the second year), they see how much those experiences challenged them and encouraged personal and professional growth. They came across as seasoned and much more senior when observed alongside second-year graduate students in joint focus group interviews. The shift in mentoring strategy was also evident in the program outcomes. Prior to the change in mentoring model, MU PREP Scholars were successful in making the transition to doctoral programs (93%), but were often placed in programs at mid-tier institutions. After the shift in mentoring approach, MU PREP Scholars are more typically placed in higher-tier institutions (Hopkins, UPENN, UNC Chapel Hill, U. of Michigan etc.) to the extent that MU has considerable more difficulty retaining its own PREP Scholars in MU graduate programs. For MU PREP Scholars who completed the PhD, time to degree averaged 5.9 years with 3.4 average numbers of publications (median 2, high 11).

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Transformational Impact of IMSD on Institutional Models for Recruitment and Graduate Training.  
*Nicquet M.J. Blake—Univeristy of Texas Health Science Center and Anthony L. DePass—Long Island University*

University of Texas Health Science Center at San Antonio (UTHSC-SA) is one of the country's leading health sciences universities with its ranking in the top 3 % of all institutions worldwide receiving NIH funding. Located in the city with the largest Hispanic population (807,000) that comprises 60% of its residents, UTHSCSA faced significant challenges in the diversification of its student population in its Graduate School of Biomedical Sciences (GSBS) where six years ago, only 12% were from underrepresented (UR) groups in STEM. Additionally, the program faced attrition of 40% of UR students who left the program in the first year, primarily for academic reasons. Of the remaining 60% that persisted, time to degree was delayed about a year compared with non- URM peers.

A series of interventions were employed to address these issues. Interventions included a strategic change in recruitment, the development of three pre-matriculation courses, individualized mentoring, tutoring and remediation programs (if needed), boot camp and community/cohort building interactions. Mentoring played a pivotal role in the development of these students. Starting with peer mentors upon acceptance of the offer, 2 faculty mentors from the admission committee, the IMSD program director students are very carefully mentoring throughout their graduate careers.

In the first year of the new recruitment plan, 8 of the 42 matriculating students (19%) were URM, up from 12% in the previous year. By 2011, the first year of the NIH funded IMSD program, the percentage of UR students applying to the integrated graduate program had increased with 42% of matriculated students coming from UR groups. Undergraduate grade point average (GPA) of matriculating UR students has improved steadily over the duration of the grant registering 3.52 in 2014 (up from 3.05). Of the 22 scholars who have been appointed to the IMSD grant, 50% completed the mandatory, 8 credit hour first year core course with a **grade of "A"**. None required remediation of the first year core course. The first IMSD student defended his dissertation in April 2015 with a time to degree of under 4 years.

The interventions that guided the dramatic improvements in the recruitment, retention and persistence of IMSD scholars have now been adopted institutional wide by the graduate school at UTHSC-SA. The Boot Camp activity that was piloted in the IMSD program has been adopted as part of the IMGP program and is now slated to be incorporated as standard across the graduate school. The UTHSC-SA IMSD program continues to have a significant institutional impact with the recent reorganization of the graduate school curriculum that will incorporate many of the practices that first saw success in the UTHSC-SA IMSD program.

### **S07: Barriers and Solutions to Advancing Careers**

*Chair: John Matsui*

Perceived Academic Career Coach Effectiveness by Coaching Style among Biomedical PhD Students  
*Veronica Y. Womack, Simon N. Williams, Bhoomi K. Thakore, Letitia A. Onyango, and Richard McGee—  
all of Northwestern University*

For the past several years, we have been experimenting with the use of coaching as a supplement to

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traditional research mentoring. Unlike a mentor, our coaches are not affiliated with the student's home institution and, consequently, can provide independent and unbiased advice. Students also have access to the knowledge and support of their peers who belong to their coaching group (10 students at a similar stage of training). This coaching model has been in existence for four years, and we now have enough data to identify, assess and compare them in association with the students' perception of coach effectiveness. The objective of this study is to 1) qualitatively determine the coaching styles and categorize the coaches by coaching style, and 2) use data from student interviews to identify perceptions of coach effectiveness by coaching style.

One hundred US biomedical graduate students were randomly assigned to one of ten coaching groups a month before beginning graduate school. Each coaching group had an equal number of men, women, underrepresented minorities (URM) and non-URM students. A senior faculty coach in the biomedical sciences led each group. The coaching groups met in person annually for 3 years. Students were encouraged to maintain virtual communication with both their coaching group and their coach throughout the year. The coaches were interviewed after in-person meetings and 6 months later. Students were interviewed the summer after their first and second years of graduate school. The interviews after the 2nd year of are the focus of the current analysis.

A researcher read the coach interviews and extracted details related to "strategies to engage", "perceptions of individual students", "perceptions of student engagement", and "self-assessment". A profile for each coach and their coaching style was constructed based on the profile content. One key theme that emerged was their degree of proactivity with engaging individuals coaching groups. This aspect of his or her coaching style categorized each coach. Previously coded student interviews were analyzed with particular attention to those within "Relationship with Coach". A summary of the students' evaluation of their coach was created. From this nine measures of coach effectiveness emerged. This study will focus on coach effectiveness as measured by "usefulness".

Of nine coaches interviewed at all time points, their proactivity with respect to engaging individual students was classified as high (n=4), moderate (n=2) or low (n=3). Coaches were categorized with respect to proactivity with engaging their groups as high (n=6) or low (n=3).

Across coach styles and student responses, coaches were perceived as useful, especially when they provided encouragement and detailed feedback on research proposals. The later was seen most frequently with female URM students. Students with a high proactivity coach (for individual or group) talked more to their coach about stressful situations than those with low proactivity coaches. Students with low proactivity coaches stated that they wanted to have more interaction with their coach and coaching group.

This study found that perceived coach usefulness for 2nd year biomedical graduate students varies by degree of coach proactivity. Future analyses will assess the thematic variations of "coach usefulness" and "coaching group usefulness" by student URM status, gender, and year of training.

Supported by DP4 GM096807 and R01 GM107701

Benefits of the Academy Coaching Intervention on Perceptions of Academic Career Success  
*Bhoomi K. Thakore, Veronica Y. Womack, Simon N. Williams, Letitia Onyango, and Richard McGee—all of Northwestern University*

Recent studies have acknowledged the many difficulties with acquiring an academic STEM career in the current economic climate. This reality exacerbates the relatively unchanged recruitment and retention of women and underrepresented minorities (URMs) into STEM faculty, despite many targeted efforts. On an individual level, intention to persist in an academic career can be informed by a number of factors. First, an individual's personal motivation to pursue an

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academic career (“Wanting”) can vary and shift during one’s academic training. Second, the dynamics associated with acquiring (“Getting”) an academic position are palpable in this current professional climate. Third, one’s ability to succeed in an academic position upon acquiring one (“Succeeding”) is related to the degree to which one’s confidence increases or remains high over time.

The Academy for Future Science Faculty (henceforth, the Academy) is a longitudinal intervention created to address the issues associated with achieving diversity among faculty in the biomedical sciences. The first wave of the Academy began with 100 beginning PhD students representing a range of biomedical sciences departments and disciplines and an equal number of controls. Those who applied were randomly assigned to Academy or control, and the Academy group was equally stratified by race and gender. The objectives of the Academy intervention are two-fold: 1) delivery of information to promote graduate student success through annual in-person meetings held between 2011 and 2013, and 2) sustained development of communities through the random placement of 10 students into Coaching Groups each headed by an Academic Career Coach (henceforth, Coach). We identified Coaches as senior scientists in the biomedical sciences who are committed to faculty diversity efforts. Both objectives of the intervention are guided by key social science theories that help explain issues of inequality in biomedical training and career placement.

In this presentation, we will use a mixed-methods approach. First, we will examine longitudinal quantitative reports of students’ perceptions of “confidence in succeeding in an academic career” after 2 and 3 years of Academy participation. After this analysis, we will use longitudinal qualitative interview data to understand those Academy students who sustain and/or increase in their perception of “Succeeding” as a result of the Academy.

Preliminary findings suggest that there are no significant differences in “Succeeding” between the Academy and Control groups, nor are there differences between URMs and non-URMs in the Academy group. However, there are significant differences between men and women in the Academy group. Specifically, men in the Academy had a similar decline in “Succeeding” to those in the control, while women in the Academy held constant. Subsequent analysis will also examine other variables, such as the relationship between “Succeeding” for those Academy students who share the same gender as their Coach.

This research was supported by DP4 GM096807 (ARRA) and R01 GM107701.

Latina STEM Pathways to the Professoriate: Findings from President’s Postdoctoral Fellowship  
Program Interview Study

*Yvette Flores, Lisceth Brazil-Cruz, Marilou de Leon Siantz, Adela de la Torre, and Laura Grindstaff—all  
of University of California, Davis*

Several barriers deter Latina PhDs from entering into STEM careers in academia. Few qualitative studies have documented the career paths of Latinas in STEM fields to understand the contextual factors leading them to choose other career pathways outside of the professoriate. This interdisciplinary team of researchers has set out to investigate the career paths of former Latina UC President Postdoctoral fellows [PPFP] in various STEM disciplines between 1998 and 2014 by conducting in-depth, semi-structured interviews. The interviews are designed to identify the social, familial, and institutional barriers PFP scholars have faced, their experiences of gender, class, and ethnic/racial discrimination, and the impact of the fellowship on their career success. This presentation will focus on the factors Latina PFP fellows experienced throughout their educational trajectories that have led them to successfully enter academia.

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## **S08: Social Psychological Factors in Student Performance**

*Chair: Mona Trempe*

### **Diversifying Science: Programs Weaken the Effect of Chronic Stereotype Threat on Maladaptive Achievement Goals**

*Anna Woodcock, Paul R. Hernandez, and P. Wesley Schultz—all of California State University*

The importance of diversifying the U.S. scientific research workforce is widely acknowledged, yet African Americans and Hispanic/Latino(a)s continue to be chronically underrepresented in research careers, and face many barriers to pursuing these fields (National Institutes of Health, 2012; National Science Foundation, 2010). One well-recognized barrier is the prevalence of negative racial stereotypes about aptitude for science-related endeavors. Negative stereotypes about one's group are a source of identity threat and have well-documented detrimental effects on performance across many stereotyped domains (e.g., Steele & Aronson, 1995; Steele, Spencer, & Aronson, 2002). The experience of persistent occurrences of stereotype threat across time predicts underrepresented minorities' disidentification with, and attrition from the sciences (Woodcock, Hernandez, Estrada, & Schultz, 2012).

We argue that disparities such as ethnic/racial underrepresentation in the scientific workforce are one consequence of contending with persistent stereotype threat across time – what we refer to as chronic stereotype threat. Achievement goals such as mastery (a focus on developing personal competence and attaining mastery of material), performance-avoidance (avoiding the appearance of incompetence, especially in the presence of others), and performance-approach (a focus on demonstrating competence, especially in the presence of others) goals are critical to how students frame and cope with academic challenges. The goals the students adopt give purpose and direction to academic achievement-related behaviors and are predictive of academic performance, field choice, and persistence (Harackiewicz, Barron, Tauer, & Elliot, 2002). The long-term impact of chronic stereotype threat on academic achievement goals has not been previously studied. Understanding how achievement goals mediate the effects of stereotype threat across time may be crucial for addressing issues of disparity. We examine the impact of chronic stereotype threat on underrepresented minorities' (URMs) academic achievement goals and persistence in science across time in the context of a well-established intervention and training program – the NIH's Research Initiative for Scientific Enhancement (RISE) program.

Previous research has shown that the long-standing NIH RISE training program is effective at retaining underrepresented minorities in science. We argue that one of the mechanisms for this success is the reduction in maladaptive achievement goals that can be brought on by stereotype threat. We report analyses of a national sample comparing RISE students with propensity-score matched controls over a six year period. Mediation analyses revealed that while RISE program membership did not buffer students from stereotype threat, it changed students' downstream responses and ultimately their academic outcomes. Non-program students were less likely than RISE students to persist in the sciences, partially because they adopted maladaptive achievement goals in response to chronic stereotype threat. We discuss how these findings extend stereotype threat and goal orientation theories and provide insight into the success of intervention programs.

In this scholarly work, we make a case for the importance of learning from successful people on an individual basis. In particular, we present case studies of Latinas who, on a daily basis, struggle to maintain a sense of balance between their professional aspirations in the STEM fields, and the multiple socio-political contexts within which their lives are enacted. We refer to this infinite set of contexts as contextual mitigating factors (CMFs) which are dynamic, and interweave community, education, family, and gender/self, to name a few. The preparation and development of these contexts create circumstances, which overlap and aggregate in time to change moment-by-moment. These contextual fluxes serve as mitigating forces that help to shape the multilayered outcomes of resiliencies and related positionalities for these women. Embracing and overcoming, or at least stabilizing, the mitigating factors are key factors inherent to the success of each of the Latinas in this story. These Latinas, because of their gender, ethnicity, and/or race, are models of resilience to sociocultural contextual mitigating factors. We do not use the word resilience in a neoliberal sense, i.e., those who tough it out can make it. Rather we think of resilience as a signature that indicates the existence of societal inequities that particularly target people because of who they are.

The case studies presented within are individual stories with general patterns. Some Latin@ readers may argue that there is no difference between their stories and those in our narrative. Other non-Latin@s may claim the same, and point to not only their stories, but also to those of a handful of others. We stridently reject either argument because to accept these notions would counter the realities that Latinas must negotiate in the United States. In other words, even though a few Latinas have been successful in their endeavors, this is no cause for a celebration; gender related inequity and social injustice still exist. In terms of inequity and social injustice, the question of success should be situated with an interrogation of the notion of societal impact of such a nature that stories of resilience disappear. For example, within the US society, the underrepresentation and disenfranchisement of Latinas in the educational pipeline (Flores & Claeys, 2011), and specifically in STEM persist (National Science Foundation [NSF], 2013; Santiago, 2008). While there has been an increase in success among Latinas, their level of accomplishment in a male-dominated world should not be romanticized; rather, given the odds of overcoming the many obstacles faced along the academic and professional paths, Latinas' successes must be highlighted. Kao (2007) argues that the lack of nurturing the potential of a large underrepresented group, such as Latinas, is the "wicket problem of education." (p. 101). While revolutionary Latinas have flexed their muscles and have stood at the crossroads of entering into the STEM fields, in spite of their successes, that world is still dominated by their male counterparts, especially White men (NSF, 2013). Latinas also must contend with other mitigating factors, such as a worldview that is not inclusive of all.

Unfortunately, the literature abounds with examples of either treating individuals from a holistic point of view, or specifically in the case of Latin@s, denying their rich but very distinct sociocultural, economic, political, and historical roots by simply considering them as a homogenous group (Flores, Sheets, & Clark, 2011; Gallard, 2009). We assert that how individuals identify themselves as racial, ethnic and/or cultural beings is paramount to understanding how they respond to how they are situated or positioned in education via a host of dynamic socio-political CMFs.

Note: We use Latin@ to reject the gendering of the category Latino/a and thus making it gender neutral.



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Cooperative Online Learning Tools for Middle School Science: Lessons Learned from a Design-based Research Study

*Fatima E. Terrazas-Arellanes, Emily Walden, Lisa A. Strycker, and Carolyn Knox—all of University of Oregon*

This symposium reports lessons learned on the NSF-funded Collaborative Online Projects for English Language Learners (COPELLS) project, in which an iterative process of development, implementation, revision, and evaluation was used to design and test collaborative online learning science curricula for middle school students, including general education students and English learners (primarily of Hispanic origin). Using a design-based research approach, two case studies and a feasibility study, with a total of 212 students and 10 teachers, were undertaken to determine the potential for adapting two online science units, originally developed in Spanish by curriculum developers in Mexico, for U.S. middle school English learners. We examined whether the refined “Let’s Help Our Environment” and “What Your Body Needs” units were feasible to implement, useful for helping teachers engage with students, and effective in improving science knowledge. Data were drawn from multiple sources, including teacher logs, student and teacher surveys, web analytics, student notebooks, content assessments, and focus groups. Results indicate that the online science units were feasible to implement, usable and helpful for both teachers and students, and associated with gains in science content knowledge. This work offers a model for the development of culturally-relevant, constructivist, and collaborative science instructional materials for English learners using online, multimedia technology.

**S09: Institutional Case Studies**

*Chair: Claudia Rankins*

**Inclusive Chemistry Success Project**

*Rebecca Ciancanelli and Julia Willis—both of Colorado University Boulder*

The Department of Chemistry and the Student Academic Success Center (SASC) at CU Boulder completed the Fall 2014 Inclusive Chemistry Success Project that coordinates pre-assessment, advising, core instruction, supplementary instruction, and post-assessment. The primary goal was to improve first-term outcomes for a freshman cohort of 20-25 underrepresented and underserved students based in SASC who plan to enroll in a general chemistry course in order to complete a MAPS requirement or to prepare for a STEM major.

SASC combines an historical commitment to social justice with an inclusive model of academic excellence that has always been, and will always be, centered on the student. We define ourselves as a multicultural learning community that serves underrepresented, underserved, first-generation, low-income, and other non-traditional students. We deliver instruction, scholarships, advising, tutoring, resources, and community to improve the recruitment, retention, persistence, and graduation rate of students who contribute to the cultural diversity and academic excellence of the CU Boulder campus.

To begin the Inclusive Chemistry Success Project, we administered the ALEKS chemistry exam as a placement tool during the summer of 2014. Students who scored below a 50% on the exam were encouraged to enroll in the SASC section of introductory chemistry, CHEM 1021. Our SASC instructor, Dr. Rebecca Ciancanelli, collaborated with the chemistry department CHEM 1021 instructor, Dr. Robert Parson, to align the pace of curriculum and assessments. The SASC instructor added two POGIL (Process Oriented Guided Inquiry-based Learning) sessions during the week; POGIL is an active learning model of chemistry instruction that has been shown to improve process skills and content knowledge.

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Of the 22 students who enrolled in the SASC section of CHEM 1021, 19 students completed the course. We have compared exam grades and course grades of this cohort with the SASC students enrolled in university's CHEM 1021 course in Spring 2014. Both the spring and fall cohorts took three midterms and a final written by Dr. Robert Parson. The fall SASC cohort showed great improvement over the spring SASC cohort on exams and course grades.

We also have examined some preliminary qualitative data provided by the CLASS (Colorado Learning Attitudes about Science Survey). This survey was administered twice, at the beginning and at the end of the semester. The data suggest improvement in students' overall understanding of how to learn and apply chemistry knowledge. For example, there was significant improvement in attitude from pre- to post-testing on these statements:

1. Learning chemistry changes my ideas about how the world works.
2. When I see a chemical formula, I try to picture how the atoms are arranged and connected.
3. To understand chemistry, I discuss it with friends and other students.

We have enrolled 24 students in CHEM 1113 (General Chemistry) this semester, and we are following the same project design. We will continue to collect data and eventually analyze the results of the SASC students participating in the Inclusive Chemistry Success Project with both the five-year average for SASC student performance and the five-year average for the general population performance in these chemistry courses. We hope to expand this project to other gateway courses in the sciences, including General Biology I and General Physics I.

Factors that Predict Interest in Pursuing Research Careers among URM Students  
*Erin Banks, Amy Leonard, and Craig Brookins—all of North Carolina State University*

The Initiative for Maximizing Student Diversity (IMSD) program at North Carolina State University utilizes a multi-tiered approach to increase the number of underrepresented minority (URM) students who attain bachelors and doctorate degrees and engage in research in the biomedical and behavioral sciences (BBS). Although the structure of IMSD and other NIH Funded programs vary by university, all have a component of social support that appears to be critical in students' success. Social integration and support found in faculty members and peers has been found critical for student retention (Astin, 1993; Bean, 1980, Tinto, 1993). Foertsch, Alexander & Penberthy (2000) report increased academic achievement, educational aspirations, self-concept and persistence among Latina/os and African Americans when involved in research and mentorship with faculty.

This presentation will focus on the role of non-academic and academic support has on students participating in a federal funded research programs across the southeast. The goal of the session is to discuss preliminary findings on the role of social support and its impact on the retention and academic success of URM students majoring in the BBS fields. This session should benefit upper level undergraduate students, graduate students, administrators, faculty members, and others engaged in the implementation of enhancement programs on campus.

Common Denominators for Successful STEM Graduate School Preparation in the School of Engineering (SoE) and the School of Computer, Mathematics and Natural Sciences (SCMNS) at Morgan State University (MSU).

*Christine F. Hohmann, Jumoke Ladeji-Osias, Michel Reece, Cleo Hughes-Darden, Lisa Brown and Stella Hargett—Morgan State University*

In the past decade, MSU has been the Baccalaureate granting institution for 45 individuals who received doctorates in Engineering and 61 individuals who received Ph.D. degrees in the Life Sciences and other STEM disciplines (WebCASPAR). This ranks MSU 9<sup>th</sup> in the nation and 2<sup>nd</sup> among

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public institutions in preparing undergraduate students for successful Ph.D. completion. This is particularly remarkable, as the mission of MSU is to provide educational opportunities to students from urban and near-urban public school systems, a population who are frequently first generation college students and over 60% Pell-grant eligible. Several undergraduate training practices in the School of Engineering (SoE) and the School of Computer, Mathematics and Natural Sciences (SCMNS) have emerged as major contributors to our outcomes.

Structured, summer and academic year research, mentored predominantly by MSU faculty, builds communities of practice among undergraduates, faculty and graduate students. Undergraduate participants in these activities are supported financially at a level equal to or better than off campus employment would afford them. This is essential, since students depend on such income to support their education. More than 85% of students in the MBRS RISE program (SCMNS) agree or highly agree that year round mentored research experience has increased their critical thinking skills, their self-confidence, leadership ability and networking skills. In a long-standing summer research program in Engineering (SEM), students pointed out their “enjoyment of working with mentors”, “exploring the field” and “doing something worthwhile”. Between SEM and MBRS RISE, paid research apprenticeships of >300 undergraduates have been supported and both show student graduation and retention rates in the major, which far exceed respective departmental averages in either School. The MBRS RISE Program has to date graduated 98 % of all participants, most in their original major, > 90 of graduates are currently engaged in a science related occupation, 85% pursued post-graduate education (MS or similar) in a science related discipline, 20% entered Ph.D. Programs and 10% have obtained their Ph.D. to date. MBRS RISE student performance outpaces those of any program in the SoE, most likely, because MBRS RISE also offers a rich, year-round menu of supplemental academic, skill building (critical thinking, scientific writing, soft skills) and research career-focused activities, all aimed towards enhancement of community, science identity and self-efficacy. For example, 100% of students rated attendance of the Annual ABRCMS conference as “extremely or very helpful” in building their presentation, communication, networking and independent research skills. Several of annual workshop activities, as well as the Critical Analysis of the Scientific Literature class were rated similarly high for “cultural adaptability training for graduate school” and providing “increased critical thinking skills”. In the SoE, on the other hand, a training component that contributes substantially to the development of science identity among participants is the PACE (Pre-freshman Accelerated Curriculum in Engineering), which incorporates group learning, to facilitate student engagement in undergraduate research.

This symposium will provide detailed descriptions of the various training components that our program evaluations have earmarked as particularly effective in student retention, graduation and importantly, progression into graduate training. We will discuss these interventions within the sociological framework that renders them effective, particularly within the epistemological environment of the SCMNS and the SoE.

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## **S10: Career Preparation: Research and Practice**

*Chair: Laura Robles*

Addressing the Intersectionality of Underrepresentation and STEM Identity through Holistic Professional Development for Graduate Students and Postdocs

*Renetta Garrison Tull, Shawnisha Hester, Amanda Lo, Piyush Waradpande, and Yara Medina—all of University of Maryland Baltimore County (UMBC)*

PROMISE: Maryland's Alliance for Graduate Education and the Professoriate (AGEP), sponsored by the National Science Foundation, is examining research in intersectionality to inform the structure of interventions that influence underrepresented minority (URM) STEM graduate students and postdoctoral fellows' retention in STEM training programs and pursuit of STEM careers. Intersectionality, originally defined by Kimberle' Crenshaw (1989) and further popularized by Patricia Hill Collins (1998), has been used as a lens to view intersecting oppressions such as those within and between race, class and gender. Our work looks at the intersection of underrepresentation in STEM, and STEM identity. URM STEM students can manifest feelings of inadequacy, struggles with departure from community and culture, and (e.g., Tinto, 1993; Giuffrida, 2006), and we're interested in investigating how disconnections from community, and internal and external lack of acceptance as "a scientist" might impact persistence. As we examine research and seek to impact practice, we learn from Carlone and Johnson's (2007) "Theory of Science Identity" which describes three dimensions: competence, performance and recognition. The PROMISE AGEP seeks to improve underrepresented minority (URM) STEM performance, by providing academic professional development to solidify competencies, using workshop-based interventions such as "Writing for Publication" and "Improving Public Speaking." In an effort to build a comprehensive program that engages URMs in STEM, we've also included the "integration and fulfillment of needs" element from McMillan & Chavis' 1986 theory of Psychological Sense of Community within professional development activities to provide concepts that are transferrable to daily life. This presentation focuses on three areas of "holistic" professional development that have had traction with URMs in STEM at the University of Maryland Baltimore County (UMBC): psychological well-being, financial Literacy, and career-life balance. We believe that the integration of holistic and academic forms of professional development build connections among URMs that encourage competencies within the discipline, and contribute to STEM identity.

UMBC's psychological well-being workshops address anxieties, and identify cognitive distortions such as catastrophizing. Financially-based seminars include investing and planning for retirement. Career-life balance sessions discuss managing family and life responsibilities, and health and wellness. Data trends from the workshops show that students agree that they are presented with tools and new knowledge, e.g., controlling apathy, credit scores, and structures for career-life integration. The workshops provide information that is not typically accessed by students of color. (As an example, URMs score the lowest on financial literacy tests, with failure percentages above 80% (Mandell, 2008).) However, our data show that URMs note that these workshops provide new information, contribute to their sense of community, connect them to others with similar ideas, and contribute to degree completion. We believe that these elements connect with the "recognition" dimension of "The Theory of Science Identity" and that URMs' regular and repeated participation in professional development (both academic and holistic) can increase depth of engagement in research, lead to higher levels of STEM competence and performance, and contribute to their STEM identity.

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The Evolution of Career Intentions of Biomedical PhD Students: A Longitudinal Qualitative Study of a Diverse Population

*Christine Wood, Remi Jones, and Robin Remich—all of Northwestern University*

Much has been written about the declining interest in biomedical academic careers as students progress through the PhD. This decline contributes to the extremely low rate of progress toward achieving faculty diversity. However, very little is known about the experiences that shape career interests and the process by which students refine future plans. In this presentation, we introduce our research that explores how biomedical PhD students make decisions about what careers to pursue as they progress through the first two years of graduate school. After a brief overview of the methods we used to longitudinally analyze career intentions and decision-making, we present preliminary findings focusing on factors that influence students' intentions toward and away from academic careers. We distinguish perceptions of three different types of academic careers: research-intensive, teaching-intensive and research/teaching mixed. We frame our findings using four patterns of student interest in academic careers, students with (1) consistently high academic career intention; (2) increase in academic career intention; (3) decrease in academic career intention; and (4) fluctuating academic career intention. We will share demographics for each pattern as they compare with our full sample revealing which patterns are more heavily populated by students under-represented in biomedical faculty positions, e.g., females, non-Whites, and non-Asians.

Our data come from in-depth interviews with 198 PhD students in the biomedical sciences conducted annually for 3-5 years, beginning with the start of each student's PhD career. Our population is diverse in terms of gender, race, and ethnicity. About two-thirds (63%) are female. Twenty-nine percent are considered under-represented racially and ethnically in the sciences (non-White and non-Asian). Specifically, 15% identified as Black or African American, 11% as Hispanic, and 2% as Native American. This research is part of the National Longitudinal Study of Young Life Scientists (NYSYLS), a longitudinal study begun in 2008 to better understand the experiences of a diverse population of students during biomedical PhD training.

For this analysis, we used longitudinal qualitative methods to compile, display, and analyze in-depth interviews conducted over time. For our analysis, we focused on data collected at interviews from questions targeted at career intentions, such as (1) "As of today, what do you want to do when you finish your PhD?" (2) "What attracts you to the particular option or options you are considering?" (3) "Right now, what priorities are most important to you as you decide among career options?" (4) "How do you envision balancing a career with other things in your life, in say 10-15 years?" For this study the team developed a coding rubric to assess strength of career intention for the three different types of academic careers, as well as assessing interest in trajectories towards industry, government, and careers outside of research.

Supported by R01 GM085385.

Toward a Career-Specific Developmental Model for African Americans in STEM  
*LaVar J. Charleston and Jerlando F. L. Jackson—both of University of Wisconsin-Madison*

This study sought to ascertain key factors that contribute to African Americans' STEM pursuits. The design of this study varied from previous research by examining the career trajectories of current STEM professionals, particularly in the field of computing sciences, rather than those who did not persist, or those in the beginning stages of the pipeline. As such, this study allowed the researchers to implicate a heuristic model that serves to help illuminate as well as facilitate decision-making

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toward educational and occupational considerations in STEM fields in general and the computing sciences in particular.

### **S11: National Networks with a Disciplinary Focus**

*Chair: Alberto Roca*

Erasing the Achievement Gap in Graduate Education for Underrepresented students: Bridge Programs run by Professional Societies

*Theodore Hodapp and Brian Beckford—American Physical Society*

In nearly every science, math, and engineering field there is a significant falloff in participation by underrepresented minority (URM) students who fail to make the transition between undergraduate and graduate studies. The American Physical Society (APS) has realized that a professional society can erase this gap by acting as a national recruiter of URM physics students and connecting these individuals with graduate programs that are eager to a) attract motivated students to their program, b) increase domestic student participation, and c) improve the diversity of their program. In only two years the APS has placed enough students into graduate programs nationwide to effectively eliminate this achievement gap. The program has low costs, is well received among graduate programs, and has encouraged a number of universities to adopt best practices that improve their graduate admissions and retention. The structure is disciplinary specific, but can be adapted to other fields of study. This presentation will describe programmatic elements and present data that demonstrate the project's effectiveness.

Re-assessing What Works-A Novel Approach to Measuring Efficacy and Early Findings from a Broad Intervention Partnership

*Mark A. Lawson, Anna Woodcock, Anthony M. Johnson, P. Wesley Schultz, Richard McGee, and Steven M. Anderson—all of University of California, San Diego*

A common theme of intervention programs that target the transition of underrepresented minority (URM) students from undergraduate to graduate study is to provide a training experience that exposes the participants to biomedical research and familiarizes them with the laboratory and scientific environment. It is expected that familiarizing students with practice of science encourages them to pursue biomedical research as a career, and evaluation of intervention programs is based on measurement of this particular outcome. Based on these assumptions, the Endocrine Society has developed a mentoring and intervention program MAP that partners minority-serving institutions with research-oriented institutions and a professional society to provide extensive mentoring and research training to prepare students for progression to post-baccalaureate and graduate study. This network leverages its community to improve training, mentorship, and career development. Based on a two-year model, Endocrine Society members recruit students from minority-serving institutions to participate in two summer research experiences. Participants attend the society annual meeting where they are introduced to peers and mentors, attend career development sessions, and are guided through the general meeting. Afterwards participants join a summer program at a partner research institution. In the second year participants again attend the meeting to present their previous summer's work. They also act as peer mentors to new participants. In addition, trainees are encouraged to attend recruiting conferences such as SACNAS and ABRCMS, and are mentored through the graduate program application process.

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The effectiveness of MAP is measured and evaluated using a novel dual quantitative and qualitative approach. The evaluation is designed to assess program outcomes and to uncover underlying mechanisms contributing to student success. The qualitative approach provides rich feedback from the students for program best practice and improvement via structured interviews and ethnographic data. The quantitative approach complements the qualitative evaluation with quantitative data. This research/evaluation approach features a longitudinal matched-control design to evaluate both the short and long-term impact of the program. Central to the evaluation, MAP students are matched with a group of non-MAP URM students who are equally talented and interested in a scientific research career and measured across time. Across three years we find significant differences in the scientific career interest trajectories of MAP and matched non-MAP students. The non-MAP students show a significant decline in intention to pursue a scientific research career across their undergraduate years. However, MAP students are buffered from this decline and retain high intentions of persisting on the scientific research career path.

This design allows us to answer questions about why programs like MAP are effective. Drawn from social psychological literature, we hypothesize that programs that are designed to develop lab skills and scientific self-efficacy, also have positive effects on students' scientific identity, opportunities to fulfill communal (helping) goals, and resilience to stereotype threat. We find that these psychological outcomes are more powerful predictors of URM persistence in science than scientific skill and self-efficacy, and this is critical for the way we design and implement programs.

Defining the Quantitative and Computational Skills of Incoming Biology Students  
*Paul J. Overvoorde and Q6 Consortium—both of Macalester College*

A number of recent national reports such as Vision and Change, Preparing Future Physicians, and BIO2010 make the case that a student's quantitative and computational preparation correlates with persistence and success in the life sciences. Unfortunately, among the students who take the ACT entrance exam, only 43 percent achieve a score that indicates that they have a 50 percent chance of earning a grade of B or higher in their first college-level math class. More disconcerting is that only 17% of high school students with an expressed interest in a STEM is considered math proficient by these standards. A further complication comes from the challenge of getting students to transfer their understanding of mathematical concepts to other discipline-specific contexts. With funding from the Howard Hughes Medical Institute, faculty from Macalester College, Bryn Mawr College, Oberlin College, Lewis and Clark College, St. Olaf College, Harvey Mudd College, Pomona College, and Keck Science Center, along with faculty and graduate students in the Educational Psychology department at the University of Minnesota formed the Q6 consortium. The goal of the Q6 group is to develop an assessment instrument that describes the quantitative and computational skills of students completing degrees in biology or closely allied fields. Starting from the knowledge domains and learning objectives described in several key reports, over the past two-and-a-half years we have developed, piloted, and refined a 22-item instrument called the Biology Science Quantitative Reasoning Exam (Biosquare). The development of this instrument and the psychometric characteristics of the items will be described. We envision the Biosquare serving at least three purposes. First, for students, the BioSQuaRE will communicate expectations for success in upper level courses and serve as a tool to direct students to relevant resources if they lack background or knowledge of a particular topic. For faculty, the BioSQuaRE will provide data on what students know, as well as when and how they gained that knowledge, allowing faculty to make intervention decisions based on evidence, rather than anecdote. Finally, at the programmatic level, the BioSQuaRE will highlight the skills biology instructors consider to be important, providing a framework to inventory and assess current curricula. Such an inventory could stimulate divisional conversations about the attention given to quantitative topics and the way these are framed by

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different departments. In the end, each level of consideration intends to supports student learning and persistence.

## **S12: Strategies with Undergraduates II**

*Chair: Richard McGee*

How to Integrate Sustainability Concerns into Retention Strategies of Minority Engineering Students through Experiential Learning Interventions

*Imelda Olaque-Caballero and Delia Valles-Rosales—both of New Mexico State University*

Global and cultural competencies of minority students could be incorporated to the engineering curriculum through experiential learning interventions. Experiential learning has been used as a retention strategy of minority students based on its capacity to foster skills and abilities more effectively learned outside a formal curriculum, specifically in real world scenarios. To understand the implications that experiential learning has on the professional performance of minority engineering graduates, the present study examined a program that has been in place since fall 2012. This program was framed on an industry-university partnership that promotes the integration of students' technical knowledge with and understanding of engineering practice in different real working environments. The proposed educational model used to ensure the development of the students' ability to value diversity and to work effectively across cultures, while learning and practicing fundamental concepts of industrial engineering such as lean manufacturing, time studies, line balancing, quality control, and safety engineering in a real world scenario. The model was framed in the sophomore and senior curriculum series of IE 316 Methods Engineering & IE 478 Facilities Planning. The model consists of five components: identification and selection of industry partners and potential projects; attendance to in-class mini-lectures & assignment of pertinent readings supporting the selected project; student's training previous to their incorporation to the project; monitoring students' progress by supervision of peer & industry mentors and class instructor; continuous evaluation and assessment of the learning experience through weekly reports and a final project presentation to the company's CEO. Completing the educational cycle, cultural competencies were developed throughout the model components by exposing the students to interactions with industry personnel at several levels including staff engineers, technicians, and blue-collar operators with different cultural and ethnical backgrounds. Partial results indicated that the design, structure, and application of the program and its success depend on the implementation of quality assurance techniques, permanent monitoring of students, and constant communication with the industry partner. Current concerns include how to ensure the long-term sustainability of the program. Proposed sustainability strategies include: Identify long-term benefits to flow from project; identify stakeholders for long-term benefits and determine level of support; identify and emphasize benefits that the industry partner; assess institutional support of the program through open ended questions evaluated through a multivariate technique called Structural Equations Modeling (allows for the study of complex relationships among variables and for inclusion of latent variables – not directly observable or measurable It is expected that this strategies will set the foundations of continuous improvement process that may help to secure the sustainability of the program.

Interventions That Work (and Some That Do Not)

*Keith H. Pannell and Denise Carrejo—both of University of Texas at El Paso*

For 30 years, using funding from the NIH MARC Program, we have mentored and guided



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undergraduate students through the last two years of their degree programs into Ph.D. programs and subsequent careers. To date a large majority of the UG participants have been successful in this transition and have obtained (are obtaining) Ph.D. degrees. Many of the graduates hold faculty positions. The positive outcome of this program is primarily associated with an intensive UG research training program, and for example, each student must write and orally defend a research thesis prior to graduation.

Concurrently for the past 5 years, using funding from the NSF S-STEM program we have embarked upon a scholarship program to facilitate the navigation of the first two years of college by our incoming freshman students. This was a time period we identified as crucial for retention in, and graduation from, a STEM degree program. A mandatory aspect of the scholarship award was on-campus living, an unusual feature at an Urban University, where the students can live only minutes away from the campus. This programmatic requirement has proven to be key to the overall success of the program, along with allocation of an individual faculty tutor. Also in our environment, which contains a large Hispanic population, the ability of the student to be home with family for portions of the weekend has been a major feature in obtaining parental approval of the program, since often the scholarship awarded covers only the cost of housing, i.e. financially it is a sum zero activity.

For both the NIH and NSF programs, a important aspect in keeping a cohort cohesiveness, and providing a depth of engagement amongst the students, is an annual research, science ethics course combining both students groups.

The outcomes of the two programs, and the various interventions used, will be presented in quantitative terms (credit hours taken, GPA achieved, time to graduation (including comparisons where available with peer cohorts not in such programs, and Ph.D. and published research papers produced). Overall a major key to this success is program flexibility and the capacity to change proposed activities to suit the needs of the students, and the local environment. Unsuccessful interventions, mentors and activities must be readily jettisoned, and their fruitful counterparts expanded.

#### Disciplinary First-Year Seminar Tackles the Achievement Gap

*Caroline Jakuba Wienhold, Tawnya L. Cary and Janet L. Branchaw—all of WISCIENCE University of Wisconsin-Madison*

As part of a HHMI Undergraduate Science Education award, we developed a series of interventions to address an achievement gap and the subsequent loss of underrepresented minority (URM) and first-generation college students (FGEN) from biology at UW-Madison. Overall, these populations of students earn lower grades in introductory biology courses at UW-Madison than majority students, and, even when earning passing grades, leave the biosciences at a higher rate. Though there are many programs for underrepresented student populations on our campus that support retention in general, there is a gap in support for student success and retention in biology specifically.

Evidence from the literature shows that having a sense of community increases student retention and success in college. Therefore, our aim was to develop interventions designed to create discipline-based learning communities to impact biology students specifically. Interventions included a 3-day freshman orientation (MadBiology Boot Camp), a learning center (BioCommons), a residential learning community (BioHouse) and a first-year seminar (Exploring Biology). The Exploring Biology first-year seminar (FYS) will be described and its outcomes to date presented.

Topical, disciplinary or remedial themed FYS introduce students to campus resources, support student acclimation to college, study skills development, and individual self-exploration. Tinto's theory of social and academic integration proposes that the level of integration achieved by a student in the first year dictates the likelihood that she/he will be retained and ultimately complete a degree. Tinto argues students achieve integration through their own motivation and,

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importantly, through support from the university in five broad categories including: academic involvement and support, early contact and community building, transition assistance, counseling and advising, monitoring and early warning.

Combining the disciplinary theme of a FYS with Tinto's theory, we hypothesized that providing transitional support in a discipline-based format would lead to improved retention and success for URM and FGEN students in biology. Exploring Biology supports students' academic, social and developmental needs as they transition to college and engages them in the exploration of biology as a discipline and potential career path. The course goals are to help students develop disciplinary ways of thinking, develop awareness of and access to biology co-curricular learning opportunities, and explore and prepare for careers in biology.

Outcomes from 6 semesters of Exploring Biology were measured using student record data, a pre/post survey, focus groups and an alumni survey. There was a significant reduction in adverse outcomes (D, F or drop grades, p).

### **S13: Student Pipelines and Teacher Training**

*Chair: LaVar Charleston*

Blended Learning Strategies in Teaching Mixed Method Research to School Teachers

*Echo H. Wu and Samir Patel—both of Murray State University*

Completing research methodology courses is now a requirement for student-teachers at graduate level in universities. However, students at both undergraduate and graduate levels often possess weak knowledge and skills in conducting empirical research (Aguado, 2009). It is commonly believed that conducting research is a tedious and very tiring and time-consuming work to do, and student teachers attending university courses, including master's degree courses, usually do not feel competent in conducting research, despite receiving training in research methodology (Bocar, 2013). Typically, students learn about quantitative and qualitative research separately and within a traditional teaching and learning framework (Onwuegbuzie & Leech, 2005). In Hong Kong, specifically, conducting empirical research is difficult for in-service student teachers, specifically, preschool and kindergarten teachers, who are often very busy in teaching and taking care of young students, who may also have less training and are lack of skills and knowledge regarding research methods (Wu, 2008).

Blended learning has been a popular topic in education. It is believed that blended learning is the combination of different training "media", including technologies, activities and events, to create an optimum training program for a specific audience (Bershin, 2004). Such programs use many different forms of e-learning, sometimes complemented with instructor-led training and other learning formats. Recent research has reports high student satisfaction with blended learning (Albrecht, 2006), and some others also reported instructor satisfaction (Vaughan & Garrison, 2006). This is consistent with the result of a study conducted by Bourne and Seaman (2005), who indicated that the interest in blended learning is to benefit the education process.

This presentation focuses on the pedagogical strategies of blended learning to teach schoolteachers how to conduct mixed method research. Through a case study at Hong Kong with in-service preschool teachers, this presentation discusses the implications of blending traditional teaching and more updated learning strategies such as e-Learning, small group work, peer interaction, and role plays, so to make the commonly-viewed by school teachers as complicated and even intimidating empirical research more comprehensible and achievable.

The Institute On Neuroscience (ION) Summer Research Program for Outstanding High School Students and Teachers

*Chris Goode and Kyle Frantz—both of Georgia State University*

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To recruit bright students into the scientific research community, we have designed and implemented an eight-week summer research program for high school students, and recently included middle and high school teachers. Program participants engage in authentic neuroscience research in working laboratories or clinics in the metro-Atlanta area (Georgia State University, Emory University, Georgia Institute of Technology, Morehouse College, or Spelman College). Since 2003, a diverse group of 110 scholars have participated in this program, called the Institute on Neuroscience (ION). Seventy-six percent of the participants were women, and 33% were from racial or ethnic groups currently under-represented in the sciences. We have used a variety of mixed-method, quantitative and qualitative approaches to examine program outcomes over the years. For example, we have tested the hypothesis that a summer research experience positively affects intent to persist in a science or research career, via improvements in scientific research self-efficacy, science teaching self-efficacy, neuroscience content knowledge, science identity, and science and research anxiety. Here, we report the results of pre-, mid- and post-program surveys of two cohorts of 12 participants each. Participants reported improved confidence with neuroscience concepts, scientific research self-efficacy, science identity, and intent to persist in a science career, as well as decreased research anxiety. Teachers reported increased science teaching self-efficacy. Regression models revealed that confidence with neuroscience concepts predicted intent to persist in a research career, and science identity and neuroscience anxiety predicted intent to persist in science. Thus, initial short-term benefits of a summer research immersion predict long-term benefits, such as retention in pathways toward research careers for students, and improvement of science teaching, which may in turn lead to improved science learning for students not directly involved in the program. Ultimately this program and its education research results contribute to preparation and diversity of the biomedical research workforce.

The Loma Linda University Health Disparities Research Pipeline Program: Best Practices, Outcomes and Institutional Impact

*Marino De Leon, Carlos A Casino, Lorena Salto, and Daisy D. De Leon—All of The Loma Linda University Health*

It has become increasingly important to establish comprehensive STEM (science, technology, engineering, and mathematics) pipeline programs that will help achieve the necessary inclusion and diversity goals in the next generation of U.S. scientists. The Loma Linda University Health Disparities Research pipeline program (LLU-HDRPP) has demonstrated significant success in recruiting and preparing more than 400 predominantly underrepresented minority (URM) students for matriculation into STEM and behavioral science graduate programs nationwide. This presentation will first describe the initial hypothesis that led us to build a comprehensive pipeline program that relies heavily on hands-on health disparities research experiences, mentorship, institutional support and community collaborations. As we detail the implementation of our pipeline program, which is already in its 17<sup>th</sup> year- we will show a best practice as well as a mixed-methods approach to evaluate our outcomes. We will also present evidence on the importance of an early high school intervention to increase URM student persistence in STEM disciplines. The LLU-HDRPP immerses high school (ABC), undergraduate (UTP), medical (MTP) and PhD graduate students (IMSD) in an 8-10 week summer research and career development internship. Our quantitative data consistently shows that the program impacts students by increasing their research self-efficacy and targeted research skills. The largest gains reported by the participants were for “conducting research,” “scientific writing,” and research self-efficacy. For the high school participants, the results indicate that the research internship mainly targeted the research capability and the STEM confidence of these participants. Further analysis shows the importance of the hands-on research experience (enactive mastery experiences), the mentor experience

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(vicarious experiences/modeling) and other factors that play important roles. The LLU-HDRPP outcomes show that 94% of the high school students obtain a college degree and 63% of those in a STEM/behavioral science degree discipline. The data also shows that 98% of the UTP students graduate from college; 94% of them with a STEM/behavioral science degree. More than 98% of IMSD graduate students are completing their PhD degree and pursuing further postdoctoral career development. The MTP students are incorporating research in their residency programs and establishing practices in medically underserved communities. Interestingly, 52% of the high school and 81% of the undergraduate students matriculate into graduate programs. Of those who have participated in our programs, 176 have enrolled in a graduate program and 121 of those have enrolled in Loma Linda University for their graduate education.

This project was supported in part by NIH grants R25GM060507 and P20MD00698.

### **S14: First Generation Graduation Students**

*Chair: Barry Komisaruk*

Can Interventions Change the Decline in First Generation Doctorate Recipients in STEM?

*Anne J. MacLachlan—University of California*

STEM doctoral education is subject to contentious discussion about how it is funded, career possibilities and training and whether there are too few or too many scientists trained. Receiving much less attention is the increasingly elite background of doctorate recipients, 78% in 2013 come from educated and highly educated backgrounds (SED, 2014). First generation students (parents with a high school diploma or less) of all ethnicities have lost substantial access to and completion of programs since 1978 when such students received 42% of doctorates (SED 2009). Members of US ethnic minorities may or may not be first generation and/or low income in 2015, but the percentage receiving doctorates in STEM is barely increasing.

There is no argument that first generation, low income children and adolescents and those belonging to other underrepresented groups are usually best served by a continuum of interventions from Headstart onwards. These and subsequent programs promote entry into the language of science and analysis, and higher level vocabulary and grammar in case it not spoken at home. However, a great many social, economic and personal circumstances can lead to participants not persisting, or not acquiring the full measure of knowledge available.

For students in these groups who successfully complete a bachelor's degree in STEM and enter a doctoral program the question addressed in this paper is whether interventions at the doctoral level can improve their success rate. It is too often inferred that the national Ph.D. dropout rate of around 50% comes from this population, but there is not enough data to support this inference (CGS). At the same time there is sufficient evidence that specific interventions at the doctoral level do promote student success. Whatever a student's background, admission to a STEM doctoral program requires successfully completing a relevant undergraduate curriculum. Barring inappropriate admission practices, students arrive with some preparation and the desire for a degree.

This paper reviews the kinds of interventions found in STEM doctoral training, the research literature on them and where they may fall short. To a limited extent it looks at the research on what students think about their training including my Spencer funded study on STEM Ph.D. recipients from the University of California. The paper is a consolidated review examining programs like AGEP, and LS-AMP which are part of a continuum, to those created often in isolation by disciplinary societies, individual universities/departments/faculty. The emphasis is on programs that address issues of first generation students. It builds on a catalog of programs I have developed over the years, focusing on shared characteristics and areas of intervention along with

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whether there are credible measures of success. It also provides a limited amount of student evaluation taken from my survey and others.

*'First-Generation' Graduate Students and Postdocs: Yes, They Exist and You Should Pay Attention!*  
*Carrie Cameron, Hwa Young Lee, Shine Chang, Cheryl Anderson, and Melinda Yates—all of The*  
*University of Texas MD Anderson Cancer Center*

Students who are in the first generation of their family to attend college (1G) have begun to receive increasing attention regarding unique challenges they may face in the undergraduate academic environment, including questioning of their belonging and academic identity, financial stressors, and family tensions resulting from their departure for college (Jehangir, 2009; Metheny & McWhirter, 2013). However, very little attention has been paid to these students when they reach the graduate and postdoctoral level. In fact, a lack of supportive policies and interventions for 1G students that pursue graduate degrees, suggests that students who have made their way into the graduate level have 'made it' and no longer encounter these stressors. Is this actually the case? Through focus groups, interviews, and surveys, at a major academic health center in Texas, we sought to find out more about the graduate and postdoctoral experience of 1G trainees, including what stressors they identify, their perceptions of their relationships with mentors, and their perceptions of their communication skills (frequently considered a manifestation of socioeconomic, racial, and ethnic identity). We also sought to tease apart the influences of family economic status during the trainee's childhood, race, ethnicity, and native language from 1G status. Our qualitative data suggest that 1G trainees feel that personal financial stressors during school and training are an extraordinarily important problem in educational and career development decisions and that the challenges of 'fitting in' increase rather than decrease at the graduate level. The quantitative results of our survey (N=218, all US citizens or permanent residents) indicate, among other things, that 1G trainees are older (mean1G=34.91, meanCEF=29.49).