UMBC

2025 RESEARCH AND CREATIVE ACHIEVEMENT ANNUAL REPORT

Inquiring Minds

R1 DOCTORAL UNIVERSITY

Public Research for Public Good

Among top 100 public universities to receive federal research funding in the nation*

**See page 2 for more information*

caption

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ON THE COVER (LEFT TO RIGHT):

1. A live demonstration of the AI-augmented autonomous systems being developed in UMBC's Center for Real-time Distributed Sensing and Autonomy (CARDS), presented by CARDS faculty and student researchers at the 2024 GRIT-X event.

2. Prableen Chowdhary, a Ph.D. student in biological sciences professor Rachel Brewster's research group, who is studying the role of the NDRG1b protein in zebrafish.

3. Todd Pittman, Ph.D. '96, (left) , physics professor and director of UMBC's Quantum Science Institute, working with students in his optics lab.

4. Student dancers rehearsing in UMBC's Dance Cube. Photo by Kiirstn Pagan '11

All photos by Marlayna Demond '11 for UMBC, unless otherwise noted.

A WORD FROM UMBC'S VICE PRESIDENT FOR RESEARCH AND CREATIVE ACHIEVEMENT

At UMBC, our research and creative achievement (RCA) community focuses every day on addressing some of the world's most pressing challenges—and we are looking ahead to solve the problems of the future.

We are uniquely prepared for this work because everything we do is built on our inherent culture of inclusive excellence. Bringing together researchers from a variety of relevant disciplines and backgrounds ensures that we take a comprehensive and interdisciplinary approach to our work right from the start. We thrive on the opportunity for our work to have a direct impact on the communities we partner with by facilitating a deeper intercultural understanding through our arts and humanities scholarship and furthering our knowledge across a spectrum of science and engineering fields.

We are proud of our Carnegie R1 status, originally designated in 2022 and recently reconfirmed by the 2025 Carnegie Classification. UMBC is among just 187 institutions in the nation with this R1 classification and one of four such institutions in Maryland. In addition, UMBC is the only academic institution in Maryland that holds Carnegie classifications both as an R1 institution and as a Community Engaged institution. Our commitment to "Public Research for Public Good" has resulted in the university's research and development expenditures reaching an all-time record of $151 million in fiscal year 2024, an increase of 79 percent over the past four years.

For three decades, UMBC has strengthened its partnership with NASA, leading to the university's current standing as the 10th-ranked institution in the nation for funding from the agency. Additionally, we have been one of the top contributors of workforce talent to the National Security Agency, and in recent years have established three research centers in partnership with the Army Research Lab in Maryland and other Department of Defense laboratories. This past year has seen the formation of new institutes and centers focused on quantum science, artificial intelligence, and cybersecurity, providing a strengthened framework that brings together dozens of faculty members in each area with well-established expertise in conducting multidisciplinary research in these fields.

In 2024, we celebrated the 25th anniversary of UMBC's Social Sciences Forum, which has brought hundreds of distinguished social scientists and preeminent scholars to campus over the years. This past year, the university launched its Institute of Politics, building on our research strengths in civic participation and democratic governance, and established the Center for Ethics and Values, which hosts prominent forums on ethical issues in contemporary society.

These initiatives—both well-established and new—wouldn't be possible without the strong and dedicated leadership of our faculty members as we continue to attract the next generation of faculty to our community each year. UMBC's early career faculty continue to thrive, with 50 colleagues having received prestigious NSF CAREER Awards, including 11 in the past five years alone—a confirmation of both the outstanding quality of our faculty members and the strong mentoring culture across our departments and colleges. Our students are an integral part of our research culture, working side-by-side with researchers at every level as they prepare for future academic and professional endeavors. Together, we are well positioned to meet the challenges and opportunities that lie ahead.

We look forward to welcoming you to UMBC.

Karl V. Steiner
Vice President, Division of Research and Creative Achievement

By the Numbers

Who We Are

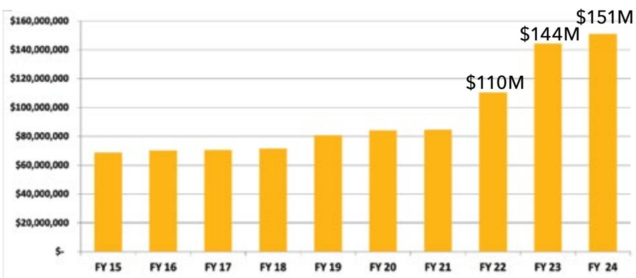
UMBC is home to 835 full-time faculty and 424 part-time faculty conducting instructional and research activities.

13,906
Total enrollment*
** As of fall 2024*

3,139
Graduate students

90+
Countries represented

Annual HERD R&D Expenditures



UMBC's HERD expenditures have increased by 37 percent over the past two years.

UMBC's National Rankings

According to the National Science Foundation's Higher Education Research and Development (HERD) survey, in fiscal year 2023, UMBC was ranked:

#10
nationally in NASA funding

#20
in federal support for geosciences, atmospheric sciences, and ocean sciences

#44
in federal support for social sciences

#53
in federal support for computer and information sciences

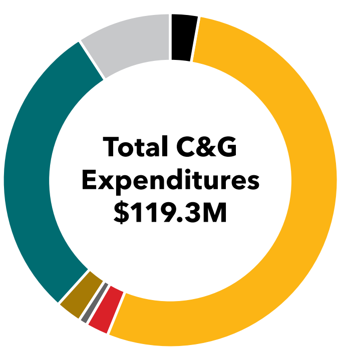
#55
in federal support for physical sciences

#96
in federal R&D expenditures among public institutions

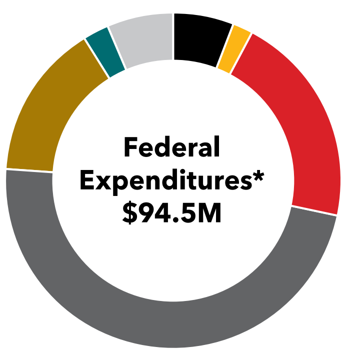
#112
in overall R&D expenditures among public institutions

Campus wide annual extramural research and development (R&D) expenditures reached an all-time record of $151 million in fiscal year 2024.

Who Funds Research and Creative Achievement at UMBC?



Corporate	$5,455,759
Federal	$62,551,594
Foundation	$2,269,146
Local	$973,849
Private	$3,153,305
State	$35,181,298
University	$9,638,841



DOD	$7,033,574
DOE	$1,904,756
HHS	$20,315,930
NASA	$41,726,445
NSF	$15,400,281
USDA	$2,789,353
Other Federal	$5,324,579

**by original funding source*

Big News

In 2024, UMBC saw advancement in its research and creative achievement activity across all disciplines. Take a look at a selection of big news from the year that exemplifies UMBC's mission of producing "Public Research for Public Good."

Soaring to New Heights with NASA

UMBC GOES TO THE MOON

One of the first three lunar instruments chosen for implementation and deployment in NASA's forthcoming Artemis III mission—humanity's first return to the lunar surface in more than 50 years—is being led by planetary scientist **Mehdi Benna** of UMBC's Center for Space Sciences and Technology. Benna's team is designing the Lunar Environment Monitoring Station (LEMS) to carry out continuous, long-term monitoring of seismic activity, namely ground motion from moonquakes in the lunar south polar region.

(LEFT) Mehdi Benna, planetary scientist with the Center for Space Sciences and Technology, stands near NASA's Dissipation sounding rocket. Benna led the team behind the development of Dissipation, which launched into space in November 2023. (Photo courtesy of Danielle Johnson/NASA Wallops Flight Facility)

DELIVERING DATA FROM SPACE

Designed and built by UMBC scientists, engineers, and students, the Hyper-Angular Rainbow Polarimeter (HARP2) wide-angle imaging polarimeter instrument is currently orbiting Earth on board NASA's Plankton, Aerosol, Cloud, ocean Ecosystem (PACE) satellite. In April 2024, the instrument's "first light" data was released for public access. The instrument is collecting data on air pollution, the effect of aerosols produced by humans on cloud formation, and the energy balance of the planet.

$47M INVESTMENT FOR EARTH SCIENCE CENTER

Scientists and engineers working in UMBC's Goddard Earth Science Technology and Research (GESTAR) II center are actively uncovering new understandings of how planet Earth works. The center, in partnership with NASA's Goddard Space Flight Center (GSFC), supports the development and operation of scientific instrumentations for ground-based, suborbital, and space missions that support NASA's strategic goals and earth science mission objectives while training graduate students and early-career faculty. GESTAR II was awarded a two-year, $47 million extension in 2024 to continue its cooperative agreement with the GSFC. Since launching in 2021, GESTAR II has employed more than 150 scientists who are distributed across nearly all of GSFC's earth science division laboratories.

Leading the Cyber Revolution

In 2024, UMBC continued to invest in interdisciplinary scholarship that addresses the present and future of the digital revolution with newly established and expanded institutes and centers. From tackling the evolution of artificial intelligence applications to understanding the power of quantum science, faculty and students across disciplines are taking on some of the most pressing issues in cyberspace.

ADVANCING AI SCHOLARSHIP

The Center for Artificial Intelligence supports and promotes communities conducting research, application, and education in all areas of AI. This interdisciplinary center includes more than 60 faculty members with research interests in AI and related areas such as robotics, machine learning, natural language understanding, data science, image processing, large language models, and more.

A POWERHOUSE IN CYBER DEFENSE

The UMBC Cybersecurity Institute (UCI) encompasses interdisciplinary research, innovation, and public outreach in cybersecurity. The institute's leadership and faculty are actively engaged with government, industry and academic organizations providing cybersecurity expertise across a range of related areas such as secure voting, encryption, privacy-preserving technologies, AI, hardware and systems security, and more. UMBC is one of the few universities in the country designated both a National Center of Academic Excellence in Cyber Defense and a National Center of Academic Excellence in Cyber Research by the National Security Agency.

BUILDING A QUANTUM-READY WORKFORCE

The Quantum Science Institute (QSI) is a cutting-edge research and education center with a science-first approach to quantum research. The center includes faculty and students across four academic departments at UMBC with a dedication to growing and diversifying the quantum-ready workforce. QSI was founded in late 2024 with support from the National Institute of Standards and Technology.

(TOP) Don Engel, assistant professor of computer science and electrical engineering, leads a demonstration in front of the Pi Squared immersive visualization wall in UMBC's PI^2 Immersive Hybrid Reality Lab.

(BOTTOM) UMBC students in the American voting behavior class conduct the Institute of Politics' Battleground Exit Poll during the 2024 election.

A Hub for Political Analysis

In fall 2024, the university launched the Institute of Politics, an academic, political research, and public outreach center that harnesses UMBC's research capacity and civic-focused public mission to provide a regional base for local, state, and national political analysis. Led by Director **Mileah K. Kromer**, the institute's inaugural poll surveyed residents and voters in the Baltimore metro region and statewide, and gauged the attitudes of Maryland adults and voters on topics such as job approval ratings for Maryland Governor Wes Moore, key economic indicators, and issues and reasons driving voter choices. The poll was covered widely in state and national news outlets, including the *New York Times*, *Baltimore Sun*, the *Washington Post*, and *Fox News*.

NIH-SUPPORTED BIOMEDICAL RESEARCH

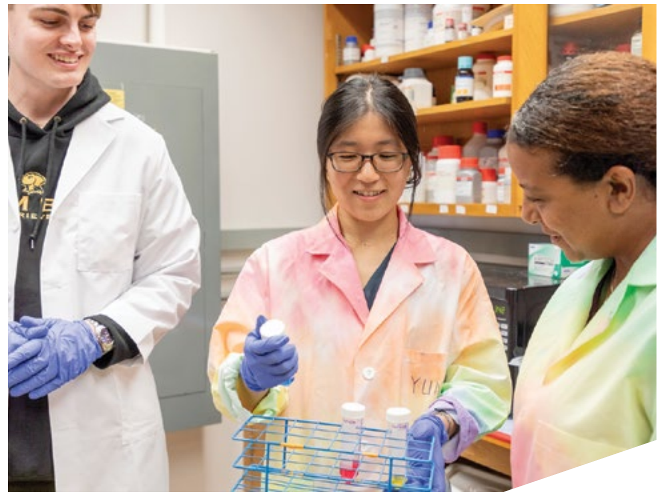
This past year, several UMBC professors who received their first National Institutes of Health (NIH) R01 awards are advancing the university's biomedical footprint through research efforts and student mentoring. Biological sciences professor **Rachel Brewster's** funding will support her research into how organisms adapt to oxygen deprivation. Associate professor of information systems **Ian Stockwell** is partnering with a major Medicaid health plan to build a machine-learning-powered system to help identify patients with social needs that impact an individual's ability to maintain their health. Assistant Professor **Laurie Sutton** in biological sciences is identifying intracellular signaling events activated by the kappa opioid receptor, which affects many physiological processes, including mood, pain, and inflammation. The NIH R01 awards will support the recipients' work for up to five years.

(TOP) Biological sciences professor Rachel Brewster assists student researchers Gabriel Otubu and Felix Rene Siewe in her lab. Otubu and Siewe are senior biochemistry and molecular biology majors.

(RIGHT) Information systems professor Ian Stockwell speaks at a UMBC seminar on healthcare.

Our Partnerships

Our partnerships are designed to ignite student enthusiasm for various industries, develop inventive career pathways, strengthen our support of regional communities, and foster research and commercialization efforts.

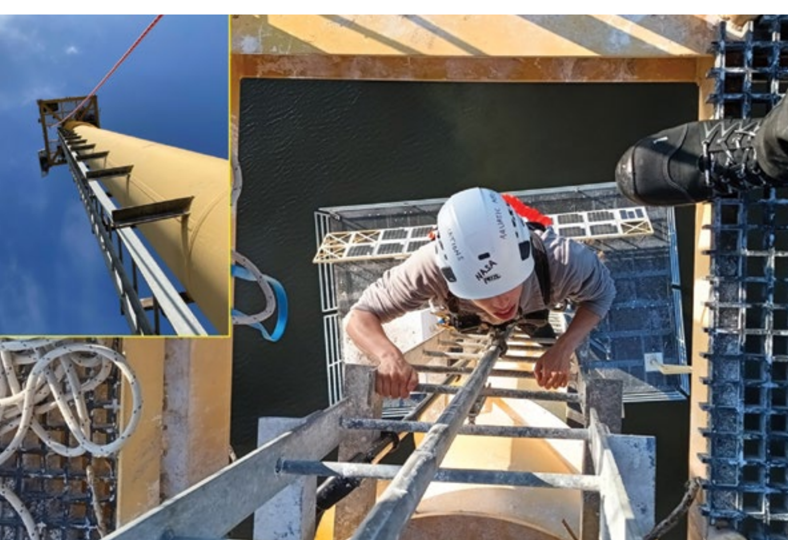


Monitoring the Chesapeake Bay

Climbing 30-meter ladders and avoiding osprey nests might not sound like typical activities for scientists who usually work with equations and models—but it's all in a day's work for **Kevin Turpie's** team. Turpie, an associate research professor with the university's GESTAR II center *(see page 3)*, along with an international group of scientists and engineers from UMBC, NASA, the Royal Belgian Institute of Natural Sciences, and the Vlaams Instituut voor de Zee, worked to install, monitor, and repair the Pan-and-Tilt Hyperspectral Radiometer (PANTHYR) instrument on top of a Coast Guard navigation tower in the Chesapeake Bay to measure water quality and environmental and ecological conditions in the Upper Chesapeake Bay.

(TOP) Ph.D. candidates Luke Mason and Winny Sun, and Maki Negesse, Ph.D. '24, biological sciences, work together in associate professor of biological sciences Erin Green's lab.

(BELOW) The upper platform of the tower that houses the Chesapeake Bay PANTHYR instrument is accessed using a ladder with a safety rail and specialized climbing gear. The inset shows the ladder system looking from the lower platform. (Photo courtesy of Dieter Vansteenwegen, VLIZ, and inset courtesy of Kevin Turpie, GESTAR/UMBC).



Biotech Industry Training with Genentech

UMBC doctoral students are reaping the benefits of an innovative partnership between UMBC and biotech leader Genentech. Each year during this five-year agreement, Genentech fully funds two life science Ph.D. candidates in the Meyerhoff Graduate Fellows Program who are progressing well through their doctoral work and are interested in pursuing a career in industry. Selected students continue their thesis work with their Ph.D. advisors during the academic year and then spend the summer as research interns at Genentech headquarters in South San Francisco, California.

"My experience at Genentech has strengthened my desire to pursue a career in biotech companies."

– Maki Negesse (pictured above, on the right) Ph.D. '24, biological sciences

STEM Makerspaces for Baltimore City Youth

Foad Hamidi, assistant professor of information systems, was awarded funding from the National Science Foundation to develop two projects offering technology-rich informal learning opportunities to diverse populations in Baltimore. The "Space for All" project, in collaboration with the Digital Harbor Foundation, will include creating accessible and engaging STEM learning spaces for young people with autism in communities throughout Baltimore City. The "Introducing Synthetic Biology Using Biomaker Activities" project will work with children and their families to co-design activities that support their STEM learning and engagement. The project is a collaboration with the University of Texas at El Paso, Baltimore Underground Science Space, and the education evaluation firm MN Associates.

Discover our centers and institutes fostering research innovation at UMBC and beyond our campus: **research.umbc.edu/research-centers-institutes**.

(LEFT) Information systems professor Foad Hamidi in his lab. (Photo by Britney Clause)

SUPPORT FOR EARLY-CAREER FACULTY

In 2022, the College of Natural and Mathematical Sciences (CNMS) and the University of Maryland School of Medicine received a five-year grant from the NIH to enhance the recruitment and training of junior faculty in biomedical science. In 2024, four faculty members joined CNMS as part of the initiative. Incoming faculty cohort includes, from left to right: Cheng-Yu Li, Jose Lemme, Gretchen Alicea, Carmen Muñoz-Ballester, Diana Elizondo, Ashira Blazer, and Amed Outtara. Li, Alicea, Muñoz-Ballester, and Elizondo are at UMBC. (Photo by Melissa Penley Cormier, M.F.A. '17, for UMBC)

Impact

Beyond the classroom, UMBC's research impact is addressing societal challenges, empowering underrepresented communities, advancing economic growth, and challenging cultural values and social assumptions.

(TOP) Fae Switzer, a student in UMBC's Translational Life Science Technology program, works at the microscope with guidance from her mentor, Emma Todd, at the biotech company ATCC.

(RIGHT) Information systems professor Karen Chen (center) talks with students, from left to right: Yetunde Okueso, Kara Nguyen, Joy Ware, and Kavin Manivannan

Hospital Price Transparency for All

In early 2024, the Hilltop Institute at UMBC introduced its Price Transparency State Profiles, an innovative public resource offering centralized access to hospital pricing data as well as links to state laws on hospital price transparency. Established in 1994, Hilltop was one of the first partnerships formed between a public university and a state Medicaid agency. Today, Hilltop and the Maryland Department of Health collaborate to conduct objective, evidence-based research and analysis to inform state health policy. Hilltop was instrumental in the 1997 launch of HealthChoice, Maryland's Medicaid-managed care program. The institute continues to carry out rate setting and actuarial responsibilities for HealthChoice, which currently enrolls 1.1 million Marylanders.

Redesigning Learning Analytics Data

Lujie Karen Chen, assistant professor of information systems, has made learning analytics a pillar of her research. She's advancing her work in using data to improve people's lives as a 2024 recipient of the National Science Foundation's CAREER Award. Chen is leading a project that puts students at the center of learning analytics—not just as subjects who supply data, but also as the designers of analytical tools and users of the insights they provide. Under Chen's guidance, students will collect data about their daily lives, such as how much sleep and exercise they get, how much time they spend talking to friends and family, how stressed they are feeling, and more. They'll also gather information related to their classes and work through data science activities, analyzing the information they gathered and seeing if they can gain insights to improve their well-being and academic success.

AI and Digital Twin Models in Healthcare

UMBC researchers are taking a closer look into how artificial intelligence and digital twinning technology can be used to treat and diagnose neurodegenerative diseases with a study led by **Snigdhansu (Ansu) Chatterjee**, professor of mathematics and statistics, **Karuna Joshi**, professor of information systems, and **Animikh Biswas**, professor and chair of mathematics and statistics. The investigators were awarded a grant from the NSF's Foundations for Digital Twins as Catalyzers of Biomedical Technological Innovation (FDT-BioTech) program to develop responsive and ethical digital twin models that incorporate the abilities of artificial intelligence.

Experiential Learning in Public Service

The Maryland Public Service Scholars program (MPSS), a 12-week summer fellowship program funded by the state of Maryland and administered by the Shriver Center at UMBC, is providing students the opportunity to develop as future leaders in the state's public and social sectors with hands-on experience, mentorship, and training. The latest cohort of MPSS fellows were paired with state agencies such as the Maryland Transit Administration, the Maryland Office of the Secretary of State, the Governor's Office of Crime Prevention and Policy, and the Maryland Department of Health in preparation for public service careers across the state.

2024 Maryland Public Service Scholars and undergraduate students Patricia Mengue Bindjeme and Dionne Cole.

"The public service sector truly is limitless and it affords any individual the opportunity to make a difference in their own way."

– Dionne Cole, biology and social work senior, a 2024 Maryland Public Service Scholars Program fellow

NEH Fellowships on the Rise

Noor Zaidi, assistant professor of history, received a National Endowment for the Humanities (NEH) fellowship to research and write *Translations of Zaynab: Gender, Sectarianism, and Citizenship in Shi'a Islam*. The book will analyze how Zaynab bint Ali, a seventh-century figure and granddaughter of the Prophet Muhammed, has been used in 20th-century political contexts. Since 2010, UMBC faculty have received nearly a dozen highly competitive NEH Fellowships and awards, including five fellowships within the past five years.

Review a selection of prestigious awards and fellowships secured by UMBC faculty by visiting **research.umbc.edu/honors-and-awards**.

Visual arts professor Kelley Bell (right, standing) and her art students pose in front of the installation of Bell's "Enchanted Jangle" project at Area 405 Gallery in Baltimore City. Pictured from top left, clockwise: Petra Janka, Yurice Lee, Kelley Bell, Kayla Moore, and Jalen Boyd. (Photo courtesy of Bell)

Inquiring Minds Spotlights

UMBC is continuing to build a robust research culture by integrating research and creative achievements into departmental and institutional priorities while providing our students with opportunities to explore and address some of today's most pressing societal questions. Here's a snapshot of our community's recent research and creative accomplishments.

Kelley Bell, M.F.A. '06, associate professor of visual arts, was awarded a 2024 Baker Artist Award, receiving the $10,000 Mary Sawyers Baker Prize. The Baker Artist program was created to support artists and promote greater Baltimore as a strong creative community.

Tamara Bhalla, associate professor of American studies and director of the Asian American studies minor, and **Kimberly Moffitt**, dean of the College of Arts, Humanities, and Social Sciences (CAHSS), were awarded a $750,000 grant from the Mellon Foundation to establish the Global Asias Initiative. The initiative will support the rethinking of Asian American issues on campus.

Lee Blaney, professor of chemical, biochemical, and environmental engineering, received funding from the Department of Defense's Strategic Environmental Research and Development Program to develop new ways to remove substances known as "forever chemicals" from water.

Ryan Bloom, senior lecturer in English, received a 2024 Guggenheim Fellowship for translation to work on the first complete edition of the French Algerian author Albert Camus' notebooks, journals, and other works. Bloom has been translating Camus' work for more than a decade.

Lee Blaney (left), professor of chemical, biochemical, and environmental engineering, works alongside student researchers in his lab.

Adi Foord, assistant professor of physics, and **Eileen Meyer**, associate professor of physics, are part of the team that was selected to further develop their proposed instrument design for NASA's Advanced X-ray Imaging Satellite (AXIS) space telescope. The AXIS team was one of two teams selected to flesh out their plans as part of NASA's "Phase A study." During the proposal development phase, Foord co-led the sub-team focused on supermassive black hole evolution.

Linda Dusman, professor of music, was awarded the International Alliance for Women in Music's Miriam Gideon Prize for her composition "Triptych of Gossips," a setting of the eponymous poem by Serena Hilsinger. The recording that accompanied the submission included **Airi Yoshioka**, professor of music, and collaborator Susan Botti.

Nardos Amanuel Kebede, a senior political science major, was selected to receive the Charles B. Rangel International Affairs Graduate Fellowship, providing Kebede with funding to complete a two-year master's degree in international affairs. Kedebe will then have a five-year appointment as an officer in the Foreign Service of the U.S. Department of State.

Curtis Menyuk, professor of computer science and electrical engineering, won the 2024 SPIE G.G. Stokes Award in Optical Polarization. The award honors Menyuk's pioneering work in the 1980s, developing equations to describe how light propagates through optical fibers, as well as his ongoing contributions to the fields of optics and photonics.

(RIGHT) English professor Earl Brooks holds a copy of his book, "On Rhetoric and Black Music" (Wayne State University Press, 2024)

(BELOW) Researchers in UMBC's Center for Navigation, Timing, and Frequency Research (CENTAUR), led by Curtis Menyuk, review data on equipment used to study photonic components. From left to right: Graduate student Logan Courtright, professors of computer science and electrical engineering Curtis Menyuk and Gary Carter, and research associate Alioune Niang.

Earl Brooks, professor of English, investigates how Black musicians like Duke Ellington and Mahalia Jackson shaped political and social discourse in the 19th and 20th centuries in his debut book *On Rhetoric and Black Music* (Wayne State University Press, 2024).

Molly Mollica, assistant professor of mechanical engineering, was a recipient of an American Heart Association Career Development Award. Mollica studies the biomechanics of blood platelets, which play an essential role in healthy blood clotting. The award will support investigations on how platelets from males versus females, and donors with varying hormone levels, respond to and generate mechanical forces.

Rebecca Schacht, assistant professor of psychology, was awarded funding from the NIH's National Institute of Drug Abuse to develop and test an adapted version of Written Exposure Therapy as a possible treatment option for individuals living with post-traumatic stress disorder and opioid use disorder in residential care facilities.

Access all of UMBC's research and creative achievement news stories by visiting **umbc.edu/news-home**.

UMBC

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