UMASS LOWELL

Kennedy College of Sciences
University of Massachusetts Lowell
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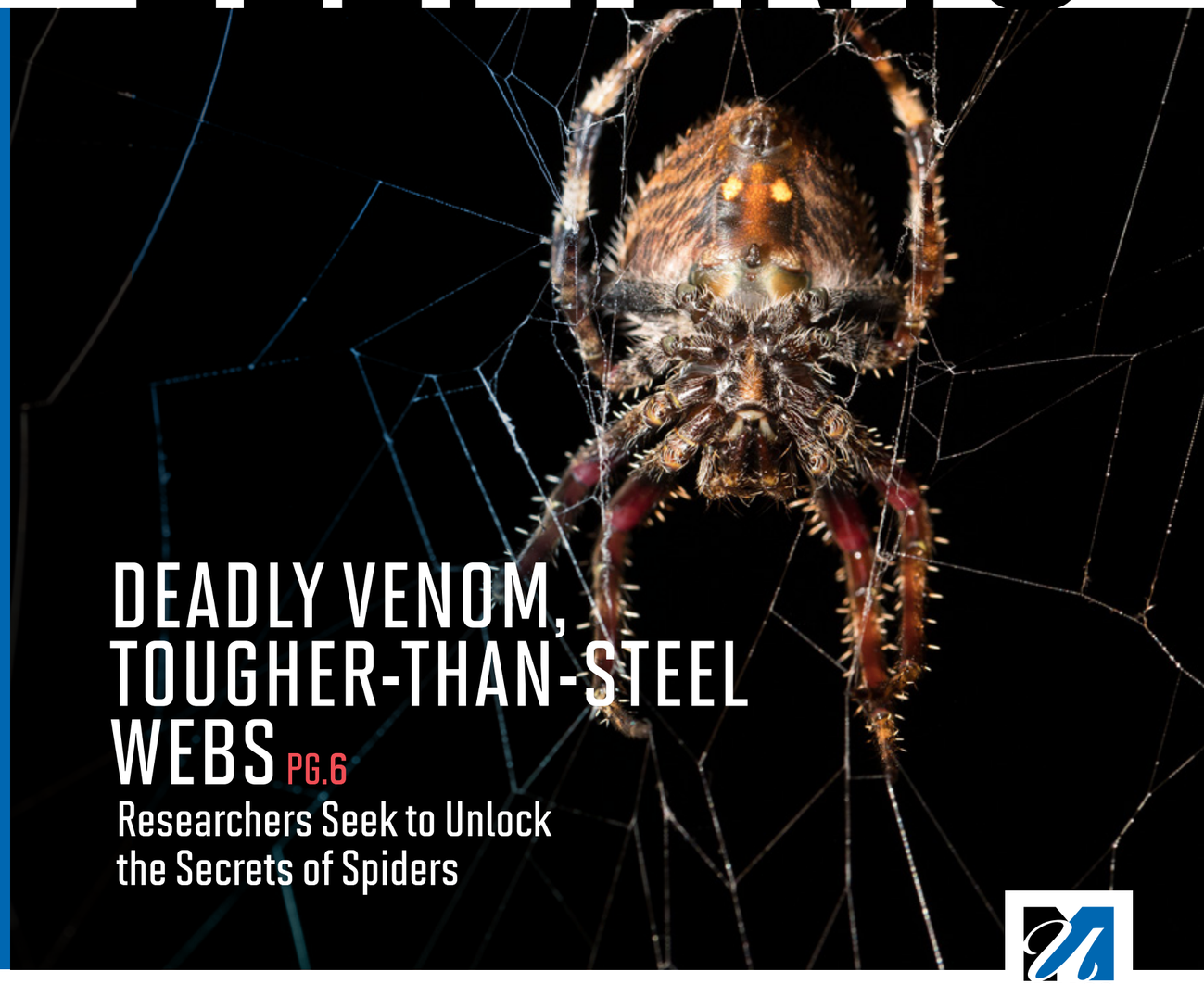
SPRING 2019

ELEMENTS OF SCIENCE



DEADLY VENOM, TOUGHER-THAN-STEEL WEBS PG.6

Researchers Seek to Unlock the Secrets of Spiders

A PUBLICATION OF THE KENNEDY COLLEGE OF SCIENCES

UMASS LOWELL

A LETTER FROM THE DEAN

Dear Alumni, Colleagues and Friends,

Welcome to the first issue of the Kennedy College of Sciences magazine, Elements of Science.

We are pleased to share with you highlights of some of the exciting work taking place in our laboratories and classrooms and to introduce you to some of our outstanding faculty, students and alumni.

This is a historic time for our college. Enrollments are up; many dynamic, new faculty members have joined us; new programs have been launched; research spending has grown; and there have been significant upgrades to the college's classrooms and labs. I am proud of what we have achieved so far and am grateful for the hard work and dedication of faculty, previous deans, staff, alumni and supporters. All have contributed to our growth and success.

When I joined UMass Lowell in 2016, I knew I was joining a community that is committed to excellence. Our college has a legacy of producing great scientists—leaders in academia, business and industry. Our graduates are helping to make a healthier and safer world and are pushing the boundaries of knowledge.

The inaugural issue of our magazine provides a snapshot of some of the groundbreaking research our faculty are conducting. You'll see how one professor's fascination with the unique properties of spiders is propelling research that could lead to next-generation materials for health care, defense and other industries. You'll read how faculty from the university's Lowell Center for Space Science and Technology are searching for new Earth-like planets beyond our solar system. And you'll learn how our faculty are researching ways to improve diagnosis and treatment for Alzheimer's disease. You will also meet some of our proud KCS alumni and students.

We hope what you read inspires you to learn more and get involved.

As dean of the Kennedy College of Sciences, I am determined to continue to strengthen our programs and to support our faculty and students as they strive in their respective fields and contribute to finding innovative solutions to some of the world's most complex problems.

As we move forward, I welcome your support and suggestions. If you have any questions or comments regarding our first issue of Elements of Science, please contact me at sciences@uml.edu or Noureddine_Melikechi@uml.edu.

Sincerely,

NOUREDDINE MELIKECHI, D.PHIL.
Fellow, Optical Society of America
Fellow, American Physical Society
Dean, Kennedy College of Sciences
Professor of Physics
University of Massachusetts Lowell

In this issue

ELEMENTS OF SCIENCE

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ON THE COVER
Spiders and the silk they weave are subjects of research in the lab of Assoc. Prof. Jessica Garb of the Department of Biological Sciences.

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UML RECOGNIZED FOR COMMITMENT TO EQUITY AND INCLUSION IN STEM

The American Association for the Advancement of Science (AAAS) has honored UMass Lowell for its commitment to diversity, equity and inclusion in STEM and for furthering positive change in the university's relevant policies and practices.

UMass Lowell, Boston University and the University of California, Davis were the first institutions to be recognized by the association's STEM Equity Achievement (SEA) Change initiative. Launched in 2018, the initiative encourages institutional transformation in support of diversity and inclusion in science, technology, engineering, medicine and mathematics.

UMass Lowell was recognized for making development of a more inclusive culture a focus of the university's strategic plan and for the use of multiple methods to assess institutional culture.

"UMass Lowell is committed to advancing an inclusive environment for all, both on our campus and throughout higher education, by leading the way through our strategic plan and other important initiatives," says Chancellor Jacquie Moloney.

Left: Danielle Niles '06; and Sarah Wroblewski '05

Former River Hawk Teammates Reunited as TV Meteorologists

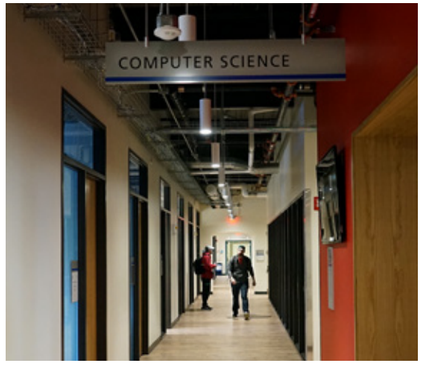
Former UMass Lowell women's soccer teammates and KCS graduates Danielle Niles '06 and Sarah Wroblewski '05 have teamed up again—this time as meteorologists at WBZ-TV in Boston. Niles has been with the Boston CBS affiliate for five years after working previously at New England Cable News. Wroblewski, who spent eight years at Boston's FOX affiliate, joined WBZ-TV's meteorology team last fall.

Wroblewski and Niles credit their UMass Lowell education and the guidance they received from Professor Emeritus Robert Gamache, as well as the rest of the Environmental, Earth and Atmospheric Sciences department, with providing a foundation for their success.

"The education at UMass Lowell along with the fundamentals of math and science for meteorology are superb, so it definitely gave me what I needed to be successful in my career," Wroblewski says.

Niles recently returned to campus to tape a segment with Gamache called "Morning Inspiration." It is part of a campaign to highlight mentors who have inspired the station's on-air talent.

Also on the WBZ-TV meteorology team is fellow alumnus Barry Burbank '72. Burbank handles weekend morning weather duties for the station, which he joined in 1978.



BUILDING UPGRADES

Kennedy College of Sciences classes, labs and meeting rooms are getting a refresh.

The Department of Computer Science, which doubled enrollment over five years, has moved into renovated space on the third and fourth floors of Dandeneau Hall, the building formerly known as Pasteur Hall on North Campus. The renovations were part of a $15.75 million overhaul of the 80-year-old building.

The renovations include 34 faculty offices, a 36-seat classroom, meeting rooms, five research labs, two computer teaching labs, a drop-in computer lab and a systems research lab. For robotics, there is a research lab, a teaching workshop and a teaching lab.

The Computer Science Department's old space in Olsen Hall is being gutted and converted to 31 faculty offices for the Department of Biological Sciences, along with conference rooms and collaboration spaces. In addition, seven new classrooms, a 75-seat team learning room and study and collaboration spaces are in the works.

Study Targets Mercury Pollution in Forests

The National Science Foundation has awarded $873,000 to Prof. Daniel Obrist of the Department of Earth, Environmental and Atmospheric Sciences to study mercury pollution in forests.

Mercury, a neurotoxin, is emitted into the atmosphere from natural sources and coal-burning power plants. It gets deposited in forests through rainfall and vegetation uptake—that is, plants absorb gaseous mercury from the atmosphere and subsequently transfer it to the soil when the plants die or shed leaves. Obrist will take measurements of the mercury uptake at forests in Massachusetts and Costa Rica over the course of a year. Researchers at Columbia University will be collaborating on the project.

In an earlier research project, Obrist led a team that conducted a long-term study of the origin of mercury pollution in the Arctic tundra. The researchers found that the absorption of mercury from the atmosphere by plants led to high loads of mercury in Arctic tundra soils, threatening the environment and the health and well-being of wildlife and humans.

A GOLDEN ANNIVERSARY

The Radiological Sciences program, offered through the Department of Physics and Applied Physics, is marking its 50th anniversary this year.

According to Assoc. Prof. Mark Tries, who is the program's coordinator, alumni now make up seven percent of the 1,266 active certified health physicists worldwide.

Established in 1969, the nationally recognized program offers a radiological health physics option to the bachelor's degree in physics and a master's degree in radiological sciences and protection. There is also a radiological sciences option to the Ph.D. degrees in physics and in biomedical engineering and biotechnology.

Elsewhere in the Physics Department, the Medical Physics program has also reached a milestone: The program has been reaccredited through 2023 by the Commission on Accreditation of Medical Physics Education Programs (CAMPEP). Launched in 2010 under the direction of physics Prof. Erno Sajo, the program offers both a master's degree in medical physics and a medical physics option to the Ph.D. degree in physics.

PHYSICS GRAD STUDENT WINS INTERNATIONAL AWARD FOR SKIN CANCER RESEARCH

Tyler Iorizzo, a Ph.D. student in the Department of Physics and Applied Physics, has won honors for his contribution to developing an imaging device that could lead to improved diagnosis and treatment of some skin cancers.

Iorizzo was one of seven university researchers from North America and Europe who received an Educational Award from Edmund Optics, one of the world's leading suppliers of high-precision optics, imaging and photonics technology.

He is part of a team at UML working on a device called an optical polarization imager, or OPI, that could help doctors identify the margins of nonmelanoma skin cancer prior to surgery, allowing them to remove the malignant tumor with more precision and resulting in fewer complications and quicker recovery for the patient.

"Currently, there is no comparable tool available in the market," says Assoc. Prof. of Physics Anna Yaroslavsky, who is the director and founder of the Advanced Biophotonics Laboratory and inventor of the OPI technology.

Yaroslavsky has several awarded and pending patents for the OPI. She and her team are working on a prototype and hope to commercialize the technology by licensing it to a medical device manufacturer.

Fill 'er Up—but Hold the Greenhouse Gases

Researchers from the Chemistry Department have found a way to safely, cleanly and efficiently produce hydrogen gas that can be used to power the next generation of electric vehicles.

Prof. David K. Ryan, who chairs the department and is the project's principal investigator, says the technique uses only water, carbon dioxide and cobalt metal particles with surface nanostructures measuring billionths of a meter in size to produce hydrogen on demand at relatively low temperature and pressure.

The hydrogen is produced inside a stainless steel canister and goes directly to the car's fuel cell, where it is mixed with oxygen to produce electricity and water.

Instead of filling up the gas tank, drivers would go to a refueling station and swap out the canister every 300 to 400 miles.

The Massachusetts Clean Energy Center has awarded Ryan a $25,000 seed grant to get the team started on the path of commercializing the technology; he will also be applying for state and federal funding. The invention was recently awarded a provisional patent; a full patent is pending.

DEAN HAS LASER-FOCUS ON MARS

When NASA launches its Mars 2020 rover mission next year, Kennedy College of Sciences Dean Noureddine Melikechi will be paying close attention.

Melikechi is a member of the science team for the SuperCam laser remote-sensing instrument aboard the robotic rover, which will be gathering data to help answer key questions, including ones about the potential for life on Mars.

Mars has been a research focus for Melikechi for several years. He has been analyzing data gathered by an instrument known as ChemCam aboard NASA's "Curiosity" Mars rover since it landed on the red planet in August 2012. ChemCam uses a technique known as laser-induced breakdown spectroscopy (LIBS) to analyze the surface composition of Mars by firing intense pulses of laser on distant rocks, boulders or sediments. The resulting flash of light is picked up by ChemCam, which identifies the different chemical elements present in the target rock, and the data is transmitted to Earth for analysis.

In recognition of his pioneering research leading to advancements in the use of lasers to study the geochemistry of Mars and for diagnosing ovarian cancer, Melikechi was elected a fellow of the American Physical Society and the Optical Society of America. He was also cited for his leadership in developing programs to attract diverse students into optical physics.

Dig This: Biology Student Tries Out for U.S. Volleyball Team

Jackie Kho, a sophomore biology major, was among 90 college-age players from across the country who tried out for the U.S. men's national volleyball team in Anaheim, California. The players were vying for spots on the senior, collegiate and junior national teams, which compete in tournaments around the world and groom players for the U.S. Olympic team.

Kho plays the "libero" position, a defensive specialist whose primary responsibility is to dig the screaming serves and thundering spikes from the opposition. He expects to find out if he made the team this spring.

Kho began playing volleyball in middle school along with his twin brother, Ricky, who is also a biology major in the Kennedy College of Sciences.

KCS Freshman Leads Team to Hackathon Win

A team of first-year students led by a Kennedy College of Sciences freshman captured top honors and $5,000 in prize money at the first Hack Haverhill 24-hour hackathon competition.

Held at the Innovation Hub on the university's Haverhill campus, the students topped 14 other teams from colleges including UMass Amherst, MIT, Boston College and Boston University, as well as area high schools.

The UML team, organized by freshman computer science major Simon Wang, used data to come up with a risk score to alert parents, teachers and others about student behavior.

Math Inspired by Paintball

Prof. James Propp of the Department of Mathematical Sciences was awarded the 2018 Trevor Evans Award by the Mathematical Association of America for his article, "The Paintball Party." Propp's write-up, which was based on his real-life experience as a dad hosting a paintball party for his 9-year-old son's birthday, was deemed the best article published in Math Horizons magazine in 2017. Propp used geometry, combinatorics and finite fields to come up with a roster for dividing the boys into teams in a fair way.

"The party was a success," he wrote. The award, which consisted of a citation and a cash prize of $1,000, was presented to Propp at MathFest 2018 in Denver.

QUANTUM LEAP FORWARD

Physics Asst. Prof. Archana Kamal is taking quantum steps forward with research that could upend everything from how computers work to our understanding of gravity.

Kamal is leading a team that won a $1.5 million grant from the U.S. Department of Energy (DOE) to expand its research on quantum information science (QIS). The team, which includes the NIST Boulder Laboratories and Raytheon BBN Technologies, is trying to enable quantum technologies that can form the foundation for the next generation of computing and information processing.

A second DOE grant worth $360,000 was awarded to Kamal and researchers at UML, Penn State University and UMass Boston to extend QIS-inspired studies to gravity and the evolution of the early universe. The importance of Kamal's research was recognized by MIT Technology Review, which selected her as one of 2018's Innovators Under 35 in the "Visionaries" category.

Self-Driven Alumna Kate Tsui

Triple River Hawk Kate Tsui puts her UMass Lowell education to work helping to drive the future of autonomous vehicles.

"I literally apply everything that I learned at UMass Lowell almost every day," Tsui told students in a recent campus visit.

Tsui, who earned her bachelor's, master's and Ph.D. degrees in computer science (in 2004, 2008 and 2014, respectively), is a user experience researcher at the Toyota Research Institute in Cambridge. She is studying the needs of senior drivers and what technologies can be developed to assist them. She is also investigating human-robot interaction related to automated driving technologies.

She was back at UMass Lowell as the guest speaker at a celebration for first-year Kennedy College of Sciences Dean's List students, sharing her experiences on the road from campus to career.

DEADLY VENOMS, TOUGHER-THAN-STEEL WEBS

Researchers Seek to Unlock the Secrets of Spiders

BY GEOFFREY DOUGLAS

A Darwin's bark spider web stretches across a stream in Madagascar.

PHOTO BY MATJAŽ KUNTNER

Jessica Garb's fascination with spiders took root in her undergraduate days at Cornell, in a course on spider biology. She was captivated by the unique characteristics of spiders, one of the most species-rich creatures on the planet (there are more than 48,000).

Some spiders are masters of disguise. Some can live for up to 30 years. Others weave threads stronger than materials in a bulletproof vest.

"I learned how truly amazing spiders are," says Garb, now an associate professor of biological sciences at UMass Lowell. "They're such a diverse group of species, with so many different behaviors. You have the crab spider, which camouflages itself as a flower, and the peacock spider, where the male flashes its colors and dances to lure a mate. And they do amazing things with their silks. It just really fascinated me."

More than 20 years later, the fascination lives on. When she came to UMass Lowell 10 years ago, Garb established her spider lab, housed on the sixth floor of Olsen Hall. In the lab, Garb and her research team are focusing their efforts on two particular spider species: the Darwin's bark spider, native to Madagascar, whose web is tougher than steel and can extend long distances without breaking, and the infamous black widow, common in the southern U.S., whose potent venom is composed of a unique set of toxins that pose an "evolutionary mystery."

The black widow's venom, Garb says, can "make people very sick"—typically by overwhelming the nervous system, causing severe pain—but generally isn't lethal. The challenge, she says, is to determine the molecular composition of the venom, through a painstaking study of its genome, to better understand how it evolved.

The project, funded in part by a grant from the National Institutes of Health, compares venom from the black widow with that of other closely related but less hazardous species, such as the common house spider, to isolate and identify the particular toxins that account for the pain and sickness that the widow's bite can cause.

The results of the project will hopefully be applied to the development of improved anti-venoms, as well as beneficial drug compounds derived from the venom itself, Garb says. This practice is already proving effective with other species. For instance, venom from the Israeli yellow scorpion, commonly known as the death-stalker scorpion, has recently received limited approval for the treatment of brain cancer, while other venoms have been used in drugs to combat chronic pain, certain blood conditions and other ailments.

"It's an area that's only going to grow," Garb says.

But for all the wonders of the black widow's venom—and the almost mythic status of the widow itself—the Darwin's bark spider may be even more remarkable, and at least as promising in what it offers the rest of us. One of the silks spun by the species, so-called dragline silk, is "among the toughest materials in nature," Garb says. Double the toughness of any other known spider silk, it is 10 times tougher than Kevlar body armor, although it weighs far less, and can be stretched long distances without breaking.

The spider, a native of the Madagascar rain forests that was discovered just 10 years ago, also constructs the largest orb webs ever recorded, sometimes stretching the full width of rivers.

So what is it about the Darwin's bark spider silks, molecularly speaking, that give them such extraordinary properties? That's the puzzle that Garb's lab, armed with a $335,168 grant from the National Science Foundation and working in collaboration with two other universities, is tasked with solving.

"This particular gene is fairly new to researchers, so there's been very little study of it," says Winny Rojas-Velez, Garb's undergraduate research assistant. "We kind of have to piece things together as we go."

One method used to do this, she explains, involves the creation of a polymerase chain reaction (PCR), activated by a single strand

Dragline silk produced by the Darwin's bark spider is among the toughest materials in nature.

Biology student Winny Rojas-Velez (left) and Assoc. Prof. Jessica Garb observe a bark spider in the lab.

of DNA serving as a primer. This process allows copies of a DNA sequence to be amplified many times, thus generating more copies of the same segment to target for study.

"It's a trial-and-error process," says Rojas-Velez, who is a pre-med student. "It's the same approach people take to researching [possible] medicines. It's really fascinating, and it's given me a strong foundation in research."

Graduate student Molly Dawson, another member of the Garb team at work on researching the silk of the Darwin's bark spider, approaches the work from a different angle. Her challenge, she says, is through bioinformatics: analyze the properties of the spider's silk "on a genomic level through RNA sequencing," then compare it to that of other known species to determine what makes it unique.

IN CASE YOU'RE WONDERING

how Garb and her fellow researchers manage to come by these black widow spiders, the answer may surprise you: They order them through the mail. As handy as this is, though, it doesn't match the ease with which she collected them as a postdoctoral researcher at the University of California, Riverside: "We'd just walk around the building and pick them up off the ground."

The work, she says, is "probably two or three years" from being complete. Once finished, the team's findings will likely be published in a scientific journal.

"It's so cool," says Dawson, "that there's this super-tough silk out there, the toughest biomaterial currently known, and I get to be one of the people studying it. There are not many other people who can claim that."

The commercial payoff, the team members agree, could be enormous. Already, says Garb, several companies are looking into the potential of spider-silk-derived products: parkas, sneakers, sportswear, accessories. But the potential, she says, extends far beyond that to all manner of durable protective wear, including helmets and body armor, as well as bandages, sutures, prosthetics and other medical provisions.

In Michigan, Kraig Biocraft Laboratories, which describes itself as a developer of "what many consider the holy grail of materials science: a practical and cost-effective technology for producing recombinant spider-silk-based fibers on an industrial scale," won a $1 million contract with the U.S. Army to develop a super-durable spider-silk fiber that can be woven into protective clothing. "We are moving rapidly to commercialize our spider silk technology, which we believe will have a significant impact on the global textiles industry," the company states on its website.

Spider silk may open up new roads to collaboration with other UML researchers. Garb says she is in discussion with a plastics engineering faculty member who is interested in developing new materials from spider silk.

In the lab, Garb and her team tend to numerous other spider species: golden silk orb weaver spiders, a wolf spider, bark spiders and even a tarantula affectionately named "Rocky." Some are used to test research protocols, some are for teaching, and others are used for community education, which is a requirement of the NSF grant. As part of the outreach efforts, Garb has done presentations at the Lowell National Historical Park and has worked with the Tsongas Industrial History Center's summer camp programs.

So how much more can we learn from spiders? As researchers continue to unlock the remarkable properties of spiders, the arachnids' web of influence will continue to grow, in the community, in the lab, in the commercial marketplace—and in our lives.

"One of the silks spun by the species, so-called dragline silk, is among the toughest materials in nature. Double the toughness of any other known spider silk, it is 10 times tougher than Kevlar body armor, although it weighs far less, and can be stretched long."

—ASSOC. PROF. JESSICA GARB

Whip Scorpions: Heavy Metal

Jessica Garb isn't the only member of the UML faculty with a fascination for the arachnid family. Assoc. Prof. of Biological Sciences Richard Hochberg is leading a research project—currently under evaluation by the National Science Foundation—as part of a larger project proposal focused on the whip scorpion, a member of the spider family. While Garb's focus is on what makes her spiders' silks so tough or their venom so potent, for Hochberg, the target is his creatures' hard shells.

It turns out, Hochberg says, that while the shell of the crab or lobster is composed mostly of protein, the scorpion's shell is "metallized." The metals involved—zinc, manganese, silicon and calcium, among others—are ingested through the scorpion's diet, then "secreted into its exoskeleton, which make it strong and resistant to cracking."

Hochberg says the metals in the scorpion's body can be mapped and quantified through a specialized technique in the research lab known as scanning electron microscopy energy dispersive X-ray spectroscopy. This yields "a better idea of why these animals are so successful in their respective environments," he says.

Ultimately, the goal is much the same as Garb's spider projects: to determine how the metals can be used in low quantities to reinforce existing materials without adding much weight. This could lead to a wide array of improved materials, such as next-generation body armor that combines the strength of steel with the lightweight flexibility of Kevlar.

ALL SYSTEMS GO!

UML TO LAUNCH PLANET-FINDING TELESCOPE, NANOSATELLITE

NASA-FUNDED SPACE MISSIONS WILL USE A HIGH-ALTITUDE BALLOON AND A ROCKET

BY EDWIN L. AGUIRRE

An artist's impression shows a Jupiter-mass planet (at the bottom) orbiting the young, nearby star Epsilon Eridani. The star is one of the test targets for UML's upcoming PICTURE-C mission.

NASA, ESA AND G. BACON (STSCI)

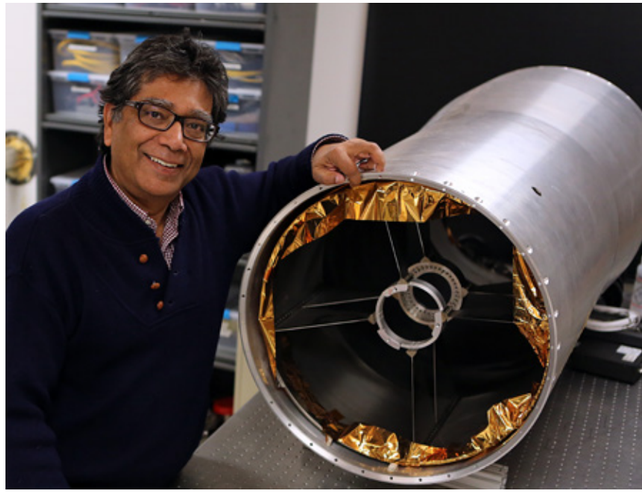
If all goes according to plan, UMass Lowell will have a planet-finding telescope soaring to the edge of the atmosphere and a miniature satellite orbiting Earth this year. The telescope and satellite are being built and tested at the university's Lowell Center for Space Science and Technology (LoCSST) by teams of UML students, faculty researchers, scientists and engineers.

"Both missions are firsts for UMass Lowell," says Prof. Supriya Chakrabarti of the Department of Physics and Applied Physics, who is the principal investigator for both projects. "Our goal is to train the next generation of astronomers, space scientists and engineers through hands-on involvement in all phases of the mission, from instrument development to data analysis."

The telescope project (dubbed PICTURE-C, which stands for Planetary Imaging Concept Testbed Using a Recoverable Experiment—Coronagraph) aims to develop and validate the technology necessary for detecting Jupiter-size planets orbiting nearby stars in the Milky Way. The project is funded with a five-year, $5.6 million grant from NASA. The team's ultimate goal is to discover Earth-like planets around sun-like stars capable of supporting life.

"PICTURE-C will enable us to learn about debris disks around other stars and to gain a better understanding of the processes and dynamics that formed our own solar system," explains Chakrabarti, who directs LoCSST. "But in order for us to do this, we have to fly the instrument to about 120,000 feet—roughly 3½ times higher than the typical cruising altitude of a passenger jetliner—to get above 99 percent of the Earth's atmosphere. Atmospheric turbulence distorts and blurs our image of the stars."

The telescope's launch is set to take place this spring from NASA's Columbia Scientific Balloon Facility in Palestine, Texas, where it will be carried aloft to the stratosphere using an unmanned helium balloon 400 feet wide and several stories high. The balloon's launch window is tight, so any bad weather at the site can potentially delay the mission for days or weeks. A second balloon flight for PICTURE-C is planned for 2020.



Prof. Supriya Chakrabarti, director of the Lowell Center for Space Science and Technology (LoCSST), has successfully launched more than 20 sounding rocket science experiments.

TO THE THRESHOLD OF SPACE

"We're extremely excited," says LoCSST research scientist Christopher Mendillo. "We've done sounding rockets before, but PICTURE-C is our very first balloon mission. Balloons are an amazing platform to use for conducting cutting-edge exoplanet research because of their relatively low cost and long observing duration."

PICTURE-C features a coronagraph, a specialized optical imaging system coupled to a 24-inch-diameter telescope designed to "mask," or block out, the direct light from the star so that faint objects very close to the star—such as planets and interplanetary dust, which otherwise would be hidden in the star's bright glare—can be studied in great detail.

High winds in the upper atmosphere are expected to buffet the entire telescope. To keep the coronagraph aimed precisely at the target, the instrument is mounted on a special NASA gimbal platform in the balloon's gondola that can compensate for any unwanted movements. PICTURE-C will use the platform in conjunction with an onboard active optical pointing control system designed and built by Mendillo and physics Assoc. Prof. Timothy Cook, who is the project's co-investigator.

"This control system can optically stabilize the light coming out of the telescope and keep the coronagraph centered on the target star to an accuracy of one milliarcsecond, or better," says Mendillo. "A milliarcsecond is equivalent to resolving an object approximately 2 meters wide on the surface of the moon, which is about 385,000 kilometers away."

Unlike a sounding rocket, which offers an observing window that lasts only for a few minutes before the payload parachutes back to the ground, the helium balloon will keep PICTURE-C aloft as long as 10 hours. At the end of the mission, ground controllers will send a command to release PICTURE-C from the balloon. A parachute is then deployed to slow PICTURE-C down and allow it to land gently for reuse in the next mission.

Aside from Chakrabarti, Mendillo and Cook, the other members of the PICTURE-C team are LoCSST mechanical engineer Jason Martel and physics graduate students Kuravi Hewawasam and Glenn Howe. Other collaborators include researchers from NASA's Jet Propulsion Laboratory and Goddard Space Flight Center as well as Caltech, MIT, the Space Telescope Science Institute and the University of California, Santa Barbara.

From left: Chakrabarti, Assoc. Prof. Timothy Cook and LoCSST Research Scientist Christopher Mendillo test the PICTURE-C telescope's primary mirror, which is visible inside the white truss structure. The telescope is scheduled for launch this spring aboard a high-altitude helium balloon (inset).

STUDENT SPACE RESEARCH

In the meantime, a total of about 100 students from physics, math, computer science, mechanical engineering, electrical engineering and computer engineering have worked on the satellite project called SPACE HAUC (pronounced "Space Hawk"), which stands for Science Program Around Communications Engineering with High-Achieving Undergraduate Cadres. The project is funded with a two-year, $200,000 grant from NASA and is based on the CubeSat model used worldwide for Low Earth Orbit space research.

"SPACE HAUC is progressing well," says Susanna Finn, a research scientist at LoCSST who is advising the team. "Currently, the students are building and testing the CubeSat components, and shortly we will be in our integration and testing phase, assembling the whole system and testing it."

Once the satellite is flight-ready, the researchers will turn it over to Nanoracks, a Texas-based commercial CubeSat deployer, to prepare it for launch to the International Space Station (ISS), from where it will be released into orbit.

DAT LE

"Launch is currently scheduled in the fall, but these things can still change," says Finn.

SPACE HAUC will be launched during a scheduled resupply mission to the ISS, either aboard a Northrop Grumman Antares rocket from the Wallops Island spaceport facility in Virginia or a SpaceX Falcon 9 rocket from Cape Canaveral, Florida.

"SPACE HAUC will be part of NASA's ELaNa [Educational Launch of Nanosatellites] payload, along with other CubeSats from other schools and NASA research centers. Nanoracks will pack SPACE HAUC into a deployer, and once our satellite is in orbit, it will be released from the ISS," says Finn.

The mission's goal is to demonstrate the practicality of communicating at high data rates in the X band using a phased array of patch antennas on the CubeSat and electronic beam steering. The antennas will operate at frequencies of 7.2 to 8.3 gigahertz from an orbit of about 450 kilometers.

"The use of X-band signal has yet to be attempted in a CubeSat and, if successful, would aid future CubeSat applications and space exploration," says Simthyrearch Dy, SPACE HAUC's student program manager. Dy is an Honors College student and a computer science, physics and math triple major from Lowell.

"Many CubeSats transmit data to ground controllers in the S-band at an average speed of 2 to 5 megabits per second. SPACE HAUC seeks to increase the speed to 50 to 100 megabits per second," he says.

The students plan to maintain a communication link between the satellite and ground stations at the university's Olney Science Center on North Campus and the MIT Haystack Observatory in Westford, Massachusetts. SPACE HAUC is expected to stay in orbit for about a year or more before it gradually loses altitude and falls back to Earth, disintegrating and burning up harmlessly high above the ground.

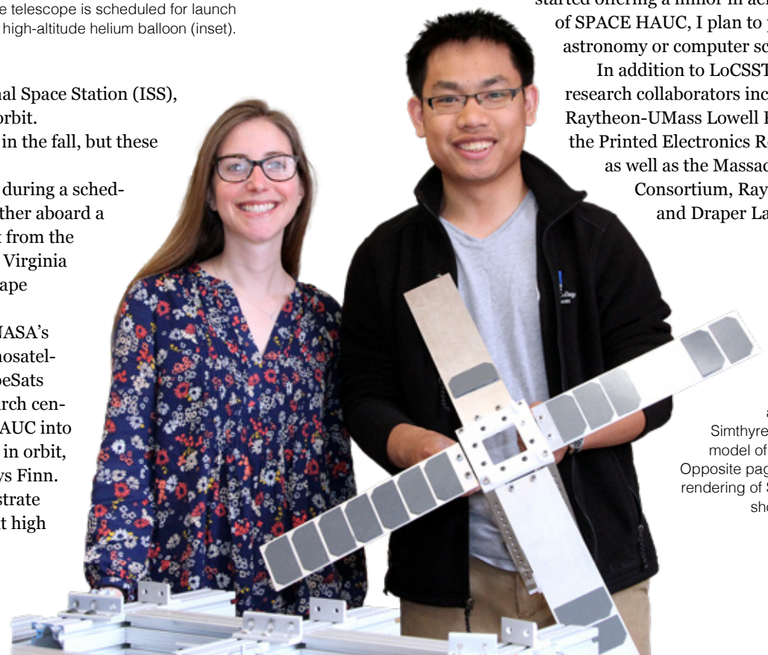
Finn says the students' drive and dedication have impressed her from day one: "They have been very independent and self-motivated to dive right in and research and learn what they need to know."

For some, the project has opened the door to new career possibilities.

"This experience has laid the groundwork for my eventual plan of working for NASA," says Dy. "I have background knowledge from my studies in STEM, and now I have R&D experience in an actual space science mission. An opportunity like this doesn't come around often, especially during one's undergraduate years."

He adds, "The Francis College of Engineering has recently started offering a minor in aerospace studies. Because of SPACE HAUC, I plan to pursue a Ph.D. in either astronomy or computer science."

In addition to LoCSST, other SPACE HAUC research collaborators include the university's Raytheon-UMass Lowell Research Institute and the Printed Electronics Research Collaborative, as well as the Massachusetts Space Grant Consortium, Raytheon, BAE Systems and Draper Laboratory.



At left: LoCSST Research Scientist Susanna Finn and undergraduate student Simthyrearch Dy, who holds a scale model of the SPACE HAUC satellite. Opposite page, bottom: This conceptual rendering of SPACE HAUC in Earth orbit shows the satellite's four solar panels fully deployed.

LoCSST'S OTHER SPACE-RELATED MISSIONS

In addition to SPACE HAUC and PICTURE-C, LoCSST has undertaken other space research programs for the university, including:

LITES (Limb-imaging Ionospheric and Thermospheric Extreme-Ultraviolet Spectrograph)
An instrument uilt in the lab at UMass Lowell to observe ultraviolet light in Earth's upper atmosphere from orbit and study irregularities in the ionosphere. LITES was launched in 2017 and is now mounted outside the International Space Station, where it is gathering data while circling the Earth.

HiT&MIS (High-Throughput and Multi-Slit Imaging Spectrometer)
An NSF-funded custom-built instrument designed to observe disturbances in the upper atmosphere at multiple optical wavelengths simultaneously and at high resolution. Two units deployed during the Great American Eclipse in 2017—one in Wyoming and the other in Illinois—recorded the formation of atmospheric gravity waves as the moon's shadow swept over the atmosphere at supersonic speed.

PICTURE-B (Planet Imaging Coronagraphic Technology Using a Reconfigurable Experimental Base)
A sounding rocket experiment designed to take direct images of the disk of dust surrounding the nearby orange dwarf star Epsilon Eridani in infrared and visible light. PICTURE-B was launched in 2015 using a NASA sounding rocket from the Army's White Sands Missile Range in New Mexico.

IMAGER (Interstellar Medium Absorption Gradient and Extinction Rocket)
A NASA-funded rocket-borne experiment designed to observe and study the creation and destruction of interstellar dust in the distant spiral galaxy M101 in Ursa Major. IMAGER was launched in 2012 from the White Sands Missile Range.

WE, ROBOT

FROM SELF-ASSESSING SYSTEMS TO MANUFACTURING ADVANCES, OUR ROBOTICISTS ARE PROGRAMMING THE FUTURE

BY ED BRENNEN

Asst. Prof. Reza Ahmadzadeh handed out two things on the first day of his Mobile Robotics 1 course this spring: a syllabus and a Cozmo, an artificial intelligence robot the size of a coffee mug that students can take home during the semester and program.

One of four new faculty members to join the Computer Science Department this year, Ahmadzadeh's expertise is in robot learning and human-robot interaction. When he earned his master's degree in mechanical engineering in his native Iran in 2001, Ahmadzadeh says, there was maybe one robot at the entire university. He's excited to now be teaching and conducting research at the Kennedy College of Sciences, where students and faculty have access to the latest in robot technology, interdisciplinary labs and testing facilities.

"I'm lucky to be here and to be able to use these resources," says Ahmadzadeh, who earned his Ph.D. in robotics, cognition and interaction technologies from the University of Genoa in Italy in 2015.

"IT'S AMAZING HOW FAR WE'VE COME IN THE LAST 10 to 20 YEARS, BUT THE PART THAT IS MISSING IS INTELLIGENCE. WE DON'T HAVE A NOTION OF INTELLIGENCE SO FAR. I WANT TO SEE WHEN THE ROBOTS GET TO HUMAN LEVEL. THAT'S WHAT FASCINATES ME ABOUT ROBOTICS." —ASST. PROF. REZA AHMADZADEH

Asst. Prof. Reza Ahmadzadeh holds a HEXA robot.

Ahmadzadeh doesn't have to go far to find one of the country's leading roboticists; his Dandeneau Hall office is next door to Distinguished University Professor Holly Yanco, director of the New England Robotics Validation and Experimentation (NERVE) Center and founder of UML's Human-Robot Interaction Lab.

Despite all the talk of robots taking over jobs, they still have a way to go before they can function on par with humans, Yanco says. In fact, during a talk on the future of human-robot interaction last year at UMass Lowell's Innovation Hub in Haverhill, she drew some surprised looks from the crowd when she described robots as essentially "stupid."

"Right now, our robots will show you a video of the last five minutes of where they got stuck," Yanco said as she described her team's latest research on giving humanoid robots and other autonomous systems the ability to evaluate how well they can perform a task—or if they can do the task at all. "They don't know how to quickly summarize a situation like people do. Our goal is to develop methods and metrics that would enable autonomous systems to assess their own performance."

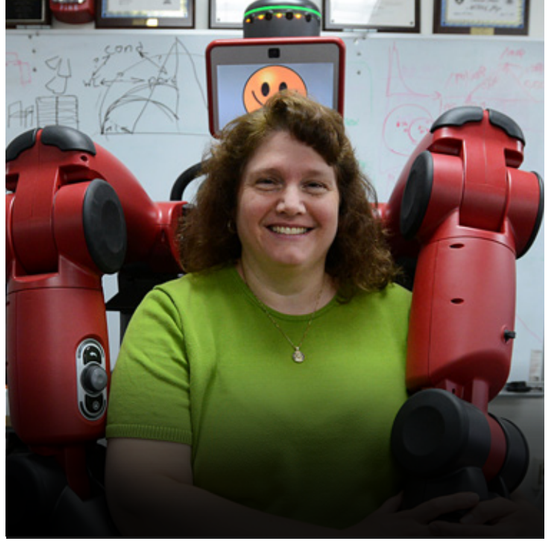
They're doing so through a project called SUCCESS (Self-assessment and Understanding of Competence and Conditions to Ensure System Success), which is funded with a $7.5 million grant from the U.S. Department of Defense. UML is collaborating on the five-year initiative with three other institutions: Carnegie Mellon University, Brigham Young University and Tufts University.

BUILDING A BETTER ROBOT

At the NERVE Center's home at 110 Canal St. in Lowell, Yanco and her colleagues are evaluating how a pair of $25,000 "Baxter" robots are able to complete assembly tasks, problem-solving scenarios and games. The red and black two-armed humanoid Baxters can display facial expressions on their built-in computer screens while they carry out their assigned tasks.

Working with researchers at Carnegie Mellon's Robotics Institute, the team is building a software database that lays out all of the variables the robots could encounter and ways in which they could execute tasks based on their previous behavior. By looking at the robots' track record, researchers hope to predict how well they will perform in the future. The data could be used by operators in the field to help them anticipate how the machines will behave. It could also help computer scientists and engineers design and build the next generation of enhanced robotics.

"Hopefully, the study will lead to better human-robot teamwork and increase the level of trust, expectation and efficiency between the two," said Yanco, who described how even the simple task of a robot handing an item to a human co-worker requires careful study and consideration.



Prof. Holly Yanco will use a Baxter robot to develop self-assessing autonomous systems.

For good old-fashioned humans, working side-by-side with robots is becoming increasingly common across many industries. According to the World Economic Forum's latest "Future of Jobs Report," by 2022, stationary robots will be employed at 37 percent of all companies.

"That's continuing to grow," says Yanco, who sees collaborative robots—such as exoskeletons that people can wear to help them complete physically demanding tasks like lifting heavy boxes—as a particularly promising "breakout market."

A BOOST TO MANUFACTURING

Since 2017, UML has also been a partner in the $250 million Advanced Robotics Manufacturing (ARM) Institute, a national initiative that focuses research on robots capable of interacting with humans on manufacturing floors and learning new manufacturing processes.

"Hopefully, this will bring back a lot of manufacturing to the country," says Yanco, who is heading up the university's regional ARM institute efforts along with the Massachusetts Institute of Technology's Computer Science and Artificial Intelligence Laboratory, Northeastern University, Worcester Polytechnic Institute and MassRobotics, a nonprofit robotics innovation hub.

"We are proud to bring our resources and expertise, along with our excellence in advanced manufacturing research, to the nation's first manufacturing innovation institute focused on robotics," Chancellor Jacquie Moloney said when Gov. Charlie Baker announced the partnership. "This field holds tremendous promise for the economy and the creation of jobs for skilled workers in the commonwealth and beyond."

Indeed, with 122 robotics-related companies employing close to 5,000 people across the commonwealth (according to the Massachusetts Technology Collaborative's 2016 statistics), demand for highly skilled professionals is strong.

Given the cluster of robotics employers in the region, it's no surprise that student interest is high. There are close to 60 students currently enrolled in UML's robotics minor, an interdisciplinary 24-credit program offered by the departments of Computer Science, Electrical & Computer Engineering and Mechanical Engineering.

In addition to landing co-ops, internships and eventual jobs at companies such as iRobot, Amazon Robotics and Symbotic, robotics students can do hands-on research at the NERVE Center, which provides testing services for industry, academia and the government in collaboration with the National Institute of Standards and Technology.

The NERVE Center's most famous alum is Valkyrie, NASA's $2 million humanoid robot that moved to MassRobotics in Boston after a two-year stay on campus. UML students now travel there to work on the 6-foot, 300-pound robot, which one day may help build a space station on Mars.

Spread over the first and second floors at 110 Canal St. in downtown Lowell, the NERVE Center features a robotic manipulation testbed called the Robot ARMada, a collection of robotic arms, end effectors and sensor systems. The center also features movement assessment and performance labs where researchers collaborate with faculty from the Physical Therapy Department to evaluate wearable robots.

One area they're currently studying is what happens to a person's muscles over time when wearing an exoskeleton. By using sensors to look at muscle activation, researchers are trying to predict whether a person's muscles will atrophy if they spend 40 hours a week carrying increased weight with robotic assistance. The goal is to develop an exoskeleton that can adjust to an individual throughout the day, thereby reducing fatigue and eventual injuries.

"In the morning, when you're feeling strong, you can lift 150 pounds. Then later, when you're not feeling so strong, the exoskeleton kicks in to help you," Yanco explains. "We have to look at how people work, and how robots work, and how they're going to work together."

But what about robots and people working together at home, à la Rosie, the robot maid on "The Jetsons"? Ahmadzadeh is working on an algorithm that would enable consumers to teach new skills to robots so they can adapt to dynamic environments—such as getting around someone's kitchen to make them a pot of coffee.

"Instead of coding the robot with a new skill, which many people don't know how to do, you can easily show the robot how to do something. It learns from your movements," Ahmadzadeh explains.

While robots have made tremendous strides thanks to recent advances in neural networks, computation and hardware, Ahmadzadeh says true full autonomy is still the stuff of science fiction.

"It's amazing how far we've come in the last 10 to 20 years, but the part that is missing is intelligence. We don't have a notion of intelligence so far," says Ahmadzadeh, who hopes to contribute to the breakthrough needed for this revolutionary step in robotics through his work at UMass Lowell.

"I want to see when the robots get to human level," he says. "That's what fascinates me about robotics."

RICH MINER '86, '89, '97

ANDROID CO-FOUNDER BUILDS AND INNOVATES AT GOOGLE

BY EDWIN L. AGUIRRE

Rich Miner is an entrepreneur at heart, skilled at building companies from the ground up. He thrives on bringing a spark of an idea to life—on assembling teams that can push the boundaries of innovation and deliver market-disrupting products.

It's what he's been doing for more than 30 years.

A triple River Hawk, Miner's reputation in the world of technology is legendary. He co-founded the company Android, which developed what is now the world's most popular mobile operating system, used by 2.5 billion people and commanding more than 85 percent of worldwide market share. The company was acquired by Google in 2005 for a reported $50 million, and that's where Miner has worked ever since.

"At Google, I initially helped lead Android development and helped create and grow Google's venture fund," says Miner, who earned bachelor's ('86) and master's ('89) degrees and a Ph.D. ('97) in computer science from UMass Lowell.

For several years, Miner was a partner at Google Ventures, the company's investment arm. These days, his focus is on developing innovative educational products and user interface technology. He works out of Google's Cambridge, Massachusetts, office and travels frequently to its Mountain View, California, headquarters.

"Currently, I am concentrating more on building and innovating than investing," he says.

A STANDOUT STUDENT

Before he was helping to reshape the technology industry, Miner left his mark at UMass Lowell.

"There was no question Rich was going to be successful—it was just a question of how soon and where," computer science Professor Emeritus Tom Costello says about his former student.

Miner credits the education and training he received at UMass Lowell as key to his entrepreneurial success. He also feels fortunate to have had great mentors, too.

"I got a solid foundation in computer science, which has served me well through all these years," he says. "Under the leadership of Profs. Pat Krolak, Tom Costello, Jim Canning and others, I got a really strong sense about teamwork and team-based, large-scale projects. I also was able to work with industry, which helped me understand the business side of things as well. All these had a huge influence on my professional trajectory."

Android co-founder Rich Miner '86, '89, '97 at Google corporate headquarters in Mountain View, California. Here, he is shown with the Android "Oreo" robot, which represents the version of the Android mobile operating system that was released in 2017.

As an undergrad, Miner considered becoming a physicist. But on the side, he wrote computer games for the Commodore 64, a first-generation gaming system, and soon discovered his love of both computer science and entrepreneurship. As a graduate student, his work with Krolak for the university's Center for Product Enhancement paved the way toward groundbreaking ideas in image processing, video digitization and videoconferencing, among other innovations.

Miner's ties to the university are enduring. He's been back to campus to meet with students and to serve as a judge in the campus DifferenceMaker Idea Challenge. In 2012, he established the Prof. Patrick D. Krolak Innovation Endowment in honor of his mentor, who was killed in a car accident just months later.

And the work Miner did on campus still applies to the projects with which he's involved today.

> "Having created Android, I realize that while smartphones have become a powerful tool for learning, they are also often used by parents as 'pacifiers' for the kids."

"Some of the projects that I am doing now at Google are actually related to my Ph.D. work [at UML] more than anything else I have done in the past," notes Miner.

MACHINE LEARNING

So what's the next big thing for Google, whose parent company, Alphabet Inc., posted revenue of $136.8 billion in 2018?

The company is pushing the boundaries of machine learning, an aspect of artificial intelligence that teaches the machine how to think and solve problems independently and to program itself.

"We are putting huge efforts behind machine learning technology and algorithms as well as the infrastructure needed to support them," Miner says.

He cites as an example Google Photos, which can automatically recognize, categorize and organize pictures.

"We are exploring ways to bring some of that power to health care, assisting diagnosis from patient photos and imaging scans," he says. "Our goal is to apply this technology to solving real-world problems and to bring this human-computer interface to consumers, like what we did with Google Assistant, which brings a friendly voice into people's homes."

As for the future of Android, Miner says consumers can expect smartphones to become even smarter with each release of the device. "We are putting artificial intelligence in the device itself—like in Google's Pixel 3 phone, for example—so smartphones can actually learn the user's habits, intentions and preferences," he says.

But as a parent of two young children, Miner sees a downside to phones that can do so much.

"Having created Android, I realize that while smartphones have become a powerful tool for learning, they are also often used by parents as 'pacifiers' for the kids," he says.

"My kids have very limited screen time," says Miner. "They use their devices only for reading books and playing chess. They are given, at most, an hour a week to do any sort of video games."

Parents need to monitor screen time and the materials being accessed and make sure children spend time interacting with a non-pixelated world, Miner says. His daughter, who is now 13, just got her first phone this year.

Miner pioneered the development of videoconferencing as a UML undergrad in the late 1980s. Here, he is shown using the technology on campus to order pizza from a shop in downtown Lowell.

"Kids should be out playing, drawing with real paper and crayons, using scissors and glue to build things like models," he says. Miner believes that people should be engaged in face-to-face conversations and interactions: "Parents should set an example—our kids get upset when we bring our phones to the dinner table."

FIRE IN THE BELLY

Prior to his success with Android, Miner founded Wildfire Communications in 1991 (which developed the world's first voice-based personal assistant), and he worked at the European mobile carrier Orange as vice president of technology and innovation. He has invested in numerous startups and served on the boards of several.

What entrepreneurial advice can Miner give to UMass Lowell students and young alumni who want to enter the tech industry?

"Do not be risk-averse—take risks when you are young, because it is easier. Do not worry about failure; learn from it," he says.

If you are a passionate entrepreneur, there are plenty of opportunities to apply for funding or to get training in large companies, Miner says.

"Make sure you are learning something and make sure you are doing projects that demonstrate that learning," he advises. "Associate yourself with the right people—bright people and good mentors—and form a strong team. Very few people became successful individually; your success comes from a strong, diverse team. Do not always just seek out people that look like you."

He adds, "Most importantly, follow your own 'fire in the belly.' It certainly has worked for me."

Indeed it has. You can Google it.

MIKE MORIN ’76

FROM THE CLASSROOM TO THE LAB: A FRONTLINE BATTLER IN THE FIGHT AGAINST CANCER

BY GEOFFREY DOUGLAS

“When I first walked onto campus [at Lowell Tech] in the fall of 1972, I wasn’t particularly driven as a student,” Michael Morin ’76 recalls. Even two years later, as a biological sciences major living at home in Lawrence and working nights as a department store clerk, he was still “pretty much drifting along,” he says.

Then, early in his junior year, Morin took a job washing glassware in Prof. Robert Lynch’s biology lab—and after a while, he began assisting students in research tasks. It was there that a new world opened up.

“I learned that with the right controlled conditions, you can actually find out things about how the universe works; you can cure disease. That just blew my mind.”

The drifting had ended. “My path was certain from that point on,” he says. “I knew I wanted to be involved in medicine—but not as a doctor. I wanted to help cure disease.”

A Ph.D. in cancer pharmacology at SUNY Buffalo was followed by a stint as a post-doctoral fellow at Yale, then by several years on the faculty of the Northwestern University Medical School in Chicago, where Morin served as head of the tumor cell biology graduate program. Then came a call from Pfizer in 1991.

Morin and his wife had just had a baby daughter. The job with Pfizer was in Connecticut. And it was “still kind of a third-tier company,” says Morin, noting that the mergers with Warner-Lambert, Wyeth and others were still a decade away, “with technology only just emerging in the area of oncology. So it was an exciting opportunity. Still, it was a major move for us, a major decision.”

He took the job and had been there only a year when the head of the cancer research program left the company. Morin was appointed as his successor. As promotions go, he says, it didn’t feel all that auspicious at the time: “Cancer research was still an afterthought [at Pfizer], a cost center that hadn’t yet produced a drug.”

Within three years, under his leadership, the company had nominated its first drug candidate into clinical development. The drug compound, Erlotinib (sold under the brand name Tarceva), which treats non-small-cell lung cancer, was an overnight blockbuster and today generates annual global sales of more than $1.5 billion.

It wouldn’t be Morin’s last success at Pfizer. Over the 16-plus years Morin was at the drugmaker, roughly 40 clinical candidates were discovered, many of them still in clinical development today. The Pfizer Cancer Group, the “afterthought” he’d taken over in 1992, grew in time to become the most productive discovery group within the company.

Morin left Pfizer in 2008. Since 2010, he has been working as a consultant to several biotech companies, often in leadership roles. In 2016, he took over as president and CEO of Immunome, a biotech company in Philadelphia, to which he commutes two days a week from his home on the North Shore. He also serves on the Kennedy College of Sciences advisory board and teaches a graduate course on cancer biology, immunology or drug discovery each semester at UMass Lowell.

So, with more than 30 years of research and teaching behind him, how does Morin view the progress in the fight against cancer?

“I believe that 20 years from now, we’ll think about cancer the way we think about diabetes today,” he says. “It’ll be manageable. You won’t want to get it, but you won’t have a deathly fear of it anymore either.”

There’s precedent for this, Morin says: “When I started out, melanoma was a death sentence, with a 5-to-10-percent five-year survival rate for a stage 3 disease. Today it’s closer to 70 or 80 percent, and that extends a little more each year.

“So there’s reason to believe,” he says. “There’s lots more to do, but there’s reason to believe.”

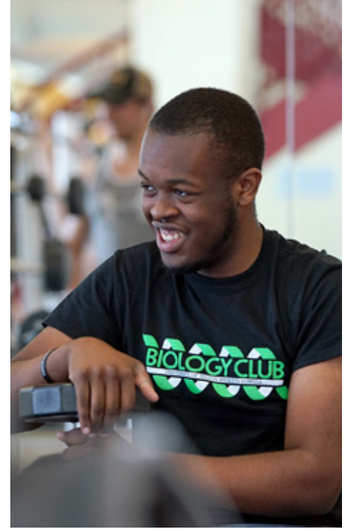
RALPH SAINT LOUIS ’18, ’19

COMBINING LOVE OF BIOLOGY AND EDUCATION

Ralph Saint Louis is a planner. He likes to be busy and to know where he’s heading. “I become complacent without goals,” he says.

Saint Louis had a plan when he came to UMass Lowell, one that would allow him to pursue two of his great interests: science and education. He earned his bachelor’s degree in biology and minored in education, getting his license to teach high school science through the UTeach program. That was a path he couldn’t find at other colleges.

Saint Louis balanced classes, a job as a research assistant and involvement in campus activities with his teacher training.



While doing his practicum at Lowell High School, he was offered a full-time job there. He’s now teaching biology and chemistry while working on his master’s degree in applied biotechnology through the university’s five-year bachelor’s-to-master’s program.

While he’s settling into his teaching job, he’s got his eye on his next goal: to work in private industry after finishing his master’s degree. He’s already had hands-on experience, starting with his job as an assistant in the lab of Asst. Prof. Jennifer Fish researching craniofacial development and abnormalities. His experience there opened up the door to other opportunities—as an intern at the biotech firm TetraGenetics and as a research intern at the Institute of Molecular Life Sciences at the University of Zurich.

“I learned the skills at UMass Lowell,” he says.

Eventually, Saint Louis plans to circle back to education. His plan is to earn a doctoral degree in education policy and focus on inequalities in education funding. Whatever path he chooses, he says his UMass Lowell education and his experiences beyond the classroom have prepared him well.—JG

ABIGAIL GIARROSSO ’17, ’19

STUDENT RESEARCH EXPERIENCES LEAD TO CAREER PATH AS CHEMIST

As an Honors College chemistry major, Abigail Giarrosso landed a work-study job as a lab assistant at the university’s Toxics Use Reduction Institute (TURI) laboratory.

That job helped shape the course of her education and career plans.

“They let me do everything,” says Giarrosso, who earned her bachelor’s degree in 2017 and stayed to pursue her master’s in chemistry. “If I wanted to learn something, they would teach me.”

One of her projects was working with TURI’s research manager to find a safer alternative to paint strippers that contain methylene chloride, a toxic chemical that has led to dozens of deaths.

The researchers identified three existing safer chemicals that, when combined in a certain ratio, work as effectively as products with methylene chloride. A company has licensed the formula from the university and will have products in stores soon.

“I am very lucky to have worked on a project that made a real and direct impact in consumers’ lives,” says Giarrosso, who plans on pursuing a Ph.D. in chemistry.

Giarrosso traveled to Minneapolis in the summer of 2018 to work as a formulation chemist for a small startup company called Remooble. Drawing on her research experience at UML, she developed the testing protocol and found safer alternatives to remove permanent markers used on white boards.

Now back on campus, Giarrosso has taken on her next research challenge at TURI: finding a safer alternative to acetone-based removers for gel manicures. Acetone can cause serious eye irritation, drowsiness and dizziness and long-term exposure may damage the central nervous and renal systems.

“I’m excited to work on this project, which will protect the health of consumers and especially nail technicians, who may be exposed to acetone every day,” she says. —KA

THE ALZHEIMER'S PUZZLE

BY DAVID PERRY

With no cure in sight, researchers piece together strategies to keep the disease at bay.

Alzheimer's disease is devastating to those who suffer from it and to their families, slowly and painfully robbing memories, language skills and independence from its victims. It's also an elusive foe to the researchers trying to find a cure for the disease, which affects an estimated 5.7 million people in the United States.

With the rapidly aging population in the U.S., the number of people living with Alzheimer's is expected to soar. By 2050, the Alzheimer's Association projects that nearly 14 million Americans will have it.

What hope does science hold out for the millions of people who are dealing with the disease? Two Kennedy College of Sciences faculty members, Biological Sciences Prof. Thomas Shea and Assoc. Prof. Garth Hall, have devoted much of their careers to Alzheimer's-related research, looking for possible causes and searching for ways to prevent the disease. They shared their perspectives on the latest advances in treatments and diagnosis and on the prospects for a cure.

LIVING WELL IS THE BEST REVENGE

To understand Alzheimer's disease, it helps to understand what causes it. Shea, who has researched Alzheimer's for more than three decades, says it's a combination of things.

"A number of factors—genetic, environmental, nutritional and more—combine to result in the manifestation of Alzheimer's disease. It may, in a very real way, be part of the human condition," he says.

Shea's research indicates that proper nutrition, mental, physical and social activity can stave off cognitive decline.

"If an individual delays cognitive decline for a protracted period, they may never experience Alzheimer's disease," says Shea, who compared this approach to the treatment for diabetes. "We don't cure it, but we can manage it and, in doing so, hold back its deleterious impact. That is a 'functional' cure."

Prof. Thomas Shea (below) and Assoc. Prof. Garth Hall (at bottom) agree that with no cure in sight, lifestyle choices may be the best way to prevent Alzheimer's disease.

"The more general knowledge we have about nervous system function and genetics, the more we can apply to what goes wrong in Alzheimer's disease and other age-related disorders."

— PROF. THOMAS SHEA

Last fall, research by Shea and Framingham State University Nursing Prof. Ruth Remington found that the early stages of cognitive decline often go unnoticed. Thus, medical intervention or lifestyle changes that could hold off or even reverse the disease are delayed. Their research, which was published in the Journal of Alzheimer's Disease, also demonstrated that lifestyle modifications are beneficial, regardless of age.

For now, living well through healthy nutrition choices and staying physically and socially active may provide the best shot for keeping the disease at bay, Shea says. "I don't see a true cure on the horizon."

Hall, whose chief concern is improving diagnostic approaches for Alzheimer's, agrees that for now, lifestyle choices may be the best bet for avoiding the disease.

"There is considerable hope that improved palliative treatments will soon emerge that mitigate and delay the progression of the disease," he says, adding that in the meantime, "staying physically and mentally active and avoiding head trauma are probably the most important general pieces of advice."

Hall's research has focused on the role that tau proteins play in Alzheimer's disease. He led a research team that found a new mechanism by which tau protein spreads within the brain and appears in the blood and cerebrospinal fluid of people with Alzheimer's. The results from Hall's research suggest that a specific kind of tau protein (tau-E2) plays a critical wrole in the spreading of Alzheimer's lesions in the brain.

Hall is currently investigating the connection between Alzheimer's and traumatic brain injury and is trying to identify "fingerprints" of proteins in body fluids that will help in diagnosing Alzheimer's, as well as assist in triaging head injuries. He has received funding from the U.S. Army's Telemedicine & Advanced Technology Research Center in support of his work. In collaboration with researchers from the Veterans Administration health care system and Boston University School of Medicine, he is also involved with the analysis of tissue and body fluid exosomes from retired National Football League players and people injured in explosions.

"Our work suggests that the development of 'fingerprint' diagnostics, based on changes in neuronal secretion that precede the onset of Alzheimer's, is a promising approach," he says.

Looking ahead, Shea says more work needs to be done to uncover the "initial, triggering event" that leads to Alzheimer's."Something occurred upstream, such as inflammation or oxidative damage, that initiates pathology that later encompasses those proteins," he says. "There is a new line of research, with mounting evidence, that earlier viral infection may trigger part of that early inflammation."

Research in other areas may help the fight against Alzheimer's. Advances in cancer treatments are likely to become relevant, and the fast-moving field of genetics may play an important role, the two researchers say.

"The more general knowledge we have about nervous system function and genetics, the more we can apply to what goes wrong in Alzheimer's disease and other age-related disorders," Shea says.

Shea and Hall also agree that more funding is needed. But it's not just a matter of more money, but rather how it's spent that could make a difference, says Hall. He expresses frustration with what he describes as Alzheimer's research resistance to small-scale projects to test new ideas. That resistance stems partly from what he believes "is a misplaced faith in the ability of expensive, large-scale research projects" to lead to an urgently needed cure for the disease.

"Since it is clear that we have only a limited understanding of the underlying biology of Alzheimer's disease, I think that funding could more usefully be spent in identifying and testing factors which contribute to the underlying disease mechanisms," he says.

FACULTY NEWS

Beyond the Classroom

ASST. TEACHING PROF. ALISON HAMILTON of the department of Biological Sciences hosted a field trip for her ecology students to Great Meadows National Wildlife Refuge in Concord to learn more about Blanding's turtles. This turtle has been outfitted with a radio transmitter as part of a long-term study on this threatened species by researchers at Zoo New England and refuge biologists.

ASSOC. PROF. HAIM LEVKOWITZ, chair of computer science, attended the 2018 Grace Hopper Celebration of Women in Computing in Houston, Texas, along with seven UMass Lowell computer science majors. The Grace Hopper Celebration is the world's largest gathering of women in computing and supports women in pursuing research and careers in computing.

ASSOC. TEACHING PROF. KHALILAH REDDIE of the Chemistry Department and her students took a field trip to the new GE Healthcare Life Sciences headquarters. Biology juniors, seniors and graduate students were invited to attend to learn about the advanced methods being used to discover, develop, produce and deliver modern medicines such as vaccines, biologicals and immunotherapeuticswhile seeing some of the equipment used throughout these processes.

Faculty Success

ASST. PROF. REZA AHMADZADEH of the Computer Science Department was appointed as an associate editor for the International Conference of Automation and Robotics.

PROF. FRANK COLBY and **PROF. MATT BARLOW,** both of the Department of Environmental, Earth & Atmospheric Sciences, were named as representatives of the University Corporation for Atmospheric Research (UCAR). Barlow was also named as an editor of the Journal of Climate.

VLADIMIR DERKACH of the University of Kiev, a recipient of a Fulbright Award for research, is visiting the university. He is being hosted by Prof. Alexander Kheifets of the Department of Mathematics.

ASST. PROF. ARCHANA KAMAL of the Department of Physics & Applied Physics was named as one of "35 Global Innovators Under 35" by MIT Technology Review magazine.

ASST. PROF. NICOLAI KONOW of the Biological Sciences Department was named a member of the Biomechanics Committee for The Society for Experimental Biology, as well as an associate of the Museum for Comparative Zoology at Harvard University.

PROF. BEN LIU of the Computer Sciences Department was named general co-chair of the 37th IEEE International Performance Computing and Communications Conference (IPCCC).

ASST. PROF. MANOS GKIKAS of the Chemistry Department and **ASSOC. PROF. JESSICA GARB** of the Biological Sciences Department received the 2018-2019 Peter E. and Anna Giants Kennedy College of Sciences Endowed Fund for Advanced Research Award.

DEAN NOUREDDINE MELIKECHI was named a fellow of the American Physical Society.

ASST. PROF. MICHAEL MYRE of the Biological Sciences Department received a 2018-2019 Wong Research Fund Award.

ASST. PROF. WIL NGWA of the Department of Physics & Applied Physics received the Award of Excellence in Medical Physics Education Innovation from the American Association of Physicists in Medicine.

PROF. DANIEL OBRIST of the Department of Environmental, Earth & Atmospheric Sciences received a NSF grant from the NSF Atmospheric Chemistry Program (ATC) as principal investigator studying "Magnitude and pathways of gaseous atmospheric mercury deposition in forests."

PROF. JIM PROPP of the Department of Mathematical Sciences was appointed chair of the Advisory Council for the Gathering 4 Gardner Foundation.

ASST. PROF. ANNA RUMSHISKY of the Computer Science Department was awarded the 2017 NSF CAREER Award.

PROF. MARINA RUTHS of the Chemistry Department was named treasurer of the American Chemical Society's Division of Colloid and Surface Chemistry and has also been appointed UMass Lowell Faculty Fellow for Launch@UML, beginning in January 2019.

ASSOC. PROF. JULIETTE ROONEY-VARGA received a $110,020 NSF Award for "iStronG (Inclusive, Strong and Green): A student-centered systems thinking, place-based and technology driven curriculum." She was also appointed as one of seven women who are "Killin' it in sustainability research" by The University Network (TUN).

ASSOC. TEACHING PROF. NAOMI WERNICK of the Department of Biological Sciences was named a section editor of the Board for JMBE (the Journal of Microbiology and Biology Education).

PROF. JIM WHITTEN of the Chemistry Department was named an editor of the "Applied Surface Science." Whitten was also made a member of the American Chemical Society Exams Committee and named as a representative of the University Corporation for Atmospheric Research (UCAR).

PROF. MINGDI YAN of the Chemistry Department was appointed chair, Division of Organic Chemistry, "Nanoscience, Nanotechnology & Beyond," at the ACS National Meeting in Boston, and was also appointed chair, "Graphene Interface," IEEE Nanotechnology Matericals and Devices Conference (NMDC) in Portland, Ore. Yan is also a principal investigator on the following grants:

–A $418,788 grant from the National Institute of Allergy and Infectious Diseases to study "Glycosylated Atomically-Precise Gold Clusters: Design, Synthesis and Antimicrobial Activity."

–A $359,977 NSF grant to study "Substrate-enhanced reactivity of pristine graphene in cycloaddition reactions."

–A $455,367 grant from the National Institute of General Medical Sciences to study "Interaction and uptake of nanoparticles by bacteria mediated by unique sugars."

PROF. HOLLY YANCO of the Computer Science Department is a principal investigator on the following research grants:

–A $475,000 National Science Foundation grant, "CHS: Medium: Collaborative Research: Manipulation Assistance for Activities of Daily Living in Everyday Environments." (Collaborative partner: Dr. Robert Platt of Northeastern University.)

Continued

FACULTY NEWS

–A $1 million grant from the Massachusetts Manufacturing Innovation Initiative (M2I2) and a $210,751 grant from the Advanced Robotics for Manufacturing (ARM) Institute, "Development of Metrics and Evaluation Methods for the ARM Institute." Yanco is also a co-PI on a $1.2 million grant from the U.S. Office of Naval Research, "SUCCESS: Self-assessment and Understanding of Competence and Conditions to Ensure System Success."

Presentations

ASST. PROF. REZA AHMADZADEH gave an invited talk on "Robot Learning of Generalizable Skills" at the University of New Hampshire.

PROF. VALERI BARSEGOV of the Chemistry Department was an invited speaker at the 25th International Fibrinogen and Factor XIII Workshop at Wake Forest University, addressing "Atomic structure of fibrin protofibrils" and "Molecular mechanism of transition from catch bonds to slip bonds in fibrin."

ASSOC. PROF. TIBOR BEKE of the Department of Mathematical Sciences gave an invited talk on "Toposes in Como" at the Lake Como School of Advanced Studies. He also gave an invited talk on "Accessible categories and their Connections" at the University of Leeds. It was supported by the School of Mathematics of the University of Leeds.

ASSOC. PROF. MATTHEW GAGE of the Chemistry Department was a speaker at the European Muscle Conference in Budapest, Hungary.

ASST. PROF. RICHARD GASCHNIG of the Department of Environmental, Earth & Atmospheric Sciences was an invited keynote speaker at the 2018 Goldschmidt Geochemistry Conference in Boston.

PROF. BOB GILES of the Department of Physics & Applied Physics gave an invited talk on "Biomedical Terahertz Imaging Research" at Western Michigan University.

ASST. PROF. ARCHANA KAMAL was an invited speaker at the EmTech Conference in Cambridge, Massachusetts.

PROF. DANIEL OBRIST was a plenary presenter at the International Conference on Mercury as a Global Pollutant in Providence and addressed "A review of global environmental mercury processes in response to human and natural perturbations: changes of emissions, climate and land use."

ASST. PROF. ANDY ROGERS of the Department of Physics & Applied Physics was on the program committee and chaired sessions at the annual APS Division of Nuclear Physics (DNP) fall meeting in Hawaii.

PROF. MARINA RUTHS was a keynote speaker at the 92nd ACS Colloid and Surface Chemistry Summer Symposium at Pennsylvania State University, addressing "Interaction forces and nanotribology of surfaces modified with bioinspired polymer coatings."

Publications

PROF. VALERI BARSEGOV, Proceeding of the National Academy of Sciences USA, "A regulatory element in fibrin triggers tension activated transition from catch to slip bond"
–Journal of American Chemical Society, "Dynamic transitions from α-helices to α-sheets in polypeptide coiled-coil motifs"

ASST. PROF. DENNIS CHRISTODOULEAS of the Chemistry Department, ACS Central Science, "Outlook"

ASSOC. PROF. MATTHEW GAGE AND PROF. JEFF MOORE, Sci Rep, "Calcium increases titin N2A binding to F-actin and regulated thin filaments"

ASST. PROF. MANOS GKIKAS, book chapter, "Hybrid Graphene Metallic Nanoparticles for Biodetection, Graphene-based materials in Health and Environment"

PROF. ENRIQUE GONZALEZ-VELASCO of the Department of Mathematical Sciences, book co-author, "The Life and Works of John Napier"

DEAN NOUREDDINE MELIKECHI, POST-DOCTORAL RESEARCH ASSOCIATE ROSALBA GAUDIUSO, Zineab A. Abdel-Salam, Mohamed A. Harith, Vincenzo Palleshi, Vincent Motto-Ros and Benoit Busser, invited review, Spectrochimica Acta Part B Atomic Spectroscopy, "Laser-induced Breakdown Spectroscopy for Human and Animal Health: A Review"

PROF. DANIEL OBRIST, Nature, "Tundra uptake of atmospheric elemental mercury drives arctic mercury pollution"

PROF. VIKTOR PODOLSKIY, of the Department of Physics & Applied Physics, Optica, "Structural second-order nonlinearity in plasmonic metamaterials"

ASST. PROF. JAMES REUTHER of the Chemistry Department, Angewandte Chemie, "Tunable Orthogonal Reversible Covalent (TORC) Bonds: Dynamic Chemical Control over Molecular Assembly"

ASSOC. PROF. JULIETTE ROONEY-VARGA, The Conversation, "How a Game Can Move People From Climate Apathy to Action"
–PLoS1, "Combining role-play with interactive simulation to motivate informed climate action: Evidence from the World Climate simulation"

NUGENT LAB, Analytical Biochemistry, "Characterization of receptor binding kinetics for vascular endothelial growth factor-A using SPR"

PROF. MARINA RUTHS, Science, "Multivalent counterions diminish the lubricity of polyelectrolyte brushes"
–Science Advances, "Multivalent ions induce lateral structural inhomogeneities in polyelectrolyte brushes"
–Langmuir, "Detection of Liquid Penetration into a Micropillar Surface Using Quartz Crystal Microbalance"

ASST. PROF. JUAN ARTES VIVANCOS of the Chemistry Department, Nature Nanotechnology, "Detection and identification of genetic material via single-molecule conductance"

IN MEMORIAM

PROF. AL DOERR (Math)
PROF. GEORGES GRINSTEIN (Computer Science)
DEAN AND PROF. MARK HINES (Biology)
PROF. RIDA MIRIE (Math)