KENT STATE Research Review 2019

BRAIN HEALTH

as a Window into Disease

How the Brain Health Research Institute is helping transform research at Kent State and beyond.

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WELCOME

Research and Innovation

This has been a great year at Kent State University. As its 13th president, I am proud to take the reins of leadership at such an exciting time for our institution, as we take even bolder steps to enhance our research and innovation successes.

In this issue, we showcase the depth, breadth and diversity of our faculty and student researchers, leading to new partnerships, new opportunities and an increase in undergraduate research.

We established and broke ground on the Design Innovation Hub, which will be the center of a broad network of interdisciplinary creativity, collaboration and discovery, providing all students and faculty with the tools and opportunities to develop and market ingenious solutions to real-world problems.

We hosted a remarkable symposium highlighting our strength in environmental science and design, inviting researchers from across the country to speak here and learn about what makes Kent State a great research partner in these fields.

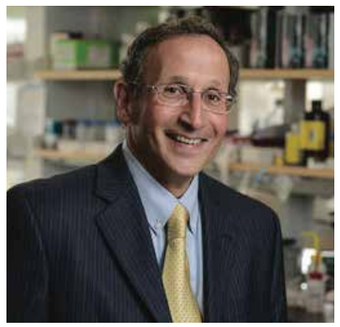
We have enjoyed one of our best external funding years in recent memory, celebrated prestigious awards and fellowships among our faculty and students and taken on key leadership roles driving innovation and technology commercialization in the region.

And we have established two strategic research institutes, in brain health and in advanced materials and liquid crystals, that will place Kent State at the center of scientific exploration and discovery. We also welcomed and appointed, as leaders of those institutes, top-tier researchers whose visions and talents will raise the bar for discovery and innovation on—and well beyond—our campuses.

As you read the stories highlighted in this issue, I hope you will share my pride and excitement for all that is sure to come next.

Todd A. Diacon, PhD
President

"Innovation occurs where fields collide."



I've learned over more than 40 years as an academic researcher that nothing successful is built quickly or easily. It takes time to see metrics increase significantly with evidence of substantial and sustained progress.

That is why Kent State's advances over the past few years are all the more remarkable. The great strides taken by the new research initiatives we have launched should be a point of pride to all the faculty, students and staff who have put great effort into growing the culture of research and innovation at our university.

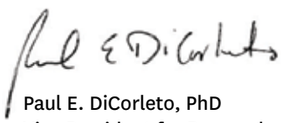
Our Kent and regional campuses are replete with individuals who are not willing to tolerate the idea of "good enough," and are impatient with the status quo or a leisurely departure from it. These passionate researchers and scholars have been the primary drivers in all we have accomplished this year.

Our shared mentality—that we will only thrive if we work together and demand the best of each other—underlies our approach to reshaping Kent State's research infrastructure.

It has been said (more than once by me) that innovation occurs where fields collide. The past academic year has shown me that everyone here, from the president to endowed researchers to assistant professors and first-semester freshmen, understand and appreciate that. We never would have come so far in such a short time if people from every discipline on campus had not been so eager to work together and engage each other across all boundary lines.

This collaborative spirit is the foundation of such major undertakings as our Brain Health Research Institute, our Advanced Materials and Liquid Crystal Institute and our four initiatives in Design Innovation, Environmental Science and Design, Global Understanding and Healthy Communities. These programs were conceived and developed by multidisciplinary teams with a commitment to pursue highly significant scientific and societal issues.

This magazine presents just a few of the many possible stories about the advances we have made and how we plan to build on our success. I hope they will prompt you to visit us on campus and partner with us in our efforts to make Kent State, Northeast Ohio and the world a better place.



Paul E. DiCorleto, PhD
Vice President for Research and Sponsored Programs

Kent State Robotics Team receives award at NASA's Kennedy Space Center.

COMPETITIONS

Kent State Robotics Team places third in NASA's 2018 Robotic Mining Competition

Teams of undergraduate and graduate students from universities and colleges throughout the United States descended upon NASA's Kennedy Space Center Visitor Complex in Florida to compete May 16-18, 2018, in the agency's 9th annual Robotic Mining Competition (RMC), which provides a competitive environment to foster innovative ideas and solutions that could be used on NASA's deep space exploration missions.

Along with 44 other teams, the Kent State Robotics Team designed and constructed a robot that was fashioned to mine simulated Martian terrain along with the gravel below it.

Kent State's robot collected a total of 1.2 kilograms of gravel underneath the regolith (loose material covering solid rock) within a 10-minute time frame, one of only six teams to qualify. They placed third in the nation in the on-site mining category, with a scoop design that enabled their robot to operate at a simple and light level, allowing excellent functionality.

"The team was very pleased with placing third out of a strong field of teams from across the country," says Darwin Boyd, PhD, team faculty adviser, assistant professor at KSU's College of Aeronautics and Engineering and a former research associate at Cleveland's NASA Lewis Research Center.

At the end of the competition, Kent State's team realized that great engineering built on ease and a simple design was the key that helped them earn their high placing.

Team from the College of Architecture and Environmental Design participates in Chinese ice-building competition

During the 2017 academic year, Kent State University was invited to participate in the "Extraordinary ICE Building Design Competition," organized by the prestigious Harbin Institute of Technology in China and Working Group 21 of the International Association for Shell and Spatial Structures.

Although the timing was tight—participants were given two weeks to design and submit proposals for a 100-square-meter ice pavilion—Kent State put together a design team of 14 students from the College of Architecture and Environmental Design (CAED), led by Mark Mistur, AIA, dean of the college, and Rui Liu, PhD, assistant professor of architecture and environmental design.

The Kent State team developed two separate designs: "PNEUMAT-ICE," which received an excellence award, and "THRICE," a fabric structure of three asymmetrical cones, which was one of six designs selected for full-scale construction in China, and the only one from the United States.

The team turned to J.R. Campbell, MFA, then director of Kent State's School of Fashion Design and Merchandising, and Vincent Quevedo, MFA, associate professor of fashion design, who helped select and sew the fabric.

Before heading to China, the team tested the prototype on the Kent Campus, then 12 students and professors Mistur and Lui traveled to Harbin to replicate the structure in temperatures dipping below 15-degrees Fahrenheit.

The team took top honors in the first round, earning them international distinction, and while there, three of the Kent State students took second place in Harbin Institute of Technology's Snow House Competition.

"THRICE" ice pavilion on site in China.

OPPORTUNITIES

From Kent to Cambridge: Recent graduate to study neuroscience at Harvard University

Ya'el Courtney, BS '19, will be furthering her education in neuroscience this fall at Harvard University. While enrolled at Kent State's Honor College, Courtney majored in biology with a minor in chemistry and completed extensive research in her field.

During the summer of her junior year, she traveled to Cambridge, Massachusetts, to work up to 70 hours per week at the Eli and Edythe L. Broad Institute of MIT and Harvard on the psychiatric research floor as part of the Broad Summer Research Program.

BOB CHRISTY, BS '95

YA'EL COURTNEY, BS '19

At Harvard, Courtney intends to conduct a significant amount of research focusing on psychiatric diseases, specifically for their potential cellular, molecular and/or genetic causes and potential therapeutic targets.

BOB CHRISTY, BS '95

Workers tend green roof at Taylor Hall.

Kent State to Co-Lead New Center of Living Architecture

At the 2018 annual CitiesAlive Conference held in New York City, a consortium of Ohio universities was selected as one of the first four North American regional centers of living architecture by Green Roofs for Healthy Cities and the Green Infrastructure Foundation.

Faculty from Kent State University will join colleagues from the University of Cincinnati and Heidelberg University to lead the Greater Ohio Living Architecture Center (GOLA), which will be dedicated to the study of integrating vegetation within and upon buildings as novel ecosystems.

The center will engage vegetated roof and wall industries in research and training activities for the Great Lakes and Ohio region through meetings, academic symposia and professional training across the three university campuses over the next three years.

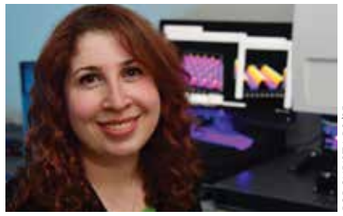
The GOLA Center will be led by the new executive director, Reid Coffman, PhD, associate professor of Kent State's College of Architecture and Environmental Design (CAED), and faculty from both CAED and the College of Arts and Sciences will participate.

"The center will build upon much of the work in living architecture already underway and set the stage for new developments in research and innovation, while helping students prepare to enter this growing discipline," Coffman says.

Young researcher invited to Lindau Nobel Laureate meeting

After receiving her doctorate in chemical physics in May, Greta Babakhanova, PhD '19, was one of 55 young researchers from the United States selected to attend the 69th Lindau Nobel Laureate Meeting in Lindau, Germany, this summer. There she spent five days with 42 of the most accomplished and inspiring scientists in the world. This year's meeting was dedicated to physics and the key topics of cosmology, laser physics and gravitational waves.

Babakhanova recently defended her dissertation, "Elastic Effects in Flexible Dimeric and Elastomer Nematics," under the direction of Trustees Research Professor Oleg Lavrentovich, PhD, of the Department of Physics and the Advanced Materials and Liquid Crystal Institute. His lab proved to be the perfect place for her to conduct interdisciplinary research.



BOB CHRISTY, BS '95

GRETA BABAKHANOVA, PHD '19

She took advantage of fruitful research collaborations with on-campus colleagues in Kent State's physics and biological sciences departments, as well as international colleagues at Eindhoven University of Technology in the Netherlands and the Otto-von-Guericke Universität Magdeburg, in Germany.

Babakhanova plans to broaden her knowledge in the biomedical fields and pursue a career in academia. She recently secured an NRC (National Research Council) postdoctoral fellowship in the Biomaterials Research Group led by Carl Simon Jr., PhD, at the National Institute of Standards and Technology (NIST) in Gaithersburg, Maryland.

HONORS

Geography professor elected president of American Association of Geographers

DAVID KAPLAN, PHD

David Kaplan, PhD, professor in the Department of Geography in Kent State's College of Arts and Sciences, has been elected president of the American Association of Geographers (AAG), the premier academic and professional geography organization in the United States for 2019-20.

"It is a huge honor for me to lead the flagship organization for geography," says Kaplan. "Not only is the AAG the largest geography organization in the United States, it is also the most important geography organization in the world, with many members from other countries."

Kaplan, who joined Kent State in 1995, says his goal as president is to expand the community of geography, to make AAG more relevant to educators at small colleges, community colleges, historically black colleges and K-12 education.

Chemistry professor named deputy editor of *Science Advances*

MIETEK JARONIEC, PHD

Mietek Jaroniec, PhD, professor in the Department of Chemistry and Biochemistry in Kent State's College of Arts and Sciences, and one of the most highly cited scientists in the fields of chemistry and materials science, was appointed to the editorial board of the journal *Science Advances*, published by the American Association for the Advancement of Science (AAAS), one of six peer-reviewed journals published by AAAS. As deputy editor, Jaroniec will review submitted articles in the fields of materials science and engineering.

In addition, Jaroniec, who joined Kent State in 1991, received a Doctor Honoris Causa from Poznan University of Technology in November 2018 at an award ceremony in his native Poland.

AWARDS

2018
Outstanding Research and Scholarship Award Winners

Kent State's Division of Research and Sponsored Programs honored the following faculty members for their outstanding work in research, scholarship and mentoring:

2018 Outstanding Research & Scholarship Awardees

Fabio J. Polanco, MFA
School of Theatre and Dance

Gregory C. Smith, EdD
Lifespan Development and Educational Sciences

Torsten Hegmann, PhD
Chemical Physics

Outstanding New Faculty Research & Scholarship Awardees

Gemma Casadesus Smith, PhD
Biological Sciences

Chanjuan Chen, MFA
Fashion Design and Merchandising

Excellence in Research Mentorship—Graduate

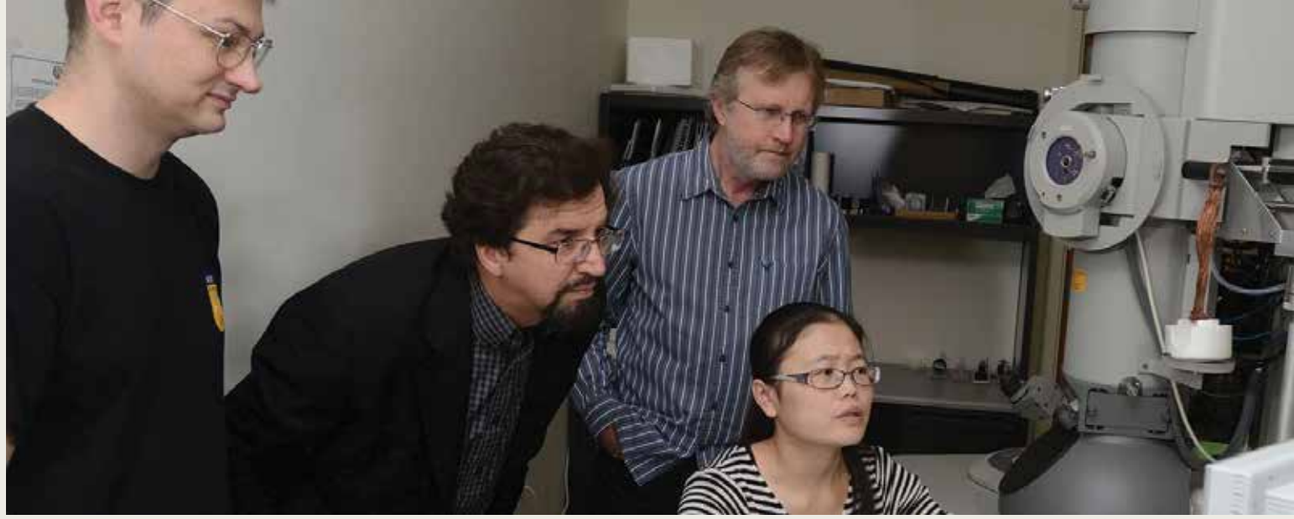
Anne Morrison, PhD
Lifespan Development and Educational Sciences

Elizabeth Smith-Pryor, PhD
History

Excellence in Research Mentorship—Undergraduate

Matthew Lehnert, PhD
Biological Sciences

Kristen Marcussen, PhD
Sociology



BOB CHRISTY, BS '95

National Science Foundation awards Kent State researcher nearly $1 million for liquid crystal studies

OLEG LAVRENTOVICH, PHD

Trustees Research Professor Oleg Lavrentovich, PhD, a chemical physicist in Kent State's Advanced Materials and Liquid Crystal Institute (AMLCI), recently received nearly $1 million between two grants from the National Science Foundation (NSF) for separate studies with potential applications in biomedical science, commercial electronics and beyond.

The larger of the two awards is a three-year, $540,000 grant for "Active colloids with tunable interactions in liquid crystals." The study follows a 2016 project in which Lavrentovich showed how bacteria placed into a structured liquid crystal environment can be made to move in a fixed pattern and even move other microscopic materials.

The other grant is a three-year, $450,000 award from the NSF for "Electrically tunable cholesteric optical fibers." Modern optical technology only allows for the changing of color through permanent filters, but Lavrentovich has been able to show that an electrical charge administered to a liquid crystal film between two glass plates will cause a dynamic color change. The voltage directly determines the color, allowing him to change the film's color.

Kent State undergraduates named 2019 Goldwater Scholars for science research

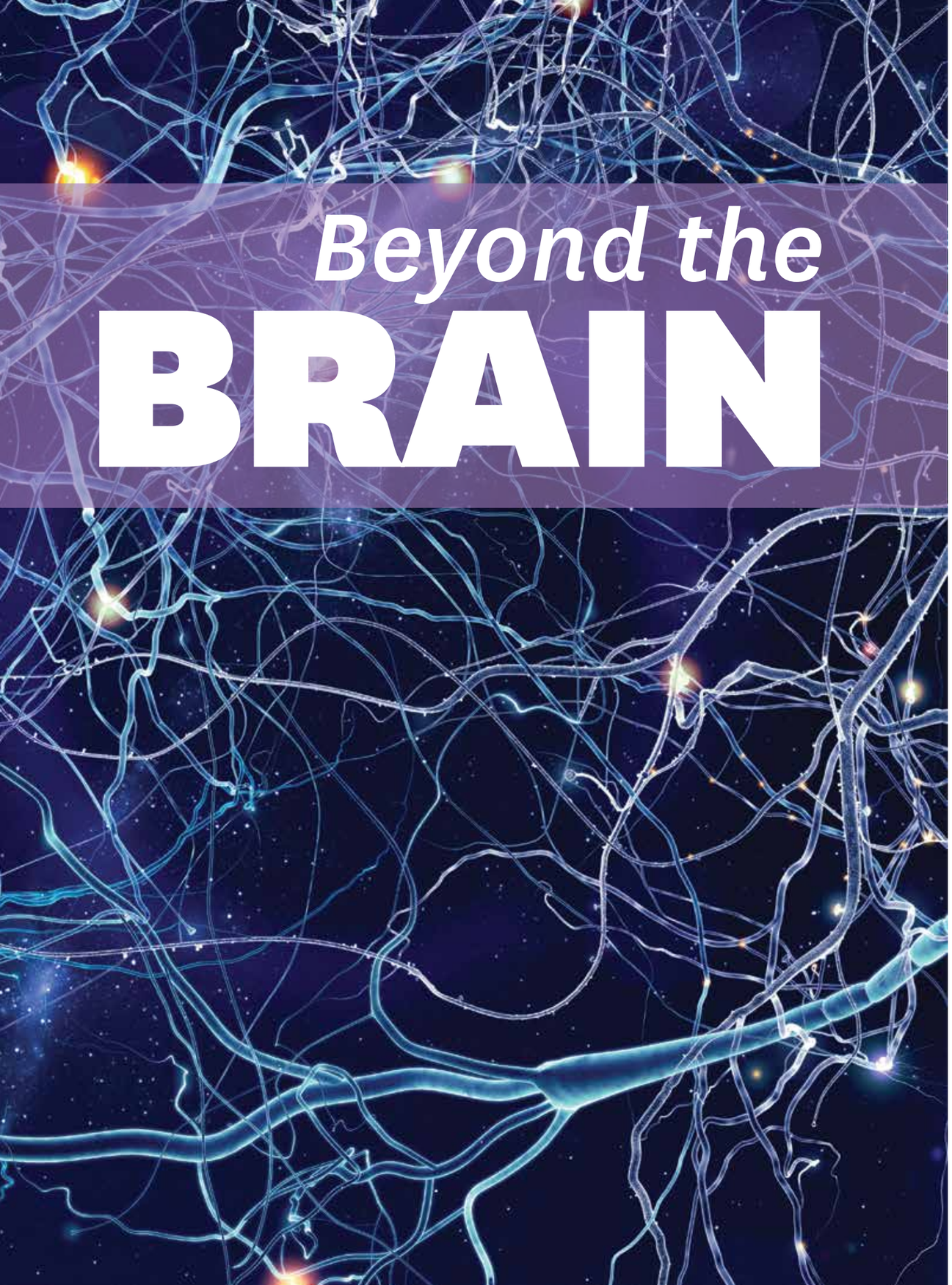
HALEY SHASTEEN

GRACEN GERBIG

Two Kent State University undergraduate students have been awarded prestigious 2019 Goldwater Scholarships from the Barry Goldwater Scholarship and Excellence in Education Foundation. The foundation awards the scholarships annually to students studying mathematics, natural science or engineering. This year they awarded 496 scholarships, each for as much as $7,500 per year.

Kent State's recipients are:
Hayley Shasteen, a junior from Berlin Center, Ohio, is pursuing a dual degree in molecular and cellular biology and psychology. She hopes to eventually obtain a doctoral degree in cognitive neuropsychology and conduct research regarding cognitive impairment in patients with autoimmune diseases, with emphasis on systemic lupus erythematosus [see page 45].

Gracen Gerbig, a senior from Dover, Ohio, is studying cellular and molecular biology. She hopes to pursue a doctoral degree in microbiology, conduct research in infectious disease and eventually teach at the university level.



How the Brain Health Research Institute is helping transform the culture of Kent State.

By Dan Pompili

The Brain Health Research Institute (BHRI) may be a recent development at Kent State, but with fresh leadership, emerging partnerships and a refined vision, it's well on its way to gaining national renown.

"The Brain Health Research Institute marks a major turning point in the history of Kent State as a research university," says President Todd Diacon. "Just as the Liquid Crystal Institute was transformational more than 50 years ago and became a cornerstone of our research identity, I think years from now we're going to remember the inception of the BHRI in the same way, as a transformational moment in the legacy of research at Kent State."

New BHRI Director Michael Lehman, PhD, believes Kent State's brain health research profile just needed a boost to earn its due attention.

"Kent State is in the midst of a major cultural transformation in terms of what the university is and how it will move forward," Lehman says. "We have research strengths that extend into the social sciences, health sciences, arts and humanities, architecture, behavioral neurosciences, integrative-level biology and psychology—and those go beyond what exists at other institutions."

Lehman came to Kent State in January from the University of Mississippi Medical Center, along with his longtime collaborator and wife, Lique Coolen, PhD, a renowned researcher who was named associate dean of the College of Arts and Sciences, with a focus on faculty research, professional development and postdoctoral affairs [see page 10]. They join more than 110 BHRI researchers across 30 departments and eight colleges, and they've built their careers on the BHRI's underlying concept—what Lehman calls the "collaboratory."

"We are committed to the idea that we want different points of view in research and education, not just from people who consider themselves neuroscientists, but also those who have an interest and are willing to work with others," he says.

CONCENTRATING the research focus

In February, Lehman convened the first BHRI faculty retreat, where KSU researchers discussed and summarized ideas about Kent State's strengths and opportunities in brain health.

Lehman brought those ideas to the BHRI Executive Committee, which concentrated them into three "themes" of research focus, each encompassing various related specialties [see page 9].

> **"The Brain Health Research Institute marks a major turning point in the history of Kent State as a research university."**
>
> — TODD A. DIACON, PHD
> *President*

"We framed the research themes in keeping with our view that brain health is a window into disease, and linking basic discovery research with translational and clinical research," he says.

As the BHRI grows, Lehman wants to attract researchers with track records of interdisciplinary work who may not fit neatly under traditional departmental labels.

"We want the best and brightest, and that's not necessarily the best physicist or chemist or biologist, but somebody who can collaborate and contribute in novel, interdisciplinary ways."

One such researcher will join Kent State's Department of Anthropology in August: Rafaela Takeshita, PhD, from the Primate Research Institute at Kyoto University in Japan.

"Dr. Takeshita will complement our ongoing research in neuroendocrinology and brain health in an innovative way, and I look forward to collaborating with her," Lehman says.

DEVELOPING trainees and enhancing programs

Research doesn't stop with faculty. "If we talk about what grows research, it's graduate students and postdocs," Lehman says. "To have well-funded, productive labs, you've got to develop a strong cadre of trainees."

One way to achieve that is by enhancing KSU's graduate-level programming, including neuroscience PhD programs in the School of Biomedical Sciences, as well as in the Department of Biological Sciences and the Department of Psychological Sciences.

Brain Health Research (BHRI)
INSTITUTE

"We want to enhance the visibility of our neuroscience training programs and expand our applicant pool," Lehman says. "With all the new faculty we have here, as well as at NEOMED [Northeast Ohio Medical University] and our other external partners, there are many more research opportunities for students to choose from."

"In addition, we want to increase our trainees' success in being awarded external fellowships from NIH [National Institutes of Health] and NSF [National Science Foundation], as well as in competing for institutional training grants."

This fall, Kent State also will add a new undergraduate major in neuroscience. "It's going to be really attractive," Lehman says. "No other institution in Northeast Ohio is offering that right now. We also are initiating a BHRI undergraduate fellowship program as a way of attracting the very best students, and we're supporting Summer Undergraduate Research Experience (SURE) students this summer as a start to that."

He says it's important, though, to see the BHRI in context and concert with other exciting developments at Kent State. "The BHRI is part of a larger transformation for the university, and we see ourselves working together with other institutes and initiatives, including the Advanced Materials and Liquid Crystal Institute and the Design Innovation Initiative."

COLLABORATING with external partners

The collaboration reaches beyond KSU. "The BHRI is a convener and a driver, but its success is only possible through partnerships that cross boundaries," says Michael Kavulic, PhD, director of Research Strategic Initiatives. "One of our goals is to make sure all of our partners are involved." Kent State's external partners agree.

"NEOMED has two groups of neuroscientists working in complementary, overlapping and mutually-supportive areas with researchers at Kent State," says Jeff Wenstrup, PhD, chair of anatomy and neurobiology and associate dean of research at NEOMED. "One is hearing research, which is a strong group that focuses on basic and translational work, from the ear to interpretation of acoustic communication signals. The other is in neurodegeneration and aging, and certainly there are Kent State researchers involved in that."

> **"We are a university-wide program, and our goal is to raise all boats. Regardless of whether you are engaged in neuroscience research and education or not, you're going to benefit from this."**
>
> — **MICHAEL LEHMAN, PHD**
> *Director, BHRI*

Leaders at Akron Children's Hospital (ACH) see different potential. "It's a natural collaboration," says Michael Kelly, MD, PhD, chief research officer at ACH. "We have a large patient population that falls into the category of neurological disorders. We have a lot of information about patients, but not always about underlying disease. It makes absolute sense to partner with the BHRI to leverage their scientists' strengths to better understand pediatric neurological diseases."

Kelly points to existing relationships with KSU researchers. Douglas Delahanty, PhD, professor of psychological sciences, conducts trials and studies with ACH patients suffering from post-traumatic stress. Sonia Alemagno, PhD, dean of the College of Public Health, has coordinated with ACH on school-based interventions for children with chronic diseases.

Kent State has also joined the Cleveland Brain Health Initiative (CBHI), which offers the potential for many other symbiotic relationships.

"The CBHI includes a lot of clinical partners—University Hospitals, Metro North, the VA and others," says Lehman. "It's another way for us to connect with healthcare in Northeast Ohio and develop collaborative grants that can complement our expertise."

INCREASING funding and supporting faculty careers

Developing new programming and forging relationships is only the beginning, though, and many challenges remain.

"Moving beyond the silos of departments and colleges is formidable," Lehman says, "but we are a university-wide program, and our goal is to raise all boats. Regardless of whether you are engaged in neuroscience research and education or not, you're going to benefit from this."

As with everything in higher education, he says, it all revolves around funding. "I can't emphasize how important it is that we come up with support for new fundable projects and get those submitted and put them in the best possible competitive situation.

"The other piece to consider is how we ultimately measure success, and that conversation should take us beyond the normal metrics. We want to increase grant funds, productivity and faculty publications, but we also want to support faculty careers. We want to show that we are engaging faculty and giving them opportunities to grow in ways they wouldn't have otherwise, and see people connect in ways they wouldn't normally.

"That's a conversation I think is going to be important for us all as we transform the culture of Kent State."

Visit Kent State's Brain Health Research Institute at www.kent.edu/brainhealth.

MATT LESTER

Research Themes:
"BRAIN HEALTH AS A WINDOW INTO DISEASE"

	Theme/Focus	*Examples of Associated Diseases/Disorders*
BRAIN BASIS OF EMOTION AND COGNITION	• Brain wellness and mental health • Language • Learning and memory • Reward and motivation • Social behavior	Alzheimer's disease Autism spectrum disorder Cognitive impairment Dementia Drug and behavioral addictions Speech disorders
BRAIN CONTROL OF MOVEMENT AND SENSATION	• Motor and sensory function in health and disease • Special senses (hearing/vision) • Spinal pathways, peripheral nerves and development	Neurodegenerative disorders Speech disorders Spinal cord injury Traumatic brain injury
NEURO-ENDOCRINE BRAIN	• Circadian rhythms • Metabolism • Reproduction • Stress	Infertility Obesity PCOS Post-traumatic stress disorder

Brain Health Research (BHRI) **INSTITUTE**

Dynamic DUO

This husband and wife neuroscience team is helping launch a new collaborative at Kent State that aims to make Northeast Ohio a national center for brain health research.

By Dan Pompili

BOB CHRISTY, BS '95

Michael Lehman, PhD, and Lique Coolen, PhD

Even with all the advances of modern science, the brain still holds a myriad of mysteries. Two nationally known neuroscience researchers have joined Kent State to continue their quest to uncover the brain's complex functions—and to collaborate with researchers from a wide range of disciplines at the university and across the region to advance our knowledge of the human brain and translate those discoveries into new treatments and care for brain and nervous system diseases.

In January, Kent State University welcomed Michael Lehman, PhD, as the Brain Health Research Institute's inaugural director, and his longtime collaborator and wife, Lique Coolen, PhD, a globally renowned neuroscientist, as the associate dean of the College of Arts and Sciences.

Lehman and Coolen have built elite neuroscience programs everywhere they have worked, most recently at the University of Mississippi Medical Center, in Jackson, Mississippi.

There, Lehman served as a professor and chair of the Department of Neurobiology and Anatomical Sciences and as founding chairman of the board of the medical center's Neuro Institute, and Coolen served as professor of physiology and neurobiology and anatomical sciences and as associate dean of postdoctoral studies in the School of Graduate Studies in Health Sciences.

The couple recently discussed their research, why they came to Kent State and how their experiences will help them build success here, too.

BUILDING BRIDGES

"I want to be at places where I can make a difference," Lehman says. "That means looking for opportunities where I can contribute in different ways, and this was a unique opportunity."

He says the vision Kent State leaders presented made it an easy decision. "I was impressed with the neuroscience community here having developed this idea for the Brain Health Research Institute (BHRI), and the senior leadership's commitment," he says. "Those things helped me in laying a framework for what I could do."

> **"To create an institute that bridges with other regional partners in academia and medicine is appealing."**
>
> — MICHAEL LEHMAN, PHD
> *Director, BHRI*

Since his days at the University of Cincinnati—where he began his career and eventually became director of UC's Neuroscience Graduate Program and vice chair for research—Lehman has known KSU and some of its leaders, including James Blank, PhD, dean of the College of Arts and Sciences and also a neurobiologist.

Lehman sees the Brain Health Research Institute as a means to draw in regional partners—including Northeast Ohio Medical University (NEOMED), Cleveland Clinic and Akron Children's Hospital—to build a network of collaborations that will expand Kent State's expertise beyond its campuses.

"What I've been able to accomplish before as a leader has been within a single university or academic medical center, and to create an institute that bridges with other regional partners in academia and medicine is appealing," he says. "The other attractive thing is the impressive diversity and breadth of neuroscience research here, spanning not just science-based departments and social sciences, but also arts and humanities."

Kent State's research profile appealed to Coolen, too. "It's a good match. There's a lot of strength here in our areas—neuroendocrinology, behavioral neuroscience—and the opportunity to have colleagues who work in those areas," she says. "Being on an undergraduate campus is attractive, as well. We are both educators—in the research lab as mentors and also in the classroom."

Although Lehman and Coolen will not teach classes at Kent State, they will contribute to the university's dynamic new neuroscience curriculum, from undergraduate to PhD and postdoctoral training. (In conjunction with the expansion of the Brain Health Research Institute, Kent State's College of Arts and Sciences will offer a bachelor's degree in neuroscience beginning in fall semester 2019.)

They also will maintain labs as fully funded researchers. "We're both passionate about what we do, and we're both going to continue our research careers," Lehman says. "In my leadership role, it's important for me to still be an active researcher so I can continue to relate to the joys of research, as well as its challenges, on a personal level."

Both specialize in neuroendocrinology and reproduction; Coolen has additional expertise in spinal cord injury and in the neural circuits responsible for drug addiction.

"Lique and I consider ourselves integrative-level neurobiologists," Lehman says. We're interested in how sets of neurons and pathways in the brain mediate basic aspects of physiology and behavior."

INCREASING VISIBILITY

The husband and wife neuroscience researchers are perhaps best known for discovering KNDy (pronounced "candy") neurons—a group of cells that synthesize specific peptides in the hypothalamus, without which mammals are infertile.

Lehman has been consistently funded with at least two parallel National Institutes of Health (NIH) grants for more than 30 years; Coolen for more than 20. Most of their graduate students and postdocs also receive NIH training fellowships, including Aleisha Moore, PhD, who accompanied Lehman and Coolen from the University of Mississippi Medical Center [see page 13].

Lehman and Coolen work closely, holding weekly joint meetings of all grads and postdocs. "It's almost like a mini NIH training grant, because trainees get to see different projects going on, different brain systems and learn a lot from what each other are doing," Lehman says.

In addition to their research and mentorship records, Lehman and Coolen's résumés boast memberships in several prestigious service positions.

Both are grant reviewers at the NIH and active in the Society for Neuroscience. Lehman just completed a term as chair of the NIH's Integrative and Clinical Endocrinology and Reproduction (ICER) study section. He is also senior editor at the *Journal of Neuroendocrinology*; secretary of the international Pan American Neuroendocrine Society; a fellow of the American Association for the Advancement of Science (AAAS), the Society for Experimental Biology and Medicine, and the American Association of Anatomists.

> **"Kent State neuroscience is based on understanding the healthy brain, and that's where we complement other universities and institutions in Northeast Ohio whose neuroscience research is more focused on brain disease."**
>
> — LIQUE COOLEN, PHD
> *BHRI*

He was recently appointed to the Board of Directors of the Federation of American Societies for Experimental Biology (FASEB), the nation's largest coalition of biomedical researchers, representing 29 scientific societies and over 130,000 researchers, and serving as the policy voice of biological and biomedical researchers.

"All of this is about visibility," Lehman says. "That's one reason I feel we can contribute here, because we bring a high level of recognition and distinction in our fields." Their service also brings experience they hope to leverage to help Kent State generate visibility on its own.

"Kent State neuroscience is based on understanding the healthy brain, and we complement other universities and institutions in Northeast Ohio whose neuroscience research is more focused on brain disease," Coolen says.

"A goal for the BHRI is to enhance Kent State's national visibility, so that's where our ties, our service on national committees, will help to further enhance our visibility and reputation on the national and even international platform."

PROVIDING OPPORTUNITIES

A vital element will be helping faculty develop projects and proposals across colleges and departments and with other institutions.

"One of the goals of the BHRI is research career and development, preparing people in terms of grantsmanship, mentoring for grant prep at multiple agencies like NSF, NIH and DOD," Lehman says. "Getting researchers from different labs, departments and colleges to submit collaborative grants as multiple investigators is a start for planning larger-scale proposals."

In this area, more of Coolen's strengths come in. As associate dean in the College of Arts and Sciences, she is working with Douglas Delahanty, PhD, associate vice president for Research Faculty Development, on a professional development program for faculty and trainees, including grant-writing support.

"This will provide more opportunities to develop things that people would not be able to develop on their own within departments," Coolen says.

Another part of growing Kent State's research profile, Lehman and Coolen say, is making the BHRI a hub for partners and peers to learn and interact in multiple ways.

"BHRI is planning its next neuroscience symposium for September 2020, and we're hoping to attract a roster of internationally recognized neuroscientists for that," Lehman says. "With the experience that Lique and I bring from organizing

international meetings and symposia, we hope to contribute to that effort as well."

They also are working with the University Library on another resource. "Michael Kavulic, director of Research Strategic Initiatives, and I have been involved with Ken Burhanna, dean of University Libraries, in developing a publication database, and using that to develop metrics that show co-authorships and collaborations, interactions in a Venn diagram, with a regional network approach," Lehman says.

"It's useful for us to see our collaborators at other places and find places where there are opportunities we haven't taken advantage of yet."

Still to emerge is the completion of the new "terrace" on the lower level of the Integrated Sciences Building, which will provide opportunities for researchers from other institutes and initiatives to collaborate with the BHRI across common spaces and shared equipment.

"For example, the shared core facilities, called 'collaboratories,' that we're proposing to create will be a nexus for multidisciplinary research, similar to [Kent State's recently launched] Design Innovation (DI) Hub [see page 24].

> **"The shared core facilities, called 'collaboratories,' that we're proposing to create will be a nexus for multidisciplinary research."**
>
> — MICHAEL LEHMAN, PHD
> *Director BHRI*

"In addition, together with colleagues in the Advanced Materials and Liquid Crystal Institute (AMLCI) we hope to explore the possibility of growing biomaterials and neuromaterials research beyond what we're doing right now."

Ultimately, Lehman and Coolen say, a successful culture comes from successful conversations—in labs and in boardrooms.

"It's important for us not just to have active collaborations with the other institutes and initiatives, but to be engaged with each other in discussing our policies, best practices and how we interact with departments and colleges," Lehman says. "In this way, we can collectively have synergistic impact as we work to advance the research culture of Kent State.

"Lique and I are excited to be here. Kent State is a remarkable and distinctive place, and we are delighted to be part of the effort, along with others, to transform the university and its research identity as we move into the future."

MATT LESTER

FERTILE *Ground*

One of Kent State's newest researchers has received funding to advance her study of a leading cause of infertility in women.

Polycystic Ovary Syndrome (PCOS) affects 1 in 10 women, roughly five million nationwide, according to the US Centers for Disease Control and Prevention. In addition to infertility, PCOS increases the risk of type 2 diabetes and other metabolic disorders—and there is no cure.

The name suggests it originates in the ovaries, but Aleisha Moore, PhD, a postdoctoral fellow in Kent State's Brain Health Research Institute (BHRI), believes the origin will be found in the brain.

"It's a multimodal disease, and there are many things that lead to it," she says. "But what we've found is that changes in the brain are likely one of the major contributors."

The National Institutes of Health certainly thinks Moore is onto something; the agency recently awarded her its most prestigious research training grant, a K99/R00 "Pathway to Independence Award"—a first for Kent State.

As a postdoctoral research trainee in the lab of Michael Lehman, PhD, director of the Brain Health Research Institute, and Lique Coolen, PhD, professor of biological sciences and associate dean of the College of Arts and Sciences, Moore will conduct her research for two years under their mentorship, then become an assistant professor with a considerable increase in funding for three more years—the K99 phase provides up to $90,000 a year, while the R00 phase awards up to $249,000 per year.

Neuroendocrinology and infertility are Lehman's specialty and one of Coolen's areas of expertise. Lehman and Coolen are co-discoverers of KNDy (pronounced "candy") cells, unique neurons within the hypothalamus that contain three peptides: kisspeptin, neurokinin B and dynorphin. Without these cells, humans and animals are infertile.

"Many people will be surprised that fertility is controlled by the brain, but it's something neuroscientists have known for many years," Moore says. "We're now trying to figure out the complexities of it."

The brain contains a massive neural network within which is a small population of cells called gonadotropin-releasing hormone (GnRH) neurons. These control fertility by releasing hormones that regulate the pituitary gland, which in turn secretes other hormones called gonadotropins into the peripheral blood. When gonadotropins reach the ovaries, they control the synthesis of steroidal sex hormones like estrogen and progesterone.

"Ovarian hormones are relayed back to the brain where they act on neurons, including KNDy cells, to provide signals to GnRH neurons, so it becomes a large feedback loop," Moore says.

> **"Many people will be surprised that fertility is controlled by the brain."**
>
> — ALEISHA MOORE, PHD
> *Postdoctoral fellow, BRHI*

Clinical studies have shown that in women with PCOS, hormones from the pituitary gland are released at an abnormally high frequency, causing the ovaries to produce excess testosterone and become cystic.

"Something leads to a state of impaired steroid hormone feedback in women with PCOS," Moore says, "so the goal of my study is to figure out where in the brain this impaired feedback occurs and why."

After decades of research, many scientists now believe KNDy cells are responsible for some of the prime feedback effects of steroid hormones on GnRH neurons, which makes them Moore's first target.—*Dan Pompili*

Brain Health Research (BHRI) INSTITUTE

Overcoming TEEN OBESITY *with Mindfulness*

The US Centers for Disease Control and Prevention report that about 21 percent of children ages 12 to 19 are obese, and lower socioeconomic groups are almost twice as likely to suffer.

Amy Sato, PhD, assistant professor of psychological sciences in Kent State's College of Arts and Sciences, recently received a two-year, $246,000 grant from the Eunice Kennedy Shriver National Institute of Child Health and Human Development at the National Institutes of Health, for her project, "Reducing Emotional Eating in Obese Low-Income Adolescents with Mindfulness-Based Behavioral Weight Management."

"If you look at the literature on weight loss in teenagers, and specifically low-income teens, outcomes are relatively poor," Sato says. "The question is if there is a variable that hasn't been specifically targeted. Our premise is that stress is the variable."

Obese teens and adolescents from lower-income families face myriad challenges to maintaining healthy diets, Sato says. While they may face stress like neighborhood violence and food insecurity, they also have access to less healthy foods. She adds that stress causes the brain to release cortisol, which drives cravings for high-fat, high-sugar foods.

"It's a perfect storm, setting them up to be less healthy," Sato says. "Our goal is that mindfulness intervention will help with the stress piece."

Mindfulness is defined as a mental state achieved by focusing one's awareness on the present moment, while calmly acknowledging and accepting one's feelings, thoughts and bodily sensations.

In previous experiments with the same population, Sato's lab found that teens who report feeling less mindful typically have a higher body-mass index (BMI), and report higher levels of stress and emotional eating."

Obese teens and adolescents from lower-income families face myriad challenges to maintaining healthy diets.

The intervention is an 8-week mindfulness-based stress reduction model developed by Sato's colleague, Elissa Jelalian, PhD, professor of psychiatry and human behavior and professor of pediatrics at Brown University, a co-investigator on the grant. Also participating in the project are David Fresco, PhD, and Manfred van Dulmen, PhD, both professors of psychological sciences at KSU, and Shirley Moore, BSN '74, PhD, RN, FAAN, professor of nursing at Case Western Reserve University.

The first stage of the project is forming a youth advisory board. "We want this model to feel relevant to teens and get their feedback on how to develop it for them," Sato says. They will then pilot the model with small groups, revise again, and proceed with randomized control trials.—*Dan Pompili*

Visit Kent State's Department of Psychological Sciences at www.kent.edu/psychology.

AMY SATO, PHD

BOB CHRISTY, BS '95

Tracing the Triggers of AFFECTIVE DISORDERS

KARIN COIFMAN, PHD

Depression is the leading cause of ill health and disability worldwide. According to the World Health Organization, more than 300 million people are currently living with depression. Even in high-income countries, nearly 50 percent of people with depression do not get treatment.

Like other affective disorders, including anxiety and stress, depression often manifests following stressful life events. Although services such as interventions, diagnostics and treatments are available in the United States, mental health practitioners find it difficult to address the problem efficiently.

The National Institute of Mental Health (NIMH) recently awarded a five-year, $2.7 million grant to Karin Coifman, PhD, principal investigator and associate professor of psychological sciences in KSU's College of Arts and Sciences, for her project, "Unpacking Emotion Inflexibility and Prospective Prediction of Affective Disease."

Coifman will collaborate with Doug Delahanty, PhD, and John Gunstad, PhD, both professors of psychological sciences at KSU; postdoctoral fellows and graduate students; as well as Richard George, MD, chief of trauma medicine at Summa Health. Summa will help the team recruit around 400 people from Portage and Summit counties who have sustained a traumatic injury to the body to participate in the 18-month study.

The researchers hope to gain a better understanding of what leads to the onset of affective diseases. Although symptoms of affective disorders are often exacerbated within the context of stress, most people are quite resilient. However, some people can develop chronic symptoms of depression, anxiety and PTSD. For clinicians, it can be difficult to know when and for whom to intervene after someone experiences a trauma.

Like other affective disorders, such as anxiety and stress, depression often manifests following stressful life events.

"In this study, we are planning to take a more contemporary approach to understanding the manifestation of these diseases—one that looks at many different variables across broad categories," Coifman says."This includes family history, early life experiences, social support and daily stress, in conjunction with measuring how people's emotion responses shift over time."

Coifman says this work builds on a long history of research on affective disorders by adding new technologies and statistical modeling techniques to develop more complex and useful models.

"Many of the processes that we study are difficult for people to report, so we use technologies like high-resolution cameras to record the subtle differences in facial expression, cardiovascular indicators and other coding software to study their behavior and how they process their emotions."—*Jim Maxwell*

Visit Kent State's Department of Psychological Sciences at www.kent.edu/psychology.

JOHN JOHNSON, PHD

Finding How **FEAR MEMORIES** *Form*

People who suffer trauma will, with few exceptions, never forget what happened to them, but a Kent State University researcher may be able to offer them the hope of living without constant fear and anxiety.

John Johnson, PhD, associate professor of biological sciences in Kent State's College of Arts and Sciences, received a three-year $450,000 grant from the National Institutes of Health (NIH) for a study that could provide a better understanding of how we create deeply ingrained fear memories—and how to stop them.

"People who have horrible things happen to them are reliving them, and the memories are ingrained," Johnson says. "Our question is: Can we reverse or block such strong memories from being made?"

He says it all comes down to the amygdala, a small area near the front of the brain that is responsible for processing emotions, including fear.

Among the cells the amygdala produces are microglia, the central nervous system's first line of immunity defense. Microglia produce cytokines. Cytokines—which are also produced by other types of brain cells—are associated with neurological problems, including chronic anxiety, depression and post-traumatic stress.

"Chronic stress can result in behavioral changes, like depression and anxiety," Johnson says. "Our lab has shown previously that animals exposed to chronic stress have increased ability to form fear memories."

In his new study, Johnson will use rodent models designed to mimic the conditions he hopes to treat in humans. "With exposure to chronic stress, we see an increased response in brain cytokines," Johnson says. "We're looking to see if these contribute to the formation of fear memories or enhance the consolidation of these memories."

Animals exposed to chronic stress have increased ability to form fear memories.

The first stage of his project is to determine the role cytokines play in the formation of fear memories. The second is to determine if the cytokines come from the microglia. If they do, Johnson says he hopes to be able to use a virus to control the microglia in order to turn cytokine production off and on.

"That's important, potentially, for anxiety and PTSD," he says. "We think that if we inhibit the microglia during the pairing of environmental cues and stress memory, then we can prevent the exaggerated anxiety that we see in rodents."—*Dan Pompili*

Visit Kent State's Department of Biological Sciences at www.kent.edu/biology.

Brain Health Research (BHRI) INSTITUTE

Understanding the **NEUROCHEMISTRY** *of Human Brain Development*

While scientists have long believed human behavior developed with the expanded cerebrum, a Kent State University researcher has shown that our path diverged while our brains were still comparable in size to those of chimpanzees.

To help her further unravel this mystery, the National Science Foundation has awarded a three-year, $310,000 grant to Mary Ann Raghanti, PhD, professor and chair of the anthropology department in the College of Arts and Sciences, for her project, "Human Origins and Comparative Neurochemistry." The project continues research she published last year.

"When *Ardipithecus* emerged (more than 4 million years ago), something changed her behavior that helped her and her descendants become very successful," Raghanti says. What makes a species behave in a different way comes down to an ancient part of the brain, the striatum—a subcortical region that regulates behaviors involved with social reward and is involved in personality styles and modern human language.

"If a behavior is not plugging into the reward circuit, you're not going to do it. That's what makes every species unique," says Raghanti, who studies the neurochemicals that modulate behavior, including dopamine, serotonin, acetylcholine and neuropeptide Y.

What makes a species behave in a different way comes down to an ancient part of the brain.

"Humans have high levels of dopamine within the striatum, which makes us more prosocial and probably feeds into our pair bonding, altruism and empathy. In addition, we have lower acetylcholine. In other species, high acetylcholine is associated with aggression and internally-motivated (read: selfish) behavior."

The shift that occured millions of years ago led to more prosocial behavior, and social relationships became more complex, leading to even more complicated neurochemistry.

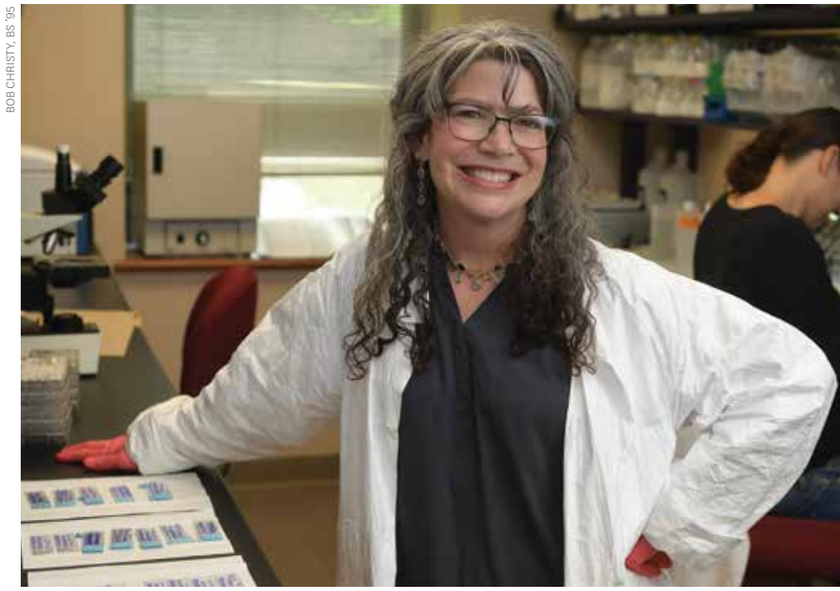
"It becomes a feedback loop: more complicated behavior increases intelligence, which leads to more complicated behavior and so on," Raghanti says.

Her current project includes the study of additional species and brain regions. The study also may lead to better understanding of neurodegenerative diseases like Alzheimer's, Huntington's and Parkinson's diseases and neuropathologies like autism, obsessive compulsive disorder and attention deficit hyperactivity disorder.

"By understanding how the human brain is different from those of all other species," Raghanti says, "we can begin to identify the targets for neuropathological processes that have devastating cognitive effects." —*Dan Pompili*

Visit Kent State's Department of Anthropology at www.kent.edu/anthropology.

MARY ANN RAGHANTI, PHD



BOB CHRISTY, BS '95

HEATHER CALDWELL, PHD

Exploring OXYTOCIN'S ROLE *in the Developing Brain*

Labeled by some as "the bonding hormone," oxytocin is well known for helping pregnant mothers with uterine contraction while in labor, milk letdown while breastfeeding and a feeling of euphoria when cuddling with their infants. But there is still much that researchers do not know about how this hormone works in the brains of children.

Heather Caldwell, PhD, professor of biological sciences and graduate coordinator in KSU's College of Arts and Sciences, recently received a three-year $450,000 grant from the Eunice Kennedy Shriver National Institute of Child Health and Human Development at the National Institutes of Health (NIH), for her project, "Sex Differences in the Developing Oxytocin System."

Caldwell's lab group will be the first to examine the function of oxytocin signaling during early development. Elizabeth Aulino, a Kent State PhD candidate in Caldwell's lab, will focus on this topic for her dissertation. Using an animal model, the researchers aim to determine how the developing oxytocin system differs between females and males and also how it impacts their neurochemistry.

The brain hormones do not themselves cause behavior, but they modulate it. The key is how they interact with a receptor, in this case, a protein in the cell's membrane. The developing mouse brain does not make oxytocin early in development, but it has oxytocin receptors ready to signal.

Emerging evidence shows that, during early brain development, oxytocin helps to organize neural circuits in the brain and that these organizational effects may help the brain develop the capacity to execute sex-specific and context-appropriate social behaviors later in life.

> ***Oxytocin is important for social cognition and social functioning.***

"We think these experiments will reveal a novel role for oxytocin in organizing sex-specific brain circuits that are critical for typical displays of social behaviors," Caldwell says. "Across mammalian species, oxytocin is important for social cognition and social functioning, and deficits in social behaviors are characteristic of several neurodevelopmental neuropsychiatric disorders such as schizophrenia."

This R15 NIH grant, an Academic Research Enhancement Award (AREA), encourages the research, education and training of future scientists through undergraduate research support for students interested in a career in biomedical/behavioral science. Caldwell is recruiting students to collaborate with her and Aulino, as well as a technician for the three-year term. —*Jim Maxwell*

Visit Kent State's Department of Biological Sciences at www.kent.edu/biology.

Brain Health Research (BHRI) INSTITUTE

Identifying CHILD INJURY VICTIMS *at Risk for* CHRONIC STRESS

The way in which a parent responds to a child's injury often impacts how upset the little one becomes. This age-old parenting wisdom is one component of a new study by a KSU researcher into predictors of long-term post-traumatic stress in children.

The National Institutes of Health (NIH) recently awarded a three-year, $460,000 grant to Douglas Delahanty, PhD, professor of psychological sciences in KSU's College of Arts and Sciences and associate vice president for research faculty development with Research and Sponsored Programs, for his project, "Emotion Processing Deficits and Risk for Impairment in Child Injury Victims."

"We're trying to identify which children and families will have a harder time after a traumatic event," Delahanty says. "A small but significant percentage will develop persistent psychological symptoms that can impact their functioning for a long time. The trick is how to identify that small group and intervene with them."

> ***Parental reactions to a child's serious injury have a large impact on the child's recovery.***

The research team consists of Delahanty, Karin Coifman, PhD, and Jeff Ciesla, PhD (both associate professors of psychological sciences at KSU), as well as Sarah Ostrowski-Delahanty, PhD, and Norman Christopher, MD, from Akron Children's Hospital.

JEFF GLIDDEN, BS '87

DOUGLAS DELAHANTY, PHD

The primary focus is to test two new factors thought to increase risk for persistent distress in child injury victims: high threat sensitivity (how likely one is to perceive danger in a situation) and low inhibitory control (the inability to assess and rationalize their sensitivity to perceived threats).

"We've also seen that parental reactions to a child's serious injury have a large impact on the child's recovery," Delahanty says. "And parental post-traumatic stress can have a large impact on a child's functioning afterwards."

A major goal was to increase the number of dads in the study. "Almost all research looks at the impact of the mother's reactions on the child," Delahanty says. "We know little of the father-child dyad."

The grant also provides major support for students to be involved in the research. Undergraduate students recruit families and collect data at Akron Children's Hospital, then follow up at regular intervals, Delahanty says. "Students gain critical research experience that increases their chances of securing employment or being admitted to graduate school." —*Dan Pompili*

Visit Kent State's Department of Psychological Sciences at www.kent.edu/psychology.

Advanced Materials and Liquid Crystals (AMLCI)
INSTITUTE

The FUTURE *is Now*

The new director of the Advanced Materials and Liquid Crystal Institute sees a bright future for the institute, as it takes on a broader range of research and collaborates with nontraditional partners to develop the next phases of advanced materials science.

By Lisa Abraham

The flat screen television on your wall, the laptop on your desk and the smartphone in your pocket may be the first items that come to mind when you think about liquid crystal displays. Yet the future of liquid crystal science is heading in new directions, predicts Torsten Hegmann, PhD, who was named the new director of the Advanced Materials and Liquid Crystal Institute (AMLCI) in July, following a national search.

"Liquid crystal research is moving more toward biology and materials that respond to their environment in unique and unexpected ways," he says. "These are the new frontiers for the field."

Hegmann, who has been associate director of the institute since 2018 and a faculty member at Kent State since 2011, says the future of liquid crystals will be its applications in biology and medical science as well as sensors and active, responsive systems—which already are part of his research focus.

"Dr. Hegmann is a highly accomplished researcher in the fields of liquid crystals as well as biomaterials and nanomaterials," says Paul DiCorleto, PhD, vice president for Research and Sponsored Programs at Kent State. "He has not only made important contributions to our fundamental knowledge in these fields, but he has also shown entrepreneurial spirit and a passion for the societal impact of his research."

DiCorleto notes that Hegmann has co-founded a company [with his wife, Elda Hegmann, PhD, assistant professor of biological sciences], Torel LLC, that uses liquid crystal sensors to detect toxic gases and vapors. The sensors can help save the lives of firefighters and other first responders. [See page 27.]

"He has demonstrated a true commitment to multidisciplinary collaborative approaches to answering important questions, which is a major goal of this institute," adds DiCorleto.

A native of Germany, Hegmann was working as an associate professor of chemistry at the University of Manitoba in Winnipeg, Canada, when he came to a seminar at Kent State's Liquid Crystal Institute in 2011. He learned of the state-sponsored Ohio Research Scholars program to attract young international research talent to the state, applied and was hired the same year.

Hegmann says coming to the Liquid Crystal Institute was an exciting opportunity: "This is where a lot of the research in this field started."

Kent State's Liquid Crystal Institute was founded in 1965 by Glenn H. Brown, a chemistry professor and pioneer in the field of liquid crystal research; later the institute was named in his honor. It is regarded globally as the birthplace of liquid crystal displays and the world's first research center focused on the basic and applied science of liquid crystals.

In fall 2018, the Liquid Crystal Institute was renamed the Advanced Materials and Liquid Crystal Institute and its focus expanded to embrace a broad array of advanced materials research and science, in addition to liquid crystal research.

Kent State President Todd Diacon says he is confident Hegmann is the right leader to guide the institute as it expands its focus. "Liquid crystal research is part of the backbone of Kent State," Diacon says. "Dr. Hegmann understands its importance to the university's history and shares my commitment that Kent State remain a world leader in the research of the newest phases of advanced materials science."

> **"Liquid crystal research is moving more toward biology and materials that respond to their environment in unique and unexpected ways. These are the new frontiers for the field."**
>
> — TORSTEN HEGMANN, PHD
> *Director, AMLCI*

Elda Hegmann, PhD, and student in her research lab.

The Hegmann Group research lab already has cross-collaboration expertise in medicine, pharmacology, nanochemistry and engineering, and Hegmann says encouraging the institute to work collaboratively with more nontraditional partners will be a key goal.

Those partners will include biologists, materials chemists, biophysicists, engineers, members of Kent State's Design Innovation Initiative and the university's Brain Health Research Institute, of which Hegmann is a member.

"Some of my own research is in nanomaterials used for drug delivery to the brain," he says. "It's a logical link for me—the combination of materials science and the brain. There are, perhaps, many more connections we can make between the brain and materials science, especially liquid crystals, which are regarded as a model system for cell membranes."

Hegmann says he is anxious to see all researchers collaborating more with other sciences, and he is looking forward to the "collaboratories" in the terrace level of the Integrated Sciences Building, which are scheduled for completion in fall 2020. The space is being designed and created for scientists from various fields to work together and conduct joint research across multiple disciplines.

Demonstrating those research links and how they benefit each other will take the institute to a higher level, he says, and make additional research dollars more easily attainable.

Key to increased research funding is being able to show that the institute has multifaceted research that crosses varied domains, Hegmann explains. While the institute is adept at soft matter and liquid crystals, expanding research into affiliated materials and engineering to complement existing research is a must.

"We need to build critical mass in other materials research domains to complement this existing liquid crystal, soft matter expertise."

Visit Kent State's Advanced Materials and Liquid Crystal Institute at www.kent.edu/amlci.

Dr. Hegmann's main goals for the Advanced Materials and Liquid Crystal Institute:

- Increasing the institute's distinctive role in the future of liquid crystal and materials science to inspire a higher level of competitiveness for research funding.
- Elevating the level of symposiums held at Kent State to national and international prominence beginning in 2020.
- Streamlining and modernizing the look of the institute's buildings and laboratories, so that they reflect modern materials science.
- Renewing the research infrastructure so that all instruments and equipment are state-of-the-art. The purchase of such equipment will be tied to better fundraising.

Focus on FUEL CELLS

The UN Intergovernmental Panel on Climate Change (IPCC) released a report in October 2018, warning that mankind has about a decade to avoid permanent, dramatic weather changes due to global warming. According to the report, the world's percentage of electricity from renewable energy such as solar and wind power would have to jump from the current 24 percent to about 60 percent.

This sobering reality makes the research of Yanhai Du, PhD, associate professor of applied engineering and technology at Kent State's College of Aeronautics and Engineering (CAE) even more relevant for today's world.

The team leader and principal investigator of Kent State's Fuel Cell Program, Du has received more than 1.5 million dollars in grants for various clean energy projects over the past six years, including the largest grant award in CAE's history in 2017 when the US Office of Naval Research awarded him $485,000 for his "Laser-Sintering System for Research on Additive Manufacturing of Advanced Fuel Cells."

Du's vision for the funding is being put into motion, with plans for creating a new laboratory to house a 3D metal printer, one of the top breakthrough technologies in 2018. The equipment will complement the college's Stratasys Objet260 Connex3 3D polymer printer, purchased with a grant from the state of Ohio.

"This new equipment will enable us to use cutting-edge technology to 3D-print advanced high energy efficiency fuel cells," Du says. "Our students will use this equipment, in part, to create fuel cells."

Ohio is among the top five fuel cell states in the nation, and Du gives Kent State students hands-on experience working with fuel cell designs and putting their creations to work.

ZEV Project

The Zero Emissions Vehicle (ZEV), a student-led project, turns heads as the vehicle's fuel cell power propels it through the Kent Campus.

The ZEV is a repurposed six-seater golf cart with an electric engine powered by three sources: a fuel cell, solar panel and batteries. The fuel cell efficiently converts fuel, such as hydrogen or natural gas, into electricity with no greenhouse gas emissions. The solar panel on the cart's roof charges the batteries all the time.

BOB CHRISTY, BS '95

Yanhai Du, PhD, and Angela Deibel try out the ZEV.

When the cart is resting or the batteries are fully charged, the electricity generated by the solar panel can be used to electrolyze water into hydrogen and store the solar energy for later use.

Angela Deibel, a marketing and engineering double major, has been team leader on the ZEV for the past three years, after interning with Du in the Summer Undergraduate Research Experience (SURE) in summer 2016.

"Renewable energy is the future," says Deibel, who credits Du with giving her the opportunity to explore sustainability and engineering, while sustaining her passion for marketing. "The biggest thing is to get students into research," she says. "Getting into it early on propelled me."

Du gives Kent State students hands-on experience working with fuel cell designs.

"Students' involvement in research doesn't only enhance their learning and apply their knowledge—it's a platform for inspiration, a channel to success in life," says Du, who received an Outstanding Faculty Award in 2019 from Kent State's College of Aeronautics and Engineering and the President's Faculty Excellence Award in 2018.

Learn more about the ZEV at www.kent.edu/cae/zero-emission-vehicle-zev.

The Next "LITTLE" Thing

While wearable technology may be all the rage among many young Americans, the average high school or college student probably doesn't know much about the science behind their high-tech apparel.

Björn Lüssem, PhD, an assistant professor of physics in Kent State's College of Arts and Sciences, recently received a five-year $500,000 Faculty Early Career Development Award from the National Science Foundation (NSF).

The award honors Lüssem, who studied electrical engineering in Germany and joined Kent State in 2014, as one of the most promising up-and-coming researchers in his field and provides funding for laboratory research and educational outreach.

His project, "The Working Mechanics of Organic Electrochemical Transistors," focuses on microscopic- to miniature-sized sensors that can be used to interact with biological tissue.

"Transistors usually are just conducting electronic current. The nice thing about this [organic transistor] is that it converts ionic current to electronic current," Lüssem says. "In our bodies, it's all ions. So if you want to interface electronics with biology, you need this kind of transistor."

Lüssem says the highly sensitive transistors could, for example, measure the amount of lactic acid in sweat or even monitor electron excitation in the brain. As one of only a few physics researchers studying the transistors, he hopes to advance understanding and use of the technology.

"The standard model has many contradictions, so people think it doesn't work very well," he says. "But it does work well, up to a certain level. We want to show why it is working, but also find out how we can make it better."

Lüssem wants to change the way students think about physics research.

Components can be added to the basic transistor to make it more sensitive to certain biomolecules, Lüssem says. With any luck, they might even be printable on devices a little more sophisticated than the average desktop printer.

An NSF Career grant comes with an understanding that the researcher will use some of the funds to become a more proficient educator. Lüssem wants to change the way students think about physics research.

"When teaching physics, it's been a linear kind of thing—A follows B follows C—and that's not how physics is," he says. "I think students get a completely wrong image of what it means to do physics research in real life. [In reality,] it's being wrong almost all of the time and being right only about five percent of the time."

Lüssem is working with Kent State's School of Visual Communication and Design to create short stories and cartoons to illustrate the scientific process and the study of physics.

He plans to try the designs in classes at Kent State, as well as reach out to local high schools and even primary schools to test how they apply to the students there.—*Dan Pompili*

Visit Kent State's Department of Physics at www.kent.edu/physics.

BOB CHRISTY, BS '95

Björn Lüssem, PhD, holds a tiny organic transistor.

Advanced Materials and Liquid Crystals (AMLCI) INSTITUTE

DRONE Disrupter

How big can a drone get and still be operational? That's what the Army Research Laboratory (ARL) wants to know. In late March 2019, they awarded a grant of more than $130,000 to Blake Stringer, PhD, assistant professor of aerospace engineering in Kent State's College of Aeronautics and Engineering, to study propulsion systems for a new generation of intermediate-sized unmanned aircraft systems (UAS), commonly known as drones.

"I would say that UAS are becoming the disruptive tech of the 21st century in the aerospace and aviation industries," says Stringer, who retired as a lieutenant colonel after serving 20 years in the Army and is the founding faculty member of Kent State's aerospace engineering program.

"This technology is changing the way we function as a society. So how do we control them? How do we implement them? How do we use them? How big can they be?"

"This [drone] technology is changing the way we function as a society."

Small consumer-grade quadcopters have been a favorite holiday present in recent years, while companies like Amazon.com, Inc. want to use them for package delivery. The military's options for moving people and supplies through the air, however, remain limited to airplanes and helicopters.

In a collaborative effort with ARL consultants and researchers at the University of Tennessee, Stringer will assess the feasibility of creating a drone that is sized somewhere in between.

"We're taking something between zero and 55 pounds, and trying to make it 1,000 pounds," Stringer says. "We want to make it able to drop off supplies or perform some mission." He says the drone needs to serve a wide variety of functions: "Maybe soldiers in an urban area need to be extracted from a top floor of a high-rise building, or you're looking to send supplies to a more remote area."

ZAC POPIK, BS '19

Blake Stringer, PhD, and a student test a drone.

His project involves building an experimental test stand. "We'll put different sized electric motors and different sized rotors on it, and measure things like thrust, speed, thermal efficiency, acceleration, deceleration and vibration data," Stringer says. "From that, we'll be able to determine how big is too big before we have to change the way we're constructing things. When you scale these things from small to big, the dynamics of the rotor change."

One of the main challenges for designing such aircraft is meeting the power requirements. "How do we efficiently produce power that's not around a gas turbine or a piston engine? Is it going to be some kind of hybrid propulsion system? Will you have a fuel cell that feeds into a battery and uses the battery for surge moments? There are a lot of different questions."

The grant is for a one-year project, but Stringer hopes the research will be successful enough to take the group project to a second phase.—*Dan Pompili*

Visit Kent State's College of Aeronautics and Engineering at www.kent.edu/cae.

Design Innovation (DI) **INITIATIVE**

PARTNERS *By Design*

Kent State's Design Innovation Hub is setting the stage for transformative research and innovation across disciplines.

By Dan Pompili

Kent State broke ground in April on the Design Innovation Hub, a $44.5-million renovation of the former Art Building on the Kent Campus. J.R. Campbell, MFA, appointed last year as the inaugural director of the Design Innovation (DI) Initiative, recently discussed how it fits into Kent State's broader research and innovation goals.

"The DI Initiative is much more student-focused but has some pretty deep implications for research as well," he says. "The core goal of DI is to build a supportive ecosystem for students to become involved in collaborative, cross-disciplinary challenge-based innovation activities."

While researchers ask questions about why something works or why a phenomenon occurs, Campbell says design innovators ask "how can we" questions.

"It implies, obviously, collaboration; the 'how' implies that we don't have a prescribed plan for addressing the challenge, and it incorporates the idea that you don't have to always be an expert to be involved in creating compelling solutions."

Supporting COLLABORATIONS

Campbell says collaboration is just as vital to the design innovation process as it is to Kent State's strategic research institutes and initiatives, all based on interdisciplinary partnership.

"The Design Innovation Initiative is not about advancing any particular research agenda, but supporting all possible agendas, using DI as the mechanism for challenge-based innovation, and for testing and tackling some of the messier multidisciplinary problems."

DI is expected to form a kind of research and innovation 'trinity' with the Brain Health Research Institute and the Advanced Materials and Liquid Crystal Institute, but Campbell hopes to participate in addressing challenges connected to each of the research initiatives and driving Kent State's research efforts across all of the Kent State campuses.

"I can imagine a scenario where a couple of researchers from the Brain Health Research Institute, possibly based in different academic units, would say 'we have this idea but we're not sure about it,'" Campbell says. "Through DI, faculty might be able to run their ideas as student-based challenges or design short-term proposals for experiments in the Hub's shared faculty labs, helping to launch their concepts into more definitive research projects."

Campbell says the DI Hub will include a large makerspace that supports most entry-level maker/prototyping/innovation needs. The Hub also will host some specialized high-tech equipment unavailable elsewhere on the Kent Campus, like a flexibly designed multimodal visualization space and a large-format waterjet cutter. These would be supported by in-house student and staff design experts.

Project-based rentable space in the DI Hub will accommodate cross-disciplinary faculty projects that require space to pull together a range of tools or technologies, says Campbell. "The idea is to stimulate cross-disciplinary research, then also use it as a way to sponsor challenge-based projects that could involve students."

"We can mix in these pieces of specific equipment that intentionally draw cross-disciplinary teams to the DI Hub, and we will focus on building the kinds of kinetic collisions that happen in the building. DI is more about coordinating and collaborating than about being a makerspace."

Building CONNECTIONS

In addition to the main hub, Campbell says there will be at least 25 other "DI Nodes" across the university's eight campuses, where students and faculty can gain support to test ideas and design disruptive technologies to solve real problems.

These nodes will include several of the "collaboratories" planned for the terrace of the Integrated Sciences Building, where many faculty members in the Brain Health Research Institute (BHRI) and the Advanced Materials and Liquid Crystal Institute (AMLCI) will conduct research.

"A good example is in AMLCI with Mourad Krifa, PhD, [an assistant professor in Kent State's School of Fashion Design and Merchandising], who is experienced in fiber science and electrospinning of fibers," says Campbell. "He can work collaboratively with AMLCI faculty to further investigate the incorporation of liquid crystal materials into textile fibers during the spinning process."

MATT LESTER

> **"Design Innovation is more about coordinating and collaborating than about being a makerspace."**
>
> — **J.R. CAMPBELL, MFA**
> *Director, DI Initiative*

With these types of connections, cross-disciplinary teams utilizing DI resources can more effectively address novel applications of technology. That idea, in concert with all of the DI Node resources across the university, is what makes Kent State's model different from other universities, says Campell. "Most of the time, those big shared-resource makerspaces are tied to a school or college of engineering or business."

Such models often skew the focus toward innovation in those contexts, sometimes unintentionally, to the exclusion of other disciplines.

"As an initiative, DI will never do something on our own as a single sponsor to an event or project," he says. "Instead, we will always work in partnership with others, because we're not trying to propagate content, we're actually supporting process. In that sense, for us no topic is out of bounds, and that makes it open to anyone."

Campbell hopes DI can set the stage for more transformative research into products and experiences, as well as social innovation. "In that context, DI also helps to leverage Kent State's unique voice. We know we have strength in areas like brain health and liquid crystals, but as a university we also have a unique heritage and strength in areas like social justice and peace and conflict studies. These are things we can build on and address differently in an innovation context than a lot of other universities."

Playing off COLLISIONS

Campbell's vision has worked for Kent State at least once already, when he was director of the School of Fashion Design and Merchandising, where he spent nine years before becoming DI director.

"When I arrived [at the Fashion School], we created the TechStyleLAB. My goal there was to put all the digital input and output technologies that can be used in the context of fashion into one space, so both students and faculty would have access to it all at once."

The move marked the first time in 30 years that Rockwell Hall saw computer science students hanging out in the building. "There were tools in there they knew how to use, and they were curious, and then all of a sudden that dynamic changed the culture of the building," Campbell says.

"Our fashion students started hanging out with computer science students and thinking about wearable technology. About that time, we launched the 'Fashion/Tech Hackathon' with LaunchNET's help." The event is now in its seventh year and has earned national renown.

Campbell hopes the "hang out" model will have similar results in the DI Hub. "On the third floor of the DI Hub we'll have essentially the largest dining facility on the north side of campus, which means we'll have students from multiple disciplines hanging out in the building."

With plenty of glass, the dining space will provide multiple views into several work areas, and Campbell also plans to create multiple mini "pop-up challenges" each semester that will spring up in the common areas throughout the building. "When you're in there just having breakfast, you're going to feel like you're connected to a makerspace. Throughout the building, we'll be creating various things that get students interested, get them hooked, then get them involved in the sponsored projects we do."

The building, projected to open in fall semester 2020, also will include a retail pizza restaurant, multimodal visualization space to accommodate individual and group-based augmented and virtual reality experiences and other immersive projects, a bay with a gantry to support robotics designing and testing, and "DI Hatchery" spaces, where student teams can further develop their concepts for implementation before deciding to launch into the incubation stage.

Says Campbell, "It's about bringing people to the building to play off of the kinetic collisions that we can create."

Visit Kent State's DI Initiative at www.kent.edu/designinnovation.

The Spark Innovation Studio, one of Kent State's DI Node resources, is a hands-on multipurpose makerspace where users from campus and community can meet to learn, collaborate, design and create.

Bringing INNOVATION *to the* MARKET

State of Ohio officials renew a technology commercialization partnership between Kent State and Cleveland State.

By Dan Pompili

In May, the Ohio Third Frontier Commission approved Round 2 of the TeCK Fund, a $600,000 hybrid technology commercialization accelerator program that assists university faculty and startup companies to bring innovative new products to the market.

The program is jointly administered by Kent State University and Cleveland State University (CSU), with funding provided by the Ohio Third Frontier Commission and the two universities. The grant awards $300,000 in Third Frontier funds; Kent State and Cleveland State will contribute $150,000 each. The award also approves the addition of two new members to the TeCK Fund selection committee, which is responsible for awarding funds to innovators.

"We are pleased the Third Frontier Fund acknowledged our unique partnership with Cleveland State, and we look forward to working closely with Kent State inventors who are interested in moving our technology out of the lab and into the market," says Stephen Roberts, director of the Technology Commercialization and Research Finance office at KSU—which helps faculty evaluate product potential, protect their intellectual property, assist with marketing and sales, and support startup and economic development. "We also encourage our faculty members to work closely with JumpStart and BioEnterprise, Northeast Ohio–based entrepreneurial support programs."

Roberts says the two universities hope to fund more projects this time by lowering the minimum award amount to stretch available funds further. Awards will range in size from $25,000 to $100,000, and are intended to build working prototypes of university inventions, test those prototypes in real-world situations and determine the most efficient pathways to commercial markets.

"CSU and Kent State have unique research portfolios that provide significant opportunities for commercialization in a host of fields, from drug development to assistive devices to liquid crystals," notes Jack Kraszewski, director of the Technology Transfer Office at CSU. "This additional award for the TeCK Fund will accelerate the process for licensing new innovations, while spurring the development of technology transfer opportunities with numerous companies across the state.

> **"We look forward to working closely with Kent State inventors who are interested in moving our technology out of the lab and into the market."**
>
> — STEPHEN ROBERTS
> *Director, Technology Commercialization and Research Finance*

Since its inception in April 2017, the TeCK Fund has supported seven projects at the two institutions, with awards totaling $700,000. Kent State will be the lead institution for this grant, which runs through May 2020.

Visit Kent State's Technology Commercialization and Research Finance at www.kent.edu/research/technology-commercialization.

Kent State TeCK Funded Projects
From Round 1

SMART BIKE: ***Exercise bicycle to help ameliorate Parkinson's disease symptoms***

Angela Ridgel, PhD, associate professor of exercise science in the College of Education, Health and Human Services, received a grant from the TeCK Fund to help pay for the design and manufacture of a SMART (Speed Manipulated Adaptive Rehabilitation Therapy) Cycle prototype, a motorized therapy bike specially tailored to help ease the symptoms of patients with Parkinson's disease. She worked with engineers at Case Western Reserve University and Rockwell Automation in Cleveland to develop advanced programming features so the cycle's controls will adapt to different patients' abilities and needs. Ridgel hopes that within several years of research and funding, Parkinson's patients could have the bike in their homes for daily therapy.

JEFF GLIDDEN, BS '87

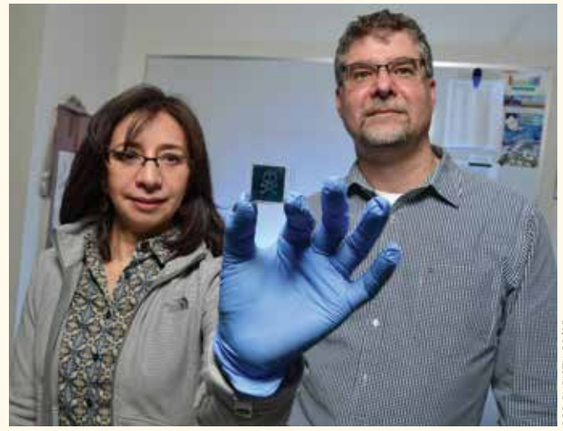
BOB CHRISTY, BS '95

Solid Oxide Fuel Cell: ***Small, cost-effective power generation units***

Yanhai Du, PhD, associate professor of applied engineering and technology at Kent State's College of Aeronautics and Engineering, received a grant from the TeCK Fund to continue research and development of fuel cells, with a goal of using additive manufacturing—more specifically 3D printing—to produce high-quality advanced technology fuel cells at lower costs.

Torel, LLC: ***Liquid crystal sensors to detect toxic gases and vapors***

Torsten Hegmann, PhD, director of the Advanced Materials and Liquid Crystal Institute, and **Elda Hegmann, PhD**, assistant professor in the Department of Biological Sciences, received a grant from the TeCK Fund to study liquid crystal-nanoparticle sensors. The integrative sensor systems, which the Hegmanns have developed with Merck Performance Materials, display a warning text or image in the presence of toxic gases and vapors. The project may help them produce various sensors that could protect the lives and health of firefighters, other first responders, military personnel in conflict zones and chemical manufacturing workers, among others.



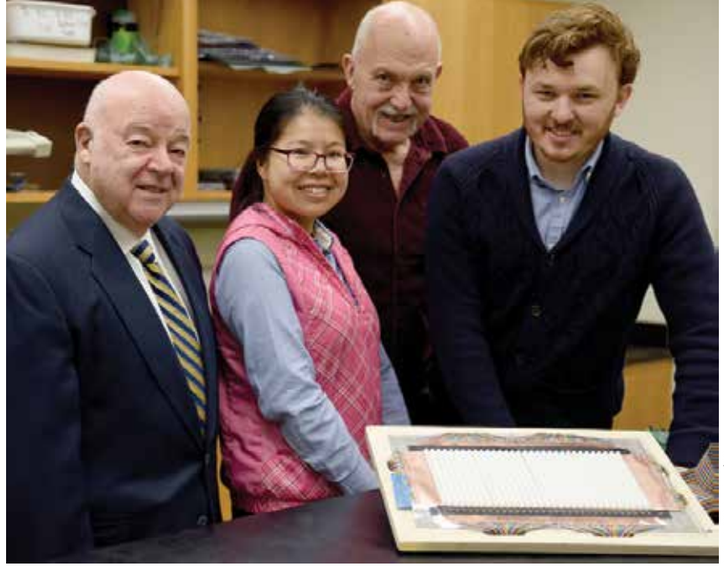
BOB CHRISTY, BS '95

Tech
INNOVATION

A STEP in the Right Direction

Kent State podiatry device takes top prize at Northeast Ohio innovation contest.

By Dan Pompili



NICK MOORE, BFA '90

Vincent Hetherington, DPM, Tianyi Guo, Peter Palffy-Muhoray, PhD, and Misha Pevnyi, PhD '15, with the prize-winning "Shear Force Mat."

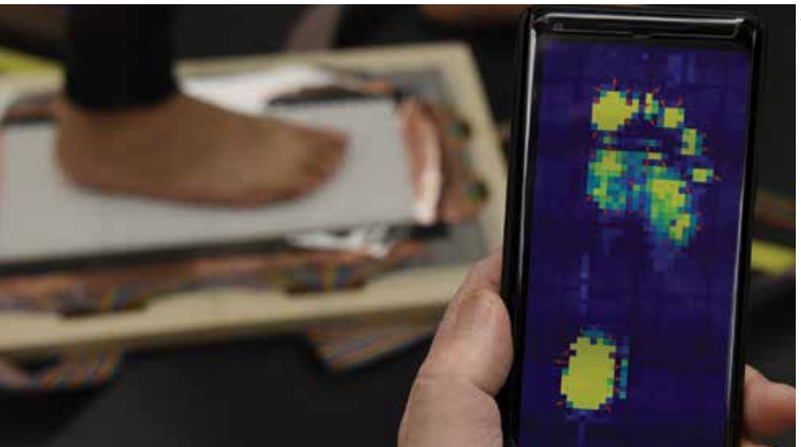
Foot ulcers are one of the most prevalent problems facing diabetic patients, but new technology developed at Kent State may soon help doctors better understand and treat them.

The device, called a "Shear Force Mat," represents a breakthrough for physicians seeking to understand how plantar ulcers form. It was developed and built by Kent State alumnus Misha Pevnyi, PhD '15, and Tianyi Guo, a graduate student in KSU's Chemical Physics Interdisciplinary Program in the Advanced Materials and Liquid Crystal Institute (AMLCI). The project, funded by a grant from the Ohio College of Podiatric Medicine, was overseen by Peter Palffy-Muhoray, PhD, and Hiroshi Yokoyama, PhD (both in the AMLCI) and Vincent Hetherington, DPM, senior associate dean and professor in the College of Podiatric Medicine.

The team took the top prize at the Burton D. Morgan Foundation's LaunchTown Soar competition, which focuses on high-tech college student businesses and was held at Baldwin Wallace University in April. Their winnings ($7,000) will allow them to further develop the device.

"They conducted interviews with 18 podiatrists, and the judges were impressed that the inventors had actually spoken with potential customers," says Stephen Roberts, director of KSU's Office of Technology Commercialization and Research Finance. "This is a great example of the value of getting out of the lab and talking to end users."

Unlike direct forces, created when the foot comes straight down, shear force pushes one part of the body in one direction and another part in the opposite direction. Recent studies suggest shear forces may play a significant role in ulcer development, but the question was how to effectively measure shear?



NICK MOORE, BFA '90

The answer, Pevnyi and Guo found, was to convert shear stresses to more easily measurable local pressures. The device's platform (about the size of a large computer keyboard) is made mostly of pyramid-shaped pressure plates that were 3D printed in Palffy-Muhoray's lab, with a pivot plate on top, and electrodes and a microprocessor for data collection beneath. The data is automatically uploaded to a website for instant access and monitoring.

> ***"This is a great example of the value of getting out of the lab and talking to end users."***

Guo worked on the 3D printing and layout while Pevnyi did the electrical and software development. AMLCI engineer Merrill Groom contributed to the IC chip design and assembly.

Hetherington says the next steps include improvements of the prototype and clinical testing, followed by use of the technology as a medical analysis tool. Future goals include developing a device for in-shoe application.

The KSU Patent Board has recently approved the device for federal patent application, and funding to continue development is currently being sought.

Visit Kent State's College of Podiatric Medicine at www.kent.edu/cpm.

VIRTUAL REALITY *Promises Real-World Results*

An interdisciplinary team of KSU professors is researching how virtual reality technology can help improve health opportunities for people with developmental and cognitive impairments.

By Natalie Eusebio

According to the Center for Disease Control, people with disabilities are among the most sedentary population in the United States, and people with intellectual or developmental disorders are five times less likely to be physically active compared to their peers.

However, little research has been done to explore tools that might encourage more physical activity among this population, until now. An interdisciplinary team of researchers at Kent State is introducing virtual reality technology—computer-generated simulation of an interactive, three-dimensional environment—as a potential solution for young adults with developmental and cognitive impairments between the ages of 18 and 28 years old.

> ***Visiting a simulated environment could help those with cognitive disabilities "frontload"—learn and prepare for a new environment before actually being there.***

The idea came from Mary Ann Devine, PhD, a professor in the Recreation, Park, & Tourism Management Program in Kent State's College of Education, Health and Human Services, who is director for the Disability Studies and Community Inclusion minor/graduate certificate.

JEFF GLUDDEN, BS '87

Students test virtual reality equipment.

She is joined in her research by Gokarna Sharma, PhD, and Jong-Hoon Kim, PhD, both assistant professors in the Department of Computer Science, and three graduate students. The team received $15,000 from the Kent State Healthy Communities Research Initiative to aid their research.

Earlier research conducted by the team revealed that young adults with cognitive disabilities were comfortable using virtual reality equipment, such as hand-held controllers and other electronic equipment. Visiting a simulated environment could help them "frontload"—learn and prepare for a new environment before actually being there.

The team created an interactive virtual reality tour of Kent State's Warren Student Recreation and Wellness Center, taking photographs of the center after hours that they used to replicate the real environment.

By taking the virtual tour, students with cognitive impairments can understand the center's setup—for example, where locker rooms and water fountains are located—and become aware of possible challenges, such as signage that may be difficult for them to read, before they step inside the actual building. The team plans to create three different environments, including an outdoors environment, a built environment and a neighborhood environment, which could be accessed on a cell phone, so there are few limitations.

The goal is to help members of the Kent State community, but the project has global potential. "This is just a start," Devine says. "We have ideas about how this could help older adults and people with mobility impairments."

The findings will be shared with policy makers, service providers, family members, architects, city planners and the public so that people may better understand how built environments impact human behavior.

Visit Kent State's Healthy Communities Research Initiative at www.kent.edu/hcri.

Environmental Science and Design Research (ESDRI) **INITIATIVE**

Dave Costello, PhD (left), assistant professor in the Department of Biological Sciences in Kent State's College of Arts and Sciences, and Devan Mathie (right), an undergraduate honors student in Costello's lab, stand in Wahoo Ditch, a tributary to Breakneck Creek in Ravenna, Ohio.

JIM MAXWELL, BS '00, MS '11

Researching RIVER-BASED ECOSYSTEMS

A Kent State ecologist is part of a global collaboration to answer pressing questions about climate change.

By Jim Maxwell

The work of 153 ecological researchers from 40 countries, including Dave Costello, PhD, assistant professor in the Department of Biological Sciences in Kent State's College of Arts and Sciences, has revealed new findings on the effect of climatic factors on river-based ecosystems.

The findings, published in a recent issue of the journal *Science Advances*, show that climatic factors, such as temperature and moisture, influence carbon-cycling rates of river-based ecosystems. According to the paper, "Organic carbon that enters rivers and adjacent ecosystems meets one of many fates: It is mineralized and released to the atmosphere as CO_2 [carbon dioxide] or CH_4 [methane], incorporated into local food webs, or routed downstream to join long-term storage pools in marine or lake sediments. The rate at which organic carbon is processed determines which of these fates predominates and has important implications for the functioning of ecosystems from local to global scales."

"This is the largest such study, with respect to spatial coverage, and allows us to study carbon cycling in streams at unprecedented global scales," says Costello, who serves as second author on the paper. "We are able to show how different biomes—large, naturally occurring communities of flora and fauna occupying a major habitat, like forests, deserts and tundras—decompose organic material into carbon dioxide, and we draw conclusions about the susceptibility of these ecosystems to rising global temperatures."

"River ecosystems play significant roles in the global carbon cycle by regulating rates of decomposition and transporting organic matter to the oceans, but we have only a rudimentary understanding of how decomposition rates vary from river to river," says Scott Tiegs, PhD, associate professor of biology at Oakland University in Michigan, who led the study.

Unlike most previous studies on carbon cycling in streams and rivers, which used locally collected types of leaf litter to measure decomposition rates, the methodology in this study was identical across all field sites. The study made use of a standardized, easy-to-use cotton strip assay, applied in river channels and along the river banks, to quantify microbial decomposition of cellulose, the most abundant polymer on Earth, the main component of terrestrial plant litter and an important source of greenhouse gas emissions from river ecosystems.

Climatic factors, such as temperature and moisture availability, that govern decomposition of organic material into carbon dioxide are increasingly impacted by human activities.

This standardized assay enabled a large number of researchers to participate in the study. Each research team deployed the cotton strips in four rivers and their adjacent riparian zones (wetlands adjacent to rivers and streams).

"As a result, we were able to quantify decomposition rates in more than 500 rivers across the globe, including every continent," Tiegs says. "In addition to providing fundamental information on how river ecosystems function, our results provide baseline data that will enable future researchers to evaluate large-scale ecological responses to warming and other dimensions of global climate change."

Costello's lab deployed the cotton strips in four sites in Northeast Ohio: Stebbins Gulch at the Holden Arboretum, Triple Springs at West Branch State Park, the Mahoning River at Jennings Woods and Breakneck Creek at the Kent State South Slates property.

"At a given river, the cotton was placed just a few meters apart, yet that boundary between the river and land made a big difference in how quickly the carbon returned to the atmosphere," Costello says. "In some cases, we predict that leaves falling on land would stay on the soil 10 times longer than leaves falling in the river."

The paper notes that climatic factors, such as temperature and moisture availability, that govern decomposition of organic material into carbon dioxide are increasingly impacted by human activities.

"There are drastic changes expected at the poles," says Costello, whose biggest role in the paper's manuscript was data analysis. "Our data show that cold temperatures are greatly restricting carbon loss from northern streams, but as the climate warms, the carbon stored in those streams has the potential to be lost to the atmosphere much more rapidly. The expected loss of carbon from thawing permafrost gets a lot of attention, but our study shows that warming streams in these areas may also amplify the loss of carbon from northern biomes."

Costello's lab is still generating data from the cotton strips to understand what other factors, besides temperature and moisture, influence decomposition rates. They are studying the role of nutrients (nitrogen, phosphorus and trace metals) on how quickly this carbon decomposes. Early results are showing that the amount of nitrogen trapped by the microbes breaking down the cotton indicates how quickly the carbon decomposes.

The research was sponsored by the Ecuadorian Science Foundation, and the article, "Global Patterns and Drivers of Ecosystem Functioning in Rivers and Riparian Zones," is posted online.

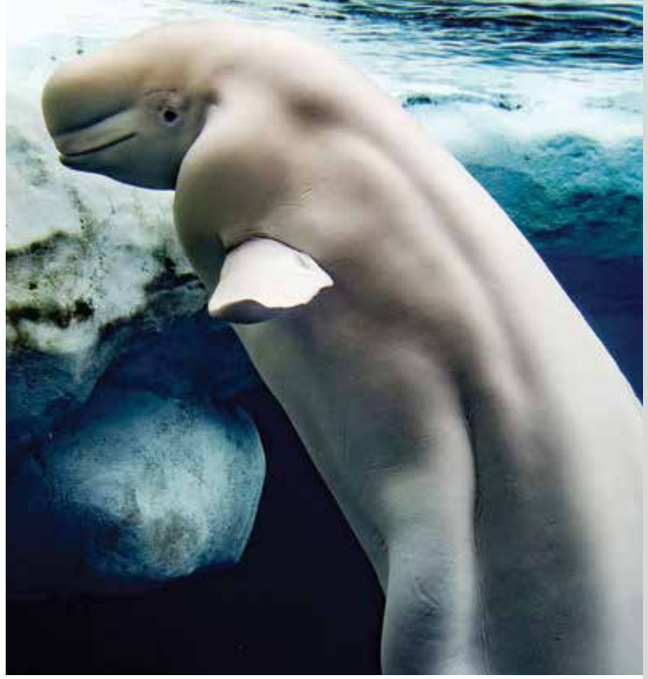
Visit the Costello Biogeochemistry Lab at Kent State at https://costellolab.weebly.com. Visit Kent State's Center for Ecology and Natural Resource Sustainability at www.kent.edu/esdri/center-ecology-naturalresource-sustainability. Visit Kent State's Department of Biological Sciences at www.kent.edu/biology.

Environmental Science and Design Research (ESDRI) **INITIATIVE**

Long in the TOOTH

Researchers end ongoing debate over how to determine the age of beluga whales.

By Dan Pompili



You have likely seen one at an aquarium—a friendly creature with an oversized head that swims up to the glass with what looks like a smile on its face. Extremely social mammals, beluga whales are often called sea canaries because of their high-pitched chatter, or melonheads for the enlarged and flexible area above their eyes that creates facial expressions.

They are thought to live roughly 60 to 70 years in the wild in both arctic and subarctic waters. However, as their arctic environment continues to change at a rapid pace, it is imperative to better understand the beluga whale's life history. When it comes to determining their age, though, their teeth are the subject of much debate.

Beluga and sperm whales have particular cavities in their teeth that allow for continuous deposits of dentin—the type of hard bony tissue that lays below the tooth enamel—throughout their lifetimes. This distinction has for decades complicated the process of determining age in those species.

A new collaborative study published by researchers at Kent State University and Northeast Ohio Medical University (NEOMED) provides evidence that the thick layers of dentin—called Growth Layer Groups (GLGs)—preserved in the teeth of beluga whales may be just as reliable for measuring age as they are in other whale species. Much like counting rings of a tree trunk, the researchers say beluga whales deposit one layer of GLGs per year, providing an easy, visual marker.

JOSEPH ORTIZ, PHD

"Some scientists felt the standard measurement (one growth layer group per year) did not apply to belugas, which made age estimation difficult," says Joseph Ortiz, PhD, professor and assistant chair in the Department of Geology in Kent State's College of Arts and Sciences. "The alternative model thought that belugas laid down two growth layer groups per year."

As their arctic environment continues to change at a rapid pace, it is imperative to better understand the beluga whale's life history.

To resolve the debate, Ortiz teamed up with researchers David Waugh, PhD, research assistant in the Department of Anatomy and Neurobiology at NEOMED, and Hans Thewissen, PhD, Ingalls-Brown Professor of Anatomy at NEOMED, along with Robert Suydam, PhD, senior wildlife biologist for the North Slope Borough Department of Wildlife Management in Utqiaġvik, (Barrow) Alaska. Together they studied tooth samples taken from whales in the Chukchi Sea (north of the Bering Sea, between Russia and Alaska).

They documented that beluga whales also laid down thin, daily layers that make up the dentin in each growth layer group, which they could then show are annual growth layers, says Ortiz. "I helped to quantify the trends in the data and the statistical significance tests we applied."

Their study is the first of its kind to confirm annual banding in beluga teeth by comparing against daily layers. The results show that these two were internally consistent, resolving the question of how much time each band represents.

Visit Kent State's Department of Geology at www.kent.edu/geology.

ESDRI SEED GRANTS

The Environmental Science and Design Research Initiative (ESDRI) was excited to offer competitively awarded seed grant funding to research teams in spring semester 2018. ESDRI was established in 2017 to support faculty efforts to achieve continued scholarly success in areas of research concerning both natural and built systems.

The projects funded demonstrate the broad nature of scholarly activity addressing the environment at Kent State, including projects related to climate change, urban health and forest restoration. The teams were chosen based on their creative and cutting-edge nature, breadth of the interdisciplinary team, and future funding potential.

The teams and project titles that were funded are listed below:

Scott Sheridan, PhD, (Geography), Terry Schwarz (Cleveland Urban Design Collaborative)
"Enhancing Climate Preparedness Through Geodesign Of Urban Green Space"

Elizabeth Herndon, PhD (Geology), Lauren Kinsman-Costello, PhD (Biological Sciences)
"Designing a sensor network to investigate how redox regimes control iron and phosphorus biogeochemistry"

Reid Coffman, PhD (College of Architecture and Environmental Design), Christie Bahlai, PhD (Biological Sciences)
"Biodiversity Roofs as Novel Ecosystems"

Anne Jefferson, PhD (Geology), Christie Bahlai, PhD (Biological Sciences), Bridget Mulvey, PhD (School of Teaching, Learning and Curriculum Studies)
"FoSTERing Restoration Success at Cuyahoga Valley National Park"

See the ESDRI website at www.kent.edu/esdri.

Shrub Encroachers FRIEND OR FOE?

Woody shrubs are moving in on grasslands around the globe. A Kent State biology professor reveals how that could affect the soil and atmosphere.

By Chris Blackwood and David Ward

Ecosystems in today's world are responding to a wide variety of environmental changes. What happens when these changes interact? That was the topic of a recent paper published by David Ward, PhD, the Art and Margaret Herrick Endowed Professor of Plant Biology in Kent State University's Department of Biological Sciences, and international colleagues and graduate students in the journal *Scientific Reports*.

Although climate change is often viewed as the overriding global challenge, grasslands around the world are often directly threatened by a simple neighboring plant. Like a neighbor who shifts their garden further and further onto your lawn, woody shrubs have been gradually moving into grasslands and displacing native grass species.

In their new paper, Ward and colleagues asked whether this encroachment of woody shrubs into grasslands in South Africa would increase or decrease the amount of carbon stored in the soil under the plants. Answering this question will help us understand whether or not grasslands of the future will become carbon dioxide sources, contributing to the increased carbon dioxide in the atmosphere and global greenhouse effect.

This study revealed an important explanation to a puzzling observation—if the goal is to store carbon in grassland soil, shrub encroachment may be harmful in one place but helpful in another place. The researchers dug down a meter into the Earth to measure carbon stored with and without the encroaching shrubs. Their findings indicate that, in these dry regions of the world, rainfall is the switch that controls the effects of shrub encroachment.

In dry regions of the world, rainfall is the switch that controls the effects of shrub encroachment.

They found that encroachment in higher rainfall areas decreases carbon stored in the soil; however, encroachment in lower rainfall areas increases carbon stored in the soil.

Identifying rainfall as a control over the different effects that shrubs can have on grasslands means that we may be able to predict the effects of shrub encroachment on climate change as we continue to learn about these important ecosystems.

For more information about this research, contact dward21@kent.edu.

DAVID WARD, PHD

Healthy Communities Research (HCRI) **INITIATIVE**

Grandparents **RAISING** *Grandchildren*

A Kent State gerontologist has developed a social intelligence training intervention to improve the well-being of custodial grandfamilies.

By Dan Pompili

Custodial grandparents and their grandchildren are a unique and little-understood population, as are the physical and social health challenges they face.

A Kent State University researcher has designed a program that could help assess the well-being of such families and provide resources to help them thrive.

Gregory Smith, EdD, professor and director of the Human Development Center in the School of Lifespan Development and Educational Sciences in Kent State's College of Education, Health and Human Services, has already advanced to the second phase of his five-year $1.2 million project, "Social Intelligence Training for Custodial Grandmothers and Their Adolescent Grandchildren," funded by the National Institutes of Health's (NIH) National Institute on Aging.

The project stands on the shoulders of two previous federally funded studies Smith has conducted since he began researching custodial grandfamilies in 1996.

About a million grandparents in the United States are taking on a custodial or skipped generation role—meaning they are raising grandchildren on a fulltime basis in their own home without involvement from birth parents (although many grandparents don't have legal custody), says Smith. Parent substance abuse, incarceration and mental illness are some of the causes behind this custodial caregiving.

"Most of the researchers who study these families are gerontologists like me," he says. "The earliest research on these families applied theoretical models and conceptual frameworks that we used to study family caregivers to older adults. Through that first study, I caught on to the fact that this is really a parenting phenomenon."

The study involved phone interviews with more than 700 custodial grandmothers and 200 custodial grandfathers from the same families, and addressed factors related to stress and the psychological health of all family members.

He found that custodial grandmothers (who do the major share of caregiving) are at high risk for psychological distress, and custodial grandchildren (who experience early life adversity) are at high risk for behavioral and emotional difficulty.

From that, a second study emerged, based upon literature showing that caregivers' psychological distress impacts children's outcomes through parenting practices.

Funded by the National Institute of Nursing Research, the study involved custodial grandmothers of children ages 4 to 12. Smith compared three interventions—cognitive behavioral therapy (designed to help parents better deal with their psychological distress), behavioral parenting training (focused on trying to improve parenting practices), and information-only support.

The findings of the study were summarized in the 2018 article, "A randomized clinical trial of interventions for improving well-being in custodial grandfamilies," published in the American Psychological Association's *Journal of Family Psychology*.

The first two interventions were equally effective in reducing distress and improving parenting behaviors among grandmothers and lessening psychological difficulties among grandchildren—and more successful than the information-only approach.

Based on all previous findings and a review of literature, Smith's current project focuses on grandmothers of children ages 12 to 18. "Adolescent grandchildren had been largely ignored, so we're the first study looking explicitly at them," he says. "Our focus on delivering the intervention to the grandmother and grandchild simultaneously makes great sense because we know female caregivers have the greatest impact on adolescents' social intelligence development, and adolescence is the peak period for developing social intelligence."

Smith says social intelligence—the ability to effectively navigate and negotiate complex social relationships and environments—is negatively affected when children experience early life adversities like being abused by a parent, having a parent incarcerated or dealing with the death of a parent. "That throws off a person's ability to form social intelligence, which in turn prevents them from forming meaningful and helpful relationships with other people."

Female caregivers have the greatest impact on adolescents' social intelligence development, and adolescence is the peak period for developing social intelligence.

The grandchildren in custodial grandfamilies are highly likely to have experienced early life adversities, given the reasons most of them are in their grandmothers' care, he says, adding that researchers suspect the grandmothers also experienced early life adversities. "It is believed that these patterns of suffering early life adversities are transmitted across generations."

Social intelligence training is thought to be especially effective in people who have experienced early life adversities, says Smith. "Ours is the first study of any type to look at the effect of delivering a social intelligence intervention simultaneously to a female caregiver and an adolescent child."

Smith and another principal investigator at Arizona State University developed an online social intelligence training program for the grandmother/grandchild dyad. The online nature of the program solves many problems, he says. Previous studies that asked the grandmothers to take part in ten group sessions at a specific day, time and place met with significant difficulties.

"With the online intervention, they just log on and they can watch it any time," he says. "They can do it together with their grandchild or separately, and they don't have to leave the house."

Visit the Human Development Center at www.kent.edu/ehhs/ldes/hdfs/human-development-center. Visit the Healthy Communities Research Initiative at www.kent.edu/hcri.

Healthy Communities Research (HCRI) INITIATIVE

Fighting Cancer on a MOLECULAR LEVEL

BOB CHRISTY, BS '95

Using single molecule fluorescence microscopy, physics professor Hamza Balci gets a detailed picture of individual molecules and their behavior.

Kent State is becoming a leading authority on a genetic structure that plays a critical role in the growth and replication of cancer cells—the G-quadruplex.

In molecular biology, nucleotides are organic molecules that form the basic structural unit of nucleic acids such as DNA. The G-quadruplex is a secondary structure formed in DNA nucleotides with high amounts of guanine, one of the four constituent bases of nucleic acids. Such nucleotides are found at the ends of DNA strands in human chromosomes. Also found at the end of every double-helix DNA strand is a single-strand tail called a telomere, formed by thousands of nucleotides in a repeating sequence—GGGTTA.

Every time a normal human cell divides, some nucleotides are lost and the tail shortens. If it reaches a critical length, the cell stops replicating (senesence) or dies (apoptosis). Cancer cells, however, can replicate quickly without dying because of a protein called telomerase. This protein lengthens telomeres as cells divide, preventing cell death.

In cancer cells, G-quadruplexes are known to block telomerase production, which can make cancer cells obey the normal laws of cell life and death. Certain proteins in the body, however, can cause G-quadruplexes to break down.

Two KSU researchers are exploring how to stabilize G-quadruplexes, and they each have won federal funding awards this year for their studies in relation to cancer treatment:

Testing New Compounds

Recently, the National Institutes of Health (NIH) awarded a four-year, $344,500 grant to Hanbin Mao, PhD, professor of chemistry and biochemistry in Kent State's College of Arts and Sciences, for his project, "Specific Recognition of G-quadruplexes."

HANBIN MAO, PHD

"We want to look at what we can use to stabilize the G-quadruplex," says Mao, who combines analytical chemistry and single-molecule biophysics in a new interdisciplinary field called mechano-analytical chemistry. "We've designed experiments to evaluate the small molecules that can bond to this G-quadruplex and interfere, hopefully, to stop the growth of cancer."

Among myriad approaches researchers are taking in the fight against cancer, telomerase targeting has been effective in killing cancer cells, and several drugs based on this model are being tested in clinical trials. So far, however, these approaches only yield a fatal shortening of telomeres in cancer cells after an extensive lag unsuitable for therapeutic applications.

Mao seeks to solve this problem by testing new compounds that inhibit transcription of the enzyme that supports telomere extension, known as human telomerase reverse transcriptase (hTERT), through specific binding of G-quadruplexes (GQs) formed in the hTERT promoter.

His recent findings show that inhibition of hTERT transcription kills cancer cells within days by interfering with the fundamental telomerase activities that, among other functions, avoid apoptosis. "Our objective is to reduce production of this enzyme by stabilizing the G-quadruplexes that form in the hTERT promoter region."

G-quadruplexes are known to block telomere extension, which can make cancer cells obey the normal laws of cell life and death.

Studying Individual Molecules

Earlier this year, the National Institutes of Health awarded Hamza Balci, PhD, a molecular biophysicist and associate professor of physics in Kent State's College of Arts and Sciences, a three-year $437,600 grant for his project, "Influence of Small Molecules on G-quadruplex Stability, Folding Kinetics, and Interactions with Proteins."

Balci's focus lies with the G-quadruplexes that form on regulatory cells. These cells determine whether or not a specific protein will be expressed, and how much of it to make. The stability of G-quadruplexes allows them to act as roadblocks, and they most often prevent protein expression, including that of telomerase in cancer cells. However, as noted previously, certain proteins in the body can cause G-quadruplexes to break down.

"Being able to see individual molecules and watch in real time how they work, gives us a lot of information on what type of mechanism the protein uses to destruct the G-quadruplexes," Balci says.

"We put these molecules on a surface, and we image them with single molecule fluorescence microscopy, so we can see individual molecules and their behavior. You get a more detailed, accurate picture. We take those molecules and conduct measurements with other small molecules, and study the stability against the protein that these small molecules induce in the quadruplexes."

Balci says pharmaceutically administering molecules that stabilize G-quadruplexes in cancer cells could prevent them from lengthening their telomeres, thereby inhibiting cancer cells from multiplying. *—Dan Pompili*

HAMZA BALCI, PHD

Visit Kent State's Department of Chemistry and Biochemistry at www.kent.edu/chemistry.
Visit Kent State's Department of Physics at www.kent.edu/physics.

Studying LIPID-PROTEIN *Interactions*

Centuries of research and discovery have given scientists a fairly comprehensive understanding of human biology, but some of the body's most fundamental processes still aren't understood.

The National Science Foundation (NSF) recently awarded a three-year, $423,000 grant to two Kent State researchers to study one of those biological fundamentals in depth.

Lipid droplets are fat particles critical to the supply and regulation of energy within the cell and serve various other roles in diverse cellular processes.

Edgar Kooijman, PhD, associate professor of biological sciences, and Elizabeth Mann, PhD, professor of physics, both in Kent State's College of Arts and Sciences, will spend the next few years researching how proteins form inside the cell target and bind to the surfaces of lipid droplets, where they regulate droplet structure and function.

"Over the past few decades biologists have found all kinds of different roles for these droplets/particles," Kooijman says. "Viruses use lipid droplets to replicate, different cellular pathways flow through lipid droplets, and there are lots of connections between these droplets and many disparate cellular processes."

While much is known about how proteins bind to the lipid membranes that compartmentalize complex cells, little is known about how proteins interact with lipid droplets.

Mann and Kooijman say a better understanding of protein-lipid interactions could lead to potential advances in treatment of lipid-related diseases like diabetes and atherosclerosis.

"Type 2 diabetes is essentially insulin resistance," Kooijman says. "One of the things we know happens in muscle cells is that if these cells accumulate too much fat (oil), it leads to dysregulation of the insulin sensing machinery and the inability to properly respond to the insulin signal—which ultimately leads to insulin insensitivity."

Lipid droplets are fat particles critical to the supply and regulation of energy within the cell.

In addition to the research itself, the grant provides funding for both professors to offer meaningful research experiences to students from lower socioeconomic and minority backgrounds, with the goal of increasing STEM degrees among diverse students. *—Dan Pompili*

Visit Kent State's Department of Biological Sciences at www.kent.edu/biology, and Department of Physics at www.kent.edu/physics.

ELIZABETH MANN, PHD

EDGAR KOOIJMAN, PHD

Global Understanding and Research (GURI) **INITIATIVE**

Growing GLOBAL CITIZENS

Kent State's summer Foreign Language Academy immerses high school students in language learning—and prepares them for living and working in our global world.

By Dan Pompili

While the daily news is filled with tense conversations about Russia and China, Kent State is helping some area high school students learn to converse in Russian and Chinese—in hopes of facilitating greater global understanding and a less contentious tomorrow.

Kent State's Department of Modern and Classical Language Studies (MCLS) received federal funding for the 12th consecutive year to host the fully immersive STARTALK Foreign Language Academy on the Kent Campus this summer. Twenty high school students from Northeast Ohio, who applied and were accepted into the free program, were immersed in learning either the Russian or Chinese language and culture (ten students in each course).

The $90,000 grant comes from the US National Security Administration (NSA) and is administered by the National Foreign Language Center (NFLC) at the University of Maryland. Kent State has received more than $2 million in STARTALK funds since 2007 and is considered a model institution. (The academy is in its 13th year, but the first year was supported entirely by an Ohio Board of Regents grant.)

Brian Baer, PhD, program director and professor of Russian translation in MCLS in Kent State's College of Arts and Sciences, says the four-week residential curriculum prepares students to enter college as language majors. "Students not only learn the language; they learn a lot about the culture. We bring native speakers into the classroom, and the students Skype with people in the countries."

> **"Teaching students other languages is a great way to develop world citizens."**
>
> — **BRIAN BAER, PHD**
> *program director and professor of Russian translation*

The students, who have no prior knowledge of Russian or Chinese, are immersed in the language and culture and provided with laptops and all the necessary software for the program. They live and study together in the Kent State Honors College, receive high school credit and can receive up to four college credits. They then participate in a mandatory full academic year follow-up process, which includes distance learning and monthly Saturday sessions. Baer says students who complete the program usually are placed into intermediate college courses.

"We also introduce them to career paths that use foreign languages," he says. "This field is on par with nursing as one of the fastest growing sectors of the US economy. Our program focuses on professional skills and careers, and that's one of the reasons we were chosen as an infrastructure program."

Last year's STARTALK grant provided Kent State with infrastructure building funds to develop videos and lesson plans that will be made available for other programs through the STARTALK website. Betsy Hart, interim executive director of the NFLC and STARTALK program director, says that while Kent State's model and materials aren't mandatory for other institutions, they would be wise to consider implementing a similar model and adapting the Kent State materials to their programs.

Students in the Chinese course play a Chinese board game.

"I've had the privilege of visiting the Kent State program several years ago, and there are several factors that contribute to Kent State's success," she says. "We're pretty prescriptive about the way we plan and the instructional strategies that need to be included. Brian and his team take it very seriously and are diligent about incorporating those strategies into their classrooms, so it's been an exemplary program."

Students in the Russian course learn a Russian dance.

Baer says the STARTALK program began in the wake of 9/11, when the US Intelligence Community received mounds of untranslated intelligence reports and didn't have enough language experts to translate them. STARTALK provides programming to teach 11 languages, many of them related to the Middle East. But Baer and Hart both see the importance of teaching Russian and Mandarin Chinese in Kent State's program.

"We can be short-sighted sometimes," Baer says. "When Communism fell, they took Russian off that list, but I think both countries will remain strategically important for a long time."

"We have political concerns and trading concerns," Hart adds. "There will be a demand for speakers of these languages in any career they may want to pursue."

Students who get early starts in learning a second language will have an advantage should they pursue government careers, Hart says, noting reports of the high costs for the government to train one individual in a language. "The intelligence community would love for new hires to be able to walk in the door and go to work."

Beyond that, however, Baer says teaching students other languages is a great way to develop world citizens—the primary objective of Kent State's Global Understanding Research Initiative, which includes Baer and other faculty members from MCLS.

"There's a great quote from Nelson Mandela," Baer says. "'If you talk to a man in a language he understands, that goes to his head. If you talk to him in his language, that goes to his heart.'"

Visit Kent State's Foreign Language Academy at www.kent.edu/mcls/fla.
Visit the Global Understanding Research Initiative (GURI) at www.kent.edu/guri.

Strengthening SELF CONTROL

Middle school can be a tumultuous time in any child's life, but some children face greater difficulties that can put them far behind their classmates and lead to problems in their adult lives.

A collaborative project between researchers at Kent State University and the University of Florida may help students overcome some of the most pernicious problems and set them on a path to success.

The US Department of Education's Institute of Education Sciences (IES) recently awarded a four-year, $3.3 million dollar grant to Stephen Smith, PhD, professor of special education in the College of Education at the University of Florida, and Brian Barber, PhD, assistant professor of special education in the School of Lifespan Development and Educational Sciences at Kent State University.

BRIAN BARBER, PHD

The project, "Efficacy of I Control: An intensive intervention to improve self-regulation for middle school students with emotional and behavioral problems," focuses on students who exhibit chronic and severe behavioral problems, and thus require intensive services to support their emotional and behavioral functioning.

"With this particular subset of students, it is common to see deficits in self-regulation interact with unsupportive home and/or school environments," Barber says. "This can ultimately lead to school failure and drop-out, legal trouble and difficulty creating or maintaining social relationships into adulthood.

"Self-regulation is recognized as a critical skill for successful functioning in many domains, including academic and social ones. Research continues to support the theory that self regulation is malleable, and students can learn to improve it."

Studies of brain development patterns show that children appear most receptive to social-emotional intervention within distinct "sensitive periods," during early childhood and again in early- to mid-adolescence, Barber says. During early adolescence, areas of the brain undergo what is known as "synaptic pruning" to eliminate weak or inefficient connections. This massive biological change coincides with new social demands for students to act with more autonomy as they move from elementary school to middle school.

> ***"Research continues to support the theory that self regulation is malleable, and students can learn to improve it."***

"During this time, when biological and social imperatives upend many students' lives," Barber says, "there's an opportunity to help struggling students strengthen some social and behavioral habits through explicit instruction and practice using self-regulation skills."

Students are selected for participation by teachers and administrators, and classroom teachers or support personnel who understand the students' special needs deliver three or four lessons a week, followed by discussion and out-of-seat activities, such as role plays. Lessons are supplemented with a computerized gaming component that involves self-monitoring and student-teacher conferences to reinforce learned skills.

Barber developed the program as a PhD student at the University of Florida, along with Smith, and they've continued to refine and test it since Barber joined Kent State in 2014. "We developed this together and tested it under an IES Goal 2 grant," he says, "and this new Goal 3 allows us to test it on a wide scale, via a randomized controlled trial."

Beginning with the 2018-2019 school year, the I Control intervention will be implemented with groups of students across 92 middle schools in Northeast Ohio and North Central Florida over the next four years.
—Dan Pompili

Visit Kent State's Global Understanding Research Initiative at www.kent.edu/guri.

DAVID LABELLE

Tribute to REFUGEES

A group of artists, educators and volunteers worked together to produce "We the People," an outdoor art exhibit at Kent State University that paid tribute to refugees from around the world who have made Northeast Ohio their home.

The exhibit spanned the Lefton Esplanade throughout the spring, showcasing large photographic portraits of individuals who fled their home countries and now live in or near the Kent area.

Françoise Massardier-Kenney, PhD, professor of French translation in the Department of Modern and Classical Language Studies in Kent State's College of the Arts—and codirector of the Global Understanding Research Initiative with Paul Haridakis, PhD, professor of communication studies in the School of Communication Studies—organized the project in collaboration with photographer Erin LaBelle of Ohio University, a former photography professor at Kent State. Several Akron-based refugee programs and some Kent State students also aided in the effort.

The 25 refugees featured in the photo display fled to the United States to avoid war, oppression or the threat of grave danger in their home countries. Massardier-Kenney says that with the "unprecedented numbers" of refugees moving to other countries, it is important to remember that the United States is a country built on immigrants.

> ***It is important to remember that the United States is a country built on immigrants.***

The exhibit is part of a larger collaborative project that seeks to document and address the lack of adequate resources for refugee/immigrant youth to develop and maintain a strong identity.

GURI's research aims to identify the most significant challenges and threats to immigrant youths' identities, take inventory of the resources available to them for developing and maintaining a viable identity in their host culture, and then use these findings to devise—in collaboration with agencies that serve refugee and immigrant youth and their families—evidence-based best practices for helping them.

Because of its high impact, "We the People" will be on display again at the same location in September.

Global Understanding and Research (GURI) INITIATIVE

Causes of the CAMBODIAN GENOCIDE

A publication by Kent State geographers sheds more light on the causes of the Cambodian genocide that wiped out roughly a quarter of the country's population in the late 1970s.

Stian Rice, MA '12, PhD '18, was a research assistant for James Tyner, PhD, professor of geography in Kent State's College of Arts and Sciences, when they coauthored the article, "The rice cities of the Khmer Rouge: an urban political ecology of rural mass violence."

> ***"What we're presenting here is a radical reinterpretation of how to understand the Cambodian genocide."***

It was published in the December 2017 issue of *Transactions of the Institute of British Geographers*, one of the foremost international journals of geographical research.

The article counters a common belief among scholars that the Khmer Rouge were anti-urban and anti-technology. "One of the points we wanted to make in this study is that re-ruralization and re-urbanization were inextricably linked to each other," says Rice, who is now a visiting assistant research scientist at the University of Maryland's Center for Urban Environmental Research and Education.

Although the Khmer Rouge evacuated most Cambodian cities immediately after they seized power, they also sought to increase revenues to industrialize the country, which they accomplished by increasing rice production.

Instead of relying on the rain-fed rice production in a tropical climate, they realized that the amount of arable land could be increased by building irrigation systems with forced labor—another of the major contributing factors in the genocide.

They soon selectively re-populated cities to ensure a chain of distribution for rice exports. Stian Rice says the urban centers not only served as export distribution junctions, but also provided the imported resources necessary to maintain the infrastructure.

This economic system also highlights another aspect of the Khmer Rouge's cruel and murderous reign. "A lot of the death came through starvation," Tyner says. "Not because the country was not producing enough rice, but because it was being mass exported to China. What we're presenting here is a radical reinterpretation of how to understand the Cambodian genocide."

The study adds to a growing body of work by Tyner, Rice and other Kent State geographers that suggests capitalist-based economics were responsible for a significant portion of the deaths that occurred under Khmer Rouge rule.
—Dan Pompili

STIAN RICE, MA '12, PHD '18

JAMES TYNER, PHD

Taking on TOXIC METALS

Though she had an interest in science at an early age, Raissa Mendonca had no idea she would end up more than 4,000 miles away from her hometown of Recife, Brazil, studying and conducting award-winning ecological research at Kent State University.

Accepted into Science Without Borders, an exchange program sponsored by the Brazilian government, in 2012 she spent her junior year away from the and attended the University of Michigan. There, she worked with Dave Costello, PhD, who at the time was a postdoctoral researcher at Allen Burton's Ecotoxicology Lab. Now he is an assistant professor in biological sciences at Kent State's College of Arts and Sciences—and her current advisor.

While pursuing a PhD at Kent State, Mendonca conducts research in Costello's lab that focuses on ecotoxicology and biogeochemistry and how environmental disturbances affect aquatic communities and ecological processes.

One of her recent projects resulted in her being the first author on a peer-reviewed journal article, "Metal oxides in surface sediment control nickel bioavailability to benthic macroinvertebrates," in *Environmental Science & Technology.*

Her research also earned her the Chris Lee Award for Metals Research, presented jointly by the Society of Environmental Toxicology and Chemistry and the International Copper Association.

The $5,000 award money is helping her fund the experiments for the last two data chapters of her dissertation, looking at the toxic effects of nickel to benthic bacteria (microbes that live attached to sediment) involved in the process of forming and dissolving metal oxides.

> ***"If we understand when these metals are harmful, we can better target when we need to clean up systems and when we can let them recover on their own."***

"If nickel is stuck onto the surface of these metal oxides it is not available for biological uptake," Mendonca says, "and, therefore, does not exert its toxic effects on organisms that live in or on the sediment."

"We found that at a macroscale, rivers and streams have capacity to 'soak up' some of the contaminants," says Costello. "If we understand when these metals are harmful, we can better target when we need to clean up systems and when we can let them recover on their own.

"Raissa did complicated field work in a remote part of Manitoba, Canada," he adds. "She had to understand geology, chemistry and biology to understand the process. That is the way the field is going—integrated projects that are not just in a lab or beaker."

Mendonca plans to graduate in spring 2020 and pursue a postdoctoral fellow position, within the field of geomicrobiology, where she can continue to explore her research interests.

—Jim Maxwell

JIM MAXWELL, BS '00, MS '11

Raissa Mendonca's research focuses on how environmental disturbances affect aquatic communities and ecological processes.

Student RESEARCH

Finding New Methods TO LOSE WEIGHT

As America's obesity problem continues, researchers strive to find new and more effective ways of losing weight.

At Kent State University, students investigate possible solutions to the epidemic under Colleen Novak, PhD, associate professor of biological sciences in Kent State's College of Arts and Science, to better understand the mechanisms to support weight loss.

"We want to find a method that allows the body to burn fat more efficiently, since a lot of people work out and don't see the results," says Jacob Wagner, a senior studying biology and pre-medicine at Kent State. As a research assistant under Novak, he is investigating the relationship between the endocannabinoid receptors and muscle thermogenesis to potentially find a new method to lose weight.

The endocannabinoid system regulates various bodily functions, from appetite to sleep to memory. The name comes from both "endogenous," which refers to anything produced within an organism, and "cannabis," as the system was discovered through its interactions with marijuana. Muscle thermogenesis is how the body processes calories by burning them to produce heat.

> ***"We want to find a method that allows the body to burn fat more efficiently, since a lot of people work out and don't see the results."***

In Wagner's study, he worked from Novak's own research to determine if there was a relationship between the two systems. Her study on muscle thermogenesis in mice found that the scent of a predator—in this case, ferret urine/feces—engaged skeletal muscle thermogenesis. Wagner used this as a control to discover whether removing endocannabinoid receptors impacted the process.

JACOB WAGNER

"We were expecting to see an increase in thermogenesis," says Wagner, "but we ended up seeing the opposite." Fewer endocannabinoid receptors suppressed muscle thermogenesis, meaning that while there does appear to be a relationship between the two systems, it was not the expected one.

Wagner plans to explore the relationship further. "We're coming at the next study with a different approach, to see if [the endocannabinoid system] directly inhibits or expresses muscle thermogenesis."

—Dan Pompili

Pursuing a Potential NEW SPECIES

Imagine being a 17-year-old high school student, and in your first semester of a geology research internship, your professor asks you to identify a tiny specimen of an extinct 300-million-year-old unknown crustacean.

While most high school students might feel intimidated, Megan Schinker—then an ambitious Stow-Munroe Falls High School junior participating in Kent State's College Credit Plus Science Experience Internship Program—jumped right in.

She began comparing the cyclid specimen to anything she could find in literature and online sources in the lab of Rodney Feldmann, PhD, a Kent State professor emeritus of geology, who continues to teach graduate-level courses in paleontology and conduct grant-funded research. The two requested samples and pictures of lost samples from all over the world and examined them closely, cataloging their physical and structural attributes.

"I don't think this quite matches anything," Schinker told Feldmann. He agreed, and they began to explore the morphology of these cyclids. Their research collaboration has led to several scientific publications and presentations on cyclids—and ignited Schinker's passion for geology. Starting in fall 2019, she is majoring in geology and chemistry at Kent State and continuing her work in Feldmann's lab.

> ***"This is pioneering work and could yield a whole new class of organisms."***

Their most recent journal article, co-authored with Carrie Schweitzer, PhD, professor of geology at Kent State, solidifies the fact that the cyclid, first reported around 200 years ago, is actually a unique species. Cyclids are extinct marine crustaceans that lived from the Carboniferous Period, about 350 million years ago, through the Cretaceous, about 65 million years ago. Their fossil remains are rare and have not been well studied—although they've been considered as belonging to many different groups of arthropods, including crabs.

"They don't fit into any other groups, so this is pioneering work and could yield a whole new class of organisms," says Feldmann, who has conducted field and museum research concentrating on fossil crabs, lobsters and shrimp at sites all over the world. "Naming this species and getting more information about different types of cyclids is important."

MEGAN SCHINKER

In November 2018, Schinker, Feldmann and Schweitzer presented their findings to colleagues at the Geological Society of America Annual Meeting in Indianapolis, Indiana. *—Jim Maxwell*

Cutting Edge ARCHAEOLOGY

BOB CHRISTY, BS '95

Doctoral student Michelle Bebber questions why ancient peoples added temper material to their clay pots.

The Eren Lab at Kent State University's Department of Anthropology is among the university's busiest and most prolific. Unlike the inanimate objects he studies, Metin Eren, PhD, assistant professor of anthropology and director of archaeology in the College of Arts and Sciences, seems to be in a state of perpetual motion—and his students are no different. Here are two of his students' recent accomplishments:

Anthropology graduate student breaks the mold with novel thesis project

While a graduate student in Metin Eren's Experimental Archaeology Lab at Kent State, Ashley Rutkoski conducted an experiment to answer some of archaeology's oldest questions.

"After stone, ceramic sherds are one of the most abundant things we find in the archaeological record," Eren says. Sherds are fragments of clay pots that ancient—and even more modern—civilizations used to collect, carry and store food and other valuable resources.

"We want to see whether or not we can tell the difference between pots that are filled with corn when they break, versus empty ones," Eren says. "If we can tell the difference between the shape of the sherds in those two conditions, we'll expand this research and try other conditions."

"It's going beyond typology and trying to gain more information about human behavior, like how pots were discarded and end up in the archaeological record in the first place," says Rutkoski. "Pots were used, but how they were ultimately discarded is just as important."

To conduct the experiment, she took the process all the way back to its roots, using raw clay that required months of processing before she could even begin crafting 30 identical pots.

"She then broke every single one over the course of two days," Eren says. Half the pots were filled with whole kernel corn, while the other half were empty. "There's never been an experiment where they break the pots like this, and they actually do the morphometrics of the sherds."

Rutkoski has already gained some insight from early results of her tests. "With full vessels, in comparison to empty vessels, there's more breakage in the base of the vessel that radiates up to the rim."

The Eren Lab's approach is to make replicas of ancient tools and pottery, then break them to study their strength and structural features.

Doctoral student publishes solo article on pottery in top archaeology journal

Research always begins with a question. In Metin Eren's archaeology lab at Kent State University, that question seems to be "Why did they make it that way?" and the answers often seem to defy conventional wisdom. The findings of a study published recently in archaeology's top journal by a doctoral student in the lab are no different.

Doctoral student Michelle Bebber, an art and anthropology graduate from The University of Akron, has made ancient pottery a part of the lab's focus. The Eren Lab's approach is to make replicas of ancient tools and pottery, then break them to study their strength and structural features.

Bebber's solo article in the *Journal of Archaeological Science* presents an argument that pottery was not made the way it was made for the reasons long believed by scholars.

"You want a quality product," she says. "People in the past, just like people today, had to make decisions about what to include in the recipe for creating pottery." Ancient peoples would make pottery primarily of clay they dug from the ground, then add crushed stones or pieces of shell called temper.

Archaeologists have long believed this temper was added to strengthen the pottery. In Bebber's study, she made some pots with the original recipe that included various forms of temper material and made other pots with only clay.

"It turns out that pure clay is almost twice the strength of some of the comparison samples," she says. "So there must be some other factor that was driving [ancient peoples] to add temper."

Bebber says it's likely that the Early Woodland people, who lived well before the pottery wheel, added the temper to help stabilize the raw clay when building by hand. "They were trading end-product strength for workability in that earlier step."

Eren says Bebber's single-author publication in a top journal, while no surprise to him, is still an uncommon occurrence for a graduate student. "It's a huge achievement."

Bebber says a follow-up study is already underway.—*Dan Pompili*

DAN POMPILI

Ashley Rutkoski, MA '19, designed a novel experiment to explore how ancient pots were discarded.

Boosting ANTIBODY *Production*

Four Kent State University students have been chosen to compete in the German pharmaceutical company Merck KGaA's International Protein Production Cell Line Challenge.

The student team, composed of biotechnology students Mitchell Lesko, Eric Veverka, Allison Davis and Joram Rana, is one of twelve teams selected from around the world. To compete, the team will seek to find what methods encourage antibody expression in a Chinese Hamster Ovarian (CHO) cell.

The teams were provided with the antibody expression construct and CHO cells and given one year to generate and submit a high expression CHO cell line. The team's cell line that produces the most antibodies will be awarded a EUR 20,000 gold prize.

"This challenge provides KSU students with the opportunity to use the skills and knowledge acquired during their undergraduate studies, and to see where their knowledge placed them on the world stage," says one of their mentors, Elda Hegmann, PhD, assistant professor of biological sciences in the College of Arts and Sciences.

Antibody production is one of the immune system's most important functions in fighting off pathogens. When the process is damaged, a host of illnesses can develop. Finding new methods to boost the body's ability to produce antibodies is crucial to understanding what causes this breakdown and helping those suffering from immunodeficiency disorders.

The students work with a three-stage process, under the guidance of Jennifer McDonough, PhD, associate professor of biological sciences. In the first stage, they must identify and sequence an unspecified antibody expression DNA sequence.

During stage two, the team will insert the sequenced DNA antibody expression into a CHO cell. Once this is done, the last and most important stage begins: researching how to optimize the cells to produce a high yield of the antibody. —*Dan Pompili*

The "Fog" of LUPUS

Student RESEARCH

As a student on Kent State University's Salem Campus, Haley Shasteen gained a strong interest in conducting research and took first place honors at the Kent State University Summer Undergraduate Research Experience (SURE) competition in 2018. Her research project, "Cognitive Impairments of those with Systemic Lupus Erythematosus," spanned 10 weeks over the 2018 summer.

Lupus is an autoimmune disease in which a person's immune system attacks the body's systems rather than any foreign "invaders" that attack the body.

"I want to find out what brain fog really is."

— HALEY SHASTEEN

"I have lupus, as does my mother, so I am interested in this subject from a personal standpoint," says Shasteen, who was diagnosed at age 13 and is now in a remissive stage. "There seems to be a lot of research related to lupus, but there are a lot of missing pieces and not a lot of replication related to cognitive impairment, or 'brain fog' as some call it."

Shasteen says having lupus gives her an edge with her research. "I know what it feels like to have brain fog," she says. "The more reading I do about this, the more interesting it all becomes to me."

Through her research, she uncovered other researchers' findings that suggest brain fog and cognitive impairment are unrelated. "I want to find out what brain fog really is."

For her research during the SURE program, Shasteen had one dedicated participant (diagnosed with lupus) who was tested every day for 10 weeks (or 70 times), using computerized "brain training" programs. During that time period, she also tracked the participant's physical symptoms and subjective cognitive symptoms, along with variables of weather, diet, stress, anxiety and mood.

Shasteen says she was somewhat surprised by the findings at the end of the 10 weeks. The two main findings included: 1) That cognitive performance is not related to the subjective feeling of being cognitively impaired; and 2) that the subjective feeling of being cognitively impaired was strongly related to stress, anxiety, the number of psychological symptoms, negative mood and the amount of sugar consumed.

While the research submitted for the SURE competition focused on one participant, Shasteen also conducted the same cognitive testing on two other participants for varying periods of time. Findings from all three participants will be included in the article she is currently writing.

She also presented her research findings at the Midwestern Psychological Association conference in Chicago this spring and is working to have her research published.

Shasteen was recognized at the May meeting of the Kent State Board of Trustees for being one of two Kent State students awarded the prestigious 2019 Goldwater Scholarship from the Barry Goldwater Scholarship and Excellence in Education Foundation (see page 5).

After transferring to the Kent Campus last fall, Shasteen is now pursuing a dual degree in molecular and cellular biology and psychology. She intends to eventually earn a doctoral degree in cognitive neuropsychology and will continue conducting research related to cognitive impairment in patients with autoimmune diseases, with an emphasis on systemic lupus erythematosus.

—*Dan Pompili*

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