Meeting Reviews

Community College Students in the Field: A review of a Community Conversation on Successful Programs and Strategies

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Introduction

To explore how field experiences can be designed to engage more community college students, the Undergraduate Field Experience Research Network (UFERN) held a "community conversation" (*Community Colleges in the Field: Successful Programs and Strategies*) on 15 October 2021. The hour-long virtual meeting featured a panel of instructors who are involved in creating opportunities for community college students to learn in field environments. The goal was to offer insights and foster a conversation about successful strategies, unique challenges, and concrete practices for participants to use in their classes, programs, or institutions. Forty-one people from field stations and marine laboratories, community colleges, and various public universities from within the United States participated in the community conversation.

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Motivations and Purpose

Undergraduate field experiences (UFEs), where student learning occurs in nature, can take a variety of forms, from field laboratories embedded within on-campus courses, day-long or multi-day field trips, weeks-long residential field courses to paid research internships (O'Connell et al. 2021). Undergraduate field experiences of a variety of formats are associated with a litany of positive outcomes and are perceived as critical pathways to career and graduate opportunities in the field-based sciences (Petcovic et al. 2014, Fleischner et al. 2017, Klemow et al. 2019). For example, field courses for undergraduates are associated with higher major retention rates (in this case Ecology and Evolutionary Biology), and the narrowing of achievement gaps for underrepresented minority (URM) students (Beltran et al. 2020). In addition, students participating in field courses tend to graduate with higher GPAs and show gains in their sense of scientific self-efficacy (Beltran et al. 2020). Patrick (2010) found that field trip experiences strengthened students' understanding of process of science and positively influenced students' attitude toward biology. A field-based research experience was shown to also increase student self-efficacy and feeling of belonging in their discipline, in this case the geosciences (Kortz et al. 2020). However, UFEs are not equally accessible to all interested students and can be laden with unique barriers to entry, particularly for URM students and students from low socioeconomic backgrounds (Morales et al. 2020, Zavaleta et al. 2020, Flowers et al. 2021, O'Connell et al. 2021). For community college students, these challenges are magnified and accompanied by institutional-specific barriers (Hewlett, 2018).

Community college students make up a large portion of the undergraduate student population in the United States. In the 2019–2020 academic year, an estimated 7.7 million students (around 35% of U.S. undergraduates) attended community colleges (US DOE 2020*a*). Almost half of all students graduating with a STEM degree in 2020 had attended community college at some point; however, degree completion and transfer rates for community college students remain low, especially in STEM fields (Zhang 2021). Students starting in community college switch out of STEM majors at higher rates than students who start at 4-year universities (NASEM 2016). Of students entering community college in a STEM program over a 7-year study period, 69% left, either by switching to non-STEM programs or leaving college altogether in comparison with 48% for 4-year college students (Chen 2013). Further, the probability of attaining a bachelor's degree in a STEM field was more than four times higher for students starting at a 4-year institution compared with students starting at 2-year institutions (Wang 2015).

The student populations of 2-year institutions are typically far more diverse than their 4-year counterparts. United States community colleges serve higher percentages of URM students (US DOE 2020*b*), students over the age of 24 (US DOE 2020*c*), low-income students (US DOE 2016), students working more than 30 hours per week (US DOE 2016), first-generation college students (US DOE 2016), and students who are parents (Noll et al. 2017, Reed et al. 2021). Given the broad and well-established benefits for students who participate in field experiences, and an urgent need to increase the inclusion and retention of a diverse student population in the natural sciences, it is valuable to target interventions, such as field research programs and field-based courses, at the community college level.

A student-run research internship for community college students

Amanda Robin is a PhD candidate at the University of California, Los Angeles (UCLA), and the director of the Community College Field Biology Alliance (CCFBA). The CCFBA is an all student-run organization established in 2018 that provides community college students with the opportunity to design and enact research projects with ecological and animal behavior components. Cohorts of interns from 15 community colleges in the greater Los Angeles area are assigned a graduate and an undergraduate student mentor. Over 9 months, the teams move through the entire scientific process from exploring the literature, developing a hypothesis, experimental design, data collection and analysis, and the presentation of a research poster. Additionally, interns attend monthly workshops aimed at providing practical skills.

Community college students are recruited to apply for the program through advertisements at their home campuses. Over the past 4 years, the CCFBA has developed a contact list of community college deans, department chairs, faculty, academic counselors, and STEM program administrators. On a yearly basis, recruitment materials are sent via email to this list. In addition, the program has also developed more formalized working relationships with STEM programs at several 2-year institutions nearby to the UCLA campus. These institutions incorporate direct links to the program application on their undergraduate research websites and facilitate more extensive recruitment outreach. Occasionally, they facilitate information sessions and have provided supplemental funding to support their students' CCFBA programming. Each year the number of applications received has increased and the program currently averages about 60 per cycle, of which 10–15 students are accepted. The CCFBA does not have any course prerequisites or GPA requirements and prioritizes accepting interns to the program with no previous research experience. This is considered a program strength in that it provides access to research for a broad range of students. The CCFBA programming aims to provide a foundational experience upon which students can build, and purposefully seeks students who may not otherwise be ready for larger, more competitive research experiences.

The CCFBA attempts to increase program accessibility through the extended nature of the program's timeline. By requiring small monthly time commitments over 9 months, interns can maintain outside commitments while engaging with research. The program emphasizes exposure to the scientific process over the resulting research product, allowing interns to scale back the scope of their projects when needed. This emphasis provides the flexibility necessary to tailor the experience to the needs of individuals. Alongside research experiences, the CCFBA also provides transfer-student-focused programming, including Q&A panels with graduate students who are former community college students and one-on-one support with application preparation. Further, each intern's undergraduate mentor is a transfer student. Graduate student mentors attend a workshop prior to starting the program that provides an overview of the transfer process.

The CCFBA has found challenges in the areas of interpersonal support for interns, maintaining accessibility, ensuring mentor engagement, and sourcing funding. Holistically supporting interns and ensuring accessible programming is a key goal but poses challenges. Many interns have actively struggled with food and housing insecurities and/or faced personal or familial health crises while in the program. The

program found it challenging as a student organization separate from where the community college students live and attend college to aid with personal crises. In response, the CCFBA has attempted to balance program rigor with the flexibility required to make the program realistically completable for the highest number of interns. Students do not receive course credit because of the logistical challenges of arranging this with each student's college, as each cohort comes from multiple individual institutions. Additionally, the quality and quantity of engagement from mentors has been difficult to standardize. More time spent communicating leadership expectations and the unique needs of community college students to mentors has mitigated some of these challenges. Finally, it has been a struggle to obtain funding that would support the expansion of the program in key ways, such as the provision of stipends for interns. Currently, a majority of program funding is secured through grants from student associations at UCLA. The average cost per intern for a remote program is ~200 dollars (USD), and the cost per intern during in-person programming is ~600 USD. All programming is provided at no cost to the community college students. Prior to the COVID-19 pandemic, program meetings were held in person and included a trip to a field station managed by the University of California Natural Reserve System ~2 hours outside of Los Angeles to collect data. Two cohorts have now been completed remotely with fieldwork conducted in the interns' neighborhoods. Technologies like Zoom and communication applications like Slack have helped to facilitate an engaged online community. This program model has proven to be flexible and could likely be successful in any location, even in areas with distinct seasons, as it designed to have data collection focused in the summer months. Furthermore, there is potential to use open-source ecological data sets or data collected by remote sensors if the prospective program needs to be conducted during times when weather may be unsuitable for outdoor field research or students are unable or unwilling to conduct research outside. While working remotely has presented challenges in maintaining student engagement, assisting interns with data collection, and providing the appropriate equipment for them to safely do so, there have been benefits. Remote programming has highlighted the synergy between ecological field research and online internships for community college students by enabling a higher number of interns to participate, securing guest speakers that otherwise would not have been able to speak in person, and making our program open to those unable to travel (regardless of pandemic restrictions). Further, conducting fieldwork within their own communities illuminates for interns that ecological fieldwork is not something only reserved for "far off" places.

Course-based field experiences

Alison Varty is a faculty member and chair of the Environmental Science major at College of the Siskiyous, a publicly funded community college in a rural California mountain town. Like most community college students, those at College of the Siskiyous struggle to fit traditional field experiences (summer field classes or extracurricular activities) into their schedules due to their responsibilities outside of school. To address this challenge, Professor Varty integrated field experiences into several credit-based classes offered during the academic year. Further, she instituted a requirement for students in the Environmental Science major to complete a discipline-related science research or work-related project prior to graduation. Most students fulfill this requirement through for-credit field experiences. Their work has included internships at the local research station (Castle Lake Research Station), the Shasta-Trinity or Klamath National Forest, local native plant nurseries, private forestry companies, and at the local fish hatchery. These kinds of field experiences are popular because they often lead to long-term employment.

Professor Varty has reached an even broader audience by creating hybrid and fully online courses that include field experiences. Her hybrid field botany course engages students in the study

of plants through online asynchronous activities, including autonomous asynchronous field trips. During these trips, students take weekly excursions on their own to collect plants to practice keying using commercially available field guides and to perform floral or fruit dissections. In addition, students attend four all day face-to-face, synchronous group field trips. These trips complement the asynchronous work by helping students learn to identify plants they encounter in the field and providing them with hands-on experience collecting overstory and understory plant community data using quadrat and point-centered quarter sampling, respectively, that they later analyze and summarize on their own. Varty also teaches a fully online environmental science class, which involves many field-based laboratory activities. She has observed that field laboratories can actually be more equitable than traditional "cookbook" laboratories, because all students can get outside to a school or park or lawn, whereas not every student may have the required supplies (e.g., measuring spoons) in their home.

The Community College Undergraduate Research Initiative (CCURI)

James Hewlett is a Professor of Biology at Finger Lakes Community College (FLCC) in Canandaigua, New York. In 2001, FLCC conducted an internal study to better understand the barriers to developing Undergraduate Research Experiences (UREs) and potential strategies for establishing an undergraduate research program. The study uncovered several interesting and unanticipated hurdles to establishing an undergraduate research program at a community college that were unrelated to the oft-cited financial barriers or ill-prepared students. For example, the weak connection between community colleges, external networks, and science researchers was found to be a serious barrier. The results were compiled and used to create a model for integrating research experiences into a community college. After an initial rollout at FLCC, these principles were tested at six partner institutions with support from the National Science Foundation. The result was the establishment of the Community College Undergraduate Research Initiative (CCURI) in 2007. Community College Undergraduate Research Initiative is currently a national network of 142 community colleges in 39 states and two countries focused on the development and implementation of undergraduate research programs. The CCURI model, which was originally constructed to address barriers at FLCC, has been modified and expanded for implementation throughout the CCURI network.

In its current form, the CCURI model incorporates solutions to the known barriers to integrating research into the student experience at community colleges. The CCURI model involves three levels. The first, "Engage," aims to immerse students in research from the moment they enter the classroom as freshman and is designed to promote conceptual understanding while also exposing students to ongoing CCURI research projects. Student-centered activities are used to teach basic scientific concepts within the context of an ongoing research project. The second level of the program is called "Explore." After engaging students in research questions as part of the freshman courses, the CCURI model creates opportunities for students to explore those questions in greater depth. These opportunities allow the students to continue these projects as a part of embedded regular course offerings at the college (CUREs; Course Undergraduate Research Experiences), a degree program (PURE; Program Undergraduate Research Experience), or as part of a credit-bearing summer experience (SURE; Summer Undergraduate Research Experience). The third component of the CCURI model, "Connect," involves connecting community college faculty and students to larger research communities. The growing CCURI network has become a rich source of collaboration on both the curricular and research sides of the CCURI model. At this level, students are connected to research

opportunities and prospects to transfer their experience to a four-year institution as they continue to pursue their STEM career.

Community College Undergraduate Research Initiative has built a nationwide network of community colleges who are committed to offering undergraduate research experiences at their home institutions. Community College Undergraduate Research Initiative partner institutions can access a suite of course curricula and professional development opportunities focused on student research. Further, the CCURI team shares data from meta-analyses of CCURI institutions as a way to develop best practices that can be shared both inside and outside the network. The goal is to continue to broaden participation in undergraduate research at our nation's community colleges.

Recruiting undergraduate researchers at a community college

Jimmy Lee is an associate professor at East Los Angeles College, a large community college located near downtown Los Angeles that serves a primarily Hispanic and Asian student population. During a summer when he was not teaching, Prof. Lee participated in the Research Experience for Teachers (RET) program at the Rocky Mountain Biological Laboratory (RMBL). The RET program embeds teachers from community colleges within research teams to strengthen the scientific expertise of teachers and create lasting partnerships between educators and NSF-funded researchers. Following his RET experience, RMBL hired Lee to serve as its Education Program Coordinator. This is part of a RMBL initiative to recruit URM students by engaging with faculty from community colleges. RMBL has spent many years networking with community college instructors like Prof. Lee to build a pipeline that attempts to prioritize the recruitment of URM students for their summer research program. These connections result in roughly 15% of the 40 students in the undergraduate research program being composed of community college students each year.

Professor Lee has found that community college students are often unaware of the benefits associated with participating in large, funded research internship programs, such as those provided by the National Science Foundation's Research Experiences for Undergraduates (REU). He finds that sharing stories and testimonials is an effective strategy to engage community college students and expose them to the potential advantages of applying to these types of opportunities. In these conversations, he talks about his own experience as an RET program participant at RMBL. Lee's work highlights how RET and REU programs can work in tandem to achieve greater diversity in participation. In addition to sharing his own experiences, he also invites past REU students from RMBL to talk with prospective students about their research projects and overall experience. Seeing and hearing from peers who have successfully participated in these programs provides students with strategies that they can then incorporate into their own academic trajectories.

Questions and answers with the session participants

Community conversation participants' questions focused on (1) the concrete challenges of funding—who receives funding, and from what sources, and (2) anticipating and responding to students' needs in the field or at field stations.

Funding

1. Panelists agreed that for programs to be successful, they must be affordable for the students involved. Ideally, all programming should be free and potentially involve the direct payment to students whenever travel or long-time commitments are required.
2. Where student funding exists, it is critical to make payments on schedule and prior to the time students are incurring program costs. Students may have encountered costs specifically related to the program long before leaving. For example, a participant may need funds to cover their transportation to the field site or to assist with the costs of childcare while they are away. Therefore, it is an unrealistic and an unnecessary burden to expect students to "front" the expenses and be reimbursed at a later date.
3. Prof. Varty mentioned that she has assisted many of her students with REU program applications, but she has found that many pass them up for full-time summer work. She has also seen students struggle when they had to cover their travel costs, and when stipend payments were delayed.
4. Specific program funding sources:
   - The National Science Foundation played a financial role for two of the panelists. NSF provides a stipend to students participating in the RMBL REU program for which Prof. Lee recruited students. NSF funds played a pivotal role in supporting the CCURI program's creation and continued expansion.
   - The CCFBA has been able to access substantial funding from student associations at UCLA to support research and travel costs, but because it operates as a student organization, there are restrictions on how they can spend their resources. For example, they are explicitly not able to award stipends to participating interns or mentors.

Understanding and prioritizing student needs

These recommended practices for meeting student needs emerged from the collective experiences of panelists and attendees:

1. Make it easier for students to maintain family, community, and employment responsibilities during their participation in programs and by providing students with appropriate and timely funding when participating requires travel or extensive time commitments.
2. Have mentors be community college-informed, either through their own experience or an orientation. Faculty and staff who usually work with 4-year college students would especially benefit from an orientation to the academic culture of community colleges and the 2-year college transfer process.
3. Appreciate the high variation in age and lived experiences of community college student populations and how that will influence the knowledge students will bring with them to the program, as well as to be aware of the distinctive challenges these students may be facing such as increased familial responsibilities, food insecurity, and employment challenges.
4. Prioritize extensive program orientations. Thorough orientations would include detailed information on what to expect throughout their time in the field and detailed instructions for procedures such as toileting outdoors. Further, orientations should be candid and proactive in addressing safety concerns associated with the field and/or the local environment, including discussions around

how to safely navigate communities where people of minoritized status may be at an increased risk of discrimination or harassment.
5. When fieldwork involves travel, have a clothing and gear closet open to all students and make a knowledgeable and trusted individual available to provide instructions on how to use the gear.
6. Involve more than one community college student at a time in a program to avoid tokenism and/or isolation.
7. Make research relevant and accessible to students through topic and/or location whenever possible, prioritize flexibility, and encourage exploration. One panelist referred to this as the "hands-on and hearts-on" style of learning.
8. Explicitly address student concerns and needs by including community college students and faculty in the development of field experiences.

Synthesis

Field research and learning experiences are important teaching and developmental tools for retaining students in STEM fields. Providing these experiences for community college students presents some unique challenges. Presenters in the UFERN Community Conversation spotlighted examples of how their institution, organization, or classes addressed these challenges. A major challenge discussed was students' family, community, and job commitments, which make participation in long-duration traditional field and research programs difficult. College of Siskiyous responds to these obstacles by providing course credit for students' internships or field experiences that take place in the community where they live. The CCFBA attempts to address this issue by spreading the research and workshop commitment over 9 months, which keeps the time required for any one activity more manageable. The CCURI program offers students opportunities to engage with research in a variety of ways from classroom-based experiences, summer long trips, and full degree programs. Further, CCURI found that there was insufficient communication between community colleges and research institutions. They responded by creating a network for community college faculty and administrators interested in providing research experiences to their students and connecting them to larger academic research networks.

Another challenge participants noted was that "research" as a concept can at times feel alien and intimidating to students, or that students may not think participating in research is possible for them. Prof. Lee encouraged community college faculty to discuss the benefits and accessibility of formal programs like REUs with their students, and provide information, encouragement, and support to students who might not otherwise consider these experiences. Where possible, faculty are encouraged to share their own or past students' first-hand accounts of research program participation to normalize the experience. Further, offering local opportunities for students to engage in research that is connected to the student's community or location can help increase accessibility of field-based learning and highlight the potential relevance of conducting fieldwork for students. Lastly, funding is a critical challenge for programming success. Community college students overall do not typically have the same financial resources as students at 4-year colleges. Any program that hopes to have community college student participants should take the financial needs of students into serious consideration when designing programming and establishing expected time commitments and when travel is required be prepared to offer funding at, or above, the level provided to students from 4-year colleges before the program begins.

Looking toward the future, research institutions and field stations should consider creating authentic partnerships and connections with community college campuses. Community college faculty and administrators can award credit for field-based internship or work experiences, and/or they can connect with national networks like CCURI to introduce research experiences to their own campuses. Faculty are encouraged to experiment with course formats to include fieldwork in students' own neighborhoods, group field trips, and even overnight excursions. Research groups at 4-year institutions like the CCFBA, as well as field stations, can work to provide students with flexible and accessible longer, mentored research experiences. Programming that is specifically designed to be thoughtful about the unique barriers community college students face will benefit the field as whole by fostering the early careers of this currently underrepresented student population in our broader community of scholars.

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