

Summary of Articles Being Developed During the Workshop on the

Dissemination of Undergraduate Research Initiatives that Support

Diversity and Inclusion in the Geosciences

November 14-16, 2019

Participant: Robert Kirsch

Draft Title: Changing Geo Department Culture with Small Group Interventions: The Sparks for Change Pilot

Summary: The article describes a unique strategy for encouraging change in attitudes toward efforts to improve diversity within an academic department. The strategy is based on teams of three individuals (“triads”) that combine expertise and influence to support each other’s efforts to broaden diversity. Triads are comprised of a “Spark”, a “Partner” and a “Sponsor”. The Spark is typically an early career minority faculty member who provides first-hand experience as a minority and a drive to broaden participation. The Partner is a supportive later-career faculty member in the same department who understands Department dynamics and has influence with colleagues. The Sponsor is external to the institution who can provide a broader perspective and advice on external resources. Participants in the Sparks for Change program, held in Boulder, CO in September 2017, were provided leadership training specific to their role in the triad, and supported in developing action plans for changing their department culture. A supportive community of practice enables ongoing connection, and leading indicators of change include growth in leadership capacity, mentoring of sparks and inter-institutional collaboration toward cultural change.

Participant: Prajukti Battacharyya

DRAFT title: Course-based Undergraduate Research within Interdisciplinary Travel-study Courses: A Way to Broaden Access in the Geosciences

Summary: The article describes a program designed to attract students from under-represented minorities into the Geography, Geology and Environmental Science department. The project combines known high-impact techniques of student research, international travel and team projects to create an intensive, hands-on learning experience for undergraduates. The interdisciplinary course, titled “Geology and Physics of Iceland,” took place during the school year with a field trip to Iceland during the period between the spring and summer terms. This allowed persons who might have to work during the summer to participate. As part of the course, students were expected to 1) identify a research question related to Iceland, 2) write a research proposal, 3) review other student proposals, 4) conduct the proposed research activities during a trip to Iceland, and 5) present their research to a general audience on- and off-campus at appropriate venues. This course was open to all students irrespective of their majors, disciplinary backgrounds, GPA, or academic standing. Research conducted by the undergraduates during the pilot project of 2018 was presented at a variety of venues on campus and off campus, including at the National Conference on

Undergraduate Research (NCUR), at the University of Wisconsin Symposium for Research and Creative Activities and at the Iceland Embassy in Washington, DC.

Participant: Tamara Pico

DRAFT title: Inching towards inclusivity in field geology: addressing exclusive historical practices in training

Summary: The article explores how the culture of geological field work acts as a barrier to entry by members of under-represented minorities. It reminds the reader that science exists in a social/political/economic context and that cultural values, assumption, and practices within a scientific discipline dictate who has influence and even what questions are asked. There are significant safety issues for women and for persons of color on geological field trips, including high rates of sexual harassment and travel to remote areas where a person of color may not feel safe. The article will also discuss how our past experiences (such as camping as children) and even the history of the field of geology (which has been founded largely by white, male explorers) may predispose some groups to enter the field and serve as a barrier to entry for others.

Participant: Laura Good

DRAFT title: The Power of Educating the Whole Student as a STEM Mentor: Supporting the Social and Emotional Learning of Emerging Geoscience Leaders in an Era of Change

Summary: The article discusses the concept of educating the whole student and its relevance to supporting the development of a diverse geosciences workforce. It considers the challenges and opportunities the prevailing culture of science can present to emerging scientists and reviews documented practices that can help to overcome barriers through research and professional experiences. The authors will provide ideas for how higher education can better support emerging geoscientists by acknowledging that STEM learning is improved when a student's social and emotional well-being is considered as well as their academic training. We as mentors must improve our own learning about how to create more inclusive STEM learning environments, research experiences, and leadership opportunities, and we must address the significance of students encountering diverse perspectives, persons, and potential career trajectories as a catalyst for their learning and success.

Participant: Jo-Anne Manswell-Butty

DRAFT title: Broadening Participation in NOAA-Mission Research for Underrepresented Rising Sophomores in the Geosciences: Program Components, Processes, and Outcomes

Summary: The article describes the work of the NOAA Cooperative Science Center in Atmospheric Sciences and Meteorology (NCAS-M) to expand access for students from under-represented minorities to geoscience careers. The Experiential Training Summer Program (ETSP) recruits underrepresented students from its 13 partner institutions, provides experiential training in NOAA mission research, and trains students to create successful applications for NOAA undergraduate scholarships. A primary goal is to increase the total number of competitive scholarship applications submitted from traditionally underrepresented communities and thereby broaden student participation. Another goal is to provide early intervention in the geosciences

talent pipeline that introduces students to research methods and skills and geoscience career opportunities. The manuscript will describe the ETSP components and present findings based on a process and outcome evaluation. The manuscript will highlight lessons learned and features that uniquely prepare underrepresented students for success.

Participant: Andria Ellis

DRAFT title: A Pragmatic Undergraduate Research Experiential Program to Increase Diversity in the Earth Sciences: 15 Years of RESESS Success Stories

Summary: The article describes an internship experience focused on increasing the diversity of students entering the geosciences: the Research Experiences for Undergraduates in Solid Earth Science (RESESS) program. The authors will present various strategies and methods of the RESESS program that go beyond the traditional NSF-funded REU model. In particular, RESESS augments the students' intensive summer research program with: 1) an option to return to the program for additional research experiences and continued support, 2) extensive weekly professional development including a technical writing workshop, career circles, and additional workforce preparation, 3) a unique, multi-tiered mentoring approach, additional financial, career, and emotional support after leaving the program, 4) funding to attending a national conference, and 5) comprehensive and continued cohort building and 6) graduate school application and GRE funding support. The paper will describe how under-represented students in the Earth science community continue to thrive after successfully completing the RESESS program and discuss the critical need for continued support for such programs.

Participant: Jeanne Sumrall

DRAFT title: An Assessment of Student-Perceived Outcomes: A Case Study of NSF funded Baja Basins REU

Summary: This article assesses the impacts of the three year NSF-funded "Baja Basin REU Project", which ran from 2014-2017. The project was unique in its international experience, near one-to-one mentorship with PhD experts, and the diversity of the mentors involved in the program. Over the three years of the project, students overwhelmingly reported growth in multiple targeted areas, including knowledge of the scientific process from inception to presentation. Qualitative analysis of student surveys and interviews revealed perceived gains in new skills that included experience with instrumentation, software, geologic identification knowledge, and the ability to work collaboratively within a research group. The students appreciated the opportunity to work closely with mentors with subject matter expertise and the international setting of the research, which provided the opportunity to interact with Mexican mentors and students.

Participant: Ambrose Jearld

DRAFT Title: The Impacts Undergraduate Student Interns Bring to a Main Stream Oceans Sciences Community: The Woods Hole Partnership Education Program Model and Outcomes

Summary: The article documents the development and evolution of the Partnership Education Program (PEP) in Woods Hole, Massachusetts. PEP is an undergraduate summer research opportunity that targets students from under-represented minorities. The program is a collaboration of all six research and educational institutions in Woods Hole and one accredited university: the National Marine Fisheries Service, the Marine Biological Laboratory, the Woods Hole Oceanographic Institution, the U.S. Geological Survey, the Sea Education Association and the Woods Hole Research Center, and the University of Maryland Eastern Shore. In addition to explaining how the PEP works, the article discusses the importance of forming a committed group of individuals to persuade all the Woods Hole scientific organizations to work together to address the need to increase diversity within the geosciences. It discusses the evolution of that small group and how they learned to trust and speak freely among themselves, leading to a common vision. The article includes an assessment of the changes within the Woods Hole scientific community as a result of the 11 years of PEP interns.

Participant: Kwanza Johnson

DRAFT title: The Partnership Education Program Model: Successes, Best Practices and Lessons Learned

Summary: The article explains the structure of the Partnership Education Program (PEP), which is a summer research internship program offered by the combined scientific institutions in Woods Hole, Massachusetts, with academic credit provided by the University of Maryland Eastern Shore. The article provides information about recruitment practices, the selection process, the students' academic and research experiences, and other, non-technical training that takes place during the PEP program, such as how to write a resume, the value of networking, and social activities to encourage bonding. The article includes a report of the career choices of former interns, lists best practices, and describes lessons learned over the course of the 11-year program.

Participant: Bingqing Liang

DRAFT title: Best Implementation Strategies and Lessons Learned from Running a Short-term Inclusive Undergraduates Research Program

Summary: The article analyzes data collected on the performance of the only National Science Foundation-funded Research Experiences for Undergraduates (REU) summer program in the state of Iowa in the field of Earth Sciences. The program introduces undergraduates to a highly interdisciplinary research environment based on the technology of hyperspectral imagery (HI) in eight different STEM fields. Students recruited for the program are highly diverse in their demographic, academic, education level, and institutional backgrounds and are not required to have prior knowledge of HI to participate in the program. The study examines major factors for successfully running this short-term inclusive undergraduate research program. The study will also summarize a series of best practices that have affected the quality of the student experience of our REU program as well as lessons learned.

Participant: Vanshan Wright

DRAFT title: The Evolution of Student Engagement, Interest, and Perception of Geoscience During Challenge-Based Courses: Insights from the GeoFORCE Texas

Summary: This article addresses the important question of how to attract high school students from under-represented minorities into the geosciences. GeoFORCE is a summer program that offers week-long geoscience courses to students attending minority-majority high schools in Texas. In 2017, the program moved from a traditional lecture-style pedagogy to a challenge-based pedagogy in an attempt to increase student engagement, interest, and awareness of the geosciences. The article analyzes the impacts of that change using pre-, post- and activity-specific surveys provided by 25 students in one of the 2019 academies. Surveys revealed that students preferred doing hands-on group activities to learning from lectures. The number of students planning to pursue a bachelor's degree in a STEM field increased from 72% at the beginning of the week to 95% by the end of the course. By the end of the course, the students' perceptions of a geoscientist generally shifted to include a scientist who studies not only the earth but also the processes influencing the earth. These results suggest that challenge-based pedagogy is a more effective means of engaging high school students from under-represented backgrounds as compared to lectures.

Participant: Kadidia Thiero

DRAFT title: SOARS Alumni Impacting the Geosciences Community: Leadership in Academia, Government, and Private Industry

Summary: The article examines the impact of the alumni of the Significant Opportunities in Atmospheric Research and Science (SOARS) program, operated by the National Center for Atmospheric Research. The SOARS program is an undergraduate research program designed to prepare historically underrepresented students for STEM careers and pathways. It was started in 1996. SOARS Alumni hold leadership roles throughout the geosciences, including in government, risks assessment in the private sector; and leadership in institutions of higher learning. Alumni remain highly cohesive and are supportive of the SOARS program. The article discusses the impact SOARS program on the geosciences in terms of mentoring, leadership, sustainability, contributions to community, and the development of a sense of belonging.

Participants: James Pierson and Lora Harris

DRAFT title: Tropical Oceanography Research Training for Undergraduate Academics: A combined academic and summer program in Puerto Rico focused on broadening participation by underrepresented minorities in the geosciences

Summary: The article describes the building blocks for an effective, multiyear STEM education and research curriculum based on a partnership between a four-year undergraduate university and a research institution, and it evaluates metrics for determining success. The program focuses on creating culturally relevant and academically rigorous geoscience programming for students at a Hispanic Serving Institution (HSI) in Puerto Rico. Mentors and instructors included faculty members from the University of Maryland Center for Environmental Science and the home institution, Universidad Ana G. Méndez in Puerto Rico. Field research experiences and seminar experiences will be assessed to determine which factors support a realistic and

sustainable STEM education pathway. In addition, the authors evaluate the experiential learning of undergraduate and graduate students who participated in the project to further improve the design for a sustainable STEM education program. Special consideration is given to accommodate family obligations and cultural expectations. Programming needs to be flexible for students who work part-time or whose extended family networks may depend on them for responsibilities such as caretaking.

Participant: Leah Turner

DRAFT title: Macrosystem-Level Assessment of Programmatic Efforts to Identify Effective Support Systems and Strategies for Diversification of the Geosciences

Summary: The article presents a macrosystem-level assessment of the GeoFORCE Texas program. It will: 1) identify and categorize extrinsic factors that support diversity in four different areas proven effective for diversifying the geosciences, 2) identify potential gaps where GeoFORCE can supplement support with additional processes and/or programming, and 3) provide innovative suggestions and implementation strategies from diversity and inclusion literature for ways to resolve said gaps. The article will discuss:

- Mentorship, including corporate mentors
- Peer Support Networks and Community Building
- Schools represented in the GeoFORCE program
- Bridge Programs and the transition to college, and
- Pedagogies such as inquiry and active learning, place-based learning and field-based learning.

Participant: Sarah Sheffield and Victor Ricchezza

DRAFT title: Measuring the effects of diverse representation in STEM classrooms

Summary: The article describes an effective technique to increase diverse representation in STEM careers. As most of the scientists discussed in typical introductory science courses are white, able-bodied, cisgender and heterosexual men, this has the effect of continuing stereotypes amongst both underrepresented and non-underrepresented students of who does and does not belong in STEM. The authors describe a new component, called “Scientist of the Week”, which they have introduced into university-level geology courses. The segment introduces diverse scientists across a wide range of STEM careers. Scientists of the Week have ranged from Nobel laureates, avocational scientists, science writers, graduate students, and more across all scientific sub-disciplines. The concept is that by showing underrepresented students that there are people who share their experiences and have succeeded in science, this will help them visualize the community in which they belong. Further, by showing students who are not underrepresented the breadth of diversity that exists in STEM serves to break down their prior conceptions about who a scientist is. To assess how this project has influenced students, the authors conducted semi-structured interviews with 15 students from the course’s previous semesters. Analysis of these interviews show that students of all backgrounds responded very favorably to this strategy.

Participant: Sorina Stalla

DRAFT title: Inclusive Design: Essential Components to Consider for Successful STEM programs in the Arctic

Summary: The article describes the pressing need to build a more diverse geoscience workforce in the Arctic. It makes the case that responding to the rapidly emerging and complex challenges of the changing Arctic requires a new Arctic STEM pedagogy that is both integrative and inclusive of Alaska Native and rural Alaskans, the groups most affected by many of the changes. The authors consider the unique features of the Arctic and examine attributes of past and existing undergraduate STEM programs in Alaska to identify the essential design components and best practices for an inclusive and integrative Arctic STEM pedagogy.

Participant: Paulinus Chigbu

DRAFT title: Enhancing Diversity in Marine Science: Design, Recruitment and Outcomes of a Research Experience Site that Targets Freshmen and Sophomores

Summary: The article assesses the success of one of only three REU sites in the ocean sciences at Minority Serving Institutions, including the academic and professional preparation of the students. The structure, student recruitment and mentoring strategies, professional and cohort building activities of the program and student outcomes are described. The authors also share information on the major factors that contributed to the creation of the REU site at UMES, and the challenges in administering and sustaining the program. Because early engagement of students in hands-on research, career and professional development activities is important for retention and success in college, the REU program at the University of Maryland Eastern Shore targets mainly rising sophomores/juniors and will consider taking rising freshmen into the program. Over a period of eleven years, 124 interns from more than 58 institutions have participated in the program of which ~80% were freshmen or sophomores, 58% were females, and 77% belonged to underrepresented minority groups. Students participated in workshops and seminars to teach them how to design field and laboratory projects, collect and analyze data, and effectively communicate their results orally, in poster form, and in writing. Based on the results of surveys, the interns reported that the program had significant positive impacts with regard to academic performance, knowledge and skills gained, and decision to attend graduate school in marine or environmental sciences or related disciplines. Of the students who have completed B.S. degrees, about 50% have subsequently completed or are currently in graduate or professional school. The experiences running the site will be beneficial to those who are interested in developing similar REU sites, especially at MSIs and primarily undergraduate institutions.

Participant: Gabriela Noriega

DRAFT title: The impact of cross-disciplinary team and project-based learning on student interest in geoscience educational pathways

Summary: The article describes a unique approach to undergraduate research experiences that uses teams to encourage both collaboration and mild competition. Interns are divided into teams, and each team works on one aspect of a research problem while all the other teams tackle other parts of the research problem. This builds a group identity and sense of belonging as well as a sense of accomplishment when all the teams

complete their tasks. This approach improves retention of minorities in the geosciences and prepares students to enter a complex, multi-disciplinary, inter-professional, global workforce.