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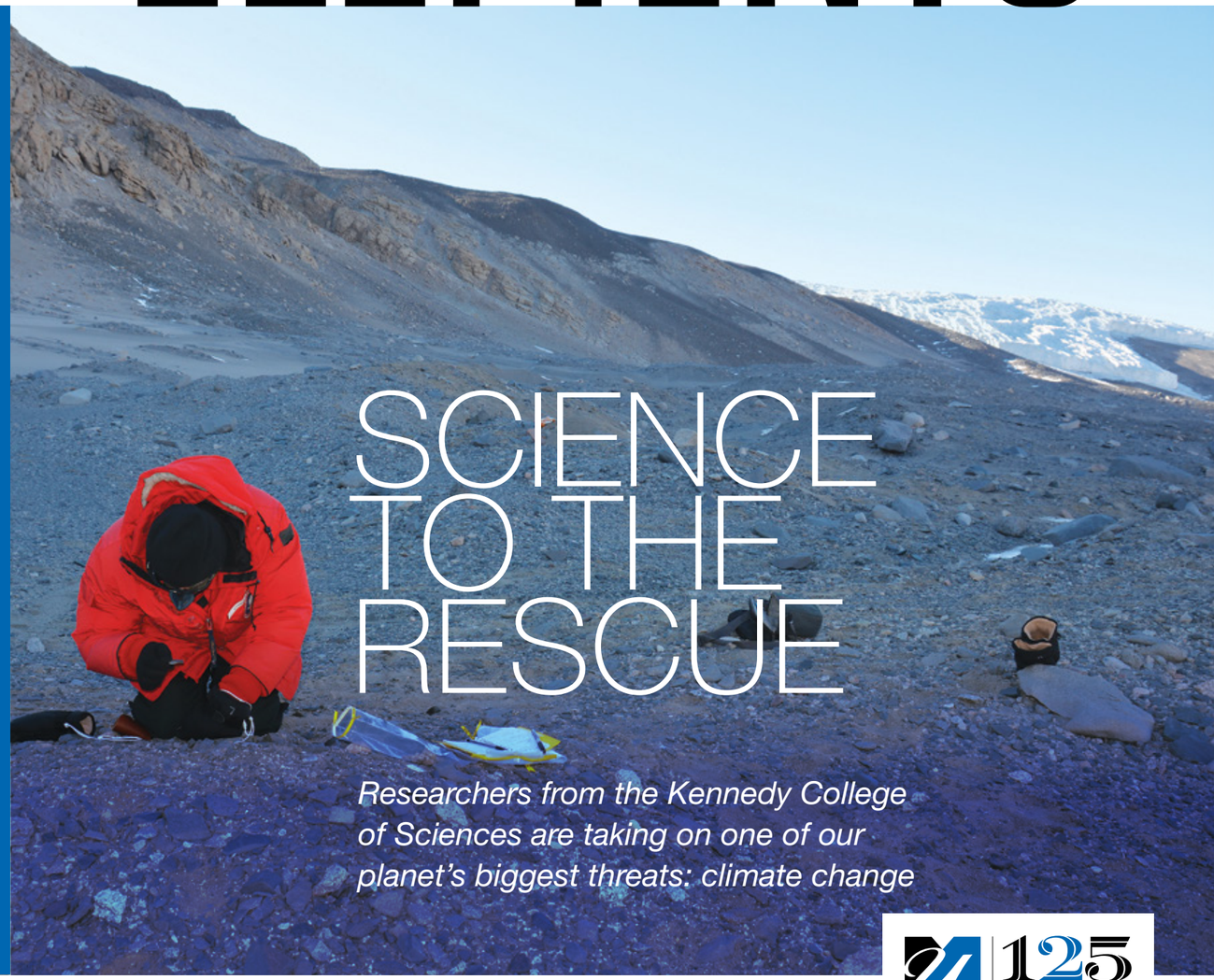
ELEMENTS OF SCIENCE



SCIENCE TO THE RESCUE

Researchers from the Kennedy College of Sciences are taking on one of our planet's biggest threats: climate change

THE UNIVERSITY OF MASSACHUSETTS LOWELL

A LETTER FROM THE DEAN

Dear Alumni, Colleagues and Friends,

Let's have a moment of science.

We are entering an exciting and inspiring time for the Kennedy College of Sciences. Our researchers and students are pushing the boundaries of discovery every day. It is happening in our laboratories, our classrooms and in the field.

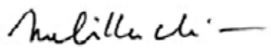
In this publication, you will read about some of the work our faculty are doing to address the complex challenges of climate science, cybersecurity and health care. These are global challenges that can be best addressed by better understanding the science behind them. Our researchers gather data, analyze it and make new discoveries that can bend history and create a path for a better future for generations to come. Our faculty in the departments of Environmental, Earth and Atmospheric Sciences and Chemistry are researching how we can combat climate change and provide for a sustainable future. In Computer Science, faculty are making advances to keep data secure and private in an increasingly connected world. Our faculty in Chemistry are collaborating with peers across campus to study how they can make health care safer for staff and patients. You'll also meet some of our accomplished KCS alumni and students.

The roots of the Kennedy College of Sciences reach back to the earliest days of UMass Lowell, which is celebrating its 125th anniversary this year. We are proud of our legacy of innovation and excellence in education. With that sense of deep pride, we are celebrating some new milestones, including the 50th anniversary of our Radiological Sciences program and the opening of the Schueller Observatory, which will give our students new views on the solar system and beyond.

We are extremely thankful for the support of the university, our alumni and our business and industry collaborators. We are always moving forward and feel good about it. I hope you enjoy learning about the college's progress.

As always, if you have any questions or comments, please contact me at sciences@uml.edu or Noureddine_Melikechi@uml.edu.

Sincerely,



NOUREDDINE MELIKECHI
Professor and Dean
Fellow of the Optical Society of America
Fellow of the American Physical Society
Fellow of the American Association for the Advancement of Science

In this issue

ELEMENTS OF SCIENCE

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ON THE COVER
In Antarctica, where temperatures recently soared to a record 69 degrees, postdoctoral researcher Kelsey Winsor examines water tracks as part of research led by Kate Swanger, associate professor of Environmental, Earth and Atmospheric Sciences. Swanger's work is helping to unlock clues about our planet's changing climate.

PHOTO BY KATE SWANGER

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STUDENTS PITCH IDEAS FOR REDUCING UNIVERSITY'S CARBON FOOTPRINT

Assoc. Prof. Juliette Rooney-Varga of the Department of Environmental, Earth and Atmospheric Sciences challenged students in her climate change course to come up with ways to reduce the university community's carbon dioxide emissions by 10,000 pounds in 10 weeks.

The student team of Lena Dziechowski, Megha Sudheendra and Brittany Segill pitched an idea to reduce five times those emissions—in half the time.

By getting one-quarter of UML students to give up eating meat one day a month, the students calculated a monthly savings of 51,141 pounds of CO_2 emissions.

Their project took home the top prize at the inaugural Rist Institute for Sustainability and Energy Student Innovation Awards. Twelve teams competed, with the top three receiving a share of $1,000 in prize money.

Runners-up included a proposal to create a bike lane to connect campus to the city's commuter rail terminal and a project that would add labels showing the carbon impact of food served on campus.

Left: Asst. Prof. Natalie Steinel and student Maeve Moynihan

A Tale of the Tapeworm

UMass Lowell researchers are studying fish with tapeworm parasites with the goal of improving our knowledge of the human immune system.

The research team, led by Asst. Prof. Natalie Steinel of the Department of Biological Sciences, is studying the interactions between parasites and their host, the three-spine stickleback, to understand how the fish's immune system can be manipulated.

"If we can find out how a parasite can modify the host's immune response, we could potentially target those same pathways to design new immunosuppressive drugs for humans," says Steinel, the project's principal investigator.

"Fish are a major food source for people, so a better understanding of how their immune systems work will also benefit aquaculture and contribute to the production of a healthy food supply," she says.

The research is funded through a five-year grant totaling $1.25 million from the National Institute of Allergy and Infectious Diseases, which is part of the National Institutes of Health.

AI-POWERED GRADING SOFTWARE EARNS HIGH MARKS

For Asst. Teaching Prof. Leslie Farris, grading 150 weekly chemistry quizzes and returning them in a timely manner is no small task.

But as one of the first UML faculty members to use Gradescope, an online tool that uses artificial intelligence to streamline the grading and feedback process, Farris no longer finds the weekly pile of quizzes quite as daunting.

"It's a phenomenal tool that saves so much time," says Farris, who volunteered to pilot Gradescope along with several other members of the Kennedy College of Sciences faculty. "I've gotten a lot of really positive feedback from students about it."

Gradescope doesn't actually grade students' work, but it does digitize and simplify the process to cut grading time in half.

The university has now made Gradescope available to faculty campuswide.

Gradescope was developed at the University of California Berkeley and is now used by faculty at more than 500 colleges and universities. UMass Lowell is the first campus in the UMass system to adopt it.

COMPUTER SCIENCE STUDENTS GET A JUMP START

The Kennedy College of Sciences has launched a summer program to help incoming first-year River Hawk Computer Science majors soar when they get to campus.

Dubbed SoarCS, the four-day program offers rising first-year students a preview of campus life and the computer science curriculum, as well as an introduction to faculty and classmates. Sponsored by Red Hat and others, the program is offered free of charge.

"Aside from learning how to code and discovering software development tools, SoarCS helps students build bonds to form a community of friends and colleagues," says Prof. Fred Martin, the associate dean for student success at the Kennedy College of Sciences, who heads the program.

Last year, 26 students participated. Nearly half of the attendees were the first in their families to attend college, according to Martin.

Arek Wol, left, and Nikhila Gubbala participated in the SoarCS program.

THE GOOD FELLOWS OF KCS

Kennedy College of Sciences Dean and Physics Prof. Noureddine Melikechi (above, left) is among the 27 physicists and 416 scientists of the American Association for the Advancement of Science (AAAS) worldwide who were recently elected as fellows of the organization.

The fellowship program honors those who have made significant contributions to the advancement of science.

Melikechi was recognized for his contributions to understanding laser interactions with materials in detecting cancers and in analyzing Martian soil samples.

Last year, alumnus Eric J. Chaisson (above, right), an astrophysicist and science educator, was elected an AAAS fellow.

Chaisson, who earned a bachelor's degree in physics in 1968, conducts research in physics and astronomy at the Harvard-Smithsonian Center for Astrophysics (CfA) in Cambridge, Mass., and teaches at Harvard University.

He was recognized for his research and teaching, including authoring a dozen books, including the most widely used astronomy textbook in the nation.

Moles Could Help Inspire the Design of Burrowing Robots

Moles, the pointy-nosed tunnel-digging animals that are the bane of lawn owners, groundskeepers and gardeners, may hold the key to improving the use of robots in disaster recovery.

Biology Asst. Prof. Nicolai Konow teamed up with researchers from UMass Amherst and the University of California Merced to research how the Eastern mole moves underground and digs through soil to forage and transport food. According to Konow and his co-investigators, understanding the mechanics of how underground animals like moles move could help in designing burrowing robots that could be deployed to navigate terrain during urban search-and-rescue missions.

The team's findings were published in two refereed journals last year. The first paper appeared on the cover of Journal of Experimental Biology; the second was published in the Royal Society Biology Letters.

Researchers Target Killer Electrons

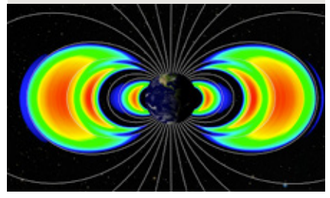
A university research team, led by Physics Prof. Paul Song, is working on a project for the Air Force Research Laboratory to study extremely high-energy particles, known as "killer electrons," in space. Traveling at nearly the speed of light, killer electrons are capable of damaging satellites' sensitive electronics and exposing astronauts to high doses of radiation.

The researchers were awarded a three-year contract, during which they will study how the harmful electrons are generated and how they can be mitigated.

The team designed and built a high-power space radio-wave transmitter, which is one of the primary instruments aboard the Air Force DSX satellite that was launched last year. The transmitter sends out Very Low Frequency (VLF) transmissions into space.

During the mission, the researchers will help operate the VLF transmitter and analyze the resulting data at UMass Lowell's Space Science Lab.

"Our goal is to better understand the wave-particle interaction process," says Song.



YOUNG ALUM WINS TEACHING AWARD

Alexander Eden (left), who earned his bachelor's degree in biology with a minor in education in 2018, struggled at first adjusting to the demands of college. Now a biology teacher at Greater Lowell Technical High School, he wants to use his experience to help high school students succeed in the classroom.

"I think I can help them and serve as a role model," he says. "I'm Hispanic, I'm first-generation, and I came from an urban background. They can look at me and say, 'If he went to college, I can go to college.'"

In recognition of his accomplishments as an educator, Eden was honored by the Massachusetts Association of Science Teachers with the Dawn Sather Exemplary New Teacher Award.

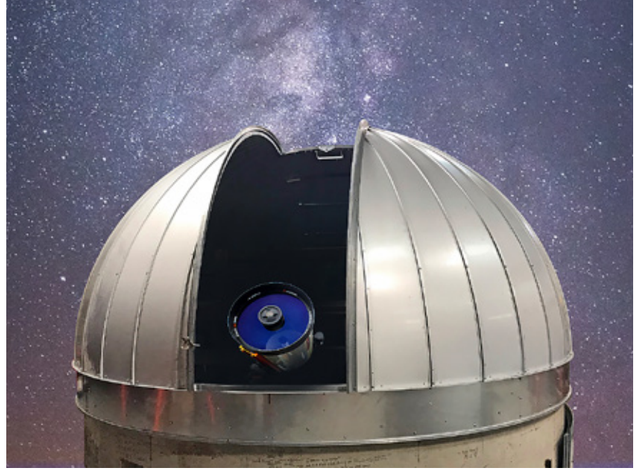
As an undergraduate, Eden participated in the UTeach program, an education minor for students in STEM (science, technology, engineering and math) majors. He is pursuing his master's degree in biology at the Kennedy College of Sciences and plans to go on for his Doctor of Education degree at UMass Lowell.

Sweet Subduction

Asst. Prof. Richard Gaschnig (right) of the Department of Environmental, Earth and Atmospheric Sciences has been awarded a three-year, $222,600 grant by the National Science Foundation to study the chemical exchange that occurs between the ocean crust and the Earth's mantle during the subduction process.

The research will help better understand this geological process, caused by collision of the Earth's tectonic plates. Gaschnig will use molybdenum and thallium isotopes as tracers to follow the chemical transfer.

Gaschnig's research focuses on the use of radiogenic isotopes, stable isotopes and trace elements to understand processes such as the formation and evolution of continents through the study of both igneous and sedimentary materials.



NEW OBSERVATORY BRINGS INFINITY AND BEYOND CLOSER TO CAMPUS

A new astronomical observatory is opening on campus, providing students, faculty and the community with a window on our solar system and beyond.

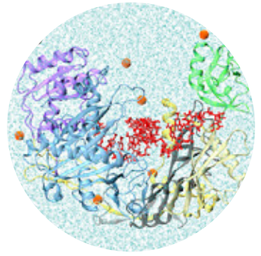
The Schueller Observatory features a Celestron 14-inch Schmidt-Cassegrain telescope that will provide high-resolution views of the craters and lava plains on the moon, the satellites and cloud belts of Jupiter and the rings of Saturn, as well as star clusters and galaxies light-years away.

Undergraduates will be able to use the telescope to conduct observations, lab exercises and capstone projects, while graduate students can use it to do research in the areas of imaging, spectroscopy, photometry and astrometry.

Free public viewings for the community are planned.

The facility is named in memory of alumnus Richard L. Schueller '86, a research scientist who was an avid amateur astronomer. His wife donated his Celestron telescope to the university after Schueller's death in 2015.

CHEMISTRY RESEARCHERS GET GRANT TO HELP ADVANCE DRUG DISCOVERY



A team of UML researchers led by Chemistry Prof. Valeri Barsegov and Prof. Emeritus Kenneth Marx has been awarded a three-year, $340,000 grant by Alnylam Pharmaceuticals to develop computational methods to improve the efficacy of drugs based on RNA interference. They will use computational modeling to study small interference RNA (siRNA), which is a new class of innovative medicines that could potentially treat people affected with rare genetic disorders as well as cardio-metabolic, liver and central nervous system diseases.

RNA interference represents a breakthrough in understanding how genes are regulated in cells. This mechanism has the ability to target proteins involved in disease and has led to a completely new approach to drug discovery and development. Prof. Craig Mello of UMass Medical School co-discovered RNA interference, which earned him a share of the 2006 Nobel Prize in Physiology or Medicine.

ART AND SCIENCE INTERSECT IN VIRTUAL REALITY CLASS

Computer science majors and art and design students are using creativity, artistic concepts and storytelling skills in developing immersive VR/AR (virtual reality/augmented reality) experiences, 3D games and transmedia art in a class that blends the boundaries of art and science.

Prof. Haim Levkowitz, chair of the Department of Computer Science, and Asst. Prof. Misha Rabinovich of the Art & Design Department, are teaching the Interactive Media II class.

The course was launched last year and taught by Levkowitz and Art & Design Asst. Teaching Prof. Yuko Oda. The students collaborated on VR/AR projects, ranging from navigating a museum and escaping a dungeon and an alien spaceship to interacting with a therapy tarantula. For their final presentations, a student from each team used an Oculus Rift headset to demonstrate their project, while the rest of the class watched the interactive experience unfold on a large flat-screen TV.

SCIENCE TO THE RESCUE

BY ED BRENNEN

Researchers from the Kennedy College of Sciences are taking on one of our planet's biggest threats: climate change.

Postdoctoral researcher Kelsey Winsor explores Antarctica's McMurdo Dry Valleys as part of research work led by Assoc. Prof. Kate Swanger.

PHOTO BY KATE SWANGER

Last September, as students were settling in for the fall semester, devastating bushfires were raging in Australia, which was in the midst of its hottest and driest year on record. By January, the still-smoldering fires had consumed more than 42 million acres (a swath roughly the size of Florida) and destroyed 2,800 homes. Thirty-three people and millions of animals were killed. Images of cities such as Sydney and Melbourne shrouded in a toxic gauze of smoke were sadly familiar.

Last summer, wildfires in the Amazon basin destroyed an estimated 2.4 million acres of tropical rainforest and cast a similar smoky pall over Brazil's largest city, São Paulo. In 2018, California experienced its worst wildfire season ever, with more than 8,000 fires burning 1.9 million acres and claiming 103 lives

On a planet that just experienced its hottest decade on record, the disastrous and deadly effects of climate change have become impossible to ignore.

"These fires have been wake-up calls," says Mathew Barlow, a professor in the Department of Environmental, Earth & Atmospheric Sciences (EEAS) who studies how climate variability and change are leading to more severe weather.

Indeed, as the frequency and intensity of wildfires, heat waves, hurricanes and floods continue to grow, climate change has emerged as arguably the greates challenge facing our planet.

"Climate change is an existential problem that affects every facet of our lives, from food security and disease control to migration," says Prof. Daniel Obrist, chair of the EEAS department.

Unfortunately, there's no silver-bullet solution for a problem on the scale and magnitude of climate change, no ingenious scientific discovery that will suddenly undo a century's worth of environmental damage. That is why faculty and student researchers from the Kennedy College of Sciences are addressing climate change on multiple fronts. They're in the field studying how the planet has evolved and how it's responding to change today. They're in the lab developing ways to turn carbon dioxide into fuel for cars. They're using computer models to predict how increasing global temperatures and greenhouse gas emissions might affect weather pattern and ecosystems in the future. And they're using their findings to educate dec - sion-makers at every level—from world leaders at the United Nations' climate negotiations to campus leadership setting UMass Lowell's sustainability goals.

"Science is really the only way that we have to understand how our actions can affect our global climate and environment, and also the potential future impacts that we face," says Assoc. Prof. of Environmental Science Juliette Rooney-Varga, one of UML's leading voices on the climate change issue. "We have no other way but science to make sense of them."

Vice Chancellor for Research and Economic Development Julie Chen says KCS faculty have embraced a multidisciplinary approach to climate change, which she says is "necessary for such a complex challenge."

"KCS faculty are contributing to our understanding of the biosphere and how earth systems—air, water, land, living organisms—interact with each other and are affected by human activities," Chen says. "They are also leaders in educating our students, the general public, and policy and decision-makers about the science and societal impact."

Here's a look at some of that work being done around the Kennedy College.

TURNING CO_2 INTO FUEL

Knock on any door at the Olney Science Center, and you'll find an expert who agrees: A leading cause of climate change is the increase in greenhouse gas emissions through the burning of fossil fuels. When scientists at Hawaii's Mauna Loa Observatory began measuring global atmospheric carbon dioxide (CO2) levels in 1958, it was 315 parts per million (ppm). In 2018, it was 407.4 ppm—its highest in the last 800,000 years.

"Sooner or later, if there's too much CO2 in the atmosphere, we're going to begin to notice it," says Prof. David Ryan, chair of the Chemistry Department, who explains that CO2 produces carbonic acid when combined with moisture. The process has already led to ocean acidification, and it will eventually make it uncomfortable to breathe.

"We can either stop generating so much CO2, or we can recycle it into something that we can use," says Ryan, who is collaborating with colleagues from the Physics Department to develop a "reverse combustion process" that combines CO2, water and energy from the sun to create a hydrocarbon that can fuel a conventional diesel engine.

"It has tremendous potential to basically give you net-zero carbon," says Ryan, who recently published a paper on the process in the journal Chemical Physics Letters. The work stems from a project originally headed by Physics Prof. Mengyan Shen, whose team received a three-year, $417,000 grant from the National Science Foundation in 2012.

Ryan, who has received previous funding from the Department of Energy to find ways to sequester and store CO2 in the deep ocean and underground wells, says the challenge is in capturing the CO2 from power plants, home heating systems and automobiles. But if that can be done efficiently Ryan can envision extrapolating the process to large areas (say, several square miles of desert) to create enough hydrocarbon to power entire cities.

Ryan is also developing technology to safely and cleanly produce hydrogen gas to power the fuel cells of electric vehicles. The process uses water, CO2 and cobalt metal particles and produces zero emissions.

"If the release of CO2 into the atmosphere could be curtailed by using a hydrogen process, that's great," Ryan says. "If we can consume CO2 and start to reverse the process, we're probably better off."

Chemistry Prof. David Ryan (right) is working on a project to recycle CO_2.

UNDERSTANDING RISING SEAS

Due to warming oceans and melting glaciers, it's estimated that sea levels are rising at a rate of about one-eighth of an inch per year. Between 1993 and 2018, the global mean sea level has gone up 3.2 inches.

As the sea rises, tidal flooding (also known as nuisance flooding) is becoming more common along the coasts. That's where EEAS Asst. Prof. James Heiss is investigating what happens when the intruding salt water mixes with groundwater.

"It's important because many coastal communities use groundwater as a source of drinking water," Heiss says. "Salt water is very corrosive, so if you have more nuisance flooding then there's going to be saltier groundwater and sewer infrastructure may not last as long."

Conversely, Heiss says, when fresh groundwater washes out into the sea, it changes the chemistry of the ocean. That can lead to algal blooms that are harmful to fish

Heiss and his student researchers are installing wells and water quality sensors in areas that experience coastal flooding, including Waquoit Bay on Cape Cod. They use the collected data to build groundwater computer models to try to replicate the field observations, which leads to additional analysis.

"From a climate point of view," Heiss says, "if we understand the impact of those increasing events on groundwater, then coastal communities can start thinking about how to distribute their sewer infrastructure to avoid areas that are going to experience nuisance flooding."

CONNECTING CLIMATE SCIENCE AND MERCURY POLLUTION

At the Parker River National Wildlife Refuge on Plum Island in Newbury, Mass., Obrist and Ph.D. student Ting Wang are literally digging for answers, trying to figure out why the salt marshes are such a hot spot for mercury pollution.

Along with research assistants Sean Haggert and Emma Daly, they've spent the past two years examining the chemistry of the soils, which date back 10,000 years to the end of the last Ice Age.

"There's a tremendous amount of mercury sitting in these soils, which we suspect is coming from some natural processes as well as atmospheric depositions," says Obrist, an expert in the atmospheric cycling and biogeochemistry of mercury who's been studying its environmental impact for more than a decade.

Ph.D. student Ting Wang, bottom photo, and Prof. Daniel Obrist and student research assistant Emma Daly, left photo, collect soil samples from the Parker River National Wildlife Refuge on Plum Island.

For hundreds of years, humans have released mercury into the environment through mining and industrial activities. Realizing the harmful effects of the toxic liquid metal, the international community adopted a treaty on mercury pollution in 2013. The good news is that the treaty has helped reduce global mercury emissions; the bad news is that the vast amount of mercury already in the environment is here to stay.

"We have these massive reservoirs sitting in surface soils because we dumped mercury on top through atmospheric deposition for 150 years," Obrist says. "That mercury still sits there, making its way from those soils to the watershed, to the fish and to humans and mammals.

Obrist and his team have found that the blood mercury levels in Plum Island's salt marsh sparrows, a threatened species, are among the highest on the Eastern Seaboard. As the salt marshes are impacted by rising sea levels and coastal flooding, it could spell trouble for humans as well

"If we have these disturbances or changes in the salt marshes, these large legacy pools (of mercury) sitting in these soils are going to get mobilized," says Obrist, who is seeking NSF funding for the work.

He's already received a three-year, $873,000 NSF grant for another study of mercury pollution—this one conducted in a 3,000-acre forest owned by Harvard University near the Central Massachusetts town of Petersham. There, Obrist and a colleague from Columbia University are using atomic fluorescence analyzers to measure the forest's uptake of atmospheric mercury, something that's never been done before in forests.

Obrist has also led an international group that conducted a long-term study of the origin of mercury pollution in the Arctic tundra, which is home to nearly half of the world's total soil mercury deposits. Their study, which was published in the journal Nature, found that 70 percent of those deposits came from mercury gas being absorbed by tundra plants and then transferred to the soil when the plants shed leaves or die.

As rapid climate change causes the tundra to thaw and erode, Obrist warns that these large legacy pools of mercury could be released into rivers, lakes and the Arctic Ocean.

Assoc. Prof. Kate Swanger stores her Antarctic samples at the National Ice Core Laboratory in Colorado, where the freezer is set to -36 degree Celsius.

PHOTO BY JOHN FEGYVERESI

CRACKING COLD CASES IN ANTARCTICA

On the polar opposite end of the planet, on the desolate continent of Antarctica, is where EEAS Assoc. Prof. Kate Swanger likes to spend her time studying glaciers, ice sheets, permafrost, sediment and rocks to learn about past climates. As a paleoclimatologist, Swanger has been to Antarctica eight times. She finds the continent "addictive.

"I like it because I get cut off from the world—no internet, no phones, no email—and I can actually focus," Swanger says. "You're just there doing research in a part of the world that is as untouched by humans as we can find.

In 2015, Swanger and postdoctoral researcher Kelsey Winsor spent six weeks collecting ice and sediment samples from Antarctica's McMurdo Dry Valleys on a project funded by a $330,000 NSF grant. They believe the clean glacial ice they found a half-meter beneath the sediment surface could be 100,000 years old.

"Finding ice that old was kind of surprising, because you'd think it would have melted out by now," says Swanger, who notes that temperatures can climb above freezing in the summer months in the dry valleys. (In February, the thermometer hit 69 degrees Fahrenheit at an Antarctic research base, the highest temperature ever recorded on the continent.)

Antarctica, which holds 90 percent of the world's fresh water in its ice, is starting to show signs of vulnerability to climate change, Swanger says.

"Fifteen to 20 years ago, the consensus was that a lot of the Antarctic ice sheets were pretty stable. They could warm up a bit and remain intact," she says. "But that idea has changed in the past 5 to 10 years. It might be more vulnerable to climate warming than we think, which is kind of terrifying. That means that even with 2, 3 or 4C (Celsius temperature rise), we could have a lot more ice melting than we expected."

Unlike most places in the world where glaciers melt and "retreat" as temperatures warm, Swanger says glaciers in the McMurdo Dry Valleys actually have advanced under warmer conditions.

"They're so cold and precipitation-starved, so when it gets warmer, they probably get more precipitation and can grow," she says.

"Paleoclimate is really important," she says. "If I help to contribute anything to the climate change discussion, it would be to better understand the natural system and the fluctuations it naturally goes through By studying the natural world, we can see how far outside the natural we are right now."

LEVERAGING POLICY WITH SCIENCE

When Juliette Rooney-Varga was a freshman biology major at Colby College, she believed science alone could solve the world's climate woes.

"I thought, maybe naively, that policymakers would always be informed by science," she says. "If science was able to elucidate how humans interacted with nature and how nature affected us, I thought we would use that knowledge for the betterment of society."

As an associate professor of environmental science, Rooney-Varga now sees the climate change issue in a different light

"Science is our best window into the future; it is always important. But it's not where the most leverage is right now with this problem," she says. "There's no techno-fix to this problem. The scale is too big."

That's why Rooney-Varga focuses so much of her work on climate change education, communication and decision support. She serves as director of the university's Climate Change Initiative (CCI), an interdisciplinary group of 30 faculty members from 13 academic departments that collaborates on research, teaching and outreach activities. She also partners with Climate Interactive, a nonprofit think tank based at the Massachusetts Institute of Technology that develops simulations and interactive workshops that have been used by everyone from world leaders at the U.N.'s climate negotiations and bankers at HSBC to Bill Nye, "the Science Guy."

Their latest creation is En-ROADS, or Energy Rapid Overview and Decision-Support, a free policy simulation model that debuted at the UN climate negotiations in Madrid in December. The simulator, which can be used in conjunction with a climate workshop and role-playing exercise, allows users to adjust variables such as energy supply, transportation, economic growth and carbon removal to see how they affect global temperature increase by 2100.

Rooney-Varga published a paper in December showing that taking part in the role-playing exercise (called Climate Action Simulation) not only improves participants' knowledge about climate change, but also boosts their personal and emotional engagement with climate issues and leaves them feeling empowered to address climate change.

Rooney-Varga and EEAS graduate student Maggie Hensel are currently researching the impact of simulation-based climate and energy education tools in programs designed to foster academic success (such as Upward Bound) among low-income, first-generation college students across the United States. Called the Geo-Interactive Project, the work is funded by a three-year, $340,000 NSF grant.

Through her work with Climate Interactive, Rooney-Varga has also recently published research showing that displacing coal with wood for power generation can increase CO_2 emissions and make climate change worse in the future. Nearly two-thirds of the European Union's renewable energy comes from bioenergy, or the burning of wood, most of which is harvested from the southern United States.

"The real problem is that current policy, whether at the international, national, state or city level, views all forms of bioenergy as carbon-neutral," Rooney-Varga says. "They want to do good, but instead they could be making things worse by upping their use of bioenergy through these types of policies."

Assoc. Prof. Juliette Rooney-Varga discusses En-ROADS at the American Meteorological Society's annual meeting in Boston.

GLOBAL WARMING

THE HEAT IS ON

2019 was the second-hottest year on record, trailing only 2016. It was 1.8 degrees Fahrenheit warmer than the 1951 to 1980 mean.

The past decade (2010-2019) was the hottest ever recorded on the planet.

The past five years each rank among the five hottest since record-keeping began in 1880.

19 of the hottest 20 years have occurred during the past two decades.

The average global temperature is now more than 2 degrees Fahrenheit (a bit more than 1 degree Celsius) above that of the late 19th century.

Source: NASA and the National Oceanic and Atmospheric Administration (NOAA)

MELTING POLAR ICE CAPS

ARCTIC SEA ICE NEARS RECORD LOW

The extent of Arctic sea ice at the end of summer 2019 measured 1.60 million square miles, which was effectively tied with 2007 and 2016 for second-lowest since modern record-keeping began in the late 1970s.

Source: NASA

SPREADING THE WORD

Despite the dire headlines, Barlow is "cautiously optimistic" about combating climate change.

He says he's seen people come together to solve big problems before, citing the United States' Clean Air and Clean Water acts and the Montreal Protocol to phase out chlorofluorocarbons and protect the ozone layer.

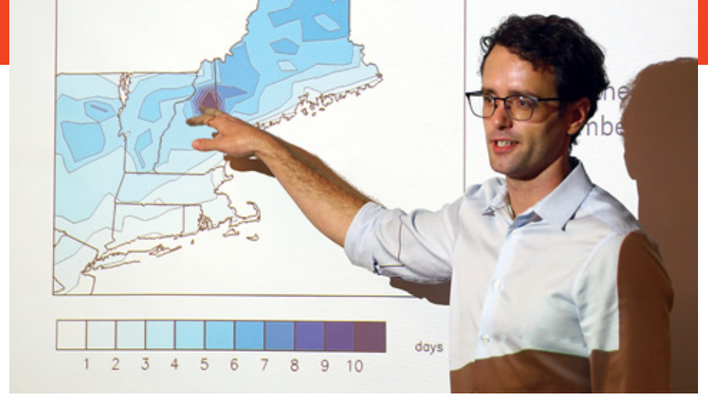
"As a global community, we've shown that we're capable of making these decisions," Barlow says. "It's really a matter of political will and pushing back against trillion-dollar business interests. It's not easy, but it's doable."

Barlow's doing his part through two streams: research and communication.

On the research side, he's in the final year of a three-year, $454,000 NSF grant to study extreme precipitation and flooding in the Northeast. Working with Assoc. Prof. Jian-Hua Qian and postdoctoral research student Laurie Agel, Barlow is looking at how well current computer climate models do in correctly reproducing the causes of heavy rainfall events. Barlow is also in the middle of a three-year, $216,000 NSF-funded project on the interaction between the troposphere and stratosphere.

On the communication side, Barlow is providing policymakers around the world with the most current scientific knowledge by serving as a lead author on an upcoming assessment report from the Intergovernmental Panel for Climate Change (IPCC). Established in 1988 by the United Nations Environment Programme and the World Meteorological Organization, the IPCC is an internationally recognized scientific authority on climate change. Every six or seven years, it issues a voluminous report summarizing the existing climate science, the potential future risks and adaptation and mitigation options. The last report, released in 2014, was 1,500 pages.

"We're trying to make it shorter this time around, because if it's so long that nobody reads it, then that defeats the point of communicating," Barlow says. "Trying to do the best possible science and also get it to people in a form they can use is challenging."



Asst. Prof. Christopher Skinner, left looks at how climate change impacts extreme weather events.

TRACKING RIVERS IN THE SKY

EEAS Asst. Prof. Christopher Skinner, who studies how climate change influences extreme weather events such as heavy rainfall, heat waves and droughts, recently traveled with Barlow to Cheyenne, Wyo., to visit the supercomputing center run by the National Center for Atmospheric Research (NCAR).

"It's an amazing facility," says Barlow, who learned that the computers generate so much heat that a hydro cooling system transfers the heat out of the building and into town, where it's used to melt snow on the city's sidewalks.

Skinner is harnessing NCAR's supercomputing power for an NSF-funded study he's conducting on atmospheric rivers, which are narrow bands of fast-moving, highly concentrated water vapor in the atmosphere that are invisible to the naked eye but can be detected by satellite.

"They look like rivers flying through the sky," says Skinner, who notes that they're most common along western boundaries of continents, providing about half of the annual precipitation for California, Oregon and Washington. "If you condense all the water in one of these events from its gaseous phase to water phase, it's more water than you'll find in the Amazon River, so they're tremendously important for the hydrological cycle."

Using NCAR's Community Earth System Model (one of about three dozen climate models available to scientists worldwide), Skinner and a colleague from Yale University are running a series of lengthy simulations to understand how atmospheric rivers respond to changes in the earth's system. By adjusting boundary conditions (or the "ingredients" of an extreme event) such as temperature, CO_2 levels and even the presence of ice sheets, they hope to get a better understanding of how atmospheric rivers shaped hydrologic changes in the past and how they might respond to (or fuel) future climate change.

The computer model work requires patience. It takes several months in real time to run a simulation that covers thousands of years. Skinner says one of the challenges is writing algorithms that can sift through the simulation's terabytes of data to automatically identify atmospheric river events and aggregate them for study.

While Skinner and his graduate research assistant, Tyler Harrington, focus on the physical science, he hopes that the findings can help inform people to make the best decisions possible going forward.

"If we can confidently say that, 'Look, if we continue on this pathway, heat waves will become X percent more common,' that may motivate people to make changes in their behaviors," says Skinner, whose portion of the three-year NSF grant is $225,000.

EDUCATING THE EDUCATORS

As part of Skinner's NSF grant on atmospheric rivers, he had to include an outreach component that communicated the broader impact of his work. So it was serendipitous to learn that one of his EEAS colleagues, Assoc. Teaching Prof. Lori Weeden (inset), ran a professional development workshop for local K-12 teachers each summer on how to incorporate climate change education into their lesson plans.

"It became a really strong part of our grant," says Skinner, who led a session at the workshop that showed teachers an exercise they can do with students to predict the declining number of snow days that New England schools will have as a result of global warming. Skinner will help fund the workshop for the next two years with funds from his NSF grant.

Weeden, whose research interests include soil carbon sequestration and surface water chemistry, created the workshop in 2018 with a $6,000 grant from the university's Sustainability Encouragement & Enrichment Development (S.E.E.D.) Fund. She was inspired to do so after seeing how little climate science education kids were getting in middle school and high school.

Rooney-Varga says students' interest in climate change has never been stronger.

"This is a critical decade for climate action, and there's never been a more important time for students to be engaged in our democracy and the issue of climate change," she says.

Students agree.

"I've always believed in climate change, but my concern has grown as I've gained more knowledge about it," says David Coe, a third-year Ph.D. candidate in marine sciences and technology who is researching changes to New England's fall season due to climate change.

Coe was among several Kennedy College students and faculty to present their atmospheric science research at the 100th annual meeting of the American Meteorological Society (AMS) in January in Boston—where climate change made its presence felt. On the conference's opening weekend (Jan. 11-12), temperatures soared to 70 degrees in Boston on consecutive January days for the first time since record-keeping began in 1872. That Sunday, Boston hit a record high of 74 degrees—more than 40 degrees above average. Globally, the average temperatures for the month were 2.05 degrees above average, making it the planet's warmest January on record.

"It's totally bizarre. It felt like summer," says EEAS Prof. Frank Colby, who presented his research on why weather models had trouble forecasting the track of 2018's Hurricane Florence.

As hundreds of conference attendees milled around the poster presentations at the Boston Convention and Exhibition Center, graduate student Michael Follensbee struck an optimistic tone when asked about climate change.

"People are no longer indifferent," says Follensbee, who presented the NSF-funded research work being done with Barlow on changes in the Siberian hydroclimate. "I just hope that people try to be proactive about it rather than saying, 'We're screwed,' and burying their heads in the sand."

Researchers from the Kennedy College of Sciences are doing their best to make sure that doesn't happen.

GREENHOUSE GAS EMISSIONS

GLOBAL GREENHOUSE GAS KEEPS RISING

Total carbon dioxide emissions from fossil fuels and industry totaled a record 36.8 billion tons in 2019, a 0.6 percent increase from 2018.

While U.S. emissions fell 1.7 percent in 2019, they grew in China (by 2.6 percent), India (1.8 percent) and the rest of the world (0.5 percent).

Source: Global Carbon Project

GLOBAL SEA LEVEL RISE

THE TIDE IS HIGH

Global mean sea level has risen about 8–9 inches since 1880, with about a third of that coming in just the last two and a half decades.

In 2018, global mean sea level was 3.2 inches above the 1993 average.

Source: National Oceanic and Atmospheric Administration (NOAA)

DIGITAL DEFENSE

RESEARCHERS SEEK TO BOOST PROTECTION AGAINST CYBER THREATS

BY EDWIN L. AGUIRRE

Malicious computer viruses lurk in the background, silently waiting while unsuspecting victims work, browse social media or shop online. They masquerade as innocuous digital ads or emails sent from a familiar address. Once triggered, they spread like wildfire and are often difficult to contain.

These viruses can wreak havoc on personal finances and privacy. They can paralyze businesses, damage reputations and bring government entities to a grinding halt.

The size or scale of an organization, or the depths of its technical expertise, do not guarantee protection from cyberattacks.

Consider, for example, that in July 2017, about 50 million Facebook accounts were hacked by cybercriminals. That same year, Equifax, one of the largest consumer credit reporting agencies, reported that more than 145 million of its client accounts had been compromised. And from 2014 to 2018, roughly 500 million Marriott customers had their account information stolen.

Meanwhile, the U.S. intelligence community says Russian hackers and trolls allegedly mounted a broad campaign to influence America's 2016 U.S. presidential election, and warns the next target is likely the 2020 presidential contest. Around the world, ransomware attacks, in which malware is unleashed to deny access to computer systems or data until a ransom is paid, are also on the rise.

The cost of such cyberattacks is staggering. According to Juniper Research, cybercrimes accounted for $2 trillion in lost revenues in 2019. And businesses and governments are spending big money to try to defend themselves. Global Market Insights estimates that by the year 2024, the market for cybersecurity products and services will reach $300 billion.

“THE CYBER RANGE ENHANCES the university’s learning and research capabilities by giving students the opportunity to practice cybersecurity exercises in a safe, interactive environment.”

—COMPUTER SCIENCE PROF. FRED MARTIN

A CAT-AND-MOUSE GAME

UMass Lowell has been devoting more resources to expanding its cybersecurity research and education programs to help defend and secure the country’s critical information systems and networks.

“The problem is, everything is running on software,” says Computer Science Prof. Xinwen Fu, a cybersecurity and cyberforensics expert and director of UMass Lowell’s Center for Internet Security and Forensics Education and Research (iSAFER). “It’s really hard to create a secure software.”

Another problem, Fu notes, is that people know how to use their mobile devices, but many lack the knowledge, experience and training to configure their operating systems and make them secure. “The hacker is always looking for ways to attack and exploit your system’s weaknesses,” he says. “It’s only a matter of time before it gets penetrated.”

Computer Science Asst. Prof. Sashank Narain agrees. “There is no device in the world that is totally secure. It’s a cat-and-mouse game between the hacker and the protector,” says Narain. “A protector has to think of a hundred ways to secure the system; the hacker only needs to find one weak point, and the hacker wins.”

He adds, “You can protect yourself only from known attacks. Any new, unknown attacks will leave you vulnerable.”

In 2016, the university was designated by the National Security Agency and the Department of Homeland Security as a National Center of Academic Excellence in Cyber Defense Research (CAE-R), in recognition of its decades-long leadership in cyberdefense education, training and research.

“UMass Lowell is one of only four universities in the state that carry the designation," says Fu. “The designation provides federal funding opportunities that are open only to CAE-R institutions.”

Aside from iSAFER, UMass Lowell is also home to the Center for Terrorism and Security Studies. Faculty from computer science and engineering to business and criminal justice are engaged in research in all aspects of cybersecurity, including Big Data, data mining and business analytics, digital forensics, health data security, network and mobile security, counterterrorism and transportation security.

“Our work is being supported by the National Science Foundation, the Department of Defense, the Department of Justice, DARPA, the Army Research Lab and many others,” says Fu.

NEW CYBERSECURITY RESEARCH LAB OPENS

Last November, UMass Lowell opened a new center for cybersecurity education, research and workforce development called the Cyber Range that will help students prepare for careers in the high-demand field.

The state-of-the-art lab facility, which is located on the fourth floor of the Wannalancit Business Center near East Campus, uses real-world scenarios and the latest technology to teach students how to defend against an array of cyberattacks, implement security measures to mitigate network vulnerabilities and harden different operating systems

“The Cyber Range enhances the university’s learning and research capabilities by giving students the opportunity to practice cybersecurity exercises in a safe, interactive environment,” says Computer Science Prof. Fred Martin, the associate dean for student success at the Kennedy College of Sciences.

“Each workstation allows students to test their cybersecurity skills by facing live cyberattacks in a sandboxed environment. The machines are isolated from the internet during live exercises,” says Narain.

Fu and Narain, who are members of the Cyber Range faculty along with Assoc. Prof. Chunxiao (Tricia) Chigan of the Francis College of Engineering’s Department of Electrical and Computer Engineering, are currently training a student team that will participate in the National Collegiate Cyber Defense Competition (NCCDC), sponsored by Raytheon. The River Hawk team made the cut in the qualifying round to advance to the Northeast Regionals, which was scheduled to be held at the University of Maine this spring.

Fu says the Cyber Range is planning to add more faculty members this year.

HOT SKILLS

Demand for computer security skills is strong, with the number of job openings in cybersecurity predicted to top 3 million by 2021, according to a recent industry report. And UMass Lowell sees a role for itself in preparing the professionals to fill those jobs

“We are proud to provide UMass Lowell students with the very best training to prepare them for careers in this important field,” UMass Lowell Chancellor Jacquie Moloney

Computer Science Prof. Xinwen Fu, left, and undergraduate student Chukpozohn Erastus Toe conduct cybersecurity research at UMass Lowell’s new Cyber Range facility.

said during the Cyber Range's official opening, whic drew representatives from Red Hat, MITRE, Spinnaker Security, the Massachusetts Technology Collaborative's MassCyberCenter and state and local official

The opening of the Cyber Range comes as the university is expanding its computer security offerings. This fall, the Department of Computer Science will offer an undergraduate option in cybersecurity

"Right now, we have more than 900 students majoring in computer science; we have doubled the number of undergrads in the last five years," says Prof. and Chair Haim Levkowitz.

UMass Lowell's other current academic offerings include training for the NIST Cybersecurity Framework, which is a set of best practices, standards and recommendations set forth by the National Institute of Standards and Technology, as well as a master's degree in security studies, an online graduate certificate in cybersecurity and other programs from the departments of Computer Science, Electrical and Computer Engineering and the School of Criminology and Justice Studies.

THE INTERNET OF THINGS

Last fall, the National Science Foundation (NSF) awarded two grants, totaling $1.54 million spread over three years, to Fu and his collaborators from the University of Central Florida (UCF) for their research on improving the security and privacy of the Internet of Things, or IoT. This refers to a network of separate physical and virtual devices that communicate with each other wirelessly, without human interaction or intervention.

"IoT is booming, with the popularity of smart, mobile devices," says Fu. "However, these devices, if left unprotected, will allow hackers to be able to collect or manipulate data using a Bluetooth connection."

The first grant, worth more than $1,198,000, focuses on building a secure, trustworthy and reliable air quality monitoring system for smart, connected communities.

"We are building sensors so that the air quality data cannot be manipulated by anybody, even by those who can physically touch and access the sensors," says Fu.

A total of 110 prototypes will be deployed across Boston and Orlando. The data collected will be transmitted to a central server for analysis.

"The techniques used for securing the sensors can also be applied to protect all kinds of IoT devices, including security cameras, hospital medical sensors and virtual home assistants, so that administrators and researchers can make correct decisions based on trustworthy data," says Fu.

The second grant, worth more than $340,000, provides education funding to build low-cost, state-of-the-art IoT security laboratory kits for use in university classrooms.

Computer Science Asst. Prof. Sashank Narain (standing), and graduate student Rakshith Singh test the security configuration of a system at the Cyber Range.

"We will teach students how to design and build secure IoT devices. They will experiment with the devices and learn how to defend them from cyberattacks," explains Fu, who is the principal investigator for UMass Lowell on both projects.

"Our project is the first to use an industrial-grade microcontroller with a crypto coprocessor to systematically develop teaching materials, including hands-on labs and case studies on IoT security and privacy," says Fu. "This IoT platform costs significantly less than existing pla - forms, and will allow for the development of a full-fledged IoT labor - tory with hardware security modules that is affordable for students and institutions."

In February, the U.S. Department of Energy awarded a $3 million grant to Fu and his UCF co-researchers to secure IoT-based automation systems used in smart buildings. Today's smart building technology uses wireless sensors, equipment controllers and cloud-based software to control heat, ventilation, air-conditioning and lighting systems to save energy, increase comfort and improve air quality.

"Depending on its size and type, each building can have 50 to 100 controlled devices, while each device can have on average 10 sensors. That is, each building can have 500 to 1,000 IoT gateway points. With such a large network, vulnerabilities exist that could allow malicious hackers to attack those sensors, connect their computer to the building's system and attack all devices hooked into the entire building," says Fu. "My job is to examine network weaknesses and design defense measures against such cyberattacks."

GET SMARTER

For his part, Narain has been studying privacy attacks on smartphones by hackers exploiting the phone's sensor side-channels. According to Narain, by using machine learning algorithms and monitoring the smartphone's gyroscope and microphone, it is possible for a hacker to infer the user's keystrokes with up to 95 percent accuracy, giving the hacker access to the user's name, password and other sensitive information. And by using models and algorithms and monitoring the phone's accelerometer, gyroscope and magnetometer, a hacker can deduce the user's travel routes and locations with high accuracy. Narain has applied for a federal grant to develop ways to mitigate these privacy attacks. The application is currently under review.

For the NSF air quality monitoring project, Fu has hired electrical engineering senior Brandon R. Keating to design the sensor's printed circuit board, assemble its various components and fabricate the housing with a 3D printer at the Cyber Range.

Keating is taking a graduate course on cybersecurity, with Fu as his adviser. The two have been working on a patent pertaining to semiconductors.

"My experience with cybersecurity is more under the surface of things," Keating says. "Part of my job is to design things with built-in resistance to cyberattacks or infiltration. My involvement is more to prevent leaks in a system than to directly repel attackers. The point of cybersecurity is to keep out infiltrators at every level. If there is a flaw in the system, one can assume it will be exploited by hackers. This attitude keeps us on our toes."

GRACE CHIN '20

COMPUTER SCIENCE MAJOR REBOOTS AND FLOURISHES

BY KATHARINE WEBSTER

Grace Chin started her college career studying computer science at Germany's RWTH Aachen University. After a semester and a half, she realized that the university's style of teaching in large lectures wasn't a good fit.

Chin applied to UMass Lowell for the opportunity to study in smaller classes where she could interact with faculty. Once here, she rebooted, starting with Computing I. Before long, she was working as a paid research assistant with Computer Science Prof. Fred Martin.

After four semesters of programming classes, Chin got a professional co-op job in Red Hat's data storage division, where she worked for the second half of 2019.

"The co-op was pivotal for my career. It helped me realize what I liked, so it oriented me both academically and professionally," says Chin, a senior. "I really lucked out coming to UMass Lowell. I think it is a hidden gem for computer science."

Now she's taking a class in cybersecurity with Asst. Prof. Sashank Narain.

The goal of that class is to prepare the brand-new UML team for the National Collegiate Cyber Defense Competition (NCCDC), sponsored by Raytheon. The team made the cut in the qualifying round to compete at the regional level at the University of Maine.

"Every practice feels like drinking from a fire hose," Chin says. "It's a really good life lesson, because I'm learning more about teamwork, communication and time management."

The Fabric of Innovation

UML RESEARCHERS WEAVE TOGETHER EXPERTISE TO CREATE GERM-FIGHTING GARMENTS

BY MADELINE BODIN

The ambulance screeches to a stop outside the hospital, siren wailing. A medical team hustles a patient through the hallway to the operating room. Surgeons scrub. Healing medicine drips into a patient's veins. Family members pace the waiting room. Every hospital is filled with life-and-death drama. But another crisis that plays out in hospitals across the globe is silent and invisible: microbial cross-contamination.

According to the Centers for Disease Control and Prevention (CDC), one of every 31 hospital patients in the U.S. picks up an infection related to their care. These infections cost patients' lives and billions of dollars in additional health care expenses. For nurses and other health care professionals, frequent exposure to pathogens makes their workplace risky.

Chemistry Prof. Yuyu Sun and Assoc. Prof. Nancy Goodyear of Biomedical and Nutritional Sciences are trying to change that. The two are leading a project to develop a material that offers health care workers true protection from harmful microbes. The material will not only survive laundering, but its anti-microbial properties can also be boosted in the wash with bleach. They are undertaking the project with a two-year grant of more than $417,000 from the U.S. National Institute of Occupational Safety and Health (NIOSH).

Microbe-laden clothing is a big problem in hospitals. Studies show that soft fabrics are quickly contaminated by bacteria and other pathogens. From the fabric, the pathogens can be transferred to clean surfaces, including a nurse's just-washed hands. Scrubs are washed every 1.6 to 1.8 days, Goodyear says, while white coats are washed even less frequently—every 11.3 to 13.5 days. About 37 percent of hospital facilities laundered their privacy curtains only when they were visibly soiled with blood or body fluids, according to Goodyear. That's a lot of opportunities for fabrics to transmit potentially deadly germs.

The anti-microbial fabrics developed by Sun and Goodyear through the NIOSH-funded research could lead to safer working conditions for health care professionals, and to healthier hospital patients, too.

CUT FROM THE SAME CLOTH

Although their expertise is in different disciplines, a common thread runs through Sun and Goodyear's research: Both scientists are dedicated to improving everyday materials to make us—and our planet—healthier.

In his laboratory in Olney Science Center on North Campus, Sun pursues research in anti-microbial and biofilm-controlling systems, drug delivery and biomedical devices. His undergraduate and master's degrees were in textile engineering, and he has an affinity for solving everyday problems by using textiles with special properties.

Three years ago, Sun won a grant from the Walmart Foundation to develop a more efficient fabric-dyeing process. He used nanotechnology to create dyes that are pulled into fabrics using magnetic fields. Controlling the dyes with magnetic fields means that more dye winds up on the fabric and less dye winds up in wastewater, where it can be a major pollutant.

Chemistry Prof. Yuyu Sun, left, and Biomedical and Nutritional Sciences Assoc. Prof. Nancy Goodyear are conducting research to reduce the occupational burden of exposure of hospital workers to harmful microorganisms that can cause various infections.

Sun has a patent pending on the technology.

Since he was a doctoral student at Fudan University in Shanghai, Sun's research has focused on polymers. He recently designed dentures that can fight off the pain and swelling of yeast infections because they are made of a plastic that can absorb and release various drugs that kill fungi and yeast.

"I don't feel the boundaries between polymers, textiles and biomedical engineering," says Sun. "I think of myself as a materials chemist. These materials are sometimes a resin used for water filtration; sometimes it is dental tubing used in a dentist's office. It can be a denture used by older patients or bone grafts for joint replacement. It may be a piece of fabric worn by doctors or a pillow used by patients. For me, they are all materials. My goal is to incorporate them into new functions to solve real-world problems."

Goodyear's research focuses on safer approaches to disinfection, particularly in health care settings. She's researched the effectiveness of vinegar and of an oil found in thyme. She has investigated mops and cleaning products and confesses that it's still hard for her to walk by a mop bucket without wondering if what's inside is safe and effective. And she was the principal investigator for a study that looked at the bacterial contamination of nursing students' scrubs.

SEWING UP THE FUNDING

Sun and Goodyear, who is a member of the Zuckerberg College of Health Sciences faculty, did not know they were on parallel paths until they met to discuss their research several years ago. They instantly recognized the common thread that ran through their work.

"It became obvious immediately that we would each benefit from collaborating," Sun says. But while it was clear that Sun and Goodyear had common research interests, it took them a while to sew up the necessary funding.

Sun has been working with N-halamines, a group of chemical compounds widely used as disinfectants, since his days as a postdoctoral researcher. N-halamines are just as good at killing germs as laundry bleach (hypochlorite bleach), but are more stable, less corrosive and less likely to break down into toxic compounds.

N-halamines have long been used as disinfectants in municipal drinking water and wastewater treatment plants, as well as in the food processing and restaurant industries. Sun's expertise is combining N-halamines with polymers to create materials that solve difficult health care and environmental problems through the N-halamines' anti-microbial properties.

In Goodyear's lab, a doctoral student had been studying contamination on nurses' scrubs. It made sense to the researchers to weave together the N-halamine disinfection research with the scrub contamination research.

A UMass Lowell seed grant funded a pilot study, which helped provide details for the federal grant application. "When we first submitted the application for funding a few years ago, the government [was] shut down," Goodyear says. That slowed the application, but eventually, it was awarded funding. "We appreciate the support from the National Institute of Occupational Safety and Health," Sun says.

THREADING THE RESEARCH NEEDLE

Sun and Goodyear, who are serving as co-principal investigators on the project, are developing an anti-microbial fabric embedded with N-halamines. Sun's lab will address how to bind the N-halamines to the fabric, while Goodyear's lab tests the anti-microbial function.

By binding the N-halamines to the fabric, instead of merely coating the fabric with it, Sun expects the anti-microbial function won't wear off through washing or rubbing. Other, coated fabrics quickly lose their anti-microbial properties in the wash. The chemical properties of N-halamines allow this fabric's anti-microbial properties to be recharged when it is laundered with bleach.

With existing anti-microbial scrubs, health care professionals have no way of knowing how quickly they are losing protection from microbes. "It's not something you can see, the way you can tell when a fabric is losing water repellency," says Sun. With the new fabric, health care professionals will be able to check the anti-microbial function with test strips that show a dark color when the protection is strong but fade in color when the protection dissipates.

Once Sun and his team, which includes research scientist Jianchuan Wen and chemistry senior Jake B. Sartorelli, have a fabric that meets their criteria, they will send it to Goodyear's lab for testing with bacteria, fungi and viruses. Adorrah-Le Khan, a student in the College of Health Science's Master of Public Health (MPH) program, has extensive training working with the many types of pathogens that will be used in the study.

MICROBE-LADEN CLOTHING IS A BIG PROBLEM IN HOSPITALS. STUDIES SHOW THAT SOFT FABRICS ARE QUICKLY CONTAMINATED BY BACTERIA AND OTHER PATHOGENS. FROM THE FABRIC, THE PATHOGENS CAN BE TRANSFERRED TO CLEAN SURFACES, INCLUDING A NURSE'S JUST-WASHED HANDS. SCRUBS ARE WASHED EVERY 1.6 TO 1.8 DAYS, WHILE WHITE COATS ARE WASHED EVEN LESS FREQUENTLY—EVERY 11.3 TO 13.5 DAYS.

ERIC DAROIS '75, '84, FRED STRACCIA '77 AND JAY TARZIA '84, '87

RADIOLOGICAL SCIENCES ALUMNI BUILD COMPANY ROOTED IN UML EXPERIENCE

BY GEOFFREY DOUGLAS

For Eric Darois '75, '84, a vision took root during his days studying radiological sciences at UMass Lowell. He wanted to build a company to support users of radiation and radioactive material. It would be called Radiation Safety and Control Services, RSCS for short—a name inspired by one of his mentors on campus.

"One of the key two-semester classes in the radiological sciences program was RS 401/402, Radiation Safety and Control. When I took this class, it was taught by Prof. Ken Skrable, who was inspiring, energetic and passionate about the subject matter," Darois says. "So, I added the word 'Services' to the end of the course name because of Ken's influence on me, and that became our company name."

Darois was confident that he would eventually reach his goal of launching the company. "I always believed it would happen," he says.

However, like most dreams, it took a while before it would come to pass. By the late '80s, Darois was working at the Seabrook Nuclear Power Plant in New Hampshire. Alongside him in the company's radiation safety department were two other alumni of UML's radiological sciences program, Fred Straccia '77 and James ("Jay") Tarzia '84, '87. Darois' RSCS dream quickly became a regular topic of conversation among them. Over time, Straccia and Tarzia bought in.

The three men continued at their Seabrook jobs, often working nights and weekends in their basements to lay the groundwork needed to start their own firm. RSCS officially launched in 1989, with radon testing and mitigation services as the early staples of its business.

Their first big break came in 1992; a supervisor at Seabrook put the men in touch with a small radiation-calibration company he knew. Not long after, RSCS was able to purchase the company and expand its business from that base.

The pace of things picked up. By late '92, the company had rented its first office space, in Stratham, N.H., and placed ads in the local Yellow Pages for radon testing, "with offices in three states." ("Between the three of us, we had homes in Massachusetts, Maine and New Hampshire, so we figured that qualified," Darois says.) Soon after, the men began teaching classes in radiation safety to clients. They continued working full time at the Seabrook power plant while family members worked part time at the new Stratham office.

Clockwise from top, Eric Darois, Fred Straccia and Jay Tarzia built their company, Radiation Safety and Control Services, on principles and practices they learned as students at UMass Lowell.

"We didn't know how hard we were working," Darois says. "We never slowed down long enough to notice. But we liked what we were doing—we liked it then, we like it now. So it never really felt like work."

Straccia was the first to cut loose from Seabrook, in 1996. "It was a big leap for him," Darois recalls. "But he was the only one of us who didn't have kids."

Tarzia left a year later, and Darois followed a few months after that. By then, the company had landed a major client: Connecticut Yankee was decommissioning its nuclear operations in Haddam, Conn., and hired RSCS to shepherd it through the process.

Darois remembers the call he got from Tarzia: "He said, 'You gotta leave. You gotta come help me. There's a lot of work here.'

"It wasn't great timing. We had just had a fire at our house and were living in a trailer [during the repairs]. So my wife wasn't thrilled, to say the least. But in the end, it was a joint decision."

For the next several years, the men lived three days a week in a bed-and-breakfast in Connecticut, working long hours on the nuclear giant's decommissioning. The shutdown, and RSCS' role in it, would last most of the next 10 years.

As the company grew, a natural division of labor evolved. Straccia was responsible for most of the work involving radiation measurement, while Tarzia oversaw the administrative end of things. Darois' specialty was—and remains—the "more technical stuff," such as decommissioning cost estimates and other complex calculations. "But all of us are knowledgeable about each of those areas. We're all health physicists [radiation-protection experts]," he says.

A year past the 30th anniversary of its founding, RSCS is now a thriving, multifaceted company with more than 200 employees. Based in Seabrook, N.H., it has established itself as a leader in nuclear decommissioning, environmental monitoring and regulatory compliance. While roughly 60 percent of the company's work is derived from the decommissioning of power plants, the firm provides consulting services to other major clients with nuclear components—Boston University and the U.S. Naval Center among them, according to Darois. In addition, the company continues to offer courses in radiation detection, measurement and protection to nuclear-dependent clients.

According to the Nuclear Regulatory Commission, there are 96 nuclear power plants licensed to operate in the U.S. All will eventually need to be decommissioned, suggesting that there is probably no near-term end in sight for the demand for RSCS's services—a subject on which Darois has mixed views.

Ultimately, he says, because green-energy companies—like those focused on solar, wind and hydro—get the bulk of government subsidies, it's challenging for the nuclear industry to compete in the wholesale electricity market in several regions of the country. "They get the subsidies, so they set the standards," Darois says. "It's an unfair system, but it's the way it is. And given what we do here for a living, it's a little hard to complain."

Meanwhile, the UML-RSCS connection continues to thrive—most recently in the person of Roberto Ciardi, an international student from Empoli, Italy, who is currently an intern at the company. Ciardi is working with scientists at RSCS and at UMass Lowell to complete his master's thesis, which involves researching new technology for data collection and the automation of advanced radiation detectors. Upon completing his thesis, he will receive his master's degree in embedded software systems from the Sant'Anna School of Pisa in collaboration with the University of Pisa.

Ciardi is not the only beneficiary of RSCS's legacy of engagement with UML. Over the past 10 years, the company has supported the university through equipment donations, thesis-research assistance and a number of internship programs, several of which have led to career beginnings for UML graduates. There are currently 16 UML alumni, from 25 to 68 years old, employed at RSCS.

Darois, who credits the university with endowing him with "a passion for our profession" and "an excellent blend of theoretical and practical problem-solving skills," sees UML as a critical reservoir for future talent, and for the nuclear industry itself.

"As the average age of the nuclear workforce now exceeds 50 years old, we need to be cultivating young professionals to ensure the continued viability of nuclear power as a clean energy source," he says.

As a means to that end, the company, as of last December, had contributed $20,000 toward an endowment that will establish a perpetual scholarship fund for students in the university's Radiological Sciences program.

"We are fortunate to have alumni like Jay, Fred and Eric who understand the critical importance of developing talent," says Kennedy College Dean Noureddine Melikechi. "They are taking a leadership role in building the pipeline for future professionals in the field."

> "As the average age of the nuclear workforce now exceeds 50 years old, we need to be cultivating young professionals to ensure the continued viability of nuclear power as a clean energy source."
>
> –ERIC DAROIS

KIMBERLY CONROY SAWYER '89
DRIVING CHANGE AT ARGONNE NATIONAL LAB

BY JENNY BLAIR

As chief operations officer and deputy laboratory director at Argonne National Laboratory, Kimberly Conroy Sawyer '89 brings technical expertise and management skills to drive change and build high-performing teams at the organization.

Kimberly Conroy Sawyer '89 has spent a career crisscrossing the private sector, government agencies and national laboratories. Trained in math, computer science and business, she's also adept in the realm of interpersonal skills, curious about cultural differences and at ease leading others.

As deputy laboratory director for operations and chief operations officer at Argonne National Laboratory near Chicago, Sawyer works to ensure a stable future for the organization, which tackles complex challenges in science and technology. A U.S. Department of Energy Office of Science national laboratory, Argonne's research portfolio includes quantum information science, artificial intelligence research, advanced transportation systems, energy storage research and grid security, among many others. Sawyer is responsible for ensuring that all operations enable the laboratory's research to proceed. Her focus is to build teams that deliver efficient, safe and high-quality operations at the lab.

"It's about getting the right people in positions. It's about driving change," Sawyer says. "I'm having a ball."

Argonne, which traces its roots to the World War II-era Manhattan Project at the University of Chicago, has an annual operating budget of $830 million and 3,163 full-time employees, including scientists, engineers and post-doctoral researchers. Sawyer works with personnel across all departments, including governance, strategy and performance management, facilities and infrastructure, information technology, human resources, cybersecurity, environmental safety and health and legal counsel.

COMBINING BUSINESS AND TECHNICAL EXPERTISE

"When I came to Argonne, I replaced folks that had Ph.D.'s," she recalls. "But because I have the business and technical expertise and I worked for a number of different industries, I can speak the language, recognize [when groups of people have] different cultures, and leverage the culture and honor it."

One such cultural difference is safety. While government lab personnel observe stringent safety practices, Sawyer says, scientists joining from the academic world may bring a more relaxed approach. Accustomed to playing multiple roles, these scientists sometimes take on risky tasks for which Argonne has trained specialists, such as replacing a capacitor in a piece of equipment. One of Sawyer's challenges has been to shift their mindset in favor of calling a specialist on those occasions. Her efforts have paid off, she says: Lab leaders successfully engaged the scientists in discussions about safety issues, offered safety training and created expert teams who are highly responsive to the scientists' needs.

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A Pittsburgh-area native, Sawyer put herself through Robert Morris University, earning a bachelor's degree in business administration. As a student, she fell in love with coding. She also set her sights on a career of executive corporate leadership.

"From the very beginning, I decided my future was going to be in management," Sawyer says.

She began her career at DuPont in West Virginia as a systems analyst. Later, she and her husband, a chemical engineer, moved to the Boston area because of his job. While working in information technology there, Sawyer took mathematics classes at Northeastern University, then decided to pursue a master's degree in math and computing at UMass Lowell.

In addition to strong professors, Sawyer says she learned much from her fellow students. Mingling with people who had worked outside academia exposed her to what other companies were doing. And being around so many international students broadened her perspective.

"Even before diversity, equity, and inclusion were popular, I was living in that kind of environment" at UMass Lowell, she says.

NOT THE RETIRING TYPE

In 2010, Sawyer stepped out of the corporate world to help lead Sandia National Laboratories in Albuquerque, N.M. She then spent nearly a decade at Lockheed Martin, the contractor in charge of Sandia at the time, serving as chief operating officer.

When the federal government held its next round of competition to run the laboratory, it selected another company. Sawyer chose early retirement.

But, she recalls wryly, "that lasted not too long."

Sawyer golfed, gardened and cooked gourmet meals, but she felt restless and took on some management consulting.

Then Argonne asked if she'd come to their Illinois headquarters for a few days. She paid a visit to the lab.

That was two years ago. Sawyer has thrived as an Argonne leader since then, dividing her time between the Chicago area, Scottsdale, Ariz. and Albuquerque. She's even finding time to golf and to cook again (a recent success: beef Wellington).

At this point in her career, Sawyer says, she's not looking to climb a ladder. That makes her work fun.

"As a leader, I can't just say, 'Here's what you need to do.' I want to plant the seeds so that people can carry on when I make room for the next person to come in and take over," she says. "That's the beauty of being at the point that I'm at. I'm really helping people to grow and giving back." E

TYLER HARRINGTON
FOR DOCTORAL STUDENT, UML OFFERS THE RIGHT ATMOSPHERE

BY KATHARINE WEBSTER

Tyler Harrington (below left) was scrolling through Google search results for Ph.D. programs in atmospheric science, and something caught his eye. It was a brief notice saying that Asst. Prof. Christopher Skinner of UMass Lowell was looking for graduate students to work with him on research into how interactions between the land and the atmosphere affect climates.

That clicked with Harrington, who is interested in studying what percentage of moisture released from the earth's surface into the atmosphere comes from plants, and how that affects climates elsewhere —for example, whether a drought in the Midwest leads to less rain in the Northeast.

Harrington, who earned a bachelor's degree from the University of Kansas, decided to apply to UMass Lowell. When he met Skinner in person, he knew he'd found the right mentor.

"I knew that this was a person I really wanted to work with," he says.

Harrington is a teaching assistant for an undergraduate class and he's working as Skinner's research assistant. He hopes eventually to have a research career, possibly at a university or in a National Weather Service laboratory.

Harrington has hands-on experience from a series of internships. Last summer, before starting the Ph.D. program, he had an internship with the Federal Aviation Administration, where he researched and wrote a report requested by Congress on how extreme weather events affect air travel. He investigated airport closings, turbulence and en route flight operations. He briefed the leadership of both the FAA and the National Weather Service on his work.

Previously, Harrington interned with the U.S. Geological Survey's Organic Geochemistry Research Lab. He was also the first university-based intern for the National Oceanic and Atmospheric Administration's SCOuT Program. Now, he hopes to help bring the SCOuT Program to UMass Lowell, so that undergraduates here can benefit from that experience. E

UNDER THE LENS

Q&A

BIOLOGY PROFESSOR UNRAVELS AN ECOLOGICAL MYSTERY

Containing an Opportunistic Pathogen Can Improve the Health of Cystic Fibrosis Patients

BY EDWIN L. AGUIRRE

Prof. Susanna K. Remold, the new chair of the Department of Biological Sciences, has been working to unravel an ecological mystery that could help improve the lives of people with diseases such as cystic fibrosis. One focus of her research is *Pseudomonas aeruginosa,* an opportunistic pathogen that is a major cause of serious infection in patients with underlying medical conditions or compromised immune systems. Remold was an associate professor of biology at the University of Louisville and a visiting program director for the National Science Foundation (NSF) before joining the faculty at UMass Lowell in 2019. Here, she shares some insight into her work.

Why did you choose *Pseudomonas aeruginosa* as the subject of your research?
This bacterium has been described in biomedical literature as being ubiquitous and common in the environment. My background is in ecology and evolutionary biology, where a central focus is understanding the diversity of life. If it were truly possible to be both common and ubiquitous, why would there be biological diversity? So I thought that there must be something more going on with *P. aeruginosa* that is yet to be discovered.

According to the Cystic Fibrosis Foundation, about 30,000 people in the United States are living with cystic fibrosis (CF), a genetic disorder that affects the lungs and other organs. And there's no cure for the disease. How can your research help patients with CF?
My research aims to help people understand how they can avoid exposure to *P. aeruginosa*. It's known that exposure increases the likelihood of infection and that chronic infection decreases lung function, which then shortens a person's lifespan. I'm particularly interested in studying homes because I want to intercept exposure in the area where people, especially children, spend the most time.

You and your team of student researchers took about 11,000 swabs of 15 homes in Louisville, Ky. What was your most surprising finding?
Although *P. aeruginosa* has been described as being everywhere and that therefore, it's hard to avoid getting exposed to it, what our study actually discovered is that it's relatively difficult to find this microorganism in a typical household. We found them almost exclusively in drains—in the kitchen and bathroom sinks, shower stalls and bathtubs. We don't know why this is the case, but this is where we found the highest concentration. The physical conditions inside the drain could be one reason, but there can be other reasons that we need to study further.

What can people do to protect themselves from *P. aeruginosa*?
We sampled only the first inch or so inside the drain—the "splash zone," where the water drains and splashes up and sprays aerosol droplets containing the bacterium into the air that get inhaled by people. *P. aeruginosa* is a very hardy microbe, so getting rid of it is not easy, especially in a hospital setting. Disinfecting the sink regularly with bleach solution would help. Bleach gel could also be used to coat the drain and garbage disposal to slow down the regrowth of the bacterium. In fact, the Cystic Fibrosis Foundation has changed its recommendations for infection control and prevention to include targeted cleaning of drains, citing our research and some other similar studies.

Who else could benefit from your study?
Anybody with compromised immune systems or respiratory problems such as asthma or COPD has the potential to benefit. If you have a condition that predisposes you to infection, and that infection is then going to decrease your quality of life or threaten your life, then knowing how to avoid infection would be valuable.

What made you decide to come to UMass Lowell?
Two reasons. First, it's the amazing hands-on experience that biology students get at UMass Lowell, and I'm really excited to be able to contribute to making this possible. Second, it's the opportunity to help students, postdocs and faculty early in their careers to develop as the next generation of biology scientists and researchers and to build interdisciplinary interactions and collaborations. UML students, even in their undergraduate years, do actual research and get papers published in refereed journals. They have access to lab courses and research opportunities where they gain hands-on skills that students at many universities don't get.

What other research projects do you have underway?
One area of study that I'm investigating is bacterial weapons, called bacteriocins. These are proteins secreted by bacteria of one strain that target and kill closely related bacteria. I'm trying to understand how these killing interactions help some *P. aeruginosa* to keep out competing bacteria that might otherwise invade and colonize the same habitat. Another project that I'm pursuing is to find out if my large collection of *P. aeruginosa* strains might have some that can help in the bioremediation of a group of environmental toxins called PFAS. Although PFAS are very resistant to biodegradation, there's a report published of a *Pseudomonas* strain being able to break down a PFAS compound. I'm curious whether household *Pseudomonas* might be able to break down PFAS too, and am planning on screening my collection of strains to find out.

UNDER THE LENS

Q&A

Applying Research Results to the Real World Adds up for Math Professor

BY JENNY BLAIR

Elisa Perrone is an assistant professor in the Department of Mathematical Science. She studies mathematical tools called copulas, which can make weather forecasts more accurate but have also been blamed for the 2008 global financial crisis. A native of Lecce in southern Italy, Perrone earned a Ph.D. in mathematics at Johannes Kepler University Linz in Austria. After a postdoctoral appointment at MIT, she joined the Kennedy College of Sciences faculty in 2019.

What is the focus of your research?

My research is in a class of statistical models called copulas, which capture how various random phenomena interact with each other—for example, how rainfall totals of two different months are dependent on each other. The combination of mathematics research and the potential applications of my results is what I really, really like in my work.

The popularity of copulas began when people started using them to model bank defaults and other things related to finance. There was a famous article in Wired magazine called "Recipe for Disaster: The Formula that Killed Wall Street" that states the reason why we had the big financial crisis in 2008 was because people chose the wrong copula to model joint defaults of banks.

I fell in love with this class of functions. They are powerful tools, and this is a relatively new type of research in statistics—there's so much that still can be done.

How can copulas be used to improve weather forecasting?

Getting good weather predictions is challenging. People usually obtain good forecasts by using not just a single forecast; they assume the forecast is a random phenomenon, so they try to use a bunch of equations to get an ensemble forecast. The problem is that these are raw forecasts; they need to be statistically corrected.

There are good correction methods that can be applied to single weather stations, for example, or to single weather variables, like the rainfall total in May or June. But there is always this problem—how do I join them together? We have infinite ways of putting together three individual weather variables.

So, for instance, one factor could increase the other two, or it could decrease them, or it could sometimes decrease one and sometimes the other?

Exactly. Or they could be independent—maybe there's no interaction at all. So copulas can be used to reconstruct a source of dependence between different weather variables. I can use them to correct multivariate weather forecasts.

It's interesting that in the realm of pure mathematics, you can say something about how the real world behaves.

There's so much overlap between different problems. They might be the same problem in the end, if we find a good way to communicate across fields. With these copulas, I found connections with statistics, but also other fields of math. It's one of the reasons why I like my research, to explore these kinds of connections.

What research opportunities are on the horizon for you?

UMass Lowell has a very good Department of Environmental, Earth and Atmospheric Sciences. My next step will probably be to go from weather forecasting to climate, and my goal is to establish collaborations with them. I could easily connect with people who are working in finance as well. There are plenty of opportunities at UMass Lowell.

Beyond the Classroom

PROF. FRANK COLBY, PROF. MATHEW BARLOW, ASSOC. TEACHING PROF. LORI WEEDEN and students from the Department of Environmental, Earth & Atmospheric Sciences attended the American Meteorological Society's 100th Annual Meeting in Boston.

ASSOC. PROF. SILAS LAYCOCK and student Erin Donovan of the Physics & Applied Physics Department attended the meeting of the American Astronomical Society. Laycock and students also hosted a table at the annual Field Trip Day at the Tsongas Center.

ASST. PROF. SASHANK NARAIN and students on the Computer Science Department's Cyber Security Team qualified for the Northeast Regional of the 2020 National Collegiate Cyber Defense Competition.

Faculty Success

DR. MATHEW BARLOW of the Department of Environmental, Earth & Atmospheric Sciences Press Coverage, NOAA Fisheries.

PROF. VALERI BARSEGOV OF THE CHEMISTRY DEPARTMENT received a research award from Alnylam Pharmaceuticals to develop computational methods to improve the efficacy of drugs based on RNA interference.

ASST. PROF. DIONYSIOS CHRISTODOULEAS has been named associate editor of Microchimica acta, one of the leading journals in analytical chemistry with specialization in applications of nanomaterials. Christodouleas was also selected to receive a travel award/fellowship from the Greek Diaspora Fellowship Program to give a workshop in Greece this summer.

ASST. PROF. OFER COHEN OF THE PHYSICS & APPLIED PHYSICS DEPARTMENT received two awards: the NASA Proposal Award, Exoplants Research Program (XRP) for work on "Modeling Exoplanet Radio Transits and their Relation to Exoplanetary Magnetic Fields" and a grant award from the Southwest Research Institute for work on "Geophysically Relevant Prediction of Solar Cycle 25."

PROF. XINWEN FU OF THE COMPUTER SCIENCE DEPARTMENT received the Best Paper Award for his co-authored work, "Microcontroller Based IoT System Firmware Security: Case Studies," in proceedings of the IEEE International Conference on Industrial Internet in Orlando, Fla.

ASST. PROF. RICHARD GASCHNIG OF THE DEPARTMENT OF ENVIRONMENTAL, EARTH & ATMOSPHERIC SCIENCES received an NSF Award, Petrology and Geochemistry, for his work on "Collaborative Research: Tracking Novel Metal Isotope Signatures During Subduction Metamorphism."

RESEARCH ASSOC. PROF. ANDREW GATESMAN OF THE PHYSICS AND APPLIED PHYSICS DEPARTMENT received a grant award from the U.S. Department of the Army for his work on "Submillimeter-Wave Signature Support."

ASSOC. PROF. TINGJIAN GE OF THE COMPUTER SCIENCE DEPARTMENT received the Best Paper Award for his co-authored work on "Finding Densest Lasting Subgraphs in Dynamic Graphs: A Stochastic Approach" at the 2019 IEEE 35th International Conference on Data Engineering.

PROF. HWAI-CHEN GUO OF THE BIOLOGICAL SCIENCES DEPARTMENT received a grant award from Advanced Functional Fabrics of America for his work on "Flexible Electronics for Garment Systems."

ASSOC. DEAN FRED MARTIN, A PROFESSOR OF THE COMPUTER SCIENCE DEPARTMENT, was a recipient of an NSF Award for collaborative research on "CS Pathways RPP: A District Ownership-based Approach to Middle School Computer Science."

DEAN NOUREDDINE MELIKECHI, A PROFESSOR IN THE PHYSICS & APPLIED PHYSICS DEPARTMENT, was named a Fellow of the American Association for the Advancement of Science (AAAS) and a Fellow of the American Physical Society (APS).

PROF. DANIEL OBRIST, CHAIR OF THE DEPARTMENT OF ENVIRONMENTAL, EARTH & ATMOSPHERIC SCIENCES, received an NSF Award, Atmospheric Chemistry Program (ATC), for his work on "Collaborate Project: Magnitude and Pathways of Gaseous Atmospheric Mercury Deposition in Forests."

PROF. VIKTOR PODOLSKIY OF THE PHYSICS AND APPLIED PHYSICS DEPARTMENT was named a Fellow of the American Physical Society (APS).

PROF. JAMES PROPP OF THE MATHEMATICS DEPARTMENT received a grant award from the Simons Foundation for his work on "Collaborative Research in Algebraic Combinatorics."

ASST. PROF. JAMES REUTHER OF THE CHEMISTRY DEPARTMENT received an MTTC Acorn Award for his work on "Self-Healable, Regenerable Polymer Adsorbents for Low-Energy, Reusable Water Filters" as well as the department's Seldon Green Chemistry Award.

ASSOC. PROF. ANNA RUMSHISKY OF THE COMPUTER SCIENCE DEPARTMENT was a recipient of an NSF Career Award for "Developing an Underspecified Representation for Temporal Information in Text."

ASST. PROF. CHRISTOPHER SKINNER OF THE DEPARTMENT OF ENVIRONMENTAL, EARTH & ATMOSPHERIC SCIENCES received an NSF grant award for his work on "Collaborative Research: P2C2—Elucidating the Drivers and Consequences of Changes in Atmospheric Rivers from the Last Glacial Maximum to the Present Day."

PROF. YUYU SUN OF THE CHEMISTRY DEPARTMENT received a grant award from the National Institute for Occupational Safety and Health for his work on "Rechargeable Antimicrobial Textiles to Reduce Occupational Risk of Health Care Personnel."

ASSOC. PROF. JIN XU OF THE CHEMISTRY DEPARTMENT received a grant award from the Massachusetts Life Sciences Center for his work on "Integrating Continuous Biopharmaceutical Manufacturing Utilizing Robus In-Line NIR Mediated Control."

PROF. HOLLY YANCO OF THE COMPUTER SCIENCE DEPARTMENT received two grant awards from the NSF for her work on "Development of Test Methods and Benchmarks for Industrial Robot Systems" and "CHS: Medium: Collaborative Research: Manipulation Assistance for Activities of Daily Living in Everyday Environments."

FACULTY NEWS

Presentations

ASST. PROF. NICOLAI KONOW OF THE BIOLOGICAL SCIENCES DEPARTMENT gave the Platform Presentation at the 2020 Society for Integrative & Comparative Biology Annual Meeting in Austin, Texas.

PROF. MARINA RUTHS OF THE CHEMISTRY DEPARTMENT gave presentations on the "Nanotribology of tunable, bioinspired polymer coatings" at the 10th International Conference on Materials for Advanced Technologies in Singapore and on the "Nanotribology of tunable polymer coatings" at the Society of Tribologists and Lubrication Engineers (STLE) annual meeting.

Publications

PROF. MATHEW BARLOW OF THE DEPARTMENT OF ENVIRONMENTAL, EARTH & ATMOSPHERIC SCIENCES, Journal of Hydrometeorology: "Hydrometeorological Conditions Preceding Extreme Streamflow for the Charles and Mystic River Basins of Eastern Massachusetts."

ASST. PROF. FREDERIC CHAIN OF THE BIOLOGICAL SCIENCES DEPARTMENT, Genome Biology and Evolution: "Genome-wide Genotype-expression Relationships Reveal Both Copy Number and Single Nucleotide Differentiation Contribute to Differential Gene Expression between Stickleback Ecotypes."

ASSOC. PROF. MATTHEW GAGE OF THE CHEMISTRY DEPARTMENT, Protein Science: "Differences in stability and calcium sensitivity of the Ig Domains in Titin's N2A Region" (co-authored).

ASSOC. PROF. ANNA YAROSLAVSKY OF THE PHYSICS AND APPLIED PHYSICS DEPARTMENT received an NSF grant award for her work on "I-Corps: Detecting Cancer in Single Cells."

ASST. PROF. RICHARD GASCHNIG OF THE DEPARTMENT OF ENVIRONMENTAL, EARTH & ATMOSPHERIC SCIENCES, Nature Geoscience: "Methanogenesis sustained by sulfide weathering during the Great Oxidation Event" (co-authored).

ASST. PROF. MICHAEL MYRE OF THE BIOLOGICAL SCIENCES DEPARTMENT, Biological Review: "Calmodulin-mediated Events During the Life Cycle of the Amoebozoan Dictystelium Discoideum."

ASSOC. DEAN MATTHEW NUGENT OF THE BIOLOGICAL SCIENCES DEPARTMENT, Journal of Biological Chemistry: "Heparin Potentiates Avastin-mediated Inhibition of VEGF Binding to Fibronectin and Rescues Avastin at Acidic pH."

ASSISTANT PROF. JAMES REUTHER OF THE CHEMISTRY DEPARTMENT, Self-Healing Polymer-Based Systems (book chapter), "Self-Healing Materials Utilizing Supramolecular Bonds"; Journal of the American Chemical Society, "Chemically-Triggered Synthesis, Remodeling and Degradation of Soft-Materials" (co-authored); Chem, "Metllotexaphyrins as MRI-Active Catalytic Antioxidants for Neurodegenerative Disease: A Study on Alzheimer's Disease" (co-authored)

PROF. MARINA RUTHS OF THE CHEMISTRY DEPARTMENT, Langmuir: "Effects of imprinted 3D surface patterning on localized changes in the tribology of human stratum corneum" and "Ion-specific effects of divalent ions on the structure of polyelectrolyte brushes" (both co-authored)

PROF. KUNNAT SEBASTIAN OF THE PHYSICS & APPLIED PHYSICS DEPARTMENT, Journal of Modern Physics: "The Coherent state of the Landau Hamiltonian and Relativistic Corrections to the Zeeman Effect in He+ ions."

New Faculty

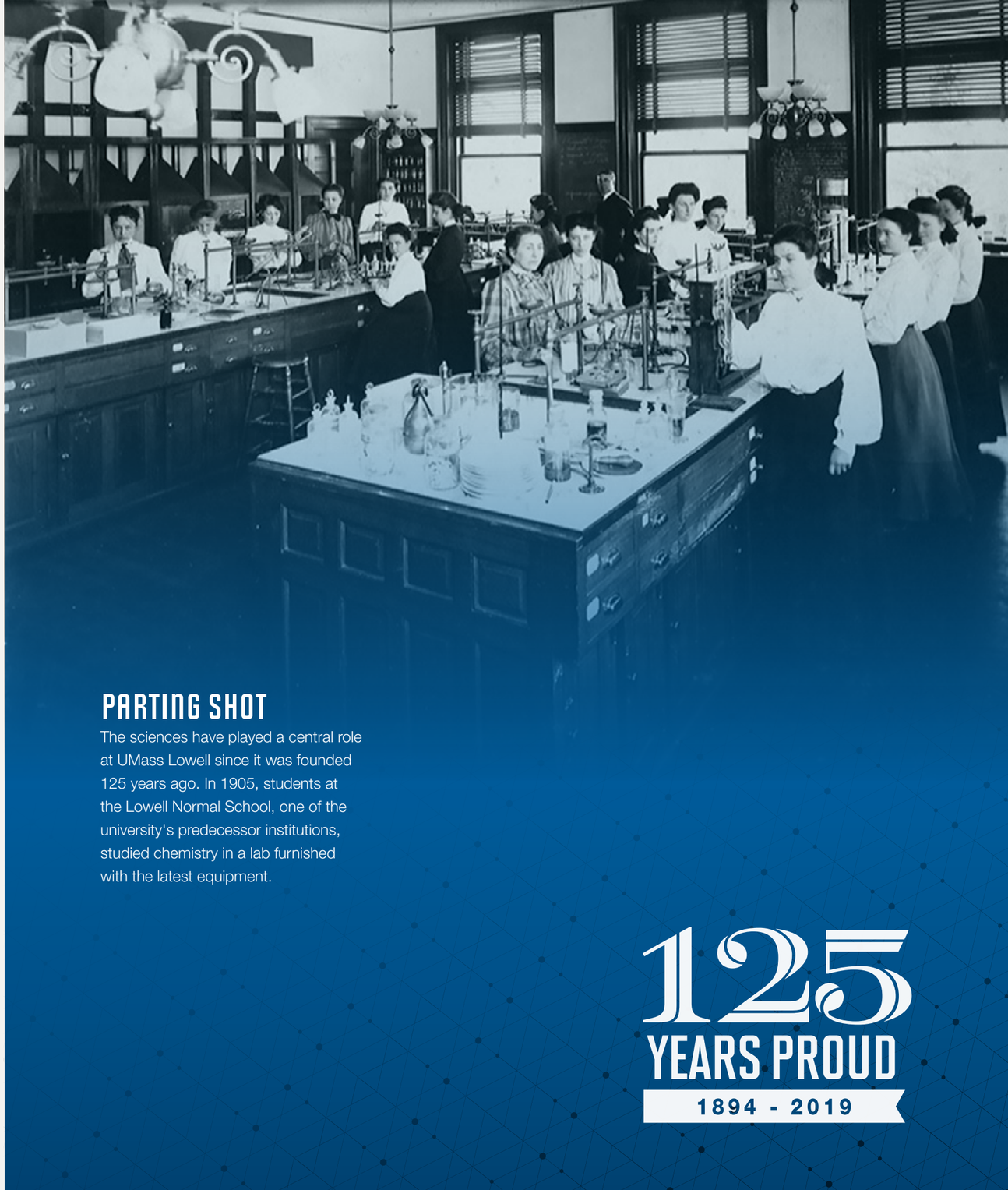
BIOLOGICAL SCIENCES
Asst. Prof. Christina Kwapich
Prof. Susanna Remold

CHEMISTRY
Asst. Prof. Pengyuan Liu
Asst. Prof. Michael Ross

COMPUTER SCIENCE
Asst. Prof. Mohammad Alam
Asst. Prof. Hadi Amiri
Asst. Teaching Prof. James Daly
Asst. Prof. Shashank Narain

MATHEMATICAL SCIENCES
Asst. Teaching Prof. Cory Fournier
Asst. Prof. Daniel Glasscock
Asst. Prof. Elisa Perrone
Asst. Prof. Amanda Redlich

PHYSICS AND APPLIED PHYSICS
Visiting Lecturer Ramanpreet Kaur



PARTING SHOT

The sciences have played a central role at UMass Lowell since it was founded 125 years ago. In 1905, students at the Lowell Normal School, one of the university's predecessor institutions, studied chemistry in a lab furnished with the latest equipment.

125 YEARS PROUD
1894 - 2019