The Reasons for Undergraduate Research

University research has grabbed plenty of headlines over the past few months. Not for the breakthroughs that propel so much of American innovation. Not for the work that advances our health and well-being, that protects our safety, our security, our sustainability. Even so, the discoveries keep coming.

No, the *new* headlines about academic research deal in the grave threats it now faces: massive cuts in the way university R&D is funded, the revocation of grants that don't align with federal priorities, the slow-walking of new grant approvals.

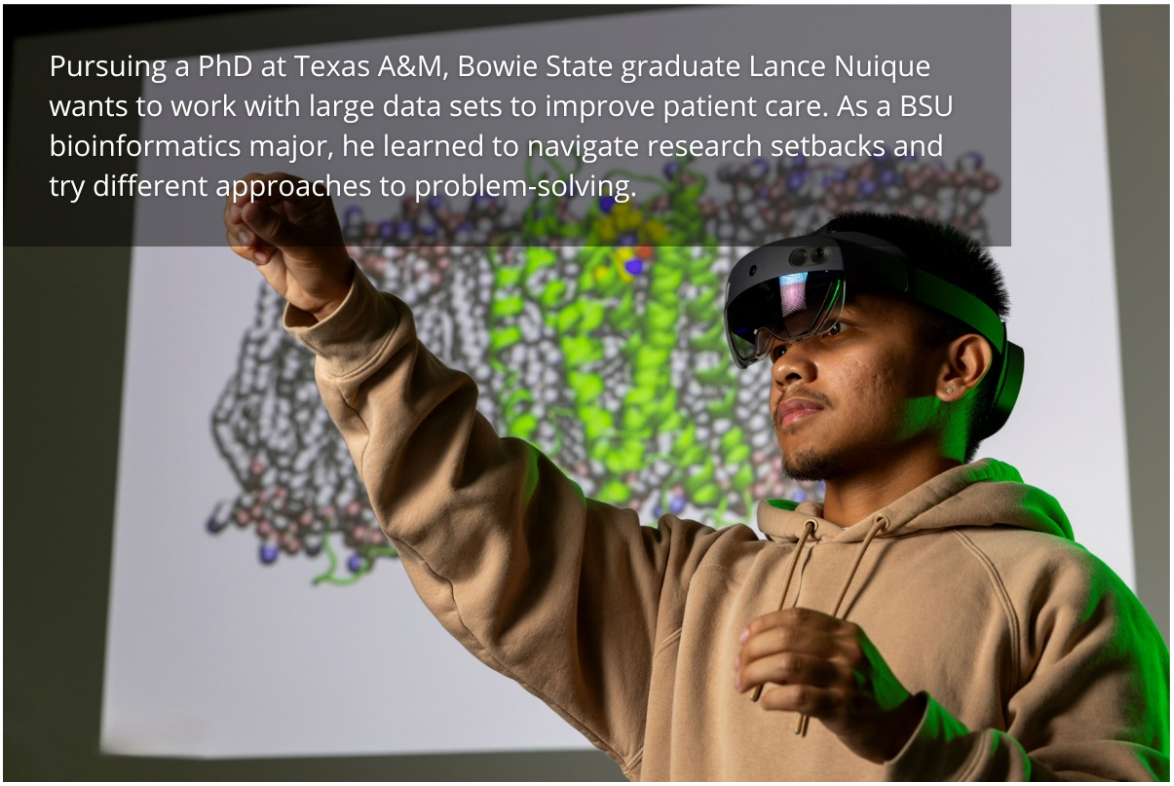
Defending science and scientific inquiry is vital right now, for all the reasons you might imagine—and for one you might not. When academic research is an integrated, meaningful part of the *undergraduate* experience, it develops students into more critical and creative thinkers, better communicators, collaborators, and problem solvers. Undergraduate research builds learners' confidence and focuses their career plans. It predicts better grades and graduation rates, and

reduces equity gaps, particularly in STEM. Students consistently say that research is among the most valuable components of their college career.

There's support for a more expansive view of research in the American university. Earlier this year, the Carnegie Foundation and the American Council on Education revamped their research classifications, creating a new category for institutions that conduct a good amount of research but don't award many doctoral degrees. The "Research Colleges and Universities" designation is intended to better reflect the range of ways that universities engage in R&D and celebrate their important contributions to our scholarly knowledge.

All three universities profiled here have won the new Carnegie Classification. All three have innovated how they provide research experiences to their undergraduates and how they integrate those experiences into the curriculum. But this is work being carried out *across* our universities, as they find ways to engage more undergraduates in research, and engage them more deeply.

As we fight for our research enterprise—and with it, the welfare of the American people and the strength of the nation itself—we'd do well to remember that we're also fighting for our students, whose early exposure to rigorous research produces the leaders we need, inside the lab and out of it.



Structured, Integrated + Mentored | Bowie State University

At Bowie State University, two programs capture its commitment to undergraduate research: The Course-based Undergraduate Research Experiences (CURE) program embeds research into course curricula, while the Semester-based Undergraduate Research Institute (SURI) pairs students with faculty research mentors.

CURE

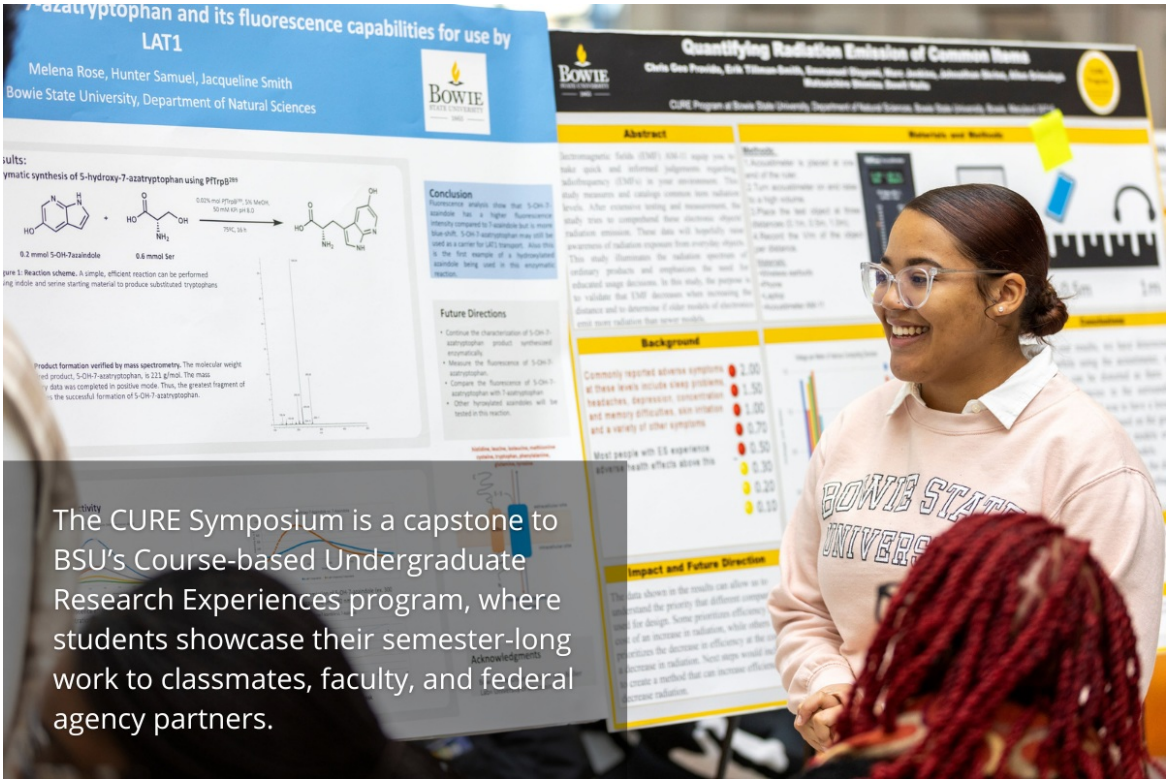
Developed by BSU's Department of Natural Sciences, CURE infuses research directly into courses and encourages students to develop their own research questions. It's a whole-class experience,

without barriers to participation, like a minimum GPA. The hands-on research allows greater collaboration among students, faculty, and staff, and opens up mentoring opportunities.

Department of Natural Sciences Chair George Ude, faculty coordinator for undergraduate research at BSU, says the program is meant for all students, even those not tempted by the sciences. (He can't help but add that the program often "unlocks" students' interest in STEM, converting some to its majors.) Dr. Ude emphasizes CURE's role in improving the quality of students' critical thinking and developing their academic readiness. CURE alumni have gone on to master's, PhD, and MD programs. And working with faculty members, they've been published (and named) in competitive research journals.

At CURE Symposia, students show off their work to classmates and to BSU's agency partners, like the EPA, NASA, and the U.S. Fish and Wildlife Service. Recent projects include a computational and particle analysis of sneezing droplets; a biodiversity comparison of mushrooms on the Bowie State campus and those in Nigeria; an investigation into improving the energy output of soil-based microbial fuel cells; and an analysis of the effects of urbanization on Bowie's bodies of water.

Bowie State President Aminta Breaux is persuaded by CURE's success. She's exploring expanding the program to the health sciences (nursing), the physical sciences (computer science), and the social sciences (history, psychology)—any discipline benefiting from research.



The CURE Symposium is a capstone to BSU's Course-based Undergraduate Research Experiences program, where students showcase their semester-long work to classmates, faculty, and federal agency partners.

SURI

Launched a decade ago as a nine-week summer program, SURI connects undergraduates to faculty mentors who serve as their research guides. Now a fixture in the fall, spring, and summer terms, SURI proves Bowie State's commitment to structured undergraduate research *and* proves students' desire to take part.

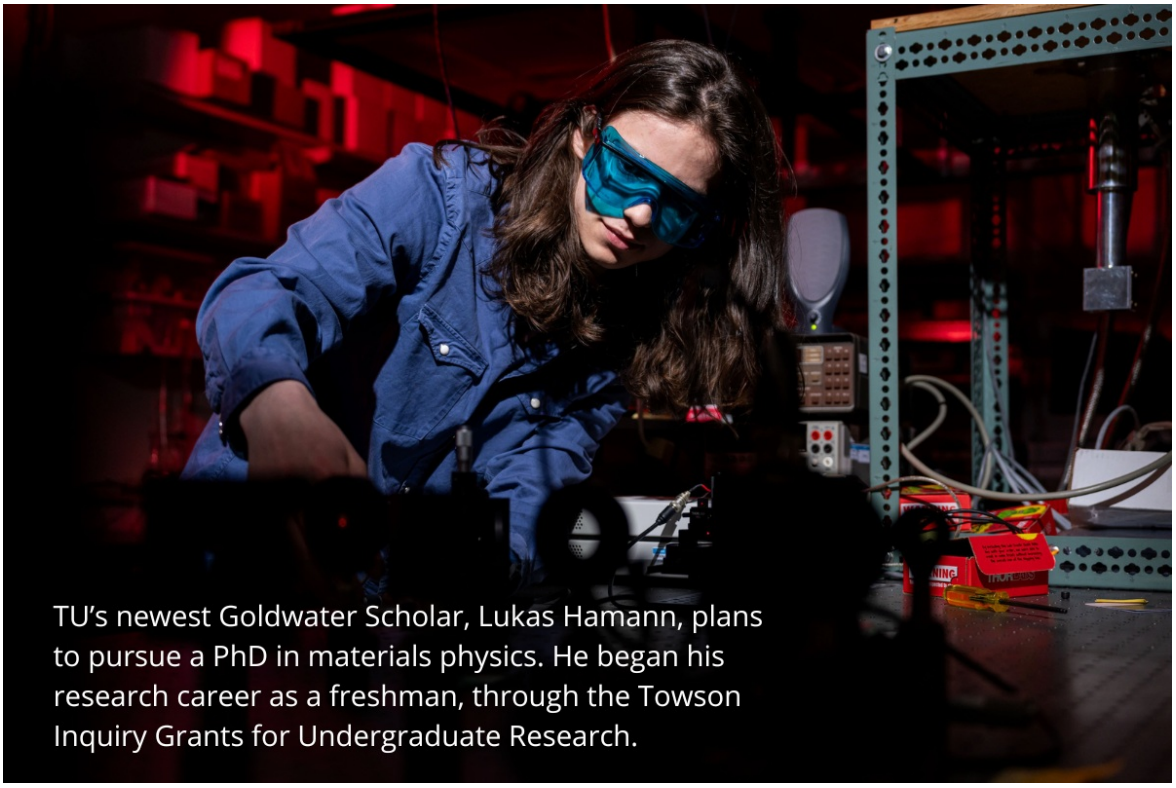
In this intensive program, up to three students conduct original research under their faculty mentor. The first three weeks function as an orientation; students are instructed in the techniques,

methodology, and overall craft of research, and the mentor guides them through the processes of data collection, data analysis, and the preparation of deliverables. Over the next six weeks, students execute the research, with opportunities to present updates, highlight accomplishments, and address challenges. The program culminates with students presenting their findings and answering audience questions at the SURI Research Symposium.

Recent symposia have featured projects exploring generative AI as a means of facilitating communication in autistic students, factors that influence student yield among Delmarva's HBCUs, bias detection and machine learning, and security vulnerabilities in voice-activated Internet of Things devices.

BSU Provost & Vice President for Academic Affairs Guy-Alain Amoussou says that the *process* of SURI can be just as valuable as the outcome, that the program promotes student initiative and can cultivate an interest in research that might otherwise never get tapped.

In the decade since its launch, SURI has engaged more than 100 faculty mentors and more than 700 students. SURI alumni have presented at national conferences and pursued PhDs. In fact, some are now faculty members themselves.



TU's newest Goldwater Scholar, Lukas Hamann, plans to pursue a PhD in materials physics. He began his research career as a freshman, through the Towson Inquiry Grants for Undergraduate Research.

Every Discipline Is a Research Discipline | Towson University

Towson University, already included among the Carnegie Classification's Research Colleges and Universities, has its eyes on something more. TU is aiming for R2 status, meaning a Doctoral University with High Research Activity. With $19.2 million in research expenditures last year, the goal is within reach.

Part of TU's institutional research priority is to create more robust opportunities for students to participate in meaningful, interdisciplinary research—year-round, in and out of the classroom, where they work alongside (and are mentored by) graduate students and faculty. TU Director of Undergraduate Research Alexei Kolesnikov says the university believes that hands-on research

ignites curiosity, creativity, and career success—and because of that, it's for undergraduates at all levels and in all disciplines.

A distinct aspect of TU's approach is making *funded* research available to undergraduates early in their academic careers—during the fall and spring semesters and over the summer. The summer programs range from a five-week experience offered to rising sophomores to a 12-week opportunity (and a $5,000 stipend) for juniors and seniors. Students also have choices when it comes to *presenting* their research: on-campus conferences and poster sessions, an undergraduate research club, and invitations to professional conferences across the country.

In keeping with its all-disciplines-are-research-disciplines ethos, TU is focusing on faculty development to advance inclusive research growth. With a premise that asking challenging questions in the hard sciences is tantamount to taking creative risks in the arts, TU is synthesizing the languages that different disciplines use to talk about research—and, through this synthesis, find the methods that predict research success, regardless of a student's area of study.

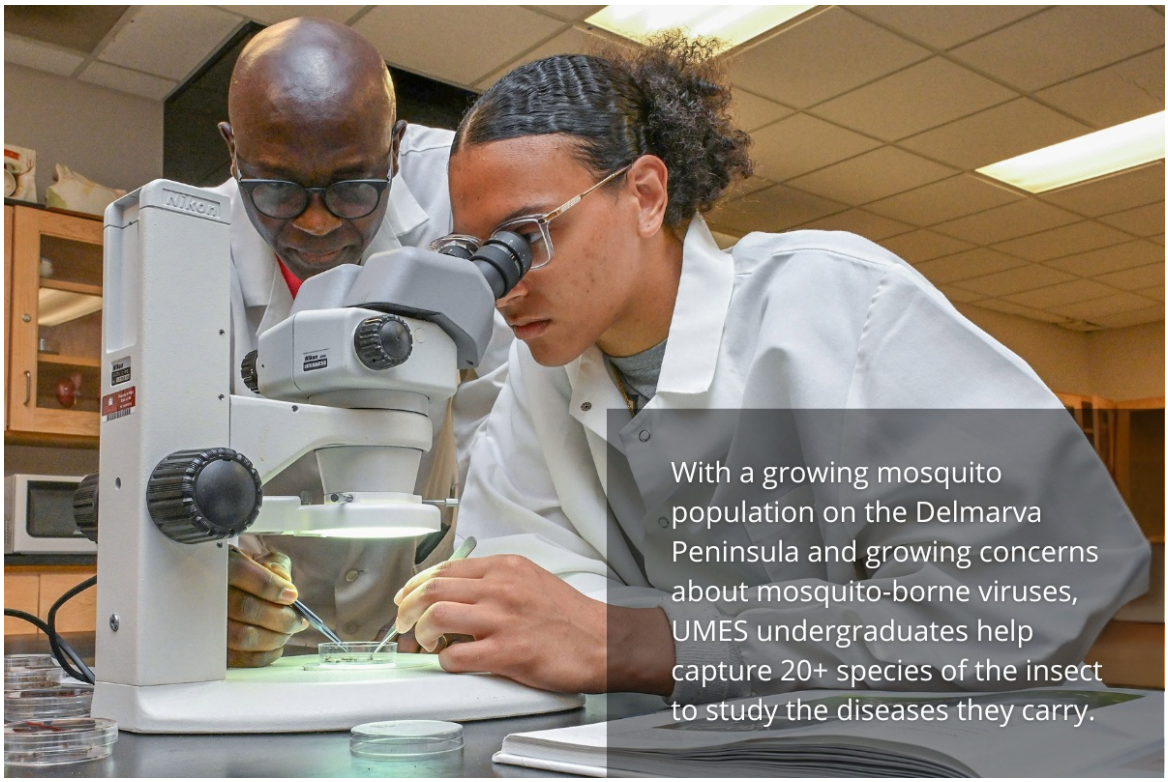
At Towson University, Delaney Mezan helps salt marshes establish long-term resilience against sea level rise. Her undergraduate work was supported with a $5,000 grant funded through TU's Summer Research program.

What that yields is enormous breadth in TU's undergraduate research enterprise.

- A student majoring in Environmental Science conducts research on salt marshes and how rising sea levels affect habitats of animals and vegetation. After her undergraduate career, she returned to TU for her master's degree, continuing her coastal ecosystem research.
- A recent graduate in International Studies won a grant to explore how and why the terrorist group ISIS engages in human trafficking. She presented her research at the Maryland Collegiate Honors Council Conference, the Northeast Regional Honors Conference, and the Naval Academy Foreign Affairs Conference.
- A student majoring in Dance blends research, embodied experience, and classical training to create original choreography in contemporary ballet. Her project, supported by a Research Impact Award, premiered at TU's Senior Seminar Concerts.
- A rising senior studying Speech-Language Pathology and Audiology—another Research Impact Award winner—uses simulated environments to explore how a listener's position in a

noisy restaurant affects speech understanding, particularly in those with hearing loss. The project informs strategies for improving speech recognition in real-world settings.

According to Dr. Sidd Kaza, associate provost for research and dean of Graduate Studies,this variety proves the efficacy of TU's all-in research plan: To expand research beyond the bench sciences (its traditional stronghold) to the social sciences, the humanities, the arts; to enlarge research from a mostly quantitative undertaking to a more qualitative approach; to update the research rubric with skills and competencies that can be adapted across disciplines.



Intentional Involvement | University of Maryland Eastern Shore

A land-grant HBCU established under the Second Morrill Act of 1890, the University of Maryland Eastern Shore has *always* had a clear charge: Provide underserved communities access to education, research, and extension services. That core mission hasn't changed in the many years since, and UMES's undergraduate research enterprise proves it.

UMES predicates that enterprise on buy-in. Faculty are asked to take on undergraduate researchers and to make research an integrated part of the curriculum. Meanwhile, students are expected to be actively involved in the research and in the formal presentation of their results.

Agricultural and Natural Sciences Dean Moses T. Kairo, UMES's acting vice president for research, says intentional involvement has far-reaching benefits. Students who've completed the research experience have landed premier internships in industry and government, been published in prestigious journals, and gone on to graduate programs across the country, including at Ivy League schools. Without fail, students say their undergraduate research experiences were key to these accomplishments.

UMES President Heidi M. Anderson, in turn, points to the support the university has won from influential organizations. UMES was the nation's very first HBCU awarded a Driving Change grant from the Howard Hughes Medical Institute. The award funds wraparound support for STEM

students and activities that nurture their success, like early research experiences and off-campus research internships. The university has long partnered in the institute's SEA-PHAGES program, a research-immersive undergraduate course that leads students through microbiology techniques and eventually to complex genome annotation and bioinformatic analyses.

One of UMES's highest profile partnerships is the NOAA Living Marine Resources Cooperative Science Center. A consortium of seven universities led by UMES, the center supports the sustainable harvest and conservation of the country's marine resources. Over the years, 400+ consortium students have been involved in research projects and internships through the center. Its research has produced 445 publications, 129 of them featuring a student co-author.

This year, UMES hosted the NOAA Educational Partnership Program's Education and Science Forum, bringing together researchers, educators, and students to explore the future of marine and atmospheric sciences. More than two dozen UMES students presented their research to the visiting scholars, and three awards went to UMES undergraduates.

UMES undergraduates Shanaya Hines and Kennedy Wallace are trained in cell and molecular biology, gene editing, and genetic engineering as part of a project to improve grape cultivars for climate resiliency.

The university embraces System partnerships, as well. Together with UMBC, the University of Maryland, College Park, and Towson University, UMES is part of the System's Louis Stokes Alliances for Minority Participation, whose aim is to grow the number of underrepresented students in STEM majors and careers. Through the program, stipend-supported undergraduates engage in sponsored research under a faculty mentor, and present at local and national research conferences.

A new opportunity has come out of the School of Agricultural and Natural Sciences' Center for Student Excellence, which last year hosted the inaugural Student-Led Undergraduate Research Symposium. True to its name, undergraduates organized and led the event, showcasing research and innovations that advance agricultural practice. The symposium featured panel discussions, keynote speakers, and undergraduate research presentations, including investigations into soil microbes, antibiotic-producing bacteria, Eastern Shore mosquito species, switchgrass and soil tolerance, and the effect of microplastics and nanoplastics on coastal waters.

The Case for Early Research Experiences

If the last several months have taught us one thing, it's this: We must explain—clearly—why research matters, why American R&D makes us the envy of the world. No one can tell this country's research story better than the universities that do so much of it.

And in that conversation, I hope we'll make the case for *early* research experiences. Because it's these experiences that nurture the students and scholars, the innovators and leaders, who understand the revolutionary power of research and urge investment in an enterprise that makes us stronger in every way.

University System of Maryland

www.usmd.edu | chancellor@usmd.edu