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Finger Lakes Community College

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he Community College Undergraduate Research Initiative (CCURI) is a national consortium of community colleges, four-year schools, government agencies, and private organizations dedicated to the development, implementation, and assessment of sustainable models for integrating an undergraduate research (UR) experience into community college STEM programs. This project is aligned with recommendations from a variety of reports and publications, including Vision and Change in Undergraduate Education, A Call to Action and The President’s Council of Advisors on Science and Technology (PCAST) report Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics.

The characterization of the reform of undergraduate science education has been extensive, and reports from a variety of organizations have converged on some common features. At the core of this convergence is a recommendation that inquiry-based methods of teaching and UR experiences be integrated into the curriculum. Conceptual understanding of scientific principles can be enhanced through inquiry-based instruction and Problem-Based Learning (PBL) strategies. UR experience should be integrated, as early as is practical, in the education of science and engineering students. In addition, reform efforts must have a well-defined strategy of assessment that involves a process of evaluation tailored to the specific mission and student demographic of the institution.

A recent analysis of high-impact educational practices identified UR as one of the most powerful tools for promoting deep learning. Deep and integrative approaches to learning receive considerable attention in higher education because students who are exposed to these approaches have been shown to perform at higher levels (measured as higher grades) and retain, integrate, and transfer information with greater proficiency.

Utilizing the latest available statistics (Fall 2012) the American Association of Community Colleges reported that an estimated 12.8 million students were enrolled at a community college. These numbers account for 45% of all U.S. undergraduates. These large enrollment numbers highlight the increasing impact that community colleges are having on the education of postsecondary students in the United States. The impact is equally dramatic when considering the role that community colleges play in the education of science and engineering students. According to a NSF Report from Mooney and Foley, from 2001 to 2007, the percentage of science, engineering, and health graduates who had ever attended community college has remained at approximately 50%. From these statistics, it is clear that the community college must take a leadership position in implementing reform efforts involving UR to ensure that any national comprehensive effort...
to enhance the STEM pipeline will be successful. This effort faces many barriers that are unique to the community college as an institution, and effective models of integration and implementation at this institution type are sparse and ill defined. While evidence continues to mount regarding what needs to be accomplished, little is known about how to achieve the desired reform. What is needed is a model of reform that can be tested, evaluated, refined, characterized and disseminated to community colleges throughout the United States.

The concept of CCURI began in 2003 in the labs of Finger Lakes Community College where I spent several months with two students working on a project focused on studying morphometric correlates for sex determination in eastern Red-tailed hawks. The impact of that experience on those two students quickly became evident. The students were working on this project for no academic credit, and my commitment was not part of the normal teaching load. I became determined to formalize this experience for larger numbers of students moving forward. After several unsuccessful attempts to offer the experience as a stand-alone course, it was clear that a more comprehensive academic model would be required in order to embed the research experience into existing academic programming. We conducted a self-study using Root Cause Analysis (RCA) tools in an attempt to understand the barriers associated with developing research experiences for community college students. The use of RCA led to some very interesting outcomes that were not associated with financial barriers or the ill-prepared student (two often cited barriers). Not surprisingly, the results of the RCA analysis suggested that what was required was a paradigm shift from a culture of research or teaching, to one where research is teaching. This led to the construction of comprehensive model for changing the culture of a community college STEM program. This model incorporates five central themes that emerged from the RCA analysis.

**The adoption of active learning instructional strategies.** The research experience should be aligned with other widely accepted instructional pedagogies, including case-based learning, problem-based learning, and teaching with data.

**The creation of opportunities for advanced exploration of student research questions.** Institutions will need to create credit-bearing, transferable programs or courses that provide opportunities for students to explore research questions independently.

**The incorporation of a customized faculty development program.** Comprehensive reform of STEM programs should include strategic planning for professional development focused on pedagogical and research skills.

**The adoption of a compatible Community College faculty model.** The CCURI Faculty model is built upon a sustainable solution that addresses the issue of teaching loads. Heavy teaching loads are often cited as a barrier to the development of a UR program at a Community College. A culture of “research is teaching” and embedded research experiences are at the core of the CCURI model.

**The establishment of sustainable networks committed to STEM reform.** CCURI institutions have access to networks of institutions focused on UR and STEM reform. Dissemination and networking activities help institutions expand access to primary research questions and build a network of mentors.

With support from the National Science Foundation, the model was tested at FLCC as part of a pilot and eventually at five other community college partner sites in an effort to expand the program regionally. The results from these initial studies were used to propose a National network of community colleges focused on embedding the research experience into their programs. With close to $4M in funding from the National Science Foundation, CCURI is now a network of 38 institutions from Connecticut to Key West and Honolulu to Seattle. More than 350 faculty, laboratory technicians, and administrators are directly involved in managing undergraduate research programs at our partner sites, and as many as 5,500 students have now participated in activities associated with those programs.

What follows are some examples of the exemplary work that has been done at CCURI partner sites. I believe the existing research on innovation can be used to inform our understanding of how our partners have fostered a culture of research at their institution. CCURI partners who have successfully navigated a path of reform exhibit characteristics that are known to be representative of innovative organizations. For example, Delaware Technical Community College combined existing resources in novel ways. The resulting synergy will become evident as you read their story. At Everett Community College, the organization itself was restructured to align with a culture of research. Volunteer State Community College recognized that hiring practices could be leveraged to spur innovation with respect to integrating the research experience in their core offerings. In working with our partners, we have learned a great deal with respect to best practices and have collected an extensive data set on the impacts of the research experience on institutions, faculty, and students.

What is evident is that the community college faculty at our partner sites have tremendous passion, and their students have unlimited potential—two pieces of evidence that will become clear as you read their stories.

James A. Hewlett
Executive Director
Community College Undergraduate Research Initiative
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Six years ago, I was approached by several enthusiastic students, including my own son, who wanted to start a club so that biotechnology students could do research. We found some unscheduled time in the biotechnology lab and I gave up going home early on Friday afternoons. Thus began the ongoing saga of noisy, bustling Fridays in the lab with security officers ushering us out of the building at closing time.

This endeavor began in spring 2009, and during the first summer I worked with another instructor and 10 students who each designed his or her own project. The instructors worked full time so as to accommodate all of the students’ schedules. Realizing quickly that continuing in this manner was not sustainable, we began to look for long-term projects that the instructors would direct. That same summer, my son and I were volunteering at the White Clay Creek Preserve in Pennsylvania to help with bat emergence counts. As part of an important statewide bat monitoring project, we counted the bats that left their roost in the meeting house attic at dusk. One particularly hot and humid summer day, we visited the preserve to use a video camera to observe bats sitting at the entrance of the meetinghouse attic. As we entered the building, I noticed bat feces lying on the stoop and thought “DNA!” Thus the goal of the first long-term project I selected was to use DNA isolated from the feces to investigate population genetics of the large brown bat maternity colony in the preserve. As we learned about the use of DNA barcoding to identify insects, the project shifted to investigating the diet of the bats.

Today, the mentored research opportunities that we offer allow students to register for research courses during the academic year and the summer. Students are actively recruited from biology courses or learn about the opportunities from other students. There are usually six different long-term research projects available from which students can choose. With three instructors and senior research students around the labs, there is usually someone available to train less-experienced students. Many students have found that participating in research while learning the techniques in their courses helps reinforce their skills and helps them see the relevance of the techniques being taught. As students master skills and come to understand the goals of the project, they spend more time with the literature and make decisions on the direction of their particular component of the overall research project.

At the same time that the mentored research projects were being developed, we worked on incorporating research into several courses in the biotechnology/biological sciences program. Currently, we have a case study on white nose syndrome, a fatal fungal disease in bats, in introductory biology, culture-dependent analysis of soil microbiomes in a microbiology course, and culture-independent analysis of soil microbiomes in the biotechnology course. Depending on the directions that the mentored research projects take, other projects have been incorporated into the biotechnology courses, such as DNA barcoding to identify insects and cloning of bacterial genes from environmental isolates with sequenced genomes.

The impact on the students has been phenomenal. In biotechnology courses, even with the inevitable failures of research projects, I have never had such vested, engaged students. We work together to troubleshoot problems, and students come in outside of class time to re-do experiments. I will never forget the look of achievement on a student’s face when he finally succeeds in obtaining clones after a third try. Beginning with the
first cohort of students involved in the research, a strong sense of community has developed among the mentored research students. Our wing of the building is a place where the students have built a community and provide support for each other. For students such as Kaliopi Bousses, who contributed a student essay to this publication, the research experience improved her technical skills as well as her self-confidence. Her experience allowed her to successfully compete for research opportunities after she transferred to the University of Delaware.

Developing the program was not without its challenges. I had been out of research for several years and needed some updating on techniques. Fortunately, Delaware Technical Community College is part of statewide networks supported by the National Institute of General Medical Sciences IDeA Networks of Biomedical Research Excellence (INBRE) and National Science Foundation Experimental Program to Stimulate Competitive Research (EPSCoR) grants. These grants provided support for professional development and supplies for project development. I was also able to form collaborations with scientists at other institutions and have access to sequencing and bio-imaging facilities at the University of Delaware. Embedding research into courses provides a more engaging experience for both instructors and students, but it requires more preparation time and leads to more uncertainties in experimental results. The excitement that the students and I feel when we are successful, however, is well worth the extra work. I also use the students’ research projects in my courses as examples of tackling real-world problems.

As with most projects that lead to changes in institutional culture, convincing other faculty members and administrators that research is an effective teaching method was a challenge. This became easier as the students had more success in gaining jobs, had successful summer research experiences at four year institutes, and as they began being accepted when they applied to present posters at national conferences. Working with the college’s institutional-research office to track students and show an increase in the retention and graduation rates of our research students has been instrumental in solidifying support for undergraduate research.

Looking back at the development of the program, there are critical components that have facilitated the program’s development over the years. These include involving as many instructors from the department as possible so as to distribute the work of program management and the mentoring of students. Also key is fostering good relationships with college administrators, personnel in the business and marketing offices, and administrative assistants. It is important to articulate to those individuals how undergraduate research and student success support the college’s mission and strategic directions. Other advice: Pursue grant opportunities. Inform the community and regional industry about the program and student successes. Develop a network of collaborators and instructors from other community colleges who are engaged in similar projects.

Despite the challenges, those of us who work with students find it to be an extremely rewarding experience both personally and professionally. If you catch me on a Monday morning after a rare restful weekend, I could truthfully say that this has been the most rewarding six years of my professional career.

...the most rewarding six years of my professional career.
Kaliopi Bousses

Growing up, I had an inclination toward classes such as biology and chemistry, as they provided me with the knowledge needed to explore the world around me. That inclination remained with me even after my family moved to Greece, in order for my siblings and me to experience our Greek heritage. Upon graduating from high school in Greece, I entered a molecular-biology program in a university there. I was disappointed with the structure of the program, however, as it did not provide the educational stimulation I expected to get at a college-level institution. The lectures were dry, and except for the labs accompanying classes, there were not many opportunities for practicing what we were being taught. Being a hands-on person, this was something I required in order to grasp the material. This led to my decision to return to the United States in order to seek better options for gaining practical experience while attending college.

Prior to my return to the U.S., I researched Delaware institutions that offered biology programs and found that Delaware Technical Community College (DTCC) offered a strong two-year program in biotechnology that included intensive lab work in all the science classes. I spoke to an advisor in the Department of Biology & Chemistry at DTCC about my prior experience, and she suggested I enroll in a learning community designed by faculty member Virginia Balke and other instructors. This program incorporated undergraduate research alongside the coursework students were expected to complete. This was the opportunity I was seeking.

In fall 2011, I started studying a population of big brown bats. I spent most of my time becoming familiar with the research techniques of biotechnology. Dr. Balke and more-experienced students were always available to help and teach new things. My research eventually focused on using cloning techniques to determine what insects big brown bats were eating. As I continued with the project, I added more skills that proved to be helpful, not only in my courses, but also in my everyday life as well. I was able to learn how to properly manage my time, to work with a diverse group of people, and to build my confidence. Furthermore, I made lasting friendships with fellow research students and later was able to help incoming students with their projects. The lab was a place where we could work on our research, de-stress, and vent to each other about our courses. Further, with the research we were doing incorporated into courses, I was more successful in my biotechnology classes and could grasp the material beyond a theoretical level.

Two-thirds of the CCURI partners leveraged their involvement in CCURI to bring in additional funding or in-kind contributions to support their CCURI activities, totaling over $1.67 MILLION.
On a professional-development level, the undergraduate research program at DTCC enabled me to attend many conferences, where I had the opportunity to present my findings and network with experts in the field. Moreover, my undergraduate research allowed me to build a strong resume and put me at an advantage when applying for internships.

Undergraduate research at DTCC was the driving force that encouraged me to continue my education, undertake research in molecular ecology, and answer environmental questions that interested me. More students opting to start their education at community colleges should be given the opportunity to gain practical experience, especially if they plan to seek for employment immediately after graduating. Research programs such as those sponsored by the Community College Undergraduate Research Initiative provide students with exactly the tools they require.
The Mathematics & Sciences Department (MSD) at Kapi’olani Community College (KapCC) in Honolulu, Hawai’i is charged with satisfying the academic needs of students through course offerings in math and science in the Career and Technology Education (CTE) and the liberal arts programs. In 2005, when MSD was awarded a National Science Foundation Tribal Colleges and University Program (TCUP) grant, an initiative to expand the number of native Hawaiian students pursuing a degree in STEM (science, technology, engineering, and mathematics) fields was undertaken.

In line with the mission of the University of Hawaii to serve as a model institution for providing educational services to native Hawaiians, this initiative was further invigorated when the department received approval to offer an associate of science in natural science degree in 2007, thus providing MSD with an avenue to enhance the academic progress of STEM students.

MSD faculty members have always tried various approaches to get students more actively engaged in pursuing their chosen fields. One of these is the undergraduate research experience (URE), to which students have enthusiastically responded. Our faculty members are dedicated and highly motivated mentors who are always looking for ingenious ways to help their students’ progress. In the physical sciences, for instance, research teams are formed and registered in NASA-Sponsored competitions where they are mentored by staff from NASA. This approach is designed so that students are provided with first-hand exposure to engineering that may be otherwise inadequate or lacking in KapCC. These teams then can participate in NASA-sponsored competitions on the U.S. mainland.

Nevertheless, as chairperson of MSD, I cannot downplay some concerns that dampened, if not hampered, the exemplary contributions our staff have made over the years. These issues include full teaching loads, the amount of time needed to appropriately mentor students, inadequate work/teaching space, insufficient funds, the need for support to sustain research initiatives, and faculty compensation. Proposals to ameliorate problems in these areas were put forward by the department and tabled by the administration in the past. More importantly, there was no structured undergraduate research program at the college, and undergraduate research activities were funded only by pass-through grants. As long as undergraduate research was not institutionalized through the curriculum, this approach was not sustainable over the long-term.

KapCC’s active participation in the NSF-funded Community College Undergraduate Research Initiative (CCURI) grant provided tremendous help to our academic staff in structuring our undergraduate research in STEM fields. In fact, the associated planning workshop that I, as department chair, faculty mentors in undergraduate research, and the vice chancellor for academic affairs attended provided us with an agenda to discuss our vision for undergraduate research in STEM fields and how its establishment should take root and grow. In our discussion, we revisited all the initiatives that were up and running and then set priorities for the next steps in a streamlined process that should guide us to achieve our overall goal. Consequently, a plan to establish and institutionalize the program took shape with support and encouragement from the administration through our vice chancellor.

The participants in the planning workshop agreed that some current laboratory courses had already been updated to include undergraduate research in the curriculum. Consequently, a request was...
submitted to the faculty senate to designate those courses as research intensive (RI) and thus allow a reduction in class size. Although the initial reception from some of our colleagues was less than enthusiastic, the request was finally approved with concurrence from the administration, after much lobbying and explanation of the rationale behind our initiative. Now the RI is a campus-wide designation that can be adopted by faculty from other disciplines who may be interested in developing a course or courses that will meet the RI-designated standards.

We also offer independent study courses that are research-oriented, with faculty mentoring students one-on-one. The curriculum committee, faculty senate, and administration subsequently approved our proposal for an umbrella STEM Research Course in which students can earn varying amounts of credits. The number of credits is commensurate with the complexity of the research topic agreed upon by the mentor and student. This initiative has worked well enough that course is now considered part of the faculty workload and is now fully integrated into the associate-degree curriculum in natural science and hence, is institutionalized and sustainable.

Student academic transcripts indicate which courses are research intensive.

The KapCC’s current undergraduate research program in STEM fields now includes recruitment of high-school students through the Summer Bridge Program. Students are engaged in STEM-related activities in addition to being enrolled in a college-level mathematics course. To improve retention of first-year students, they are enrolled in an “Introduction to STEM” multidisciplinary activity-based course. Many students seeking the associate’s degree in natural science engage in a variety of UREs.

The following quotes from faculty outline their reactions to these initiatives.

Said Herve Collin, assistant professor of physics and mentor of Holm Smidt, who contributed a student essay: “Incorporating undergraduate research in my curriculum not only assisted me to stay current with the current research in my field, but also allowed undergraduate students to think like future researchers, which changed dramatically my teaching pedagogy. The main impact I observed in students is the significant increase in self-confidence … and their willingness to mentor other students going through the same experience.”

Observed Matthew Tuthill, assistant professor of microbiology: “Incorporating UR into my course has given the students opportunities to explore capacious topics and develop contemporary lab techniques beyond those of traditional lab courses. Because students gain conceptual and technical skills at an enhanced rate, the transition into directed-study UR projects is more efficient, while also allowing undergraduate students to think like future researchers, which changed dramatically my teaching pedagogy. The main impact I observed in students is the significant increase in self-confidence … and their willingness to mentor other students going through the same experience.”

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Add Kathleen Ogata, assistant professor of chemistry: “Teaching courses that center around student research in biofuels and the identification and characterization of bioactive compounds in Hawaiian medicinal plants has been fun and challenging. It has developed my creativity with experimentation and has involved evolution of effective instructional methodology for application of chemical concepts. In the undergraduate research experience, students take ownership of their learning through hands-on experience in solving real-world problems, which builds analytical, problem-solving, and integrative skills through engaging pedagogy.”

Our research-oriented program highlights student accomplishments by providing them opportunities to present at local or national conferences or to participate in international competitions in engineering. These experiences help mold students’ focus on their chosen fields and build their self-esteem, confidence, and insights. All of these elements become stepping-stones to their future careers. That a large number of our research students have opted to pursue four-year degree programs in STEM fields attests to the success of our initiatives and programs. I am confident that we have steered the program in the right direction, as the entire college now has committed to incorporate a similar RI model into various other disciplines across the curricula.
Holm Smidt

I am an engineering student in my junior year at the University of Hawaii at M’noa and started working on undergraduate research projects as a freshman at Kapi’olani Community College in Honolulu, Hawaii. I have since worked on several research projects. Being given the space and financial resources, in addition to mentoring support, to work on research projects with a purpose has proven to be a very rewarding experience, giving me the opportunity to develop critical hands-on skills, travel, network with fellow students, and gain a better perspective on my career goals.

My undergraduate research experience has been very rewarding because working on projects allowed me to further my understanding of course content through practical applications. More specifically, I believe that my undergraduate research experience has given me a more practical perspective on theoretical concepts, which in turn makes it easier to understand theoretical concepts in my classes. In addition, my research encouraged me to learn various practical skills such as computer-aided design (CAD), computer programming, data analysis, proposal writing, and various hands-on skills—all of which are invaluable for any engineer. Besides the technical merit of my research projects, I always valued the high level of teamwork and team effort involved in the research.

The great complexity of projects and the interdependence of team members demand that everyone works together efficiently. From my experience, I found that good teamwork can lead to impeccable results that would not have been achieved by an individual in a given time frame. In addition, I worked with team members of various backgrounds and academic standing, which allowed me to network with and learn from my co-researchers.

Furthermore, I was very fortunate to have the opportunity to travel on multiple occasions to national research colloquia and collegiate-level robotic competitions, which gave me networking opportunities with students from across the nation. These events also allowed me to better my presentation skills and experience real-life engineering, which ultimately helped me identify my career goals.

Through the hands-on lab work, literature research, real-life engineering experiences, and valuable networking opportunities (with fellow students, mentors, and professional engineers) during my undergraduate research, I was able to identify my major strengths and interests, which better prepared me for the four-year institution and helped me define my academic and career goals.

I am very thankful for the many opportunities that were given to me. My research experience has given me insight into real-life engineering and system-design life-cycles, which I believe will benefit me in my future endeavors in and out of academia.
At 82% of CCURI partner colleges...
Over the last four years, I have had the privilege of being a co-investigator on a National Science Foundation award funding the Community College Undergraduate Research Initiative. This organization disseminates best practices of undergraduate research (UGR) to community colleges nationwide. Almost simultaneously, I directed the building of the Biotechnology Program at Jamestown Community College (JCC), a medium sized community college in New York State serving rural Appalachia.

The JCC biotech curriculum was developed in response to a call from the National Science Foundation (NSF) to science educators to implement high-impact practices in science classrooms (including case-based learning, interdisciplinary teaching, and UGR). JCC biotech students begin their research in a first-semester biology course called Biology: A Molecular Approach (BAMA) which continues in all classes in the program until graduation. BAMA students don't just memorize facts. They are forced to think and solve problems collaboratively in context of a research project studying mosquito evolution.

NSF awarded another nearly $1 million dollars to the JCC biotech program via the Advanced Technological Education Program, which funded the creation of a regional network of high schools teaching BAMA. JCC trains high-school teachers in the research skills and concepts needed to teach BAMA, and provides supplies and $10,000 of new equipment for UGR at each site. Through BAMA, very large gains in critical reasoning have been achieved, both among first-year JCC biotech students and among high-school students enrolled in the college-level course. Amazingly, the gains exceeded the national average for graduating college seniors, underscoring the effectiveness of UGR. With 38 percent of school districts in the JCC service area teaching BAMA, it is having a very significant impact on our region of Appalachia.

Surprisingly, though, my journey began as a skeptic. I arrived at JCC with extensive experience in biomedical research and teaching. Like so many with this type of background, I was convinced that first and second year college students could not do research. However, I reflected on my own struggles training new technicians and graduate students. They often graduated at the top of their class but still could not keep lab notes, make solutions, do lab math, and use routine equipment. I realized that putting students in an authentic environment was perhaps the only real way to truly teach young scientists to effectively perform science. Why is it that somehow we expect scientists to become great scientists without ever using the primary instrument of science, the scientific method? What other profession does this?

That said, UGR is not for the faint of heart. While it is extremely gratifying to watch young students become excited by research, UGR is also a complicated pedagogy. Students become frustrated...
Why is it that somehow we expect scientists to become great scientists without ever using the primary instrument of science, the scientific method?

by unexpected experimental outcomes and their technical growth curve. Instructors contend with tight budgets and other educators who stress “tried and true” pedagogies over innovation. Administrators may simply say “we are not a research institution.” Staff members may not understand why institutional procedures should change (e.g., the need to rush order replacement enzymes because of student mishandling). Others may simply say community college faculty can’t do research, as I once did. So there is significant push-back. A faculty mentor may cite obvious successes (for example, improved college retention, or significant increases in student performance in advanced coursework and critical reasoning) but in the end, being a change agent is hard. Struggles with those who advocate for the status quo is one of the most challenging aspects of using UGR in the classroom in any non-traditional context.

Eventually however, a graduate will say, “I like my new school, but we don’t have research in the courses! Can I come back and continue my project in my free time?” Or a student will come into your office and ask, “When are we going to publish a paper? And hey, when are you leaving today? I have an experiment to set up.” Or a faculty member from a four-year institution will rank your students on par with their graduate students. Or a researcher at a national conference will be stunned when they realize that standing before them is a community-college student with a good point. Or a partnering instructor will remark that using UGR in their classroom has revitalized their enthusiasm for teaching, and comment “This is what I got into science for in the first place!” Or a colleague from another institution will tell you, “Well, I thought you were exaggerating about all of this, but then I talked to your student. She is awesome!” These are real experiences from my trajectory using UGR. They refocus all of us on what is really important—improving the lives of those in our community, regardless of the many hours of largely unrecognized hard work that supervising UGR entails.

Now, four years later, I find myself trying to imagine the JCC biotech program without UGR—conducting labs using manuals, implementing so-called “unknowns” that really aren’t, getting the same result every semester, reading lab reports that have no chance of ever contributing to scientific knowledge, or never having students present their research at a scientific conference. Or worse yet, never really realizing that my students are capable of doing far more than I expected of them.

Even with the hard work, long hours, and resistance, I have to conclude that anyone who is not using UGR should try it just once. Yes, do so with feet “firmly planted” on the ground. Yes, prepare for the, “Wait a minute, you want to do what? We don’t do that.” Just change a few labs and lean on those who have been successful using UGR. But for the benefit of your students, try the pedagogy just once and step back and watch all the good things happen. Not everyone’s teaching will be transformed by the experience, but all (including your students and colleagues) just might find their perspective on science education changed forever. We are just a mid-sized community college serving the rural and urban poor of Appalachia, but our students have accomplished truly amazing things.

DID YOU KNOW?

89% of the CCURI partners modified existing courses

33% created new courses as part of their CCURI activities.
Maria Sena

I am a recent graduate of the biotechnology program at Jamestown Community College (JCC), where I experienced a research-oriented program focused on giving undergraduate students ample opportunities to work in the lab. JCC biotech students do research in their first semester and continue it in every biotech course over two years. JCC has a fully operational lab with state-of-the-art equipment where students participate in research projects and have the opportunity to use all of the instruments in the lab. At JCC, I performed cancer biology research as a biotech, where I studied the expression of proteins during programmed cell death in bone marrow cells.

In fact, even though I am currently enrolled in the molecular genetics program at the State University of New York at Fredonia, I am still continuing my JCC research in my spare time. I could have just moved on, but I really enjoy working in the lab at JCC, and I love the project. During the summer of 2014, I also studied the immunology of asthma in a National Science Foundation-funded summer research program at the Penn State College of Medicine.

I have found that my research created practical lab experiences that improved my understanding of lecture material. This was very different from any of my standard lecture/lab classes. The hands-
The hands-on learning in the lab solidified what I was learning in the coursework. In fact, it was difficult at times to visualize concepts taught in lectures without having practical experiences to reinforce the concepts, so classes that did not involve practical research experiences actually required more studying.

Undergraduate research has taught me many other invaluable skills such as persistence, critical thinking, and problem solving, all of which have improved my ability to execute an experiment or analyze data. When I worked in collaboration with other students, we learned from each other and taught each other. Research teams give you a chance to bounce ideas off other people and generate new and unexpected perspectives on data and concepts, in the end, often making them easier to understand. This type of collaboration, in fact, actually strengthened my content knowledge. I learned how to package ideas in order to pass them on to my peers or to repackage them to explain something that a fellow student did not understand. This forced me to think about the concepts learned in class and the data generated in the lab in new ways.

Undergraduate research also has helped me to shape the goals for my future career. Transferring to SUNY Fredonia, I already understood what science actually was and what scientists really do, unlike my peers who were not exposed to authentic undergraduate research. As a result, I was prepared to succeed after I transferred, as my background had put me on a clear, strong path to the future. In fact, I plan to earn a doctorate and perform research in immunology, specifically cancer biology. I aspire to find a new treatment or cure to better the lives of people impacted by this disease. I look forward to contributing to advances in the scientific and medical communities. My hope is to partner with medical professionals in my desired field of research, directly interacting with the physicians in their clinical practices.

I cannot imagine what my first two years of college would have been like without doing research. Undergraduate research has taught me how to approach life, and it has set me up for success. 😊
Community college instructors conducting undergraduate research with students often describe their own powerful and personal academic experience as the primary catalyst. These experiences are invariably described as requiring hard work, persistence, and resilience, and in nearly every case these experiences are defined by an inspirational and formative mentor. Memorable mentors go beyond content area expertise and gently build student confidence through a refinement of trial, error, and reflection. The lessons from these experiences extend beyond the direct experiment or field work; they hasten the development of skills and strategies used in other aspects of their lives. My own mentors provided opportunities to engage in the questioning nature of science while immersed in the marine environment, and I realized how important and rare that experience was for students when I became an instructor. Thus, I have endeavored to create a magnet, two-year interdisciplinary program with a mission to provide formative mentors who foster student development of key traits relevant to success such as resiliency, persistence, and grit while exploring complex marine ecosystem dynamics.

Eleven years ago I founded the Ocean Research College Academy at Everett Community College, in Everett, Washington, using start-up funding from the Bill and Melinda Gates Foundation. The design replicated the process and nature of science with questions at the core, but it also incorporated a positive mentoring/relationship aspect that connected students with the same instructors for two years. Students’ investment and ownership of the research is achieved by engaging them as active participants in a real-world research project connected to where they live. This project is unusual in that the research is not driven by an instructor’s interest, but by student-generated questions.

The project we established is called the State of Possession Sound (SOPS), which involves 50 students annually monitoring the health of an estuary 30 miles north of Seattle. Students collect bio-geo-chemical data and then analyze and interpret these data. The success of the SOPS project is evident through student evaluations as well as resulting publications, two direct National Science Foundation (NSF) grants, and a partnership NSF grant from the Community College Undergraduate Research Initiative (CCURI).

Initial planning and implementation required networking to find a vessel to charter, writing grants to obtain equipment funds, connecting with local, state, and federal agencies to obtain sampling protocols and data-sharing opportunities, and taking a risk that students would learn more from active engagement in field research than simply being told about the research. Instructors from the English and history departments collaborated with mathematics and oceanography instructors to build a framework and common language to help students develop the requisite critical-thinking, problem-solving, and communication skills. Central to the project was a deliberate focus on student and faculty reflection in all classes through quarterly student surveys and during weekly faculty meetings.

What started as a plan to integrate introduction to oceanography content with statistics coursework has evolved into a massive multi-year project, generating sharable data on topics including counts and distribution of marine mammals and birds, water-chemistry metrics, water-quality data, nutrient concentrations, levels and distribution of sediment and heavy metals, and river flow and tide interactions coupled with plankton sampling. I am not an expert in any of those areas, so my focus is a mentoring strategy of asking students leading questions to support them in their pursuit of trying to understand the
data they have gathered. This support is fundamental when the questions students ask lead to more questions, and sometimes frustrations. In an era rich with students afraid of failure, we delicately provide opportunities for students to grow by reflecting on what did not go the way they had planned, what they learned from that, and what they could do differently next time. This creates an ethos of resiliency, which is critical to success in STEM (science, technology, engineering, and mathematics) fields. It also leads to more sophisticated questions, and it expands students’ understanding of scholarly work.

A primary challenge was changing the mindset of how instruction works in this context. Very few instructors experienced their introductory courses structured this way; the learning outcomes set for courses typically focus on breadth as opposed to depth of factual knowledge. Convincing the college administration that learning outcomes could be achieved through different methods was an initial hurdle, as was finding instructors willing to adopt a way of teaching that was different from how they were taught. Involving administrators in SOPS cruises and inviting them to student presentations was an effective way of creating buy-in. I have been fortunate to find instructors who constantly review the evidence of student learning in a metacognitive way and continue to ask questions about how to improve student learning—very much like the reflection we ask of our students.

Many metrics indicate the success of the SOPS project and of the Ocean Research College Academy. The unique and effective undergraduate research initiative received NSF support to build a student research laboratory overlooking the focal estuary and a custom-designed research vessel to provide access to study sites. Students are invited to present their research projects at local, national, and international conferences, and a recent graduate had her research accepted for publication in an academic journal. As a two-year program, the graduation rates of participating students are unparalleled—85 percent of ORCA students earn the associate’s degree in two years, compared to the Washington state-wide degree-completion rate of 14 percent in three years. Additionally, 66 percent of ORCA graduates indicate a desire to pursue a STEM major at a university. Alumni often highlight the SOPS research experience as having been transformative in building the confidence, persistence, assertiveness, and networking skills that enabled them to obtain further research opportunities at the university level and beyond.

The increasing complexity of student-driven questions continues to enrich my own scholarship, educational leadership, and networking opportunities. Writing NSF proposals (and recently serving as a reviewer) enhances my resiliency and persistence. The support from colleagues with whom I’ve worked for eleven years is energizing as I continue to try to find ways to support them as they have supported me. To anyone considering taking on an undergraduate research initiative, my advice is to reflect on this question: What is it about your own research experiences that has had a lasting impact and how can you create and perhaps enlarge that experience for your undergraduate students?
Emily Olsen

I first learned about the marine-biology centered Ocean Research College Academy (ORCA) at Everett Community College when I was at an orientation session in my sophomore year of high school. I learned about the fascinating student research that was going on in this program, which includes both high school and community-college students, and how students got to pursue a unique research question that interested them. When I was admitted to the program as a junior in high school, taking college classes full time, I immediately became involved in boat-based sampling of biogeochemical processes in an estuary. I worked with a partner to form a unique research question based on our shared interest in heavy metals and their contribution to toxicity in the marine environment and then we built a research project around it.

We decided how to collect and analyze data in order to best answer our question. Our work continues as we share collection methods and data, but now we each have a separate focus for analysis. A unique aspect of my experience was that the instructors at ORCA were not experts on heavy metals and their toxicity, but they were able to guide me to resources that could help me answer my questions. Because the ORCA curriculum integrates all subjects, I learned skills in mathematics, history, and English classes which helped me overcome challenges that arose in writing my final research paper. This combination of different disciplines provides a holistic view of research for every student, and I was able to use the statistics I learned in math and the critical thinking, analytical, and interpretation skills learned in history and English—and reinforced in science classes—to analyze the research my partner and I conducted.

The hands-on nature of the ORCA program, in conjunction with the traditional-style college classes I enrolled in at Everett Community College, gave me background information that strengthened my ability to make hypotheses and analyze data. Through field research and data collection I have gained experience that I hope will give me access to more outside-of-class opportunities that require field and lab experience, as well as giving me prerequisites to take higher-level classes. I have also learned networking and collaboration skills. ORCA has also given me a new perspective on research, teaching me that research is never finished.
and collaboration skills that enable me to make numerous connections with people who can assist me in my current research and that which I plan to undertake in the future. In addition, I will have already completed two years’ worth of college credits by the time I finish the ORCA program.

I am now a seventeen year old sophomore in college, and I intend to enroll in a four-year university where I plan to major in kinesiology. My research has given me valuable experience that will distinguish me from other university students, from the behind-the-scenes work of data collection and collaboration to the formal experience of presenting a paper at the University of Washington’s Undergraduate Research Symposium and a poster at the Community College Undergraduate Research Initiative poster session in Washington, D.C. ORCA has also given me a new perspective on research, teaching me that research is never finished and that the research I do can be used by students in the future, thus contributing to the wealth of data collected at ORCA.
The undergraduate research program at Volunteer State Community College (VSCC) in Gallatin, Tennessee, began in 2011 with an invitation to faculty and administrators to attend a workshop offered by the Council on Undergraduate Research and the National Council of Instructional Administrators “Developing Undergraduate Research at Community Colleges: Tapping the Potential of All Students.” Four colleagues and I attended the workshop to evaluate the feasibility of undergraduate research on our campus. Integral to that workshop was meeting other community college faculty who were conducting vibrant undergraduate research programs. A year later we were one of 26 community colleges selected to participate in the NSF-funded project, the Collaborative: Community College Undergraduate Research Initiative (CCURI). I was one of seven VSCC faculty members who attended a strategic-planning workshop in which we developed an action plan to focus our program on water quality.

Volunteer State’s main campus is a mile from Old Hickory Lake, a man-made lake created by the Tennessee Valley Authority in the Cumberland Watershed. This watershed provides the drinking water for over one million people in the Nashville metropolitan area. A number of streams serving as tributaries to the lake and river are impaired (polluted), and therefore are ideal laboratory environments for our students. The strategic plan incorporates research into several science courses, using issues in water quality as foundational problems impacting our region and service area.

The project began with several courses across science disciplines structured or redesigned to include attention to water-quality problems. Introductory Biology, Introductory Environmental Studies, Introductory Chemistry, and Organic Chemistry students have the opportunity to engage in hands-on research. Two of our focus streams have three land uses: residential, agricultural, and commercial. As we continue with our strategic plan, these uses present a myriad of other problems that our students will investigate.

Our initial four-year strategic plan for undergraduate research has changed over the last two years due to faculty departures and retirements and broadening interests. Filling those positions with faculty who have interest and/or experience in mentoring undergraduate-research projects has been important to our program. Our four-year strategic plan for water-quality studies has expanded into a 10-year longitudinal study that also looks at the impact of storms, quantifying chemical analysis of the streams and delineating their watersheds, and comparing methods of habitat assessments. Based on the many professional-development workshops offered by CCURI, our faculty have become involved in animal-behavior studies, developed a biofuel research project in the chemistry laboratory curriculum, and genomic-analysis projects.

I developed a research methods class that enrolls between 10 and 14 students each semester. They work in one of three groups working collaboratively, reviewing literature, developing research methods, and implementing the research as we develop and refine projects embedded in science courses and laboratory curricula. Giving students these opportunities quickly increases their academic motivation, presses them to see the bigger picture, and uses course content as the foundation for acquiring.
new information and proceeding in the scientific process. Mentoring students in this way has been extremely rewarding as we invoke the “master learner” and “learner” approach.

The impacts of undergraduate research and our association with CCURI have been tremendous for our students. The first major impact I noticed from research was with a student in general chemistry. He was struggling with performing basic techniques in the lab and lacked confidence. A fellow student encouraged him to join a research project, during several weeks, the students collaborated in the lab. The breakthrough occurred when the student finally put several ideas together regarding the collection of absorbance data. For him it was an epiphany that produced a surge of confidence in his ability to solve problems and develop aspects of critical thinking. I have seen similar epiphanies in dozens of students.

In the 2014 summer term, three former organic chemistry students began a project looking at green and microscale methods of flavone syntheses. Flavones are secondary plant metabolites that show a broad range of biochemical properties. Synthesis of flavones was the area of my graduate research, and I had always hoped to renew this research focus. I assigned these students several literature searches, and we embarked on investigating and developing research methods. They eventually presented their preliminary findings at the 66th Southeastern Regional Meeting of the American Chemical Society. The three students entered the only community-college poster among 80 institutions in the Organic Chemistry Division. They were awarded first place. Further, in the last two years, 23 of our students have presented posters at national and regional scientific conferences and symposiums. This has validated the success of undergraduate research at the community college level.

Developing an undergraduate-research program has certainly not been easy. Overcoming barriers and obstacles requires the ability to adapt, modify, and change. Integrating undergraduate research into courses, however, seems to us to be the best way to use this pedagogy. Two keys in developing our research program have been a constant review of our strategic plan and the development of partnerships with local agencies, as well as with state agencies and non-profit environmental groups. We have used these relationships to acquire a significant amount of equipment we use in field and lab work, gain scientific support, and learn of problems our students can investigate concerning water quality.

The key lessons learned include the following:

- The need to develop sustainable programs. We search for and cultivate projects that are low cost, that make a significant impact on students’ academic advancement, and that examine relevant problems facing society.
- Use case studies as the entry and the hook to encourage students to become involved in research.
- Align research projects with course learning-outcomes and with the campus’s desired general-education outcomes.
- Develop a detailed action plan that is feasible, has timelines, and can impact the community you serve.
- Develop several short “elevator speeches” about your research. Often at campus meetings, in the community, or in individual conversations with students, I pitch the merits of undergraduate research as a best practice for teaching.
- View students as scholars and expect them to contribute to the discipline.

To paraphrase a well-known and highly successful collegiate coach Nick Saban “Instead of spending time with students … invest time.” Investing time is a significant aspect of what undergraduate research is about at the community-college level.
Phillip Martinez

When I began my studies at Volunteer State Community College in the fall semester of 2013, I had doubts about my ability to find and convince an instructor to let me begin a research project. I did not believe there would be any resources available for such an endeavor at a two-year institution. My search, however, did not last long because I soon met Parris Powers. He had already set up an undergraduate research program with the help of the Community College Undergraduate Research Initiative (CCURI).

Initially, I was uncertain and scared. I had wanted to go into research since I was little. What if I did not enjoy it as I had imagined I would? In those first hesitant moments, I believe that my new mentor read my mind and encouraged me in a way for which I will never be able to thank him enough. He eased my qualms and helped me take my first tentative steps toward my goals.

Thus, I began my first project investigating the pretreatment of switch grass for biofuel production as a part of the existing research program Powers had set up. Although biofuels were far from my future career interests in public health and infectious disease, I fervently immersed myself in the work. I realized then that no matter how long I spent in the lab, I was happy.

That spring, I presented my first poster in Mesa, Arizona, at a national CCURI conference. That first step gave me a taste of what was to come. I used that
perhaps-modest accomplishment as a springboard to my next endeavor.

I applied for, and received, a summer internship at the Meharry Medical College Microarray and Bioinformatics Core. Confident and hopeful, I approached the task of the next stage in my career: medical research. During this ten-week internship, I had the opportunity to greatly expand my understanding of microbial genetics and infectious disease. I worked hard and used the skills that had begun to develop at Volunteer State to investigate the proteo-genomic characteristics of a bacterial isolate. This involved the assembly and analyzation of the bacterial genome as well as the expression of its genome. As a result of my dedication and tenacity, I was invited to continue my work there for as long as I desired.

Upon returning to Volunteer State in the fall 2014 semester, my mentor Powers, two other students, and I began work on the green synthesis of flavones, which are naturally occurring phenolic compounds centered around a 2-phenyl-1-benzopyran-4-one backbone commonly found in many plant tissues. Flavones have been indicated as having possible medicinal applications including anticancer properties, neurogenesis promotion, and antimicrobial activities.

The many hours four of us dedicated in the lab paid off and our resulting poster took top honors in the organic chemistry division at the Southeastern Regional Meeting of the American Chemical Society in October 2014. We represented the only community college among 80 universities in our division.

Undergraduate research at the community-college level has provided me with the confidence needed to continue on my path to becoming a research physician. I have developed the skills to effectively communicate my research to a non-scientific audience and to network with colleagues in my field. I also learned the political structure of the scientific community.

Hesitance and fear have been replaced with confidence and assurance. Because of the kindness and encouragement by my first research mentor, I now believe that I will achieve my goals.
The Power of Undergraduate Research
Investing in Impact

Tulsa Community College (TCC) began offering its first courses in a new biotechnology program in 2006 as we also began construction of the new Health Sciences and Biotechnology Learning Center on the Southeast Campus in Tulsa, Oklahoma. Having just completed a doctorate in biosciences at Oklahoma State University as a non-traditional student, I understood the thrill and rigor of authentic research. I knew that my best learning occurred while I was digging deep into the literature and working in the lab to find answers. Accordingly, I knew that in order to create a program that produced research scientists, the students needed authentic experiences. Through much collaboration and communication, our biotechnology team has been able to build a rigorous program with layered research opportunities for our students, outreach to secondary education, outreach to the community, and professional development for our faculty.

Our work has been informed by numerous studies and white papers issued by the National Academies, National Research Council, American Association for the Advancement of Science, National Science Foundation, and Council on Undergraduate Research. At TCC, we worked with faculty and administrators from the four campuses to develop a strategic plan for the STEM (science, technology, engineering, and mathematics) disciplines that we called the STEM Student Partnership Hub: Empowering a Culture of Scientists, Technologists, Mathematicians, Engineers, and Entrepreneurs in Oklahoma. The document focuses on the steps necessary to produce scientists who can continue to lead our nation in discovery and entrepreneurship.

A we work to build our biotechnology infrastructure to support the feeding, fueling, healing, and cleaning of the world, we have focused on the mechanics of embedding research within the curriculum by developing summer undergraduate research courses, developing faculty professionally, and creating paths for our graduates after completion of our two-year degree. As we created these research opportunities, we also developed outreach to secondary-school faculty and students and built a rigorous scientific program of study for the students in our program.

Our successes include the fact that among our graduates from 2009 through the spring of 2012, 92 percent are either continuing their education—43 percent are in graduate or medical school—or work in the field of their degree. Our students also now have the opportunity to participate in seven different levels of research experiences from curriculum-embedded research to new research courses to internship opportunities.

Partnerships have been integral to the growth of opportunities in our program. We offer an apprenticeship course in which the Oklahoma State University Center for Health Sciences hosts our students in a one-semester, 160-hour research project. Through our participation in the NSF Community College Undergraduate Research Initiative (CCURI), we were able to develop a summer research course for students taking our first biotechnology class. The students learn to perform DNA extractions, plasmid ligations, transformations, and bioinformatics analyses during the summer course. The students in our program also experience embedded research units in our courses titled Cell Culture and Molecular Biology and Techniques. In the summer research, cell culture, and molecular biology courses, students are required to produce a science poster and present it in a science forum. These units of study provide learning activities that vary from writing abstracts to the collection of field samples.

Within our region, we have developed the Tulsa Area Bioscience Education and Research Consortium (TABERC). This group of nine area academic institutions meets regularly and provides internship opportunities for students. TCC

Graduates from 2009 through the spring of 2012, 92 percent are either continuing their education—43 percent are in graduate or medical school—or work in the field of their degree.
provides a one-week course to prepare the bioscience students at the nine institutions for work in a research lab. Our students also have the opportunity to apply for summer research internships for community college students through the Oklahoma IDeA Network of Biomedical Research Excellence (INBRE) program. The program is competitive, but guarantees the experience of 40 hours of paid work per week in a research lab during the summer.

Our curriculum also requires that students write personal statements and develop their résumés, which eases the application process for internships. Most recently, we had students in our program secure internships at the Oak Ridge National Laboratory and at Colorado State University through an NSF Research Experiences for Undergraduates program. Such achievements are not the norm for community college sophomores.

Throughout the process of developing our bioscience program, we were mindful that our pool of potential students comes from our local, often-rural high schools. Oklahoma often ranks very low among states in per-pupil funding for education. Having previously taught science to Oklahoma high school students for 22 years, I wanted to create new opportunities for the students and teachers in our region. Federal grants from the NSF’s Advanced Technology Education program titled Stimulating Enthusiasm, Exploration and Discovery Through Biotechnology Education (SEEDBed), as well as the National Institutes of Health’s grant program titled Medicines, Explorations and Discoveries in Biotechnology Education (MEDBed) helped develop the bioscience potential in the Oklahoma secondary schools. The NSF grant loaned equipment for faculty use in their institutions and student academies and workshops that engaged more than 7,500 participants each year. The NIH grant provided faculty workshops in the region for 70 teachers in 49 schools. It also provided bioscience learning for more than 8,000 students each year and provided the teachers with bioscience equipment for their schools. Funding through Oklahoma INBRE enables us to provide several workshops for high school and community college faculty each year. Additionally, the CCURI team has invited us to host the annual national Lab Methods Workshops each summer.

Many barriers exist to offering undergraduate research in a community college. Authentic research with problem-based learning is not the tradition on such campuses. Classes may be large, and the infrastructure often does not exist to provide the space, time, and money needed. Community college faculty members are often not required to publish for tenure, unlike professors at research universities. More programs like the CCURI initiative are needed that connect like-minded researchers and help develop research networks for the faculty.

The business of undergraduate research is demanding and requires flexibility, but the benefits are worth the work. When my students and I are investigating a new topic, I can hardly wait to see the results on a gel or the sequences of our sample DNA. There is also a guaranteed magical moment every time I lead a group of students through the research process. It often happens in the last days of the investigation when we are analyzing our data. The students and I become colleagues, and we work together evaluating the materials. The students begin to lead the way. The abstract, data, and analysis become their own. During the poster sessions, I witness more growth. The intensity that I see when I watch the students share their science with fellow researchers and professors, and their growth in confidence as they learn the techniques and gain knowledge, always validate all the effort.

**Questions**

Is the increased faculty collaboration within disciplines, across disciplines, or both? (N=65)

- Both within and across disciplines: 54%
- Within disciplines: 28%
- Across disciplines: 18%
Ashton Williams

My academic path has been an unconventional one. I have attended a variety of different types of universities and enrolled in a variety of different types of programs. I started at a local private university without declaring a major and left the university as a mechanical engineering major. From there I transferred to a regional university that offered a biomedical engineering major, which I had decided was the right path for me. Toward the end of my degree program, however, I realized that I yearned to engage in biological science that focused more on micro-level components (that is, cells, DNA, proteins, etc.) than on macro-level components (such as medical devices). That realization took me to the biotechnology program at Tulsa Community College (TCC).

When I first entered the program, my expectation was to simply take two to three semesters worth of classes, obtain the necessary hands-on laboratory skills I needed to get a job in the biotechnology field, and leave. I didn’t expect to get to know professors or students; I just planned to keep my head down, do the work, and get out. Thankfully, my experience has been anything but what I expected. From day one, I was engaged both by remarkably supportive professors and an exceptional group of fellow students. It quickly became clear to me that the professors were dedicated to creating a challenging, but supportive, learning environment.

<table>
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<tr>
<th>CCURI Student Participant Success</th>
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<tbody>
<tr>
<td>Received awards, scholarships, and fellowships</td>
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<tr>
<td>Completed internships (paid and unpaid)</td>
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<tr>
<td>Were hired into STEM employment. (One student was selected over other candidates with Bachelor degrees.)</td>
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<tr>
<td>Changed majors and career plans to continue research</td>
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<tr>
<td>Changed academic goals (now planning on graduate school)</td>
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<tr>
<td>Transferred to four-year institutions and graduated with STEM degrees</td>
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<tr>
<td>(Reverse transfer students holding Bachelor’s degrees) were accepted directly into graduate school after community college research experiences</td>
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<tr>
<td>Presented at professional conferences</td>
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<tr>
<td>Prepared and presented posters</td>
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<td>Published research results</td>
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Part of that environment was the incredible number of hands-on research opportunities I was exposed to both in class and as a result of being in the program. TCC offers an impressive array of curricular research projects for students. In both the Cell Culture Techniques and the Molecular Biology Techniques classes, students plan and execute a research project, including creating a poster and presenting it. For example, I took part in a project in my Cell Culture Techniques class in which we evaluated the impact of effluent from a local refinery on mammalian cell viability.

In addition to academic-year research, the biotechnology program offers summer research courses for students who wish to enhance their skills. These research projects allow students to gain experience in performing hands-on research and in giving scientific presentations, both of which involve invaluable sets of skills that prepare students both for a job in the biotechnology industry and for graduate school.

I strongly believe that my participation in the TCC Biotechnology Program and its research activities led to my being accepted into the highly competitive Oklahoma Idea Network of Biomedical Research Excellence Summer 2014 Undergraduate Research Program. In fact, one of the first things that my mentor at the Oklahoma State University Center for Health Sciences told me when I arrived for the summer program is that his university loves to get students from the TCC Biotechnology Program because they come equipped with important lab skills. It is no small feat that a community college has a program that produces students that a biomedical-science graduate school (and medical school) is eager to receive.

My short time in the program has taught me a remarkably large range of laboratory skills. But even more importantly than that, it has instilled in me a sense of confidence in my work and my abilities. I have no doubt that the foundation I have built at TCC will help me secure a job in the biotechnology industry, not to mention forge the path to my ultimate goal of working at the intersection of biology, mathematics, and computer science. 😊

DID YOU KNOW?

CCURI Student Demographics

The demographic breakdown of these 2,694 students is as follows:

- 58% female
- 56% white
- 10% African American/Black
- 4% Asian
- 2% Hawaiian/Pacific Islander
- 15% Hispanic/Latino
- 1% Native American/Alaskan Native
- 2% Multi-Ethnic
- 10% Unreported
Collaborative Research: Community College Undergraduate Research Initiative (CCURI)

NSF Award Number
1118679
1118680

CCURI Partner Colleges

Cochise College  AZ
Estrella Mountain Community College  AZ
Glendale Community College  AZ
Mesa Community College  AZ
Los Medanos College  CA
Moreno Valley College  CA
Pueblo Community College  CO
Trinidad State College  CO
Capital Community College  CT
Delaware Technical Community College  DE
Florida Keys Community College  FL
Seminole State College  FL
Kapi‘olani Community College  HI
Ivy Technical Community College  IN
Muskegon Community College  MI
Anoka Ramsey Community College  MN
North Hennepin Community College  MN
Gaston College  NC
Mesalands Community College  NM
Truckee Meadows Community College  NV
Jamestown Community College (NSF subaward)  NY
Tompkins Cortland Community College (NSF subaward)  NY
Finger Lakes Community College  NY
Redlands Community College  OK
Tulsa Community College  OK
Portland Community College  OR
Piedmont Technical College  SC
Volunteer State Community College  TN
Austin Community College  TX
Del Mar College  TX
Lone Star College  TX
McLennan Community College  TX
Midland College  TX
Edmonds Community College  WA
Everett Community College  WA
Lake Washington Institute of Technology  WA
Central Wyoming College  WY