RESEARCH

Disease and the Environment:

A Health Disparities CURE Incorporating Civic Engagement Education

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Introduction

Course-based undergraduate research experiences (CUREs) offer a novel avenue for engaging students in the scientific process (Bangera and Brownell, 2014). In contrast to traditional laboratories, CUREs are designed to foster autonomy through student-driven hypothesis generation, experimentation, data analysis, and dissemination of findings (Auchincloss et al., 2014; Spell, Guinan, Miller, and Beck, 2014). Current evidence suggests that participation in CUREs in the biological sciences leads to significant increases in students' development of scientific process skills, ability to "think like a scientist," and affective dispositions in the domain (Brownell, Kloser, Fukami, and Shavelson, 2012; Brownell et al., 2015; Jordan et al., 2014; Olimpo, Fisher, and DeChenne-Peters, 2016). Despite the importance of these documented benefits, few studies (e.g., Ballen, Thompson, Blum, Newstrom, and Cotner, 2018) have examined the mechanisms for establishing connections between students' research and the larger community—what, in the CURE literature, is referred to as broader relevance—as well as the impact of those connections on cognitive and non-cognitive student outcomes. Review of published CUREs, including those cited in the CUREnet database (https://serc.carleton.edu/curenet/index.html), further suggest that this is especially true when considering civic engagement as a form of experiential learning and capacity building with the local community.

In this article, we describe the development and evaluation of the BIOL 1108: Health Disparities in the Border Region II CURE, which represents our efforts to address the aforementioned concerns through purposeful integration of civic engagement education into the CURE curriculum. A health disparities course theme was identified given the widespread health inequalities along the U.S.-Mexico border that have posed a challenge to the U.S. healthcare system (Bastida, Brown, and Pagán, 2008; Rosales, Carvajal, and de Zapien, 2016). In this context, civic engagement "encompasses actions wherein individuals participate in activities of personal and public concern that are both individually life-enriching and socially beneficial to the community" (AAC&U Civic Engagement VALUE Rubric, 2018). While the incorporation of civic engagement instruction into science, technology, engineering, and mathematics (STEM) pedagogy is not unique to our work, the research presented here is novel in several ways. First, the limited number of studies focusing on civic engagement within course-based research experiences have largely been conducted in inquiry- or discovery-oriented contexts (rather than in environments adopting a CURE model) (e.g., Ahmed et al., 2017; NASEM, 2015); conversely, the CURE may be structured such that it has public health implications, but students are not directly engaged with the public (e.g., Smyth, 2017). Secondly, our efforts and findings are responsive to recent work in the field (Ballen et al., 2018); we contend that this work provides a significant first step in examining broader relevance but that, due to methodological constraints, it misconstrues the level of importance of broader relevance in CUREs as being "insignificant," particularly for non-major (i.e., non-biology) populations. Finally, we present robust assessment of student outcomes following engagement in the BIOL 1108 CURE in a manner that serves to highlight the strength of civic engagement as an alternative mechanism for achieving broader relevance beyond commonly employed approaches within CUREs, such as student co-authored publications or presentations (e.g., Kloser, Brownell, Chiariello, and Fukami, 2011; Laungani et al., 2018).

Specifically, a quasi-experimental, mixed methods design was used to examine the following research questions:

1. What impact does engagement in the BIOL 1108 CURE have on students' development of public health outreach skills?
2. To what extent does participation in the BIOL 1108 CURE influence students' sense of project ownership, science identity and networking skills development, and researcher self-efficacy?
3. What perceptions do students hold of the BIOL 1108 CURE experience, particularly as it relates to their understanding of the relationship between science and society?

We hypothesized that student involvement in the BIOL 1108 CURE would lead to a significant increase in their public health outreach skills development and perceptions regarding the connections between science and the public, given the explicit focus on civic engagement within the context of the CURE. This assertion is supported by prior evidence in the field, which suggests that students highly value opportunities to engage with their community and report feeling equipped to do so following formal civic engagement instruction (Ahmed et al., 2017; Donovan and Schmitt, 2014). Furthermore, in concordance with empirical studies on the efficacy and benefits of CUREs in the biological sciences (e.g., Brownell et al., 2012; Fisher, Olimpo, McCabe, and Pevey, 2018; Mader et al., 2017; Olimpo et al., 2016), we anticipated that participation in the BIOL 1108 CURE would result in enhancement of students' science identity and researcher development.

Course Description: Health Disparities in the Border Region II (BIOL 1108)

Health Disparities in the Border Region II (BIOL 1108) is the second course in a year-long, research-driven sequence within the Department of Biological Sciences at the University of Texas at El Paso (UTEP). Eighteen two-semester CURE series exist within the department and university as part of the Freshman Year Research-Intensive Sequence (FYRIS; https://fyris.utep.edu), an NIH-funded program modeled after the University of Texas at Austin's Freshman Research Initiative (https://cns.utexas.edu/fri). Each course sequence possesses a distinct topical focus aligned with the lead faculty's area of scholarship and enrolls a maximum of twenty-four students per section per term, with the intent of retaining the same cohort of students throughout the duration

of the experience. Building upon the structure of Health Disparities in the Border Region I (BIOL 1107), which emphasized development of technical skills and experimental design (see Appendix 1 for the course syllabus), BIOL 1108 was developed to meet six core course objectives, as described in Table 1. During the 15-week term, class sessions occurred twice weekly for an average of 120 minutes each session. Students predominantly spent class time continuing to iteratively and collaboratively engage in the research projects that they had initiated in BIOL 1107, receiving feedback from their peers and the course instructors (J.T.O. and J.A.) about their progress, and outlining and implementing their civic engagement initiative as deemed feasible. This latter component of the BIOL 1108 course is unique in comparison to all other CUREs at the institution and was purposefully designed to connect students and their research with the communities in which that research occurred and which that research, at least in part, was intended to benefit (see Table 2 for alignment of student research interests and their corresponding civic engagement component).

In order to increase the fidelity of implementation of student outreach initiatives, research teams first constructed a community engagement plan during week #11 of the course (see Appendix 2 for the BIOL 1108 course syllabus). Specifically, this plan required that each group: (a) identify the individuals within the community with whom they intended to interact during the initiative; (b)

TABLE 1: BIOL 1108 Course Objectives, Associated Activities, and Assessment.

Course Objectives	Course Activities*	Assessment
1. Students will utilize scientific process skills to make informed decisions throughout all aspects of the experimental process.	Weekly PI meetings with course team; engagement in authentic research projects (Table 2)	Formative monitoring of students' weekly research progress
2. Students will apply principles of scientific inquiry to conduct a descriptive and/or analytical study of their choosing within the fields of health disparities, environmental health, molecular epidemiology, and public health bioinformatics.	Iterative planning and implementation of authentic research projects (Table 2)	Formative monitoring of students' weekly research progress
3. Students will demonstrate an increased understanding of qualitative and quantitative research methods, as evidenced in written and oral deliverables.	Weekly entries in laboratory notebook; research roundtable presentations; data analysis workshop; end-of-semester outreach presentations	Summative evaluation of individual students' laboratory notebooks; summative evaluation of outreach presentations
4. Students will make meaningful empirical connections between diseases and the environment.	Engagement in authentic research projects (Table 2)	Formative monitoring of students' weekly research progress
5. Students will describe, succinctly, the results of their research to both lay and scientific audiences.	Biweekly research updates; professional development workshops (Appendix 2)	Formative feedback provided on biweekly research updates
6. Students will describe the impact of their research to communities of practice outside of the classroom.	Development and implementation of civic engagement initiatives (Table 2)	Summative evaluation of end-of-semester outreach presentations

* Please contact J. Olimpo (jtolimpo@utep.edu) if you are interested in obtaining course activities and/or assessments.

TABLE 2: Alignment of Student Research Projects and Civic Engagement Initiatives.

Research Project	Research Approaches	Civic Engagement
Agricultural Impacts of *Coccidioides* in the Southwestern United States	Molecular Epidemiology; Metagenomic Analysis	Development and Implementation of Public Awareness Events at Farmers Markets
Air Quality Monitoring and Prevention of Air Quality-Associated Illnesses on Campus and in the Region	Engineering (Monitor Development); Survey Methods; Air Quality Surveillance	Tabling Event at the UTEP Earth Day Celebration; Formation of the Student Society for Science and Civic Engagement; Contact with Local Government
Prevention of Hospital-Associated Infections (HAIs): A Study in Hygiene Practices	Survey and Semi-Structured Interview Methods	Nursing Student Workshop; HAI Community Awareness "Nerd Night"*
Metagenomic Analysis of Microbial Diversity on the Campus Bus System	Molecular Epidemiology; Metagenomic Analysis	Organization of a Student-Focused Mini-Symposium on Local Health Issues and Related Social Media Development

* Nerd Nights are hosted by the University as a means to bring science to the public in interactive ways.

describe what role those individuals would have in the outreach process; (c) articulate how contact would be made with external partners; and (d) generate an outline detailing how the outreach event would be organized, executed, and monitored. At the conclusion of the first session, students were invited to participate in a gallery walk, which allowed them to observe other team's engagement plans and to provide feedback on those plans. Similarly, this allowed the course instructors to formatively assess student progress and address any questions or concerns that emerged. Research teams then used the constructive criticism provided by their peers to revise their community engagement plans during the second weekly session.

Revised plans required subsequent approval from the course instructors, and, once finalized, teams could proceed to the implementation phase. In this context, it is important to note that the majority of research teams (n = 3) elected to initiate contact with community partners with minimal guidance and facilitation from the course instructors. For instance, members of the air quality monitoring team directly e-mailed the local organizer for the UTEP Earth Day Celebration to express their interest in the event and to request a table for their outreach activity, which included an "adverse effects of air pollution" matching activity for children and opportunities for adults to view and discuss existing air quality data for the region. Likewise, members of the HAI team identified and contacted a clinical professor in the UTEP School of Nursing, who provided them with access to collect data from and speak informally with nursing students who were currently participating in clinical rotations. Notably, all student groups were successful in executing one or more components of their outreach plan (see Table 2 for an overview).

We contend that this success is attributable to several factors. First, BIOL 1108 is a continuation of BIOL 1107. Accordingly, students have already established relationships with one another and are already invested in their research projects, with moderate to high levels of perceived project ownership reported (see Methods and Results sections below). Second, the BIOL 1108 CURE convened, on average, for four hours each week, which provided substantial time for peer-peer and peer-instructor discussion to occur with respect to each student team's research and outreach agendas. Course deliverables, including weekly updates and the final civic engagement presentation, likewise held students accountable for their efforts and promoted metareflective practices among both

the students and the instructors. Lastly, the course's central focus on place-based health issues within the Paseo del Norte region likely encouraged students to formulate outreach plans that primarily necessitated interaction with individuals at UTEP or in the community, with whom they were already at least somewhat familiar.

Methods

Participant Recruitment

Participants (N = 16) represented a convenience sample consisting of all students enrolled in the BIOL 1108: Health Disparities in the Border Region II CURE at the University of Texas at El Paso in the Spring 2018 semester. As discussed previously, this course is a successor to BIOL 1107: Health Disparities in the Border Region I (Appendix 1) and is intentionally designed to provide students with opportunities to connect their independent research initiatives to the local community (see *Course Description: Health Disparities II [BIOL 1108]* and Appendix 2). The majority of the students (n = 13) completed BIOL 1107 prior to entering BIOL 1108; however, none of the participants had prior civic engagement or service-learning experience. Participants were predominantly female (62.5%) and majoring in STEM (93.8%), although the course was open to any individual whose degree requirements included BIOL 1108. Approval was received from the University of Texas at El Paso's Institutional Review Board prior to conducting research involving human subjects.

Public Health Outreach Flowchart (PHOF)

Given the explicit focus of BIOL 1108 on research and civic engagement, we sought to examine the degree to which students were successful at constructing public health outreach plans prior to and following their participation in the course. To accomplish this objective, a modified version of the Scientific Process Flowchart Assessment (SPFA; Wilson and Rigakos, 2016), the PHOF, was developed and validated (via expert-panel review). Specifically, the PHOF presented students with a hypothetical scenario in which two introductory biology students were tasked with creating an outreach program to address the high incidence of asthma in their community due to widespread public exposure to pesticides. Participants were prompted to create a flowchart diagramming their plan and could use any text, arrows, and objects to accomplish the task (Appendix 3). Responses were blinded and scored using a modified version of the SPFA rubric (Wilson and Rigakos, 2016), which was likewise subjected to expert-panel review for the purposes of content and construct validation (Appendix 3). Each response was evaluated by two individuals with expertise in the social sciences and bioeducation research. High interrater reliability was achieved (κ= 0.93; $p < 0.001$), with all disputes being resolved through discussion among the coders. Aggregate data were then entered into SPSS (v.23, IBM) and paired t-tests used to assess for pre-/post-semester shifts in performance.

Persistence in the Sciences (PITS) Survey

As a complement to the PHOF, the PITS (Hanauer, Graham, and Hatfull, 2016) was utilized to assess the impact of the BIOL 1108 CURE on students' sense of project ownership (content- and emotion-related), researcher self-efficacy, science identity development, scientific community values, and networking skills (post-only). An adapted version of the PITS was created for pre-semester utilization, in which the question stem was modified, where appropriate, to inquire about students' initial beliefs and expectations (e.g., "I believe that the research I conduct this semester will help to solve a problem in the world"). Psychometric analyses indicated a high degree of construct validity (as established via expert-panel review) and reliability for both the pre-test (Cronbach's α= 0.943) and post-test (Cronbach's α = 0.857) versions of the instrument (Cronbach's $\alpha \geq$ 0.754 for each individual subscale). Given that all students in the course intended to continue to engage in research in subsequent semesters (as indicated in an end-of-semester one-minute response paper assignment), we did not inquire about their interest in persisting in conducting scientific research on the post-semester PITS diagnostic. Data were entered into SPSS (v.23, IBM), and, with the exception of the Networking scale, a series of paired t-tests were used to examine pre-/post-semester shifts in response. Descriptive statistics were tabulated for all Networking items.

FIGURE 1: Examination of Student Performance on the PHOF Reveals a Significant Shift in Total Item Count, Total Rating, and Flowchart Structure Following Engagement in the CURE. Error Bars Represent +/- SEM. All Comparisons are Significant at $p \leq 0.039$.

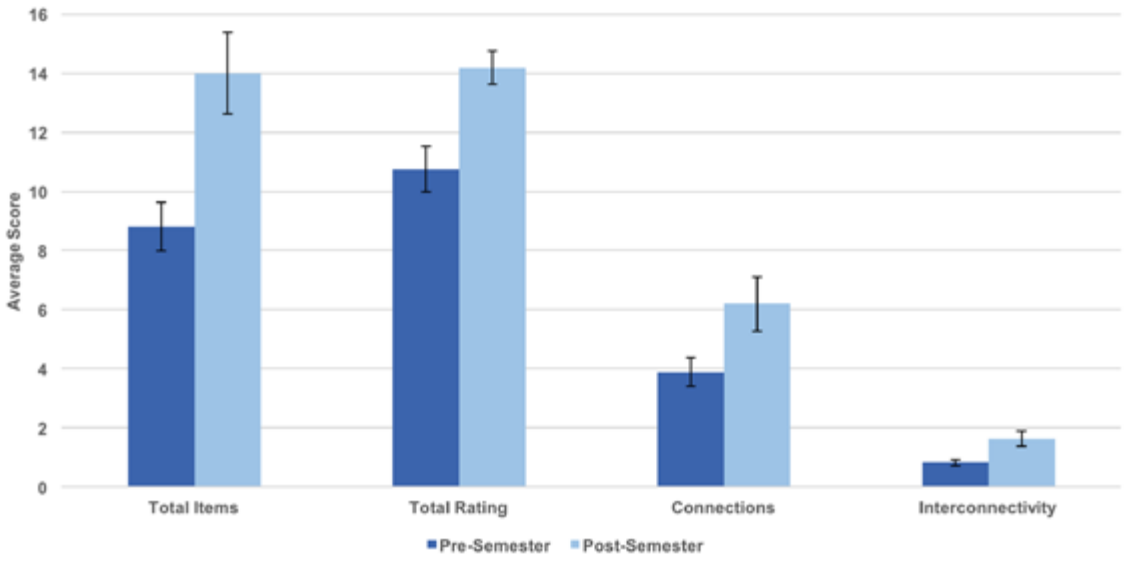
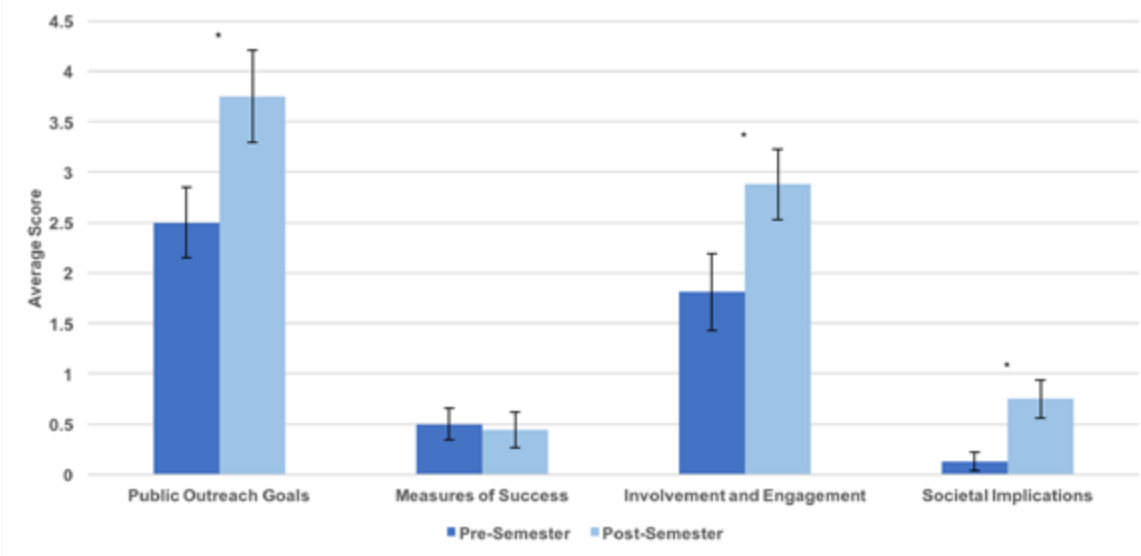


FIGURE 2: Examination of Student Performance on the PHOF Reveals a Significant Shift in Students' Understanding of Factors Impacting Public Health Outreach Initiatives Following Engagement in the CURE. Error Bars Represent +/- SEM. Flagged Comparisons (*) are Significant at $p \leq 0.020$.



Student Perceptions of the Course (SPC)

To better understand how the BIOL 1108 CURE impacted students' beliefs about the relationship between science and civic engagement, we asked participants to respond to three open-ended prompts at the end of the term (Appendix 4; adapted from Lancor and Schiebel, 2018). Responses were analyzed using a descriptive interpretive approach (Tesch, 2013), with emergent themes identified via iterative cycles of open and axial coding. Each response was scored by two individuals with expertise in the social sciences and bioeducation research. High interrater reliability was achieved ($K = 0.97$; $P < 0.001$), with all disputes being resolved through discussion among the coders.

Results

Participation in the CURE Results in a Significant Increase in Students' Development of Public Health Outreach Abilities.

A series of paired t-tests were performed to examine pre-/post-semester shifts in participants' PHOF responses with respect to the six rubric dimensions (Appendix 3). Results indicated a statistically significant increase in the total number of items reported ($t(15) = 3.463$; $p = 0.003$) and total flowchart rating ($t(15) = 3.218$; $p = 0.006$), as well as in the number of connections made between concepts ($t(15) = 2.259$; $p = 0.039$) and interconnectivity ($t(15) = 2.360$; $p = 0.032$), following engagement in the BIOL 1108 CURE (Figure 1). Significant increases in all other categories were likewise observed with the exception of the Measures of Success dimension (Figure 2).

TABLE 3: Analysis of Students' Pre-/Post-Semester Responses to the PITS.

Construct	Pre-Semester (M; SEM)*	Post-Semester (M; SEM)	p-value
Project Ownership (Content)	4.34 (0.12)	4.64 (0.10)	0.012
Project Ownership (Emotion)	4.27 (0.17)	4.17 (0.16)	0.409
Self-Efficacy	4.15 (0.13)	4.51 (0.11)	0.004
Science Community Values	4.48 (0.12)	4.69 (0.13)	0.201
Science Identity	3.94 (0.17)	4.16 (0.14)	0.913

Engagement in the CURE Enhances Students' Sense of Project Ownership and Researcher Self-Efficacy

Paired t-test analyses of student responses to the PITS revealed a significant, pre-/post-semester shift for both the Project Ownership (Content) scale ($t(15) = 2.841$; $p = 0.012$) and Researcher Self-Efficacy scale ($t(15) = 3.381$; $p = 0.004$) (Table 3). Remaining comparisons were not statistically significant. Descriptive analysis of networking data indicated that students engaged in research-related conversation most frequently with friends and least frequently with faculty external to the course (Figure 3).

Research-Civic Engagement Connections Are Evident in Students' Post-Semester Written Questionnaire Responses

In addition to examining the above cognitive and non-cognitive outcomes, we sought to understand the more globalized perceptions students possessed regarding connections between their research and the broader community. Qualitative analysis of SPC responses revealed, in a collective sense, that students valued the need for increasing community awareness of public health issues in the region and that this could be accomplished both through practical means (e.g., increased communication) and through professional means (e.g., students pursuing careers with

FIGURE 3: Descriptive Statistics Regarding Student Networking Practices.

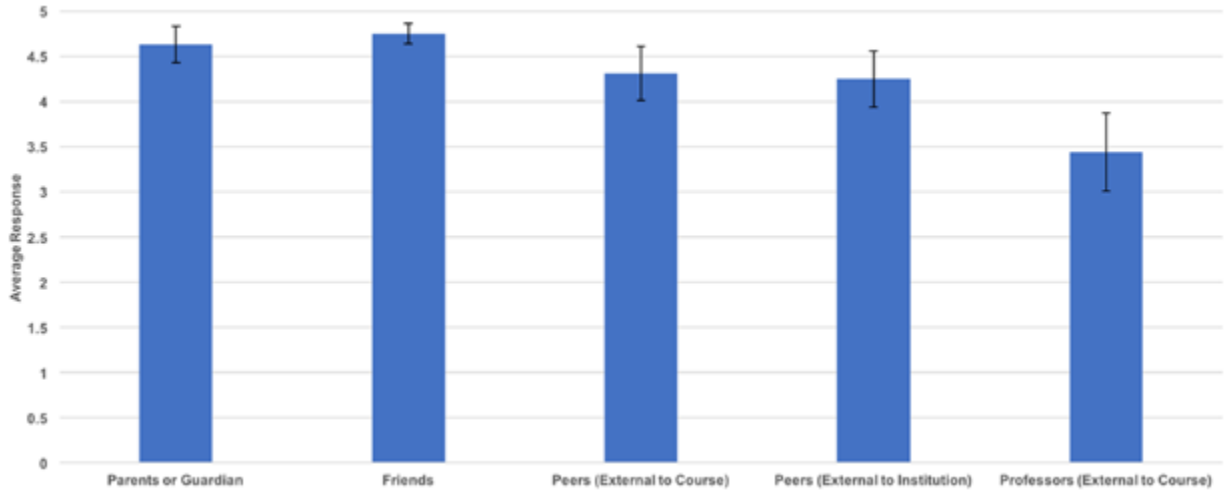


TABLE 4A: Student Responses to the Question "How Will You Continue to Engage with Science and the Public in Your Future Career?"

Theme: Research Engagement	**Number of Responses (%)**: 10 (62.5%)

Sample Student Responses:

"After my time in this lab, I plan to find professors who are doing research and request to participate, particularly research [that] has to do with public health."

"As I develop as a scientist, I would get involved in more on-campus research as well as internships pertaining to my field of interest in Environmental Science."

Theme: Increase Public Awareness/Outreach	**Number of Responses (%)**: 7 (43.8%)

Sample Student Responses:

"I would like to continue to participate in scientific organizations."

"In my research on air quality, [the public] will be able to build their own air sensors [to measure air quality], which will give them a sense of engagement in our research."

Theme: Career Advancement	**Number of Responses (%)**: 6 (37.5%)

Sample Student Responses:

"I intend to pursue professional school either in pharmacy or medicine (physician). In addition to this, I would like to pursue a double-degree that would allow me to have more direct contact with the community (e.g., MPH)."

"I am interested in possibly pursuing graduate work in the area of epidemiology/public health."

Theme: Academic Connectedness	**Number of Responses (%)**: 2 (12.5%)

Sample Student Responses:

"By belonging to the FYRIS program, I will have academic opportunities to continue to engage in science that impacts the public."

"As a BUILDing SCHOLAR, I am able to develop my scientific abilities and create networking opportunities for myself [and] my future endeavors."

TABLE 4B: Student Responses to the Question "In Your Opinion, What is Your Role as a Scientist in Communicating with the Public?"

Theme: Educate the Public	**Number of Responses (%):** 10 (62.5%)

Sample Student Responses:

"A scientist must be able to teach others what they have learned such that all of society's knowledge as a whole can improve."

"By communicating to the public, we are sharing our findings [with] the world."

Theme: Increase Public Awareness/Engagement	**Number of Responses (%):** 5 (31.3%)

Sample Student Responses:

"[My role] is to raise issues that are vital and that affect every human by spreading awareness."

"I have been working on my project for some time, and I want to share my findings."

Theme: Improve Quality of Life	**Number of Responses (%):** 5 (31.3%)

Sample Student Responses:

"We are the gatekeepers and facilitators for people to live a better quality of life."

"Whether it be public health, clinical research, or environmental public health, all people deserve the right to be informed about the many factors affecting their daily lives."

TABLE 4C: Student Responses to the Question "What Have You Learned in This Course That Will Equip You to Effectively Connect the Broader Community with Issues in Science?"

Theme: Increased Research Knowledge	**Number of Responses (%):** 5 (31.3%)
Sample Student Responses:	
"With the knowledge of research skills that I have learned in this class, I can better understand how [science and society] are connected and how to reach out [to community stakeholders]."	
"I have learned to obtain consent to acquire data, create engagement pieces (such as proposals), and create surveys that will obtain desired information for our research."	
Theme: Increased Public Outreach Knowledge	**Number of Responses (%):** 5 (31.3%)
Sample Student Responses:	
"With the knowledge of community outreach that I have learned in this class, I can better understand how scientific research and the community are connected and how to reach out."	
"I have learned how to address the community by increasing awareness of issues and incorporating citizen-science pieces [into my work]."	
Theme: Engagement with the Community	**Number of Responses (%):** 11 (68.8%)
Sample Student Responses:	
"Throughout our study, we incorporated the broader community in order to effectively reach everyone, not only our target community."	
"What makes science engaging and more meaningful from a community standpoint is specifically spreading awareness for scientific research that affects them."	
Theme: Professional Skills Development	**Number of Responses (%):** 4 (25.0%)
Sample Student Responses:	
"In this course, I have learned how to communicate; how to find resources; how to fully understand the goals/outcomes of my research; how to problem-solve; how to better manage my time; and how to become a better presenter."	
"I have improved in my communication and writing skills."	

a civic engagement focus). Furthermore, several students (n = 10; 62.5% of the participants) noted that the research projects that they initiated in the course could serve as a platform for engaging in future scholarship that served to "bring science to the public." One student stated, for instance, that she "wanted to become a primary care physician one day" and hoped she could "continue doing research in the field of public health so [she could] better advocate for [her] patients' lifelong health." Another, in documenting what he believed he learned in the course that could enable him to effectively connect the broader community with issues in science, wrote that "among all of the typical things [he] discovered in the course (e.g., how to write a research proposal; laboratory methods), [he] learned not to hesitate to communicate ideas about the direction of research and how to make progress." In doing so, he could then also "better communicate any possibility of something bad or beneficial [about his research] to the public in an effective manner." Comprehensive analysis of student responses, including identified themes, is presented in Tables 4A - C above. In interpreting these outcomes, it is important to note that across all open-ended prompts, more than 81% of responses were identified as belonging to two or more coding categories.

Discussion

Since their inception, CUREs have sought to extend the benefits of research to an increasing number of undergraduates at all academic levels (Bangera and Brownell, 2014). Indeed, efforts within the discipline indicate that CUREs have the potential to promote the development of cognitive and non-cognitive student outcomes ranging from increased science literacy to science identity formation and persistence in STEM (e.g., Brownell et al., 2012; Brownell et al., 2015; Jordan et al., 2014; Olimpo et al., ,2016). While this is the case, few studies (e.g., Ahmed et al., 2017; Ballen et al., 2018) have expounded upon the extent to which those outcomes are fostered by purposeful

integration of civic engagement education into the CURE curriculum.

In this article, we describe the structure of the Health Disparities in the Border Region II CURE, highlighting connections between student-driven research that examines health challenges within the students' local community as well as the civic engagement/public outreach initiatives that course participants developed to connect their research to the broader society. Furthermore, we present both quantitative and qualitative evidence suggesting that participation in the CURE positively impacts students' development of public health outreach skills, researcher autonomy and self-efficacy, and affective dispositions toward the role of science in society. These findings are consistent with several prior studies, which note that targeted instruction that establishes tacit links between student research projects and the public good increases students' attitudes about the role of science in society, their understanding of the nature of science, and their appreciation and value for "doing" scientific work (e.g., Ahmed et al., 2017; Smyth, 2017).

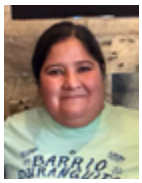
In considering the outcomes reported here, we also wish to acknowledge the limitations associated with our work. Specifically, the structure of the FYRIS program and the resources allocated for the Health Disparities sequence (e.g., physical materials, financial incentives) were only intended to support a single implementation with a relatively finite population of students. There currently exists no opportunity to repeat the course sequence, although we are in the process of exploring alternate strategies to sustain and scale the CURE. In addition, although we believe it would be ideal to conduct a comparative examination of CURE and non-CURE courses with embedded civic engagement opportunities, no parallel non-CURE course presently exists within the department that incorporates direct outreach to the local community. While these caveats should be considered when evaluating reported outcomes both here and more broadly within the CURE literature (Brownell, Kloser, Fukami, and Shavelson, 2013), they also promote meaningful contemplation of future research directions in this area.

For instance, what factors are required to ensure that CUREs incorporating civic engagement education into the curriculum are both sustainable and scalable? Are these factors the same as those that are necessary to support sustainability and scalability of CUREs that do not integrate civic engagement experiences? In what ways do CUREs that promote civic engagement through science-society connections (ProCESS CUREs) allow us to examine as yet unexplored benefits of student participation in course-based research, and how do we effectively measure those outcomes?

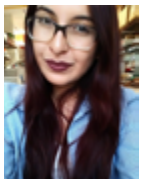
With specific regard to our own work, and in response to those limitations cited above, we likewise seek to engage in future studies that: (a) examine the replicability of the findings reported here (e.g., through analysis of outcomes in course iterations with larger student sample sizes); (b) implement multiple sections of the course in the same semester and vary whether or not students participate in civic engagement experiences, which will afford us an opportunity to more closely understand the direct impact of such experiences; and (c) collaborate with other UTEP CURE faculty to promote incorporation of civic engagement into their curricula and to conduct CURE-CURE comparative studies using similar methods as those described in this article. Pursuing these and other relevant areas of inquiry is a critical step toward understanding how CUREs can continue to foster growth in the classroom and beyond.

About the Authors

Jeffrey T. Olimpo, Ph.D., Assistant Professor in Biological Sciences at the University of Texas at El Paso (UTEP), is a discipline-based education researcher with more than five years of experience in the development, implementation, and evaluation of CUREs. His current research focuses on the cognitive and non-cognitive outcomes associated with novices' participation in authentic research opportunities as well as the impact of professional development experiences on the career growth of graduate, postdoctoral, and faculty instructors. He is currently PI of the NSF-funded Tigriopus CURE and Ethics/RCR in CUREs initiatives and is a Tips and Tools Section Editor for the Journal of Microbiology & Biology Education. E-mail: jtolimpo@utep.edu; Phone: (915) 747-6923.



Jennifer Apodaca, Ph.D., is Lecturer and Lab Coordinator in the Department of Biological Sciences at the University of Texas at El Paso, where she teaches classes covering topics in introductory biology, microbiology, molecular biology, comparative genomics, animal physiology, animal behavior, and evolutionary biology. Her primary research interest in bioeducation involves curriculum development and evaluation of course-based undergraduate research experiences and civic engagement in science activities that employ genome-scale experimental and computational approaches to topics in public health, microbiology, and genetics.



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Yok-Fong Paat, Ph.D., is Associate Professor in the Department of Social Work at the University of Texas at El Paso. Her interests focus on family well-being, community participatory based research, and social integration.

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DISEASE AND THE ENVIRONMENT: HEALTH DISPARITIES IN THE BORDER REGION (BIOL 1107) – FALL 2017

Instructor: Drs. Jennifer Apodaca and Jeffrey Olimpo
Office: B226C Biology Building (Fri. 11:00am - noon)*
E-mail: japodaca15@utep.edu; jtolimpo@utep.edu

*These are hours when I am **guaranteed** to be in my office. If these times do not work for you, please send me an e-mail, and we can arrange another time to meet. I'm here to help!

COURSE DESCRIPTION

Welcome to *a study of life*! This course offers students a unique opportunity to explore the relationship between disease, the environment, and public health through an intensive, self-driven research experience. As opposed to traditional laboratory coursework, this means that *you* will be determining your own research questions, methods to use, types of experiments to perform, and "next steps" in the research process based on obtained conclusions. We (as your instructors) seek to promote an environment where (reasonable) risk is rewarded, overcoming failure is part of true scientific inquiry, and the contributions *you* make to science are invaluable.

COURSE OBJECTIVES

This course is designed to provide students with an authentic research opportunity in the biological sciences. Upon completion of the course, students will be able to:

- Compare and contrast the various descriptive and analytic study designs utilized in the fields of epidemiology, public health, and biological sciences
- Utilize scientific process skills to make informed decisions throughout all aspects of the experimental process
- Apply principles of scientific inquiry to conduct a descriptive and/or analytic study of their choosing within the fields of health disparities, environmental health, molecular epidemiology, and public health bioinformatics
- Demonstrate an increased understanding of qualitative and quantitative research methods, as evidenced in written and oral deliverables
- Make meaningful empirical connections between diseases and the environment
- Describe, succinctly, the results of their research to both lay and scientific audiences

COURSE MATERIALS & CO-REQUISITES

1. *Health Disparities in the Border Region* laboratory manual (available in PDF on our Blackboard site; Olimpo *et al.*, 2017)
2. Laboratory notebook (a *non*-spiral bound composition book will suffice) and pen
3. Personal Protective Equipment (PPE) needed: laboratory coat; goggles

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ACADEMIC INTEGRITY

As members of a scholarly community dedicated to healthy intellectual development, students and faculty are expected to share the responsibility of maintaining high standards of honesty and integrity in their academic work. All material for this course must be your work and no one else's. **Cheating or plagiarism in any form will not be tolerated.** This includes, but is not limited to, copying someone else's work on an assignment. Please note that all suspected instances of plagiarism or academic dishonesty will be referred to the Dean of Students' Office, in accordance with UTEP policies and procedures.

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COMMUNICATIONS

When you e-mail me, please include a proper subject, any message you are responding to, the course name and CRN, as well as your name. Please use your UTEP account to ensure the e-mail is not blocked by the university's spam filter. If you e-mail directly from the Blackboard course, essential information like the course name and section will automatically be included. I will do my best to respond to your e-mail within 24-48 hours. If you do not receive a response within this timeframe, I ask that you please re-send your e-mail. Please be sure to regularly check the e-mail account listed for you in Blackboard, as this is where all course correspondence will be sent.

CENTER FOR ACCOMMODATIONS AND SUPPORT SERVICES

Students needing special accommodations in this course must be registered with the Center for Accommodations and Support Services (CASS) Office in Room 106 of the Union East Bldg. You may contact them at (915) 747-5148 or cass@utep.edu for more information. Once you are registered with the CASS Office, please notify me as soon as possible so that we may meet to discuss appropriate accommodations, as recommended by CASS.

The IT Support Team can assist with Blackboard, password resets, and student e-mail accounts. Hours and other helpful information can be found at http://www.helpdesk.utep.edu.

COURSE GRADING & EXPECTATIONS

COURSE GRADING:

- Structured Homework Assignments 10%
- Participation/Attendance 5%
- Research Question 5%
- Preliminary Proposal 5%
- Rough Draft of Proposal 10%
- Final Draft of Proposal 15%
- Laboratory Notebook 10%
- Final Presentation 20%
- Final Laboratory Report 20%

A = 90 – 100%	D = 60 – 69%
B = 80 – 89%	F = <60%
C = 70 – 79%	

ATTENDANCE

Your attendance is **required** for all laboratories, unless otherwise noted. Class will begin promptly at **4:30pm** and will run no later than **6:50pm**. If, for whatever reason, you cannot make it to class on time, please do your best to enter quietly when you do arrive. More than two absences will result in an automatic grade of "F."

LABORATORY CONDUCT

Please make every effort to be courteous to your fellow students and myself. Policies regarding responsible conduct of research and ethics are expected to be adhered to (we will discuss these in class) and are essential not only in a "local" sense but in a broader, professional sense as well. Transparency and open lines of communication in the laboratory are critical. Therefore, please report all laboratory accidents, suspected instances of research misconduct, etc. to me ASAP.

BLACKBOARD

This course makes extensive use of Blackboard® (https://adminapps.utep.edu/blackboardlearn). You will use Blackboard to download the laboratory manual, submit assignments, download or print additional course materials, and check your grades. Please note that your login and password are the same as you would use to access your UTEP e-mail account.

STRUCTURED HOMEWORK ASSIGNMENTS

In an effort to provide you with the necessary training and skills required for successful completion of your independent research projects, a series of ten (10) structured homework assignments will be administered this semester. These assignments correspond with the series of confirmatory laboratory exercises that occur at the start of the semester. All completed homework assignments are due at the beginning of the following class (see laboratory schedule below).

RESEARCH PROPOSAL, FINAL PRESENTATION/REPORT, AND NOTEBOOK

Details regarding expectations and grading criteria for the research question and proposal, final research presentation/report, and notebook can be found as appendices within the laboratory manual. We will discuss these items in greater detail throughout the course.

LABORATORY SCHEDULE

Wk.		Date	Laboratory Topics	Assignment(s) Due
1	T/R	Aug. 29	-- NO LABS --	-
2	T	Sept. 5	Introduction to Laboratory	-
	R	Sept. 7	Lab #1: Scientific Inquiry	-
3	T	Sept. 12	Lab #2: Research Prop. Dev.	HW #1
	R	Sept. 14	Lab #3: Pop. Literature Lab #4: Eval. of Databases	Prelim. Prop.
4	T	Sept. 19	Lab #5: Qualitative Methods	HW #2
	R	Sept. 21	Lab #6: Quantitative Meths.	HW #3
5	T	Sept. 26	Lab #7: Peer Review + Ethics	HW #4
	R	Sept. 28	Lab #8: Biotechnology I	HW #5; Rough Draft
6	T	Oct. 3	Lab #9: Biotechnology II	HW #6
	R	Oct. 5	Lab #10: Microscopic World	HW #7
7	T	Oct. 10	Lab #11: Bioinformatics I	HW #8; Final Prop.
	R	Oct. 12	Lab #12: Bioinformatics II	HW #9
8	T	Oct. 17	Independent Research	HW #10
	R	Oct. 19	Independent Research	Notebook
9	T	Oct. 24	Independent Research	-
	R	Oct. 26	Independent Research	Notebook
10	T	Oct. 31	Independent Research	-
	R	Nov. 2	Independent Research	Notebook
11	T	Nov. 7	Independent Research	-
	R	Nov. 9	Independent Research	Notebook
12	T	Nov. 14	Independent Research	-
	R	Nov. 16	Independent Research	Notebook

13	T	Nov. 21	Independent Research	-
	R	Nov. 23	~~ *THANKSGIVING* ~~	-
14	T	Nov. 28	Independent Research	Notebook
	R	Nov. 30	Analysis Workshop	-
15	T	Dec. 5	Final Presentations	Presentation
	R	Dec. 7	Wrap-Up + "Next Steps"	Final Lab Report

* ***Please note that the course drop date is Nov. 3rd.***

*** Disclaimer: I reserve the right to change the contents of this syllabus due to unforeseen circumstances. Students will be given notice of relevant changes through Blackboard and e-mail. Assignment due dates will* ***NOT*** *change.*

DISEASE AND THE ENVIRONMENT: HEALTH DISPARITIES IN THE BORDER REGION II (BIOL 1108) – SPRING 2018

Instructor: Drs. Jeffrey Olimpo and Jennifer Apodaca
Office: B226 Biology Building (Fri. 11:00am - noon)*
E-mail: jtolimpo@utep.edu; japodaca15@utep.edu

*These are hours when I (Dr. Apodaca) am **guaranteed** to be in my office. If these times do not work for you, please send me an e-mail, and we can arrange another time to meet. I'm here to help!

COURSE DESCRIPTION

Welcome to *a study of life*! This course offers students a unique opportunity to explore the relationship between disease, the environment, and public health through an intensive, self-driven research experience. As opposed to traditional laboratory coursework, this means that *you* will be determining your own research questions, methods to use, types of experiments to perform, and "next steps" in the research process based on obtained conclusions. We (as your instructors) seek to promote an environment where (reasonable) risk is rewarded, overcoming failure is part of true scientific inquiry, and the contributions *you* make to science are invaluable.

COURSE OBJECTIVES

This course is designed to provide students with an authentic research opportunity in the biological sciences. Upon completion of the course, students will be able to:

- Utilize scientific process skills to make informed decisions throughout all aspects of the experimental process
- Apply principles of scientific inquiry to conduct a descriptive and/or analytic study of their choosing within the fields of health disparities, environmental health, molecular epidemiology, and public health bioinformatics
- Demonstrate an increased understanding of qualitative and quantitative research methods, as evidenced in written and oral deliverables
- Make meaningful empirical connections between diseases and the environment
- Describe, succinctly, the results of their research to both lay and scientific audiences
- Describe the impact of their research to communities of practice *outside* of the classroom

COURSE MATERIALS & CO-REQUISITES

1. Completion of BIOL 1107 *and* prior or concurrent enrollment in BIOL 1306
2. Laboratory notebook (a *non*-spiral bound composition book will suffice) and pen
3. Personal Protective Equipment (PPE) needed: laboratory coat; goggles

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ACADEMIC INTEGRITY

As members of a scholarly community dedicated to healthy intellectual development, students and faculty are expected to share the responsibility of maintaining high standards of honesty and integrity in their academic work. All material for this course must be your work and no one else's. **Cheating or plagiarism in any form will not be tolerated.** This includes, but is not limited to, copying someone else's work on an assignment. Please note that all suspected instances of plagiarism or academic dishonesty will be referred to the Dean of Students' Office, in accordance with UTEP policies and procedures.

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COURSE GRADING & EXPECTATIONS

COURSE GRADING:

- Weekly Research Updates 15%
- Participation/Attendance 15%
- Laboratory Notebook 10%
- Research Roundtable 20%
- Individual Development Plan (IDP) 5%
- Personal Statement 5%
- Résumé *or* Curriculum Vitae (CV) 5%
- Community Outreach Presentation 25%

A = 90 – 100%	D = 60 – 69%
B = 80 – 89%	F = <60%
C = 70 – 79%	

ATTENDANCE

Your attendance is **required** for all laboratories, unless otherwise noted. Class will begin promptly at **4:30pm** and will run no later than **6:45pm**. If, for whatever reason, you cannot make it to class on time, please do your best to enter quietly when you do arrive. More than two absences will result in an automatic grade of "F."

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LABORATORY SCHEDULE

Wk.		Date	Laboratory Topics	Assignment(s) Due
1	T/R	Jan. 16	-- NO LABS --	-
2	T	Jan. 23	Orientation (Welcome)	-
	R	Jan. 25	Research Project "Reboot"	**Weekly Update**
3	T	Jan. 30	Independent Research	-
	R	Feb. 1	Independent Research	**Weekly Update**
4	T	Feb. 6	Independent Research	-
	R	Feb. 8	Independent Research	**Weekly Update**
5	T	Feb. 13	Independent Research	-
	R	Feb. 15	Independent Research	**Weekly Update**
6	T	Feb. 20	Independent Research	-
	R	Feb. 22	Independent Research	**Weekly Update**
7	T	Feb. 27	Independent Research	-
	R	Mar. 1	Research Roundtable Wkshp	-
8	T	Mar. 6	Research Roundtable Wkshp	-
	R	Mar. 8	**Research Roundtable**	**Roundtable; NB**
9	T	Mar. 13	~~ SPRING BREAK ~~	-
	R	Mar. 15	~~ SPRING BREAK ~~	-
10	T	Mar. 20	Careers in Science Wkshp	**IDP**
	R	Mar. 22	Research Internships	-
11	T	Mar. 27	Public Health Outreach (I)	**Résumé; Statement**
	R	Mar. 29	Public Health Outreach (II)	Outreach Plan
12	T	Apr. 3	Civic Engagement/Outreach	-
	R	Apr. 5	Civic Engagement/Outreach	**Weekly Update**
13	T	Apr. 10	Civic Engagement/Outreach	-
	R	Apr. 12	Civic Engagement/Outreach	**Weekly Update**
14	T	Apr. 17	Civic Engagement/Outreach	-
	R	Apr. 19	Civic Engagement/Outreach	**Weekly Update**
15	T	Apr. 24	Data Analysis Wkshop	-
	R	Apr. 26	Presentation Wkshop	-
16	T	May 1	Com. Outreach Presentations	**Presentation; NB**
	R	May 3	* End-of-Semester Potluck *	-

** **Please note that the course drop date is March 29th.***

*** Disclaimer: I reserve the right to change the contents of this syllabus due to unforeseen circumstances. Students will be given notice of relevant changes through Blackboard and e-mail.*

Public Health Outreach Flowchart (PHOF)

Instructions: Laura and Luis are undergraduate research assistants at a large, public university in Texas. They have observed, in their studies, a correlation between exposure to pesticides and increased incidence (i.e., number of cases) of asthma in their community. Resultant from this work, they now seek to create a public health outreach program that addresses this issue. **In the space below, draw a flowchart that, in YOUR opinion, best outlines the course of action that Luis and Laura should pursue in order to successfully implement all aspects of their outreach program.** You may use shapes (circles, squares, etc.) to separate ideas/terms and any arrows (→ OR ←→) to connect the ideas/terms. **Please be as complete and detailed as possible.**

Consider the Following:

- What goals are Laura and Luis trying to achieve, and how will they accomplish them?
- How will success be measured (i.e., how will they determine if their goals are achieved)?
- Who is involved in the process? Why?
- What are the societal implications of Laura's and Luis' efforts?

Appendix 3

Public Health Outreach Flowchart (PHOF) Assessment Rubric

Connections
What type of connector is used to link ideas, concepts, etc. within the flowchart?

Public Outreach Goals
What is/are the purpose(s) of the outreach effort? Example items include: *increase public awareness*, *educate the public*, *increase community engagement*, *support ongoing or planned research efforts in the area of interest*, *etc.*

Measures of Success
How will you know if the outreach effort has been effectively implemented? Example items include: *qualitative research*, *quantitative research*, *mixed methods research*, *successful enactment of new policies*, *social media activity*, *etc.*

I**nvolvement and Engagement**
Who will be involved in the outreach effort? Example items include: *parents*, *children*, *local government officials*, *community foundations*, *students*, *research participants*, *etc.* NO CREDIT is given for mentioning either Laura or Luis!

Societal Implications
What are the impacts of the outreach effort on the broader community? Example items include: *Improved healthcare or quality of life*, *access to resources*, *increased awareness or knowledge among community stakeholders*, *etc.*

I**nterconnectivity**
In what manner are ideas, concepts, etc. connected within the flowchart?

Dimension	#	Naïve (1)	Novice (2)	Intermediate (3)	Proficient (4)	Expert (5)
Items should only be counted once for any of the following.						
1. Connections						
Lines that connect ideas		Only	Some	None	None	None
Single-sided arrows		None	Some	Only	More	Less
Double-sided arrows		None	None	None	Less	More
2. Public Outreach Objectives/Goals		0 - 1	2	3	4	≥ 5
3. Determining Success of Public Outreach Efforts		0	1	2 - 3	4 -5	≥ 6
4. Involvement and Engagement		0	1	2 - 3	4 -5	≥ 6
5. Societal Implications		0	1	2 - 3	4 -5	≥ 6
6. Interconnectivity		Linear		Circular		Integrated
7. Counted Items and Total Ratings		**Total Items (Sum Items #1 - #5):**			**Total Rating (Sum Ratings #1 - #6):**	

Appendix 4: End of Semester SPC Prompts

1. How will you continue to engage with science and the public in your future career?
2. In your opinion, what is your role as a scientist in communicating with the public?
3. What have you learned in this course that will equip you to effectively connect the broader community with issues in science?