

Inquiring Minds

UMBC RESEARCH AND CREATIVE ACHIEVEMENT



 **UMBC**

**Public research
for public good.**

UMBC research impacts our lives and communities and unravels the mysteries of our universe while preparing a diverse new generation of scholars.



NATIONAL LEADERSHIP

UMBC is a national leader in research funding and impact. According to the 2021 National Science Foundation (NSF) Higher Education Research and Development survey, among all U.S. colleges and universities, UMBC is:

#14

in annual NASA funding

#112

in annual NSF support

Nationally, UMBC is a leader in federal support for:

#33

Geosciences, Atmospheric Sciences & Ocean Sciences

#40

Social Sciences

#53

Physical Sciences

#55

Computer & Information Sciences

Across all U.S. public universities, UMBC is:

#105

in federal research and development expenditures

#123

in overall research and development expenditures

UMBC has achieved this by attracting top talent.

Our engineers, scientists, social scientists, humanists, and artists are drawn to UMBC as an inclusive, supportive learning community. And they are accomplishing great things.

- UMBC faculty submitted more than \$530 million in extramural funding applications in FY 2021 and secured more than \$114 million in new extramural awards during FY 2022.
- Campus-wide annual extramural expenditures reached an all-time record of over \$110 million in FY 2022, including \$65 million from federal funding sources.
- UMBC junior faculty members have secured 46 NSF CAREER awards since 1995, including 10 since 2020.
- Arts and humanities faculty regularly receive support from state and federal agencies, foundations, and cultural institutions recognizing the tremendous value and public impact of their work. A few recent supporters include the American Council of Learned Societies, Carnegie Corporation of New York, Mellon Foundation, and National Endowment for the Humanities.

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For more information on
UMBC's research and creative
achievement, visit
umbc.edu/rca.

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PUBLIC RESEARCH FOR PUBLIC GOOD



Welcome to *Inquiring Minds*. We have carefully selected this title for our publication to highlight the breadth of research and creative achievement initiatives at UMBC, which are guided by our motto, “Public research for public good,” and our strong commitment to interdisciplinarity.

Our work reflects the focus of our faculty and students across basic, translational, and applied research areas. We thrive on opportunities to directly impact our partner communities, facilitate deeper intercultural understanding through our arts and humanities scholarship, and further our knowledge across a spectrum of science and engineering fields.

We are proud to be an R1 university, as designated by the Carnegie Classification of Institutions of Higher Education, placing us among the top 146 research universities in the country. This is the result of over 20 years of work conducted across our academic departments and research centers. Our community of passionate and inquiring minds has been focused on creating a research institution that can perform at the highest level while staying true to UMBC’s overall mission.

We build on the inherent strengths in our vibrant interdisciplinary and collaborative research culture, with a strong nationally recognized reputation for integrating

undergraduates in mentored research. Our most impactful research efforts are often based on collaborations among several disciplines across our campuses, with other academic institutions, and with our corporate and community partners.

Our key research and creative achievement themes are well aligned with regional and national priorities, which include:

- Climate and environmental sciences
- Data science, artificial intelligence, and cybersecurity
- Community, equity, and social justice
- Health and life sciences
- Creative engagement
- Earth and space sciences
- History, identity, and society

Each of these key themes benefits from an inclusive approach, by taking into account civic engagement, social sciences, ethics, public policy, and other important considerations to provide comprehensive solutions.

We are delighted to share some of the exciting and innovative work of UMBC’s researchers and scholars in support of the state of Maryland, the nation, and beyond. We welcome you to learn more about our community of inquiring minds.

Karl V. Steiner

Vice President for Research and Creative Achievement

At UMBC, high-impact research and top-ranked teaching go hand-in-hand.

Our students’ achievements show the power of this dual commitment. UMBC is a top university for undergraduate research and creative projects and is consistently named the nation’s leading producer of Black undergraduates who go on to earn Ph.D.s in the natural sciences and engineering.



AN INTERVIEW WITH PRESIDENT VALERIE SHEARES ASHBY



President **Valerie Sheares Ashby** began her tenure at UMBC on August 1, 2022. She previously served as dean of Duke University's Trinity College of Arts & Sciences, and she felt an immediate connection with UMBC's inclusive community and emphasis on excellence across the arts, humanities, social sciences, and STEM fields. The university's vision statement, she says, spoke to her:

Our UMBC community redefines excellence in higher education through an inclusive culture that connects innovative teaching and learning, research across disciplines, and civic engagement. We will advance knowledge, economic prosperity, and social justice by welcoming and inspiring inquisitive minds from all backgrounds.

Here, she reflects on her impressions of UMBC and vision for UMBC's future as a distinctive research university that leads through inclusive excellence.

UMBC News: What do you find to be distinctive about UMBC's approach to research and creative achievement?

Sheares Ashby: We have inclusive excellence as a core value, and we're an institution that recognizes excellence in research does not exist without it. Through that lens of inclusive excellence, our approach to community-engaged scholarship and the depth of research experiences our students access are also

distinctive. In community-engaged research, we do not tell communities what they need; they tell us what their needs are. Truly inclusive excellence is essential in community-based research, or else you can do more harm than help.

UMBC News: What is most exciting to you about UMBC's future in research and creative achievement?

Sheares Ashby: What is most exciting to me is addressing the big problems in the world. We must harness every bit of brain power and human energy towards these problems, and I think we can do it in a way that will be game-changing because of who we are and who we will engage.

For example, if you want to figure out how to deal with the challenges in the environment but you are not doing that with an understanding of how culture and race and ethnicity affect communities, you will create more disparities with your solutions. And the most challenging issues, from tackling misinformation to increasing health equity, involve bringing together perspectives from all disciplines.

The big problems of the world require a diverse group of thinkers. We do not have billions of dollars, but we do things that matter for humankind by recognizing what we are uniquely qualified to address.

UMBC News: What is something interesting about research and creative achievement at UMBC that you've learned from our community since becoming president?

Sheares Ashby: Shortly after becoming president, I went to see a UMBC exhibit at The Peale, Baltimore's community museum, and received a tour from **Irene Chan**, an associate professor of visual arts. Her work for the exhibit dove into the life of a man who was born in Hong Kong, brought as an orphaned child to the U.S. for schooling in 1852, and was enslaved in Baltimore before running away to fight for the Union in the Civil War at age 16.

As she spoke I assumed the story was from an archive, but she went on to share that this man's story, like many 19th-century Chinese Americans, has been forgotten. She learned what she could about him and then worked with students to build out his story creatively, imagining his experience and what he would look like. She even created a jacket (displayed in the exhibit) similar to what he would have worn in the war, covered both in symbols of his achievements and the racial slurs that he would have heard.

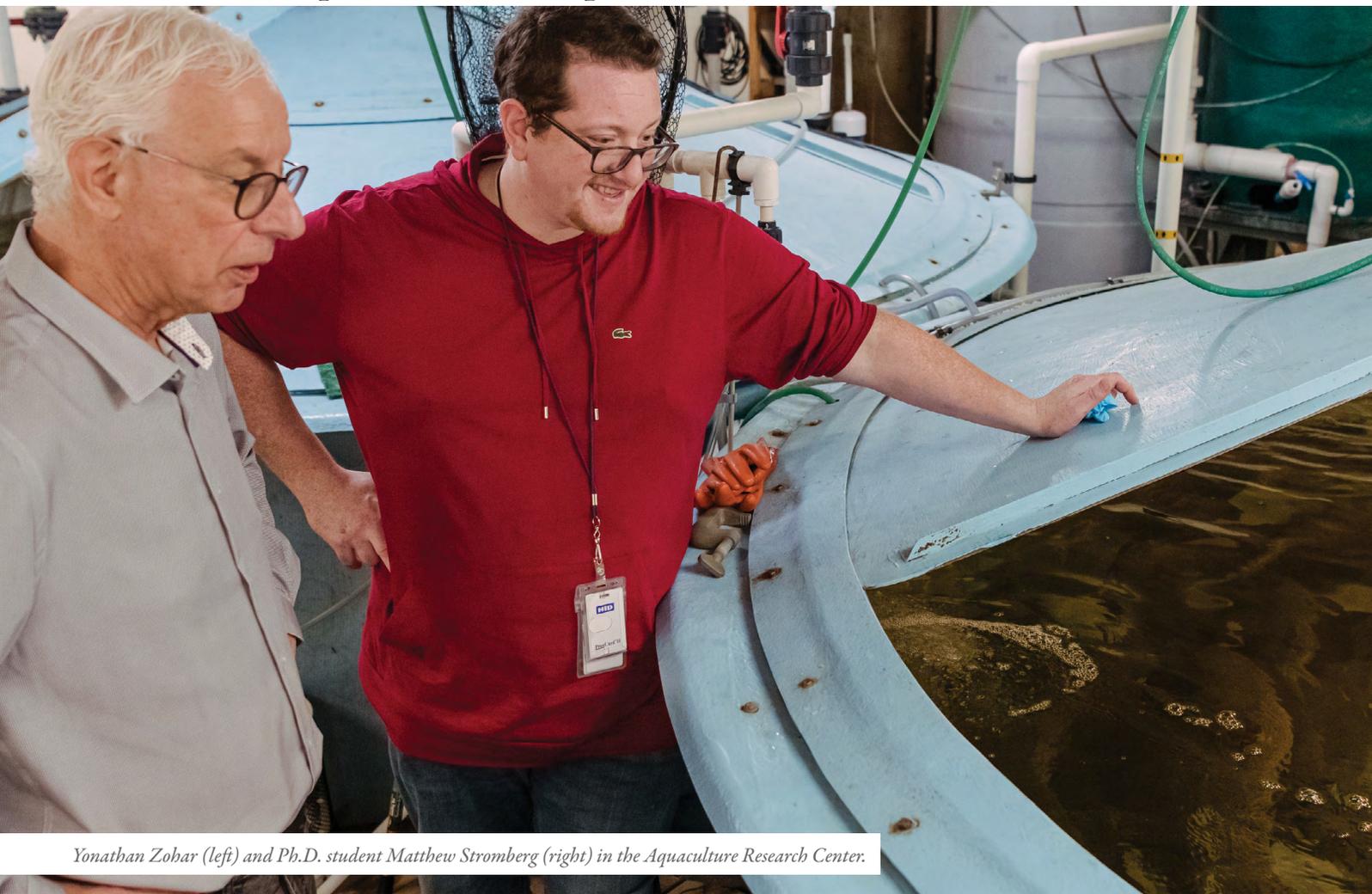
She and her students combined art and archival research to bring to life an historical Asian American experience, the good and the bad. It was stunning. Her work is built on history, but it matters right now, when Asian Americans are experiencing so much violence and discrimination in the U.S. And she is changing the narrative.

So many of our faculty and students are changing the narrative in their fields, from this phenomenal artist to people like **Yonathan Zohar**. He's the chair of marine biotechnology and director of our Aquaculture Research Center. He has been working for decades to develop large-scale, resource-conscious, environmentally sustainable aquaculture—growing fish on land as a healthy source of food—and his vision is becoming a reality.

This work is changing lives right now and will have an even greater impact in the future. I want to share it with the world.

CLIMATE AND ENVIRONMENTAL SCIENCES

Global Leadership in Sustainable Aquaculture Research



Yonathan Zohar (left) and Ph.D. student Matthew Stromberg (right) in the Aquaculture Research Center.

More and more U.S. states, from Texas to Maine, are increasing their capacity to produce fish for human consumption in land-based facilities. These operations are less susceptible to disease and result in fresher fish for locals. They also remove the risk of releasing waste or farmed fish into the environment and reduce costs and the carbon footprint associated with shipping. Plus, they create jobs and help decrease American reliance on seafood imports.

Decades of research led by **Yonathan Zohar**, professor of marine biotechnology, have led the way for these paradigm-shifting developments. In the last few years in particular, land-based aquaculture has taken off in the U.S. and abroad, and Zohar's contributions have not gone unnoticed.

In October 2021, the U.S. Department of Agriculture awarded \$10 million, the maximum allowable amount, to a set of projects led by Zohar targeted to solve remaining aquaculture challenges. The project, dubbed Sustainable Aquaculture Systems Supporting Atlantic Salmon, or SAS², builds on another Zohar-led project, the Recirculating Aquaculture Salmon Network, or RAS-N.

"RAS-N has been developing a prioritized list of the challenges we need to address and where we should invest resources. It asks: What are the gaps in knowledge? What are the main hurdles in technology, biology, and engineering?" Zohar explains. "And now, with SAS², we're taking that information and implementing it."

Sustainability through partnership

The work Zohar and colleagues have done over decades is also bearing fruit in the form of new partnerships. In December 2021, a delegation from the Israeli Ministry of Agriculture and Rural Development visited the Aquaculture Research Center, which Zohar leads at the Institute of Marine and Environmental Technology (IMET) in Baltimore's Inner Harbor.

Leaders from UMBC, including Zohar, and members of the Israeli delegation signed a new statement of intent that builds on decades of collaboration between Zohar and Israeli researchers. It will enable them to grow their ongoing efforts to improve and expand the aquaculture industry around the world. Developing zero-waste systems, improving fish health and performance in captivity, and scaling

up land-based aquaculture systems are all among the partners' priorities.

"There is an urgent need to promote agriculture in a sustainable way in the U.S., and we hope to contribute as much as possible to that effort," said Russell Hill, director of IMET.

Measuring impact

Before these big land-based aquaculture projects, though, Zohar made fundamental contributions that permanently changed the aquaculture industry—land-based or otherwise. In 2020, the Binational Agricultural Research Development (BARD) Fund, a partnership program between the U.S. and Israel, reviewed more than 1,300 projects funded by BARD in its 40-year existence and found Zohar's work to have had the greatest economic impact.

Zohar's BARD-funded research in the 1980s, which solved the problem of fish not spawning in captivity, made it possible for high-value commercial fish species such as Mediterranean sea bream, European sea bass (branzino), salmon, and striped bass to be grown through hatchery-based aquaculture. This has resulted in an estimated \$12 billion in economic growth.

From bedrock contributions to fish endocrinology to technologies that make land-based systems more sustainable, Zohar and colleagues have had an incredible impact on the ability of people around the world to access seafood. As many of these projects move forward, they will rely on those contributions—and he and his team will undoubtedly continue to make new ones.

—*Sarah Hansen, M.S. '15*



Yonathan Zohar (left) with visiting Israeli dignitaries in 2021.

Improving Management of Common Pool Resources



Maria Bernedo Del Carpio.

Sustainable management of common pool resources (CPRs) such as water, forests, clean air, and fisheries is a global concern that's getting increased attention in the context of climate change. **Maria Bernedo Del Carpio**, assistant professor of economics, and colleagues have conducted a field experiment to isolate one feature of local CPR governance: externally supported, technology-facilitated community monitoring.

"These studies allow us to directly see how community-based monitoring can support more desirable natural resource management outcomes and to analyze the ways to attain those outcomes," says Bernedo Del Carpio.

The team initiated their study in Costa Rica, to isolate and test community monitoring, and published the results in the *Proceedings of the National Academy of Sciences*. Bernedo Del Carpio and her team worked with community-based water management organizations (CBWMOs) in 16 communities in the Pacific coast and northern plains regions of Costa Rica. Using a water-monitoring smartphone app designed by the authors, monitors collected and reported information about residents' experiences with water service.

The app produced weekly summaries that were shared with the CBWMOs and the rest of the community over a period of nine months. After one year, measures of water use showed progress in the desired directions: reductions in groundwater pumping, better water quality, and more satisfied users.

Jointly with scholars in the U.S., Canada, the U.K., Kenya, and China, the team has implemented this approach in six other countries, with promising results.

—*Catalina Sofia Dansberger Duque*

Centering Communities in Climate Action

American cities face environmental challenges that are exacerbated by climate change, from air and water quality issues to flooding and heat. The U.S. Department of Energy has funded projects in three American cities to generate resilience-enhancing solutions to urban environmental concerns in collaboration with community organizations. The Baltimore Social-Environmental Collaborative (BSEC) will receive \$24.5 million through the program, with UMBC receiving \$2.3 million of this larger grant.

Claire Welty, professor of chemical, biochemical, and environmental engineering and director of UMBC's Center for Urban Environmental Research and Education, leads UMBC's work on the project.

Welty and UMBC colleagues such as **Andrew Miller**, professor of geography and environmental systems, bring decades of experience in environmental monitoring to the BSEC. They've honed their expertise through projects like the Baltimore Ecosystem Study, founded in 1998, which recently

received \$500,000 through the U.S. Forest Service. In addition, a \$4.8 million NSF award is supporting their work to explore Earth's critical zone, which extends from the tops of trees to the base of bedrock, in urban centers along the Eastern Seaboard.

The BSEC will involve similar work, but the primacy of community engagement is new. "What we want to try to do is partner with the communities to come up with solutions to these climate impact problems, and then what we're bringing to the table are our tools to implement that," Welty says.

Whatever priorities and concerns local communities bring to the forefront, the BSEC group is ready to bring their tools to bear in ways that best serve Baltimore residents. Building coalitions with researchers and community members and then finding the most effective ways to address communities'



Claire Welty (left) and Andrew Miller at one of their field research sites in Catonsville, MD. Photo by Victor Fulda.

needs "is like a giant puzzle to put together," Welty says. "It's going to be exciting to see how it all unfolds."

– Sarah Hansen, M.S. '15

Advancing Energy Technology Research

Among UMBC's many innovators working to address environmental and health challenges are three mechanical engineering faculty focused on new energy technologies.

In 2020, **Carlos Romero-Talamás**, associate professor, received one of 15 grants from the U.S. Department of Energy's Advanced Research Projects Agency-Energy program to advance nuclear fusion energy research. Through the \$4 million grant, his team is developing and building a centrifugal mirror that can conduct electricity and generate energy from fusion reactions.

The team is building a rotating magnetic mirror machine to produce nuclear fusion energy, which Romero-Talamás calls the "holy grail" of energy because of its inexpensive and abundant fuel supply. "We will address the most important physics questions that could put us on a path to a demo reactor in years, not decades," he says. His team includes researchers

from both UMBC and the University of Maryland, College Park.

The Maryland Innovation Initiative (MII), a partnership between the State of Maryland and five academic research institutions in Maryland, including UMBC, promotes the commercialization of research. **Deepa Madan**, assistant professor, received a phase I MII award to develop zinc-chitosan gel-based batteries that are enclosed in flexible plastic and will revolutionize how everyday devices are powered. Madan's flexible batteries are a game-changer, with possible uses in technologies like wearable health monitoring devices.

Soobum Lee, associate professor, studies energy harvesting, specifically how vibrations from massive wind turbine blades (beyond the rotating movement of the blades) can power portable devices on a small scale. With support from an MII grant, Lee is developing sensors for wind turbines to alert operators if the blade gets damaged or requires maintenance.



Carlos Romero-Talamás in the Centrifugal Mirror Fusion Experiment lab.

Until now, wind turbine sensors have been battery-powered and require changing every few years—a time-consuming, dangerous task for people maintaining the turbines. "The sensors are to help with maintenance, but if they also create a maintenance need, it's a problem," says Lee. He has developed a six-inch-tall, two-pound power management circuit and integrated it with a power source, sensor, and data transmitter that does not require an external energy source.

– Megan Hanks Mastrola

Bats, Waste, and Oysters: Applied Environmental Research

Bats as biomonitors, community connections to the zero-waste movement, and oyster aquaculture are just a few of the topics that students in the Interdisciplinary Consortium for Applied Research in the Environment (ICARE) master's program are exploring through Baltimore-centered community-engaged research.

In his undergraduate and working experience, **Chris Blume**, M.S. '23, geography and environmental systems, found that “the social aspect was missing” in conservation science, he says. “And that’s what drew me to ICARE, because it seemed like there was a focus on the community.”

In his project, Blume is using bat guano to detect levels of heavy metals in different neighborhoods across Baltimore. Blume is also giving away bat boxes to local residents and offering evening “bat walks” to teach Baltimoreans about these important native critters. In the future, he wants to pursue a Ph.D. and continue his bat research as well as continue to create citizen science and community engagement opportunities.

Natalia Figueredo, M.S. '23, geography and environmental systems, has always been community-oriented, influenced by her early childhood in Bolivia and her teenage years in Queens, New York, which drew her to ICARE. The program “was trying to build that bridge between scientific research and community engagement,” she says.

Figueredo’s research project focuses on engaging South Baltimore residents in the zero-waste movement, in the context of recent battles over a nearby trash incinerator. She is also working closely with partners at the Global Alliance for Incinerator Alternatives and the South Baltimore Community Land Trust, in addition to her faculty mentor **Maggie Holland**, associate professor of geography and environmental systems.

Darryl Acker-Carter, M.S. '23, marine, estuarine, and environmental science, is studying a new method of oyster aquaculture in collaboration with Solar Oysters. His project tests the company’s solar oyster production system, which aims to produce

healthier, more-uniform oysters in less space, against traditional methods.

Acker-Carter sees oysters as a nexus of social science and biology research. Making change is “all social science,” Acker-Carter says, “because it’s all managing people and their perspective about how to harvest oysters and their relationships to natural resources.”

The ICARE program has helped Acker-Carter see how research fits into community engagement. “I used to think research was very isolated,” he says, “but in ICARE, you’re putting that research into practice,” creating benefit in communities.

Committed to community

For program leader **Tamra Mendelson**, professor of biological sciences, ICARE is exceeding expectations. “The students are so strong, and they’ve bonded as a cohort,” she says. “I think that’s a huge secret to success—having students feel like they have a network of peers that are supporting each other.”

The community partners have also been critical. One meeting brought students and partners together for a brainstorming session



Chris Blume examines a bat from one of his bat boxes. Photo courtesy of Blume.

across projects and topic areas, embodying the program’s commitment to bridging science and community. “Bringing everyone to the table, literally, and helping everyone see that their voice is equally important in solving these environmental problems and doing the research was really powerful,” Mendelson says.

That community-engagement piece makes ICARE different from other environmental science programs, **Kevin Omland**, professor of biological sciences, explains. “We’re definitely tackling different issues in different places than lots of environmental science has, even 10 or 20 years ago,” he says, “so it’s really satisfying to see that coming into place.”

– *Sarah Hansen, M.S. '15*



Learning from Historic Floods

UMBC humanities faculty make significant contributions to environmental research, such as **Christopher K. Tong**, assistant professor of modern languages, linguistics, and intercultural communication and Asian studies. Tong received funding from the Fulbright Program and American Council of Learned Societies to conduct archival research in the People’s Republic of China and to analyze how narratives of environmental disasters describe emergent political rhetorics and practices. Here he stands in front of the former Hankow Customs House in Wuhan, China, with plaques showing high-water marks for previous floods. For the full story, visit umbc.edu/stories/turning-the-tides.

Photo courtesy of Christopher Tong.



DATA SCIENCE, AI, AND CYBERSECURITY

The Future of Artificial Intelligence and Autonomy



The CARDS team tests a drone.

From surveillance tools to autonomous machines, countries around the world are ramping up their military artificial intelligence (AI) assets. Such robust technologies are necessary to protect the U.S. from surprise attacks, which occur these days not only on the ground but also in the cloud.

In 2021, UMBC partnered with the University of Maryland, College Park (UMD), and the DEVCOM Army Research Lab (ARL) on a \$68-million, five-year endeavor, funded by the ARL. The goal is to strengthen Army AI technology so that it is able to meet the demands of today's national defense. A team of UMBC researchers is using a \$20-million subcontract to advance AI-based autonomous systems for use by the military.

"The question we're trying to solve is: Can we design and develop tools, techniques, algorithms, software, and hardware that can work autonomously and make their

own decisions but also collectively interface with human decision makers?" explains UMBC's principal investigator (PI) **Aryya Gangopadhyay**, professor of information systems. "The landscape of war is changing, and we must build systems that can make human-like decisions in real time and under real-world pressure."

Secure, effective, and resilient

The project, AI and Autonomy for Multi-Agent Systems (ArtIAMAS), aims to advance science and technology around three core research areas: collaborative autonomy, harnessing the data revolution, and human-machine teaming.

The UMBC team has been working to develop solutions for AI-based networking, sensing, and edge computing—which brings data storage and computation closer to a location—for the battlefield Internet of Things, or IoT. This will allow them to deliver secure, effective, and resilient U.S. Army assets,

including AI systems related to search-and-rescue, surveillance, robots and machinery, and augmenting humans in performing decision-making tasks.

"We are delighted with this exciting next step in our statewide partnership with our colleagues at UMD and at the ARL," says **Karl V. Steiner**, vice president for research and creative achievement. "Artificial intelligence is one of the key technologies in the ongoing transition to autonomous systems, both in the defense and civilian sectors, and it does take researchers from a variety of backgrounds to innovate and develop the most promising solutions. This alliance builds on the expertise and commitment of many of our colleagues."

Today's conflict landscape

On the battlefield, there are soldiers with body cameras, guns with sensors, as well as ground-based and airborne machines operating in rough and volatile terrains. Retrieving data



The CARDS research team, including participants in camouflage, tests equipment on an autonomous vehicle.



A test course in the CARDS research space.

Protecting Medical Data and Devices

Among UMBC's strategic research partnerships with the nearby University of Maryland, Baltimore (UMB) is work at UMB's Institute for Clinical and Translational Research (ICTR). UMBC partnered with the UMB-ICTR in 2019 as a way to leverage the university's expertise in cybersecurity, artificial intelligence, and machine learning. Together, UMBC and UMB are now working to protect medical data and devices from cyberattacks as well as pursue additional research involving medical data.

UMB-ICTR aims to remove barriers to clinical and translational research. The program provides faculty with resources such as high-quality, cost-effective informatics, biostatistics, clinical resources, mentorship, and other core services. Through the partnership, UMBC provides services and expertise, called core resources, to ICTR's Informatics Core, with the Cybersecurity and Artificial Intelligence Core. With UMBC's assistance, this core enables the design of machine-learning models to analyze large data sets, determine what additional data could be collected to potentially improve analysis, and uncover and overcome possible cybersecurity risks associated with devices and/or systems. Since 2019, twenty collaborative research projects between UMB and UMBC faculty have been funded under the ICTR program.

– Adriana Fraser

and making decisions from these multi-modal sources can be difficult, especially in challenging networking conditions. Understanding and developing adaptable cross-domain solutions for these environments will be at the forefront of the work of co-PI **Nirmalya Roy**, professor in information systems.

“There may not be time to send data to a command center or the cloud, so some of the processing, computing, and interference may be done on the devices themselves. How do you navigate the available computing resources in hand and process data on the devices themselves to make an informed decision and in real time? These are the concepts I’ll be working on,” Roy says.

The UMBC team includes more than 15 researchers from the departments of information systems, computer science and electrical engineering, mathematics and statistics, physics, and mechanical engineering, as well as scientists and engineers from ARL. The Center for Real-time Distributed Sensing and Autonomy (CARDS) leads the research being conducted by UMBC faculty. The ArtIAMAS cooperative agreement is led by PI **Derek Paley**, director of UMD's Maryland Robotics Center.

The team is expected to grow to nearly 50 researchers, and future projects will include other University System of Maryland institutions. Together, the group will publish

fundamental research and identify similar and cross-cutting research endeavors, improving collective information-sharing.

“The cross-disciplinary nature of this project is well-suited to our College, which brings together computing, engineering, and information systems faculty and student researchers. The project team includes a significant number of the exceptional faculty we have recruited through recent hiring made possible through our state’s support,” says **Keith J Bowman**, dean of UMBC's College of Engineering and Information Technology.

Advancing AI research

While the work will undoubtedly improve military AI, it will also enhance AI research in other domains. A goal of the project is to establish a long-term center with a vision of advancing AI-based autonomy.

“This is an opportunity for UMBC to bring together talented researchers from across departments to participate in fundamental, and potentially groundbreaking, research,” says Gangopadhyay. “To make a big impact in the research space, you need long-term, multi-institutional partnerships and collaborations. Working with UMD and the ARL will allow us to collectively advance AI in the military space.”

– B. Rose Huber

Leading the Way in Climate Data Science



UMBC's iHARP team, led by Vandana Janeja (right, standing) with co-PI Jianwu Wang (left, standing).

Tens of millions of people live in areas that are at risk for flooding due to climate change, sea level rise, and melting of glaciers. UMBC's **Vandana Janeja** is leading a team of researchers using data science, machine learning, AI, and polar science to analyze enormous volumes of climate data and Arctic and Antarctic observations in ways that could help populations prepare for and respond to these risks.

Janeja, professor and chair of information systems, is the PI on the five-year, \$13 million grant from the National Science Foundation's Harnessing the Data Revolution (HDR) Big Idea program. With support from the grant, Janeja is directing iHARP, the NSF HDR Institute for Harnessing Data and Model Revolution in the Polar Regions.

"The research we're doing in iHARP will help us understand global drivers of sea level rise and its impacts. This work will look at complex dynamics in the polar regions, evaluating heterogeneous data and connections between climate processes. This will help us get to more certain assessments, to drive the science responding to climate change," she explains.

Data science meets climate science

Climate scientists rely on data that are incredibly challenging to disentangle. AI offers solutions to analyzing these large data sets, providing sophisticated models that make the best use of the available data.

"Researchers in iHARP are already looking at ice sheets in the Arctic and the Antarctic,

including labeling of ice layer images. They are examining anomalous trends in ice thickness and creating new algorithms for understanding which factors are causing which types of changes in such a dynamic environment," explains Janeja.

The iHARP researchers will reduce uncertainties in projecting sea level rise by combining physics-driven modeling, machine-learning techniques, and data analysis. The results of the work will inform policymaking to address national and global priorities related to the climate crisis.

An interdisciplinary team has been assembled to move forward this important collaboration. Janeja is working with co-PIs **Jianwu Wang**, associate professor of information systems at

UMBC; Mathieu Morlighem at Dartmouth College; Shashi Shekhar at the University of Minnesota; and researchers from the University of Colorado Boulder. The team will also investigate novel data science techniques that can be applied to other disciplines encountering challenges related to complex data.

Project collaborators in education, government, and industry across the country include additional researchers and collaborators at the University of Colorado Boulder, Dartmouth College, the University of Minnesota, the University of Alaska Fairbanks, the University of Northern Texas, Amherst College, the University of Texas at Austin, the Universities Space Research Association, the NASA Jet Propulsion Laboratory, NVIDIA, IBM, and Amazon.



The iHARP team tests equipment in their research labs.

“The research we are doing in iHARP will help us understand global drivers of sea level rise and its impacts.”

—Vandana Janeja

The iHARP program also involves undergraduate and graduate students and postdoctoral researchers, and will support educational and outreach activities, with an eye

and lectures and training opportunities for data science and domain science professionals. Students will work alongside research partners and will have internship opportunities with federal and industry partners.

“This major multi-institutional NSF award reflects so much hard work and ingenuity. National programs like iHARP, with its focus on some of the great challenges our society is facing, add to UMBC’s growing reputation for innovation and excellence in public impact research,” says **Karl V. Steiner**, vice president for research and creative achievement at UMBC.

Impact of multidisciplinary teams

The team’s research may impact the future of medicine, computer vision, responsible AI, and remote sensing. And students working on the project will become the next generation of experts addressing these global issues.

“The College is experiencing extraordinary research growth. This is made possible by both the development of multidisciplinary teams and our increased focus on leadership development,” says **Keith J Bowman**, dean of the College of Engineering and Information Technology. “This project team, and others recently funded or pending, benefit from the tremendous faculty talent we have recruited in the last several years.”

In addition to Janeja and Wang, the UMBC team also includes **Aryya Gangopadhyay**, professor; **Karen Chen**, assistant professor; and **Osman Gani**, assistant professor, all in information systems, as well as **Don Engel**, associate vice president for research development and assistant professor of computer science and electrical engineering.

—Megan Hanks Mastrola

The International Cybersecurity Center of Excellence

UMBC is a founding member of the International Cybersecurity Center of Excellence (INCS-CoE), a global university network dedicated to securing critical systems against cyber threats. The founding members include UMBC and Northeastern University in the U.S.; Imperial College, London and Royal Holloway University of London in the United Kingdom; and Keio University and Kyushu University in Japan.

The INCS-CoE supports the efforts of the participating universities as they work together to address cybersecurity challenges

facing society. The collaboration focuses on cybersecurity for critical national infrastructures, including information technology, public transit, and financial services.

Trust is one of the key pillars for a free and interconnected world, for commerce and for exchange of information,” says UMBC’s **Karl V. Steiner**, serving as INCS-CoE board chair in 2023. “This first-of-its-kind global Center of Excellence enables us to rapidly exchange ideas and find solutions to developing issues in an increasingly networked world.”

—Megan Hanks Mastrola

Working to Improve Fairness of AI Systems

James Foulds, assistant professor of information systems, was drawn to working in artificial intelligence (AI) and machine learning by “the possibility to make a direct impact on people’s lives and the health of our society” through advancing technology. He recently earned a National Science Foundation CAREER Award of nearly \$550,000 over five years to support his research on improving the fairness and robustness of AI algorithms. Foulds’ lab focuses on human-centered approaches to AI fairness, working to address many practical limitations in the field.

Thanks to advances in AI, computers can accomplish tasks that would take a human a lifetime, but technologies built by people also perpetuate people’s biases, Foulds says. These biases can then have real impacts on people’s lives, often disproportionately harming already disadvantaged groups. For example, skewed AI and machine learning models have informed college admissions, credit card approvals, and recommendations for bail in courtrooms. The ethics of adopting such systems and ways to mitigate their potential harms have become focal points in Foulds’ work.

Toward using AI fairly and effectively

Foulds’ research demonstrates that developing an AI algorithm that prioritizes fairness can in fact yield more robust results. Models are often used to make generalizations about a population of interest, which can be helpful. But when a model is developed based on biased data, the model can sometimes describe a relationship between variables that doesn’t actually reflect reality.

In these cases, the model’s predictions can be misleading, rather than useful, and can cause real harm. A model that underscores fairness could provide more stable generalizations and help avoid perpetuating or amplifying existing biases and false interpretations.

Through his CAREER Award-supported research, Foulds wants to develop a unifying framework to quantify fairness in algorithms. From there, he will create a user interface to study how people come to a consensus on defining fairness in a given situation.

The project will target decisions or advice based on things like Medicaid waitlist data, career recommendations, and social media usage data. These all have intrinsic biases that can significantly impact trends and outcomes in society or the way industry or government addresses specific problems.

Foulds believes his research will mitigate barriers to responsible and effective deployment of AI technologies by showing that it is possible to develop a discipline-standard model for fairness. He hopes to make his lab a source of user-friendly AI tools for those who want to implement the model in their work.

Creating positive change

Foulds’ work goes beyond the technical, however. As an educator, “I want to inspire the students I come into contact with to see how fascinating and exciting (and potentially lucrative) AI, machine learning, and data science are,” Foulds shares. “And I want to instill in them the importance of ethical thinking in the practice of data science.”

Jordan Troutman ’21, M29, computer science and mathematics, is one of the students who has worked with Foulds. After conducting research

with Foulds at UMBC, today Troutman continues to pursue this work at Stanford University as UMBC’s first Knight-Hennessy Scholar. Troutman exemplifies the scholarship’s core values: independence of thought, purposeful leadership, and civic mindedness.

Troutman thinks of his research as “computational social sciences” and says it incorporates ideas from a broad range of experiences he had at UMBC. Elective courses in philosophy helped him understand how to articulate nonquantitative concepts such as fairness, for example. A particular Honors College course about how the media uses faces and how viewers internalize those representations also stuck with him. And a number of leadership roles taught him that “when you are passionate about something, and you care about the people and not the power or the position, you can do good work and effect good change.”

“While Jordan was working in my lab,” Foulds says, “I was gratified to see his enthusiasm grow as he realized that his technical research could be a part of the efforts he was already making toward creating positive change in our society.”

– Sarah Hansen, M.S. ’15



James Foulds (in green shirt) with student researchers on his team, including Jordan Troutman (far left).

The Maryland Institute for Innovative Computing

The Maryland Institute for Innovative Computing (MIIC), administered by UMBC, is continuously growing the pipeline of tech talent ready to support state agencies, helping them run securely and efficiently. The MIIC is a collaboration between the University System of Maryland and partners in the public and private sectors, launched in 2021. Students at colleges and universities across Maryland are eligible to apply for internships through the MIIC, connecting skilled students with state employers seeking fresh tech talent.

Advancing student success

In early 2022, **Nadja Franklin '23** was exploring summer opportunities through the UMBC Career Center when she heard about a chance to connect with tech internships at Maryland's state agencies. As a business technology administration major, her interest was piqued. She arrived at the on-campus internship event with résumé in hand, ready to discuss her skills, and her preparation and enthusiasm paid off.

Franklin is a Transfer Scholar in Information Technology and Engineering in UMBC's Center for Women in Technology who transferred to UMBC from the Community College of Baltimore County. At the MIIC event, she connected with the Maryland Department of Transportation (MDOT) about projects that would draw on her interests and experience, and she realized the opportunity could be a great match.

In addition to her core tasks, Franklin has particularly enjoyed the chance to meet with MDOT's chief information officer and deputy chief information officer. She's also had a chance to learn about the broad range of projects across MDOT, and how project management works, through supporting directors' meetings.

Talent meets opportunity

In 2022, the MIIC connected nearly 40 interns with opportunities at state agencies across Maryland, including the Department of Labor, Department of Information Technology, Department of Health, Department of Transportation, and the Chief Data Office within the Governor's Office.



Nadja Franklin in front of the Maryland Department of Transportation Building, where she interned.

"The MIIC reflects Maryland's dedication to ensuring our state agencies have the technical staffing and internal infrastructure they need," explains **Annie Weinschenk**, who served as program director of workforce initiatives in the UMBC Career Center.

"With cyber crime on the rise, including attacks on government agencies, MIIC is helping to build a skilled workforce dedicated to service within the state of Maryland," Weinschenk says. "MIIC internship areas range from data science, cybersecurity, and artificial intelligence to geographic information systems at seven agencies across Maryland."

K-12 and higher ed partnerships

While Franklin came to UMBC interested in a career in tech, that's not the case for many students who have the talent and skills to succeed in tech fields. With this in mind, the MIIC has also focused on expanding K-12 initiatives to help prepare students earlier on for these high-demand careers, particularly in cybersecurity.

In 2022, then-Governor Larry Hogan announced the launch of the Maryland Cyber Range for Elevating Workforce and Education, operated by the MIIC. This \$1.2 million initiative will expand cybersecurity education and training through collaboration with the Maryland Center for Computing Education, Virginia Tech' U.S. Cyber Range, and the nonprofit Teach Cyber.

This partnership will include initiatives at all educational levels, from K-12 through higher education and workforce training. The Cyber Range will provide access to a high-quality simulated environment for teachers and students to learn cybersecurity. **Jack Suess '81**, mathematics, and M.S.'95 information systems, UMBC's vice president of information technology and chief technology officer, notes that this effort will enable Maryland to continue to grow and strengthen the state's cybersecurity education infrastructure, developing the next generation of highly skilled researchers and practitioners in this field.

– Megan Hanks Mastrola

COMMUNITY, EQUITY, AND SOCIAL JUSTICE

Advancing Immigration Research: Collaborating with Thriving Immigrant Communities



Thania Muñoz Davaslioglu (left) with Tania Lizarazo (right) speaking with community members about Intercultural Tales. Photo by Rachel Wallace.

UMBC faculty are leading interdisciplinary, community-engaged immigration research that challenges stereotypes and works to dismantle systemic racism in higher education.

“It’s paramount to have such stellar colleagues committed to the vital work of exploring the realities, lived experiences, and challenges of our immigrant communities,” says **Kimberly R. Moffitt**, dean of the College of Arts, Humanities, and Social Sciences. “We can only thrive by supporting and working with all communities and recognizing their contributions to the world.”

Intercultural learning experiences

In 2020, *The New York Times* reported that U.S.-born children of immigrants or immigrant students raised in the U.S. accounted for nearly 60 percent of the growth

in U.S. university enrollment since 2000. Most are the children of international students from India who stayed in the U.S. to work and of Latin Americans and refugees who came seeking better living conditions.

The study “Immigrant Students and Global Education,” co-led by **Felipe Filomeno**, associate professor of political science and global studies, shows that project-based assignments centering immigrant students’ intercultural experiences could yield significant contributions to the global education of immigrant and non-immigrant students alike.

Sharing knowledge

Digital storytelling is one approach to community-centered research. One such project is “Intercultural Tales: Learning with Maryland’s Immigrant Communities,” developed by **Thania Muñoz Davaslioglu**,

assistant professor of modern languages, linguistics, and intercultural communication (MLLI), and **Tania Lizarazo**, associate professor of MLLI and global studies.

The researchers found that the process of sharing and valuing knowledge in some cases enabled their students to reframe fear, confusion, and shame, revealing feelings of pride, solidarity, and insight that shaped a less hierarchical learning space.

In the story “Pack Your Bag,” **Hecjin Hong** ’18, MLLI, shares her parents’ transitions from Korea to Paraguay, her time living in Brazil and Mexico, and her experience settling in the U.S. “I’ve been living in the U.S. for over a decade and used to focus on what I didn’t have,” says Hong. “Now, I realize that I gained courage, independence, patience, and a positive outlook... to forge ahead.”

An article detailing this work, published in the *Journal of Community Engagement and Higher Education*, notes that this research is “informed by feminist theory and the field of critical intercultural communication in which power structures and hierarchies are emphasized,” says Lizarazo. These lenses “facilitate (not guarantee) a more nuanced understanding of immigration as part of UMBC (instead of outside of it).”

Community-building

Another Baltimore-focused project, “Moving Stories: Latinas en Baltimore,” produced by Lizarazo with local immigrant Latinas, visualizes their diverse experiences and dispels stereotypes. In “When Baltimore Became My Home,” Camila Daniel shares her hardships as a Black-Brazilian Latina in Baltimore and the process of “creating a family that does not have my blood or nationality but one heart.”



Felipe Filomeno discusses his research.

In 2017, Lizarazo and Filomeno partnered with Baltimore’s Latino Racial Justice Circle on “Honest Conversations on Immigration.” This dialogue and digital storytelling project convenes U.S.-born citizens and immigrants that share faith-based spaces but rarely engage in dialogue. Filomeno continued the project after the first year. Since 2019, about 85 members of 15 congregations have participated.

In 2021, Filomeno received the Hispanic Heritage Award from Baltimore Mayor

Brandon Scott in recognition of his work facilitating dialogue and leading multiple research projects that became critical in shaping the mayor’s strategic vision of immigrant affairs.

Thriving places

Beyond Maryland, **Yolanda Valencia**, assistant professor of geography and environmental systems, explores the Mexican immigrant community of Pasco, Washington, and how residents create places of peace, tranquility, and family under disadvantaged conditions. Her forthcoming book *Relational Life: Legal Death* is “a historical political economy analysis of geographies of oppression overlaid with an analysis of spaces where this community thrives, as they both happen simultaneously across scale, time, and border,” says Valencia, a recipient of a Career Enhancement Fellowship from the Institute for Citizens and Scholars, among other awards.

Sarah Fouts, assistant professor of American studies, has also been highly engaged with immigrant communities. The Whiting Foundation awarded Fouts a \$50,000 Public Engagement Fellowship, along with New Orleans organizers Toya Ex Lewis and Fernando López, to implement “Project Neutral Grounds: At the Intersection of People, Street Food, and the Hustle.” This project celebrates, shares, and documents New Orleans’ Black, Brown, LGBTQ+, and immigrant food vendors.

Challenging extractive research

This innovative research intentionally values the knowledge of immigrants and broadens how academics think about primary sources. It highlights thriving communities and enables communication, personal reflection, and empathy while challenging systemic racism and the role of education and institutions in perpetuating inequalities.

“Recognizing each other’s humanity is not an abstract process. It requires a commitment to questioning pedagogies that reproduce the hierarchies we critique,” Muñoz and Lizarazo explain. “Teaching and learning are inextricable from struggles against the dehumanization of immigrants and minorities.”

– *Catalina Sofia Dansberger Duque*

Breaking the M.O.L.D.

In 2021, the Andrew W. Mellon Foundation granted UMBC, Morgan State University, and the University of Maryland, College Park \$3 million to launch Breaking the M.O.L.D. (Mellon/Maryland Opportunities for Leadership Development). The program aims to develop a pipeline to higher education leadership for scholars in the arts and humanities. It will focus on faculty members at the rank of associate and full professor, particularly women faculty and Black, Hispanic, and American Indian/Alaska Native faculty.



Kimberly Moffitt (left) and Patrice McDermott (right).

Kimberly Moffitt, dean of the College of Arts, Humanities, and Social Sciences and professor of language, literacy, and culture, serves as the project’s lead principal investigator. Joining her in leading UMBC’s implementation of Breaking the M.O.L.D. is **Patrice McDermott**, vice provost for faculty affairs.

This program seeks to reshape institutional structures, ultimately aiming to disrupt systemic practices that have left women, Black, Hispanic, American Indian, and Alaska Native arts and humanities faculty out of university leadership. The partners plan to combine information gathered over the program’s duration with current research on inclusive excellence to design tools that will help universities rethink their recruitment processes for faculty leaders.

– *Catalina Sofia Dansberger Duque*

Studying COVID-19-Related Discrimination Against Asian Americans

Since the start of the COVID-19 pandemic, **Charissa Cheah**, professor of psychology, has focused her research on utilizing anti-racist frameworks to address the recent increase in anti-Asian violence and discrimination. In 2020, Cheah, along with other UMBC faculty, students, and researchers from University of Maryland, College Park (UMD), received a Rapid Response Research (RAPID) grant from the National Science Foundation (NSF) to support this work.

Their study, “RAPID: Influences of the Coronavirus (COVID-19) Outbreak on Racial Discrimination, Identity Development, and Socialization,” was one of the first NSF RAPID grants in response to the COVID-19 outbreak. It examined the different types of intensified discrimination that Chinese American families experienced during the pandemic.

“The negative impact of infectious diseases on psychological health is understudied but highly significant, especially for minority groups linked to the disease through social group categorization,” says Cheah, principal investigator (PI) of the study. “I saw the potential impact [COVID] might have on Asian American populations in the U.S. based on what we saw with SARS, Ebola, and other forms of diseases that have been racialized. I wanted to be at the forefront of being able to capture and document it more empirically, which wasn’t done very well in previous pandemics.”

Co-investigators of the study included **Shimei Pan**, assistant professor of information systems at UMBC, and Cixin Wang, assistant professor of school psychology at UMD. The research examined the impact on the identities, parenting, and mental health of parents and their children. Cheah and Pan analyzed large samples of outbreak-related social media posts to account for how public opinion, anxiety, and discriminatory attitudes evolved in the span of 1.5 years.

The project also provided graduate and undergraduate students with an opportunity to conduct culturally sensitive research with racial and ethnic minority families using multi-method and interdisciplinary approaches.



Charissa Cheah. Photo by Crystal Tseng.

Reaching doctors and policymakers

The first set of findings were published in *Pediatrics*, which underscored the significance of healthcare professionals addressing the racism-related experiences and mental health needs of Chinese American parents and their children throughout the pandemic. It was the first published study on multiple dimensions of perceived racial discrimination due to COVID-19 experienced by Chinese American families and associations with their mental health.

“Our goal was to document Asian American experiences around race,” Cheah said. “We wanted to capture the salience of the racialization of their experiences during COVID and how it was used, essentially, by the government and different folks to justify xenophobia.”

The findings were also incorporated into the Asian American Psychological Association’s written testimony before the U.S. House of Representatives Judiciary Committee hearing on “Discrimination and Violence Against Asian Americans” in March 2021. Additionally, a portion of the research was cited in the U.S. Surgeon General’s advisory “Protecting Youth Mental Health” in 2021.

Expanding the research

During the data-collection process for the RAPID study, Cheah recognized an increase in civic engagement and civic participation as well as political participation and engagement from many Asian American families. To further

capture the continued changes in the COVID-19 landscape in relation to the civic response, Cheah led an interdisciplinary project funded by the Russell Sage Foundation to study the “bi-directional socialization processes” among Chinese, Korean, and Filipino American parents and their adolescent children regarding civic engagement and political participation.

“We noticed that most of the parents were first-generation immigrants and a lot of the teens and adolescents were really pushing their parents to think differently about these issues,” said Cheah. “Their children had more knowledge and, in some cases, a [better] understanding of the racial landscape in the U.S. We saw kids pushing back and pushing their parents to be more engaged, and we wanted to capture that bi-directional socialization process.”

The research team includes UMBC’s **Shuyan Sun**, associate professor of psychology, along with Cixin Wang and Janelle Wong, professor of American studies and government and politics at UMD.

Cheah has appeared on WYPR, Baltimore’s NPR station, multiple times to describe both her research and issues of underrepresentation and racism in science itself. These new collaborative studies, she tells listeners, work to fill a long standing gap in the psychological sciences on research into the experiences of Asian Americans.

– *Adriana Fraser*

Making the Case for Survivor-Centered Housing Services

In fall 2016, the DC Coalition Against Domestic Violence (DCCADV) approached **Nkiru Nnawulezi**, associate professor of psychology, to collect data on the experiences of domestic violence survivors in Washington, D.C. Nnawulezi's research examines the factors that enhance equity in housing for domestic violence survivors, including survivors of color, queer and trans survivors, and those who are low-income, unhoused, experiencing addiction, living with HIV, or experiencing severe mental health conditions.

"As a community psychologist, it's a dream come true to be able to do a study that community partners initiated, said they wanted, asked for, and would meet a particular need in the community," says Nnawulezi.

"I believe that it's possible for us to have a city where survivors are treated justly and fairly."
—*Nkiru Nnawulezi*

The researcher convened four round-table discussions with scholars, service providers, and legal experts from area universities and community organizations, including American University's Washington College of Law Domestic Violence Clinic; Catholic University's Columbus Community Legal Services and Families and the Law Clinic; and Howard University's Interpersonal Violence Prevention Program.

The meetings revealed housing as the most pressing issue facing survivors of domestic violence in D.C. The Virginia Williams Family Resource Center (VWFRC) serves as the central point of intake for families experiencing housing instability in the District. Many survivors seeking assistance through the center were not being housed. Understanding why and how this was happening became the purpose of the study.

Designing a community-based study
Nnawulezi and Liz Odongo, DCCADV director of grants and programs, co-founded the

Domestic Violence Action Research Collective (DVARC). To support their work, the collective received funding from the Center for Victim Research, through the Office for Victims of Crime within the U.S. Department of Justice.

"DVARC gathers victimization researchers, advocates, and practitioners to design and conduct community-based research and evaluation studies to enhance survivors' safety, build their power, and support policy and practice within multiple systems across the city," says Nnawulezi.

In a year, the team connected with more than 700 clients seeking housing assistance, with more than 200 of that group identifying as having experienced domestic violence. The study's in-depth confidential interview process included 41 survivors between the ages of 24

and 52. The survivors were primarily Black, heterosexual, cisgender women.

The data showed that the survivors reported numerous systemic and cultural barriers to accessing safe, affordable, and equitable housing in D.C. Many women described treatment by staff as unfair or dismissive. Some reported

Early Childhood and K-12 Education Research

Since 2017, UMBC's Sherman Center for Early Learning in Urban Communities has helped to strengthen and expand early childhood education in Maryland, investing more than \$38 million towards growing UMBC's education initiatives. The center was founded with the support of a \$6 million grant from the George and Betsy Sherman Family Foundation. In 2022, the foundation donated \$21 million to UMBC to launch the Betsy & George Sherman Center as a national model to advance excellence in urban schools.

The Sherman STEM Teacher Scholars program, founded in 2006, prepares UMBC undergraduate and graduate students to



Nkiru Nnawulezi. Photo courtesy of Nnawulezi.

bias incidents based on their race and class that made it increasingly challenging to ask for and receive services. Others reported not receiving services regardless of need or having to return to the VWFRC an average of two to five times to attempt to become eligible for services.

The DVARC recommended that the District continue to fund sustainable community-based systems of support that are survivor-centered and trauma-informed and to address the challenges already identified. To determine next steps, the DCCADV convened an advisory group with the study's participants to review the preliminary data and provide recommendations for future advocacy and research studies.

"I believe that it's possible for us to have a city where survivors are treated justly and fairly," says Nnawulezi. "I love being able to think at the systems level about what needs to shift to improve people's lives."

—*Catalina Sofia Dansberger Duque*

become highly qualified PreK–12 teachers with a focus on STEM education. The program has yielded more than 170 educators who are now teaching across the Baltimore region, the State of Maryland, and beyond, often in the most vulnerable school communities. The center has also implemented four other programs developed with and for teachers and families across five Baltimore City Public Schools. UMBC students volunteer over 400 hundred hours in partner schools each year. Additionally, the Sherman Center is investing in early childhood educators with its Maryland Early Childhood Leadership Education Program.

—*Catalina Sofia Dansberger Duque*

HEALTH AND LIFE SCIENCES

Creating New Antiviral Drugs: Innovative Fleximer Research



Katherine Seley-Radtke (right) with graduate student Charles Waters in her lab.

In 2022, the National Institute of Allergy and Infectious Diseases, part of the National Institutes of Health (NIH), awarded nine research consortia a total of \$577 million to create Antiviral Drug Discovery (AViDD) Centers for Pathogens of Pandemic Concern. **Katherine Seley-Radtke**, professor of chemistry and biochemistry, is contributing her innovative work on more flexible antiviral compounds to this effort.

Seley-Radtke is a member of the consortium led by the University of North Carolina at Chapel Hill, which will receive \$65 million over five years to work on five separate projects. UMBC is guaranteed \$2.2 million for the first three years, with another \$1.3 million to come for the final two years if the projects are making satisfactory progress.

The unique consortium structure includes an international, interdisciplinary team of academic

researchers in virology, immunology, chemistry, and biology along with corporate partners. Their goals are ambitious, with increased urgency due to the COVID-19 pandemic.

“Many people in the antiviral field had been pushing for many years, warning people that this kind of viral pandemic could happen,” says Seley-Radtke, who is also president of the International Society for Antiviral Research. “We have to be better prepared. That’s the point of the AViDD program—to quickly get us to the point where we have broad spectrum, small molecule antivirals that can be stockpiled, can be orally administered, and can be shipped to every corner of the Earth.”

Flexible fighters

Seley-Radtke is in a strong position to contribute to the development of compounds that can fight a wide range of viruses. She first invented compounds called fleximers in 2000.

Fleximers are modified forms of an established class of antiviral drugs called nucleoside analogues—with a very useful twist.

“The thing that’s clever about the fleximers, because they’re flexible, they can adjust to a binding site to obtain better binding than a normal rigid nucleoside analogue would,” Seley-Radtke says. They can be more effective against a virus that has accumulated some mutations or against different viruses that have similar, but not identical, structures.

For example, acyclovir is an antiviral drug used against herpes. Acyclovir itself isn’t effective against any viruses of pandemic concern, but a fleximer based on its basic structure “shows incredible activity” against several viruses of interest, Seley-Radtke says. A drug that can target multiple viruses is exactly the kind of “broad spectrum” treatment researchers are seeking.

The consortium is also working toward combination therapies. In these treatments, multiple drugs are packaged together, as is common for HIV medications.

“Combination therapy is critical,” Seley-Radtke says. Because these therapies attack several parts of a virus at once, she explains, they can “exponentially cut down the chances of the virus developing resistance to the treatment. That’s why we’re looking for not just one broad spectrum inhibitor but a combination of things that can be used together to fight whatever rears its ugly head.”

Fast-tracked progress

Having academic researchers and industry partners working together “will facilitate things moving much faster than the normal process,” Seley-Radtke says. “There’s a workflow.”

Her lab will “decide what the target’s going to be. Then we design the compounds, we make the compounds, and then we send them off to the next lab to be tested for activity” against viruses of interest.

If the initial testing detects any winners, another consortium partner will produce the compounds at scale so that they can run more tests. If after that the compounds are still showing promise, they’ll be sent on to clinical trials through pharmaceutical company partners.

“I’m really grateful to be able to participate in such high-impact work,” Seley-Radtke says. “It’s an amazing opportunity and a brilliant concept.”

Proactive approach

Seley-Radtke will work on two of the projects in the consortium. One will focus on SARS-CoV-2 (the virus causing COVID-19), dengue

fever, and other viruses in the flavivirus family. These RNA viruses are most often spread by ticks and mosquitoes. Another project focuses on filoviruses, which include diseases like Ebola and Marburg virus disease, known for causing severe hemorrhagic fevers.

The members of the different projects meet with each other and with NIH regularly to gauge progress and keep everyone on track. The goal is to develop individual drugs with activity against many viruses, and combination therapies, quickly.

“It’s definitely within reach—and not just with my compounds,” Seley-Radtke says. “The AViDD centers are a fantastic effort. I applaud NIH for putting the money into this program and recognizing we’ve got to stop being reactive and be proactive.”

– *Sarah Hansen, M.S. ’15*

Revolutionizing Data Analytics to Advance Health

For nearly 30 years, The Hilltop Institute at UMBC has led high-impact research projects impacting healthcare delivery and access in Maryland and across the nation.

UMBC launched Hilltop in 1994, in partnership with the Maryland Department of Health. Hilltop designed HealthChoice, the state’s Medicaid managed care program that now serves more than 1.7 million Marylanders. The partnership has grown to advance access to high-quality healthcare by providing Maryland policymakers and state agencies with the information they need to make well-informed, evidence-based decisions about healthcare delivery and financing.

This collaborative work has garnered Hilltop national recognition as a model public university–state agency partnership. Hilltop is a founding member of a national network of partnerships representing 27 states that are leaders in advancing sophisticated analytics to inform state health policy.

Hilltop worked with the Maryland Department of Health to advance the health of residents with low incomes and disabilities in the Medicaid program. Hilltop’s interagency

agreement with the Department for Policy Analysis and Analytical Support for the Medicaid program—renewed annually since 1994—topped \$10 million in 2022. Hilltop maintains an extensive data repository to house Maryland Medicaid data. Using these data, it calculates the fixed monthly payments the state pays to health plans for each of its members participating in HealthChoice, totaling more than \$7 billion in 2022.

Hilltop has developed innovative analytical tools to support Maryland’s healthcare system through the Total Cost of Care Model. Maryland hospitals use one web-based tool to report community benefits and expenditures. It also streamlines those data and enables longitudinal analysis. Hilltop recently also launched a model to help identify patients in the Maryland Primary Care Program who would benefit most from intensive primary care coordination.

When the COVID-19 pandemic began, Hilltop quickly responded to requests for data on COVID-19 testing, hospitalizations, and vaccinations. They provided daily support to the Maryland Department of Health on implementing data-informed emergency

measures and guidance for healthcare providers. Hilltop researchers also expanded their Pre-AH Model to predict a patient’s risk of being hospitalized for COVID-19, funded by an Accelerated Translational Incubator Pilot grant under the UMB-UMBC Institute for Clinical and Translational Research partnership.

Hilltop has continued to address long-standing critical public health concerns. As a member of the Maryland HIV Medicaid Affinity Group and the Greater Baltimore HIV Health Services Planning Committee, Hilltop provides technical support and analytics for HIV services offered to Medicaid participants.

The institute collaborated with the Center for Mississippi Health Policy to quantify the financial impact of tobacco use on Mississippi’s Medicaid program and estimated the economic impact on the state budget and hospitals if the state were to expand Medicaid as the Affordable Care Act allows. With funding from the National Institute on Drug Abuse, Hilltop and 12 other states’ university partners are assessing the quality of opioid-use disorder treatment and its outcomes for Medicaid participants.

– *Catalina Sofia Dansberger Duque*

Developing Nanoparticles That Stop Internal Bleeding

When a person experiences a trauma that leads to significant bleeding, the first few minutes are critical. It's important that they receive intravenous medication quickly to control the bleeding, but delivering the medication at the right rate can prove challenging. Slower infusions can cause fewer negative reactions, but the medication might not work fast enough, particularly in the case of a serious trauma.

Four UMBC researchers have developed a unique way of modifying the surfaces of nanoparticles within these lifesaving medications to provide infusions that can be delivered more quickly but with a reduced risk of negative reactions.

Infusion reactions can cause a range of symptoms, such as rashes and inflammatory responses. This can include anaphylaxis, a life-threatening respiratory failure. Up until this point, the seriousness of these reactions has limited the use of promising nanomedicines, and reducing the likelihood of adverse reactions could be game-changing.

In a paper published in *Nano Letters*, **Erin Lavik**, professor of chemical, biochemical, and environmental engineering; **Chuck Bieberich**, professor of biological sciences; **Nuzhat Maisha**, Ph.D. '21, chemical engineering; and **Michael Rubenstein**, M.S. '14, Ph.D. '22, biological sciences, discuss their novel approach to the research. They focused on the core material of the nanoparticles delivered to patients.

"We found that using a polyurethane core reduced the markers associated with infusion reactions," explains Lavik, who is also the associate dean for research and faculty development in UMBC's College of Engineering and Information Technology.

Currently, seven percent of people experience infusion reactions, the authors note in their paper. "These reactions...limit the treatments available in a substantial portion of patients," they explain.

"We, like most of the field, have spent a lot of time trying to modify the surfaces of nanoparticles to modulate the reaction," says



Erin Lavik (right) working in the lab with Adam Day '16, M.S. '19, chemical engineering.

Lavik. She shares that while that approach does help to a degree, going a step further by changing the core material appears to have a greater impact.

This research lays the groundwork for future testing of preclinical models using nanocapsules to stop internal bleeding.

Lavik explains that collaboration was an important element of this work, especially being able to conduct the research in UMBC's Interdisciplinary Life Sciences Building,

– Megan Hanks Mastrola

Informing Policy and the Public During COVID-19

When the COVID-19 pandemic began, the world scrambled to develop a data-informed response to the public health emergency. **Zoë McLaren**, associate professor of public policy, is one researcher who has worked extensively with the media to make sense of these issues for the public.

"My media engagement during the pandemic required me to evaluate new data and provide analysis in real time," says McLaren, who is also an affiliate of the Health Econometrics and Data Group at York University. As a health economist, she develops rigorous applied statistical approaches to answer important policy questions using real-world data.

In fall 2020, concerns about COVID-19 rapid antigen testing caused contentious debates about their use, accuracy, and reliability in helping to reduce transmission. McLaren was among the earliest and strongest advocates for

making them widely available. She explained their benefits and limitations in an article appearing in *Fast Company*, titled "The key to stopping the coronavirus spread are new tests that prioritize speed over accuracy."

"I was confident in my analysis despite a lot of hesitancy and pushback from the medical and public health establishments," says McLaren. "The *Fast Company* piece has stood the test of time. It's been gratifying to see my assessment borne out in the real world over the past two years. Rapid tests aren't perfect, but they are very powerful."

Author and science enthusiast Bill Nye agreed, inviting McLaren onto his podcast *Science Rules!* for the episode "Coronavirus: Everything You Could Possibly Want to Know About Testing." Once tests were readily available, McLaren wrote an article for *The Conversation* explaining when to use at-home COVID-19 tests, which was read more than 225,000 times.

In May 2021, McLaren wrote "One-Size-Fits-All Mask Guidance Isn't Going to Work Anymore" for *WIRED*, advocating against relying too heavily on masks only and instead encouraging innovation in a wider range of tools for COVID-19 detection and protection. The article included creative ways to boost vaccination rates and the use of opt-in vaccination verification systems and rapid antigen testing.

McLaren's *New York Times* guest essay, "The Math That Explains the End of the Pandemic," helped explain the underlying dynamics of COVID-19 transmission and brought clarity to the next phase of this public health crisis. She continues her work to develop innovative, data-driven policy solutions to help the country and the world move forward safely.

– Catalina Sofia Dansberger Duque

Committed to Student Success at All Levels

Dedicated students searching for answers to complex questions find a home at UMBC where their points of view are valued and they can access specific kinds of training they may need along their educational and career journeys.

Meeting critical workforce needs

In January 2022, UMBC received a \$900,000 grant from the National Institute for Innovation in Manufacturing Biopharmaceuticals to develop and implement a new, short-term biomanufacturing training program to help meet critical national workforce needs. **Annica Wayman** '99, M6, mechanical engineering, associate dean for Shady Grove affairs in the College of Natural and Mathematical Sciences (CNMS), and co-lead **Manik Ghosh**, assistant director of the Translational Life Science Technology (TLST) laboratories at UMBC at The Universities at Shady Grove, are leading the program's development.

The programming is modeled on UMBC's Biotech Boot Camp, launched in February 2021 to train workers who had lost employment due to the pandemic for new, in-demand roles.

EDUCATE program

In 2021, the National Institute on Drug Abuse awarded UMBC more than \$1 million over five years to create the EDUCATE program, which stands for Educating Diverse Undergraduates for Careers in Addiction and substance abuse research via Training Experiences. Since the program's launch, students in fields as diverse as economics, computer science, and chemical engineering are finding ways to connect their interests to this important topic.

Yetunde Oshagbemi '23, economics and mathematics, wants to study economic development in Nigeria, and she is interested in understanding how drug abuse has impacted development.

The EDUCATE program "broadens your horizons and your views on the ways drug abuse is being studied in different disciplines," Oshagbemi says. "It's allowed me to see that there are different ways to answer the questions I have about my interests."

G-RISE

In 2022, CNMS received funding from the National Institutes of Health to fund the Graduate Research Training Initiative for Student Enhancement (G-RISE). The \$5.6 million award will support the initiative for five years. Led by **Rachel Brewster**, professor of biological sciences, the program will support graduate students from underrepresented groups in STEM with up to three years of funding and an array of training opportunities.



Charmaine Hipolito '20, and Titina Sirak '20 (right), alumni of UMBC's TLST program at The Universities at Shady Grove, speak at a special event at the Shady Grove campus.

G-RISE offers scaffolded support to help graduate students choose and then actively pursue their specific goals. Tracks in the program include academic research and science education, biotechnology and entrepreneurship, science policy and administration, and science communication.

All three programs, among others at UMBC, create opportunities for students to expand their ideas of where their education can take them. The students can then pursue their goals with a strong community of support at their back, setting no limits on what they can achieve.

—*Sarab Hansen, M.S. '15*

Connecting with the Public Through *The Conversation*



Sebastian Deffner, physics, wrote a piece for The Conversation explaining static electricity. Every winter, when dry air and static increase, the article gets a fresh boost of views.

UMBC researchers regularly share their work and expertise with the public through *The Conversation*—a nonprofit news outlet that provides current, informative content to news publications worldwide, free of charge. More than 250 *Conversation* articles have been written by more than 130 different UMBC researchers, and UMBC's *Conversation* articles have surpassed 11 million reads.

The stories offer context to current events, explain natural phenomena, introduce new research in an accessible way, and more. Top republishers of UMBC's *Conversation* content include *Quartz*, *Smithsonian Magazine*, *Fast Company*, *Scientific American*, *Business Insider*, and CNN, along with countless local newspapers around the world. These articles often inspire additional original news coverage on faculty research as well, from *The New York Times* to NPR stations.

The Conversation has a global impact. More than 40 percent of readers of UMBC-authored *Conversation* articles are based outside the U.S. Many of these readers are in Canada, India, Australia, the United Kingdom, France, the Philippines, and Singapore, among other nations. They access both English-language content and UMBC articles that have been translated into other languages.

—*Sarab Hansen, M.S. '15*

CREATIVE ENGAGEMENT

Merging Hip-Hop, Computing, and Cultural Analysis

Tahir Hemphill speaks at the Brooklyn Museum in Brooklyn, New York. Photo by Ryan Lash/TED.

The UMBC's Fellows for Faculty Diversity program welcomes scholars and creative practitioners who are committed to diversity and inclusion and prepares them for possible tenure-track appointments at UMBC and successful careers in higher education. Nearly two dozen talented scholars have joined UMBC through the program, which received over 500 applications in 2021 alone. Emerging from that group was **Tahir Hemphill**, who came to UMBC as the university's inaugural Fellow for Faculty Diversity in the Visual Arts. This new track is specifically designed to support creative and artistic practitioners.

Hemphill has developed a multifaceted practice as a creative technologist, multimedia artist, and design researcher. He uses his varied backgrounds in engineering and the arts to create graphic designs and projects that inform audiences about the world in which they live.

"I was groomed to be an electrical engineer," Hemphill says. "So the physical sciences—chemistry, math, physics—play an important role in how I see, view, and understand the world." Much of his current work utilizes computational analysis to explore what is usually unseeable in the semantic structures within large bodies of archival text, working especially within the world of hip-hop.

Developing his focus

Coming of age in the 1980s, Hemphill divided his time between practicing various elements of hip-hop culture and exploring cyberspace via a dial-up modem. A fundamental affinity between hip-hop culture and hacking would define the trajectory of his professional and creative life.

Starting in middle school, he accessed engineering-oriented opportunities to build and create, acquiring tech knowledge and skills. At the same time, hip-hop's "golden

age" (mid-1980s to early 1990s) informed his perspectives on popular culture and politics. He has synthesized the theoretical frameworks behind these two educational influences into his current creative endeavors.

Over the past 20 years, as an artist who works with technology, Hemphill has found inspiration in scientific work that pushes investigation to artistic limits and artistic work that pushes repetition towards scientific method. His reverence for the scientific method as well as his irreverent tinkering with it fuel this productive tension between art and technology.

A distinctive career path

Hemphill arrived at UMBC with broad experience in higher education, commercial design, and the nonprofit sector. After earning a B.A. in Spanish language from Morehouse College, a strategic planning certificate from Miami Ad School, and a master's degree in communications design from the Pratt Institute,



he went on to receive a Creative Research Fellowship at Carnegie Mellon University and a Hiphop Archive Fellowship at the W.E.B. Du Bois Institute for African and African American Research at Harvard University.

He has served as the Harissios Papamarkou Chair in Education at the John W. Kluge Center at the Library of Congress and as Behavioral Science Resident at the Rockefeller Foundation Bellagio Center.

In the commercial sector, artist residencies at Spotify and Autodesk Pier 9 have recognized his creative work. He's also received grants from the National Endowment for the Arts and the Saul Zaentz Innovation Fund. Additionally, the Talk to Me exhibition at the Museum of Modern Art in New York features his work.

Hip-hop as a lens on culture

In recent years, Hemphill's work has concentrated on the intersection of hip-hop and

data, manifested especially by the Rap Research Lab, a creative technology studio he founded to explore rap as a cultural indicator. The lab uses a hip-hop framework to develop new ways for people to engage with data and culture.

In a presentation through UMBC's Center for Innovation, Research, and Creativity in the Arts, Hemphill shared details on A Mapper's Delight, an interactive virtual and augmented reality tool.

"It's a sculptural data visualization," Hemphill says, "and it's built on a semantic relationship of hundreds of thousands of rap lyrics. It shows how...rappers cover the globe with their lyrics with references to cities, neighborhoods, regions." He shares that "it looks at the geography of language and hip-hop and creating language as political exercise."

A Mapper's Delight has added content in around 30 languages, says Hemphill, "so it's truly a big data hip-hop cultural project."

Recently, Hemphill's Rap Research Lab began its national launch of Mapper's Delight AR, an augmented reality learning platform and curriculum for middle school youth in partnership with the Verizon Innovative Learning Schools initiative. With more than 500,000 students enrolled in the program, the iOS app is being used in classrooms to encourage further studies in STEM and data analysis using hip-hop lyrics as data points.

Additionally, the Rap Research lab is a part of the third Headstream Accelerator cohort. The accelerator program supports the building of meaningful digital places and social technologies for young people.

Hemphill's creative work will be on display at UMBC's Center for Art, Design, and Visual Culture in spring 2023.

– *Tom Moore*

Reimagining the Classical Music Canon



Pianist and composer Daniel Pesca, assistant professor of music. Photo courtesy of Pesca.

The classical music world is increasingly coming to terms with a lack of opportunities, support, and recognition for people of color in the field. As part of this movement, **Daniel Pesca**, assistant professor of music, has developed initiatives designed to advance diversity, equity, and inclusion in classical music, supported by awards from the Charlesmead Initiative for Arts Education and the Hrabowski Innovation Fund.

Pesca's Charlesmead grant has funded a multi-year collaboration with the Carter School of Music at New Shiloh Baptist Church in Baltimore City. This partnership has fully funded the musical education of 10 students, ages 8 – 14, from the Sandtown-Winchester neighborhood. Each participating student has received an electric piano and takes piano classes at the Carter School, which Charlesmead jurors characterized as a “a key community and spiritual hub.”

Those students also participated in a Summer Enrichment Academy course with Pesca to

further advance their studies. This year they will have opportunities to tour the UMBC campus, meet music majors, participate in workshops and masterclasses, and perform for the first time on professional concert grand pianos.

Keys to Inclusion

Pesca was awarded a Hrabowski Innovation Fund Award for Keys to Inclusion, a multi-year initiative to imagine a more inclusive piano canon. He has co-lead an effort to bring music departments and piano studios from five institutions around the country together to research, perform, record, and teach the piano music of Black American composers.

“Many works by Black American composers are out of print or unpublished,” explains Pesca, “and many are not recorded or readily available.” He and partners from Northeastern Illinois University, San Diego State University, Denison University, and Loyola University New Orleans are working to change that.

Students at the five institutions will be empowered to grow as musicians as they enjoy the benefits of working with professionals from across the country, learning the process of making a high-level recording, and discovering unfamiliar repertoire. The fruits of this year-long effort will be shared via an online database, now under construction.

The group presented their preliminary findings at the 2021 National Conference on Keyboard Pedagogy and at the 2022 Music Teachers National Association conference. In fall 2022, Keys to Inclusion participants met to further discuss their findings and to develop plans to expand their reach by encouraging other institutions to join the initiative as part of a larger conversation about inequities in representation in classical music.

– *Tom Moore*

Engaging the Public with Media and Visualization Research

The Imaging Research Center (IRC) leverages new technologies and emerging media platforms to create meaningful connections between knowledge and people. Founded more than 30 years ago as part of UMBC's visual arts department, the interdisciplinary center houses state-of-the-art 3D visualization tools and immersive technologies. Here is a brief sampling of IRC-supported projects.

Losing Winter

Visual arts professor **Lynn Cazabon** approached the IRC with a project to help address climate change by capturing and sharing people's personal experiences of winter and the emotional impact of global warming.

The project, designed as a mobile application, was a part of Cazabon's 2021 – 2023 exhibition *Losing Winter* at the Maryland Center for History and Culture. Funding was provided by the Saul Zaentz Innovation Fund. Co-investigators included **Mark Jarzynski**, '11, computer science, Ph.D. candidate in computer science and electrical engineering (CSEE) and former IRC technical director for software engineering; **Ryan Zuber**, IRC technical director for modeling and animation; and **Tristan King**, technical specialist and software development lead.

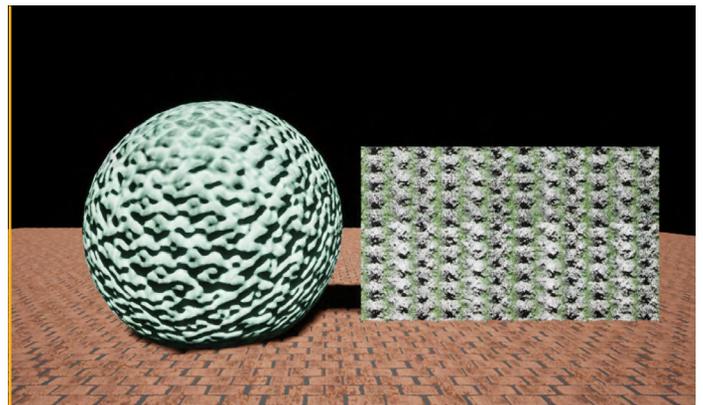


An image from Losing Winter by Lynn Cazabon.

Rendering realism through randomness

Mark Jarzynski and **Marc Olano**, associate professor of CSEE and affiliate professor at the IRC, collaborated to evaluate methods of generating 'random' visualizations to achieve the appearance of realism using computer-generated graphic imagery, better known as CGI, such as to animate ocean waves.

Their goal was to compare the quality of the results (just how random they are) with the computational effort required to create them. This would allow those creating computer graphics for things that should appear random to choose the appropriate algorithm, or random hash function, for a given situation. Their findings were published in the *Journal of Computer Graphics Techniques*. The research was funded in part by video game company Epic Games.



A visualization by Mark Jarzynski and Marc Olano.

Black Power in D.C. story map

George Derek Musgrove, associate professor of history, worked with the IRC in 2019 to further develop a storytelling website sharing his research on the history of Black Power activism in the nation's capital since the early 1960s. The project expands on research related to his book, *Chocolate City: A History of Race and Democracy in the Nation's Capital* (North Carolina University Press, 2017), co-authored with Chris Myers Asch.

With support from an IRC Summer Faculty Research Fellowship, Musgrove collaborated with student researcher **Kirubel Tolosa**, M.S. '23, information systems, and IRC Director **Lee Boot** to develop the website Black Power in D.C. This site is a unique way for visitors to explore historical texts and photographs (1961 – 1998) in the context of the D.C. geography.

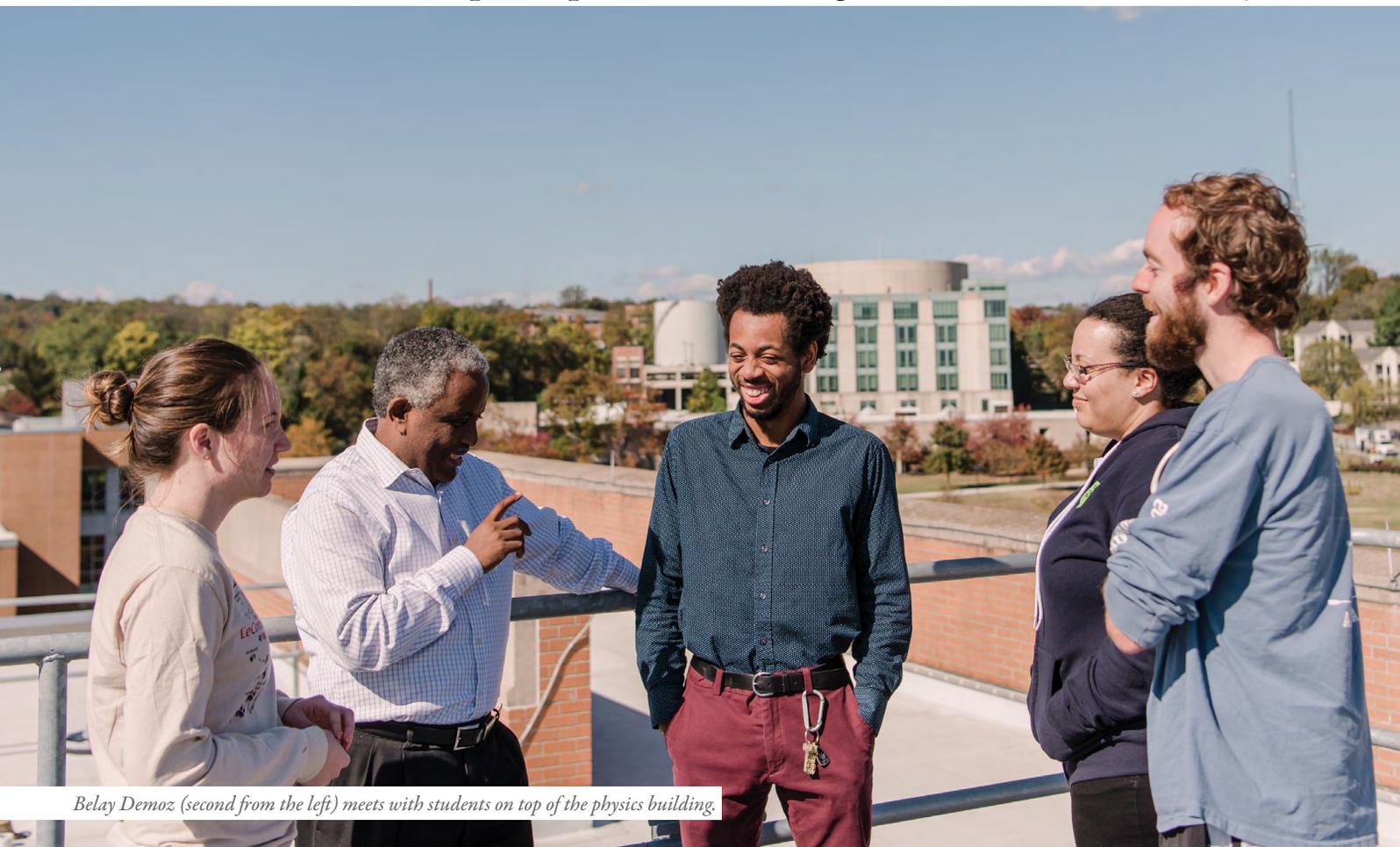
– *Adriana Fraser*



Screenshot from the Black Power in D.C. website.

EARTH AND SPACE SCIENCES

UMBC's NASA Partnerships Deepen Understanding of Our Own Planet and Beyond



Belay Demoz (second from the left) meets with students on top of the physics building.

Whether studying Earth's atmosphere or wind on Mars, UMBC's partnerships with NASA enable research that increases understanding of our planet, our solar system, and beyond. UMBC's stewardship of NASA research funds also serves to prepare a diverse new generation of space scientists, as undergraduate and graduate students contribute directly to the research.

In October 2021, NASA announced a major award of \$72 million over three years for the new Goddard Earth Sciences Technology and Research (GESTAR II) Center. UMBC serves as the lead for a national consortium and will receive over \$38 million. Morgan State University serves as the primary partner, and other universities and corporations are also involved.

Belay Demoz, founding director of GESTAR II and former director of the Joint Center for

Earth Systems Technology (JCET), describes the team members as "powerhouses in earth science research and administration."

The new GESTAR II Center replaced JCET as it concluded two-and-a-half highly productive decades. The award enables ongoing projects to continue while also creating opportunities for expansion under a new structure.

UMBC researchers for GESTAR II are already producing groundbreaking results using innovative remote-sensing techniques and data collected by NASA satellites. For example, **Tianle Yuan**, associate research scientist, led a team that generated a global map of pollution caused by cargo ships over 18 years. Changes over time reflected implementation of fuel regulation standards. The research will also help scientists refine how climate models integrate the effect of clouds.

Unlocking technologies

NASA also supports UMBC research investigating celestial objects far beyond our own planet. In May 2021, NASA committed \$178 million to the Center for Research and Exploration in Space Science & Technology II (CRESST II). The center was founded in 2006 and first renewed in 2016, and the new support will carry it through 2027. UMBC and the University of Maryland, College Park (UMD) are the two primary funding recipients in a six-university consortium, which UMD leads.

The Center for Space Sciences and Technology (CSST) primarily consists of the UMBC arm of the CRESST II consortium. The CSST faculty comprises more than 60 scientists and engineers. The things CSST researchers learn about galaxies far, far away might one day influence our experience on Earth, explains **Don Engel**, director of CSST

and assistant professor of computer science and electrical engineering.

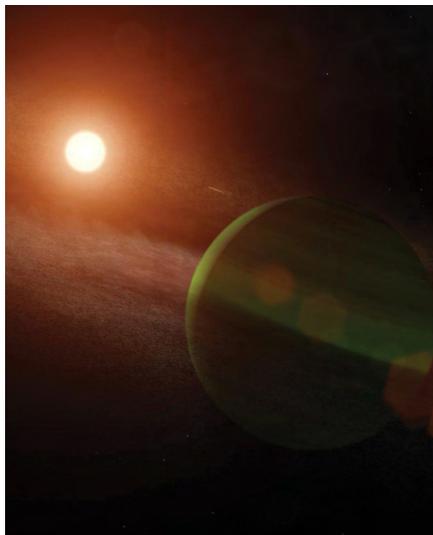
“Some of the greatest mysteries that remain in physics can really only be further probed by looking at things that are massively large or very dense—extremes that we can only find by looking far away,” Engel says. “And yet, these mysteries always end up unlocking fascinating new technologies that change people’s lives.”

Our Sun and solar system

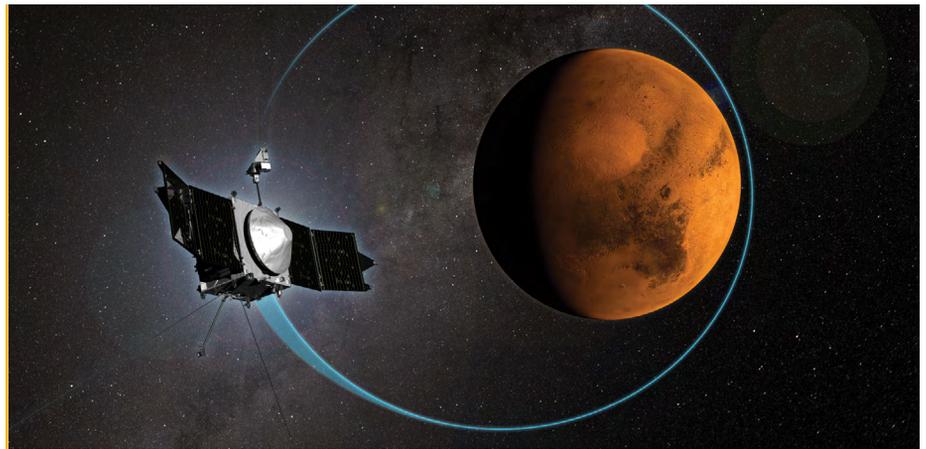
In between Earth’s atmosphere and the far reaches of space, the Partnership for Heliophysics and Space Environment Research (PHaSER) supports research on the Sun and how it affects and interacts with the solar system, including its role in space weather. In September 2021, NASA awarded the new, six-institution consortium \$64.1 million to fund it for the next five years. The overall PHaSER award is led by Catholic University and UMBC will receive \$10 million from the award.

PHaSER replaces the Goddard Planetary Heliophysics Institute (GPHI), a three-institution consortium that NASA initially funded in 2011 and renewed in 2016.

“The primary purpose of PHaSER is to collaboratively support the NASA Heliophysics



A 2020 paper by CSST scientist Tom Barclay published in Nature reported the discovery of a Neptune-sized planet orbiting a young, nearby star. This visualization shows an interpretation of the planet, AU Mic b (green), and its star, Microscopii. Image courtesy of NASA's Goddard Space Flight Center/Chris Smith (Universities Space Research Association).



MAVEN spacecraft orbiting Mars, artist concept. Image courtesy of NASA.

Science Division (HSD) in studying plasma processes in our solar system and developing new missions and instruments,” **Jan Merka** says. He served as GPHI director and now directs the UMBC arm of PHaSER. “UMBC has a long tradition of working with NASA and HSD,” Merka adds, noting that in 2021 alone GPHI funded 30 full-time researchers, 15 of them at UMBC.

GPHI research has included identification of a phenomenon known as the Terminator, which helps describe solar cycles and could improve decade-scale weather forecasts. UMBC’s **Robert Leamon** led that research, and a new paper of his expands on the work.

Supporting students

These partnerships all generate pathfinding research that increases understanding of our world. They also create opportunities for students to gain experience working on real NASA missions under the mentorship of dedicated researchers, setting them up for rewarding careers.

Demoz, in particular, has been recognized for his ongoing commitment to mentoring students from all backgrounds in climate science. His scientific and mentoring work is driven by his early life in Eritrea, which was struggling with drought and other climate-induced challenges that continue today.

This commitment to mentoring will be carried forward by **Charles Ichoku**, professor of geography and environmental systems, recently named director of GESTAR II.

In recent years, CSST has also focused on offering training for budding space scientists. Graduate students with NASA fellowships are co-advised by UMBC faculty and NASA scientists, undergraduates have internship opportunities on-site at the Goddard Space Flight Center, and postbaccalaureate programs offer recent grads a chance to get more experience before applying to jobs or graduate school. Career workshops are available to all.

“We’re trying to do more to support their growth and prepare them to move on to other things afterwards,” Engel says. “We’re also building more infrastructure around career support for our scientists, especially those at earlier levels.”

PHaSER’s goals, too, include nurturing early-career and underrepresented researchers. Specific programs designed to do that will be a hallmark of the center, including student internships and funding for postdocs. Beyond generating high-quality research, Merka says, “another significant benefit of PHaSER is connecting students with research opportunities and mentors in heliophysics.”

All of these partnerships demonstrate UMBC’s commitment to collaboration with NASA and other institutions that share the university’s research and teaching missions. Moving forward, centers like GESTAR II, CREST II, and PHaSER, as well as those that follow, will continue to emphasize high-quality scientific output in tandem with supporting students and early-career researchers.

– Sarah Hansen, M.S. '15

Building Next-Gen Satellite Tech to Examine Earth's Atmosphere



Vanderlei Martins, Roberto Borda, and Dominik Cieslak (left to right) look at a model of the original HARP cubesat.

The first Hyper-Angular Rainbow Polarimeter (HARP) was a mini-satellite about as big as two shoe boxes. Developed by **Vanderlei Martins**, professor of physics, and his team of scientists and engineers at UMBC's Earth and Space Institute, the HARP cubesat launched to the International Space Station in November 2019 and was released into orbit in February 2020. HARP spent over two years collecting first-of-its-kind data on Earth's atmosphere and was deorbited in May 2022.

Soon, HARP2 will be part of NASA's Plankton, Aerosol, Cloud, ocean Ecosystem (PACE) mission. The HARP team is preparing to compete for a spot on the future NASA Atmosphere Observing System mission as MegaHARP.

From the HARP cubesat, "We have data now on clouds. We have data over the ocean. We have data over land surfaces in a way that we never had before," Martins says. The instrument was so impressive that the American Institute of Aeronautics and Astronautics named it SmallSat Mission of the Year in 2021. "Now," Martins says, "we are using HARP data to develop algorithms and methodologies that we will use for these other missions."

Proving it works

On its 27-month flight, HARP's unique sensors collected new kinds of information about clouds and tiny particles in Earth's atmosphere, such as wildfire smoke, desert dust, and human-generated pollutants. These

particles, collectively known as aerosols, have many effects on the global climate and the health of organisms. The data may inform refined climate models or strategies to reduce the effects of air pollution.

HARP captures images, but "it's not a camera that takes pictures. It's something a lot more sophisticated," Martins explains.

A single composite image generated by HARP can contain the information from up to 1,000 original images. Each image and its information are extractable from the composite, which allows researchers to look at many different parameters depending on their goals.

Opening the path

HARP's physical design is also innovative. A single instrument with no moving parts houses the sensors and algorithms used to process all the different data types. That's a big benefit for any instrument facing the harsh environment of space.

"For us, HARP was a pathfinder," Martins says. "We launched HARP to demonstrate that this technology is possible and to open the path for other missions that are coming after that."

HARP2 is already taking advantage of lessons learned from HARP. It will fly on NASA's PACE mission in 2024. "HARP2 is basically an advanced copy of the instrument payload in the HARP cubesat," Martins says. Everything from calibration systems to the raw materials has undergone improvements.

Due to greater computer power on the larger PACE mission compared to the original cubesat, Martins explains, "HARP2 in five hours will collect as much data as HARP cubesat collected in two years."

Launching satellites—and careers

Since its inception, HARP has also lived up to UMBC's mission to educate students and support the regional economy and workforce. The team's success and expertise has attracted interest from Northrop Grumman Space Systems, which led to a new collaborative research project between Northrop and UMBC, and students have played key roles in all phases of HARP and now HARP2.

"Relationships with federal agencies like NASA, all the work that we do with private companies around us, plus the training of students, who then go on to lead the same field they were working in, all fit very well the goals of our public research university," Martins says.



Dawn gradually breaks behind the Antares rocket (carrying the HARP cubesat) on launch morning. Photo by Bill Ingalls/NASA.

Through HARP, HARP2, and early preparation for MegaHARP, every iteration of the project has prepared students for successful careers, proven new technologies, and generated new knowledge about the world. But, as an educator, perhaps the most rewarding part for Martins is seeing his students grow, find success, and then reach back to help others.

"Students were involved in the inception of the idea for HARP from the beginning," he says. "And today, students who were there working on HARP at the beginning are now in positions at NASA supporting the next generation."

— Sarah Hansen, M.S. '15

Uncovering New Findings on Black Holes



Eileen Meyer (left) works with a student in her research lab.

Eileen Meyer, associate professor of physics, and her team are uncovering new findings on black holes and how they behave. A recent study has confirmed that a black hole eight billion light years away is zipping away from its galaxy's center at 2,000 kilometers per second, or more than 4.5 million miles per hour. The result also provides, for the first time, very strong evidence that it is possible for two black holes to merge.

The galaxy where this is happening, named 3C 186, was first discovered in 2017. Initial observations suggested that 3C 186 was the result of two galaxies (and their respective black holes) merging. However, there were still other possible explanations. The new study, published in *Astronomy & Astrophysics*, strongly supports only one of the remaining scenarios: that two black holes merged and the resulting black hole is moving away from the galaxy's center.

"This is probably the most clear-cut case" illustrating this phenomenon that scientists are aware of, Meyer says. She is co-lead of the study with Gianluca Castignani at the University of Bologna.

Speedy departure

The two major findings—the black hole merger and its ouster from the galaxy's center—are

related. Theorists have predicted that if two black holes were to merge, they would release huge amounts of energy in the form of gravitational waves, Meyer explains.

Sometimes, "depending on how the black holes are spinning and their relative mass and how they're oriented," she says, that energy is not equally distributed in all directions. If there is "a lot of gravitational wave energy in one direction, there is consequently going to be literally kinetic energy given to the black hole in the other direction." That means the black hole is going to move—in this case, very quickly.

Puzzle pieces

"There were basically two pieces of evidence that made this story come together," Meyer says. First, an earlier paper established the physical offset between the black hole and the galaxy's center. However, Castignani and Meyer's new paper confirmed a critical second finding: the velocity of the black hole, at 2,000 kilometers per second.

The imaging plus the velocity comes as close as you can in astronomy to proving the scenario that Meyer and her colleagues believe is correct: A merged black hole has been kicked out from the center of its galaxy as a reaction

to gravitational wave energy headed in the opposite direction. This is the first time both physical offset and velocity have come together so convincingly.

For systems so far away, where direct observation is difficult or impossible, it can be hard to narrow down the possible scenarios for what's actually happening. This new study takes a big step forward by translating theoretical predictions into observed phenomena at galaxy 3C 186.

Finding the first

The new finding "is actually very important," Meyer says. "People always want the evidence for the scientific story, and now we have that evidence."

The results are also encouraging for a new major mission led by the European Space Agency. The Laser Interferometer Space Antenna will observe gravitational waves from space and could help detect more instances of merged black holes at the centers of galaxies. Finding this first clearly documented example has been an important step ahead of that mission.

—*Sarah Hansen, M.S. '15*

HISTORY, IDENTITY, AND SOCIETY

Carnegie Fellow Examines Black Political Movements in the U.S., 1980 – 1997



George Derek Musgrove (left) and Chris Myers Asch (middle) with moderator at the Oprah Winfrey Theater in the National Museum of African American History and Culture in 2017.

George Derek Musgrove '97, history, associate professor of history, was one of 28 scholars across the U.S. to be named as a 2022 Andrew Carnegie Fellow.

The fellowship, from the Carnegie Corporation of New York, provides recipients with \$200,000 to further their research in the humanities and the social sciences. The goal: to support the publication of a book or a study that tackles today's most challenging problems. Musgrove's forthcoming book will focus on the Black political mobilizations that rose in opposition to the economic recession of the early 1980s and the resulting rise in conservative politics—what he calls the “Black Power resurgence.”

“Receiving the Carnegie Fellowship is a real honor. It is also a powerful endorsement of the importance of exploring the Black political and cultural mobilizations of the 1980s and '90s,” says Musgrove. “We continue to live in the world those activists helped make and to fight the battles that those activists fought.”

Black Power resurgence

Musgrove's forthcoming book, “*We must take to the streets again: The Black Power Resurgence in Conservative America, 1980 – 1997*,” aims to provide an in-depth history of the years between the Civil Rights Movement and today's Black Lives Matter movement.

Musgrove has devoted years of archival study to the project. He has spent hours

examining documents from the National Black Leadership Roundtable, Southern Christian Leadership Conference, NAACP, and National Council of Negro Women. The fellowship will allow him to travel to additional archives and interview activists, community members, and political leaders.

Musgrove plans to engage fellow scholars and the community at large to explore these histories through several points of connection. These include speaking engagements, writing op-eds, building a project website with archival materials, and organizing a conference on the “Black 1980s.”

This commitment to sharing historical knowledge with the public has long been part of Musgrove's approach to historical research and teaching. “Dr. Musgrove is a generous mentor and teacher and active in service to the history department, UMBC, and the greater community,” says **Amy Froide**, professor and chair of history.

“He does all this while teaching large undergraduate courses in African American and Civil Rights history and mentoring both graduate and undergraduate students,” Froide notes. “His scholarship, pedagogical ideas, and collegial service contribute so much to the history department and UMBC.”

D.C.'s place in history

This new work will also further Musgrove's

highly acclaimed research on African American history in the nation's capital, completed over the past decade.

In 2021, Musgrove created *Black Power in Washington, D.C., 1961 – 1998*, an interactive website that maps 185 major events and organizations of the Black Power movement and its resurgence in Washington, D.C. The project was in collaboration with UMBC's Imaging Research Center.

In 2017, Musgrove published *Chocolate City: A History of Race and Democracy in D.C.* (University of North Carolina Press) with co-author Chris Myers Asch. They launched the book at a special event at the National Museum of African American History and Culture. The book covers 400 years of race and democracy in Washington, D.C.

“*Chocolate City* established Dr. Musgrove as one of the leading scholars of Black and urban politics in the post-Civil Rights era,” says Froide. She notes the book has appealed to a wide audience, is being read in public schools, and has attracted the attention of political and policy leaders alike. “He is a consummate historian who is also a trusted voice for political and policy action.”

Musgrove is UMBC's second Carnegie Fellow, following historian **Kate Brown**, now a professor at MIT. She received a 2016 Carnegie Fellowship for nuclear disaster research.

– Catalina Sofia Dansberger Duque

Illuminating the History of Working from Home

Due to COVID-19, remote work has hit unprecedented highs, but **Elizabeth Patton**'s scholarship reveals that it's far from a new idea. Patton's book *Easy Living: The Rise of the Home Office* (2020, Rutgers University Press) explores how Americans think about the modern home office and why. Patton's book is a historical view of how marketing and popular media have shaped how mostly white, heterosexual, upper-middle-class families in the U.S. have talked about working from home.

"I was interested in learning about how people talked about working from home from the early 19th century to today," says Patton, associate professor of media and communication studies. "I wanted to understand how certain public figures, technology and real estate companies, film, and TV contributed to these conversations and shaped today's idea of working from home."

Patton's book comes at a time when many adults and children have had to shift their work and learning spaces from the public office and school to the home. This change has reopened questions about private and public work spaces



Elizabeth Patton. Inset, the cover of *Easy Living: The Rise of the Home Office*.

and work-life balance, as well as class, equity, and access.

"I'm always thinking about who is missing or left out in the conversation. I'm telling this history, but this history is not possible without depending on people of color and people

working in service jobs," explains Patton. "This is where class and race intersect. It is necessary to keep this idea of working from home going, even more so now with a pandemic."

— *Catalina Sofia Dansberger Duque*

Experimental Nonfiction: *Desire Lines* Centers Trans Voices

Filmmaker **Jules Rosskam**, assistant professor of visual arts at UMBC, received a Creative Capital award—one of the most sought-after prizes in the art world—to support production of his new feature film, *Desire Lines*.

Building on Rosskam's body of work devoted to examining liminal spaces—the margins inhabited by trans people and artists blurring boundaries in genre and method—*Desire Lines* explores the ways that trans men emerge into gay sexual attractions during transition and



Aden Hakimi (left as Ahmad) and Cyd Nova (as Stranger) in *Desire Lines*. Photo by Emilia Aghamirzai.

the ways that these narratives have historically been suppressed.

"Trans people, people of color, queer people, we are so often written out of history and [struggle] through those silences and institutions not feeling like our lives are worth documenting," Rosskam says.

Desire Lines centers its narrative on a gay-identified trans man seeking information on these hidden histories and begins the search by delving into researching archives.

"I typically describe my work as experimental nonfiction. I am almost always working in a hybrid space between fiction and nonfiction, because that to me feels very trans, and I think it's important in the work to unsettle that line," Rosskam shares.

Desire Lines is currently in production and is set to be released in early 2024.

— *Rabue Alexander, M.F.A. '21*



Behind the scenes, filming *Desire Lines*, Cyd Nova, Aden Hakimi, and Jules Rosskam (left to right). Photo by Emilia Aghamirzai.

Community-Building in Baltimore Through Public Humanities

Over the last decade **Nicole King**, professor of American studies and director of the Orser Center for the Study of Place, Community, and Culture, has worked with colleagues to develop public humanities research methods that address disconnections, misrepresentation, and inequalities in Baltimore City and in the classroom. King helps students actively listen to and partner with Baltimore communities in research to create multimedia narratives as a vehicle of community-building and advocacy.

“Place-based public history projects demonstrate that students and scholars can engage and collaborate with communities to identify, analyze, and respond to pressing social problems,” says King. “Public history methods can create dynamic social spaces in which scholars and residents work together to frame questions, conduct research, and preserve urban places.”

King’s work has reached a broad range of audiences, from an article on megadevelopment and community coalitions in *Urban Affairs* to media coverage of “A Place Called Poppleton.”

“We cannot forget the ‘public’ in public humanities”

—*Nicole King*

“A Place Called Poppleton”

In July 2022, Sonia and Curtis Eaddy celebrated as Baltimore’s mayor announced their home in the historic Poppleton neighborhood of West Baltimore, dating back to the late 1800s, would not be demolished for redevelopment as previously planned. Among those whom Sonia thanked for support were King and her students.

King originally connected with the Eaddy family through their son, Curtis Eaddy II, who shared his story as a third-generation Poppleton resident in 2019 for the “Baltimore Traces: West Baltimore” storytelling series. He became a strong partner in leading walking tours of West Baltimore through UMBC’s Baltimore Field School before interviewing his parents for “A Place Called Poppleton,” which King co-created in 2020 with students, residents, and **Bill Shewbridge**, media and communication studies professor of the practice.



In Poppleton (left to right): Nicole King and Curtis Eaddy II interview Curtis and Sonia Eaddy. Courtesy of Nicole King.

Students listened to residents who live, work, and are connected to Poppleton. They shared their voices through films, a digital walking tour and historical timeline, a zine, and a brochure.

The broader “Baltimore Traces” project, which began in 2015, brings together different disciplinary perspectives to explore the place-based social history of Baltimore’s

residents and changing neighborhoods. The series has produced the Telly Award-winning documentary *Mill Stories: Remembering Sparrows Point Steel*

Mill, the Baltimore Green Space podcasts, and the project “A Walk Down West Baltimore Street.” Laying the foundation for these projects were several radio segments produced by UMBC students.

“Getting out, showing up, listening to people, and meeting people where they are was so important to building [this] project,” King explains. “It’s something that organically grows to educate students...to do work that matters on the ground.”

Baltimore Field School

The Andrew W. Mellon Foundation awarded King \$125,000 to establish the Baltimore Field School in 2020, to enhance the visibility of communities in South and Southwest Baltimore. It works to build a national model of effective, ethical humanities research, teaching, and learning about Baltimore and cities like it.

In 2022, the American Council of Learned Societies awarded King; **Sarah Fouts**, assistant professor of American studies; and **Tahira Mahdi**, adjunct professor of psychology, a National Endowment for the Humanities-supported public engagement grant totaling more than \$150,000 for “Baltimore Field School 2.0.”

The team works with community members, graduate students, and faculty to continue to develop frameworks for ethical and sustainable community-engaged research between local communities and academia, around topics such as public information, racial equity, and food and land justice.

Baltimore’s past and future

These are some of the same core themes explored in *Baltimore Revisited* (2019), a contemporary anthology on the city’s complex history and efforts to address long-standing inequalities. King co-edited the book with long-time collaborators **Kate Drabinski**, principal lecturer of gender, women’s, + sexuality studies, and the University of Baltimore’s Joshua Clark Davis.

“We hope the book raises questions about how history can inform the present to understand the roots of the city’s many inequalities,” said Drabinski, when it was published. “We wish readers to imagine new ways of being in and organizing for Baltimore now and in the future.”

Thinking of the anthology and all that has followed it, King reflects, “We cannot forget the ‘public’ in public humanities.”

— *Catalina Sofia Dansberger Duque*



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