



PURM

Perspectives on Undergraduate
Research & Mentoring

Enhancing Undergraduate Research Experiences through Community and Science Communication

London N. Dixon, B.A., University of Maryland (Indixon@umd.edu)

Sabrina C. Adaba, M.A., CUNY Graduate Center

Sarah E. White, B.A., Ohio State University

Kathryn Campbell-Kibler, Ph.D., Ohio State University

Nikole D. Patson, Ph.D., Ohio State University

Laura Wagner, Ph.D., Ohio State University

Introduction

The National Science Foundation's Research Experience for Undergraduates (REU) Site programs are dedicated not only to promoting and training the next generation of scientists, but also to broadening that pool through innovative ways of inspiring and teaching STEM students. In this paper, we discuss the NSF REU Site located at The Ohio State University, called "The Science of Language and the Language of Science". This site exemplifies the kind of high-risk/high-reward opportunities that the REU programs allow. Further, as the science topic area of the site was language, the impacts reported here contribute to our understanding of student experiences conducting research in the social sciences (Haegar et al., 2020; Ruth et al., 2025). Based in a lab on the floor of an award-winning science museum, the program invited students primarily from community colleges and small institutions to spend a summer learning research and public engagement skills in a context of cooperative community. While the program included traditional classroom training, students spent the majority of their time at the lab interacting with museum visitors, recruiting them as research participants, and engaging with them in educational activities about language science. Students worked collaboratively on their research studies, sharing the equipment in the lab. At the final capstone event, each student presented a conference-style poster about their summer research project and debuted a new public engagement activity that they created themselves.

This site has been funded three times, beginning in 2015, and has trained 9 cohorts of students. Three of these students are co-authors on this paper (Dixon, Adaba, and White) and we feature their experiences with the program and its impact on them in their careers. Moreover, we augment their perspectives with insights from a structured interview study (Patson & Wagner, 2024) conducted with additional former participants. The remaining three co-authors (Campbell-Kibler, Patson, and Wagner) each served as a PI and as a Co-PI on the supporting NSF grants, as well as serving as research mentors to multiple students in the program. Overall, this site demonstrates how a distinctive high-impact learning experience benefits students from a diverse range of backgrounds and broadens the pool of individuals entering STEM (see also Weidman et al., 2024). Further, it demonstrates how crucial reliable sources of funding are to ensuring broad participation in the sciences (Pierszalowski, et al., 2021).

The Program: The Science of Language and the Language of Science

Our REU Site was structured around language science, an interdisciplinary field that includes researchers from multiple academic departments, including linguistics, psychology, English, education, speech & hearing sciences, and computer science. The Language Sciences Research Lab is a fishbowl-style lab located within the Center of Science and Industry (COSI) (Wagner et al., 2015). The “Pod”, as it is informally known, is run on a collaborative model, with faculty from all participating departments contributing to and benefiting from its resources. Each faculty member manages their own research program. Those with the interest, time, and necessary mentoring skills were invited to include an REU student on a project for the summer. All of the research projects studied human language in some way, but given the range of researchers involved, the specific questions and the methods varied quite a bit. For example, one project examined how quickly and accurately participants processed words spoken in different regional accents. Another tracked participants’ eye movements while they followed directions in speech that stressed different words. A third investigated children’s ability to find iconic elements within sign languages. Each project was part of the larger research programs of the faculty mentors, and all have yielded multiple peer-reviewed articles and conference presentations (of which over 20 included program students as co-authors).

Located within a science museum, the Pod is not only a busy working research lab, but also a center of public engagement. Research activities prioritize informal science goals as well as research goals, and debriefings on experimental goals are designed to also serve as public engagement tools for participants. In addition, lab personnel also conduct non-research interactive demonstrations on the museum floor that engage families and teach them about language science. Many of these activities leverage museum visitors’ own language practices and intuitions to prompt discovery moments, which can then be explored and expanded through discussion. The activities cover a wide range of language topics, including using models of the ear and larynx to share how the human body produces and perceives speech sounds, the classic “gavagai” question of how we learn words in an unfamiliar language, an introduction to the ancient Egyptian hieroglyph writing system, and opportunities to learn a few words in Korean, Spanish, or American Sign Language. Activities are developed by faculty and students with materials accompanied by written guidelines to encourage Pod personnel to use best practices in informal science learning (e.g., Fenichel & Schweingruber, 2010). During the year, the engagement activities are primarily run by undergraduate and graduate students in a dedicated informal science course, for which much of the material was adapted for the classroom teaching of the REU site.

REU students had to share the resources of the lab and were often moving fluidly between their research and public engagement obligations. All of the materials and equipment for the research and public engagement functions of the Pod are housed in a single room, and the Pod’s “territory” for engagement and recruitment is confined to a single exhibit and the hallway area immediately in front of it. This arrangement led to benefits in terms of community building.

Adaba notes:

The workplace taught us how to teach and work collaboratively. From tag-teaming with different fellows on informal learning exercises, to communication amongst ourselves to ensure coverage on the museum floor, almost every aspect of the program fostered a sense of community. We were dependent upon one another, teacher and students, to ensure all aspects of the program worked for everyone.

The classroom provided critical training in research methods and informal science communication and also featured a variety of professional development training to promote student success in

school and their careers. Philosophically, all of these components were connected through an intentional layering of wrap-around mentoring which provided the students with multiple contacts to faculty members, graduate students, undergraduate students and local community professionals, with the goal of creating a rich scholarly community for the program's students.

White identified one element of the professional development training that was particularly meaningful for fostering community:

Another important source of community came from weekly lunch talks with guest speakers, professors from various departments who shared their academic journeys. Hearing their stories reinforced the idea that there is no single “correct” path to success. Many of these speakers shared my identities as women and people of color, and seeing reflections of myself in their narratives strengthened my sense of belonging. These conversations offered both practical guidance and a glimpse into possible futures, helping me envision a place for myself in academia and research.

A Diverse Cohort Structure

The site focused on recruiting students underrepresented in STEM, particularly students of color and first-generation college scholars. Additionally, we focused recruitment on students from schools with limited research infrastructure and on students who had little (and often no) experience conducting research. Our goal was to provide a high-quality mentored research experience to students who would not otherwise have access (Pierzalowski, et al., 2021). Of the 103 students who participated in this site (including 82 students fully funded by NSF, as well as others funded by their home institutions or related programs such as Summer Research Opportunity Programs (SROP)), 80% were women, 75% identified as non-White (including 49% who identified as African American/Black and 8% who identified as Latino/a), and approximately 40% were first-generation students. However, numbers do not tell the whole story, as the individual experiences of our student authors show.

Adaba participated in the second cohort of the program. She writes that:

In May of 2016, I was a 32-year-old single mother to a teenager. I had just completed my first semester of senior college after returning to school in 2013 after a decade-long hiatus. I was determined to have the college experience I had missed, so I participated in everything that might approximate the experience of going away to college and being integrated into a college community. I joined clubs, became a peer mentor, was a research assistant, and eventually studied abroad. When I came across the REU experience, I felt it might appease the dorm-life aspect of the college experience with the added benefit of an immersive research experience.

Dixon participated in the fourth cohort:

I found the REU at the Ohio State University through complete kismet: seeing a flyer on an announcement board at my community college. I had entered college knowing that I wanted to major in linguistics and was playing with the idea of eventually applying for graduate school. Due to financial issues, I had enrolled in a community college. While community colleges provide affordable and accessible education, they often lack research opportunities for undergraduates. This was the case at my institution, so knowing that graduate schools valued research experience, I applied to the REU and found myself introduced not only to human-subjects research but also informal science communication.

White participated in the program's eighth cohort:

I began college as a nursing major before discovering speech and hearing science, a field that allowed me to combine my love for languages and communication with the life sciences of anatomy and physiology. Changing majors late in my undergraduate career came with excitement, fear, and a loss of community. This experience was further shaped by my identity as a Black woman in a field where Black and African American individuals remain significantly underrepresented. When I learned about this program as a way to explore language science and research, I approached it with curiosity and motivation, alongside uncertainty about my place in the field. Even so, I took a leap of faith and applied.

Community through Diversity

While the overall structure of the program was intentionally designed to foster community, one of the strongest elements of community that was built arose among the students themselves. The faculty organizers were astonished to see the energy each successive cohort put into community-building with little prompting. As our student authors note, the diversity of the students' backgrounds was an important part of their community experience.

White states:

My cohort included students from a wide range of academic years and majors, fostering an environment where curiosity was encouraged and all questions were welcomed. Beyond our academic diversity, our differing lived experiences, as people of color, first-generation students, women, and individuals on the autism spectrum, created a space rich in intersectional brainstorming and collaboration. Our cohort demonstrated that the underrepresentation of ethnically and linguistically diverse individuals in language science is not due to a lack of interest, but rather a lack of accessibility. This REU allowed us to experience a research environment without paywalls or exclusivity and underscored the importance of programs like this in reducing barriers to entry in linguistics and speech and hearing sciences. This community instilled in me a commitment to give back and support others who may feel as isolated as I once did.

Dixon adds:

My 2018 cohort pulled from a diverse background of students. I found myself in an environment where I was able to learn about the ins and outs of language science research and science communication with support not only from the faculty but also my cohort. For the first time, I encountered other Black women who were interested in language science. It was encouraging to be in an environment where talking about language science was met with eagerness rather than confusion. Through classroom sessions, shifts at the Center of Science and Industry, and off-the-clock excursions, my cohort built a rapport that still remains.

Adaba further explains:

I was nervous that my non-traditional student status might inhibit my ability to connect with fellow participants, however the structure of the program presented several opportunities for connection. In the classroom, we were able to discuss amongst ourselves and with various subject matter experts (who also acted as advisors/mentors) the benefits of continuing our education, motivations for pursuing doctoral studies, and the ways our interests might manifest career paths. Our interdependence within our learning and work environments also

fostered a reliance on one another for fun and recreation. The mix of local and out-of-area students facilitated a vibe where local students recommended cool events (like the Pride Parade and July 4th celebration), locales (Museum of Art and Columbus Zoo & Waterpark), bars, clubs, and restaurants to the out-of-towners. A bonus was, my son got to share part of my experience when he visited, and it's one of his favorite adventures.

Communication for Public Engagement

Given the Pod's public engagement mission, this REU differed from many others in its substantial outreach component. Classroom training incorporated best practices for informal science learning, including how to generate interest and promote excitement about science, how to avoid jargon and technical terms, how to engage people with questions, and how to scaffold activities for individuals of different ages (cf., Wagner et al., 2021). Most importantly, students spent 8 hours/week on the museum floor practicing these lessons with the museum visitors. Communicating with the public about complex scientific concepts is a skill that benefits greatly from practice, so sustained time on the floor was the most valuable training tool of the program. Students were encouraged to work with each other on the floor. They were allowed to select the activities they presented, often selecting paired activities that provided a natural segue to their partner's demonstration, such as one presenting the ear model and their partner presenting the larynx model. Students typically selected activities at the beginning that matched their own language science interests, and then after some practice, were encouraged to step outside their comfort zones with a less familiar activity. Faculty members experienced in outreach would observe on the museum floor and offer feedback after the conclusion of demos, while class time was also set aside for debriefing and troubleshooting issues that arose. The engagement component culminated with students creating their own engagement activity, including writing up guidelines, with a particular emphasis on the "pyramid" style of deepening layers of information to adjust the discussion to suit different levels of audience interest. Many student-developed activities have since been integrated in the Pod's regular rotation for ongoing use.

The public engagement aspect of this program is a distinctive one and as such, we have investigated it formally through a structured interview study with two dozen former program participants (Patson & Wagner, 2024). In that study, we found that while a majority (nearly 60%) of students initially approached the idea of talking with the public with a fair amount of anxiety, ultimately, they came to appreciate its benefits and, in most cases, found it fun to do. Half (50%) of the students felt that doing public engagement helped them better understand their career options and two-thirds (67%) felt they had developed transferable skills, especially related to public speaking. A strong majority of students (83%) liked getting the visitors excited about language science with many students (45%) expressing enthusiasm and joy in the activities. Additionally, one-third (33%) of the students felt that the activities helped them clarify science concepts and many (42%) linked the activities positively to their own identities as scientists. These findings were consistent with previous literature showing positive impacts of public engagement training on graduate students (DeKoven & Trumbull, 2002; Laursen et al., 2007; Page et al., 2011; Stamp & O'Brien, 2005). Likewise, Petry et al (2025) reported an increase in participants' awareness and skills in an REU program centering the potential of STEM impact on social change.

Elaborating on this point, Dixon notes:

One key feature of the REU that caused me the most initial anxiety and ultimate enjoyment was the hands-on public engagement at the Center of Science and Industry (COSI). Prior to the REU, I had had some exposure to public engagement through various customer-facing jobs, but I was nervous about communicating language science to the public. I was worried that I didn't know enough and wouldn't be able to answer questions that museum-goers had.

With each shift, I grew more comfortable interacting with families and children from summer camps. Watching parents and children discover the automaticity of reading through the Stroop Effect became the highlight of my days. By the end of the summer, I knew that science communication was something that I wanted to continue.

White reflects:

The REU shaped how I think about communication, particularly accessibility. As a current master's student in speech-language pathology, I am trained to consider my communication partners carefully, whether explaining a diagnosis to a family or providing therapy to a client. I first developed these skills during the REU by leading informal science education demonstrations that required me to explain complex linguistic phenomena to audiences of all ages. Balancing maintaining scientific accuracy with participant engagement demanded intentional language choices and perspective-taking.

As an informal science educator, you have the power not only to teach others, but to show them how to take agency and think like scientists. One moment that has stayed with me occurred while I was using a model of the ear to explain how sound travels from the air to the brain to a young child. After the demonstration, her father approached me and shared that she would soon need tubes placed due to persistent ear infections. He asked where the eardrum was located. Before I could answer, the child confidently pointed to the eardrum and explained that this was exactly where her tubes would be placed. In that moment, I saw how accessible communication had given her the tools to understand her own care. It affirmed for me that communication is not only about sharing information, but about empowering others to ask questions, build understanding, and claim knowledge for themselves.

Post-Program Success

Through periodic follow-up contacts with our former students, we know they go on to success. Of the 77 students who had completed college as of 2025, a majority (65%) went on to pursue or have earned an advanced degree (MA/PhD). The most popular area of study among our former students is speech language pathology, although several have gone on in the fields of education and linguistics as well. Dixon, Adaba, and White are representative of the post-program successes our students enjoy. Here they reflect on how they have continued to draw on what they learned in the REU.

Dixon is pursuing a PhD:

In 2021, I started my PhD in linguistics at the University of Maryland and joined the Language Science Center, an interdisciplinary community of language scientists across the university. I volunteered with the Language Science Center's outreach team and joined the Language Science Station at Planet Word. The Language Science Station is a project that, through a multi-university partnership, trains students who are underrepresented in the language science community and introduces language science to the public through demonstrations and research. My time at the REU has been especially influential in my work at the Language Science Station because it is the spiritual successor to the REU's work at the Center of Science and Industry. As a part of the Language Science Station, I've been able to not only mentor other students from various universities but also continue to introduce language science to the public. I have continued to use my training from the REU not only at the Language Science Center but also day-to-day as a teaching assistant, breaking down complex linguistics topics into bite-sized pieces for undergraduates. The REU

has been instrumental in helping me develop into a well-rounded researcher and science communicator.

White is currently pursuing an MA degree:

Since the REU program, I have pursued research through a post-baccalaureate research fellowship at the University of Chicago and now as I complete my masters in speech language pathology, I am also a graduate research associate in the Spanish and Portuguese department at The Ohio State University. The REU is the reason I believed I could reach for research, supported by a community that never stopped telling me that I could.

Adaba is employed:

The most important aspect of this experience, however, is how I have used what I learned to hone my career path. I studied linguistics with the goal of becoming a teacher, however, I was apprehensive about being in the classroom. This program taught me the concept of informal (science) education and made me realize that was the direction I wished to follow. In my current role as an administrative coordinator and research assistant at an academic laboratory, part of my role facilitates learner-led discussions about neuroscience for middle and high school visitors. I have no doubt that my confidence and ability to do this work (without being a subject matter expert) is a result of my experiences facilitating learner-led discussions at COSI. Additionally, my role as a research assistant (and previous role as a graduate student) is reminiscent of working with my REU advisor/mentor. That aspect of the program taught me the many features of the human subjects research process and has continued to benefit me greatly. Contributing to this volume has illuminated how integral my REU experience has been, and I don't think I truly appreciated that until now. I am forever grateful, and hope students like me will continue to have these life-changing opportunities.

Conclusion

Nurturing the next generation of talented scientists depends on combining intellectual inspiration and training with supportive relationships, not only with mentors but with each other. We found that the path to a community that provided these values started with the practical and logistical structure granted from the NSF program as a whole. From those resources, our REU site was able to build on the practical foundation, recruiting mentors, providing training, and connecting students to faculty and each other. On those faculty-provided layers, the students built a true community, within and across their cohorts, in which they could learn from each other. The new and sometimes scary things we asked them to try were made accessible in a context where it was OK for them to show up with their whole selves. We intentionally built diverse cohorts, and our students appreciated being valued as individuals. Our approach was consistent with nurturing the kinds of experiences that the students in Zou et al. (2022) found to be most valuable in their research experiences, particularly in developing transferrable skills and in highlighting the meaning of the research in the world outside the academy.

At the heart of our program was an unfortunately rare experience: being a working scientist inside of a science museum. In this setting, students were able to learn the typical research skills that one would expect from conducting studies while also developing vital science communication skills. More than that, the public engagement component fostered community by creating a joint challenge for students to work on together. The continual public engagement also offered ongoing feedback in the form of visitor reactions. This feedback guided students' developing engagement skills but also demonstrated directly the value of connecting science to the everyday interests and concerns of others and one's own.

Funding from the NSF was critical for this program, most crucially the student stipend. Most of our students could simply not afford an unpaid summer internship, no matter how worthy the educational experience. Offering a stipend meant we could recruit any student without concern for financial status. Funding was also key for creating the special environment that we did. It provided practical support for researchers and the projects on which the students worked; it provided support for undergraduates at The Ohio State University, often former REU students, who provided the peer mentoring; it provided an experienced and caring graduate research assistant to manage the program and connect with the students on a more accessible level than faculty can; and it provided the supplies needed to allow for public engagement. We were also able to take advantage of special events, such as field trips to local conferences and bringing in guest speakers. Additionally, we were able to create a supportive atmosphere for our students through lunch visitors and our capstone event, to which we encouraged students to invite family members. Our students did not begin as committed members of a language science STEM community. The NSF funding provided them with the time to join ours and provided us with the resources to make it work.

Acknowledgements

We thank the Columbus Center of Science and Industry (COSI) for being outstanding hosts of this program. We also thank all the research mentors, lunch guests, and other individuals who provided community for the program. Very special thanks go to Josie Miranda at the National Science Foundation for her leadership of REU Site programs in general. This program was funded by NSF REU Site grants SMA-2146474, SMA-1757020, and SMA-1461039.

References

- DeKoven, A., & Trumbull, D. J. (2002). Science graduate students doing science outreach: Participation effects and perceived barriers to participation. *Electronic Journal of Science Education*, 7(1).
- Fenichel, M., & Schweingruber, H. A. (2010). *Surrounded by science: Learning science in informal environments*. National Academies Press.
- Haeger, H., Banks, J. E., Smith, C. A., & Armstrong-Land, M. (2020). What we know and what we need to know about undergraduate research. *Scholarship and Practice of Undergraduate Research*, 3(4), 62–69. <https://www.cur.org/wp-content/uploads/2023/08/Sum20SPUR-Haeger.pdf>
- Laursen, S., Liston, C., Thiry, H., & Graf, J. (2007). What good is a scientist in the classroom? Participant outcomes and program design features for a short-duration science outreach intervention in K–12 classrooms. *CBE—Life Sciences Education*, 6(1), 49–64. <https://doi.org/10.1187/cbe.06-05-0165>
- Page, M., Wilhelm, M. S., & Regens, N. (2011). Preparing graduate students for teaching: Expected and unexpected outcomes from participation in a GK–12 classroom fellowship. *Journal of College Science Teaching*, 40(1), 32–37.
- Patson, N. D., & Wagner, L. (2024). Building a more engaged scientist from the bottom up: The impact of public engagement training on undergraduate students. *PLOS ONE*, 19(4), e0302671. <https://doi.org/10.1371/journal.pone.0302671>
- Petry, L., Crosson, K., Pinnell, M., Karlin, M., Kandiah, R., Nedunuri, K., & Generas, E. (2025, June). [Work in progress] Lessons learned from a collaborative NSF REU program thematically centered on STEM research for social change and its impact through community engaged learning. *ASEE Annual Conference & Exposition*.
- Pierszalowski, S., Bouwma-Gearhart, J., & Marlow, L. (2021). A systematic review of barriers to accessing undergraduate research for STEM students: Problematising under-researched factors for students of color. *Social Sciences*, 10(9), 328. <https://doi.org/10.3390/socsci10090328>
- Ruth, A., Brewis, A., Beresford, M., & Stojanowski, C. M. (2025). Research supervisors and undergraduate students' perceived gains from undergraduate research experiences in the social sciences. *International Journal of Inclusive Education*, 29(10), 1669–1686. <https://doi.org/10.1080/13603116.2023.2288642>
- Stamp, N., & O'Brien, T. (2005). GK–12 partnership: A model to advance change in science education. *BioScience*, 55(1), 70–77.
- Wagner, L., Moore, L. C., & Campbell-Kibler, K. (2021). Training students to conduct outreach in an informal science learning environment (Chapter 10). In D. Farland-Smith (Ed.), *Enhancing learning opportunities through student, scientist, and teacher partnerships* (pp. 179–197). IGI Global.
- Wagner, L., Speer, S. R., Moore, L. C., McCullough, E. A., Ito, K., Clopper, C. G., & Campbell-Kibler, K. (2015). Linguistics in a science museum: Integrating research, teaching, and outreach in a language sciences research lab. *Language and Linguistics Compass*, 9, 420–431.

Weidman, A., Parham, A., Fisher, M. H., & Wilhelm, J. (2024). Measuring student success and outcomes in undergraduate research programs. *Scholarship and Practice of Undergraduate Research*, 8(1), 33–42. <https://doi.org/10.18833/spur/8/1/6>

Zou, T. X. P., Susanto, J., Wahab, A. A., Hong, N., Chiu, C. S. T., & Leung, L. Y. Y. (2022). What made undergraduate research experiences significant: A collaborative critical incident analysis with student co-researchers. *Higher Education Research & Development*, 42(8), 1808–1823. <https://doi.org/10.1080/07294360.2022.2157799>