Community College Undergraduate Research Experience Summit

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A report from a summit sponsored by the National Science Foundation and the American Association of Community Colleges

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AMERICAN ASSOCIATION OF COMMUNITY COLLEGES

Baton Rouge Community College students collect freshwater sponge samples in Louisiana as paid interns for a faculty-led, statewide biodiversity study. Other photos on the cover feature (clockwise from left) community college students engaged in a course-based research project, an independent study, and the international student underwater remotely operated vehicle (ROV) competition organized by the Marine Advanced Technology Education (MATE) Center, which is at Monterey Peninsula College in California.

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As the voice of the nation's community colleges, the American Association of Community Colleges (AACC), delivers educational and economic opportunity for approximately 12 million diverse students in search of the American Dream. Uniquely dedicated to access and success for all students, AACC's member colleges provide an on-ramp to degree attainment, skilled careers, and family-supporting wages. Located in Washington, D.C., AACC advocates for these not-for-profit, public-serving institutions to ensure they have the resources and support they need to deliver on the mission of increasing economic mobility for all.

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Introduction to the Community College Undergraduate Research Experience (URE) Summit

The American Association of Community Colleges (AACC) convened the Community College Undergraduate Research Experience Summit of 120 thought leaders at the request of, and with the support of, the National Science Foundation's Advanced Technological Education (NSF ATE) program.*

The summit held November 20 to 22, 2019, in Washington, D.C., used a think-tank approach to gather insights from community college and university educators, community college students and alumni, government officials, and representatives of business, industry, and nonprofit organizations about how community colleges can build, implement, and sustain undergraduate research experiences (UREs) in STEM education and for career preparation.

"We are enthusiastic to learn about how your institutions are using UREs to help attract, retain, and prepare students for the workforce," Mary Heiss, senior vice president of Academic and Student Affairs at AACC, said at the opening plenary.

V. Celeste Carter, lead program director of the Advanced Technological Education (ATE) program at NSF, said the planning committee intentionally structured the summit to leverage the knowledge and expertise of community college educators. In addition to sharing their insights for the summit proceedings report, Carter expressed the hope that new activities that advance student success would come out of the summit.

"I think it's an amazing chance for all of us to develop more networks, more partnerships through this summit—talk about what's working; challenges we've overcome; where we'd like to see this going in the future. I was just really, really happy that people were willing to create as broad a definition of undergraduate research experiences as we have," Carter said.

The URE Summit planning committee defined undergraduate research experiences as those that use the scientific method and/or the engineering design process to promote student learning by investigating a problem where the solution is unknown to students or faculty.

Examples of UREs currently offered by two-year colleges include:

- Course-based research
- Internships
- Independent studies
- Honors projects
- STEM design challenges from real-world scenarios
- Competitions that blend academic and technical skills
- Mentored research that is part of a larger project

* The ATE program awards competitive grants to test innovative ideas for improving technician education in the advanced technology fields that are important to the nation's economic health and security. Two-year college faculty members have leadership roles in most ATE initiatives, which are carried out in partnership with industry and other education sectors.

Summit Purpose and Organization

The summit was convened to assist community colleges, NSF, other federal agencies, and various stakeholders in accelerating the value and impact of community colleges in STEM workforce development. Thought leaders were assembled to share their insights about UREs and identify priorities for recommendations about building, implementing, and sustaining UREs at community colleges.

A steering committee designed the summit to highlight community college leadership in STEM and to raise awareness of the effectiveness of UREs at community colleges.

An application process was used to identify and select community college educators who lead undergraduate research experiences. In addition to involving proponents of the various types of UREs, the selection criteria considered the need for summit participants to include representatives of diverse disciplines and geographic regions, as well as leaders of new and established URE programs.

Seven individuals who were either current students or alumni of community college undergraduate research experiences participated in the small group discussions. Two students and two alumni shared their insights during a moderated panel discussion that was the focus of the opening plenary session.

University educators, leaders of nonprofit organizations, business, and industry interested in undergraduate research, and representatives of federal agencies were also invited to participate.

For the formal sessions, participants were assigned to tables with an intentional mix of disciplines and experiences. In this way, the steering committee hoped to seed the exchange of diverse opinions during the small group discussions and informal gatherings that were part of the three-day meeting.

The roundtable discussions were structured so that each group identified key areas of focus that all the summit participants then considered during a gallery walk review on the last day of the event. The priorities identified through the consensus-building process became the basis for the summit's recommendations.

Opening Plenary

The summit's formal sessions began with podium addresses by NSF and AACC leaders and a moderated panel discussion featuring two current community college students and two alumni of community college UREs. Afterward the summit participants mingled and talked while viewing 38 scientific conference posters about UREs, which people attending the summit submitted to exhibit. (See PDFs of the posters at www.aacc.nche.edu/URESummit).

In his welcoming remarks, Lee Zia, deputy division director of the Division of Undergraduate Education at NSF, praised both the summit's broad definition of undergraduate research experiences and the involvement of people from multiple disciplines and an array of institution types. "Without a diversity of opinion, the discovery of truth is impossible," Zia said.

V. Celeste Carter, lead ATE program director, pointed out that in 2006, NSF made the first ATE award to explore the use of UREs at community colleges to the Council on Undergraduate Research (CUR). Two community college educators who had other ATE grants were involved in that initiative. They went on to lead additional ATE projects and then years later served as "rotator" program directors at NSF. Carter said she hoped the summit would spark similarly productive connections for individuals and institutions.

On behalf of AACC, Mary Heiss thanked the conference participants for sharing their innovative thinking. "We are eager to learn about your work," she said.

Students Reflect on Power of Research Experiences and Importance of Faculty Encouragement to Pursuit of STEM Careers

During the panel discussion moderated by V. Celeste Carter, two current community college students and two community college graduates described their research experiences as powerful and positive. Each panelist shared details about numerous learning experiences and career opportunities that came their way as a result of a community college professor inviting them to become involved in an academic competition, research project, or internship.

All the panelists urged community college educators to involve students in research experiences.

"Students are hungry to learn more outside the bounds of the classroom," said Paula Kirya, a bioengineering student at Pasadena City College in California who has done research on the nanostructures of butterfly wings. Her involvement in the project started when Chemistry Professor Jared Ashcroft asked her if she wanted to participate in the college's Early Career Undergraduate Research Experience program. It was a brief conversation during a class lab. Her enthusiastic approach to the research prompted Ashcroft a few months later to tell Kirya about a nanotech internship at Pennsylvania State University, for which she applied and was selected.

Kirya urged college instructors to make the effort to inform individual students about specific URE opportunities. She asserted that when instructors talk one-on-one with students to encourage them to pursue internships, participate in competitions, or attend scientific conferences, it persuades students to invest the time and effort that UREs require.

Alexa Bennett noted it was the leadership and personal attention of Virginia Balke, a biology professor at Delaware Technical Community College (DTCC), that put her on track for a career in microbiology. Bennett is enrolled in a bioinformatics data science Ph.D. program at the University of Delaware.

In addition to teaching, Balke led an active BioChem Club. Bennett learned about the club and that its members would be doing research from a general announcement in the biology class. Joining the club meant Bennett benefited from being part of a cohort of students who shared her scientific interests.

When Balke later told Bennett about a university research internship that would be "great for her," it spurred her to apply for it. Working on that project helped Bennett win a scholarship for her bachelor's degree and taught her polymerase chain reaction techniques that helped her obtain a good-paying industry job right out of college.

Danial Nasr Azadani's interest in a biotech career took hold while he was participating with other Del Mar College students in the international search for viruses that feed off and kill bacteria. The course-embedded project was for the Science Education Alliance-Phage Hunters Advancing Genomics and Evolutional Science (SEA-PHAGES) program. Presenting his SEA-PHAGES research at conferences has been a positive experience for Nasr Azadani, but he is even more enthusiastic about Community College Innovation Challenge (CCIC) that his Del Mar College team won in 2017.

"It was the most phenomenal thing that I was part of," Nasr Azadani said, explaining how the competition caused dramatic changes in the way he thinks. "It sparked the entrepreneurial spirit in me," he said of CCIC. From that point on, whenever he worked on projects in the college laboratory, he thought about their potential commercial applications. Nasr Azadani completed his associate degree in biotechnology from Del Mar and a bachelor's degree in biomedical sciences from Texas A&M University-Corpus Christi in December 2019, and took a gap year in 2020 before beginning graduate school.

Reginald King said his technical skills were transformed by what he learned participating in the remotely operated vehicle (ROV) competitions organized by the Marine Advanced Technology (MATE) Center at Monterey Peninsula College. Learning Softworks software to create the ROV for the Seawolf 6 team at Copiah-Lincoln Community College in Mississippi helped him figure out that he liked design work.

The actual competitions honed his troubleshooting and teamwork skills. "The big thing to learn from the competitions was how to fix something when everything goes wrong," King said.

Most important is how the ROV competition improved his career prospects. King said that including info about what he learned with the ROV project on his LinkedIn page helped him obtain a job as a design engineer at Hol-Mac Corporation. The company offered him a full-time job a few months before he completed his bachelor's degree in engineering from Mississippi State University in December 2019.

Biology Club Research Leads to Ph.D. for Alexa Bennett

Alexa Bennett

Conducting research as a Delaware Technical Community College (DTCC) student profoundly influenced **ALEXA BENNETT'S** career path.

First, it gave her the confidence to change her major from production agriculture to biological sciences. Then it led to a paid summer internship at the University of Delaware, where she transferred after earning an associate degree. Her hands-on lab skills helped her obtain a full-time job as a microbiology lab technician after completing her bachelor's degree.

In 2019 she began a bioinformatics data science Ph.D. program at the University of Delaware in the same lab where she interned as an undergraduate. Her doctoral research is part of the Water in the Changing Coastal Environment of Delaware (WiCCED) project, which has received NSF and state grant support.

Bennett traces her academic and career success to DTCC Biology Professor Virginia Balke's announcement that the BioChem Club was expanding its activities to include authentic research projects. As a co-principal investigator of the Community College Undergraduate Research Initiative (CCURI), Balke not only encouraged students to do research but to present their findings at CCURI student colloquia.

"Attending a poster session or symposium, or particularly the CCURI workshops … you kind of get this boost of inspiration and energy out of it," Bennett said. Talking to people about her research at poster sessions pushed Bennett to think "more holistically." It is a skill she now utilizes for WiCCED's outreach to elementary and secondary school students who are collecting soil, water, and sediment samples for her and other researchers to analyze.

"I'm so happy to have had that opportunity as an undergrad—particularly as an undergrad at a community college—to put together a poster and learn from those mistakes early, as opposed to graduate school," Bennett said.

Posters Spark Lively Conversations

The energy level in the ballroom became even more exciting after dinner on November 20, as people moved through the displays of 38 URE scientific conference posters showcasing the outstanding work of students and faculty attending the summit.

As the decibel level rose with the many collegial conversations, it became apparent that poster creators were interested in dialoguing with viewers, not just expounding about their own work.

"That's an awesome idea," Chitra Solomonson, a Green River College physics instructor, complimented Candice Foley about her URE. Foley, a chemistry professor at Suffolk County Community College (SCCC), was standing near her poster about the URE collaboration between SCCC and Stony Brook University. It involves Ph.D. candidates from the university as instructional interns and post-doctoral students as mentors to SCCC students who take an online Introduction to Science Research course. About 10 SCCC students each year move on from campus UREs to competitive internships at national labs and federal agencies.

"This gives them [the community college interns] so much of a broader umbrella of transformational experiences, and also mentors that they can keep in their cadre," Foley said of the interactions the community college students have with the doctoral candidates and post-docs.

Solomonson came to the summit with questions that she asked people after telling them about the solar energy research course she teaches at Green River College in Washington. The course consistently maxes out with 10 students despite a goal in the college's strategic plan to offer more research opportunities.

So Solomonson asked people who stopped to view her poster how their colleges provide research experiences beyond "boutique" courses that have small enrollments and are usually taught by a small group of faculty. She also asked other summit participants how their colleges compensate faculty for the time involved in guiding students as they conduct research.

A few rows over, Mahalaxmi (Gita) Bangera, dean of the RISE Learning Institute at Bellevue College in Washington, shared information about a community of practice that focuses on undergraduate research experiences. Bangera and several colleagues lead the informal, virtual community to share instructional practices and other tips for offering UREs. For example, the Bellevue team has shared information about Bellevue's financial awards to help faculty implement UREs in introductory courses with large enrollments. The community of practice involves faculty from 24 community colleges and three universities.

After the meeting Jared Ashcroft, who co-leads an internship program at Pasadena City College in California, described the poster session as the first of several eye-opening experiences at the summit. Despite his years of placing students in internships in various fields, Ashcroft said he was unaware until the poster session of the powerful outcomes for students from academic competitions and the wide variety of UREs underway at community colleges.

Kristen Genet, a biology instructor at Anoka-Ramsey Community College in Minnesota, reported in the reflection section of the summit participant survey that she appreciated the questions and feedback she received about her poster that compared the results of a URE for online students with a URE for students "seated" in a course on campus. "I have some great ideas to continue that work and I think it's really important to keep thinking about how to include our ever-growing online population in UREs," Genet wrote.

Foley, the SCCC chemistry professor, was even more positive in her comments: "The ability to exchange ideas in this dynamic environment was wonderful."

PDFs of the posters displayed at the URE Summit may be viewed at www.aacc.nche.edu/URESummit.

CCURI Leader Advises Alignment of Student Research Initiatives with College Goals

James Hewlett shared his insights about what it takes for community colleges to start and sustain undergraduate research during the plenary on the morning of November 21.

As executive director of the Community College Undergraduate Research Initiative (CCURI) at Finger Lakes Community College in New York, Hewlett was uniquely suited to address summit participants before their small-group discussions on how to scale undergraduate research at community colleges.

Since 2005, when Hewlett received his first NSF grant to embed student research experiences in a biology course, he has grown CCURI into a network of more than 120 two-year colleges that offer undergraduate research opportunities in multiple disciplines. More than 80 percent of CCURI colleges offer research experiences within courses. Additional surveys of CCURI member colleges found that course-embedded research is the most common URE because it most readily fits curricula and students' schedules.

During his many years as a leading advocate for undergraduate research at community colleges, Hewlett has often heard remarks such as "but you're in a community college, I thought you guys just teach."

Hewlett said this thinking makes no sense.

"To me, if you are doing collaborative learning, if you are doing inquiry-based stuff, project-based learning, these are all tools in your toolkit that we know are high impact practices … Undergraduate research is just one of those tools. I just happen to think it is one of the best, if not the best. So, to me undergraduate research is teaching," Hewlett said.

He acknowledged it can be challenging to start a new research course because of barriers, such as lack of departmental or administration support, and the need to recruit students.

"We know that once you institute undergraduate research, your students get great opportunities," he said.

To develop a campus culture that supports undergraduate research, he advises community college faculty to

- **ALIGN** their UREs with the college's strategic plan, mission, and vision statement;
- **NETWORK** with other college faculty engaged in UREs; and
- **SCAFFOLD** research experiences from introductory to advanced courses.

"It is not a one-off," he said, explaining capstone courses that include research are not sufficient.

At colleges where the culture supports research, the students "are getting their research experiences in pieces connected across the curriculum." These colleges scaffold research tasks from introductory courses to bigger projects with more complex data analysis in subsequent courses.

"I think the reason this helps a college become sustainable is because in order to scaffold, you have to involve a lot of people. It appears if you do stuff across departments with multiple people that have to be involved, you are going to build that culture more quickly," Hewlett said.

The other commonality with successful undergraduate research initiatives analyzed by CCURI is that they fit with the college's strategic plan, mission, and vision statement.

"Aligning with institutional priorities, I would tell everyone to do that first, if you are thinking you want to sustain this," Hewlett said.

Videos Showcase Dynamic Undergraduate Research Experiences at Community Colleges

To help ground the small group discussions in the student outcomes possible with UREs, brief videos from various community college UREs were shown during plenary sessions on November 21 and 22. Links to them are at www.aacc.nche.edu/URESummit.

Paula Kirya Embraces Internship and Envisions Research Career

Paula Kiry

PAULA KIRYA considers doing research a great way for people to figure out what to do with their lives. A research project at Pasadena City College (PCC) on the nanostructure of butterfly wings "really opened me up to wanting to pursue more research," she said.

The butterfly research led to other research opportunities, which Kirya thinks have given her access to resources that other students did not know about or have. For this reason, Kirya would like more community college instructors to share information about research opportunities in their classes as PCC Chemistry Professor Jared Ashcroft does.

"Students are hungry to learn beyond the bounds of the classroom," Kirya said during the student plenary at the URE Summit. A bioengineering major, Kirya encouraged faculty to announce research opportunities in their classes and encourage students to apply for internships and participate in scientific conferences.

During an interview she talked about the qualms she initially had when Ashcroft suggested she apply for a summer nanotechnology internship at Pennsylvania State University. She was aware of other students who did not apply for similar opportunities that he suggested to them because they were intimidated about competing with students nationally and uncertain about handling the logistics of internships far from their homes.

"I decided I didn't have much to lose by applying ... Either I get it or I don't. It's fine. It's better that I had the chance of getting it than never putting any effort to do it in the first place. That's why I did it. And I'm glad I did," she said.

After being selected, Kirya had to explain her growing interest in research to her parents. Kirya said that her parents, who are natives of Uganda, worked hard to immigrate to the United States and expected her to focus on her courses in order to complete her associate degree and then a bachelor's degree as quickly as possible.

She said her parents told her: "You can't play around. You can't mess around. You can't dabble in research, if it's not going to take you somewhere."

An important motivation for Kirya is being able to support herself financially when she graduates. At Penn State, Kirya learned that she enjoys the miniscule details of laboratory research. "Even though I'm just watching, literally, bacteria grow—even though it's just that—I find it exciting," she said.

Since returning to PCC, she has continued working with a student research group that is collaborating with a California Institute of Technology post-doctoral fellow on a thermal infrared sensor based on their butterfly-wing research. She says this most recent research experience is preparing her to transfer to the University of California San Diego. She hopes her studies there lead to a Ph.D. The multiple career paths she is considering include community college teaching and encouraging students of color to do research.

About one career matter Kirya is certain: She wants to do research for the rest of her life.

Discussions on Expanding the Impact of the Practice of UREs on Students, Faculty and Two-Year Institutions

The steering committee designed the summit as a think tank, where structured working group discussions and informal conversations were intentionally exploratory and solution-seeking. Professional meeting facilitator Steve Brigham, a principal with Public Engagement Associates, helped keep summit participants focused on the role of community colleges in building, implementing, and sustaining UREs in STEM education and career preparation.

Before the small group discussions began on November 21, Brigham set the overarching goal "to work toward solutions that will matter in the future."

Brigham also shared the following ground rules for participants' discussions: Be forward-thinking; build on one another's ideas; listen with openness and intention to learn; be ready to move faster than normal and to move before everything is perfect and complete; share airtime; agree to disagree civilly; and turn cell phones off or to silent.

Brigham asked everyone to bear this question in mind: **"How do we do the right things to get more students involved in undergraduate research experiences at community colleges?"**

To bring positive energy and attention to implementing and scaling UREs at community colleges, rather than dwelling on things that impede UREs, a handout on the *Barriers to Implementation of UREs* was included in the information packets participants received. (See Appendix). The handout content was based on a study conducted by CCURI and summit participants' responses to questions posed in the summit application.

For the morning discussions, five tables each focused on questions about the impact of UREs on students, faculty, or institutions. While two hours was not sufficient time to reach formal consensus on every point, the groups prioritized their top three responses to each question.

The discussion tables focused on students considered these questions:

- **WHAT** are the most important benefits that students receive from participating in UREs?
- **WHAT** are the most important opportunities for students participating in UREs?
- **WHAT** are the most challenging barriers for students participating in UREs?
- **WHAT** is the short-term as well as long-term impact of students' learning and skill development by participating in UREs?
- **WHAT** are the common lessons learned across URE types regarding students' outcomes and success?

The discussion tables focused on faculty considered these questions:

- **WHAT** are the key benefits that faculty receive by teaching UREs and, in some cases, leading the URE efforts at an institution?
- **WHAT** type of support do faculty need to implement UREs?
- **WHAT** type of support do faculty need to sustain their leadership in UREs over time?
- **HOW** do faculty ensure that the UREs offered align well with industry/career preparation needs?
- **WHAT** are the common lessons learned regarding faculty success across URE types?

The discussion tables focused on institutions considered these questions:

- **WHAT** are the most important benefits that accrue to an institution that commits to and grows their URE efforts?
- **WHAT** are the elements of an institutional culture at community colleges that will accelerate the practice of UREs over time?

- **WHAT** are the elements of infrastructure at community colleges that will accelerate the practice of UREs over time?
- **WHAT** factors can lead to a college administration taking on greater ownership of implementing UREs?
- **HOW** do institutions ensure that the UREs offered align well with local industry/career needs? Participants were asked to propose up to three promising strategies.

During a plenary session, representatives from each table shared a compelling idea that surfaced during their discussions and ideas about the interrelationship of various UREs.

The ideas shared included the power of connecting UREs with employers and community service and the importance of inclusivity. One table suggested involving adjunct faculty in UREs. Another stressed that faculty must take steps to ensure first-generation college students and other populations historically underrepresented in STEM careers are included in UREs.

One table relayed that the word "research" could be a concern for some audiences. "What it [research] used to mean may not be what it means today. It's an ever-evolving process and linguistics is at the heart of it," one table spokesperson said. "Experimental learning opportunities" was suggested as an alternative term.

Other table representatives said it was imperative for URE proponents to use both numbers (i.e., transfer rates, student outcomes data, and evidence of closing equity gaps) and narrative (i.e., compelling student and faculty stories) to explain how UREs engage students.

To persuade administrators, industry partners, and others to buy-in to the idea of UREs at community colleges, another speaker said proponents should explain "what's in it for them" by giving students the opportunity to learn with UREs.

After lunch, facilitator Brigham shared his summary of key points made during the discussions to help prepare the participants for the afternoon's in-depth discussions and the recommendations they would generate for all the summit participants to consider on the morning of November 22.

Groups Consider Key Questions for URE Expansion

For discussions on the afternoon of November 21, participants were assigned to facilitated working groups based on preferences indicated on their summit registration forms. Each small group had an assigned facilitator and a note taker.

For three hours the groups discussed questions related either to scaling and sustaining UREs; partnerships for UREs; equitable access to UREs in STEM; or measuring impact/continuous improvement of UREs.

Summit staffers collated the group responses and placed them on poster papers, which were hung in the large meeting room for the gallery walk.

On the morning of November 22, the last day of the summit, all the summit attendees participated in the gallery walk to read the responses and help identify the key areas of focus for the summit proceedings report recommendations. A blank poster paper was displayed next to each group of responses for people to write additional comments, which were also considered in the synthesis for the report of the summit proceedings.

The following sections summarize key points made during the discussions and highlight the recommendations that were prioritized during the gallery walk.

To view a compilation of the small groups' responses to the November 21 morning discussion, and detailed notes from the afternoon working groups organized by topic area, see www.aacc.nche.edu/URESummit.

Scaling and Sustaining UREs

Question 1: *What are the elements, resources, and/or practices that should be in place for establishing UREs at an institution?*

Faculty—what they need to develop to continue using UREs as a pedagogical tool—were the focus of much of the dialogue on this question. Educating faculty to add UREs through campus events such as Research Days, poster sessions, and art installations were mentioned. Participants' lists of helpful institutional support include appropriate space, equipment, and dedicated support staff for UREs. Several participants noted the need for release time and additional compensation for faculty who, in general, must absorb the extra investment of time to start UREs. There was widespread agreement that adjunct faculty should be included in professional development to engage faculty in UREs.

Summit participants recommend colleges

- **DEVELOP** inclusive cultures that engage the community in discussions and plans for UREs, which should align with the priorities in institutions' missions, vision statements, and strategic plans; and
- **INCENTIVIZE** URE stakeholders—faculty, students, administrators, staff, industry partners, and others—with awards and public recognition, as well as additional compensation for college faculty involved in UREs.

Question 2: *How do practitioners garner and mobilize further institutional support as URE practice grows within an institution?*

Setting clear, defined goals for UREs that align with institutional missions, strategic goals, and/or other initiatives was suggested as a first step for mobilizing support within campus communities. Developing multidisciplinary topics for UREs that allow for collaboration between multiple instructors in different fields was mentioned as a strategy that several community colleges have used effectively. To maintain consistent visibility for UREs, it was suggested that URE champions use social media and other college communication platforms to highlight the value of UREs for students. There was general agreement that mobilizing institutional support requires sharing of information about how UREs fit degree programs and facilitate persistence and other positive student outcomes.

Summit participants recommend colleges

- **DEMONSTRATE** the benefits of UREs by sharing quantitative data from program assessments and student outcomes, as well as qualitative data from student success stories and alumni testimonials.

Question 3: *How does an institution and its faculty build the right organizational and physical infrastructure for scaling the practice of UREs at an institution? What are some innovative resources and strategies that have been successful?*

Many of the discussions touched on the hope that creative approaches will involve the organization of physical spaces and college personnel in novel ways that help UREs expand across disciplines and continue for many years. Dedicated labs and collaborative work spaces were identified as optimal environments for raising the profile of UREs and setting the stage for cross-discipline projects. Developing partnerships with employers was mentioned as useful for setting up internships and other work-based research experiences, and possibly obtaining equipment donations.

Successful strategies for sustaining UREs that faculty shared include highlighting UREs in the print materials distributed by college public relations departments as well as the college's website and accreditation reports. Sharing information about UREs in public service announcements, and during college events, campus tours, and orientation sessions were cited as low-cost ways to build students' interest in UREs. Publicizing UREs for first-year experience and capstone courses is another way to raise students' awareness of these powerful learning opportunities.

Several speakers noted that colleges that have scaled UREs began their efforts with explicit support of faculty piloting small-scale UREs to improve programs. These colleges provided "safety nets" for faculty to work through implementation challenges.

Summit participants recommend colleges

- **DEVELOP** collaborations with student organizations; with faculty across departments and disciplines; among vocational and academic programs; between institutions; with stakeholder businesses; at research institutions; with government agencies; and with non-governmental organizations such as professional societies.

Question 4: *How do individual institutions sustain the success and use of UREs over time in ways that significantly reduce burdens on participating faculty? What types of policies and procedures need to be in place to help sustain them?*

Weaving UREs into colleges' usual operating procedures was mentioned repeatedly as essential for sustainability. In addition to dedicated institutional funding, UREs flourish with ongoing institutional support for professional development programs and faculty creation of URE curricula.

Colleges that have institutionalized UREs document them, provide faculty with teaching and evaluation resources, dedicate space for research, and assign staff such as a lab technician or other support personnel to help faculty with the tasks involved in preparing students to carry out research.

When the usual operating procedures at community colleges allow for flexibility within courses to accommodate UREs, it assures faculty they have the backing to test new ideas and to strive for improvements. Integrating UREs into faculty appraisal and tenure processes was suggested as a way to encourage more faculty members to participate in UREs. Public recognition for faculty doing UREs was also mentioned as helpful.

Summit participants recommend colleges

- **SUPPORT** undergraduate research experiences by compensating faculty for research mentorship time and for providing opportunities to more students as part of their teaching loads.

Question 5: *What are the institutional considerations when determining which URE model(s) to pursue?*

Fit is the key consideration identified in every discussion. To attract and retain the attention of students and faculty, UREs must fit within the constraints of space, time, money, the availability and interests of faculty, students and industry partners, as well as institutional services and resources.

Summit participants recommend colleges

- **EVALUATE** how UREs fit within degree and certificate program(s), and how UREs align with institutional mission and goals; and
- **TAILOR** UREs to the job market and local employers and their willingness to offer internships and apprenticeships, and to participate in competitions.

ROV Competition Tasks Help Reginald King Find Career

Reginald King

REGINALD KING'S maturation is reflected in his involvement on the remotely operated vehicle (ROV) team over the six years he earned three associate degrees at Copiah-Lincoln Community College in Mississippi. As he evolved as a student and man, the ROV competition experience informed his career decisions and caught an employer's attention.

The first time King joined the team in 2011 he was just a passive member. It was his second year out of high school and he describes scrapping through his classes to earn a pre-engineering degree in spring 2012. "I was just not putting forth the effort," King said.

At his post-graduation job he quickly learned he needed more and better skills. He re-enrolled at Copiah-Lincoln Community College and completed an automotive technology degree in spring 2014. After working for a year at a metal fabrication company, he was still yearning for a more substantial career.

In fall 2015 when he enrolled in the electronics engineering technology program at Copiah-Lincoln Community College, it was with greater purpose. He studied harder than before and re-joined the ROV team.

This time he pro-actively engaged in constructing the robot for the international competition organized by the Marine Advanced Technology Education Center, an ATE center at Monterey Peninsula College in California.

In 2016-2017 he was the technical leader of the ROV team. "Getting to do more of the design work, showed me that I really enjoyed design work … and led me to pursue my degree in mechanical engineering," King said.

His ROV team experience helped him obtain a co-op position with Toyota Manufacturing Mississippi in 2018 while he worked on his bachelor's degree at Mississippi State University. The ROV competition provided useful background info for his senior project—a modular buoy system that allows forestry researchers to take incremental measurements of dissolved oxygen in streams.

King was hired as a design engineer by Hol-Mac Corporation before he finished his mechanical engineering degree in December 2019. The company contacted him after reviewing his LinkedIn profile that lists "designing, building, competing, and promoting the [ROV] product built for competition as a business model" and other skills. Interviewers at the company told King, "They were already happy with every technical skill I had from working with robotics."

Partnerships for UREs

Question 1: ***How does an institution decide what type of partnerships will be most valuable for its URE initiatives? What criteria should it use?***

The groups considered how URE leaders' relationships with employers and universities shape URE initiatives. The two main factors in determining whether partnerships last or even begin are whether a URE aligns with career preparation needs or the potential for students to matriculate to baccalaureate programs. Geography is frequently a consideration (i.e., Does the real-world application of the URE fit with local or regional needs? Is the URE site in a place where students can access it easily?). Several people said it was important for partnerships to be mutually beneficial. Others pointed out each partners' investments in the URE should be transparent and publicly acknowledged.

Summit participants recommend that the criteria for partnership decisions be

- **ALIGNMENT** with the community college's mission; the college's internal strategic plan; students' feelings of purpose; and how the authentic experiences lead to higher quality careers;
- **IMPACT** on students' employability and transfer placement; and
- **SUSTAINABILITY**—both long and short-term—of financial support, location of UREs, relationships with partners, infrastructure, and administrators' buy-in.

Question 2: ***Pick two types of partnerships on which to focus. Determine three or four important mutual benefits that each partner can provide across students, faculty, and institutions.***

One of the four groups that worked on the partnership questions categorized partnerships as formal and informal. The benefits cited for formal partnerships are shared resources, greater intellectual merit that leads to broader impacts, and mutual accountability. The main benefits listed for informal partnerships were their flexibility and their potential to cast a wider net to inform the community about programs.

Another group focused on competition partners, industry partners, and academic partners. The chief benefits listed for competition partnerships are the creation of innovation and the potential for participants to make a novel contribution to science.

Academic partnerships and industry partnerships were the types of partnerships chosen by the two other groups as well. Collaborations within the college and other education sectors were listed as the main benefits of academic partnerships. Academic equality, students' transferability, and shared resources for managing grants and boosting institutional infrastructure were among the other benefits listed by the three groups.

The opportunity to improve students' self-efficacy was cited as the main benefit of industry partnerships for UREs. Internships that lead to jobs are another direct benefit for students. The potential for employers to help faculty by facilitating relationships with additonal industry partners was among the other benefits listed by the groups.

Question 3: *How do you most effectively build and sustain your top two identified partnerships?*

The key points identified through the gallery walk cut across all the types of partnerships.

To sustain URE partnerships, summit participants recommend community college personnel

- **ENGAGE** partners intentionally with frequent communication and public recognition;
- **BUILD** staffing capacity and plan for leadership transitions within the URE program and the coalition that supports it;
- **FACILITATE** efforts to build and nurture relationships with partners;
- **DEVELOP** connections with local four-year colleges and industry to establish pathways for students as they move beyond the URE;
- **ESTABLISH** articulation agreements with four-year institutions to facilitate students' transfer to baccalaureate programs; and
- **REVIEW** and adjust activities on an ongoing basis through regular conversations with partners.

Question 4: *What institutional infrastructure is needed to support these types of partnerships?*

The groups discussed hiring practices, data collection and management assistance, planning, and marketing that included signage to brand facilities used for UREs.

To support URE partnerships the summit participants recommend

- **IDENTIFYING** the necessary on-campus support for UREs among grant writers, financial office staff, marketing team, and the institutional planning office;
- **GIVING** faculty release time;
- **DESIGNATING** personnel to UREs including support staff, partnership team members, and a partnership coordinator; and
- **ESTABLISHING** a URE partnership coordinator position to fit the partnership(s). This could be done with an endowed chair, creation of project coordinator position, or funding of URE duties to a faculty or administrator position.

Nathan Shih Maximizes Internships for Career Exploration

Nathan Shih

Thanks to his involvement in the STEM to Stern program at Bellevue College in Washington, **NATHAN SHIH** participated in three internships and a year-long undergraduate research project in his first two years out of high school.

"These undergraduate research opportunities really helped me find my footing and explore career paths," Shih said during an interview at the URE Summit.

Shih said he "loved" Bellevue in large part because of STEM to Stern and its process for accelerating students' STEM career connections. During their first year in the credit program, students meet weekly to hear from different STEM professionals and learn how to apply for internships. During all three quarters of the second year, students work on group research projects with guidance from a faculty mentor. Shih's group studied the use of reinforcement learning to program a small robot.

That research experience taught him about teamwork while the off-campus internships taught him what he liked and did not like about particular fields and jobs.

His first internship involved assisting with 3-D modeling of aneurysms in the lab of a University of Washington scientist who spoke to the STEM to Stern class. Shih took the unpaid position because he had been planning to go into bioengineering. By the end of the summer, Shih decided to major in electrical engineering with its entrée to a wider breadth of careers than bioengineering.

His second internship at the National Renewable Energy Laboratory sealed his decision to pursue a career in renewable-energy. Creating models of the degradation and non-uniform soiling of solar panels in the innovative, collaborative environment of the national laboratory in Colorado showed Shih that he prefers to blend engineering with work outdoors.

"That was one of the best experiences of my community college career because of the hands-on learning experience … It gave me a better understanding of the renewable energy field, but also gave me a better understanding of my interests and future career paths," he said. He values the one-on-one interactions he had with the senior scientist who mentored him, but all the grant-writing required of scientists does not appeal to him.

In 2019, when he interned at NASA's Ames Research Center in California, Shih's mentors structured an astrobiology study to fit his renewable energy career interests. Although he had not taken a biology course since high school, Shih measured the photosynthesis efficiency of microbial mats.

"That I didn't really know very much kind of pushed me out of my comfort zone; but also helped me grow a lot more than I otherwise would have, I think. Being so uncomfortable helped me push my boundaries and be more confident in myself because I realized that I could do this research. I could meaningfully contribute to this research even as a community college student without much of a background in biology because of the multi-disciplinary nature of research and how different skill sets complement each other."

As a junior majoring in electrical engineering at the University of Washington, Shih shared this perspective on his community college undergraduate research experiences: "Trying new things is a great opportunity to grow as a person, but also be exposed to new ideas and different people. I've found that aspect of research to be very interesting and intellectually stimulating. So that's super cool."

Equitable Access to UREs in STEM

Question 1: *How do we ensure that more students have access to UREs at community colleges, especially those that have been historically underrepresented in STEM disciplines?*

There were many comments during these discussions about the need for faculty to make UREs as inclusive as possible and to take specific actions to involve diverse populations in UREs. For instance, including UREs in mandatory introductory courses or highly recommended electives makes them available to students of all incomes and races. It was suggested that following Universal Design for Learning guidelines and using flexible scheduling would eliminate barriers to UREs for students whether they have documented disabilities or personal challenges such as parenting and job responsibilities. Offering online research projects could make it easier for rural students and others with transportation limitations to participate in UREs.

Because equitable access involves meeting students where they are, many suggestions were shared about how to reach particular populations. For example, faculty could invite professionals who are racial or ethnic minorities, the first in their families to attend college, or from low-income backgrounds to talk with students about their academic journeys and career paths. The college's disability services offices and veterans' support groups could be utilized to promote UREs as positive opportunities.

To ensure that more students have access to UREs at community colleges, summit participants recommend that colleges

- **EDUCATE** faculty broadly about Universal Design for Learning concepts, cultural awareness, and disabilities that are visible and those that are hidden;
- **OFFER** UREs that are community-based or otherwise relevant to students to pique their curiosity and encourage them to persist; and

Equitable Access Defined for Discussion Groups

For the purpose of the URE summit, the steering committee offered the following definition to aid in discussions about UREs and how to expand them at community colleges:

> **Equity is the idea that students from marginalized and underrepresented populations have access to resources that empower student success and close completion achievement gaps. Equity is based upon the principle of fairness and is distinct from equality. While equality involves treating everyone the same way, equity provides each individual, or group, what they need to have an equal opportunity to succeed.**

- **PROVIDE** faculty with professional development about the various types of UREs to encourage more instructors to incorporate research in their courses or to offer other types of UREs to reach more students.

Question 2a: *What pathways should institutions consider in order to engage and retain underrepresented students in STEM UREs?*

Clear communication was mentioned repeatedly as a way of establishing pathways that engage and retain students. Faculty should explain why UREs are important and how research tasks build toward larger goals. Faculty and staff also have to be intentional about how they communicate. For example, students that are deaf or hard of hearing cannot follow side conversations or understand what is being said when people speak while writing on the board.

In some settings it may be helpful to utilize peer mentors or peer tutors, who have received rigorous preparation for these roles, to connect students with individuals who can serve as models for succeeding in particular courses and college.

To engage and retain populations that have been historically underrepresented in STEM URE experiences, the summit participants recommend that colleges

- **EXPOSE** students to research in the first semester (e.g., a library research project on a topic the student chooses); and
- **RECRUIT** diverse faculty, alumni, and community groups to work with students in UREs.

Question 2b: *What are the major challenges to overcome to retain students during and after a URE?*

Keeping communication open was mentioned repeatedly during discussions about retaining students. Faculty need to address students who feel uncertain about doing UREs. Informing students' families through social media or handouts that explain what the family can expect during the URE were among the effective practices summit participants shared.

It was also suggested that faculty work with other college personnel, such as retention specialists, to support students who are struggling and guide them to appropriate resources.

To retain students during and after a URE, summit participants recommend that colleges

- **FACILITATE** a sense of community among students that helps them persist when challenges occur.
- **MEET** non-academic needs and eliminate obstacles that impede some students from participating in UREs; and
- **BUILD** UREs into career pathways that are explained to students.

Question 3: *How do we design UREs in STEM disciplines to meet the full range of underrepresented students' needs?*

Rather than merely surveying students about their needs, faculty could talk with students to identify their interests and experiences. These discussions could provide the basis for new UREs. Several people stressed the value of structuring UREs to build on students' assets and to cultivate career skills. Professional development and mentoring to promote cultural sensitivity could help faculty design UREs. So, too, would a central repository of community college STEM resources such as instructional tools, videos, modules, and journals.

To design UREs that meet the full range of underrepresented students' needs, summit participants recommend that colleges

- **ASSESS** needs, desires, and strengths of students using an equity/opportunity gap analysis that checks whether UREs are reaching students and if students are succeeding.

Question 4a: *Beyond access for these students, how do we ensure that underrepresented students in STEM disciplines benefit from their URE experiences?*

Making sure faculty know the effective practices for mentoring undergraduate researchers was suggested as an important first step. Then, when UREs are completed, students should be recognized for their URE accomplishments and receive guidance on how to articulate the gains they made with UREs when they speak with prospective employers.

To ensure that underrepresented students in STEM disciplines benefit from their URE experiences, summit participants recommend that colleges

- **EDUCATE** faculty and student mentors about implicit biases and other diversity and inclusion issues; and
- **EXPAND** and sustain funding for UREs at community colleges.

Question 4b: *What are the unique factors or dimensions of UREs that impact the student learning experience?*

Because many course-based UREs occur in smaller-sized classes, students who participate in UREs usually benefit from lower student-faculty ratios. Whether a URE involves a team competition or a capstone course, peer learning often flourishes in these settings where students are exposed to skills not often taught in traditional courses. By emphasizing the learning process rather than production of peer-reviewed journal articles, UREs at community colleges provide "safe environments" for students to gain practice in independent exploration, troubleshooting, failing, recovering from mistakes, and persevering.

Summit participants suggest that the unique factors of UREs that impact student learning are

- **ENGAGEMENT** in learning that leads to student "ownership" of the learning process; and
- **APPRECIATION** of one's role in the scientific endeavor, and identification as a inquirers of scientific questions or engineering design processes.

Kristen Pisarcik Gains Pivotal Biotech Skill through URE

Kristen Pisarcik

KRISTEN PISARCIK considers learning the CRISPR technique for modifying genetic codes during an undergraduate research experience at the Gene Editing Institute a profoundly important life experience. The institute is a partner with Delaware Technical Community College (DTCC) on an ATE grant that teaches faculty and students about CRISPR, which stands for Clustered Regularly Interspaced Short Palindromic Repeats.

Pisarcik used CRISPR for beta tests on a new product in the institute's lab for a research project that she did while finishing up three associate degrees at DTCC. After graduating from DTCC, she went to work at the institute.

Now as a science educator for the Technician Training in Gene Editing project (an ATE grant project at DTCC), Pisarcik translates the gene-editing steps done in the institute's laboratory into protocols that faculty can follow when they instruct students in CRISPR techniques. The protocols are designed for use in schools without sophisticated lab equipment.

Having skills that she learned during an internship put her in a position to teach faculty about a technology that she considers revolutionary is just the latest in a string of positive outcomes that Pisarcik traces to conducting research as a community college student.

"The amount of opportunity that it [undergraduate research] opens you up to is amazing and completely unknown. When I started I had no idea I even wanted to potentially do gene editing let alone in a slightly more educational setting. But it kind of directed me that way, and I love it," she said.

In addition to her work for the ATE project, Pisarcik is pursuing a bachelor's degree in applied molecular biology and biotechnology at the University of Delaware.

Measuring Impact of UREs

Question 1a: *How do we effectively measure the impact of UREs on student learning?*

The small groups discussed various quantitative metrics and the challenge of obtaining reliable data on multiple outcomes unique to UREs at community colleges. For instance, it would be advantageous to know what opportunities students gained from UREs. However, many colleges struggle to maintain contact with alumni to find out less nuanced information.

It was suggested that assessing student skills by looking at different competencies at the end of UREs would provide stronger data than students' self-assessments before and after the URE. Triangulating students' reflection statements with comments by faculty and an independent observer could make qualitative data more robust. Wage data from the U.S. Department of Labor was cited as one public source that could provide data about students' career paths following UREs.

To measure the impact of UREs on student learning, summit participants recommend that colleges

- **USE** multiple measures such as retention, completion, pre- and post-course assessments, student stories, and gap analysis; and
- **HAVE** a feedback loop within the assessment process that is transparent to students.

Question 1b. *How do we effectively measure the impact of the practice of UREs at the institutional level?*

The groups discussed the potential to use some of the data gathered for performance-based funding such as retention, graduation, and transfer rates to gauge the impact of UREs. Setting up comparison groups of URE participants and non-participants was also considered.

To measure the impact of UREs at the institutional level, summit participants recommend that colleges

- **COLLECT** stories and other metrics that augment institutional data; and
- **WORK** with four-year institutions to obtain data about URE students' academic performance after they transfer.

Question 2: *How do we customize the measurement and proper assessment for the different types of UREs offered?*

A clear takeaway from these discussions is that the unmet need for ways to measure the impacts of various UREs is an opportunity for educators to devise a system that fits the broad definition of undergraduate research experiences evolving at community colleges. The ideal system would capture students' acquisition of technical skills and soft skills.

To customize measurement and assessment of UREs, summit participants recommend that colleges

- **CREATE** a standard set of assessment tools from which instructors can pick and choose;
- **PROVIDE** professional development workshops for two-year college instructors to learn how to use URE assessment tools and interpret results; and
- **DEFINE** student learning outcomes and URE goals upfront.

Question 3: *How do we evaluate UREs in ways that ensure continuous improvement of these programs and of the broader impact they have?*

Several participants described the need for an iterative improvement process that allows educators to reflect on how to modify UREs to make them better. Several of the strategies considered by the groups would change the usual student-teacher dynamic. For instance, regular evaluation of mentors by students was one idea discussed. Another was to use student-led focus groups to provide constructive feedback to URE leaders.

Several people advocated for formal faculty learning communities to provide ongoing education for faculty.

To evaluate UREs for continuous improvement, summit participants recommend that colleges

- **FIND** creative ways to track the longer-term effects after students have left college; and
- **DESIGN** assessment tool(s) to identify not only what people and initiatives are doing well, but what they could do better.

Question 4: *How do we use evaluation to communicate the value of students' URE experiences? To communicate the return on investment for students? For the institution?*

Retention data and exit placement information were suggested as information that would show return on investment. However, much of the dialogue about these questions focused on the need to highlight students' personal narratives and emphasize successes (i.e., scholarships, career opportunities) that often follow involvement in UREs. Having students who have participated in UREs tell other students, faculty, administrators, and board members about their research experiences and the impact it had on their lives was described as quite powerful.

To communicate the return on investment of UREs on students and institutions, the summit participants recommend that colleges

- **TRACK** and emphasize how retention and graduation rates are affected by UREs; and
- **PROVIDE** students with opportunities to showcase their UREs to the community via poster sessions, question and answer sessions, video vignettes, infographics, and other campus events.

Question 5: *Are there success factors common to all (or most) URE types? If so, what are they?*

UREs that align with faculty members' interests and that stimulate the intellectual interests of both faculty and students were cited as good starting points for all UREs. The employment of a URE coordinator who communicates well with instructors and brings UREs to the attention of the community was mentioned as a factor at community colleges that have successfully implemented UREs in multiple disciplines. Information was also shared about the value of having alumni remain actively engaged in certain high-impact URE experiences.

Summit participants identified the top success factors common to all types of UREs as

- **ADMINISTRATION** (department chair, dean, vice president, president, and college trustees) supporting faculty in their URE endeavors; and
- **STUDENTS** having ownership in their projects.

Community College Innovation Challenge Sparks STEM Entrepreneurial Drive in Danial Nasr Azadani

Danial Nasr Azadani

Doing authentic research in an introductory biology course led to a series of research experiences—scientific conference poster presentations, an internship, and the Community College Innovation Challenge—that have collectively piqued Danial Nasr Azadani's interest in entrepreneurial science.

Nasr Azadani's enthusiasm for a STEM career is a dramatic change from a few years ago, when the large classes at the university he attended in Canada and impersonal treatment by professors there disillusioned him.

During an extended visit with his sister in Corpus Christi he enrolled in Del Mar College in Texas just to pick up a few college credits at a lower cost than at his home institution. He liked the hands-on activities of an applied technology course, and the ember of his interest in science reignited in a biology course where he worked on a bioinformatics project connected with the Science Education Alliance-Phage Hunters Advancing Genomics and Evolutional Science (SEA-PHAGES) program. Students engaged in this international undergraduate research effort check soil samples for new bacteriophages, which are viruses that have the potential to kill antibiotic-resistant bacteria.

"As soon as I saw all this stuff happening, it was a no-brainer to be part of it. I had to be part of all this research," Nasr Azadani said.

Biology Professor J. Robert Hatherill took him and other students to a Texas branch meeting of the American Association of Microbiology where they presented posters about their research findings. Nasr Azadani received a third-place award for his presentation. His confidence got another boost a few weeks later when the same poster on display at a Del Mar College student poster session so impressed a Texas A&M University-Corpus Christi professor that he offered Nasr Azadani an internship.

In 2017, Nasr Azadani was on the Del Mar College team that won the Community College Innovation Challenge with their plan for a spray that slows the spread of antibiotic-resistant bacteria. Their product development was informed by their biophages research.

As exciting as it was to win the competition that the American Association of Community College organizes with National Science Foundation support, Nasr Azadani said that the CCIC week-long boot camp was the real game-changer for him. The experts who advised the 10 finalist teams on how to launch businesses from their inventions provided such helpful business and interpersonal skill advice that he still refers to his boot camp notebook and frequently shares information from it with other students.

"It was the most phenomenal thing that I was part of," he said at the URE Summit where he explained that since enrolling at Del Mar College he has participated in 20 conferences and workshops, competed in multiple academic competitions, and had scientific papers published. Following his 2019 graduation from Texas A&M, Nasr Azadani took a year off to work and start a business before beginning a Ph.D. program.

At the URE Summit, Nasr Azadani said he was grateful to Hatherill for incorporating research in his biology courses. "That was among the top greatest things that have ever happened in my life—just going to a community college and getting the opportunity to do undergraduate research," he said.

Summit Wrap Up

A lively plenary discussion followed the gallery walk and report out on November 22. Participants shared many positive statements about the the summit. They also made suggestions for devising the summit's proceedings report to launch a movement that results in more two-year college students having research experiences.

"I think we would probably all agree that what you don't want to happen is for this discussion to stop with this meeting," said John Mateja, president of the Barry Goldwater Scholarship in Excellence in Education Foundation.

Michael Reiter, professor, director and chair of Environmental Science at Bethune-Cookman University in Florida, said expanding UREs at community colleges requires a transition management approach. He said this means that colleges that want to expand UREs should bring together representatives of students, faculty, campus leaders, and college system or state education leaders to come up with strategies for coordinated movement of three or more levels of the institution simultaneously.

Summit Spins Off New URE Activities

In their public comments and the personal reflection statements included in post-summit surveys, several participants mentioned specific actions they planned to take as a result of the summit. Three months after the summit several follow-up activities were underway.

The largest of these efforts is a series of Zoom meetings organized by Jared Ashcroft, chemistry professor at Pasadena City College in California. During bimonthly meetings, summit participants and others interested in UREs share information about effective URE practices. In a December 2019 interview, he explained his hope to develop a community of practice around UREs. Ashcroft said, "To me it's more of a national conversation—like how do we support each other at community colleges? How can we maybe leverage different [undergraduate research] programs that are really successful?"

Patricia Turner, dean of science, engineering and technology at Howard Community College in Maryland, explained in a February 2020 email that she had submitted a proposal for a session about UREs at the statewide community college conference on May 1, 2020. She hopes that this session will lead to a core group with representatives of every Maryland community college collaborating to expand the use of UREs. "There is a lot of energy around this right now," she wrote.

Devoun Stewart, assistant professor of chemistry at Sacramento City College in California, wrote in a February 2020 email that he had started to develop course-based undergraduate research experiences for a general chemistry course. The college also plans to submit an S-STEM grant proposal to NSF. The S-STEM program was one of several URE funding opportunities shared during the summit.

In his reflection statement, Darren Mattone, a biology professor at Muskegon Community College in Michigan, mentioned his hope to improve coordination of research at the college so that various research efforts could develop a common marketing message. In February 2020, he wrote that the summit prompted him to take a different route: "I applied for a sabbatical for fall 2020 to develop a proposal for a research-based honors college/program that spans all disciplines. I felt that this honors approach would foster more interdisciplinary collaboration and research between faculty and students, and build on what others are already doing. This will then lead to the college-wide Scholars' Day I've envisioned for years, in addition to the marketing of what we as faculty do."

Next Steps

These early off-shoot activities indicate the strong interest among summit participants to enhance UREs in response to what they learned at the summit. They are precisely the sort of individual and collective activities AACC hoped to generate by convening the summit to focus on the role of community colleges in building, implementing, and sustaining UREs in STEM education and workforce preparation.

This report of the summit proceedings aims to raise awareness of innovative UREs at community colleges and to highlight how UREs build STEM career skills, improve student retention and completion, and help students succeed in their careers.

The report is also intended to stimulate URE-related proposals to the NSF ATE program. On March 6, NSF issued a "Dear Colleague Letter" to ATE grantees inviting them to request supplemental funds for development and implementation of UREs in STEM that support workforce preparation of students at two-year institutions. (See Sidebar).

The information shared at the summit provided evidence of the enormous potential among community college faculty and administrators to shape the powerful pedagogical tools inherent in UREs to address students' educational needs and to fit STEM curricula. Given the energetic support of UREs at community colleges that have scaled them, adoption of UREs by more two-year colleges could help accelerate the value and impact of community colleges in STEM workforce development.

New Funding Opportunity for Advanced Technological Education Undergraduate Research Experiences (ATE-UREs)

New funding for novel undergraduate resource experiences (UREs) is available to current principal investigators of Advanced Technological Education (ATE) projects and centers.

On March 6, 2020, the National Science Foundation's Directorate for Education and Human Resources issued a Dear Colleague Letter inviting current ATE grantees to submit requests for supplemental funding to support UREs that promote workforce preparation for students at two-year institutions.

The funds may be used to support all levels of URE development from the idea phase to well-established program implementation. "All projects must include evaluation and analysis of how UREs promote development of students' work skills and career outcomes," the letter states.

This new initiative broadly defines UREs as "experiences developed using the scientific method and/or engineering design processes to promote student learning by solving a problem and proposing workable solutions."

The letter lists these examples of ATE-UREs: course-based undergraduate research experiences; traditional, independent undergraduate student research experiences; problem-based learning; case-based learning; independent studies; capstone projects; employer-based research such as internships and co-ops; hackathons; STEM design challenges; and STEM competitions.

Interested ATE principal investigators are encouraged to initiate a conversation with their NSF program directors about their ideas for ATE-URE funding.

Supplemental funding proposals are due May 15, 2020. Funded activities must start before December 31, 2020.

APPENDIX: Summit Agenda

Community College Undergraduate Research Experience (URE) Summit

November 20-22, 2019 | Omni Shoreham Hotel, Washington, D.C.

WEDNESDAY • NOVEMBER 20

4:00 p.m. **Summit Registration**
Blue Room Pre

4:00 p.m. **Poster Session Set-Up**
Blue Room

5:00 p.m. **Welcome from NSF and AACC**
Overview of Summit Purpose and Agenda
Blue Room
Lee Zia, *Deputy Division Director, Division of Undergraduate Education, National Science Foundation, VA*
Mary Heiss, *Senior Vice President, American Association of Community Colleges, DC*
V. Celeste Carter, *Program Director, National Science Foundation, VA*
Steve Brigham, *Principal, Public Engagement Associates, DC*

6:00 p.m. **Preparing Students for the 21st Century Workforce through Undergraduate Research Experiences**
Alexa Bennett, *Student, University of Delaware, DE*
Reginald King, *Student, Mississippi State University, MS*
Paula Kirya, *Student, Pasadena City College, CA*
Danial Nasr Azadani, *Student, Del Mar College, TX*
Moderator: V. Celeste Carter, *Program Director, National Science Foundation, VA*

7:00 p.m. **URE Poster Session**
Blue Room
(Posters will be available for viewing for the duration of the summit through Friday, November 22.)

8:00 p.m. **Adjourn**

THURSDAY • NOVEMBER 21

7:30 a.m. **Breakfast**
Blue Room Pre

8:30 a.m. **Broadening Participation in UREs: The Expanding Role of the Community College**
Blue Room
James Hewlett, *Executive Director, Community College Undergraduate Research Initiative, Finger Lakes Community College, NY*

9:05 a.m. **Student Video Vignettes**

9:10 a.m. **Expanding the Impact of the Practice of UREs on Students, Faculty, and Two-Year Institutions** (Facilitated small group discussion at assigned tables.)
Blue Room
Tables 1-5: Student Impact
Tables 6-10: Faculty Impact
Tables 11-15: Institutional Impact

11:30 a.m. **Reflection and Report Out: Common Themes, Compelling Ideas, and Promising Strategies**
Blue Room

12:10 p.m. **Student Video Vignettes, Agenda Review & Instructions for Afternoon Working Groups**

12:30 p.m. **Networking Lunch**
Blue Room Pre

1:40 p.m. **Facilitated Working Group Breakouts**
(Participants were assigned to working groups per preferences indicated on their URE registration forms.)

1. **Scaling and Sustaining Working Group**
   Governors Room
2. **Partnering Working Group**
   Blue Room

THURSDAY • NOVEMBER 21 (CONTINUED)

3. **Equitable Access to UREs in STEM Working Group**
   Calvert Room

4. **Measuring Impact/Continuous Improvement Working Group**
   Capitol Room

5:00 p.m. **Report Out & Sharing of Working Group Highlights** (All groups reconvene in the Blue Room.)
Blue Room

5:30 p.m. **Adjourn**

FRIDAY • NOVEMBER 22

Blue Room Pre & Blue Room

7:30 a.m. **Breakfast**
Blue Room Pre

8:30 a.m. **Friday Meeting Overview & Student Video Vignettes**
Blue Room
Steve Brigham, *Principal, Public Engagement Associates, DC*

8:40 a.m. **Gallery Walk & Prioritization of Strategies, Solutions, and Insights from the Thursday Afternoon Working Groups**

10:15 a.m. **Review of Top Strategies, Solutions, and Insights from the Gallery Walk**
Steve Brigham, *Principal, Public Engagement Associates, DC*

10:30 a.m. **Individual Reflections – Summit Impacts**

10:50 a.m. **Sharing Individual Reflections at Tables/ Table Discussions**

11:20 a.m. **Report Out: Guidance on Final Report & Insights from the Summit**

12:00 p.m. **Next Steps**

12:15 p.m. **Complete Summit Evaluation Forms**

12:30 p.m. **Adjourn**

APPENDIX: Barriers to Implementation of UREs

The following list of identified barriers to the implementation of UREs was compiled from the Community College Undergraduate Research Initiative (CCURRI) network and from data gathered from the applications to the Community College URE Summit.

TIME

- Students
  - Lack of time to participate in UREs due to personal schedules (many students work, have family obligations, etc.)
  - Limited hours available for students to commit to research
  - Limited number of quarters/semesters that students stay at college (and not enough time in quarter/semester to conduct research)
- Faculty
  - Lack of personal faculty time to develop URE projects
  - Lack of faculty time to lead URE projects and mentor research
  - Faculty teaching loads are too high to accommodate the time to implement UREs
  - Lack of time within course that has required content to implement URE

FINANCIAL

- Students
  - Lack of funds for students to travel (to travel-based UREs, conferences, etc.)
  - Barrier of student financial aid rules preventing students from participating in UREs
  - Lack of funds for student support/challenge participating in unpaid projects
  - Challenge of having students participate in UREs (such as summer experiences) when they work
- Faculty
  - Lack of compensation for faculty to develop and run UREs
  - Lack of funds for faculty to travel (to travel-based UREs, conferences, etc.)
  - Lack of faculty release-time to support UREs
- College/Institution
  - Lack of funds and administrative support to run UREs
  - Lack of state funds that support UREs
  - Lack of funds for equipment, materials, and supplies needed to support UREs

SPACE/COLLEGE INFRASTRUCTURE

- Limited or no space available to offer research projects
- Labs not set up for research (equipment and supplies are moved between labs making it difficult for students to conduct research and troubleshoot)
- Labs share equipment/no dedicated equipment or space for UREs
- Lack of access to research quality facilities on or off campus
- Lack of equipment and lab supplies
- Lack of space limits research projects

FACULTY

- Lack of faculty buy-in
  - Perception of research as having no place in or not being a serious pursuit at a community college
  - Question of appropriateness of UREs due to learning goals
  - Resistant to change
  - Challenge grasping what is possible in the first two years of postsecondary work
  - "Traditional" views on education

- Various comfort levels on UREs
- Misconceptions among faculty on level of research that should be conducted

- Other faculty barriers to implementing UREs
  - Need for professional development/training
  - Challenge in providing authentic projects that align with existing learning outcomes
  - Challenge of finding/developing interesting projects in diverse fields
  - Challenges in handling large numbers of students in UREs
  - Initiative fatigue
  - Loss of critical faculty members/faculty turnover
  - Challenges of part-time faculty in managing UREs
  - Faculty maxed out on teaching
  - Low morale
- Disparity among faculty working in UREs
  - Lack of communication and sharing of information/opportunities (particularly among colleges with different campuses)

STUDENTS

- Lack of student awareness of URE offerings and value of participating in UREs
  - Challenge in recruiting/retaining students in UREs, particularly nontraditional and underrepresented students
  - Transient nature of students makes recruitment and retention in UREs challenging
- Lack of student participants due to course requirements
- Lack of student participants due to financial aid rules
- Lack of student preparation to participate successfully in UREs (working at edge of students' abilities, students not accustomed to focusing on research of real-world problems)
- Low student motivation
- Students intimidated by research
- Student perception of UREs as too challenging
- U.S. citizenship status required for some UREs can serve as a barrier

INSTITUTIONAL/ADMINISTRATION

- Administration not supportive or has not bought into UREs at community colleges
  - Lack of institutional culture that supports UREs
- Turnover of administration resulting in faculty losing support or having to re-educate on the value of URE
- Allocation of resources is challenging in times of budget restraints
- Class size
  - Lack of support for running courses with low enrollments
- Credit limits for degree programs
- Lack of infrastructure that supports research
  - Lack of institutional review board (IRB)
  - Lack of an institutional animal care and use committee (IACUC)
  - Lack of support in course development
  - Lack of technician support
  - Lack of cohesive plan for running UREs
- Size of institution
  - Too large
- Location of institution
  - Geographic isolation
- Lack of four-year partnerships
- Lack of URE partners and industry support
- Lack of policies for transfer credit for UREs
  - Courses not accepted for transfer
- Lack of access to sites for field work

APPENDIX: Summit Participants

David Asai, Senior Director of Science Education, Howard Hughes Medical Institute, MD

Jared Ashcroft, Professor of Chemistry, Pasadena City College, CA

Danial Nasr Azadani, Student, Del Mar College, TX

Virginia Balke, (Retired), Delaware Technical Community College, PA

Mahalaxmi (Gita) Bangera,* Dean, Bellevue College, WA

Christine Barlow, Associate Professor of Biology, Ivy Tech Community College, IN

Carol Bascom-Slack, Assistant Professor, Tufts University, MA

Maria Bautista, Interim Vice Chancellor for Academic Affairs, Kapiolani Community College, HI

Craig Bayse, Associate Dean, Old Dominion University, VA

Jonathan Beck, Director, National Center for Autonomous Technologies, MN

Heather Belmont,* Vice President of Academic Affairs, Indian River State College, FL

Alexa Bennett, Student, University of Delaware, DE

Heather Bock,* CCURI Project Director, Finger Lakes Community College, NY

Kerry Brenner, Senior Program Officer, National Academies of Sciences, Engineering, and Medicine, DC

David Brown,* Consultant, Nine Twenty-Four Strategies, CA

Kitrina Carlson, Professor, Madison College, WI

Britt Carlson, Associate Professor of Chemistry, Parkland College, IL

V. Celeste Carter,* Lead ATE Program Director, National Science Foundation, VA

Terri Chambers, Director, Learning and Career Development, American Chemical Society, DC

Miriam Chavez, Regents' Professor of Biology, University of New Mexico - Valencia Campus, NM

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Vince DiNoto, Director of GeoTech Center, Jefferson Community and Technical College, KY

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David Durkee, CSSIA Competition Director, Moraine Valley Community College, IL

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Maria Mercedes Franco, Associate Professor and Chair of Math and Computer Science, Queensborough Community College, NY

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