

2026 RESEARCH AND CREATIVE ACHIEVEMENT ANNUAL REPORT

Inquiring Minds



UMBC



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ON THE COVER:

Clockwise from upper left: To discover the building blocks of hand movements, researchers are looking to classical Indian dance for inspiration; Philip Mann conducts UMBC’s Symphony Orchestra; Researchers work in UMBC’s Observatory, one of the largest optical telescopes on the east coast; UMBC’s new \$1M Cyber Range opens doors to discovery.

Inside cover: Members of the SAE Baja Racing Team test drive the car designed and built by the team.



A word from UMBC’s Vice President for Research and Creative Achievement

Every time I enter the UMBC campus, I am inspired by the impact our researchers make in the world on a daily basis. Even as the research landscape shifts around us, they continue to put their full hearts and minds into the work because—as our motto states—we believe deeply in our mission of “public research for public good.”

The big challenges we seek to address through our research remain, no matter the state of the budget. And so, as we push forward with our work, I cannot help but take a moment to appreciate some of the things that make our research enterprise unique. It’s not just about what we accomplish—it’s how we do it at UMBC that I find so special.

For instance, UMBC is proud to hold both Carnegie R1 status—placing us among the top five percent of research universities in the nation—and the Carnegie Community Engagement classification. This designation recognizes universities who systematically share knowledge and resources with those of the public and private sectors to enrich scholarship, research, and creative activity in order to contribute to the public good. This combination of national designations perfectly illustrates the common purpose behind everything we do.

UMBC is also leading at local and international levels in key areas that affect all of us: environmental research that seeks to protect common resources like water and air; technology development at the forefront of AI and quantum technology that builds in ethical guidelines along the way; and engagement across disciplines to build an inclusive community. These areas of emphasis are integral to UMBC’s mission and vision and are essential for the mutual flourishing of our nation and of humankind.

UMBC takes a truly cross-disciplinary approach to research, as you will see throughout this annual report. That means bringing researchers together from different disciplines to explore questions in new ways while also living up to our university’s mission of inclusive excellence by creating welcoming spaces for the next generation of researchers. Inviting new perspectives makes all of our work stronger.

As you read today, you will find the impact of UMBC’s research to be as impressive as ever. I hope you will begin to understand what gets me so excited to come to work each day—the unbounded energy that comes from big ideas, caring collaboration, and a mission to serve our community and planet. We are up for the challenge!

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

By the Numbers

Who We Are

UMBC is home to 594 full-time faculty and 391 part-time faculty conducting instructional and research activities.

13,530

Total enrollment*
*As of Fall 2025

11,087

Undergraduate students

2,443

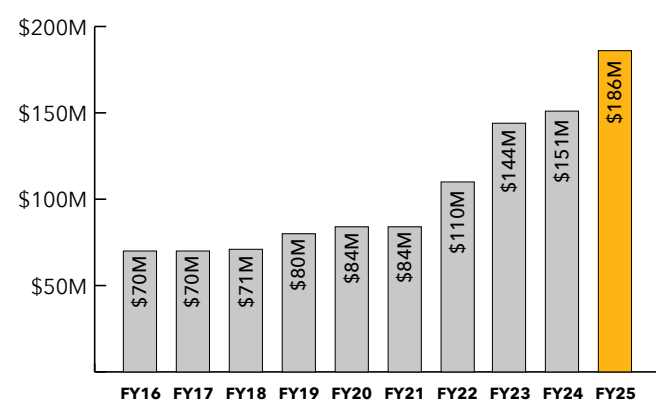
Graduate students

90+

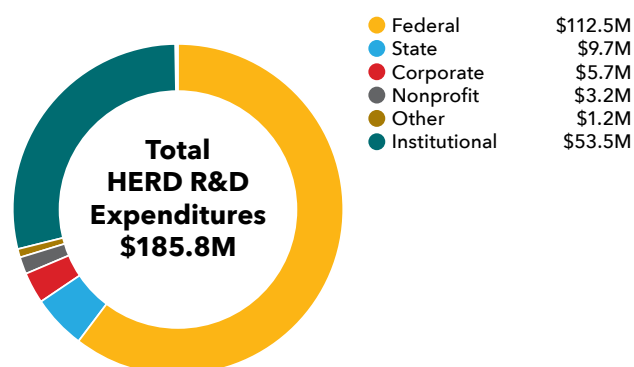
Countries represented

Annual HERD R&D Expenditures

UMBC's HERD expenditures have increased by over \$100M (120%) over the past four years.



Who Funds Research and Creative Achievement at UMBC?



UMBC's National Rankings

According to the National Science Foundation's Higher Education Research and Development (HERD) survey, in fiscal year 2024, UMBC was ranked:

#11

nationally in
NASA funding

#33

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

#50

in federal support for
social sciences

#55

in federal support
for computer and
information sciences

#75

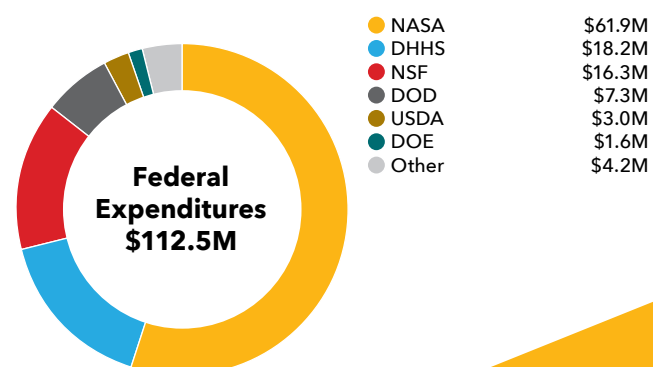
in federal support for
physical sciences

#93

in annual
USDA funding

#99

in federal R&D
expenditures among
public institutions



Up for the Challenge: Environment

In an era of evolving environmental challenges—shifting weather patterns, stressed ecosystems, and the need for sustainable growth—UMBC researchers are delivering practical, data-driven solutions that protect natural resources and strengthen communities.

Their work spans continents and disciplines: high-resolution stream mapping that will guide targeted watershed restoration, NASA satellite data revealing global plant health to inform agriculture and carbon management, refining forecasts that help communities brace for extreme weather, and building more resilient disaster-response systems with federal partners.

Through immersive digital exhibits, campus sustainability projects, and collaborations that reach from the Chesapeake Bay to the Himalayas, these efforts deliver cleaner water, more reliable food systems, reduced emissions, earlier warnings, and much more—all contributing to a broader public understanding of our changing world and securing a healthier environment for generations ahead.



"The Polar Ice Museum: From Greenland to South Baltimore," a 3-D rendering of an installation by the Imaging Research Center in collaboration with iHARP, 2025. Courtesy of the IRC.

Virtual Visit to the North Pole ▲

Visitors to a new art exhibit at UMBC might feel a chill, not just from the walls of ice that seem to surround them, but also from the images of a coastal Maryland town submerged in flood water. The art illustrates the vital work of **Vandana Janeja**, Information Systems, and other UMBC researchers at the NSF-funded Institute for Harnessing Data and Model Revolution in the Polar Regions (iHARP), who seek to better predict when polar ice will melt.

Improving Management of Common Resources

Sustainable management of common-pool resources (CPRs) such as water, forests, clean air, and fisheries is a growing global concern. All over the world, local communities manage CPRs, but despite decades of observational studies, it is unclear what features determine successful local CPR governance models. **Maria Bernedo Del Carpio**, Economics, has made headway on this challenge in an ongoing field experiment to isolate one feature of local CPR governance: externally supported, technology-facilitated community monitoring.



PREPPING FOR DISASTER RESPONSE ▲

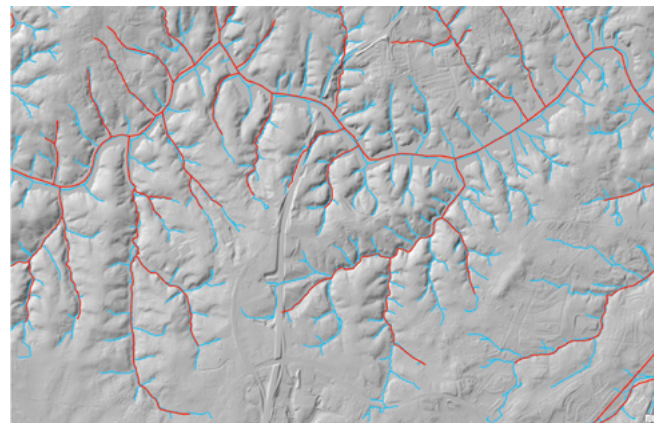
Hurricanes in the Caribbean are not only occurring more frequently; the time between major storms is now shorter than the time required for a full recovery, says **Farah Nibbs**, Public Policy and Emergency and Disaster Health Systems, who studies the intersection of critical infrastructure and disasters. **Ming Xie**, Physics, who contributes research on vulnerable communities' disaster preparedness and resilience, asks how states could manage catastrophic events without the assistance of FEMA.

TREE SAP BATTERIES

Samuel Bendek, a mechanical engineering student at UMBC, used to work at a soccer ball company in his native Colombia. The experience got Bendek thinking—what if rubber could store more than the energy of a soccer player's kick? What if it could store energy from the sun and wind? In early 2025, the first-ever Pava LaPere Innovation Awards granted funding for Bendek's company, Elastic Energy, to address his entrepreneurial question and further its development of a mechanical battery made from natural rubber.

New Map Doubles the Data ▼

A new set of AI-powered stream maps developed by **Matthew Baker**, Geography and Environmental Systems, and alumni at the EPA and Chesapeake Conservancy more than doubled documented stream miles in the Chesapeake Bay Watershed, dramatically reducing the cost and time required for stream mapping at the same time. This breakthrough empowers stakeholders to effectively target restoration efforts across six states.



From Nepal to NASA ►

Greema Regmi's passion for atmospheric physics took root in her mountainous home country of Nepal. Her Ph.D. research aims to improve climate models by refining how atmospheric dust is accounted for. Her work uses a more realistic model of dust particles' shape, which affects how much heat they reflect back to space. Now supported by NASA's prestigious FINESST fellowship, her improved climate models could inform climate resilience and mitigation decision-making.

Tracking Global Plant Health

A novel method for assessing global plant health leverages satellite data from NASA's PACE mission to monitor plant responses to environmental changes like water availability and temperature. Led by **Fred Huemrich**, Goddard Earth Sciences Technology and Research II (GESTAR II), the research will enhance carbon sequestration tracking and early stress detection, offering a cost-effective way to monitor global ecosystems and support conservation and agriculture.

The Environment Is for Everyone

With an emphasis on engaged community input, Geography and Environmental Systems professor **Dawn Biehler's** research in Baltimore includes work with local organizations about environmental justice, green space, housing and food justice, mosquito ecology, and the local effects of climate change. Her most recent book, *Animating Central Park: A Multispecies History*, tells the story of how non-human animals, in relationship with diverse human communities, struggled over public green space in New York City.

Going Green Starts at Home

UMBC is making changes on campus to address a variety of environmental challenges. Organized by the Office of Sustainability, a recent \$1.2M Maryland Energy Administration grant is powering solar installations, invasive species are being removed, and a clean energy master plan is in effect to cut emissions.



Understanding Our Beginnings

Kevin Omland, Biological Sciences, has spent 25 years teaching and researching evolution. In his new book, *Understanding the Tree of Life*, published by Cambridge University Press, Omland challenges what he views as an outdated understanding of evolution and celebrates the interconnectedness of all species. The book surveys the tree of life, including everything from primates to invertebrates, challenging outdated concepts like "primitive" species.



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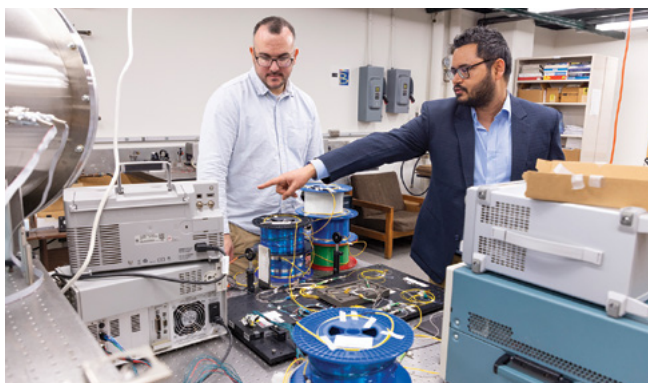
Up for the Challenge: Harnessing Tech

UMBC researchers are at the forefront of today's rapid technological change. They navigate the promises and pitfalls of new technology—pioneering innovations to meet pressing challenges, while keeping on guard for the unintended negative consequences of new tools. UMBC gathers experts in robotics, artificial intelligence, sensors, photonics, quantum technologies, and more.

Researchers reach across disciplines to collaborate on projects such as harnessing AI to turbocharge the engine of scientific discovery and exploring how concepts from dance can improve the way robots move. As society accelerates into the sometimes unnerving technological landscape of tomorrow, the university offers expertise grounded in its public-serving mission.

Detangling Quantum ▼

UMBC's Quantum Science Institute, led by **Todd Pittman**, Physics, and fueled by a \$1.5M NIST grant, brings together faculty and students in mathematics, physics, computer science, and more for quantum research and education. From pioneering entanglement-dependent ghost imaging in 1995, to modeling unpredictable train schedules with quantum devices in 2025, UMBC is empowering knowledge breakthroughs and training a diverse, quantum-ready workforce. Below: Recent Ph.D. graduates from **Yanhua Shih's** lab in Physics (left-right) **Tom Smith** and **Binod Joshi**.



Don't Knock Wood

UMBC's Center for Advanced Sensor Technology, under the leadership of **Govind Rao**, Chemical, Biochemical, and Environmental Engineering, recently debuted a new environmental sensor made out of simple balsa wood sheets. Choosing wood served two purposes: making the sensor low-cost and also environmentally friendly. The inexpensive sensors detect nitrate levels with an accuracy comparable to standard devices on the market that cost many times more.

Meet the AI Scientists

With the launch of UMBC's new Center for AI, led by **Tim Finin**, Computer Science and Electrical Engineering, UMBC researchers across disciplines are turning to AI to improve the process of science itself. Computer scientists, chemical engineers, and physicists are all building tools to navigate the vast body of scientific literature, assess the feasibility of scientific claims, write error-free and up-to-date code for scientific computing, and more.

Harnessing Light for Navigation

Every day, radio signals from GPS satellites help millions of people figure out what time it is and where they are. Yet the system is vulnerable to disruptions and attacks and does not penetrate water, which covers about 70 percent of the planet. **Curtis Menyuk**, Computer Science and Electrical Engineering, and his team in the Center for Navigation, Timing and Frequency Research are working to develop alternative, light-based timing and navigation technologies.



Guarding 'Smart Factories' Against Cyberattacks ▲

UMBC has installed and is operating one of the first cyber ranges in the country focused on ensuring that manufacturing facilities—which are increasingly reliant on robotics and computer control systems—are digitally secure. As an innovator in cybersecurity education and research, UMBC provides faculty, students, and researchers access to a variety of technical platforms that support the university's mission in this critical industry discipline. The Center for Research in Emergent Manufacturing (CREM), directed by **Nilanjan Banerjee**, Computer Science and Electrical Engineering, has trained hundreds of small and medium-sized manufacturers in cybersecurity and is helping lead the nation's transition to a more productive manufacturing landscape shaped by technologies such as smart sensors, AI, cloud computing, and advanced analytics.

Preventing Type 2 Diabetes ▼

Doctoral students **Ashley Splain** and **Sumaiya DeLane**, working with researcher **Tasneem Khambaty**, Psychology, are leading one of the first research studies to use continuous glucose monitoring technology to investigate the precise associations between low and high glucose levels, cognitive function, and key Alzheimer's disease biomarkers in middle-age and older adults at risk for type 2 diabetes.





Next Level Robotics ▲

In UMBC's Center for Real-time Distributed Sensing and Autonomy (CARDS), teams are performing cutting-edge research in robotics and AI, demonstrating their transformative impact across a variety of complex scenarios, including providing crucial support in rescue operations and Human-Robot teaming. By enhancing decision-making capabilities, **Aryya Gangopadhyay**, Information Systems, and team are paving the way for more robust and independent systems that can adapt to and manage complex tasks with minimal human oversight.



INVESTING IN CYBERSECURITY ◀

UMBC's Cybersecurity Institute (UCI) continues to lead the way with its interdisciplinary approach, hiring nine new faculty into seven departments over the last two years. Through the institute, UMBC is one of the few universities in the United States designated a National Center of Academic Excellence both in Cyber Defense (CAE-CD) and Cyber Research (CAE-R) by the National Security Agency.

Going to the Moon ▶

President **Valerie Sheares Ashby** (left) visited NASA to learn more about the Lunar Environment Monitoring Station (LEMS) led by planetary scientist **Mehdi Benna** (right) of UMBC's Center for Space Sciences and Technology. LEMS was selected as one of the first three candidate payloads to be a part of Artemis III, NASA's mission that will send astronauts to explore the region near the lunar South Pole. They were hosted by **Cynthia Simmons**, NASA Goddard Acting Director (center). Inset: The completed LEMS instrument ready for deployment.

Robots You Can Talk To

Cynthia Matuszek, Computer Science and Electrical Engineering, is working to build robots that everyday people can instruct, control, and interact with intuitively and naturally. The robots will understand spoken language and be able to learn new concepts, such as how to dice a vegetable, after a human demonstrates. Such robots, Matuszek suggests, might help fill the huge unmet demand for caregivers to assist people as they age.

Powering Underwater Sensors with Phytoplankton

Right now, a vast network of underwater sensing devices in oceans around the world conducts environmental monitoring and supports national security—and most of these devices rely on batteries and underwater cables for power. **Kevin Sowers**, Marine Biotechnology, is developing biologically-powered underwater sensors, work supported along with other projects by \$7.8 million from the Defense Advanced Research Projects Agency. Sowers is leading the development of a testing environment for the devices at the Institute of Marine and Environmental Technology in Baltimore.



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Up for the Challenge: Community

Community at UMBC is a vibrant network of intersecting groups that exemplify the Retriever spirit in every setting—whether online, in the kitchen or the classroom, in the lab, or throughout Baltimore and beyond. Named again this year as a Carnegie Community Engaged campus, UMBC has been recognized as an institution that promotes the mutually beneficial exchange of knowledge and resources in a context of partnership and reciprocity.

Together, we learn about ourselves, each other, what we value, and the challenges we all face. Then we take bold steps forward together—to create knowledge that moves hearts, minds, and bodies through collaboration, compassion, and discovery.

Rebuilding Key Bridge ▼

Retrievers have a role to play in rebuilding Baltimore's Francis Scott Key Bridge. This past summer, students **Cristian Mena**, **William McConnell**, and **Emily DiMarzio** worked on the bridge rebuilding project as interns with the Maryland Transportation Authority and got hands-on experience in project management, environmental analysis, construction oversight, and community outreach. "It hurt when the bridge went down," says McConnell, who grew up in Baltimore. "So when the opportunity came along to apply for this internship, I jumped on it."



Sharing the Stage ▼

UMBC theatre and acting majors recreate the hustle and bustle of New York City's Penn Station terminal during the 2025 - 2026 season opener, *Shakespeare in Harlem*, directed by **Gerrad Alex Taylor**, Theatre, in celebration of the Harlem Renaissance's 100th anniversary and in partnership with Baltimore's Chesapeake Shakespeare Company. In 2026, UMBC remounted the play for a week's run at the company's stage in downtown Baltimore.



Shared Resources in the Sciences

For over 20 years, the NIH-funded Chemistry Biology Interface (CBI) program at UMBC, led by **Aaron Smith**, Chemistry and Biochemistry, has trained Ph.D. students to become interdisciplinary leaders with wide-ranging skill sets who can communicate clearly with those outside their specialty. Today, CBI alumni are thriving in industry, government, and academia—meeting the growing demand for versatile researchers while crediting the program's emphasis on collaboration across disciplines for much of their success.

Teaming Up for Cleaner Water

Communities around Maryland turn to UMBC experts for guidance on cleaning up their water. **Upal Ghosh**, Chemical, Biochemical, and Environmental Engineering, advises Washington, D.C. leaders who want to make the polluted Anacostia River safe for fishing and recreation again. **Lee Blaney**, Chemical, Biochemical, and Environmental Engineering, works with community leaders and engineers in Baltimore who want to monitor PFAS, or "forever chemicals," in local waters.

Telling Community Stories

In a new book by **Tania Lizarazo's**, Modern Languages, Linguistics, and Intercultural Communication, she builds on her research in Latin American cultural studies and transnational feminist to explore the Gender Commission of COCOMACIA, Colombia's largest Afro-Colombian peasants' association. *Postconflict Utopias: Everyday Survival in Chocó, Colombia*—which won the 2025 Best Book Award from the Association of Colombianistas—documents the collaboration between Lizarazo and the Afro-Colombian women of the Gender Commission. The team used digital storytelling tools to document the commission's daily efforts to build networks and share resources that strengthen their families, schools, jobs, and communities.

Supporting Federal Workers ▼

Launched in 2025, UMBC's Paws & Pivot has hosted 15 sessions, amassed 150 registered participants, and engaged with over 900 impacted federal workers and government contractors. The Department of Professional Studies—which organizes the program—looked at the regional analytics and found that over 19 percent of Maryland's workforce is employed in local, state, or federal government. Responding to these numbers, they developed the award-winning initiative that has become a model of regional engagement, scalable virtual learning, and social impact, grounded in the values of continuing education, career resiliency, and access.





Step into STEM ◀

Five years ago, **Cindy Greenwood** helped organize a tutoring initiative for Baltimore City high schoolers after her capstone research project in UMBC's community leadership program revealed the need. Last summer, the continuing partnership between Building STEPs—a college-preparatory program for students from under-resourced city high schools—and UMBC offered a two-week summer program on campus for the first time. Building STEPs students participated in activities adapted from a new interactive math class for non-STEM UMBC students, which was developed by Dean **William LaCourse** and others to fill a learning gap.

UMBC's other partnerships with Baltimore City high schools also flourished this year, including with the city's premier STEM-readiness Ingenuity Project. "Our partnership with Ingenuity has allowed us to interact with some truly exceptional students and share the wonder of higher mathematics," says **Justin Webster**, Mathematics. "The diverse collection of mathematically gifted students at Ingenuity is truly amazing."

Internships that Make an Impact

Retrievers regularly build on the foundational knowledge of the classroom through applied learning, and it's paying off: 85 percent of recent alumni engaged in internships, research, service-learning, or leadership during their time at UMBC. These hands-on experiences have helped 93 percent of our graduates leave with firm plans for employment or graduate school within six months of graduation.

"I'm continually inspired by the way our students engage in applied learning to launch their careers," says **Marykate Conroy**, associate director of internships and employment. "UMBC students are entering the workforce prepared and in demand."

For a Healthier World

A study out of UMBC, published in *Nature Communications*, reveals how enteroviruses—including pathogens that cause polio, encephalitis, myocarditis, and the common cold—initiate replication by hijacking host-cell machinery. The research fills a knowledge gap on this critical step and could pave the way for a new class of antiviral drugs that are effective against multiple viruses. "My lab has been really motivated to understand how RNA viruses produce their proteins inside the cell and multiply their genome to make more virus particles," says senior author **Deepak Koirala**, Chemistry and Biochemistry.

National Leadership ▶

Christine Mallinson, Assistant Vice President for Research and Scholarly Impact, has been a co-founder of a rapidly growing national community called the Humanities, Arts & Social Sciences - Research Leader Network (HASS-RLN), which she co-founded with her colleague Shelome Gooden at the University of Pittsburgh in 2023. Its second national meeting, held in Washington, D.C. in September 2025, brought together HASS research leaders from 25 universities with leaders from national organizations and foundations to explore strategies and opportunities to generate support for these critical areas.

Globally Minded ▶

Even though it has been a particularly trying time for international students, more UMBC students are studying abroad than ever before, says **Katie Heird**, director of education abroad and global learning at UMBC: "Our students are discovering new perspectives, building global connections, and transforming their futures through these life-changing experiences." Additionally, UMBC has continued to be well represented in Fulbright placements, with alumni, graduate students, alumni, students, faculty, and staff continuing to conduct research and teach English globally. At right: A faculty-led trip to England.



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DIVISION OF RESEARCH AND CREATIVE ACHIEVEMENT

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