Utah Valley University
Principal Investigator, Dr. Geoffrey Zahn
Title: MORE-BIO: Mentored Research Experiences for Improving Biology Student Outcomes
Excerpts from NSF Scholarships in STEM proposal, 2018

Table 2: UVU MORE-BIO Project Goal and Objectives	
Goal: Build on the successes of a previous S-STEM Track 1 program by: 1) promoting student success and degree completion for students in biology at UVU through financial-need-based scholarships to academically promising students; 2) providing faculty-mentored research learning experiences and other support services aimed at enriching participants' education and increasing their preparation for the workforce and graduate school; 3) increasing STEM enrollment and completion in an open-enrollment teaching institution with traditionally low enrollments in STEM disciplines; 4) expanding program interventions that are effective for women students and underrepresented minorities; and 5) advancing knowledge of evidence-based practices relative to the roles of self-efficacy, teacher immediacy, and effectiveness of faculty mentoring in student success.	
Process Objectives	**1.** Provide full-tuition scholarship support to at least 37 low-income students in biology, including students from traditionally underrepresented groups, who have demonstrated academic aptitude, perseverance, and determination. (Scholarships will be at least $5,830 per year and will cover full tuition and a book allowance.)
	2. Support participant's academic development through mentored research with committed and trained faculty mentors; support participants' research proposals with additional funds for research materials, transportation, memberships in scientific societies, and conference travel; support participants' research progress with peer mentors.
	3. Foster participant's professional development through career guidance, mentors from STEM professions, connections to education-relevant part-time employment opportunities and internships, and conference attendance and presentation.
	4. Build on promising results of the S-STEM Track 1 project by providing purposeful enrichment activities to foster peer-support, professional engagement, career advancement, and a sense of community, especially among women and minorities.
	5. Advance knowledge of evidence-based practices relative to the roles of self-efficacy, teacher immediacy, and effectiveness of faculty mentoring in student success by conducting formative and summative assessments pertaining to these activities.
ObjectivesMeasureable Outcomes	**A.** A minimum of 17 scholarship recipients will graduate with baccalaureate degree in biology, biotechnology, or botany by the end of year five. (13 will still be enrolled)
	B. A minimum of 80% of program graduates will enroll in graduate school or obtain career-related employment in a STEM field within six months of graduation.
	C. A minimum of 80% of program participants will attend a national or regional discipline-specific STEM research conference and will present a paper, presentation, or poster related to their mentored research.
	D. A minimum of six presentations, one published paper, and two regional workshops from members of the project team will contribute to advancing knowledge about the roles of self-efficacy, teacher immediacy, and effectiveness of faculty mentoring in student success in biology programs at a comprehensive, open-enrollment university.

G. S-STEM Student Support Services and Programs

The MORE-BIO program will leverage substantial student support services within UVU and the College of Science (see *Facilities* for a description of the most relevant). In addition, the MORE-BIO program will extend or adapt successful evidence-based practices from UVU's PRO-STEM Track 1 program. The planned support services and programs have been selected to increase student learning, confidence, performance, retention to graduation, and career or post-baccalaureate education placement.

***MORE-BIO Orientation Course*.** Upon selection to the program, scholarship recipients will meet with a Biology Advisor and register for the three-credit MORE-BIO Orientation Course. (Options are described below). The first week will include an orientation to the program and an overview of the mentored research projects in the department. Faculty mentors will give presentations highlighting the work their research students are doing and the major research questions driving their labs (the information will also be compiled as an on-line brochure). At the end of the first week, MORE-BIO scholars will rank their interest in each faculty member's research and PMT will schedule five research rotations for each student, pairing them with their top five ranked faculty mentors when possible.

Research rotations will consist of spending two weeks in each potential mentor's research group, attending lab meetings, and shadowing more advanced research students. At the end of each rotation, MORE-BIO scholars will submit a short reflection about the ongoing research in each lab they visit. Scholars will again rank the faculty mentors they are most interested in working with, and potential faculty mentors will meet with scholars for a final interview before formally admitting them into their lab groups. During the final five weeks of the course, MORE-BIO scholars will work closely with their selected faculty mentor to develop a research proposal and prepare a poster presentation outlining the context and importance of their question along with proposed methods for addressing it. At the end of the semester, scholars will host a poster session for students in general education biology courses. This will serve as a recruitment tool for the next cohort of scholars and provide a foundational experience for the students presenting their proposed research projects. Grades will be determined jointly by each student's faculty mentor and the PMT member assigned to the course.

Faculty-Mentored Research. All MORE-BIO participants will be strongly encouraged to participate in faculty-mentored research each semester for which they receive a scholarship (see *Options* below). Students may elect to receive academic credit by enrolling in courses designated as independent research, they may receive salary through one of several UVU sources of funding (described above), or they may volunteer their time. Participants will be introduced to available research opportunities and assigned a research mentor through the MORE-BIO orientation course. Mentored research will be used as a means to directly instruct students in research methodology, the use of instrumentation, statistical analysis and numerical tools, etc. The *Facilities* document describes current faculty research projects.

Research Stipends. MORE-BIO students will be eligible to apply for a stipend of up to $1,000 for research materials and minor equipment (supplies), field transportation, or stipends to facilitate their research projects. Students may apply at the end of their first semester and annually thereafter through a formal research proposal. Actual award amounts will be determined by the SSC based on students' proposals. Faculty mentors will assist students in learning the skills associated with producing proposals.

Options to Research. Scholarship recipients who are unwilling or unable to participate in the research activity described above will be given options that are not overly burdensome and not interpretable as payment for work. These might include a course or series of courses with a strong research component or a library/internet research project under the direction of a faculty mentor. Seniors may also receive credit for work as a teaching assistant, for which they would be trained and

mentored. [*See Response to Program Officer Questions on page 40.]

Multi-level Mentoring Network. The project is designed to establish a mentoring network of multiple individuals in order to meet the various needs of the students.[1] In the research groups, more experienced students will take on leadership roles to supplement faculty mentorship and provide a peer-based avenue of accountability for MORE-BIO scholars which leads to increased voluntary self-development activities and personal identification with STEM fields.[2] Further, as students advance through the program, they can assume peer-mentoring leadership roles, which effects a major boost to STEM success and retention, particularly for underrepresented groups.[3] And, in addition to faculty research mentors described previously, MORE-BIO students will be connected to a professional mentor from the local workforce or academic community suited to their needs. The Multicultural Center and the Utah Women & Leadership Project will assist the project team in locating appropriate mentors (see *Letters of Commitment*). Well-chosen mentors will help address the varied needs of students and should be especially effective in retaining and advancing students from underrepresented backgrounds.

Professional Development Opportunities. Faculty mentors will aid students in identifying appropriate conferences, meetings and seminars in which careers in STEM may be explored. Each student will receive approximately $1,000 per year for conference travel, memberships in scientific societies, and professional development. Actual award amounts will be determined by the Scholarship Committee based on students' proposals. (Other institutional resources for student research will be leveraged as well.) All students will attend at least one major national or large regional discipline-specific conference for which they will be encouraged present a paper, talk or poster. In addition, students in their second and third years will attend the Utah Conference on Undergraduate Research (UCUR) as a cohort with their faculty mentors to present oral and/or poster presentations of their work. Faculty mentors will train recipients in the preparation of such presentations. The project team and faculty mentors will seek collaborative associations with other institutions, governmental agencies, and STEM businesses in the region. Students will also be encouraged to apply for STEM REU positions, internships and other off-campus opportunities for summer breaks. Students will develop professional networks outside UVU.

***MORE-BIO Meetings*.** The MORE-BIO program will build a sense of academic community and an atmosphere of scientific engagement among student cohorts through participation in cohort meetings and activities. Monthly brown-bag lunch meetings will consist of guest speakers, special topics, student presentations, field trips to industry sites, etc. At least one discipline-specific speaker will be brought to the UVU campus each year from an external institution to provide both a topical seminar and to discuss STEM careers in their fields. Students will have opportunities to meet both formally and informally with invited guests. Non-S-STEM students will be invited to appropriate MORE-BIO meetings as a means of recruitment and of benefitting more STEM students at UVU. MORE-BIO students will also be encouraged to participate in other departmental speaker presentations and meet-and-greet activities. [**See Response to Program Officer Questions, p. 4.]

Women in STEM. The three women on this project team will join with women faculty in the College of Science to revitalize UVU's defunct Women in STEM (WISTEM) program. WISTEM has lacked leadership for some time and has not been the dynamic tool it could be for supporting women

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1 Chesler, N. C., & Chesler, M. A. (2002). Gender-informed mentoring strategies for women engineering scholars: On establishing a caring community. Journal of engineering education, 91(1), 49-55; Painter, S. (2012). Statistical models of self-efficacy in STEM students. Journal of Undergraduate Research at Minnesota State University, Mankato, 12(1), 7; Pita, M., Ramirez, C., Joacin, N., Prentice, S., & Clarke, C. (2013). Five effective strategies for mentoring undergraduates: Students' perspectives. Council on Undergraduate Research, Spring, 33(3).

2 Holland, J.M., Major, D.A., and Orvis, K.A. (2012). Understanding How Peer Mentoring and Capitalization Link STEM Students to Their Majors, The Career Development Quarterly, 60 (4) 343-554. https://doi.org/10.1002/j.2161-0045.2012.00026.x

3 Palmer, Robert T.; Maramba, Dina C.; Dancy II, T.E. (2011). A Qualitative Investigation of Factors Promoting the Retention and Persistence of Students of Color in STEM, *Journal of Negro Education*, 80 (4) 491-504; Wilson, D.M., Bates, R., Scott, E., Painter, S.M., and Shaffer, J. (2015). Journal of Women and Minorities in Science and Engineering, 21(1), 27-45.

students. Feedback from current students indicates that a well-planned, worthwhile program would be well received and would benefit both the MORE-BIO students and women students throughout the College of Science.

An annual record of scholarly work will be compiled electronically and distributed to the cohort of students and faculty as a record of work accomplished. The record will contain summaries of student research and scholarly activities, informal reflections by the participants, photos of events, etc. The record will be made available on the Biology Department web page for general viewing and dissemination. An email announcing the web-publication will be sent to the Dean of Science, the Senior Vice President for Academic Affairs, the UVU President, and other select administrators.

Response to Program Officers Questions

*** 1. Please elaborate on the other offerings for scholarship students that are not interested in participating in research. Please provide specific examples.**

Though research will be encouraged, other roles for students who not interested (or are unable to participate) in research will be provided. These can take many forms, and will be chosen in consultation with students on a case-by-case basis. Examples may include:

- **Teaching assistant roles –** MORE-BIO scholars could assist in setting up introductory biology labs, in grading coursework, and in leading study groups for introductory courses. As students gain more experience in leading supplementary study groups, they can begin to perform that role in more advanced courses as well.
- **Courses involving research** – Students, in consultation with biology advisors and faculty mentors, could agree on a series of courses that contain significant research components. These would count toward graduation.
- **Library literature review with writing component** – Students interested in contributing to science but unable to engage in rigorous laboratory-based research could work with their mentor to conduct an extensive literature review on a topic of interest, with the ultimate goal of generating a review article for publication.
- **Outreach and service** – Students interested in outreach and/or science communication would be able to develop a service and outreach plan with their mentor that could involve K-12 educational components, community outreach, and/or the development of educational materials.
- **Internships** – Students could participate in internships with local biological science industries as described in #7 below. These internships should be for a length of time comparable with a research project and have a written reflection component that will be reviewed by the faculty mentor.

****3. The cohort model could be improved by creating more group activities and opportunities to provide a more cohesive experience. Please describe the formal and informal cohort meetings and activities in more depth. Will these be aimed at enhancing their educational experiences per se, or social in nature?**

Rather than having meetings only monthly (as originally proposed), we will have cohort activities on alternating weeks. These meetings will serve a variety of purposes. At the beginning and end of the semester, we will have informal socials to allow the students to get to know one another better. During the semester, we will alternate between student-led presentations such as journal clubs or research talks, and invited speaker presentations over various topics ranging from research seminars to professional development advice. For invited speaker presentations, we will solicit students for their advice and

suggestions, so as to choose speakers that will be relevant to their interests and needs. Below is a sample schedule that describes example proposed activities. S-STEM students will be expected to attend at least 60% of the activities, and to present at least once during the period of their scholarship.