EDUCATIONAL PROPOSAL

STATEMENT OF THE PROBLEM AND ITS SIGNIFICANCE. My educational plan is divided into two aims, both of which address the idea of increasing access for students: (**Aim #1**) to near-peer mentors who do not exist at primarily undergraduate institutions (e.g., PhD students and postdoctoral fellows) and (**Aim #2**) to undergraduate research experiences, or UREs. The overarching goal of these approaches is to increase student confidence and networking opportunities, particularly for those from marginalized groups who may not have prior knowledge of the unwritten rules of academic culture, which in turn creates barriers to success.³³

Aim #1: To provide students from our primarily undergraduate institution (PUI) with near-peer networking opportunities and direct exposure to research at regional research-intensive institutions through a biennial *Life Sciences Symposium*. Background and Significance: The benefits of near-peer mentoring, or mentoring by trainees at a similar or advanced stage, is well documented.³⁴⁻³⁷ While many of

these studies examine senior undergraduate mentoring of younger students, my experience as the undergraduate manager (~10 undergraduate students per year) in Dr. John Kuriyan's lab during my postdoc at UC Berkeley revealed profound effects of near-peer mentoring by PhD students and postdocs for undergraduate students as well. Because we do not have PhD students or postdocs at WWU, I wanted to provide an opportunity for our students to develop these relationships. Therefore, in October 2019, I developed, planned, and executed the first *Life Sciences Symposium* at WWU. The main goals of the symposium were to: (1) Unite biochemistry, molecular biology, and other programs (e.g., behavioral neuroscience) research at WWU, (2) Provide access and networking opportunities for



Figure 7. Life Sciences Symposium 2019 research talk by University of Washington PhD student Sam Witus (Dr. Rachel Klevit lab).

students at WWU to PhD students and postdocs in biomedical and life sciences, (3) Allow PhD students and postdocs to give research talks at an outside institution, as well as to reflect on their own undergraduate experiences as they develop into teacher-scholars themselves, and (4) Bring together biomedical and life sciences research in the Pacific Northwest. We hosted 7 PhD students, 6 postdoctoral fellows, and 1 research



Figure 8. Life Sciences Symposium 2019 poster session. Left picture: Biochemistry senior Savanna Takasaki describes her research to former Chemistry department chair, Dr. Spencer Anthony-Cahill. Savanna is matriculating into the Biochemistry PhD program at the University of Washington in Fall 2020. Right picture: Masters student Chris Swanson describes his research to (from left-to-right) senior Biochemistry student Wyatt Parks (matriculating in the Chemistry PhD program at the University of Oregon in Fall 2020), Masters students Micah Nakao and Erin Rosenkranz, and senior Biochemistry student Kristina Boyko (matriculating in the Biophysics PhD program at UC Berkeley in Fall 2020). scientist from the Pacific Northwest, including the University of Washington, Institute for Protein Design, Allen Institute. Fred Hutchinson Cancer Research Center, and the University of Oregon in a 1-day symposium that was attended by over 80 students and faculty from WWU (Figure 7). In addition to giving scientific talks, our 14 speakers led networking round-tables during lunch, which included themes of: tips for applying to graduate school, networking, deciding where to go to graduate school and/or what to do after, communication and interviewing skills, diversity and inclusion, science writing (including funding!), and work/life balance (i.e., maintaining mental health!). Finally, we

also had a poster session at the end of the day highlighting research from WWU (**Figure 8**). In parallel with the poster session, Drs. Aaron Moss (Certera) and Rich Gardner (University of Washington) gave an informal Q&A about the biotech industry and a presentation on "How to get into grad school," respectively. This event was funded by \$1000 from each of the Chemistry and Biology departments at WWU. This symposium led to my lab forming a collaboration with Dr. Rachel Klevit's lab at the University of Washington, including regular correspondence of one of my undergraduate students with a PhD student in her lab.

PLAN OF PROCEDURE. After a hugely successful first event, I would like to expand this event to be conducted

biennially and to also include scientists from other regional areas (e.g., Vancouver, British Columbia). As described below, I gathered feedback, in the form of exit assessments, from speakers, student, and faculty participants, and this feedback will be incorporated into future events. The most common feedback that I received regarding improvements to future events was to decouple the industry and grad school sessions from the poster session, and to provide the speakers with name tags, as it was challenging for WWU students to identify who was a speaker prior to their research talks. Finally, I propose to recruit colleagues from Biochemistry, Molecular and Cellular Biology, and Behavioral Neuroscience to form a committee that will contribute to the planning of future events, in order to ensure longevity of the Life Sciences Symposium. Funding from the Cottrell Scholars Award will directly impact my ability to hold future events, because although the Chemistry and Biology departments are interested in future support of this event, the COVID-19 pandemic will impact internal funding opportunities in the next few years. After holding this symposium 1-2 more times (in Fall of 2021 and 2023). I plan to pursue options to increase the event to more than one day (likely, continuing into a Saturday so as to prevent disruption to courses), to provide travel reimbursement for speakers, and to ensure its sustainability by securing dedicated internal and/or NSF funding. We are also interested in incorporating a keynote talk from a regional faculty member. We will plan to provide the option of virtual attendance at all future events, to increase accessibility and in the event that there are continued COVID-19 pandemic mitigation policies. IMPACT: As mentioned above, this event provides a number of benefits to our students, including meeting and networking with potential near-peers that are not at WWU, as well as the speakers, including giving a research talk at an outside institution. In addition, if we expand this event to occur on a Saturday, we could invite students from other regional PUIs (e.g., the University of Puget Sound) and community colleges (e.g., Whatcom Community College) to attend.

Aim #2: To increase equity, inclusion, and diversity in how we recruit students to UREs in the Chemistry department by creating an elective course for first and second year (and transfer) students. Background and Significance: The benefits of UREs are well understood and include (quote from Hayward *et al.*, 2017), "personal and professional gains, research skills, career clarification, enhanced preparation for careers and graduate school, and the ability to think and work like a scientist."^{38–40} Despite this, it is also well documented that for many universities, the selection criteria for UREs are not attainable for all students who

may benefit from such opportunities. For example, selection is often "competitive, based on cumulative GPA in a declared STEM major; letters of references; prior enrollment in a CURE [Course-based Undergraduate Research Experience]" or "Specialized, based on status as underrepresented minority or other criteria," and finally, "Student initiated based on faculty contact."41 In our Chemistry department at WWU, URE selection is consistent with the above criteria. Within the labs of the 22 tenured and tenure-track faculty members in the department in the academic year 2019-20, we had a wide variety of available research opportunities in varying fields of chemistry (Figure 9). Feedback from a qualitative assessment that I gave in Spring 2019 to our senior BS Biochemistrv students suggested that "lettina underclassmen know about research opportunities early" would help to foster an inclusive sense of community in the



Figure 9. Research in the WWU Chemistry dept.

department." Also that students who feel the strongest sense of community do so because they "do research." Therefore, I would like to develop a way to formally introduce first- and second-year students, including transfer students, to our research programs, providing a path to successful entry to UREs.

Previous work concludes that academic culture and early barriers to success disproportionately affect students from marginalized groups, and specifically students of color.³³ I am interested in addressing these issues of inequity by breaking down hurdles that address the third selection criteria described above, or the requirement for students to initiate faculty contact in order to secure an URE. In my three years as an Assistant Professor, I have noticed that it is challenging for many students to approach faculty, particularly those who teach upper division courses (e.g., biochemistry and inorganic and physical chemistry). Similarly, those who are brave enough to approach a faculty member or send an initial email, but are unaware of the

unwritten prerequisites to that contact (e.g., expressed knowledge of familiarity with the faculty member's research program), are often overlooked for the limited number of UREs in our department.

Taken together, the overarching problem that I aim to address is inequities in how we currently recruit and admit students to our research labs, due to the barrier that requires student-initiated faculty contact. This problem is two-fold, students may not know how to or feel comfortable initiating contact, and conversely, requiring student-initiated contact without formal opportunities to do so limits the students available to faculty teaching in upper division areas. Consistently, lower division students may not be aware of what subfields of chemistry research they are interested in, having not yet taken those that are the focus of upper division courses. The significance of this problem is that UREs are an important determinant of student retention and success in STEM fields, particularly for those from marginalized groups.³³ In order to provide one possible solution to this problem. I plan to introduce first and second year (and transfer) students to the research labs at WWU through a 1-credit elective course taught in the Fall quarter. As described below, the foundation of this course will be to have faculty members give short research introductions during the guarter, thus providing direct access for students. In addition, we will cover professional development topics, e.g., writing a CV, writing emails to faculty, and include a panel with upper division and/or graduate students in the department. While this course does not engage students directly, e.g., UT Austin's Freshman Research Initiative or UMBC's FIRE program, a formal internship program is proposed as a future direction. The broader impact of this course is that I plan to write up implementation and outcomes of this course for a peer-reviewed STEM education journal, to provide a template for other universities to introduce students to the research in their departments.

PLAN OF PROCEDURE. In order to address inequities in how we currently recruit students into our research labs, I plan to develop and teach a 1-credit elective course that introduces first and second year (and transfer) students to research and faculty in the department. This course will be developed in communication with our Curriculum committee. In addition, our Science, Mathematics, and Technology Education (SMATE) department currently holds an Advancing Excellence and Equity in Science (AEES) grant from the Howard Hughes Medical Institute (HHMI). As a part of this multiyear grant, faculty in multiple science disciplines, including Chemistry, have developed first year (and transfer) seminars, called S³- seminars. These seminars aim to retain students from marginalized identities in STEM fields and offer excellent educational and professional development training about being a student of science. As a mentor for a seminar this past academic year, I saw first-hand how powerful it was for young students to have honest conversations with faculty. This elective course is not meant to take the place of these seminars, but will enhance the experience for any students who are enrolled in both, because it will provide a direct path to research in Chemistry, which the S³-seminars do not do.

During the 10 weeks of Fall guarter, this course will meet once per week. We currently offer BS degrees in Chemistry and Biochemistry, as well as a BA in Chemistry. Because of bottleneck issues in enrollment in a number of our upper division courses (specifically, upper division labs), our department requires students to declare an intention to major in Chemistry/Biochemistry (Phase I) prior to applying for Phase II admission before their final 2 years of coursework. Therefore, this course will be targeted and advertised to Phase I Chemistry majors, of which there is a Canvas group and email list. In addition, this course will be advertised in General and Organic Chemistry lower division courses during the Spring guarters. Ideally, each week, two or three faculty members from different areas (Figure 9) will give approximately 10-minute introductions to their research programs. The rest of the time will be spent with informal discussions with these faculty members. These discussions would be held in a small group format in order to further decrease the barriers to student engagement. Students will also be required to draft potential emails to faculty that will be edited by the instructor, as well as to work on CV design. At the end of the guarter, there will be a panel with current Masters graduate students in the department, in order to provide another near-peer networking opportunity for students. Ideally, this course will be the beginning of a larger plan to implement an internship-type program, where we solicit applications via a web-based portal in the fall quarter and offer ~6 six-month research opportunities in different labs during the Winter and Spring quarters each year. This internship program would be modeled after similar systems at Dartmouth College, specifically the Women in Science (WiSP) program and the Undergraduate Research Application Portal (URAP) at UC Berkeley. IMPACT: The impact of this course is high for multiple groups in the department. The Phase I undergraduate students directly benefit by increased access to faculty members, decreasing barriers to initial contact. Masters graduate students benefit by meeting students who they may end up mentoring in their research labs. Faculty members benefit by gaining exposure to Phase I students, who can be recruited to their research labs early, leading to higher scientific productivity. This is of particular importance for faculty (e.g., in Biochemistry) who typically only teach upper division courses.

ASSESSMENT PLAN FOR EDUCATIONAL PLAN AIM #1: For the inaugural *Life Sciences Symposium* in October 2019, feedback forms were provided for all participants after each session, including students, faculty, and speakers. In addition, although registration was free for the event, it was suggested that participants register via a Typeform survey, which created a list of contact information for those who registered. This allowed me to follow up with the 80+ registrants after the event to solicit additional feedback. Although the symposium was very well received and all participants were supportive of future events, there was also very useful feedback from students, faculty, and speakers that can be incorporated. These types of surveys will be extremely useful in determining whether or not our stated objectives are being met following each event, and allow us to incorporate feedback into future events. The <u>expected outcomes</u> of the *Life Sciences Symposium* are: (1) to motivate WWU undergraduate students to pursue advanced degrees in biomedical research, (2) provide the opportunity for WWU students to meet, network, and get contact information for PhD students and postdocs in the area, and (3) allow PhD students and postdocs in the area to gain practice giving research talks to an outside institution.

FOR EDUCATIONAL PLAN AIM #2: The <u>expected outcomes</u> of this elective course are: (1) a higher number of Phase I majors will matriculate into research labs prior to Phase II admission into their chemistry major of choice, and (2) feedback surveys from all Phase II students will reveal that barriers to entry into UREs are perceived to be lower. Assessment is a critical component of this course. Because the students who take this course will all be declared Phase I majors in the Chemistry department, they will have assigned Chemistry academic advisors and will be known by our office staff. A contact list will therefore already exist while they are at WWU. In addition, we can cross-reference students in this course with enrollment in our independent research credits, CHEM 201/301/401. Current and past students will be asked to fill out online surveys each year, in order to gather continuous feedback and assess how this course facilitated their entry into UREs in the department. Any student who takes this course will also be added to a Canvas group that provides a platform for further discussion act to establish intradepartmental near-peer mentoring relationships, as emphasized in **Aim #1**. In order to assess whether or not stated project objectives are being met each year, all Phase II students will be surveyed about department climate and URE accessibility. This survey will occur in both the BS Chemistry-required Physical Chemistry and BS Biochemistry-required Biophysical Chemistry courses ensuring that all Phase II students all Phase II students all Phase II students all Phase II students will plan to disseminate implementation and outcomes of this course as a peer-reviewed manuscript in a Chemistry or STEM education journal, in order to broadly communicate a method for introducing lower division students to UREs.

COLLEAGUES WHO MAY PLAY A ROLE IN THIS EDUCATIONAL ENDEAVOR:

Professor Clint Spiegel (Chemistry department, Chair): (mentor, collaborator) Dr. Spiegel acts as Dr. Amacher's mentor in the Chemistry department. He was consulted during development and planning of the 2019 *Life Sciences Symposium* and is a supporter of the event. Dr. Spiegel has also published in STEM Education journals.

Dr. Elizabeth Raymond (Chemistry department): (mentor) Dr. Raymond is the longtime chair of the Curriculum committee in Chemistry and she will provide knowledge about how to design and register a new elective course. She is also a co-leader of the WWU Chem Club, which provides an important avenue for advertising this course.

Professor Spencer Anthony-Cahill (Chemistry department): (mentor, collaborator) As department chair (term ended June 2020), Dr. Anthony-Cahill secured funding and supported the inaugural *Life Sciences Symposium*. He is a supporter of this event and helped with its development, specifically by advocating for including industry expertise at the event, which was very well received by students. He will be consulted in planning for future events.

Professor Emily Borda (Chemistry department and Director of SMATE): (mentor, collaborator) Dr. Borda is a longtime faculty member of Chemistry and SMATE at WWU. She is an excellent resource for assistance in designing effective Assessment tools and publishing in STEM education journals. Furthermore, SMATE is very open about willingness to help faculty with assessment design.

Assistant Professor Erin Duffy (Chemistry department): (collaborator) Dr. Duffy is an expert in Chemistry education and, along with Dr. Borda, will be consulted for assistance in designing appropriate Assessment tools for both educational aims, as well as in publishing in STEM education journals.

Associate Professor Lina Dahlberg (Biology department): (collaborator) Dr. Dahlberg is an expert in educational practices and was involved in brainstorming discussions for the 2019 *Life Sciences Symposium*. She is interested in playing a larger role in future events.

Assistant Professor Suzanne Lee (Biology department): (collaborator) Dr. Lee has expressed interest in helping to plan future *Life Sciences Symposium* events and being on an established committee for the event.