UMASS BOSTON

RESEARCH

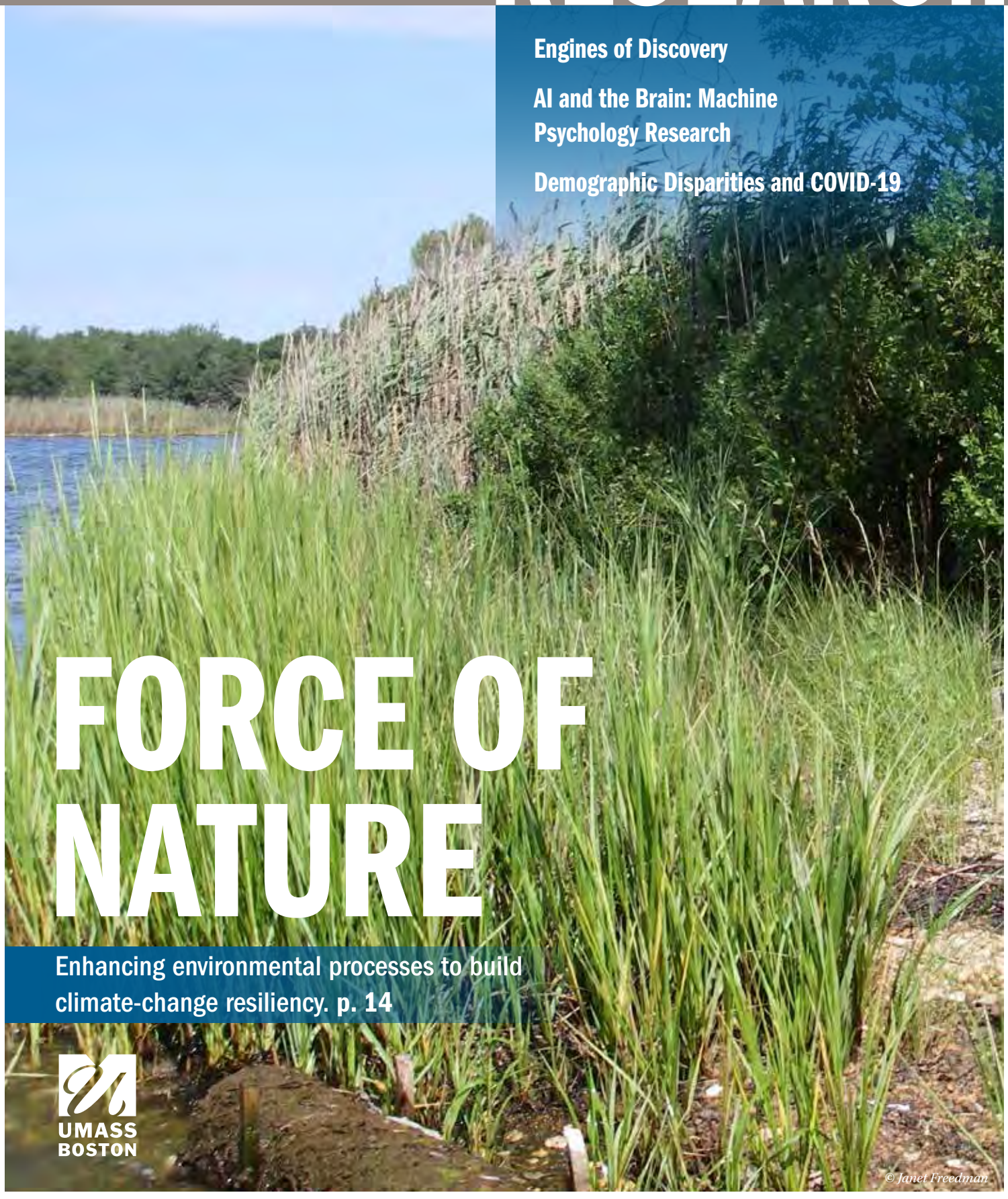
Engines of Discovery

AI and the Brain: Machine Psychology Research

Demographic Disparities and COVID-19

FORCE OF NATURE

Enhancing environmental processes to build climate-change resiliency. **p. 14**



UMASS BOSTON

A Message from the Chancellor

The global pandemic this year presented many challenges for our university community. Scholarship and research at all levels have been impacted by limited access to campus facilities, subjects, and travel. Adaptation became the norm, and resilience has been the catchword for these times.

Against this backdrop, it is impressive what you will find in this second edition of *UMass Boston Research*. Our university has a long tradition of persevering in the face of adversity, and this is no less true during these times when so much is at stake—even the very lives of many of our fellow citizens.

Illustrated in the reports and profiles in this issue is our university's and our faculty's commitment to creating new knowledge, building on the research discoveries in their fields, and taking on some of our most vexing challenges as a region, nation, and world.

I hope you find this report as compelling as I do in shedding light on the robust research activity at UMass Boston.

Sincerely,

Marcelo Suárez-Orozco

A Message from the Vice Provost for Research and Strategic Initiatives and Dean of Graduate Studies

The pandemic and its genesis, the SARS-CoV-2 virus, have been important motivators for research activities in many academic settings, and our campus is no exception.

On the more clinical side, our focus has been on developing inexpensive, paper-based, testing protocols as well as work on adjuvants intended to strengthen vaccine response. However, a still more important facet has been the recognition of the clear asymmetries in the demographic impacts, which resulted in a repurposing of campus expertise to offer support, strategies, and interventions to communities most affected by the pandemic.

The horizons of both classes of activity extend well beyond the current situation and are part of a larger campus effort rooted in preparedness and overall resilience to help address future impacts of the "forces of nature." Developments in these and other topics will be highlighted in future issues as well as on the campus research website, www.umb.edu/research/magazine.

Best Wishes,

Bala Sundaram

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On the front cover: Fringing marsh project, Indigo Point, South Kingston, RI. Photo courtesy of Janet Freedman, Rhode Island Coastal Resources Management Council.

© Liz Cook, Boston Harbor Now

ENGINES OF DISCOVERY

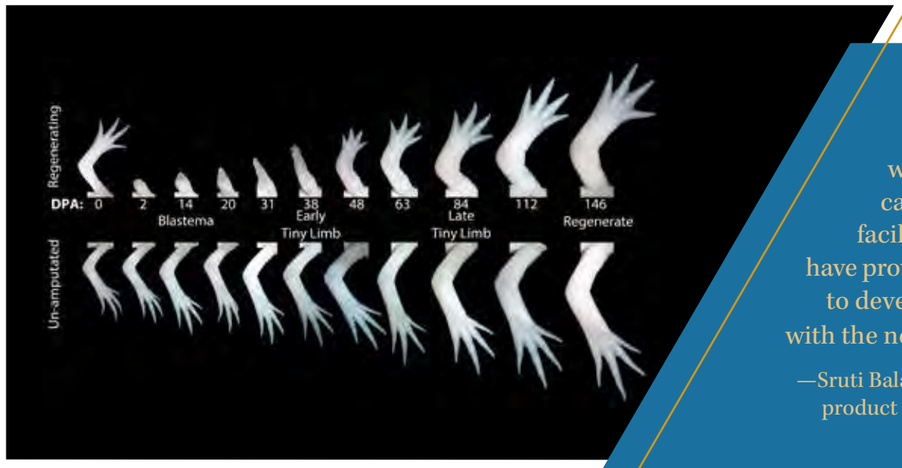
Salamanders, nanocoatings, dangerous bacteria, and mutant flies are just a few subjects of the research taking place in UMass Boston's research core facilities. These cores provide specialized equipment and services to faculty and students, and a recent state initiative increases access for local businesses as well. "Core facilities are an integral component of modern research institutions, and it's been an exciting time at UMass Boston as we have started to realize the value of investing into our cores," said Associate Vice Provost for Research Matthew Meyer, noting the "explosion of collaborations with many start-up companies, both within our Venture Development Center and with others who previously had no campus connections." The state-sponsored Innovation Voucher Program funds subsidies that enable small companies to use the core facilities for projects that increase innovation and jobs. One such company, Boston-based Fluid-Screen, has used UMass Boston's Genomics Core and Advanced Digital Design and Fabrication Core for biomedical research and bacterial genome sequencing. "Whether it's from protein-based sample analysis, genomics sequencing, BSL2 cell sorting, 3D printing, smart fabrication technologies, or confocal microscopy, the core facilities are able to identify and deliver fundamental research results that our local biopharma and biotech companies need," Meyer said.

The last issue of UMB*Research* featured Professor Jill A. Macoska's work as director of the Center for Personalized Cancer Therapy (CPCT), which founded and operates the Genomics Core. The CPCT was developed through a $10 million award from the Massachusetts Life Sciences Center, which enabled Macoska to purchase the equipment that now comprises the research core facilities. The Genomics Core has been instrumental for the success of research efforts in the CPCT. "Our laboratory performed difficult studies to identify and validate urinary RNA biomarkers predictive for kidney cancer diagnosis and prognosis. These studies simply would not have been possible without the Genomics Core, which provided innovative and technically challenging genomics approaches to pursue this project," Macoska explained.

It's not just faculty and local businesses that benefit from the core facilities. Student research assistants benefit, too. The following project updates demonstrate what the core facilities make possible at UMass Boston and beyond:

Faculty

The salamander's ability to regrow missing limbs and repair its organs is a mystery for now, but Catherine McCusker is on the case. "Salamanders are a science-fiction writer's dream," said McCusker, an assistant professor in UMass Boston's Biology Department, noting the salamanders' amazing ability to regenerate organs and tissues. McCusker focuses on the Mexican Axolotl, which can regenerate entire limbs and other organs throughout its life. Her team of student researchers studies how this phenomenon plays out in the cells in salamanders' limbs. The lab uses the new Flow Cytometry Core to purify limb cells before and during regeneration, preparing the cells for further analysis. This work could lead the team to discover how salamanders initiate regeneration, which would bring the team one step closer to learning how to regenerate human limbs. Insights gained along the way could advance other applications, such as treatments for burn victims or controlling the behavior of cancer cells, McCusker added.



Top: (left) Cross section showing cells regenerating and (right) GFP and ectopic limb.

Bottom: Natural versus regenerative contrast

> "As a small company with limited budget for capital expenditure, the facilities at UMass Boston have provided us the capability to develop and test products with the needed technical rigor."
>
> —Sruti Balasubramanian, director of product development at ACTnano

Students

Mutant flies are not just horror-movie monsters. In fact, *Drosophila* flies with a so-called *minibrain* genetic mutation could help researchers understand human conditions such as Down syndrome. PhD student Melissa Brown is leading this research in the lab of biology professor Alexey Veraksa. *Drosophila* flies with a *minibrain* protein mutation have much smaller brains than normal flies, suggesting that the protein is critical for the proper development of the nervous system. Humans have a very similar protein called DYRK1A, which has been linked to the pathology of Down syndrome when it is overactive and to microcephaly when it is insufficient. "We are using the *Drosophila minibrain* to learn more about its downstream functions and the mechanisms of brain development under its control," Veraksa explained. This research project uses UMass Boston's Imaging Core.

Industry

Spectrus LLC is an analytical chemistry services provider in Beverly, Mass. "As a small business, Spectrus benefits greatly from resources made available by the Commonwealth to support our endeavors. This helps not only financially but also by providing resources that we might otherwise have some difficulty procuring," said Michael Ziebell, Spectrus cofounder and president. One such resource is the Fusion Lumos mass spectrometer, managed by Associate Professor Jason Evans. "Starting in 2019, UMB facilities have helped us deliver superior results in four large projects. We intend to continue this engagement in the coming years," Ziebell said.

Boston-based ACTnano uses the Imaging Core to characterize the material morphology and thickness of nanocoatings for applications related to waterproofing electronics. The core's resources allow ACTnano to bid contracts for new products without having to make large investments beforehand. The company also uses the Advanced Digital Design and Fabrication Core and the Environmental Analytical Core facilities at UMass Boston.

These opportunities will continue to grow as UMass Boston brings more facilities online. A Nanofabrication Core headed by Matthew Bell, assistant professor of engineering, is already in the works. The university is also considering future additions such as a Chemistry Core and Stone Living Lab Core.

A FLY FOR AN EYE: RISTER LAB SEES CLUES ABOUT OCULAR DISEASE IN *DROSOPHILA*

© Deepshe Dewett

Jens Rister and his research team celebrating his first R01 grant from the NIH.

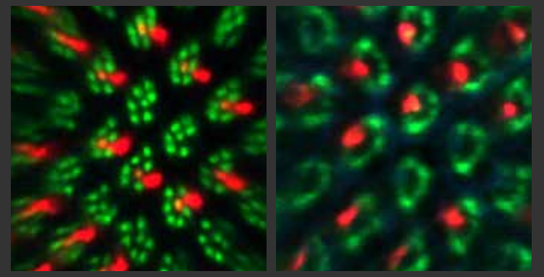
Top: Performing a behavioral experiment ("optomotor response") during which the fly runs on a styrofoam ball and follows a moving stimulus. This experiment is used to determine how MPS preserves vision.

Fruit flies look like simple kitchen pests when they orbit ripe bananas and swarm the garbage, but appearances can be deceiving. In fact, we have a lot in common with these tiny insects. *Drosophila* flies have close equivalents to about 75% of human disease-causing genes, and their bodily functions are surprisingly similar to ours, making them useful models for research. UMass Boston Assistant Professor Jens Rister studies *Drosophila* flies to understand eye function under dietary stress. Rister's research focuses on vitamin A deficiency, the top cause of preventable childhood blindness, according to the World Health Organization. Although the consequences of vitamin A deprivation are widespread, the development of problems ranging from night blindness to permanent blindness is poorly understood. Rister and his collaborators have made a breakthrough in that area that could have far-reaching implications for the treatment of human eye disease.

Humans source vitamin A from foods such as spinach and other green leafy vegetables, orange and yellow vegetables such as carrots and squash, and dairy products, while fruit flies source it through their vegetarian diet. The Rister Lab found that fly eyes deprived of vitamin A imitate human eye disease with a key difference—their photoreceptors do not die, which makes it possible to perform chronic deprivation experiments. That discovery led Rister to suspect that damaged fly photoreceptors are stabilized by unknown cellular processes. In testing the hypothesis that specific molecular mechanisms can respond to dietary stress and preserve eye function, the Rister Lab discovered a novel protein with remarkable capabilities: it can stabilize a damaged eye and maintain vision. "We decided to call it 'My Precious Stabilizer' (MPS) because the mutant that lacks MPS has damaged photoreceptors that fuse to a ring-like shape," Rister explained. "Given this shape and how precious our novel protein is, the coincidence reminded us of Gollum and *Lord of the Rings*!"

UMass Boston students participate in every step of the scientific process in the Rister Lab. Last year, students in the lab traveled to Dallas to share their research at the largest international *Drosophila* conference, presenting alongside specialists in fields ranging from neuroscience to immunology. Three graduate students and three undergraduates collaborated with Andrej Shevchenko of the Max Planck Institute in Dresden and found that *Drosophila* flies chronically deprived of vitamin A experienced a dramatic increase in the MPS protein in their photoreceptors. Research in partnership with Roger Hardie of the University of Cambridge revealed evidence that the novel MPS protein preserves vision. These international connections allow UMass Boston students to experience new research contexts. Undergraduate Clara Poupault traveled to Dresden to work with collaborators at the Max Planck Institute, where she learned mass spectrometry and electron microscopy. Poupault won UMass Boston's Excellence in Research award in biology this year for her research into the novel protein that stabilizes damaged photoreceptors. "The spectacular [electron microscopy] pictures that were taken by our collaborators revealed that without the stabilizing protein, the vitamin A-deprived photoreceptor membranes completely collapsed and formed highly unusual 'curtains,'" Rister explained.

A roughly $1.9 million five-year grant from the National Institutes of Health and an Endowed Faculty Career Development Award from UMass Boston support the Rister Lab's research, while partnerships within the university and around the world extend its scope. The group's multidisciplinary efforts include genetic work, behavioral analysis, and large-scale quantification efforts for gene expression, collaborating with the UMass Boston Center for Personalized Cancer Therapy, as well as protein expression, working with the Max Planck Institute. The lab is working to open new frontiers in the treatment of eye disease, and Rister's mentorship puts students at the forefront.



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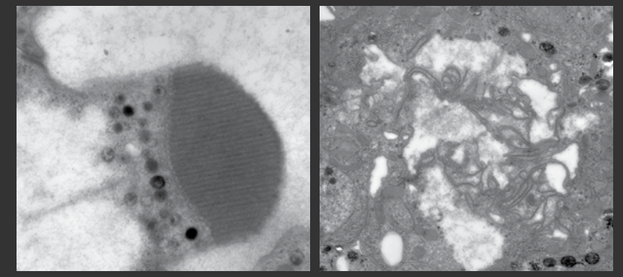
Vitamin A deprived wild type eye (left) vs. mps mutant eye (right), confocal microscopy, staining: F-actin Rhodopsin 6

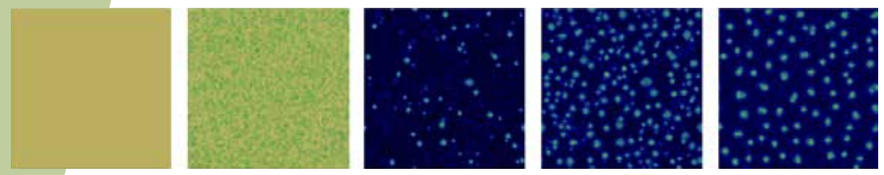


© Michaela Rentsch, Urska Repnik, and Clara Poupault

Vitamin A deprived wild type photoreceptor (left) vs. mps mutant photoreceptor (right), electron microscopy

Student Spotlight: Alexis Perry

A senior majoring in biology at UMass Boston found her life's purpose in the eye of a fruit fly. Alexis Perry works with the Rister Lab on two projects that examine the *Drosophila* eye, which have possible applications for treating human diseases. The first project studies the effects of vitamin A deprivation on the development of photoreceptors. Perry is also involved in research that seeks to identify novel tumor suppressors and growth regulators of the Hippo tumor-suppressor pathway, which could improve our understanding of human cancers. Based on her contributions to these projects, she was nominated for the prestigious Barry M. Goldwater Scholarship for undergraduate research in STEM. "These experiences and the realization that each discovery leads to more questions and new directions to investigate were an important ingredient in shaping my career choice," Perry explained. Laboratory work at UMass Boston has already given her a foundation of skills in using powerful molecular genetic tools, gene editing, and cell-type-specific genomic techniques. Perry is ultimately interested in pursuing a career involving both clinical care and biomedical research. "Working in the lab has made me realize what further purpose and medical applications my research could have," Perry said. "I hope to continue to pursue my fascination with science and to apply research findings to real-world problems."



© Jason Green

Computer simulation of a model of two chemical species, one that acts as a fuel and another that is replicated as the fuel is consumed. When mixed, these species react and diffuse, causing their local concentrations to form intricate spatiotemporal patterns (Left to Right). Bright spots in the rightmost panel indicate high concentrations of the replicated species.

Seeking Universality in Chemistry

Green Forges a Path Toward Prediction

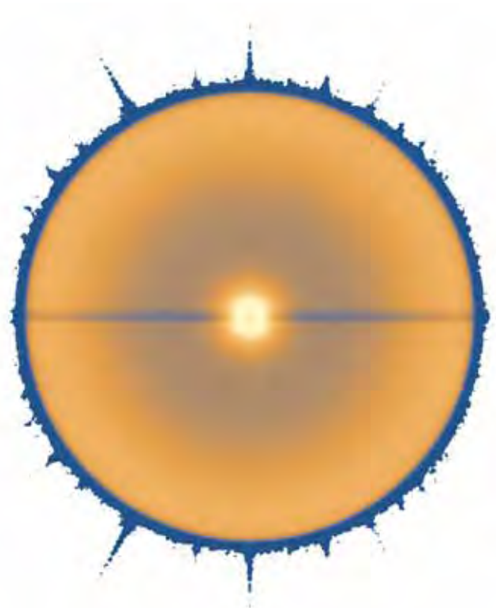
Chef Samin Nosrat started a movement with *Salt, Fat, Acid, Heat*, the book and Netflix miniseries that distilled the essence of cooking to those four fundamental elements. Nosrat's universal laws of taste and texture apply to everything from pesto to pavlovas, and they provide a road map through the vast and daunting universe of highly specialized culinary techniques. UMass Boston associate professor Jason Green aims to do for chemistry what Nosrat did for cooking: he has received a two-year, $234,800 grant from the John Templeton Foundation to search for universal laws within chemistry. To investigate whether different chemistries share common laws, Green is working in the realms of theory, modeling, and computer simulations. Discovering universal laws of chemistry could lay the groundwork for exciting advances in the development of new drugs and materials, among other potential applications. "We're just beginning to think about how this idea could be used to make new quantitative predictions—predictions that could be used to help design these syntheses," Green explained.

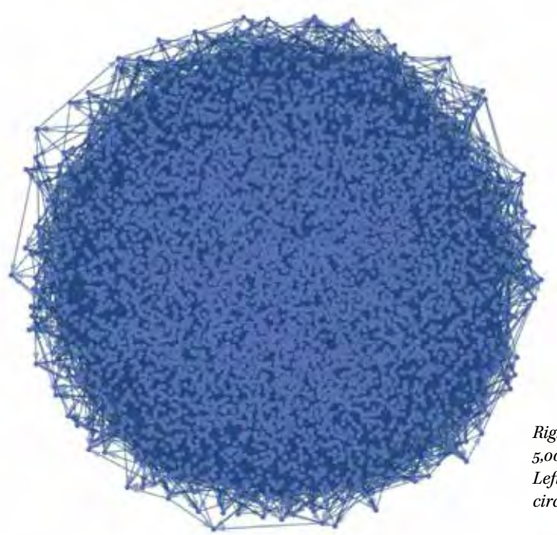
In the sciences, universality, or the notion of common laws that govern very different systems, is usually associated with physics. Some laws of physics—*every action has an equal and opposite reaction*, for example—have reached the status of colloquial truisms. In chemistry, classification is highly fragmented across subfields. It tends to be qualitative, not quantitative. Chemical reactions are organized into categories such as inorganic, organic, biological, polymer, atmospheric, and medicinal, but the distinctions between types are not always straightforward. As Green sees it, categorizing and classifying are scientific steps that pave the way for prediction and control. "Success for us would be to understand how universality might emerge in chemistry and have a first pass at cataloging the classes within chemistry," he said.

Green is exploring predictive possibilities in other areas as well. He received a three-year $435,001 grant from the National Science Foundation that provides funding through May 2022 to work on mathematical equations, computational methods, and computer code designed to predict pathways that systems take in order to assemble a specific structure. The project focuses on so-called active materials, which have properties that can change in a controlled manner due to external stimuli such as light or temperature. Active materials have remarkable abilities to change their own structures and even repair themselves, and their applications include drug delivery and biosensing. As researchers work to tap the potential of these materials, they face a significant challenge: forecasting active materials' behavior depends on understanding the history of their formation. Green and his team plan to address this problem by establishing mathematical theory to predict the structure, lifetime, and yield of materials that stem from chemical reactions. Eventually, he aims to develop a theory that could accomplish that goal from known molecular properties, using computer simulations and models that can be studied experimentally along the way. A better understanding of the formation of active materials will help researchers find the most energy-efficient ways to build them.

Both projects will get UMass Boston students and postdoctoral researchers involved in sharing their findings in open-science computational notebooks. "As we develop answers to our scientific questions, we're going to port them over to computational notebooks that demonstrate the idea. We'll post them online so others can follow along," Green said. This approach to publicizing findings will expand the work's relevance beyond the field of chemistry. As Green explained, "This is a way of reaching an audience that we might not have otherwise, but also incorporating undergraduate researchers and getting them familiar with the types of problems that we're trying to tackle."

These collaborative instincts have been productive. Green's research has recently appeared in high-impact journals that include *Nature Communications* and *Nature Physics*. The latter paper was the result of research with Schuyler Nicholson, a postdoc in Green's group; Luis Pedro García-Pintos, a postdoc researcher at the University of Maryland, College Park; and Adolfo del Campo, an adjunct professor at UMass Boston and director of the quantum science and technology group at the Donostia International Physics Center in Spain. They showed that so-called quantum speed limits have classical counterparts—which they call time-information uncertainty relations—that set slimits on how fast observables such as heat can change in time. Mathematical realizations of the aphorism "more haste more waste." This discovery promises insights into many chemical and biological processes. The paper "Time-information uncertainty relations in thermodynamics," was published online by *Nature Physics* in September 2020.





Right: A representative model of a chemical reaction network with 5,000 chemical species (nodes) and 10,000 reactions (links), Left: the distribution of eigenvalues with signatures of the universal circular behavior that is characteristic of larger networks.

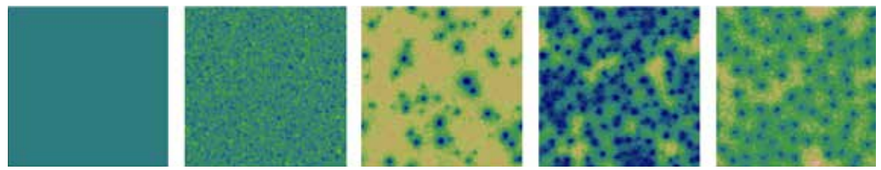
© Zachary Nicolaou

Postdoctoral Researcher Spotlight: Schuyler Nicholson

© Mica Green

Statistical mechanics, a branch of physics that originated in the 19th century, has important applications for 21st-century issues such as climate change. "[D]espite almost two hundred years of effort, there are still many unanswered questions," postdoctoral research assistant professor Schuyler Nicholson noted. Nicholson studies statistical mechanics and thermodynamics as a member of Associate Professor Jason Green's research group. Broadly speaking, statistical mechanics uses statistics to understand how basic quantities such as heat, work, and energy are transformed under different conditions. The common theme in Nicholson's research is the dichotomy between thermodynamic quantities and information. "What drew me to statistical mechanics is the fact that it sits at a fundamental level in the hierarchy of physics, underlying everything from the industrial revolution to the limits of computational power in computers, to the arrow of time," he said. Technological advances have expanded researchers' tools to address contemporary questions with this theory. "The Chemistry Department here at UMass Boston has given me the opportunity to pursue this directed creativity toward a wide range of interesting and pressing problems," he said. Over the past few years, the research group has undertaken interdisciplinary theoretical work supported by massive computational resources to study the transient chemical species that are formed during the combustion process. "This has direct implications for increasing the efficiency of the fuels we burn and is thus important to combating climate change," Nicholson explained. Another recent project studied molecular building blocks self-assembling when a system is driven by a fuel source. That research could pave the way for new drug-delivery methods, among other possible applications.

The same simulation of a model of two chemical species, showing the pattern formed in the local concentrations of the fuel. Dark spots in the rightmost panel indicate low fuel concentrations.



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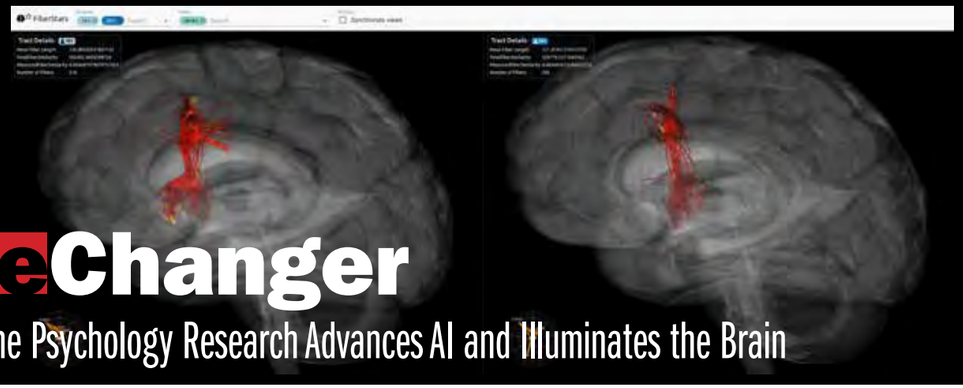


The FiberStar application allows the comparison of brain fibers of multiple subjects.

© Loraine Franke

GameChanger

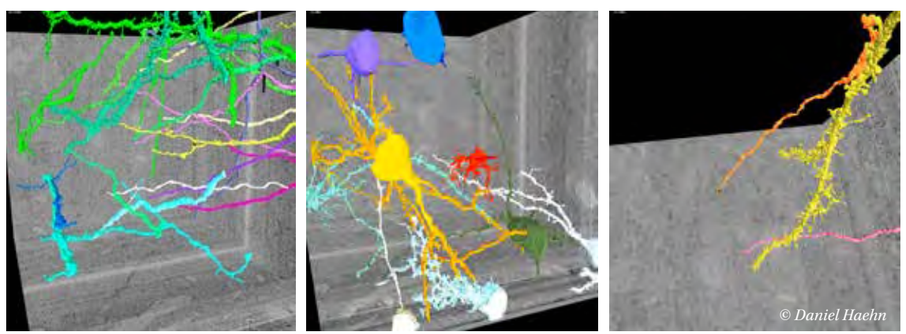
Haehn's Machine Psychology Research Advances AI and Illuminates the Brain

To glimpse artificial intelligence catching up to humans, watch it beat us at our own games. IBM's Deep Blue computer outmaneuvered chess world champion Garry Kasparov in 1997, and its Watson computer bested top contestants on the quiz show *Jeopardy!* in 2011. Two decades after Deep Blue's chess victory, Google's artificial intelligence program AlphaGo overcame the world champion of the highly complex board game Go, Ke Jie. These games have stable rules, clear winners and losers. As AI takes on increasingly pervasive roles in our lives, it's not so simple. Turn from the scoreboard to the world at large, where AI assists with everything from hospital diagnostics to smartphone cameras, and rating the performance of machines versus humans becomes more difficult. Daniel Haehn, an assistant professor of computer science at UMass Boston, has embraced that challenge. His research aims to understand the gap between the brain and artificial intelligence—and narrow it.

Haehn explores the distinctions between human and machine intelligence as director of the Machine Psychology research group at UMass Boston. Neuroscientific discoveries power advances in machine learning, a major subset of AI, but current methods are troublesome to generalize and require unwieldy amounts of data. Haehn addresses that problem by seeking a better understanding of the brain itself via connectivity analysis, studying connections right down to the synapse level. The most visible milestones in the development of AI are framed as oppositions. Mind versus machine, Kasparov versus Deep Blue. Haehn approaches the relationship between studying brains and machines as a two-way flow of information. Neuroscientific discoveries can inspire machine learning methods, and visual computing methods can aid brain connectivity analysis. As one field advances, the other can, too. Haehn's research also investigates how top-down studies of machine perception can help us understand computational models, an area with wide-ranging applications.

Haehn uses data science to fight breast cancer as the project leader for the Oregon-Massachusetts Mammography Database. That project will create data to train modern deep-learning systems to detect breast cancer early. Since this data is extremely time-consuming to generate manually, the researchers will design intelligent annotation methods that combine machine learning algorithms with human annotators to increase labeling throughput. The database recently received a $750,000 grant from the Massachusetts Life Sciences Center's Bits to Bytes program, which supports projects using sizable datasets to answer life science questions. "Partnering with a local medical imaging company, we will then create the world's largest publicly available annotated mammography dataset and fine-tune existing classifiers for automatic breast cancer detection," Haehn said, adding, "This funding will allow us to massively upgrade the on-campus computing resources with new GPUs and fast storage."

Haehn tasks his undergraduate and graduate students with key research initiatives, and their work has concrete benefits for the scientific community beyond UMass Boston. Yahiya Hussain, an undergraduate student in computer science and mathematics, studies electron microscope images, diamond-knife-sliced brain scans captured at a high enough resolution to show individual synaptic connections between neurons. Aligning these images is both tricky and expensive. Hussain discovered a procedure to improve the process in the deep-learning framework he uses, Image-and-Spatial Transformer Network (ISTN): he includes biological information such as the location of mitochondria, which can enhance automatic image alignment methods. Hussain won the spring 2020 Undergraduate Research Fellowship Award in the College of Science and Mathematics, which supported his work on this innovation.



© Daniel Haehn

Selected neurons, somas, and synapses in a 100 micron cube of brain tissue. The data was acquired at nano-meter resolution and is 2 Terabytes in size.

Student Spotlight: Cristina Rodriguez-Quijada

Seafood aficionados can thank Cristina Rodriguez-Quijada for advancing new methods to test oysters for foodborne pathogens, but she didn't come to Boston for the shellfish. Rodriguez-Quijada, who earned her PhD in biomedical engineering and biotechnology in spring 2020, chose UMass Boston to pursue interdisciplinary research focused on the interactions between inorganic materials and biomolecules, aiming to enhance the performance of biomaterials with therapeutic or diagnostic uses.

Her most recent project, a collaboration with Kimberly Hamad- Schifferli, an associate professor in the Engineering Department; Michael Shiaris, a professor in the Biology Department and associate dean of the College of Science and Mathematics; and Michael Tlusty, an associate professor in the School for the Environment, is a departure from her past research areas and has special significance for New Englanders.

"The final aim of our latest work is to provide a rapid test for the detection of foodborne pathogens," Rodriguez-Quijada explained. "To meet this aim, we'll need to work toward having a fieldable, self-contained, and low-cost detection test that is easy to use." *Vibrio parahaemolyticus* bacteria found in oysters can cause vibriosis, a disease that affects 80,000 Americans annually and proves fatal in about 100 cases per year, according to the Centers for Disease Control and Prevention.

"While working on this project, I was really happy that I have never enjoyed eating oysters," Rodriguez-Quijada concluded.

© Julie Raynor

UMass Boston undergraduate Yahiya Hussain holds a modern Tesla V100 graphical processing unit (GPU). Professor Haehn and his team use these GPUs for their research.

Computer Science PhD student Loraine Franke approaches brain imaging in a different way. She collaborates with researchers at Brigham and Women's Hospital, Harvard Medical School, and the Harvard Center for Brain Science on visualization research that gives neuroscientists an interactive way to explore the anatomy of brain fiber bundles. The visualization framework Franke is working on combines 2D and 3D views, and she is especially interested in making ensemble visualizations that allow quick comparisons from different times and multiple subjects.

To improve researchers' understanding of machines' visual perception at a larger scale, computer science PhD students Jesse Freeman and Aswin Vasudevan are helping Haehn create a platform that provides visualization benchmarks for machines. The platform they are developing, LE-V-EL, allows researchers to test and evaluate their own machine perception algorithms. Deep far-learning networks frequently struggle with visual tasks that involve generalizing when slight variations are introduced. Haehn's own research addresses that problem by training neural networks to estimate elements such as angles, curvature, volumes, and textures, and comparing machine perception to human perception of complex visual forms such as pie charts. On that score, Haehn finds that machines, specifically convolutional neural networks, still have a long way to go before they catch up to their human counterparts. Freeman and Vasudevan are designing the datasets and ranking combinations of machine learning classifiers in a web-based leaderboard for LE-V-EL, to increase access and, with it, the knowledge available to their field.

Haehn and his students use UMass Boston's high-performance research computing infrastructure to process and store brain images and train artificial neural networks. Recall Google's AlphaGo, which uses two neural networks to process information about the game Go using millions of neuron-like connections. On its website, the DeepMind group that developed the program quotes one Go champion defeated by it, Lee Sedol, who entered the match believing AlphaGo was "merely a machine." Eventually, though, the computer made an innovative play that convinced Sedol that "[s]urely AlphaGo is creative." The spread of AI puts into question what it means to be human. For Haehn, working to reduce the gap between AI and the human brain is far more than a game: it is an opportunity to seek a better understanding.

TRANSLATING BODY LANGUAGE INTO VIRTUAL REALITY

Personality-driven movement system

Virtual characters are popping up everywhere from educational contexts to the Instagram influencer sphere, and their interactions are increasingly sophisticated. Ongoing research by UMass Boston computer science professors Funda Durupinar and Marc Pomplun could support the creation of simulated personalities that respond dynamically to users' preferences. Building rapport with virtual characters increases users' engagement and improves performance of related tasks, Durupinar noted. However, compelling characters are not one-size-fits-all: it's about compatibility. "Behavior adaptation leads the way to empathetic communication, which is especially important in education, where embodied social agents have proven to be beneficial," she explained.

To address that challenge, Durupinar and Pomplun are studying how virtual characters' nonverbal cues affect users. Their current project applies eye-tracking technology and pupillometrics, which gauges user interest by measuring how the eyes' pupils react to stimuli. Durupinar and Pomplun are conducting empirical studies to investigate the relationship between virtual characters' personality-driven movements and user attention. In tandem with those studies, a computational model creates characters that adapt their personalities to meet specific users' needs. The final product of their venture will be a virtual framework that hosts presentations by simulated human characters with distinctive personalities.

Student Spotlight: Cynthia Schofield

Cynthia Schofield worked as a mental health counselor in a facility for addiction and mental illness before she became a UMass Boston student, and she was disturbed to learn that treatment plans tend to address symptoms rather than causes. "It was that frustration and a desire to better understand the neurobiology behind the disease that drove me to return to school to pursue research in this field," Schofield said. The UMass Boston senior, majoring in biochemistry with a minor in psychology, is an Honors College student and an Initiative for Maximizing Student Development Scholar. She is already receiving recognition for her neurobiological research, winning a prestigious Barry M. Goldwater Scholarship earlier this year. "A significant amount of the credit goes to the opportunities I have had access to at UMass Boston," Schofield said.

Schofield works in the neurobiology lab at MIT's McGovern Institute for Brain Research with institute professor Ann Graybiel, studying the molecular mechanisms that control decision-making and habit formation. That research focuses on how flawed neural signaling can contribute to conditions like drug addiction. Schofield plans to pursue a PhD in molecular neuroscience. She aspires to run a neurobiology lab of her own where she can research the molecular underpinnings of motivation and reward processing as they relate to neurodevelopmental and addiction disorders.

DEMYSTIFYING THE DISSERTATION PROPOSAL

The dissertation proposal provides a road map for a PhD student's culminating years of research. UMass Boston has an innovative program to support students in this crucial proposal-writing phase—the Transdisciplinary Dissertation Proposal Development (TDPD) Program. UMass Boston is one of five campuses nationwide that received funding from the Social Science Research Council (SSRC) to develop a dissertation proposal development program based on the SSRC's proposal workshop model. The TDPD program exposes PhD students to inter- and transdisciplinary research design and gives them a space to share knowledge across departments and programs. Another core goal is to foster pipelines to academic and applied research careers for students from underrepresented groups. "Student participants have an overwhelmingly positive response to the program, noting its supportive environment, exposure to different disciplinary perspectives, space for discussing broader professional development questions, and impactful proposal feedback," said Andrea Leverentz, an assistant professor of sociology who developed the program along with Rosalyn Negrón, an associate professor of anthropology and former professor of Asian American studies Loan Dao. The TDPD Program faculty facilitators (including, to date, Dao, Negrón, Professor Bob Chen, Professor Michael Johnson, and Associate Professor Patricia Krueger-Henney) lead workshops in the spring and fall, with a structured format designed to foster constructive feedback. Participating students also receive a $3,000 grant to conduct summer research for their dissertation proposals, which could include preliminary field work, data collection, data acquisition, or additional training. Since 2017, a total of 51 students from 16 PhD programs at UMass Boston have participated. The program will welcome its sixth cohort of students in the spring of 2021.

THE **CVIP** HELPS INNOVATION SEE THE LIGHT OF DAY

The Office of Commercial Ventures and Intellectual Property (CVIP) at UMass Boston guides research along the path from the university's laboratories to the world at large. There are complexities beyond some faculty and students' expertise in securing patents and negotiating with potential business partners, and the CVIP's David Glass has three decades of experience with technology transfer at academic institutions in Massachusetts and elsewhere in the United States. The office works with investigators to identify research results that may have commercial value or other benefits to the public, and to protect them. UMass Boston received six U.S. patents during the last two fiscal years. Beyond legal protections, the CVIP helps researchers find potential industry partners for their innovations. The office recently negotiated an exclusive license agreement with a Singapore-based start-up company to commercialize inventions in advanced microscopy that were patented by physics professors Gopal Rao and Chandra Yelleswarapu. UMass Boston also granted a non-exclusive license to a patent for a device related to quantum computing to Millimeter Wave Systems, an Amherst-based company. The device was invented by Professor Matthew Bell and his colleagues in UMass Boston's Department of Engineering. With the CVIP ready to assist in patenting and industry relations, UMass Boston faculty and students can focus on their research.

Faculty Spotlight: Holly Jackson

Holly Jackson, an associate professor of English in the College of Liberal Arts, is a scholar of 19th-century American cultural history. Her latest book, *American Radicals: How Nineteenth-Century Protest Shaped the Nation*, was selected for *Smithsonian Magazine*'s list of the ten best history books of 2019. "Though I was trained in literary studies, my work on the 19th-century United States has involved a range of research methods, such as searching genealogical records and the census, studying periodicals, deciphering letters, reading hundreds of pages of convention minutes and congressional records," Jackson noted. "At UMass Boston, students in my courses, such as my interdisciplinary seminar on the Civil War for the Honors College, use these strategies to learn about a range of topics from the Confederate economy to the contemporary monument debates." Her other courses include Radical Boston: American Protest Literature to 1900; and Sex, Family, and Nation in the American Novel. "It's a privilege to work for the people of Boston alongside colleagues who are so committed to public education and social justice," Jackson said. "Some of my best moments as a teacher have been delving into local history with students to unearth the past lives of the city, doing site visits and hands-on research at places like the Boston Public Library and the Boston Atheneum."

Student Spotlight: John DeBrota

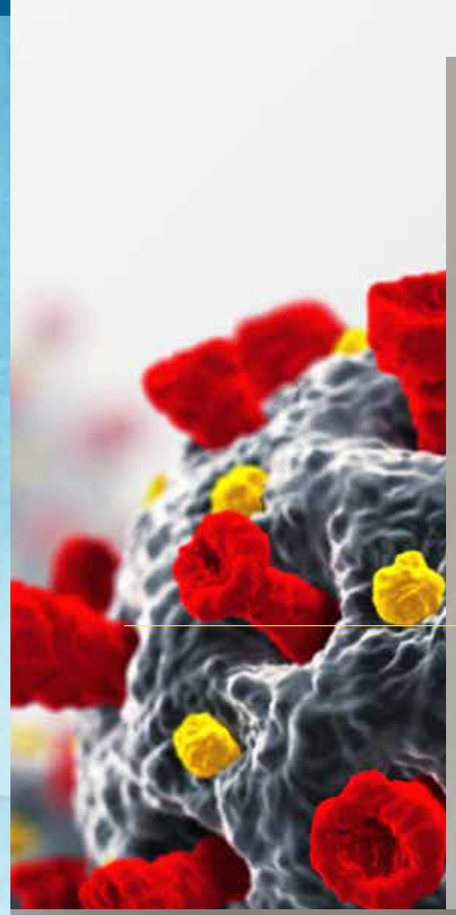
Five years ago, John DeBrota had a crisis of scientific faith. After deferring his acceptance to a theoretical chemistry PhD program, he found himself torn between two similar fields: condensed matter theory and theoretical/computational chemistry. “What drew me to those areas in the first place was the tangibility,” he explained. Both fields offered clear practicality and feasible experiments. “Given that, it’s kind of funny, the 180 I’ve done,” he added. DeBrota traveled to Waterloo for a one-year master’s program at the Perimeter Institute, where his path took an unexpected turn. It started when his mentor introduced him to the work of UMass Boston physics professor Chris Fuchs. “I felt a curiosity and passion for the research [Fuchs] and his collaborators were conducting that totally overpowered my feelings for the specialization I thought I’d wanted to pursue,” DeBrota explained. He went on to read many of Fuchs’s papers and his correspondences with other thinkers. “When I learned Chris was looking for graduate students, I knew I had to make the jump,” he said.

Fuchs leads a research group at UMass Boston that studies QBism, the area of quantum mechanics he pioneered. QBism is an interpretation of, and ongoing research project about, the meaning of quantum mechanics. The QBist view is distinguished by its insistence that many aspects of the quantum formalism are subjective in nature, meaning they concern the actions and experiences of a decision-making agent. This approach has the advantage of removing certain paradoxes that have long troubled the field. DeBrota was not an obvious future QBist. However, as he investigated physicists’ understanding of nonrelativistic quantum theory, he became disillusioned with the status quo. “The reality is that most physicists either weren’t bothered by the types of things that were bothering me or had learned to keep quiet about such matters,” he said. “Learning not to worry, to be happy with merely mathematical clarity, and to subsequently ‘shut up and calculate’ can feel like a rite of passage for a physicist.” Determined to ask why quantum mechanics is the right theory to use in our universe, DeBrota was thrilled to find Fuchs and his group engaging with that very question. Fuchs and his colleague Alioscia Hamma, also a professor in the Physics Department, shared their vision in “Back to the Future: Quantum Opinions” in the last issue of *UMB Research*.

Refusing to shut up and calculate could have profound implications. DeBrota expects QBism could eventually impact the design of quantum algorithms, and help scientists quantify how powerful quantum computers are and how best to build them. On an abstract level, he believes the group’s work “may actually contribute to a future paradigm shift of remarkable degree about the nature of reality.”

As a UMass Boston PhD student, DeBrota found strong support for his research. He won the Distinguished Doctoral Fellowship offered by the Office of Graduate Studies, which funded two of his first four years, and he received grant funding for the remainder of his degree. In his time here, DeBrota traveled around the globe for conferences and collaborations.

In September 2020, DeBrota began postdoctoral research at Tufts University. He says, “of particular importance is understanding when and how a quantum computer can do better than a classical computer for a particular problem,” adding, “I think it’s time to start proving the worth of our ideas in a bit of a lateral direction. If we solve a problem that others didn’t by leveraging QBist intuitions, there will be a pragmatic incentive to further the work we’ve begun!”



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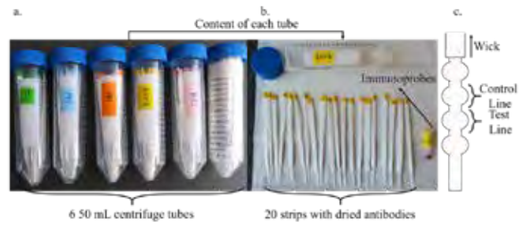
Paper tests

ADAPTABILITY IN THE COVID-19 PANDEMIC



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Virology kit

It sounds like a catch-22. Researchers are chasing scientific breakthroughs to fight COVID-19, but public health measures to curb the pandemic can obstruct research. Fortunately, scientists are expert innovators. Kimberly Hamad-Schifferli, an associate professor of engineering at UMass Boston, is developing COVID-19 tests—and remote teamwork strategies. “While restricted lab access, travel, and in-person meetings have impeded research, we ship kit contents and use video calls to train collaborators,” she said. Hamad-Schifferli is designing paper COVID-19 diagnostics in partnership with Jose Gomez-Marquez, co-director of MIT’s Little Devices Lab. Unlike standard tests that require sophisticated lab equipment to process, these diagnostics work like pregnancy tests. The paper strips contain gold nanoparticles linked to antibodies that bind the viral proteins, displaying two colored dots for a positive test and one dot for a negative result. “The paper tests take minutes to run and cost only a few dollars,” Hamad-Schifferli noted. This simple, easy-to-use format could dramatically increase accessibility and prevent testing bottlenecks that leave positive cases undetected for days. Hamad-Schifferli is working on models that would diagnose a COVID-19 infection, and tests that would detect antibodies from a past bout. The time it takes to create antibodies that recognize the virus can cause delays in traditional testing, but the team found a workaround that allows them to repurpose stockpiled antibodies. They have already published their results and filed a patent.

Only one team member is conducting lab work, Delyan Hristov, a postdoc in engineering. The disrupted workflow has a surprising side effect. “[T]he shutdown has actually been beneficial, as it has forced us to rethink kit design and how we transmit instructions,” Hamad-Schifferli said. She is concerned with equal access to diagnostics, especially in settings that may have limited resources and health care or uncertain supply chains. Hamad-Schifferli’s team is reaching out to potential partners around the world to expand a list of collaborators that spans Honduras, Chile, Senegal, and Ecuador. They are building distributable, open-access tools to help these communities locally manufacture their own tests in the form of LEGO-like reconfigurable blocks. As it turns out, thinking remotely is conducive to acting globally.

Shortly after UMass Boston shut down due to the pandemic, the university reopened chemistry professor Wei Zhang’s lab so he could return to work on a COVID-19 vaccine. Zhang is collaborating with Ofer Levy and David Dowling of Boston Children’s Hospital and Harvard Medical School on an Adjuvant Discovery Program, which aims to boost immune response in vaccine recipients. UMass Boston students are so integral to the research that three students are part of the essential team: PhD student John Mark Awad, senior Kellianne MacFarlane, and postdoc Wenfei Hu. “They have come to the lab to conduct the organic synthesis of compounds that were submitted to the biology lab for testing on their agonistic properties in known human immune response systems,” Zhang explained. A National Institutes of Health grant to Boston Children’s Hospital and Harvard Medical School supports this research.

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FORCE OF NATURE

As cities around the world look to seawalls and other costly, invasive structures to fend off rising oceans, superior fixes may be hiding in plain sight—just ask Paul Kirshen and Bob Chen. The two professors in UMass Boston's School for the Environment (SFE) work in a field called nature-based solutions, designing coastal resilience strategies that mimic aspects of nature. Boston's Harbor Islands are a perfect example of the paradigms waiting just offshore. A simple question posed by Cathy Stone, president of the James M. and Cathleen D. Stone Foundation, spurred Kirshen, Chen, and other SFE colleagues and researchers from the Woods Hole Group to begin studying the islands: What is the islands' role in protecting Boston from flooding? That role turned out to be huge. "We found out that the islands are very important because they break up the wave energy from a coastal storm," Kirshen explained. Computer modeling showed that three-foot waves from 2018's major winter storms would have swelled to 25 feet without the islands' barrier effect.

Encouraged by the interest and support of the Stone Foundation, the researchers started asking, is there some way you could modify the islands so that you could actually make them more effective in controlling waves? They considered ways to enhance the islands' physical profile—by expanding them, for example. When they got wind of 300,000 cubic yards of available dredge, a mixture of stone and mud, it sounded like kismet—but no luck; that didn't work out. Back to square one. When the dredge fell through, it may have been a blessing in disguise. Instead of treating the islands as a one-off flood-protection project, the team arrived at something far more ambitious: a living laboratory that will study a wide range of nature-based approaches to coastal resiliency for years to come.

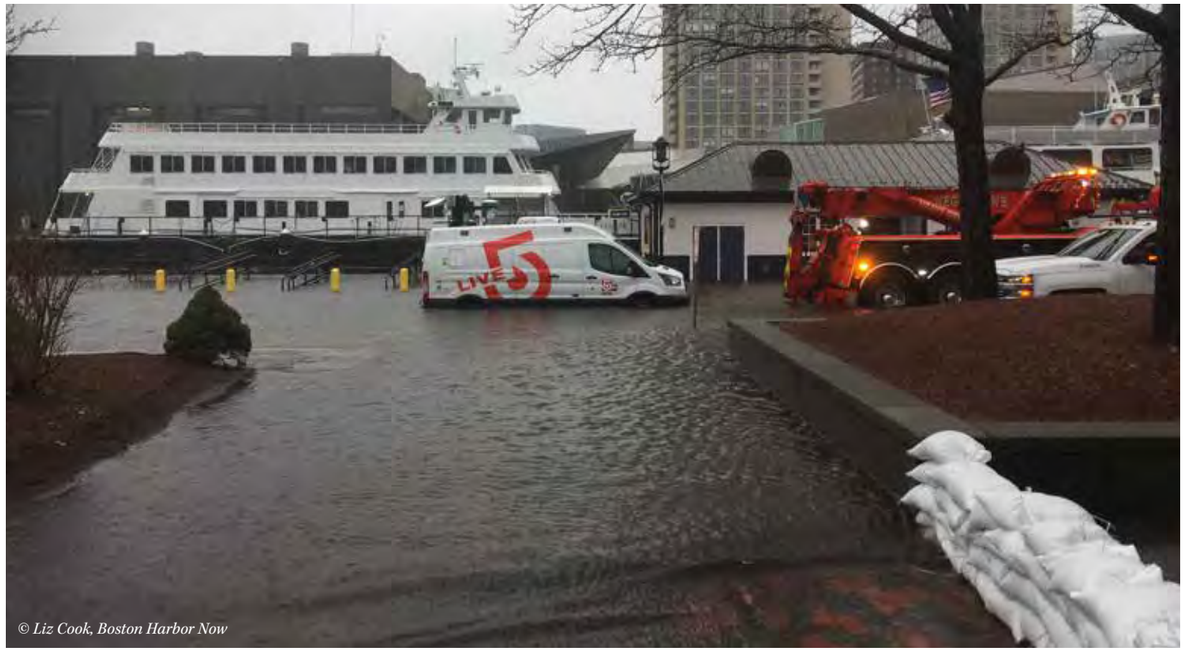
Above: The Boston Harbor Islands are a natural barrier to storm-driven waves and offer a perfect setting for research into nature-based methods for enhancing their protective features.

Top right: Some members of the Stone Living Lab team looking at potential islands sites in 2019.

Bottom right: Although much experimental data will be gathered by the lab's monitoring system, human observation of research projects will also play an important role.

The School for the Environment at UMass Boston is developing the Stone Living Lab, a major new research and education initiative within the Boston Harbor Islands National and State Park, in close partnership with Boston Harbor Now, the National Park Service, and the City of Boston. The project is funded by a five-year grant from the Stone Foundation. The Woods Hole Group is also an active partner. The journey to build that unusual coalition was crucial in shaping the lab's mission.

The team found inspiration at a charrette. The collaborative planning meeting was organized by the Stone Foundation, Boston Harbor Now, and Harvard's Graduate School of Design to determine the best way to enhance the resiliency of the Boston Harbor Islands and leverage the protective role they play for the mainland. The field was not limited to the sciences. "We've been thinking in the School for the Environment about *transdisciplinary*—what does it mean to approach complex wicked problems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Above: Flooding on Long Wharf from a coastal storm in winter 2018.

Below: This high tide flood along Boston's waterfront occurred in October 2016.

from many, many different perspectives, not just from engineering or science, but from social science, from art? We really liked this idea of getting together with the Graduate School of Design, engineers, scientists, policy makers, funders, everyone who was in there," Chen said. In brainstorming sessions, landscape architects shared their visions while biologists contributed vital information about relevant ecosystems. The UMass research team was galvanized by the creativity and the diversity of ideas. It was this primordial chaos that showed them a way to harness the islands' full potential. "At the meeting, the idea of this living lab really grabbed hold," according to Kirshen. Students, civic organizations, and advocates are codeveloping solutions to problems alongside scientists.


© Christian Merfeld

A living lab is not about research in a vacuum. "We're not just carrying out engineering or biological experiments," Kirshen explained. "We're also doing policy research and planning research, because you can


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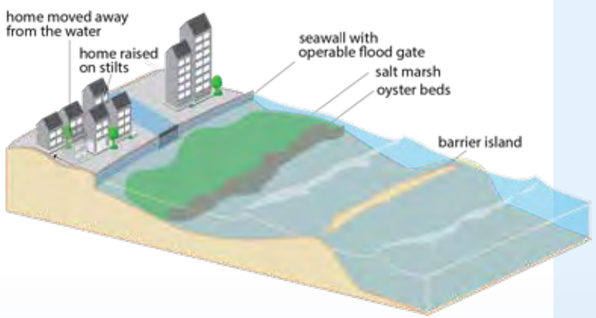
TURNING THE TIDE

Paul Kirshen and his School for the Environment colleague Ellen Douglas have advised the City of Boston and other communities on coastal resilience for over a decade. In 2018, Kirshen led a study that determined Boston should not pursue an immense offshore harbor wall and gate system stretching from Deer Island to Hull. The recommended alternative was shore-based systems to protect against the flooding—particularly nature-based solutions instead of more traditional concrete flood walls. Below he provides the reason for this (edited for length and clarity):



Hybrid infrastructure figure. Reprinted from Environmental Science & Policy, *Sutton-Grier, A. E., Wowk, K., & Bamford, H., Future of our coasts: The potential for natural and hybrid infrastructure to enhance the resilience of our coastal communities, economies and ecosystems, 51, 137-148, copyright 2015, with permission from Elsevier.*

Imagine: *The coastline is being flooded. You could just build a concrete wall to keep out the floodwaters, but there are several disadvantages. One is that it upsets a lot of the natural processes and encourages erosion at the base of the wall, so the wall will eventually collapse. Also, these walls are not ecosystem-friendly; it's just a slab of concrete. They only can be used as a flood wall. Plus, the walls are very ugly. Now let's look at a so-called nature-based system. Think of a dune system with dune grass on it. They're elevated, they protect what's behind them from flooding, they're attractive to look at. They slope away from the ocean, so they absorb the energy of the waves. Because they're in harmony with nature, they don't upset the natural transport of sand along the coast. In fact, they might even adjust as the climate changes. They not only provide flood protection: they also have co-benefits. The grasslands can support ecosystems. Also, they have recreational benefits. They might be cheaper to build than a gray concrete wall. Sometimes in nature, a series of natural systems manages flooding. Think of a tropical offshore reef. It's very attractive for a habitat, but it's also very important because if you get a big storm and a wave, the coral breaks up the wave energy. By the time that wave gets to shore, it's lost a lot of its power. We're thinking about systems that are layered like natural systems, like an offshore reef and then a marsh system and then some elevation on land, mimicking this idea of a tiered system of flood management.*

From left to right, Joe Bagley, Bob Chen, Francesco Peri, Paul Kirshen, and Leslie Fields.

have the greatest design, but if you can't implement it, then you're wasting your time." When the scientists were exploring innovative ways to modify the Harbor Islands, they encountered regulatory challenges. Now, one of the lab's goals is to create a toolbox for people who want to protect the coast from sea-level rise and erosion. "Right now, we have walls as the primary tool," Chen said. When it comes to infrastructure, novelty can be a roadblock. It's challenging to compare the cost of constructing a seawall versus, say, a salt marsh or a living shoreline. Contractors don't usually provide quotes for the nature-based options, especially when they're not optimistic about permits. "There's no pathway forward, so the tools don't just include what it is and how to build it, but also how to get it through the regulatory process," Chen said. The living lab model tackles the disconnect between ideas and implementation, combining research with community outreach, education, and policy engagement.

At the Stone Living Lab, that translates into learning residents' needs at the neighborhood level and giving locals and students opportunities to contribute to experiments. It also means collaborating effectively with local, state, and federal regulators during the environmental review process and involving citizens and stakeholders at all levels to prepare Boston for the effects of climate change.

For now, the focus is on ramping up the monitoring system on Rainsford Island, with a sequenced set of experiments expected to start in spring 2021. UMass Boston professors and graduate students across the sciences already have exciting plans. For one, School for the Environment professor Crystal Schaff and research engineer Francesco Peri intend to use lidar remote-sensing technology to measure cliff erosion starting in 2021. This information will be useful in determining the effectiveness of living shorelines. The lab is staying true to its transdisciplinary roots: Amit Patel, an assistant professor of public policy and public affairs in the McCormack Graduate School, and Rosalyn Negrón, an associate professor of anthropology in the College of Liberal Arts, are proposing to study the co-benefits of nature-based solutions along with Kirshen and PhD student Jessica Lillquist. Centering co-benefits is one way to make sure the climate infrastructure will benefit Boston's vulnerable populations, a key aspect of the lab's social justice and equity mission. J. Cedric Woods, the director of the Institute for New England Native American Studies at UMass Boston, has provided valuable guidance on understanding coastal resilience over a longer time scale and considering both human and non-human benefits.

Beyond the Boston-based partnership, the Stone Living Lab team is already in touch with climate researchers from San Francisco to Venice to the Netherlands, and it has a globally recognized Scientific Advisory Committee. The lab's long-term plans include an annual conference that will gather scientists from all over the globe to exchange knowledge. As the lab grows, the team hopes its research capabilities will attract a hub of businesses in the blue tech sector—think green tech, but focused on oceans and coastlines. The stakes are high. Boston is the eighth most vulnerable city in the world to possible damages from rising seas, according to a 2013 World Bank study. To address those risks, Kirshen was a major contributor to the City of Boston's "Resilient Boston Harbor" plan, with redesigned waterfront parks, elevated land, and restored marshes instead of a colossal harbor wall. Each feature is tailored to its distinctive coastal neighborhood, with improved public access and recreation benefits in mind. The lab's partnership with the city, Boston Harbor Now, and the National Park Service promise more opportunities to come. "We're in it for the long haul, because climate change is in it for the long haul," Chen concluded. To learn more, visit stonelivinglab.org.

SUPERSIZED SAMPLES

Studying coastal environments has taught Bob Chen to expect the unexpected. The first priority at the Stone Living Lab is to build out a comprehensive monitoring system that will make a rich trove of data available to researchers affiliated with the lab and also the general public, so that everyone from students to citizen scientists to international observers can benefit. Here, Chen makes his case for a data-forward approach to coastal resilience (edited for length and clarity):

Coastal systems are complex in that things change sometimes in seconds, sometimes in days, sometimes over decades. You don't know when the change is going to happen, so we're looking holistically at everything: the physics, the chemistry, the biology, the water quality, the optics, the erosion, also the co-benefits, what people think of it. To be able to observe what you don't expect is very difficult. We're designing a monitoring program that is real-time and in-depth, capturing way more data than you need, because you'll probably need it at some point but you didn't know that you needed it. We call it oversampling. We're going to have cameras and real-time wireless beaming of data coming from under water and on land constantly, so that when the unexpected happens, we'll know what happened. And when the unexpected happens to the biology instead of the physics or the sedimentation, we'll have that data, too. We're providing a real-time observatory of the island.

© David Burdick, UNH

The lab will monitor how creating more natural coastal barriers may build flood-control capacity.

Demographic Disparities and COVID-19

Latinos' share of COVID-19 cases in Massachusetts is 30%, more than double their 12.3% share of the state's population. The Mauricio Gastón Institute for Latino Community Development and Public Policy at UMass Boston investigated the unequal distribution in a report released in June. A team of researchers in public health, psychology, education, sociology, and economics collaborated on the report, applying multidisciplinary frames to data from the American Community Survey and the Massachusetts Department of Public Health to better understand Latinos' vulnerability to COVID-19 infection and predictive factors. "The report identified some key social determinants of health that are critical to understand the rapid spread and differential rates of COVID-19 among Latinos in Massachusetts," said Lorna Rivera, director of the Gastón Institute. The main factors appear to be higher poverty rates, population age, household size, occupational segregation, chronic health conditions, and access to health care, she explained. Disparities in these areas have devastating consequences in a pandemic. Take, for example, Latinos' homeownership rates, which are the lowest of any racial or ethnic group in Massachusetts. "The lack of affordable housing pushes Latino families towards larger household sizes to compensate for high rental costs," Rivera said. Over 52% of Latinos live in households with four or more people, compared to 38% for non-Latino households, she noted. In a pandemic, this leaves households vulnerable as distancing becomes more challenging.

The report made a series of recommendations to protect the Latino community. At the state level, it called for a database of cases disaggregated by race and ethnicity to keep up-to-date numbers available. The report also made a case for universal health care for all, including immigrants and their families. "Affordable access to health care is critically needed for underserved Latinos throughout the state where there continues to be a need for more COVID-19 testing and treatment," said co-author Eduardo Siqueira, an associate professor in the College of Public and Community Service.

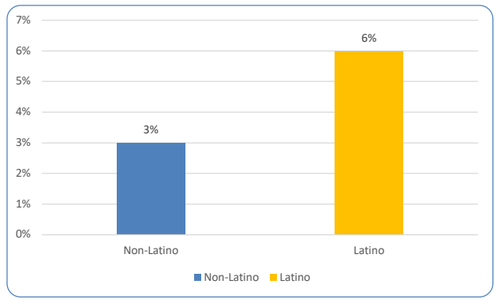
Table 1: **MA COVID-19 Cases & Deaths by Race & Ethnicity**

	Proportion of MA Population (Total=6.893M)	Proportion of COVID-19 cases (total=105,885)	Proportion of Deaths from COVID-19 (total=7406)
Asian	6.5	2.0	2.7
Black	6.8	9.4	8.2
Latino	12.0	19.0	6.8
White	72.2	29.4	73.4

Source: MA-DPH Dashboard, June 16, 2020 and 2014–2018 American Community Survey (PUMS)

The team is pursuing further COVID-19 research in partnership with the Latino Education Institute at Worcester State University and community-based organizations in the Greater Boston and Worcester areas. To help a broader audience stay informed, the Gastón Institute developed a live, interactive dashboard on its website to trace the race and ethnicity of COVID-19 cases and deaths in Massachusetts and provide related data and infographics. The institute is also engaged with the impact of the public health crisis on education, co-sponsoring a series of webinars with In Pursuit of Equity, Accountability, and Success, which has explored that topic since the beginning of the pandemic. Past webinars include titles such as "Education in the time of COVID-19: The voice of the educators." Students in the institute's spring 2020 Latino Leadership Opportunity Program cohort produced films throughout the semester documenting their experiences. An event called "COVID-19 Family Portraits: Stories of Vulnerability, Love, and Resilience" screened those films and brought in community leaders for a panel discussion of the effects of the pandemic on students and communities of color. From health care to education, the Gastón Institute has provided timely interventions throughout the pandemic to hold institutions accountable to Latino communities.

Figure 2: **Persons without Health Insurance.**



Source: 2014–2018 American Community Survey (PUMS)

Faculty Spotlight: Silvia Dorado-Banacloche

Silvia Dorado-Banacloche, an associate professor in the College of Management, investigates ways to "tame" wicked social problems such as poverty. "My research follows from my interdisciplinary training in business, sociology, and planning. It builds on my work experience in the private, public, and nonprofit sectors," Dorado explained. Her research stays true to those interdisciplinary roots, making use of disciplines such as economic development, nursing, and education in studying individuals and organizations dealing with social problems associated with poverty and inequality. "It draws on my home discipline, management, regarding the organizational dynamics that define how individuals engage with these social problems," she added. One research area explores social enterprises, organizations engaged in commercial activities in service of a social purpose. A recent paper out of this research stream is forthcoming in *Research in the Sociology of Organizations*. In it, Dorado conducts a historical analysis of how regulatory changes have influenced sheltered workshops, a type of social enterprise that emerged in the mid-1800s, and their commitment to the social purpose of providing employment for people with disabilities. She enjoys the community of scholars with similar research interests she has found at UMass Boston. "I also appreciate teaching in a university with an urban mission and a high percentage of first-generation university students," she said. Dorado's course offerings include Tackling Grand Social and Environmental Challenges.

Faculty Spotlight: Elizabeth L. Sweet

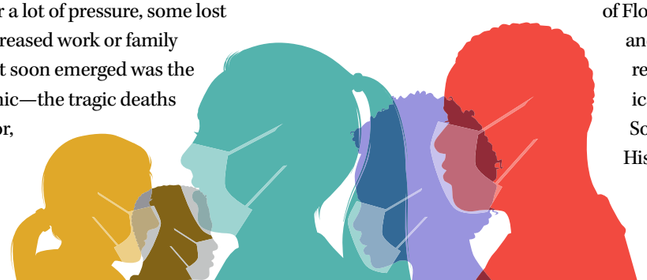
Elizabeth L. Sweet engages in collaborative community economic development and violence abolition research. She is working to provide practical interventions that push the boundaries of urban planning theory and methods. Sweet, an assistant professor of equitable and sustainable development, teaches in the Department of Urban Planning and Community Development and the Department of Africana Studies. Her work in U.S. Native, Black, Latino, and Latin American communities has led to long-term collaborations and inclusive projects, using a feminist antiracist/decolonial framework. Her latest research focuses on the erasure of Blackness/Nativeness in Mexico and its impact on Mexicans in U.S. cities. Sweet is thriving in the UMass Boston community. "Even though I have only been here for a year, I have found my people! Not only in Urban Planning and Community Development and Africana Studies but across campus, I have been embraced and supported and been able to feel reciprocity as a community norm," she said."I am working on linking my research to local communities, but I am basking in a place that is UMass Boston with all its complexity and compassion. Students have been great. They are intellectually curious and ask good and hard questions. Their experiences are diverse and provide a perfect space for reflection and action on social, racial, and gender justice."

Looking from Boston to Africa to Fight a Double Pandemic

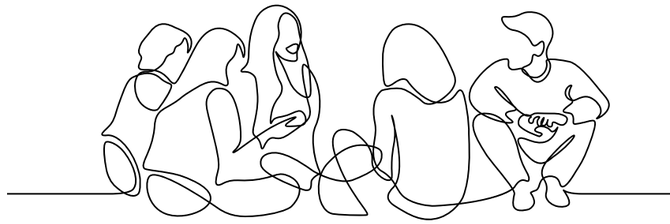
COVID-19 created an urgent research agenda for the William Monroe Trotter Institute for the Study of Black Culture at UMass Boston. Quito Swan, a historian who joined the Africana studies faculty in 2019, became director of the Trotter Institute one month before cases spiked across the country. "Did I come from a health [practitioner's] background? No. But I knew UMass Boston was a hub for engagement with the community's intersecting concerns around how systemic racism manifested itself in racial disparities in health care," he said, adding that faculty and students were crucial to guiding an informed response with a public health focus. As the university shifted to remote learning and stay-at-home advisories limited ways of connecting with local residents, the Trotter Institute developed an eclectic toolset. It launched the Project Resilience initiative with a mandate to research the effects of COVID-19 on Black communities in Massachusetts, while also documenting and supporting community groups, scholars and organizers addressing the pandemic. What he and several other researchers on race found went far beyond the virus. "COVID-19 has highlighted preexisting disparities, hence the colloquial term, the preexisting health condition that Black people had was racism," Swan said. The scope of Project Resilience expanded to include racism as a public health crisis.

Swan mined Boston Health Commission data that measured the virus's impact by zip code and ethnicity. In April 2020 the insitute released a policy brief, "COVID-19, Black Skins, No Masks" Resilience 1.1 that revealed an outsized number of cases and deaths among Black Bostonians. To understand the experiences and needs of these Black communities on a granular level, the Trotter Institute sought to work with local partners, including the Codman Square Neighborhood Development Corp., a Dorchester-based nonprofit that had painstakingly gathered information from its constituents via telephone calls. Swan also mined information from social media—which he views as an underutilized resource for researchers—and participated in digital forums where scholars shared resources and data. UMass Boston students also inform the institute's research. "Students were under a lot of pressure, some lost family members, some had increased work or family responsibilities," he said. "What soon emerged was the ugly face of the double pandemic—the tragic deaths of George Floyd, Breonna Taylor, Ahmaud Arbery, and others reminded us of the crisis of police brutality. We had to pivot to address this double pandemic." The Trotter Institute released a series of policy briefs confronting the double pandemic, from COVID-19 to racial disparities in police stops to Black athletes and protest. This included analyzing publically accessible data released by the Boston Police Department about its Field Interrogations and Observations (FIOs). Swan participated in and documented Black Lives Matter protests organized by various groups across the city, in an effort to capture the moment via audio, video, interviews, print media, ephemera, and photographs. "I was keen to try to find that sense of resilience," Swan said. "While we were not succesful in all our aims, I felt that was much more that we could do with greater resources."

The Trotter Institute has enriched its local insights with global ones. Since African countries have already dealt with pandemics such as Ebola, "there was a set body of knowledge in terms of how to deal with pandemics. There's a lot of this discourse in the Black community, looking at newspapers from Africa, looking at newspapers outside of CNN, outside of the United States, folks sharing things through WhatsApp and social media," Swan noted. To highlight responses from Africa and its diaspora, the Trotter Institute held a webinar in June that brought UMass Boston scholars together with activists from Canada, Senegal, South Africa, and beyond. One of the critical things discussed was how "a number of African heads of state and medical officials met in January [2020] to talk about the potential impact of COVID-19 on Africa and what best practices should be in terms of having a continental strategy, that to this day the United States never developed." As the U.S. evolves its strategy, Swan advocates programs to help Black communities that come from the communities themselves, encompassing the double pandemic and its economic impact. "I would add that we should look at Africa and other countries [as in the Caribbean] that implemented national programs for addressing COVID-19," he said. Swan's research into African diaspora history informs his global perspective. His latest book, *Pauulu's Diaspora: Black Internationalism and Environmental Justice* (University Press of Florida) came out in 2020, and made the nationally renowned African American Intellectual History Society's list of Best Black History Books of 2020.



Mirrors, Windows, and Doors for Student Scholars



Mona Abo-Zena approaches equity and social justice issues in her scholarship by centering diversity in children's lived experiences from an intersectional perspective. Abo-Zena, an assistant professor in the College of Education and Human Development, recently had two distinctive opportunities to apply these practices and share them with other researchers in her field. Last year, she co-edited a special issue of the journal *Research in Human Development* with Aerika Brittian Loyd, an associate professor of psychology at UC Riverside. Departing from the traditional format, the issue featured papers led by undergraduate students mentored by faculty around human development coursework and other disciplinary perspectives. "Following the students' leads produced qualitatively different products and areas of focus," Abo-Zena noted. "Further, it integrated teaching and research while supporting students in their ongoing development of critical and applied scholarship."

Research in Human Development is an interdisciplinary scientific journal drawing from biological, psychological, sociological, anthropological, economic, and historical perspectives. The students contributed articles with multi-method research designs across disciplines and diverse populations to the issue, called *Introduction to Mentored Scholarship: Mirrors, Windows, and Doors to Understanding and Supporting Research in Human Development*. "The mentored scholarship illustrated in this special issue provides mirrors so that diverse students can see themselves and their experiences reflected in developmental scholarship, windows for the field to see authentic representations of communities and experiences that are often marginalized, and doors that enable the co-construction of knowledge and engagement in research and practice," Abo-Zena said. She emphasized that this inclusive, reciprocal approach helps every aspect of the work address problems of inequities, inequality, and marginalization.

When Abo-Zena co-edited the first themed issue of the interdisciplinary journal *Religions* this year with Meenal Rana, an associate professor of child development at Humboldt State University, she saw an opening. "While the last two decades have marked a burgeoning focus on the role of religion and spirituality in the positive development of youth, there remain multiple under-explored processes, contexts, and processes that shape development and outcomes for diverse youth and families," she explained. The issue used an ecological framework and life span perspective to address gaps in scholarship related to underrepresented populations, socialization contexts, and positive youth development, as well as challenges to it. Beyond the role of religion and spirituality, the issue provided an intersectional perspective on religious identity development. Find more in the themed issue titled *Ecological Perspectives on Religion and Positive Youth Development*. In editing the special issues of both journals, Abo-Zena described an overarching commitment to "examining privileged and minoritized experiences and how to promote just scholarship and action given stratified contexts and relations."

Faculty Spotlight: Kerrie Wilkins-Yel

Kerrie Wilkins-Yel, an assistant professor of counseling psychology in the College of Education and Human Development, combines approaches from vocational psychology and social justice advocacy in her research. She co-leads the CareerWISE research program, a National Science Foundation-funded initiative examining how interpersonal support and resilience can help women from diverse backgrounds thrive in STEM. Recent program findings indicate that sexism, gendered racism, and microaggressions have significant psychological costs for graduate women in STEM. "Support, particularly from a faculty advisor, continues to play a significant role in buffering these negative interpersonal encounters in STEM environments," she says.

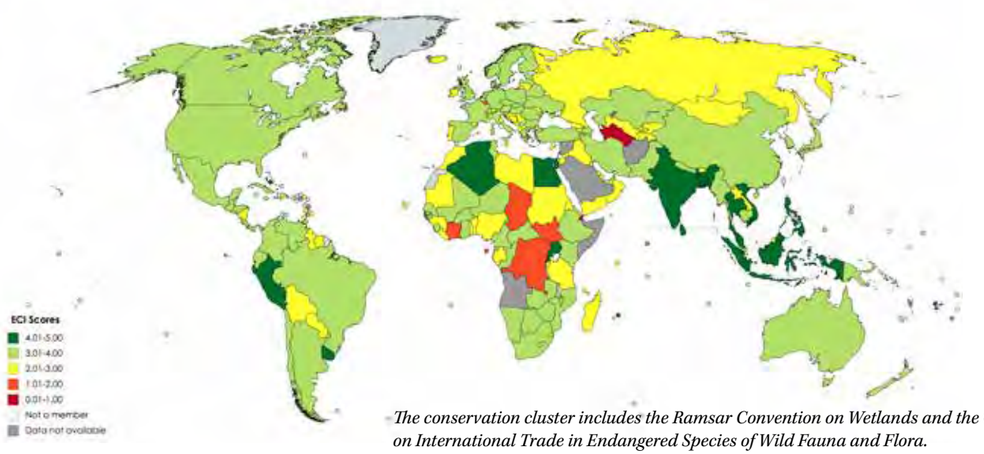
Wilkins-Yel founded and co-directs the I CAN PERSIST (ICP) STEM Initiative, a multigenerational mentorship program that promotes persistence in STEM among women and girls of color. "One of our greatest accomplishments in ICP is seeing women and girls of color in STEM graduate and pursue the lives that they have worked so hard for," she said.

Connecting Research and Policy: The Environmental Conventions Index

International cooperation on environmental issues such as climate change, hazardous chemicals, and biodiversity is evolving, and Maria Ivanova, associate professor of global governance in the McCormack Graduate School of Policy and Global Studies, is working on initiatives to improve implementation. To help governments quantify their progress toward meeting environmental benchmarks, Ivanova and Natalia Escobar-Pemberthy, who received her PhD from UMass Boston in 2017, created the Environmental Conventions Index. Developed with support from the Federal Office of the Environment of Switzerland, the United Nations Environment Programme, and an Andrew Carnegie fellowship from the Carnegie Corporation, the index draws from the national reports that countries submit to the convention secretariats on the implementation of their international obligations. The index is a tool for governments and researchers, and it has already provided the foundation for several dissertations.

The researchers analyze countries' national reports and code responses on hundreds of questions, developing new time series data on implementation since 2001. This process creates granular portraits by country and environmental convention and produces unique profiles as well as broader trends. It becomes possible to determine that, for example, Norway, similar to other industrialized nations, is leading on the implementation of policies to manage persistent organic pollutants, an area that involves extensive scientific and technological capabilities, Ivanova noted. "Importantly, the empirical results reveal how—contrary to conventional wisdom—many developing countries are meeting obligations and even outperforming developed states," Ivanova said. "Countries like Indonesia, for example, rank ahead of Norway in protection of endangered species and preserving world heritage. And countries like Rwanda have made real strides across all conventions, as the deep-dive analysis by the Center for Governance and Sustainability at UMass Boston illustrates," she added. Not only does this systematic empirical evidence show governments how their performance compares to that of their peers; it also helps them identify best practices and challenges, and design measures to meet their international obligations. Ivanova and Escobar-Pemberthy, now an assistant professor of international relations and global governance at

Figure 1 Average ECI for conventions in the conservation cluster

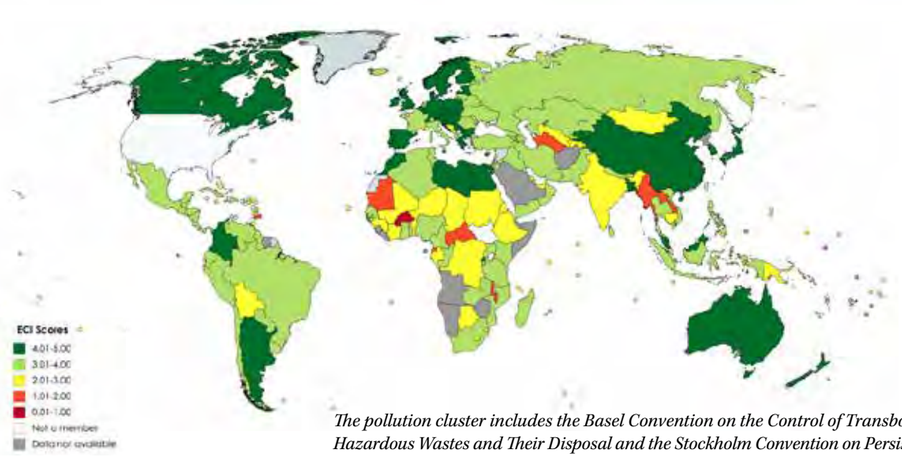


The conservation cluster includes the Ramsar Convention on Wetlands and the Convention on International Trade in Endangered Species of Wild Fauna and Flora.

Faculty Spotlight: Karen Johannesson

As a professor of geochemistry in the School for the Environment, Karen Johannesson draws from multiple disciplines to better understand the natural world. Her specialties include biogeochemistry, a scientific field that examines ecosystems' responses to change from an interdisciplinary perspective. Johannesson's research applies analytical, experimental, and modeling approaches across fieldwork and laboratory experiments. Her areas of focus include the biogeochemistry of trace elements in coastal and estuarine environments, and her research has illuminated issues such as the importance of submarine groundwater as a major flux of lanthanides to the ocean.

Figure 2 Average ECI for conventions in the pollution cluster



The pollution cluster includes the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal and the Stockholm Convention on Persistent Organic Pollutants.

Universidad EAFIT in Colombia, detail their process in an article published in the September 2020 issue of *Sustainability*, "Implementation of Multilateral Environmental Agreements: Rationale and Design of the Environmental Conventions Index."

Ivanova and the student researchers at the Center for Governance and Sustainability are working to put this knowledge to practical use. The center's research team is partnering with the United Nations Environment Programme and the Government of Rwanda to develop what Ivanova describes as a "knowledge hub and policy cooperation strategy to analyze the implementation of global environmental conventions in East Africa." Together, they are delivering an online course that will engage government and convention officials and non-governmental organization representatives. Followed by a regional conference in Kigali in 2021, this initiative linking research, policy, and practice will provide opportunities for countries to share their lived experiences and improve their performance. It also offers unique opportunities for graduate students to pursue knowledge with real-life impact. For her latest book, Ivanova focused on one specific institution. Her study of the past, present, and possible future of the United Nations Environmental Programme, *The Untold Story of the World's Leading Environmental Institution*, is forthcoming in February.

Student Spotlight: J. Michael Denney

Michael Denney's PhD in global governance and human security allowed him to translate research into practice, working directly with communities affected by deficiencies in global agriculture. The program provided opportunities for fieldwork in Ethiopia, where he assisted the Horn of Africa Regional Environment Center and Network with enterprises such as a shea butter value chain development project. Denney helped that organization create and conduct a survey to determine where in Gambella it would be most profitable to invest in shea nut collection and shea butter processing. He then analyzed the data to estimate the feasibility of the project and the amount of income it could generate for local villagers. Denney also co-founded a consulting firm in Addis Ababa that guides businesses and entrepreneurs in adopting sustainable development goals. Clients include a group of women investors interested in starting a value-added coffee export company, who discussed goals related to gender, decent work and economic growth, and responsible consumption and production.

Fieldwork made Denney especially sensitive to assumptions that can create blind spots. "Researchers wield a lot of power when they conduct research in low-income communities," he said. Speaking informally with local stakeholders as he implemented research designs in the field, Denney became frustrated with the idea that researchers can function as neutral actors conducting objective studies. "This is rarely the case. Researchers wield the power to set research agendas and to enforce dominant ideologies," he said. "It is important for researchers to recognize that they and their projects are not neutral, and that we have to let stakeholders have input into our research design." A responsible approach not only solicits input, which most researchers in the field now accept as necessary. "It's about how you solicit and value input," Denney said. "It's about taking local knowledge seriously and valuing it similarly to how we value our credentialed expertise."

Denney chose UMass Boston in order to study with his advisor, Associate Professor Maria Ivanova. His interdisciplinary research received wide support, including a National Science Foundation Integrative Graduate Education and Research Traineeship fellowship from 2014 to 2016. For his dissertation, Denney analyzed the mainstreaming of environmental science into World Bank lending projects between 1990 and 2015. Now that he has completed his PhD, Denney puts these lessons into action as a consultant advising American nonprofits on fundraising and program design. He hopes to continue his work with sustainable development programs in sub-Saharan Africa.

Pandemic Heightens Age-Related Economic Stresses Tracked by the Elder Index

"The economic fallout from the COVID-19 pandemic is hitting older people hard, as many are losing jobs or having hours reduced," said Jan Mutchler, a professor in the Gerontology Department and director of the Center for Social and Demographic Research on Aging at UMass Boston. Economic security was already elusive for many senior citizens pre-COVID-19, and the pandemic is pushing it further out of reach. People who become unemployed later in life find it harder to get a new job, Mutchler noted. That scenario can easily set off a domino effect: a forced early retirement, which leads to enrollment in Social Security before reaching eligibility for full benefits, which causes a permanent benefit reduction. Most older people rely on Social Security in retirement, often with few or no other sources of income. Locking in a lower benefit rate can be disastrous. Even without an early opt-in, "our research demonstrates that Social Security benefits fall short of covering necessary expenses in every county in the U.S.," Mutchler said. Economic shortfalls are especially steep for people of color, with African Americans and Latinos facing rates of economic insecurity 50 percent higher than their White counterparts, Mutchler noted.

The Elder Index is a cost-of-living measure for people 65 and older produced by faculty, researchers, and students at UMass Boston. "Current conditions have highlighted the fault lines in all of our systems and structures, including those relating to economic security in later life," Mutchler said. "An essential feature of any plan to address this problem is education and awareness—something that the Elder Index supports especially well." This unique indicator of what it takes to get by in retirement, produced county-by-county for the entire U.S., has been featured in a Congressional Budget Office retirement security report. More than a dozen UMass Boston students have worked on the Elder Index and participated in related conference presentations and publications. The research team is working with partners and funders across the country who use the Elder Index to strengthen services for older people or seek policy changes that will improve their economic security. "Our work highlights the importance of improving public education and rethinking policy and social service program access based on actual needs in retirement," Mutchler concluded.

Top: Economic Security and Insecurity Rates among Older Singles, by Race Group, 2019 . Bottom: Rates among Older Couples, by Race Group, 2019 .

Faculty Spotlight: Azizah Jor'dan

Azizah Jor'dan, an assistant professor of exercise and health sciences, specializes in aging, age-related diseases, and interventions. Her latest research examines the direct link between neurophysiology and balance control. "My research involves various disciplines, such as neuroscience, physiology, kinesiology, gerontology, and biostatistics. There are, however, many other disciplines that may help explain the variation seen in data (e.g., psychology, genetics)," she said. "Taking an interdisciplinary approach to my research allows . . . a more complete picture of balance control as it relates to the functional integration of the individual, task, and the environment."

With funding from the National Institute on Aging, Jor'dan is studying the effects of aging, diabetes, and Alzheimer's disease on walking, standing, and related brain activity. Her project will also test the efficacy of electrical brain stimulation, a potentially effective method for improving walking and standing. Jor'dan aims to provide proof-of-concept that brain stimulation can be a safe rehabilitative strategy for age-related conditions and diseases.

Researchers Across Disciplines Develop Emerging African Studies Program

The Africa Scholars Forum at UMass Boston is drawing from over three decades of research, programming, and teaching to create a formal African studies program at the university. The interdisciplinary coalition formed in 2018 to build a program from existing offerings, including courses in the Africana Studies Department; study-abroad programs in South Africa, Cape Verdes, Togo, and Senegal; and the Center for African, Caribbean, and Community Development, which collaborates on research and projects in West Africa with a Boston-based nonprofit, the West African Research Association. As many regions embrace global cooperation on initiatives to combat pressing problems such as climate change and the COVID-19 pandemic, UMass Boston's deep capability in African studies provides a platform to participate. The founder and chair of the Africa Scholars Forum is Rita Kiki Edozie, a professor of international relations and associate dean of the McCormack Graduate School of Policy and Global Studies. A political scientist drawing from multiple disciplines, Edozie focuses on African affairs, politics, international relations, and development studies. Her eighth book, *Africa's New Global Politics*, co-authored with Moses Khisa, a Ugandan assistant professor of politics at North Carolina State University, is forthcoming in 2021.

African studies research at the university stretches across disciplines, from the food security case study in Mozambique led by Heidi Gengenbach, an associate professor of history, to the key insights about Rwanda's implementation of global environmental agreements from Maria Ivanova, an associate professor of global governance. Read more about Ivanova's assessment of countries' progress meeting climate goals and benchmarks on page 24. Students also have rich opportunities for African studies coursework in Boston and research abroad; learn more about J. Michael Denney's experience on page 25. These opportunities support UMass Boston's role as a local university with a global reach.

Testing Early Interventions for Children with Autism Spectrum Disorder

Psychology professor Alice Carter has received a five-year grant from the National Institute of Mental Health (NIMH) providing $4,714,509 in funding to evaluate the effectiveness of parent-mediated Reciprocal Imitation Training, an intervention for young children with social communication challenges and/or autism spectrum disorder. Reciprocal Imitation Training uses play-based methods to improve motor imitation—a child's ability to mimic another person's movements—and joint attention, in which a child and an adult engage with the same object. These nonverbal communication techniques provide an interactive context for learning social, play, and language skills. The NIMH grant will support Carter's work with investigators at three other sites to conduct an implementation trial with community-based early-intervention providers.

The study will include 160 early-intervention providers working with 440 families under Part C, a federal grant program that facilitates assistance for infants and toddlers with disabilities. Carter and her collaborators will randomize providers to either Reciprocal Imitation Training or treatment as usual. They will evaluate outcomes including children's joint attention and language abilities, seeking insights that could guide a large implementation effort. In this study, Carter is collaborating with Professor Wendy Stone at Washington University, Professor Brooke Ingersoll at Michigan State University, and Assistant Professor Allison Wainer at Rush University Medical Center.

Carter has also received a subcontract on a NIMH grant to study school-aged outcomes for children who screened at risk for autism spectrum disorder as toddlers. Working with Boston University Medical School pediatrics professors Emily Feinberg and Sarabeth Broder-Fingert, she will evaluate children who participated in Project Early, a program that assessed the role of community health workers known as "family navigators" in connecting families to Part C early-intervention and autism spectrum disorder diagnostic services. Carter will assess Project Early participants who were randomly assigned to family navigation or routine services alongside a community contrast group, focusing on cognition, social behavior, adaptive functioning, school achievement, and family functioning.

Faculty Spotlight: Serra Acar

Serra Acar is an assistant professor of early childhood education and care in the College of Education and Human Development. Her research interests range from international perspectives on early intervention to executive function in bilingual and dual-language learners. "I began my professional career as a preschool teacher in Istanbul, Turkey," Acar said. "My passion for improving outcomes for children with or without disabilities and their families has driven my professional life and will continue to be my focus. I am committed to early intervention/early childhood special education, because I want to be a part of a larger social movement in service of social justice, equity, diversity, and inclusive education." Her current research includes serving as principal investigator for the Interdisciplinary Collaboration in Early Childhood Education Project (ICEP), which prepares master's-level students to assist young children with disabilities and their families. "ICEP aims to prepare scholars to work as a team with the family and other professionals to gather accurate assessment information. Our goal is to increase the number and improve the quality of interdisciplinary personnel who serve young children with disabilities and their families, especially the ones with culturally and/or linguistically diverse backgrounds," she said. The project received a $1.1 million five-year grant from the U.S. Department of Education in 2019.

Understanding Racism's Effects on Childbirth Outcomes

As UMass Boston researchers investigate childbirth-related racial and ethnic disparities, they are also tracking the impact of the pandemic. Lisa Heelan-Fancher, an assistant professor in the College of Nursing and Health Sciences, and Laurie Nsiah-Jefferson, director of the Center for Women in Politics and Public Policy, are working with a PhD student on a study that addresses maternal and infant health inequities in childbirth. "This study will examine the associations between gendered racism and power as knowing participation in change with childbirth outcomes among pregnant and/or postpartum Black women in the Boston and Greater Boston area," Heelan-Fancher said. The study will explore perceptions of how COVID-19 has affected Black women's access to prenatal care and delivery care experiences during the pandemic, in addition to persistent underlying problems. "Institutional, interpersonal, gendered, and anticipatory racism are chronic stressors that are associated with an increased risk for preterm birth and low-birth-weight infants," said Nsiah-Jefferson. "This is most evident when Black women who had higher levels of education and income had a higher rate of preterm birth compared to white women who had similar and lower levels of education and income. This suggests that interventions are needed to address gendered racism within the context of anticipatory and institutional racism at multiple levels to promote health equity in birth outcomes and beyond," Nsiah-Jefferson added. Ultimately, the study will assess what participants believe they need to have a healthy pregnancy as a Black woman, and strategies they think could improve childbirth outcomes. The Faculty Fund for Enhancing Interdisciplinary Research between the McCormack School of Policy and Global Studies and the College of Nursing and Health Sciences provided a grant to support the study starting in the summer of 2020.

Interventions are sorely needed. Black women are 49 percent more likely to deliver their infants preterm than White women in the United States, with similar rates in Massachusetts. "Black women are also more likely to have a cesarean delivery compared to White women, and this is of utmost concern because the risk of dying from a cesarean delivery is 3 times greater compared to a woman who delivered her infant vaginally," Heelan-Fancher added. Overall, the most recent maternal mortality data released by the U.S. Centers for Disease Control show a rate about 2.5 times higher for Black women than White women in 2018, one of the highest maternal mortality rates in the developed world. Heelan-Fancher and Nsiah-Jefferson expect their study findings will contribute to interventions and public policy recommendations designed to reduce racial and ethnic disparities in childbirth.

Faculty Spotlight: Joseph N. Cooper

Joseph N. Cooper, UMass Boston's inaugural Dr. J. Keith Motley Endowed Chair of Sport Leadership and Administration, studies the intersection between sport, education, race, and culture. "My lived experiences as a Black male former athlete greatly influenced my interest in my research," he said, adding, "I was and remain deeply interested in understanding the interplay between individual and group experiences and outcomes and different ecological systems (chrono, macro, exo, meso, micro, and sub)." Cooper's research into Black male athletes' socialization and lifetime outcomes formed the basis for his 2019 book, *From Exploitation Back to Empowerment: Black Male Holistic (Under)Development Through Sport and (Mis)Education*. Though there are many ways for educational institutions to improve, Cooper suggests that their first step should be to "acknowledge Black male athletes as holistic individuals deserving of support for all their identities." He puts that principle into practice as the faculty founder of Collective Uplift, a group that helps students grow in and beyond their athletic activities.

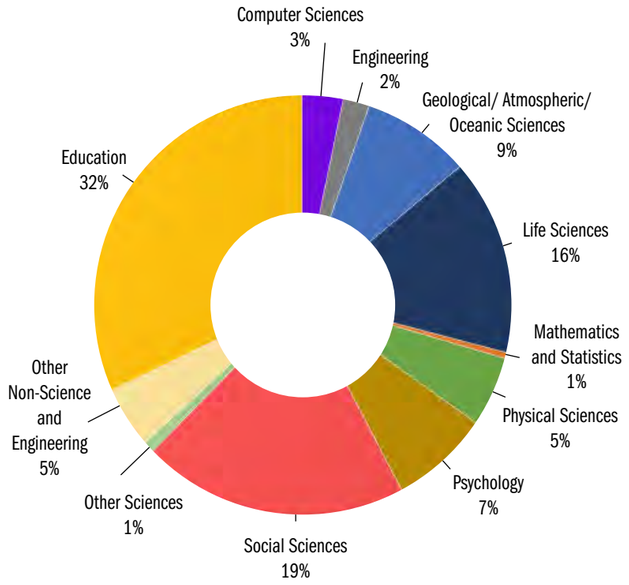
Advocating for Gender and Racial Equity among UMass Boston STEM Faculty

Katalin Szelényi, an associate professor of higher education; Adán Colón-Carmona, a professor of biology; Hannah Sevian, a professor of chemistry; and Andrea Leverentz, an associate professor of sociology, are leading an institutional self-assessment designed to promote gender and racial equity among the university's STEM faculty. Like many research universities, UMass Boston faces challenges with underrepresentation. "In spring 2019, women made up 44 percent of faculty across natural and social science departments included as STEM fields in this project. Women full professors, however, made up only 8.4 percent of tenure-track faculty in these departments, compared to 19.2 percent for men full professors," Szelényi said. "Racial inequities are evident more broadly, with underrepresented racial groups accounting for just 10 percent of all STEM faculty. In addition, full professors from underrepresented racial groups made up 2.1 percent of tenure-track faculty in STEM departments, compared to 25.5 percent for non-underrepresented groups," she added.

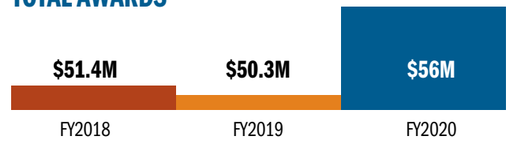
The assessment will determine the systemic barriers to, and facilitators of, gender and racial equity in hiring, tenure, promotion, work experiences, and faculty's sense of belonging. It will also pilot a strategy to address the systemic causes of gender and racial inequities in UMass Boston's faculty. Finally, the assessment will encourage faculty and administrators to promote equity in STEM as part of the university's five-year strategic plan. "If we look at our student demographics, it's critical that the faculty reflect the student body. Ultimately that's what this mechanism is trying to do," Colón-Carmona said. "My hope is that our self-analysis will influence hiring and promotion processes for the university, which may lead to cultural change at UMass Boston." The two-year project is funded by a $300,000 National Science Foundation ADVANCE Catalyst Grant.

Research by the Numbers

FY2019 TOTAL R&D EXPENDITURES



TOTAL AWARDS



TOP SPONSORS

- **$8.3M** US Department of Education
- **$5M** National Science Foundation
- **$4.9M** National Institutes of Health
- **$4.5M** MA Department of Early Education and Care
- **$2.5M** University of Massachusetts Foundation
- **$2.1M** US Department of Health and Human Services
- **$1.4M** MA Department of Developmental Services
- **$1M** James and Cathleen Stone Family Foundation

TOP DEPARTMENTS, CENTERS, INSTITUTES RECEIVING EXTERNAL FUNDING

- **$12.6M** Institute for Community Inclusion
- **$4.8M** Institute for Early Education
- **$3.3M** School for the Environment
- **$3M** Biology Department
- **$2.3M** Gerontology Institute
- **$2.3M** Chemistry Department
- **$1.9M** McCormack Graduate School – Collins Center for Public Management
- **$1.8M** Psychology Department
- **$1.7M** Center of Science & Mathematics in Context (COSMIC)
- **$1.7M** Center for Survey Research
- **$1.7M** College of Science & Mathematics – Dean's Office
- **$1.3M** Exercise & Health Sciences Department
- **$1.2M** Engineering Department
- **$1M** Center for Personalized Cancer Therapy
- **$1M** Center for Social Development and Education

Economic Development

The Venture Development Center, UMass Boston's hub for innovation and entrepreneurship, has incubated 110 companies since its 2009 opening, which now have over 1,500 employees. The VDC also connects startups with UMass Boston's core facilities, giving them access to state-of-the-art equipment that can take their research to the next level. Some VDC members have grown independently while others expanded their platforms through buyouts. The second category includes online pharmacy PillPack, which was acquired by Amazon.com for $753 million, and machine intelligence startup Kensho, which sold to S&P Global for $550 million. The VDC marked a milestone in 2020 when SQZ Biotechnologies became its first incubatee to complete an initial public offering. Before its $71 million debut on the New York Stock Exchange, the cell therapy company spent 18 months at the VDC, a crucial period in which it obtained venture backing from Polaris and landed a $500 million deal with Roche. A number of UMass Boston students who were first hired as interns stayed on to become full-time senior research associates at SQZ. At the end of this banner year, William Brah, the founding director of the VDC, retired. Thanks to his vision and execution, VDC companies have raised a total of $1.56 billion and engaged 2,392 UMass Boston faculty members and students with opportunities ranging from workshops to jobs.

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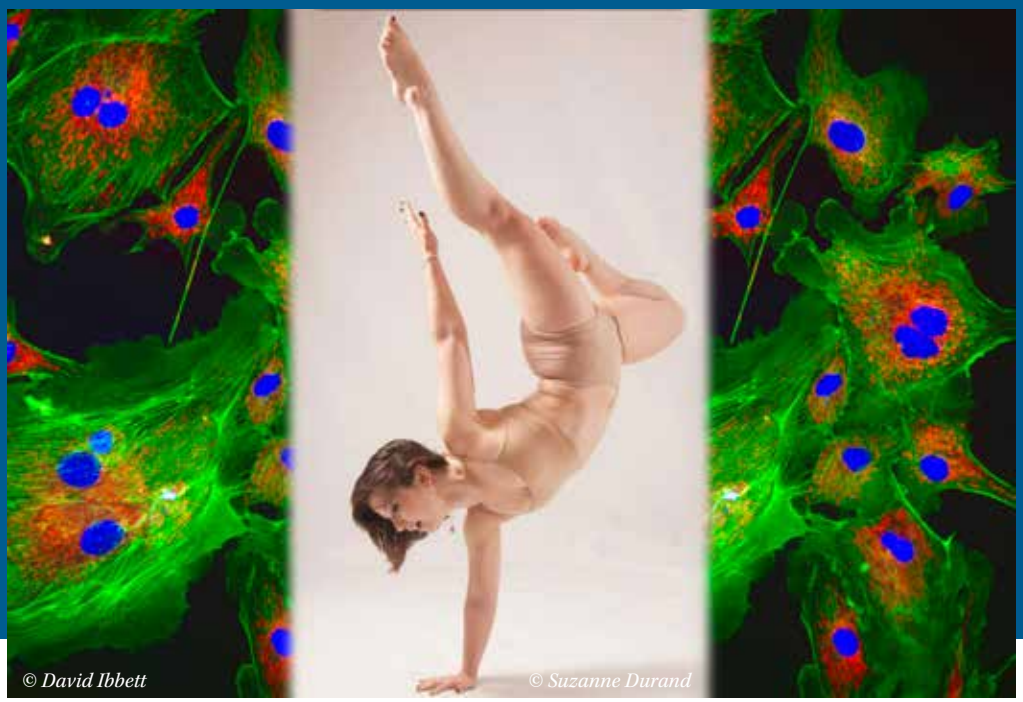
Life at the intersection of biology, music and dance:



Professor Alexey Veraksa collaborated with composer David Ibbett and choreographer Meg Anderson at Multiverse, a concert series merging music with science, and cellular imaging was transformed into cellular imagining. The partnership resulted in *Cellular Dance*, a multimedia ballet animating the motions of living cells. (To learn more about the performance, see www.multiverseseries.org/cellulardance.) For more stories on campus scholarship and research, please visit www.umb.edu/research.

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