

Broadening Geosciences Preparedness through a Cross-Campus Experiential Partnership

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Motivation

Strengthening and diversifying the geosciences pipeline requires creative investments in effective evidence-based strategies to broaden access and reinforce retention. Geosciences fields, in particular, lack racial and ethnic diversity at doctoral levels and are cited as having the lowest diversity of all the STEM fields at all levels of higher education (National Center for Science and Engineering Statistics, 2015). In 2010, while 20% of all U.S. bachelor degrees were awarded to underrepresented minorities, fewer than 7% of geosciences bachelor degrees were awarded to the same groups (Stokes et al., 2014). These statistics highlight the need for innovative and inclusive strategies to broaden geosciences access and reinforces retention.

The Federal STEM Education Strategic Plan (2013) recommended new strategies to attract and retain undergraduates to science, technology, engineering, and mathematics (STEM) majors, including:

- 1) Revision and replacement of traditionally uninspiring introductory courses
- 2) Opportunities for professor-supported student mentorship in core mathematical skills
- 3) Programs to help students, particularly underrepresented students, see themselves as STEM professionals

The President's Council of Advisors on Science and Technology (PCAST) (2012) called for the diversification of evidence-based teaching methods to engage all students—especially the 'underrepresented majority' (women and members of minority groups, who constitute ~70% of college students). Successful programs commonly use three interventions widely recognized for inspiring STEM students:

- 1) Early research experiences
- 2) Active learning in introductory courses
- 3) Membership in STEM learning communities

Partnership between MSMU and USC



Mount Saint Mary's University of Los Angeles, CA



USC/Wrigley Marine Science Center on Catalina Island, CA

As described in the 2011 report "*Expanding Underrepresented Minority Participation*" (National Academies, 2011), cross-institutional diversity represents a prime vehicle for addressing disparities in STEM participation and enhancing success across underrepresented groups. In 2017 Mount Saint Mary's University (MSMU) in partnership with the University of Southern California (USC) was awarded a National Science Foundation (NSF) Improving Undergraduate STEM Education in the Geosciences (IUSE Geopaths) grant (NSF #1700871). The program forges a sustainable, scalable model partnership between a minority-serving geosciences-limited 2-year/4-year women's institution (MSMU) and a larger R1 university (USC).

Mount Saint Mary's University (MSMU):

Serves 1,561 traditional undergraduates, primarily women, who make up 96% of the student population and 100% of STEM majors. As a federally designated Hispanic-Serving Institution, MSMU has a long-standing commitment to providing quality educational programs to underserved and financially disadvantaged populations. MSMU serves a student body closely resembling the profile of Los Angeles: Hispanics (61%), Asian or Pacific Islanders (21%), Caucasians (8%), African-Americans (5%), multiracial/other (5%), first-generation students (52%), and low-income students (60%).

University of Southern California: (USC) Wrigley Marine Science Center (WMSC)

USC has a strong commitment to inclusivity and increasing diversity in all its academic programs. In 2016, the Wall Street Journal/Times Higher Education survey ranked USC 15th nationally overall in higher education, in large part because of the commitment to foster diversity. The Wrigley Marine Science Center (WMSC) on Catalina Island provides a unique contrasting environment for studying land-ocean interactions when compared to the urbanized and human impacted coastal zone adjacent to Los Angeles. A lively mix of faculty and student researchers reside on the WMSC campus year-round. The 21,000 sq ft, 3-story laboratory includes teaching facilities and 6 shared-use research laboratories.

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Social Media



Website: <https://www.msmu.edu/resources-culture/iuse/>
<https://dornsife.usc.edu/wrigley/wmsc/>
Twitter: @echo_echo and @USCWrigleyInst
Instagram Hash tag: #atheniansingeosciences

GEOPATHS Program Goals and Design

The GEOPATHS program is designed around four overarching goals:

- 1) Attract greater academic interest and awareness among entry-level MSMU students in geoscience and environmental fields
- 2) Increase the retention of MSMU students in related STEM courses and minor/major tracks
- 3) Facilitate post-program engagement in STEM and geoscience curricular, co- ,and extra-curricular opportunities
- 4) Create an institutional STEM training partnership between MSMU and USC to enhance undergraduate student opportunities in curricular and extracurricular data- and field-centric experiences

The GEOPATHS program supports three annual cohorts of 14 students each in year-long scaffolded programming (Table 2) in the form of extended research experiences, fieldtrips, workshops, and opportunities to present science while covering the disciplines of oceanography and earth sciences in the following ways:

- 1) Introduce oceanography and environmental science fields through project based learning at USC's WMSC Catalina campus
- 2) Conduct field/laboratory studies mentored by USC and MSMU faculty and researchers
- 3) Build expertise and confidence for subsequent participation in national programs and advanced geoscience courses at USC that are unavailable at MSMU
- 4) Inform students about geoscience graduate school and workforce opportunities

The program consists of year-round programming, including: two extended research experiences at USC/WMSC, three fieldtrips, three workshops, and four opportunities to present their research.

Cohort 1 Programming (2018)

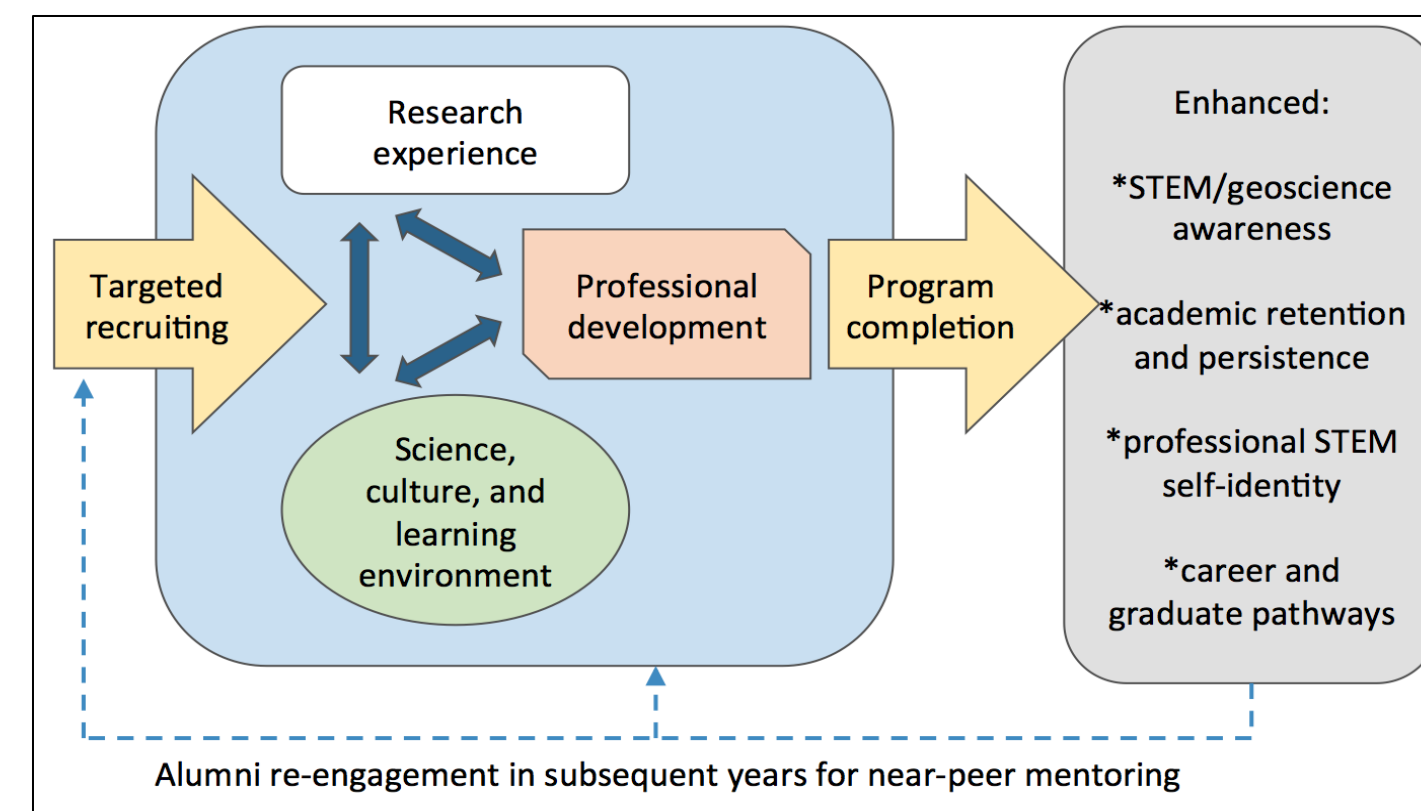


Figure 2: Schematic of scaffolded program activities and goals.

Programming completed for Cohort 1 (Feb-Dec 2018)

Spring 2018

- 1st Fieldtrip: Griffith Park Observatory
- 1st Catalina: Research Program Activities
- 1st Catalina: Research Experience: 5 days at USC/WMSC. Introduction to Oceanography. Large group project.
- 1st Workshop: Data Summit to prepare for first presentation.
- 1st Presentation: Oral presentation at the MSMU Academic Symposium

Summer 2018

- 2nd Catalina Research Experience: 15 days at USC/WMSC. Small group independent projects.
- 2nd Fieldtrip: 1 day Oceanographic research cruise
- 2nd Presentation: Oral presentation at USC/WMSC of summer projects

Fall 2018

- 3rd Fieldtrip: NASA Jet Propulsion Laboratory (JPL)
- 2nd Workshop: Geosciences Career Panel
- 3rd Workshop: Personal Statement workshop and Graduate Student Panel
- 3rd Presentation: Poster presentations at MSMU STEM symposium
- 4th Presentation: Poster presentations at Southern California Counsel for Undergraduate Research (SCCUR)

References

- National Center for Science and Engineering Statistics. 2015. Women, Minorities, and Persons with Disabilities in Science and Engineering: Special Report NSF 15-311, National Science Foundation, Arlington, Va.
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- Federal Science, Technology, Engineering, and Mathematics (STEM) Education 5-Year Strategic Plan. 2013. A report from the Committee on STEM Education National Science and Technology Council. Executive Office of the President, National Science and Technology Council, Washington, DC.
- President's Council of Advisors on Science and Technology (PCAST). 2012. Report to the President. Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering and Mathematics. Washington DC.

Cohort 1 - 2018



Photos from Cohort 1 during the GEOPATHS Program

Assessment – Preliminary data

IRB approval was obtained to collect participant data. Assessment is conducted by an external evaluator

- 1) Annual Pre- program Online Surveys (N=14 per year). Before the program begins each spring, participants complete an online survey (pre-test), about 15 minutes in length.
- 2) Annual Post- program Online Surveys. Upon completion of the program each fall, students will complete a second online survey (post-test), about 25 minutes in length. Examining the change in students' responses from pre- to post-test will allow measurement of program impact.
- 3) Retrospective Online Survey (N=42). After the program's third year, all program graduates will be contacted for career tracking purposes, and to reflect on how the program influenced their educational and career choices.

Pre program survey (Feb 2018). N=14

Q: What are you hoping to get out of this program? Why did you apply?

"I'm hoping to get more involved at school and gain more hands on experience in geosciences. In addition, I am exploring a new field that I haven't really considered before and hope to gain more knowledge about geosciences to see if it is possible something in interested in!"

"I'm hoping to gain a first-hand experience on research involving environmental science. I chose to apply because I know that I will learn a lot from this program even be able to demonstrate my leadership skills. Lastly, I chose to apply for this scholarship because I wanted to make sure that majoring in Biology was something I really wanted to do.

"I am hoping to gain a better insight in geo-science research and learning how to cooperate with my colleagues. I applied because it seemed like a great opportunity to dip my feet in for research and gain a better appreciation for the geo sciences."

"This program allows me to expand my knowledge within the ecological aspect of biology. It not only grants me privileges to research so early, but it let's me explore the other side to biology as well as grow aware of the impact it has on the way we view and care for our ecosystems and communities."

Post program survey (Dec 2018). N=13

Q: What was the MOST VALUABLE part of the program? What makes you say that?

All students report that the program met (3) or exceeded (10) expectations.

"Getting a whole new experience in a field I was not familiar with and spending time with my friends and professors. The support system it offered me. While I truly believe I gained a lot of lab skills and tools to design my own research projects, it also gave me a new set of friends whom I can talk to and get feedback from. The connections I made in this program are truly worthwhile."

"The knowledge and experience. I don't know anyone my age who has already completed a research program, and worked on a project that might have a huge impact in the future."

Q: How would you rate the program overall?

Group Mean = 9.4 out of 10

"I was able to visit an island for the first time because of this program. It allowed me to meet amazing people who I was lucky enough to work and share experiences with. I learned about a whole new branch of science (oceanography) and went night snorkeling for the first time. I would not trade this experience for anything else".

"It is a program unparalleled to any other. From the workshops to the team bonding and the research itself, it was an amazing and unique opportunity I really don't think I will find anywhere else. This program has definitely opened my eyes to all the STEM field has to offer."

Q: How have your ACADEMIC/EDUCATIONAL goals changed as a result of this program? How did the program influence these changes?

"The program and this experience also taught me leadership skills and time management skills. This has allowed me to perform better in school and participate more in class discussions. Academic and educational wise I want to become the best version of me so that I can be able to guide someone one day like the program mentors guided me."

"I have become a more confident student after the program. I feel like I have become a better mentor for my mentees at MSMU. I also feel more confident in my abilities to pursue research for a graduate career."