PURM
Perspectives on Undergraduate Research & Mentoring

Opening Pathways to Undergraduate Research for Community College Students: Outcomes from a Course-Embedded Research Initiative and Multi-Institutional Partnership

James M. DeVita, Ph.D., University of North Carolina Wilmington (devitaj@uncw.edu)
Kristi M. Wiley, M.A., University of North Carolina Wilmington
Denise Henning, Ph.D., University of North Carolina Wilmington

Undergraduate research is a high impact practice (HIP) (Kuh, 2008) that provides students with meaningful learning opportunities to develop research-based skills, connects them with faculty and peers, and prepares them for future engagement in independent research, among other outcomes (Linn et al., 2015; Lopatto, 2010). Among the many positive outcomes of HIPs is that they have been shown to minimize or eliminate achievement gaps among marginalized populations (Kuh et al., 2017; Linn et al., 2015; Sweat et al., 2013). Among the populations with less access to HIPs, like undergraduate research, are community college and transfer students, when compared to traditional first-year students (Chamely-Wiik et al., 2021). Moreover, because pathways to research opportunities are not always open to community college students, they are disadvantaged when seeking to engage in undergraduate research compared to their peers who start as first-year students.

At the University of North Carolina at Wilmington (UNCW), we sought to develop a partnership that could address the gap in access to undergraduate research by developing a dual enrollment initiative that engaged community colleges prior to transfer. The Community College Undergraduate Research Experience (CCURE) was intended to open pathways to undergraduate research for community college students prior to transferring to UNCW or another four-year institution. CCURE worked collaboratively with community college partners to engage students in an undergraduate research experience while still enrolled at their respective community college. The course-embedded experience allowed community colleges to earn transferable credit from UNCW while participating in a faculty-mentored research experience. In the discussion below, we share an overview of the CCURE initiative as well as outcomes from our assessment of the pilot program that occurred in Spring 2021 and worked directly with partners at Cape Fear Community College (CFCC), Craven Community College (CCC), and Lenoir Community College (LCC).

Literature Review: The Benefits of Undergraduate Research

Kuh (2008) introduced HIPs as a framework for how to engage and retain undergraduate students. HIPs are intended to give students a deeper level of learning by promoting student engagement and are often geared toward underrepresented students. The HIPs first identified by Kuh (2008) include first-year experiences, writing-intensive courses, global learning, service learning, capstone projects, and undergraduate research, among others. In the section below, we summarize literature on the types and benefits of undergraduate research experiences that informed the design and development of CCURE.

Course Embedded Undergraduate Research Experiences

Undergraduate research is considered a HIP that aims to engage undergraduate students in applied research opportunities. Undergraduate research experiences (UREs) can take the form of mentored internships in a laboratory or faculty-led research group, or course-based undergraduate research experiences (CURs). CURs provide course-embedded opportunities for students to address a research question or problem with unknown outcomes or solutions that are of interest to external stakeholders (Dolan, 2016). CURs present an opportunity to serve all students who enroll in a course rather than other research experiences that may include only students who seek out research internships or who participate in specialized programs, such as honors programs or programs that support research participation by disadvantaged students (Auchincloss et al., 2014).

Although CURs vary in structure and theme according to several factors (e.g., discipline, level of course), they are defined as having the following five elements that are representative of authentic research: 1) engaging students in scientific practices, 2) emphasizing collaboration, 3) examining broadly relevant topics, 4) exploring questions with unknown answers to expose students to the process of scientific discovery, and 5) integrating iteration into the course, so students can see how science builds on itself (Auchincloss et al., 2014). Reflective of their diversity, CURs have been implemented in fields beyond those that rely on lab-based research (e.g., STEM fields) into fields like education, history, and psychology. Additionally, CURs are supported by a diverse range of institutions, including four-year universities and community colleges.

Currently, there are ongoing undergraduate research opportunities called community college undergraduate research initiatives (CCURI) that began in 2005. CCURI aims to identify pedagogies for incorporating various disciplines to help community colleges increase undergraduate research opportunities on their campus (Hewlett et al., 2019). CCURI provides a new model for the classroom experience at community colleges through the incorporation of course-based undergraduate research. Providing CURs to students is an effective way to introduce students of varying backgrounds to research, thereby potentially broadening the diversity of the scientific community (Bangera & Brownell, 2014).

Benefits of Undergraduate Research Experiences

Undergraduate research opportunities offer an array of benefits for student researchers and faculty mentors, as well as for the institution. Students can gain new experience, skills, and networks by participating in undergraduate research opportunities. While participating in undergraduate research projects, students gain skills such as critical thinking and the ability to work with teammates (Sell et al., 2018). Students are challenged to consider research questions, identify problems, and find solutions in ways they are not often challenged to do within regular coursework. They also learn transferable skills such as managing multiple inputs of ideas and perspectives (Ketcham et al., 2017). Participation in undergraduate research often leads to higher grade point averages (GPAs), opens opportunities for students to pursue advanced or graduate degrees, and provides a foundation for success in their future job fields (Sell et al., 2018). Research experiences can lead to student success, better academic achievement, graduate school preparation, retention, and persistence (Bowman & Holmes, 2018), which benefit students directly but also support institutional goals related to student success.

The positive effects of engaging in undergraduate research for students are reinforced by mentor-mentee relationships, which establish working relationships between students and faculty mentors that directly support student development (Ketcham et al., 2017). Faculty members also benefit from the relationships established through undergraduate research experiences. Faculty mentors can continue growing their research while working to develop students and may benefit both professionally and personally from their efforts mentoring undergraduate students in research

experiences (McKinsey, 2016). Institutions can create undergraduate research opportunities to support and encourage faculty members to work directly with undergraduate students. Without support for access to HIPs-like undergraduate research, students may not gain the experiences necessary to continue on a research trajectory.

Design of CCURE Pilot

CCURE was designed to reflect best practices in faculty-mentored undergraduate research, which leads to enhanced opportunities for student engagement and success (Bowman & Holmes, 2018; Ketcham et al., 2017; Kuh et al., 2017; Price & Tover, 2014; Sell et al., 2018). CCURE sought to directly address the lack of undergraduate research opportunities available to students who transfer from North Carolina's community colleges by developing an undergraduate research experience that dual-enrolled students in an introductory research course at UNCW. CCURE was modeled on an existing First Year Research Experience (FYRE), which provides funding for hands-on, faculty-mentored undergraduate research experiences for first-time, first-year students enrolled at UNCW. FYRE was first implemented in 2018 as an introductory-level experience for students in the second (spring) semester and was intended to intentionally connect students with faculty members who could open access to additional research experiences (e.g., lab-based research, thesis mentorship). The design of CCURE, which is described in greater detail below, mirrors the FYRE initiative, including the curriculum and structure of the 1-credit undergraduate course in Honors titled HON 191: Introduction to Research and Discovery. Additionally, previous FYRE instructors were hired as faculty mentors to the CCURE instructors.

The idea for CCURE evolved from our review of assessment data on participation in undergraduate research experiences, which revealed that transfer students had less access to this HIP than traditional first-year students. For example, one internal report found that while we supported over 1100 undergraduate research experiences in 2018, less than 25% of participants had transferred to UNCW. When compared with the 46% of transfer students among the overall student population in 2019, we recognized an over-representation of first-time enrolled students among undergraduate research participants. In subsequent discussions, we reflected on the development of FYRE as a way to open pathways for first-time, first-year students to research opportunities, but that we had failed to create a similar access point for community college transfer students; thus, CCURE was devised to address that gap.

Purpose and Goals

The purpose of CCURE was to improve community college transfer students' access to undergraduate research experiences. As a HIP, undergraduate research provides meaningful opportunities for students to connect with faculty mentors and to develop skills that prepare them for graduate school or careers, among other positive outcomes (e.g., Bowman & Holmes, 2018; Kuh et al., 2017; Price & Tover, 2014). Pathways to participation in undergraduate research are often difficult for transfer students to access; thus, CCURE sought to collaborate directly with community college partners to engage students in an initial research experience prior to transferring to UNCW or another four-year institution.

UNCW and the Community College Collaborative (3C)

UNCW is a four-year, public, research (level 2) university located in the Southeast region of North Carolina. In 2020-2021[1], UNCW enrolled approximately 15,000 total students who identify predominantly as white (77%) and female (65%). UNCW's legacy as a regional university contributes

[1] Institutional data were adapted from public dashboards (https://UNCW.edu/irp/id/dashboards.html) available from UNCW's Office of Institutional Research and Planning.

to our emphasis on student success and community engagement. When developing CCURE, we wanted to reflect our values and develop an initiative that was mutually beneficial to all partners. Thus, we worked collaboratively with the Community College Collaboration (3C) that was developed in 2019 and is led by Denise Henning. This "shoulder-to-shoulder" alliance was developed and implemented as a result of a study on community college leadership programs as part of the College of Education's graduate programming and also from important input garnered from an Appreciative Inquiry (AI) gathering of community college leaders from Eastern North Carolina community colleges. The study, discussions, and action planning identified the need for a collaborative effort that would partner with the community colleges and the university to develop strong future leaders and offer programming and best-practice conferences to strengthen higher education for all students, faculty, and staff among the partnering institutions.

Results from the aforementioned discussions and planning activities from the partnership initiatives of 3C have had impactful results in a very short period of time. Notably, 3C has provided multiple professional development opportunities around issues that impact students' experiences and prepare emerging leaders by instilling skill sets needed to better serve students and become positive leaders, including the Challenging the Paradigm Conference and Aspiring Leaders: Community College Leaders' Summit.

The Challenging the Paradigm Conferences are specifically focused on best-practice partnerships and future trends that impact community colleges and student experiences. For example, the 2021 conference focused on diversity, equity, and inclusion, and on the political environment and challenges that were deeply felt in response to the murder of George Floyd, as well as the historical oppression in the southern states of the U.S. A second initiative, Aspiring Leaders, was created by community college leaders for aspiring community college leaders, in collaboration with four-year university partners. This initiative brings strengths-based skills development for faculty and new administrators who aspire to have community college career journeys to prepare them for leadership positions. The interactive learning experience engages participants in critical student development areas that support students' transition to universities and overall student success. There are six facilitator-mentors, four of whom are leaders in community colleges while two are leaders in the four-year university, personifying the commitment to a shoulder-to-shoulder partnership.

The initiatives and networking developed by 3C provided a strategic opportunity to support the development of CCURE. Building on the strong and growing partnership of the UNCW/3C Collaborative, UNCW continues to build upon our successful CCURE pilot project. The partnership between 3C and CCURE also provided us with a peer-to-peer mentoring model that we utilized to support the community college instructors who taught in CCURE.

CCURE Partners: CFCC, CCC, and LCC

Partnerships created through UNCW/3C Collaborative led to three community colleges volunteering to participate in the pilot program in the spring of 2021: CFCC, CCC, and LCC. Each of these community colleges offers unique opportunities to students.

Based on the North Carolina Community College Dashboard (2021), CFCC is located in Wilmington, NC, serves 22,652 students and has a demographic of 69% White, 9% Hispanic, and 14% Black students, 51% of them male and 49% female. The largest age population of students is within the 18-24 year-old age range (37%) and the second largest group is 24-44 (34%). CCC is located in New Bern, NC, and serves 7,296 students with a demographic of 62% White, 9% Hispanic, 20% Black, and 3% Asian students, 50% male and 50% female. The largest age population that CCC serves is 25-44 (37%) and the second is 18-24 (34%). LCC is located in Kinston, NC, and serves 11,978 students with a demographic of 51% White, 11% Hispanic, and 35% Black students, with 49% of

them as male and 51% female. The largest age population is 24-44 (43%) and the second is 18-24 (28%). Overall, these colleges serve in the eastern region of the state, but they have different demographics among their students.

CCURE Course: HON 191

The CCURE initiative was designed as a dual-enrollment opportunity where current community college students were provided access to a credit-bearing undergraduate research experience at UNCW. Dual-enrollment credit was offered to CCURE participants through a 1-credit course in UNCW's Honors College titled HON 191: Introduction to Research and Discovery. The course provides students with an overview of the research process and allows them to practice those skills through an applied project. The partnership with the Honors College at UNCW connected CCURE to FYRE, which is also supported by Honors, and provided an interdisciplinary course designation that allowed flexibility to align with instructors' skills and areas of expertise.

HON 191 was designed to provide students with a course-embedded faculty-mentored undergraduate research experience. Community college instructors were hired to teach HON 191 to their respective community college students because we wanted to both ensure that the students who participated in CCURE had some familiarity and comfort with their instructor, and because we wanted to continue to expand the network of collaborative partnerships between UNCW and the participating community colleges. The CCURE instructors were selected to teach in the pilot initiative because of their interest in working with students on research projects at their respective institutions.

The activities completed as part of the course required students to work closely with their faculty mentors to complete a hands-on, applied research project. While project topics varied according to the instructors' discipline and expertise, all sections required students to develop a research question, collect and analyze data, and produce a research poster. The HON 191 instructors were the only assigned mentors to support students through the development and completion of their respective projects. Because sections were relatively small for the three institutions (with 5, 4, and 13 students, respectively) faculty and students had multiple opportunities to work collaboratively on course activities, which contributed to more meaningful interactions and stronger relationships for both students and faculty.

Each of the CCURE instructors selected the topic for their course and were given freedom to build them as they deemed appropriate. Two of the CCURE instructors decided to allow students to work on projects individually and one did a group lab-based project. CCC's instructor, Kate Amerson, focused her course on ethical leadership, and students focused their research on their future career. CFCC's instructor, John Metzger, allowed his students to focus on a topic that was important to them. LCC's instructor, Dr. Jarrett Whelan, did a lab-based project focusing on soil bacteria growth of antibodies (see Appendix A).

CCC's project allowed students to learn more about what ethical leadership was and how it is beneficial and gave them opportunities to connect to resources at UNCW. One student focused on marine biology, specifically sea turtles, and learned more about Sylvia Earle and marine protected areas (see Appendix B). Within this project, the student gained a connection to the Karen Beasley Sea Turtle Hospital located in Wilmington, NC, and learned about internship and scholarship opportunities. By participating in this CCURE, the student gained research experience, did a conference presentation, and learned about internship opportunities.

LCC's CCURE focused on a lab-based experiment that was run as a group research project (see Appendix A). The five students collected soil samples and worked in the lab to isolate and identify

antibiotic-producing soil microbes with the hope of discovering novel therapeutics. This STEM-focused CCURE allowed students to learn through discovery, work collaboratively, and focus on strengths of their peers. Dr. Whelan had students from many different majors participate in this course, and each student used their strengths throughout the project. Many students had not been part of a lab-based research project outside of a class they had taken, and they were allowed an opportunity to work directly with an instructor on a lab experiment.

CCURE Student Recruitment & Enrollment

CCURE students were recruited by administrators at each of the respective community college partners. Administrators worked with the CCURE instructors at their institutions to recruit students who they knew had an interest in research and in transferring to a four-year institution. Since each of the CCURE instructors was connected to the Honors program at their institution, most of the students were recruited directly from their affiliation with Honors. We acknowledge that the recruitment process limited our access to the wider student population at each institution, and as demonstrated in the demographic data, students represented less racial and ethnic diversity than we expected. Admittedly, when we were designing the initiative, we failed to adequately anticipate the level of interest we would have in CCURE. Our assessment data have provided insights like the need for more intentional engagement in student recruitment to ensure equitable access. We anticipate that an extended planning timeline in future iterations will help address this limitation from the pilot phase.

The enrollment process, which carried funding stipulations, also impacted the recruitment process and limited access. Students applied as visiting students to UNCW with fees waived and, in partnership with the Office of Admissions, were admitted and awarded scholarships that covered tuition and fees. Students had to meet certain criteria to participate in CCURE, which also aligned with restrictions in place for the scholarship funds used to support the program: 1) interest in undergraduate research and transferring to a four-year institution, 2) completion of at least 24 credit hours of coursework with a 2.5 GPA or higher, and 3) North Carolina resident status. We also required students to acknowledge that they could complete all scheduled activities in order to be accepted to the program. The criteria for participation caused us to exclude several Early College students who expressed interest in the program as well as some out-of-state students. Funding for a future iteration of CCURE removes those restrictions and will allow us to open access to a more diverse group of participants.

CCURE Programming and Timeline

The pilot program for CCURE occurred virtually via distance technology during the Spring 2021 semester due to the COVID-19 pandemic. The planning team started meeting to discuss the initiative in Fall 2020. By December 2020, UNCW had committed resources to fund the pilot program and our three partner community colleges had recruited instructors interested in teaching HON 191 Introduction to Research and Discovery sections for CCURE. Planning and implementation required coordination across multiple units at UNCW, which was led by James DeVita, who also facilitated the administrative aspects of CCURE (e.g., application, enrollment, instructor pay) in collaboration with multiple units, including Honors, Admissions, and Financial Aid. Additionally, DeVita and Henning worked collaboratively to supervise Kristi Wiley, a current doctoral student at UNCW and community college instructor who served as an intern for CCURE. Together, DeVita, Wiley, and Henning worked collaboratively to support all programmatic aspects of CCURE and related assessment activities.

Because our planning processes were slowed by the ongoing COVID-19 pandemic, we adapted the course-embedded experience associated with CCURE from a 15-week timeline (full semester) to eight weeks to occur in the second half of the Spring semester. This allowed us to secure additional time for planning as well as for collaboration among the CCURE instructors and UNCW faculty

mentors, who provided peer support to their community college colleagues. We (i.e., all the authors of this manuscript0) facilitated multiple meetings with both CCURE instructors and UNCW faculty mentors in January and February to encourage collaboration, finalized course activities and assignments, and provided support as needed. Wiley helped facilitate meetings, maintained regular communication across all stakeholders, and led the planning of a research showcase that served as a culminating experience. Finally, a website was developed that includes an overview of CCURE, news about the initiative, and examples of students' work completed during the pilot (see https://uncw.edu/appliedlearning/ccure/).

Throughout the implementation of the CCURE pilot, CCURE instructors and UNCW faculty mentors were expected to meet regularly and discuss ways to engage with the community college students participating in the initiative. The UNCW faculty mentors provided direct support to the CCURE instructors by sharing course syllabi, accessing UNCW-specific resources (e.g., library), and attending class sessions to connect with the community college students and co-facilitate discussion. Future iterations of CCURE will include an extended planning phase that will allow for the development of relationships between the community college instructors and UNCW faculty mentors. Although the instructor-mentor relationship was primarily consulting-based during the CCURE pilot, , we hope to develop closer relationships that could evolve into co-teaching partnerships.

Assessment of CCURE Pilot

We knew that it was critical to document both processes and outcomes from the CCURE pilot phase in order to advocate for additional resources to sustain and scale the program in the future. Therefore, we developed an initial assessment to collect feedback from stakeholders engaged in CCURE (i.e., instructors and students) and further refine the goals of CCURE. Data collection relied primarily on the pre- and post-surveys distributed through Qualtrics. The pre-and post-surveys included both quantitative data (Likert-scale) and qualitative data collected through open-ended reflection prompts, and they were administered at the start and end of the program, respectively.

Student Pre- and Post-Surveys

The student pre-survey was shared during the first week of class for HON 191. The pre-survey included questions about student demographics (i.e., gender, ethnicity, major, and transfer status) as well as two matrices that prompted students about their level of experience and comfort with research. The experience matrix utilized a four-point Likert scale that ranged from 1-none to 4-extensive for level of experience, while the comfort matrix utilized a five-point Likert scale that ranged from 1-strongly disagree to 5-strongly agree for level of comfort. The prompts for each question are included in Tables 1 and 2 below. Open-ended questions varied according to the timing of the survey (i.e., pre- v. post-). In the pre-survey, students were asked to set goals for engaging in the experience and to discuss their hopes and expected challenges. In the post-survey, students were asked to reflect on their overall experience, the strengths of the initiative, and what they would change and/or keep about the initiative in the future.

Instructor Pre- and Post-Surveys

Similar to the students who participated in CCURE, instructors were surveyed at both the start and end of the pilot. In the pre-survey, instructors were asked to reflect on their comfort with engaging partnerships and mentoring students, as well as their own research abilities. Instructors were also asked about their goals for CCURE, the outcomes they expect to see students achieve, and possible challenges they may encounter. The post-survey required instructors to reflect in-depth on their experiences as instructors in CCURE. Reflection prompts focused on the perceived impacts of CCURE on the students who engaged as well as the opportunities and benefits afforded to them as instructors. We also used the instructor post-survey to collect their feedback on the various elements of the program and to get critical feedback for future programming.

Table 1. *Student Demographics (N = 18)*

Category	Representation
Gender	6 Males (33.3%) 12 Females (67.7 %)
Race/Ethnicity	13 White (72.2%) 3 Asian American (16.7%) 1 Hispanic/Latino (5.6%) 1 Two or more races (5.6%)
Intended Major	8 STEM fields (44.4%) 4 Nursing (22.2%) 3 Psychology (16.7%) 1 Education (5.6%) 1 English (5.6%) 1 Sociology/PreLaw (5.6%)
Intended Transfer Institution **Participants were able to list more than one option for this item*.	8 UNCW 6 East Carolina University (ECU) 3 Undecided 2 NC State University 2 UNC at Chapel Hill

Table 2. *Level of Experience*

Rated Level of Experience	Pre-Average	Post-Average
Collecting Data	2.79	3.38
Analyzing Data	2.84	3.31
Presenting results in written papers or reports	2.79	3.50
Presenting results orally	2.63	3.00
Writing research questions	2.05	2.94
Conducting a literature review	2.63	3.13

Data Analysis

The data collected in the pre-post surveys were analyzed using a constant comparative method that most closely resembles a concurrent mixed-methods approach (e.g., Tashakkori & Teddlie, 2003). Descriptive statistics were conducted on quantitative data to examine patterns in responses and compare differences in pre-post ratings. Since all survey responses were anonymous and included less than 20 total responses, only means were calculated and compared for real differences. Frequencies for demographic variables were also compiled and are reported below. Open-ended responses (i.e., qualitative data) were independently reviewed by all team members to interpret the

data and identify themes in a process that most closely resembled open coding (Strauss & Corbin, 1990). We engaged in multiple discussions about our codes and agreed upon the themes presented below. This process helped ensure the trustworthiness of our findings through triangulation (Lincoln & Guba, 1985).

CCURE Students and Instructors

A total of 19 students from three community colleges successfully completed the CCURE pilot initiatives in Spring 2021. Table 1 represents the self-reported[2] demographic data from 18 participants who completed the post-survey; one participant did not respond. Student participants were majority white (72.2%) and female (67.7%) interested in majoring in various STEM[3] fields (44.4%), Nursing (22.2%) and Psychology (16.7%). While several participants were interested in transferring to UNCW, most had other intentions.

CCURE instructors were recruited from current faculty at the partnership community colleges engaged in the pilot. The CCURE instructors were all affiliated with Honors and/or scholars' programs at their respective institutions, and they represented a range of disciplines from English to Biology. CCURE instructors were paired with UNCW faculty members from comparable disciplines who could serve as peer mentors. UNCW faculty mentors were recruited from current FYRE instructors with prior experience leading undergraduate research projects[4]. UNCW faculty mentors were paid a stipend for their time meeting with CCURE instructors and engaging with CCURE students.

Assessment Results

Likert-Scale Data from Student Pre-Post Surveys

One set of Likert scale data included in the pre- and post-surveys focused on students' experience with various aspects of research. Table 2 demonstrates that students reported higher levels of experience with all aspects of research, including presenting the results in both written and oral formats, in the post-survey. The differences from pre- to post-survey responses range from 0.37 for presenting results orally to 0.89 for writing research questions, with five of the six aspects of research increasing by at least a half-point on a four-point Likert scale. When compared with open-ended responses, we are confident in concluding that students who participated in CCURE reported higher levels of experience with the aspects of research included in Table 2.

The second set of Likert-scale data included in the pre- and post-surveys focused on students' comfort and confidence with engaging in various aspects of research. Table 3 below summarizes the average results from both pre- and post-survey responses and shows that CCURE students started with a higher-than-expected average rating on nearly all aspects of comfort and confidence with research. For example, the pre-survey average for five of the seven prompts was 4.21 or higher on a five-point Likert scale, which leaves little room for growth in the post-survey. While post-survey results suggest some change in comfort and confidence, we believe that either these prompts were not effectively framed for these students or that their recruitment from Honors-like programs may have contributed to more confidence than we expected. When compared with open-ended responses, we note that while some students who started with low levels did experience growth in

---

[2] Student demographic data were self-reported and collected in the post-survey. We have neither requested nor tracked institutional data related to student or institutional demographics.

[3] Although Nursing and Psychology may both be considered STEM fields, this statement references other STEM fields in addition to Nursing and Psychology.

[4] We believe it is important to explicitly recognize and thank the community college instructors who engaged in this experience, including Kate Amerson, John Metzger, and Jarrett Whelan, and UNCW mentors, including Kate Bruce, Kevin Kizer, and Julie Ann Scott.

confidence, most students were focused on the experiences provided by CCURE and the associated benefits.

Table 3. *Level of Comfort*

Rated Level of Comfort	Pre-Average	Post-Average
I've taken a course that involves research.	3.84	4.25
I am confident that I have the ability to engage in research.	4.21	4.38
I am comfortable participating in a research project.	4.21	4.38
I am comfortable discussing research with a faculty member.	4.21	4.25
I am comfortable writing a research proposal.	3.79	3.88
I am comfortable engaging in a mentoring partnership.	4.32	4.13
I will engage in research again after this experience.	4.26	4.38

Open-Ended Responses from Student and Instructor Pre-Post Surveys
Three themes emerged after our analysis of the open-ended responses collected from both students and instructors who participated in the CCURE pilot initiative: 1) access, 2) positive outcomes from engagement, and 3) collaboration leading to change.

Access. Multiple aspects of access were discussed by the participants, particularly in their post-survey responses. Access to resources in general was noted by multiple students. One noted that "As a result of my participation in CCURE, I have learned so much more on how to utilize different tools available and overall, how to better conduct research. I have learned how to better navigate the way in which I ask research questions and my overall understanding of research has been greatly built upon all throughout the course!" Another student commented on access to library resources and support for creating a research poster (a required final product for students): "The online library resources from UNCW are very helpful. Videos on how to make a poster is what I have not experienced prior to the CCURE." Even among students who had prior research experience, CCURE provided additional benefits. For example, one student reflected that "At the beginning of the course, I did have some research related-skills. This course has helped me to hone them, as well as showed me some new resources I can use."

Some students noted that the design of CCURE, which did not include any cost to the student participants, provided access they would not have otherwise had because of their identities as parents, adult learners, and lower socioeconomic status. For example, one student-parent shared that "I enjoyed every bit of this class and I am very appreciative for the opportunity to come to UNCW and experience the research family. Thank you for offering this class for free. As a single dad I probably would have not been able to afford a class at UNCW outside of my degree plan." The instructors reflected on access and how CCURE affected the community college students who participated. One instructor shared that "One student has talked about transferring to UNCW for two

years. His financial situation will make the transfer extremely difficult. He was so excited to participate and is doubly determined to find scholarships to make the transfer to UNCW next year."

The instructors also emphasized the value that access to resources played for the community college students who participated in CCURE. One instructor, in particular, reflected on the value of access to resources:

> When students are asked to conduct scholarly research, they often are overwhelmed by the resources they are asked to explore. Their natural default is Google searches. In our classes, we teach students how to search the college's academic databases. We tell them they will use many of the same databases when they transfer to a university. The students in CCURE course were given access to the UNCW Randall Library and were given the opportunity to learn how to navigate academic databases. Our course used Randall librarian tutorials and Credo Reference mind maps and other resources to gain a firm understanding of periodical types, advanced search tools, and subject specific databases. Students were given access to UNCW's Canvas [Learning Management System]. Learning to navigate a different learning platform provided another edge for students planning to transfer. They were given tools from the Honors College and CSURF to create research style poster sessions. Overall, I observed the nervousness of the students at the beginning of the term vs. the confidence they exhibited through their final projects. UNCW welcomed these students into the Honors College and created an eagerness to prove they were worthy of the investment.

Positive outcomes from engagement. Nearly every student identified positive outcomes from their engagement in CCURE. Some succinctly stated specific skills they developed: "[I have] learned more about writing research questions;" "Before I took the class, I had little experience with collecting and analyzing data. Now after taking the class, I have more experience;" and "My data collection has definitely improved. My ability to synthesize research into a cohesive main point." One student went into greater detail about how the course provided her with new knowledge about research as well as skills she can use in the future: "I did not know what to expect from the CCURE program. I knew the course dealt with scientific research, but I was not aware of what I would learn from the experience. After the course, however, I easily noticed the benefits. The class was primarily a hands-on experience. It taught me how to document, analyze, and present results from experiments in a scientific manner." These reflections are consistent with the quantitative findings discussed above, which showed that students reported increased levels of experience with different aspects of research (see Table 2).

Students also reflected on how the experience affected their confidence to engage in research in the future. One student succinctly stated, "I am much more comfortable participating in research projects. I will be seeking more research opportunities in the future." Although ratings were high for most students on comfort with research in both the pre- and post-surveys, one student commented on how the experience directly raised their confidence: "Before engaging in this class, my comfort was very low with no confidence but now that I have done the research and learned how to do it right. My comfort and confidence have gone up because of this class and I feel that I can be proud of my work."

The instructors noted students' growth in confidence as well. One instructor reflected on the fact that a student "stated that this was the first time in her life that she felt her ideas were important and worth considering." A powerful statement about the positive effects of the initiative was reflected in another instructor's comments: "It was very rewarding to witness growth in such a short time. Each

student in the class experienced a level of growth and understanding that I normally do not see in my other classes. This gave me an incredible sense of pride and accomplishment that is often not visible in a typical class." The positive outcomes from engagement suggest that the experience was transformational for both students and instructors and we, indeed, see opportunities for sustainable change as a result of the collaborations developed through CCURE.

Collaboration leading to change. We do not want to overstate the benefits of a short-term initiative that engaged a relatively small number of students; however, as the instructors shared in their reflections, there are aspects of the CCURE initiative that have the potential to change the dynamics between UNCW and its partner community colleges. As one instructor summarized in his final comments: "The partnership with UNCW makes involvement in CCURE more attractive to students. Additionally, these types of relationships with four-year institutions help mitigate the stigma that is often, and sadly, associated with the perceptions of community college." Another instructor noted that "in this, all parties benefit. I have benefitted by expanding my network and making new contacts at UNCW. This will also benefit CFCC by providing better links between these two institutions. Students in these classes feel empowered to succeed and feel that their ideas have value. This program can have a lasting effect by giving two-year students a 'leg up' on their peers." We are grateful to see that our intention to build mutually beneficial partnerships was reflected in instructors' perceptions of CCURE.

Instructors also reflected on the direct connections that resulted from the partnerships established via CCURE, which have the potential to be transformational for individual students. One instructor explicitly described the ways in which the CCURE partnership positively impacted a student in his CCURE section: "My faculty mentor made UNCW campus contacts for students interested in Marine and Environmental Biology and internships at the Sea Turtle Rescue Hospital. One student registered for this course specifically to learn more about these opportunities and was emotional when the contacts were made on her behalf." Although this effort may have been minimal for the UNCW faculty mentor, such connections are critical to opening pathways for students that can lead to continued engagement in HIPs like undergraduate research (e.g., Kuh et al., 2017) and reflect our intentional design.

Another instructor discussed how meaningful CCURE was in renewing his interest in promoting undergraduate research at his institution:

> My background is in basic research with more than 12 years of experience before starting in the community college seven years ago. Initially, my goal was to bring a research program to the college. Unfortunately, while we had the resources, we found it challenging to recruit students interested in biotechnology. CCURE has provided me with a renewed excitement about bringing research to the college and utilizing resources that we already have to get students involved in science.

Although we expected some benefit to the instructors who participated in CCURE, we had not anticipated the direct effect on instructors' motivation to participate in research and/or support research among their students.

Finally, instructors also noted the institutional connections that were established with the gift bags of free UNCW-branded "swag" (e.g., t-shirts, stickers, notebooks) as well as our efforts to directly support students. One instructor discussed the excitement created at her community college by the free "swag" sent to participants: "This collaboration has created an excitement . . . for students who already have an interest in transferring to UNCW. It is also swaying Associate of Science students as they hear current students talk about their experiences in this course. . . The UNCW team sent

Honors College and Watson College of Education t-shirts and other "swag" to each participant. I have seen those t-shirts being proudly worn on campus." A second instructor reflected on the meaning that students associated with CCURE: "UNCW also has done a really good job of supporting the students and making them feel welcome. For example, really awesome swag bags were delivered to the students. This may not seem like much, but it really goes a long way in making the students feel appreciated and supported." The instructor concluded, "But the real takeaway was the overwhelming feeling of accomplishment that students revealed at the end of the course." We hope that feeling leads students into future undergraduate research experiences that further their development after transferring.

Discussion and Recommendations

The purpose of CCURE was to develop a pre-transfer experience that could intentionally open pathways for community college students to engage in undergraduate research post-transfer to UNCW or another four-year institution. We designed the program aligning with HIPs (Kuh, 2008; Kuh et al., 2017) and promising practices for undergraduate research experiences that include mentorship and applied learning, among other factors (e.g., Chamely-Wiik et al., 2021; Ketcham et al., 2017). Findings from our analysis of assessment data demonstrate positive outcomes for both students and faculty engaged in the experience. However, we acknowledge that we will not know the true success of the initiative until we can track students longitudinally. Indeed, one recommendation (and an action item for our team) is to develop a more comprehensive assessment process that includes longitudinal measures.

Still, we are encouraged by our initial findings which support our primary goal of opening access for students as many acknowledged that they would not otherwise have had access to such an experience. Chamely-Wiik et al. (2021) emphasized that opportunities to engage in high-impact undergraduate research experiences can be a primary barrier for community college and transfer students. CCURE's intentional approach to enroll community college students in a research experience *before* transferring was successful at opening an initial entry point to a research-based pathway. While this finding is notable, we anticipated more diversity in terms of race and ethnicity than what was represented among the community college participants in the pilot. One lesson learned is that we need to be more explicit in our recruitment of non-white and male participants in future iterations. We also seek saturation across other marginalized identities, including non-traditional student populations like parents, adults, and military-affiliation, among others, and need to intentionally build that effort into the recruitment process in the future.

Throughout their reflections, students and instructors clearly described the benefits of engaging in the CCURE initiative, which aligned with many of the positive outcomes of engaging in undergraduate research identified in previous scholarship (e.g., Chamely-Wiik et al., 2021; Ketcham et al., 2017). For example, participation in CCURE provided students with meaningful opportunities to practice research skills and engage in collaborative work with peers and faculty members. We intentionally designed CCURE to align with other successful high-impact learning experiences, particularly an emphasis on supporting student-faculty mentoring relationships, which are especially meaningful in undergraduate research experiences.

In order to facilitate the mentoring relationships between CCURE faculty and students, we hired community college instructors as adjuncts at UNCW. The instructors were paid a stipend for teaching HON 191, but they were also provided with an additional stipend for their time mentoring students and meeting with their assigned UNCW mentors. This structure rewarded the CCURE instructors for their contributions, supported students' learning and development throughout the experience, and helped CCURE overall to maintain a connection with each of the community colleges that participated in the program.

As indicated in the assessment findings above, students benefited in multiple ways from the mentorship they received from their CCURE instructors. In fact, our assessment findings demonstrate similar outcomes as other scholars who have researched faculty-mentored research experiences. Notably, students made close connections to their peers and faculty members (Foertsch, 2019; Sell et al., 2018) that helped them learn to negotiate the relationship and to develop a supportive network (Bage, 2019; Ketcham et al., 2017). Students shared the direct benefits of getting connected with other individuals through their CCURE instructors. One student noted an outreach to the UNCW faculty mentor that resulted in a direct connection to other HIPs and experiential learning opportunities (i.e., internship, fellowship) related to the student's interest in researching sea turtles. Other students described the benefit of their instructor's efforts to connect them to UNCW resources, such as the library, as well as to services like financial aid and academic advising.

While it is notable that both students and instructors identified meaningful, positive outcomes from their engagement in CCURE, the initial pilot occurred over a short period of time -- eight weeks. Future iterations of CCURE will extend across a full 15-week semester in order to extend the experience and opportunities for engagement, but it is important to consider that even a short-term initiative can have a positive impact on students. Institutions seeking to develop similar initiatives should not be deterred from doing so based on duration or size of the program. Our findings suggest that even a short duration program can have meaningful effects on students, and initiatives with small numbers of participants can create meaningful opportunities to work with partners.

The value of partnerships and collaboration in this work cannot be understated. While we hoped that we could bring about some meaningful change through the collaborations we supported, we did not fully understand the potential that existed in bringing community college and four-year institution stakeholders together to do this work. CCURE instructors and UNCW faculty mentors established relationships that have contributed to multiple tangible outcomes, including at least one application for external funding to date and plans for co-teaching opportunities outside of CCURE.

UNCW's investment in resources that directly supported current community college students has resulted in several benefits to the institution as well. It is important to know that nearly half of the new students who enrolled at UNCW in 2020 were transfer students from other institutions[5]. In this context, despite of being a relatively small group of students, the CCURE pilot included at least eight community college students who were interested in or had already applied to UNCW. Those students will have advanced preparation and access for engaging in undergraduate post-transfer. Additionally, UNCW leadership has been able to share CCURE as an example of mutually beneficial partnerships with community colleges. Although we do not immediately know the full value of these relationships, our assessment findings and subsequent planning for future iterations of the initiative suggest the potential for sustainable change and development of a truly collaborative culture between UNCW and our community college partners.

References

Auchincloss, L. C., Laursen, S. L., Branchaw, J. L., Eagan, K., Graham, M., Hanauer, D. I., Lawrie, G., McLinn, C. M., Pelaez, N., Rowland, S., Towns, M., Trautmann, N. M., Varma-Nelson, P., Weston, T. J.,

[5] UNCW enrolled 1953 new transfers out of 3978 total new students in 2019. Thus, 49% of new students in 2019 were transfer students. Institutional data were adapted from public dashboards (https://UNCW.edu/irp/id/dashboards.html) available from UNCW's Office of Institutional Research and Planning.

& Dolan, E. L. (2014). Assessment of course-based undergraduate research experiences: A meeting report. *CBE--Life Sciences Education*, *13*(1), 29–40.

Bage, G. (2019). Putting research first? Perspectives from academics and students on first-year undergraduates learning research. *Student Success*, *10*(1), 73-87.

Bangera, G., & Brownell, S. E. (2014). Course-based undergraduate research experiences can make scientific research more inclusive. *CBE--Life Sciences Education*, *13*(4), 602–606.

Bowman, N. A., & Holmes, J. M. (2018). Getting off to a good start? First-year undergraduate research experiences and student outcomes. *Higher Education, 76*(1), 17–33.

Chamely-Wiik, D., Frazier, E., Meeroff, D., Merritt, J., Johnson, J., Kwochka, W. R., Morrison-Shetlar, A. I., Aldarondo-Jeffries, M., & Schneider, K. R. (2021). Undergraduate research communities for transfer students: A retention model based on factors that most influence student success. *Journal of the Scholarship of Teaching and Learning*, *21*(1), 193-224.

Dolan, E. L. (2016). Course-based undergraduate research experiences: Current knowledge and future directions. *National Research Council Communications Paper*, *1*, 1-34. https://sites.nationalacademies.org/cs/groups/dbassesite/documents/webpage/dbasse_177288.pdf

Foertsch, J. (2019). Impacts of undergraduate research programs focused on underrepresented minorities: Twenty years of gradual progress and practices that contributed to it. *Scholarship and Practice of Undergraduate Research, 3*(2), 31-37.

Hewlett, J., Patton, M., & Bock, H., (2019). *Redefine, reinvent, reinvigorate*. Community College Undergraduate Research Initiative. https://38ee22dd-6114-4625-898b-718021ffc55d.filesusr.com/ugd/e84dcd_4065c35c83474d24bc300eb78a76ab9e.pdf

Ketcham, C. J., Hall, E. E., & Miller, P. C. (2017) Co-mentoring undergraduate research: Student, faculty, and institutional perspectives. *Perspectives on Undergraduate Research and Mentoring*, *6.1*. https://www.elon.edu/u/academics/undergraduate-research/purm/wp-content/uploads/sites/923/2019/06/final_Ketcham-Hall-Miller_main.pdf

Kuh, G. D. (2008). *High-impact educational practices: What they are, who has access to them, and why they matter*. Association of American Colleges and Universities.

Kuh, G. D., O'Donnell, K., & Schneider, C. G. (2017). HIPs at ten. *Change: The Magazine of Higher Learning*, *49*(5), 8-16.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Sage.

Linn, M. C., Palmer, E., Baranger, A., Gerard, E., & Stone, E. (2015). Undergraduate research experiences: Impacts and opportunities. *Science*, *347*(6222), 126175.

Lopatto, D. (2012). Undergraduate research as a high-impact student experience. *Peer Review*, *12*(2). https://www.aacu.org/publications-research/periodicals/undergraduate-research-high-impact-student-experience

McKinsey, E. (2016). Faculty mentoring undergraduates: the nature, development, and benefits of mentoring relationships. *Teaching & Learning Inquiry*, *4*(1), 25-39.

Price, D. V., & Tover, E. (2014). Student engagement and institutional graduation rates: Identifying high-impact educational practices for community college. *Community College Journal of Research and Practice*, *38*(9), 766-782.

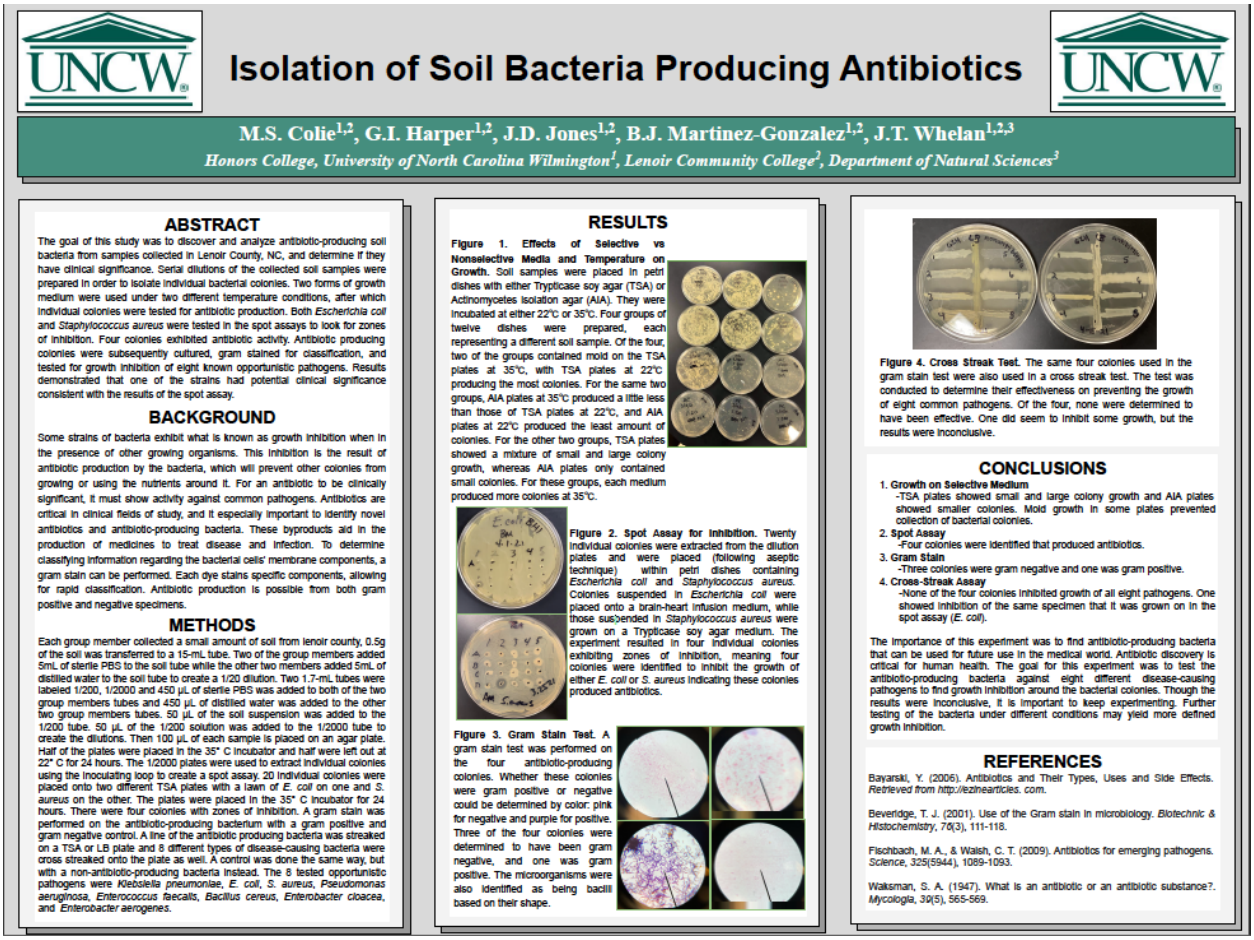
Sell, A. J., Naginey, A., & Stanton, C. A. (2018). The impact of undergraduate research on academic success. *Scholarship and Practice of Undergraduate Research, 1*(3), 19-29.

Strauss, A., & Corbin, J. (1990). *Basics of qualitative research: Grounded theory procedures and techniques.* Sage.

Sweat, J., Jones, G., Han, S., & Wolfgram, S. M. (2013). How does high impact practice predict student engagement? A comparison of white and minority students. *International Journal for the Scholarship of Teaching and Learning*, 7(2), 1-24.

Tashakkori, A., & Teddlie, C. (2003). The past and future of mixed methods research: From data triangulation to mixed model designs. In A. Tashakkori & C. Teddlie (Eds.), *Handbook of mixed methods in social & behavioral research* (pp. 671-701). Sage.

Appendix A



Isolation of Soil Bacteria Producing Antibiotics

M.S. Colie[1,2], G.I. Harper[1,2], J.D. Jones[1,2], B.J. Martinez-Gonzalez[1,2], J.T. Whelan[1,2,3]

Honors College, University of North Carolina Wilmington[1], Lenoir Community College[2], Department of Natural Sciences[3]

ABSTRACT

The goal of this study was to discover and analyze antibiotic-producing soil bacteria from samples collected in Lenoir County, NC, and determine if they have clinical significance. Serial dilutions of the collected soil samples were prepared in order to isolate individual bacterial colonies. Two forms of growth medium were used under two different temperature conditions, after which individual colonies were tested for antibiotic production. Both *Escherichia coli* and *Staphylococcus aureus* were tested in the spot assays to look for zones of inhibition. Four colonies exhibited antibiotic activity. Antibiotic producing colonies were subsequently cultured, gram stained for classification, and tested for growth inhibition of eight known opportunistic pathogens. Results demonstrated that one of the strains had potential clinical significance consistent with the results of the spot assay.

BACKGROUND

Some strains of bacteria exhibit what is known as growth inhibition when in the presence of other growing organisms. This inhibition is the result of antibiotic production by the bacteria, which will prevent other colonies from growing or using the nutrients around it. For an antibiotic to be clinically significant, it must show activity against common pathogens. Antibiotics are critical in clinical fields of study, and it especially important to identify novel antibiotics and antibiotic-producing bacteria. These byproducts aid in the production of medicines to treat disease and infection. To determine classifying information regarding the bacterial cells' membrane components, a gram stain can be performed. Each dye stains specific components, allowing for rapid classification. Antibiotic production is possible from both gram positive and negative specimens.

METHODS

Each group member collected a small amount of soil from lenoir county, 0.5g of the soil was transferred to a 15-mL tube. Two of the group members added 5mL of sterile PBS to the soil tube while the other two members added 5mL of distilled water to the soil tube to create a 1/20 dilution. Two 1.7-mL tubes were labeled 1/200, 1/2000 and 450 µL of sterile PBS was added to both of the two group members tubes and 450 µL of distilled water was added to the other two group members tubes. 50 µL of the soil suspension was added to the 1/200 tube. 50 µL of the 1/200 solution was added to the 1/2000 tube to create the dilutions. Then 100 µL of each sample is placed on an agar plate. Half of the plates were placed in the 35° C incubator and half were left out at 22° C for 24 hours. The 1/2000 plates were used to extract individual colonies using the inoculating loop to create a spot assay. 20 individual colonies were placed onto two different TSA plates with a lawn of *E. coli* on one and *S. aureus* on the other. The plates were placed in the 35° C incubator for 24 hours. There were four colonies with zones of inhibition. A gram stain was performed on the antibiotic-producing bacterium with a gram positive and gram negative control. A line of the antibiotic producing bacteria was streaked on a TSA or LB plate and 8 different types of disease-causing bacteria were cross streaked onto the plate as well. A control was done the same way, but with a non-antibiotic-producing bacteria instead. The 8 tested opportunistic pathogens were *Klebsiella pneumoniae*, *E. coli*, *S. aureus*, *Pseudomonas aeruginosa*, *Enterococcus faecalis*, *Bacillus cereus*, *Enterobacter cloacea*, and *Enterobacter aerogenes*.

RESULTS

Figure 1. Effects of Selective vs Nonselective Media and Temperature on Growth. Soil samples were placed in petri dishes with either Trypticase soy agar (TSA) or Actinomycetes isolation agar (AIA). They were incubated at either 22°C or 35°C. Four groups of twelve dishes were prepared, each representing a different soil sample. Of the four, two of the groups contained mold on the TSA plates at 35°C, with TSA plates at 22°C producing the most colonies. For the same two groups, AIA plates at 35°C produced a little less than those of TSA plates at 22°C, and AIA plates at 22°C produced the least amount of colonies. For the other two groups, TSA plates showed a mixture of small and large colony growth, whereas AIA plates only contained small colonies. For these groups, each medium produced more colonies at 35°C.

Figure 2. Spot Assay for Inhibition. Twenty individual colonies were extracted from the dilution plates and were placed (following aseptic technique) within petri dishes containing *Escherichia coli* and *Staphylococcus aureus*. Colonies suspended in *Escherichia coli* were placed onto a brain-heart infusion medium, while those suspended in *Staphylococcus aureus* were grown on a Trypticase soy agar medium. The experiment resulted in four individual colonies exhibiting zones of inhibition, meaning four colonies were identified to inhibit the growth of either *E. coli* or *S. aureus* indicating these colonies produced antibiotics.

Figure 3. Gram Stain Test. A gram stain test was performed on the four antibiotic-producing colonies. Whether these colonies were gram positive or negative could be determined by color: pink for negative and purple for positive. Three of the four colonies were determined to have been gram negative, and one was gram positive. The microorganisms were also identified as being bacilli based on their shape.

Figure 4. Cross Streak Test. The same four colonies used in the gram stain test were also used in a cross streak test. The test was conducted to determine their effectiveness on preventing the growth of eight common pathogens. Of the four, none were determined to have been effective. One did seem to inhibit some growth, but the results were inconclusive.

CONCLUSIONS

1. **Growth on Selective Medium**
   -TSA plates showed small and large colony growth and AIA plates showed smaller colonies. Mold growth in some plates prevented collection of bacterial colonies.
2. **Spot Assay**
   -Four colonies were identified that produced antibiotics.
3. **Gram Stain**
   -Three colonies were gram negative and one was gram positive.
4. **Cross-Streak Assay**
   -None of the four colonies inhibited growth of all eight pathogens. One showed inhibition of the same specimen that it was grown on in the spot assay (*E. coli*).

The importance of this experiment was to find antibiotic-producing bacteria that can be used for future use in the medical world. Antibiotic discovery is critical for human health. The goal for this experiment was to test the antibiotic-producing bacteria against eight different disease-causing pathogens to find growth inhibition around the bacterial colonies. Though the results were inconclusive, it is important to keep experimenting. Further testing of the bacteria under different conditions may yield more defined growth inhibition.

REFERENCES

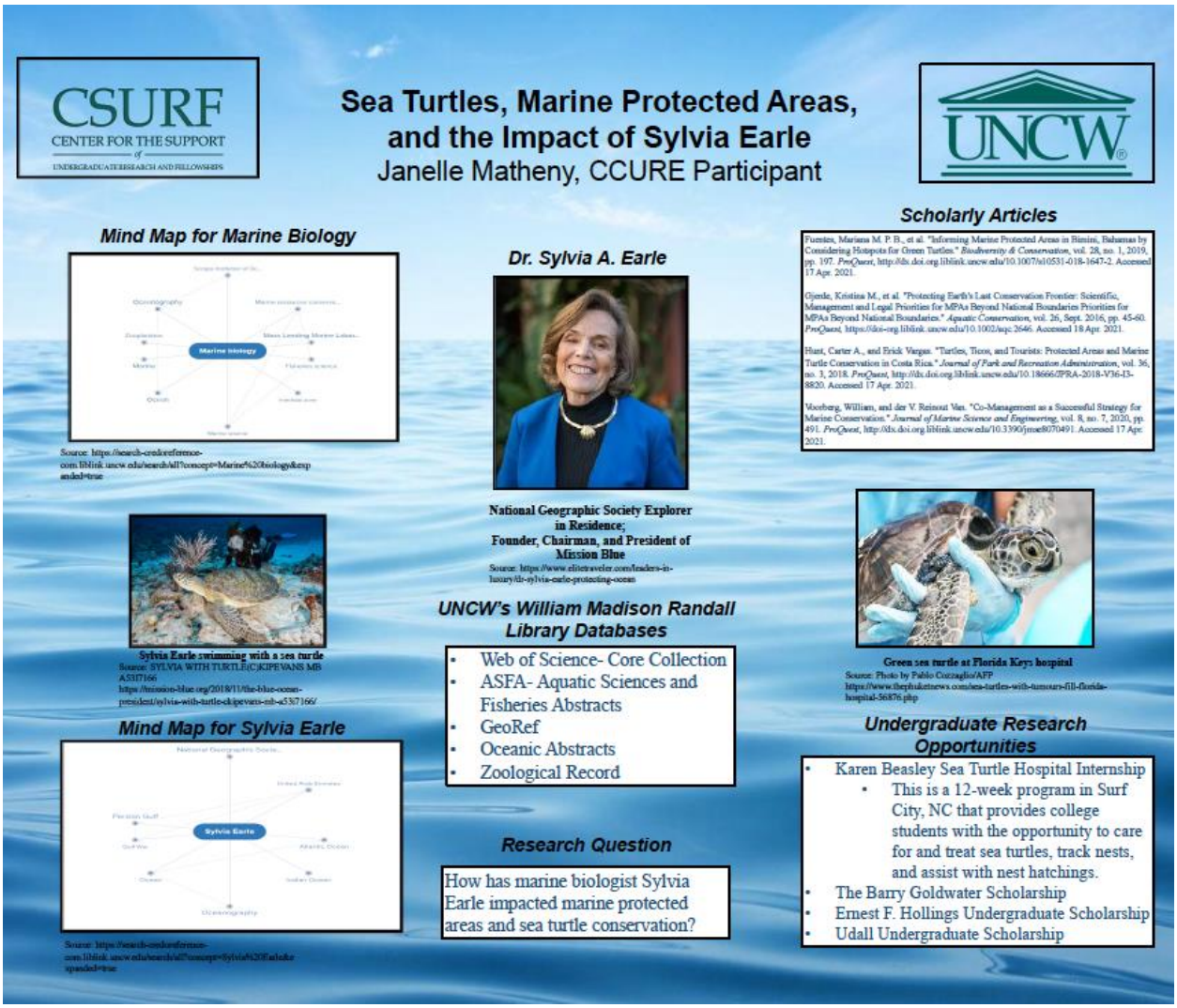
Bayarski, Y. (2006). Antibiotics and Their Types, Uses and Side Effects. *Retrieved from http://ezinearticles. com.*

Beveridge, T. J. (2001). Use of the Gram stain in microbiology. *Biotechnic & Histochemistry*, *76*(3), 111-118.

Fischbach, M. A., & Walsh, C. T. (2009). Antibiotics for emerging pathogens. *Science*, *325*(5944), 1089-1093.

Waksman, S. A. (1947). What is an antibiotic or an antibiotic substance?. *Mycologia*, *39*(5), 565-569.

Appendix B


CSURF
CENTER FOR THE SUPPORT of UNDERGRADUATE RESEARCH AND FELLOWSHIPS
Sea Turtles, Marine Protected Areas, and the Impact of Sylvia Earle
Janelle Matheny, CCURE Participant
UNCW
Mind Map for Marine Biology
Marine biology
Source: https://search-credoreference-com.liblink.uncw.edu/search/all?concept=Marine%20biology&expanded=true
Dr. Sylvia A. Earle
National Geographic Society Explorer in Residence;
Founder, Chairman, and President of Mission Blue
Source: https://www.elitetraveler.com/leaders-in-luxury/dr-sylvia-earle-protecting-ocean
Scholarly Articles
Fuentes, Mariana M. P. B., et al. "Informing Marine Protected Areas in Bimini, Bahamas by Considering Hotspots for Green Turtles." Biodiversity & Conservation, vol. 28, no. 1, 2019, pp. 197. ProQuest, http://dx.doi.org.liblink.uncw.edu/10.1007/s10531-018-1647-2. Accessed 17 Apr. 2021.
Gjerde, Kristina M., et al. "Protecting Earth's Last Conservation Frontier: Scientific, Management and Legal Priorities for MPAs Beyond National Boundaries Priorities for MPAs Beyond National Boundaries." Aquatic Conservation, vol. 26, Sept. 2016, pp. 45-60. ProQuest, https://doi-org.liblink.uncw.edu/10.1002/aqc.2646. Accessed 18 Apr. 2021.
Hunt, Carter A., and Erick Vargas. "Turtles, Ticos, and Tourists: Protected Areas and Marine Turtle Conservation in Costa Rica." Journal of Park and Recreation Administration, vol. 36, no. 3, 2018. ProQuest, http://dx.doi.org.liblink.uncw.edu/10.18666/JPRA-2018-V36-I3-8820. Accessed 17 Apr. 2021.
Voorberg, William, and der V. Reinout Van. "Co-Management as a Successful Strategy for Marine Conservation." Journal of Marine Science and Engineering, vol. 8, no. 7, 2020, pp. 491. ProQuest, http://dx.doi.org.liblink.uncw.edu/10.3390/jmse8070491. Accessed 17 Apr. 2021.
Sylvia Earle swimming with a sea turtle
Source: SYLVIA WITH TURTLE/C.KIPEVANS MB A5307166
https://mission-blue.org/2018/11/the-blue-ocean-president/sylvia-with-turtle-ckipevans-mb-a5307166/
Green sea turtle at Florida Keys hospital
Source: Photo by Pablo Cozzaglio/AFP
https://www.thephuketnews.com/sea-turtles-with-tumours-fill-florida-hospital-56876.php
UNCW's William Madison Randall Library Databases
Web of Science- Core Collection
ASFA- Aquatic Sciences and Fisheries Abstracts
GeoRef
Oceanic Abstracts
Zoological Record
Mind Map for Sylvia Earle
Sylvia Earle
Source: https://search-credoreference-com.liblink.uncw.edu/search/all?concept=Sylvia%20Earle&expanded=true
Research Question
How has marine biologist Sylvia Earle impacted marine protected areas and sea turtle conservation?
Undergraduate Research Opportunities
Karen Beasley Sea Turtle Hospital Internship
This is a 12-week program in Surf City, NC that provides college students with the opportunity to care for and treat sea turtles, track nests, and assist with nest hatchings.
The Barry Goldwater Scholarship
Ernest F. Hollings Undergraduate Scholarship
Udall Undergraduate Scholarship