



2019

Annual Report



IDEA
EPSCOR
NEBRASKA

Established Program to Stimulate Competitive Research

COVER IMAGE: The Center for Root & Rhizobiome Innovation conducts field tests at the Eastern Nebraska Research and Extension (ENREC) facilities, which include a first-of-its-kind system in the United States: using Spidercam for unique plant phenotyping via an automated, cable-suspended carrier system that holds multiple cameras and sensors for positioning over plots. THIS PAGE: Corn plants, studied by CRRl, move through the LemnaTec High-Throughput Plant Phenotyping system at Nebraska Innovation Campus' Greenhouse Innovation Center: a 45,000-square-foot facility with state-of-the-art computer environmental controls, heated and cooled with sustainable energy. To learn more about how CRRl innovatively uses robotics in its NSF-funded agricultural research, read the cover story on pages 8–9.

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*Established Program to Stimulate Competitive Research
Institutional Development Award Program*

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MESSAGE FROM THE NE EPSCoR DIRECTOR

AS I WRITE THIS, I am nearing the completion of my first six months on the job as Director of the Established Program to Stimulate Competitive Research (EPSCoR) for the State of Nebraska. I want to take this opportunity to thank our previous Nebraska EPSCoR Director, Dr. **Fred Choobineh**, for his leadership and years of service, resulting in the excellent program that we have today.

My wife, Kate, and I arrived in Lincoln in late June from Oregon State University, where I was the Executive Associate Dean for the College of Science. On July 1, I started working in the EPSCoR office and also began my position as Professor in the School of Natural Resources at the University of Nebraska-Lincoln. I am grateful for the opportunity to serve my new state as a scientist and administrator—with the goal of enhancing Nebraska’s research enterprise and preparing our students for STEM careers. In late July, I had a wonderful opportunity to learn more about Nebraska on a trip hosted by the Institute of Agriculture and Natural Resources: traveling from Lincoln to Scottsbluff, with many interesting stops along the way.

Over the course of these first six months, the Nebraska EPSCoR office hosted the National Science Foundation’s first site visit of our NSF-funded Center for Root and Rhizobiome

Innovation, September 9-11; we evaluated pre-proposals for Nebraska’s next NSF EPSCoR \$20 million Research Infrastructure Improvement Track-1 project; we selected finalists to compete for the 2020 FIRST Awards, designed to help Nebraska’s junior research faculty prepare for NSF CAREER Award submissions; and we planned the 2020 Young Nebraska Scientists camps that introduce middle school and high school students to research and careers in STEM disciplines. Overall, my first six months have been a great introduction to Nebraska and the tremendous STEM opportunities that exist here. From middle school and high school, through higher education and private industry, Nebraska’s research enterprise continues to grow, and it’s clear to me that the future is bright. ◇



Matthew T. Andrews

► Learn more about Matt Andrews at <http://bit.ly/NEnewdir>.

STATE COMMITTEE

COMMITTEE CHAIR SPEAKS TO YOUTH ON STEM

“SCIENCE: IT’S LIKE MAGIC, but it’s real.” By the time that quote appeared on a slide, near the end of a talk about viruses to Lincoln’s Pound Middle School students, scientist guest **Jon Anderson** had the students engaged with his information.

Anderson is an Innovation and Technology Manager with LI-COR Biosciences, and chairs Nebraska EPSCoR’s State Committee. He also gives talks at local schools, to help get students excited about science, technology, engineering and math—the STEM subjects, which are crucial to the state’s workforce growth.

Halfway through his talk at Pound, Anderson got the students involved in a hands-on virus replication activity, with LEGOS® representing cell materials. One team followed the instructions to build a model structure, but the other team had a communication challenge: instructions read aloud but without visual contact with the individual doing the building. This example showed how mutations might occur as a virus progresses.

Anderson repeated his talk several times that day for Pound’s other science classes to attend. Each time, the session closed with multiple questions from the young scientists, including more than a few who caught interest in future scientific careers. ◇



LI-COR’s **JON ANDERSON**, who chairs Nebraska EPSCoR’s State Committee, discusses properties of viruses with students during a STEM talk at Pound Middle School.



APPOINTED

Professor **Jerry Hudgins** chairs the University of Nebraska-Lincoln’s Department of Electrical and Computer Engineering, with locations in Lincoln and Omaha. Currently, he is also Interim Director of the Nebraska Center for Energy Sciences Research.

HONORS

Phil Kozera, former executive director of Bio Nebraska, was named CEO of MatMaCorp: a device and systems company for science, agriculture and medicine.

Two recent members of Nebraska EPSCoR’s State Committee were named fellows of the National Academy of Inventors:

- **Robert “Bob” Wilhelm**, UNL vice chancellor for research and economic development and the Kate Foster Professor of Mechanical and Materials Engineering, was selected for his expertise as an engineer, inventor and administrator.
- **Lyle Middendorf**, senior vice president of advanced research and development, and chief technology officer at LI-COR Biosciences, was honored for his collaborations with Nebraska faculty on innovations in DNA sequencing and fluorescent-labeled DNA, resulting in eight university patents. LI-COR, based in Lincoln, is a global manufacturer of scientific instrumentation.



DEPARTING

After eight years of service each, **Nick Stergiou** (middle left) of the University of Nebraska at Omaha and **Iqbal Ahmad** (middle right) of the University of Nebraska Medical Center reached their term limits on the Nebraska EPSCoR State Committee. Nebraska EPSCoR thanks them for sharing their energy and expertise on behalf of the state.



TRACK-1 CRRRI HOSTS NSF SITE VISIT



CONGRATULATIONS

In 2019, two CRRRI scientists were named Fellows of the American Association for the Advancement of Science (AAAS):

- **Edgar Cahoon**, project co-PI with University of Nebraska-Lincoln (UNL) Biochemistry
- **Tom Clemente**, past CRRRI scientist with UNL Agronomy and Horticulture

YEAR 4 OF NEBRASKA'S five-year, \$20 million Center for Root and Rhizobiome Innovation (CRRRI) grant included a site visit from representatives of the project's funder, the National Science Foundation. CRRRI Aim leaders gave talks about progress in the research, and students presented posters on their work for the project. One half-day was devoted to tours of labs (including UNL's Beadle Center) and field sites at UNL's East Campus and Havelock Farm.

CRRRI's external evaluator collected post-visit reactions from host participants, and one CRRRI faculty member commented, "We had done so much work in the past two years [that culminated in the tour] where we could show the NSF panelists our accomplishments. During the tour, we showed the field layout, the experimental design, and demos of how we conducted the root digging procedure to collect the data over two to three acres."

Newly-arrived NE EPSCoR Director **Matt Andrews** valued the visit's in-depth opportunities, which aided his own learning about the project, and agreed with positive factors cited by CRRRI researchers, including: the ability to present results from their innovative approaches, gather feedback from colleagues in other areas of the project who saw alignment with their own work, gain exposure to new experts in related areas providing new perspective, and observe leadership among CRRRI peers who helped organize and conduct the tour aspects. ◇



UNK Biology Professor and CRRRI researcher **PAUL TWIGG** speaks at the 2019 NSF Site Visit.

REMEMBERING JIM ALFANO

JAMES "JIM" ROBERT ALFANO, 56, passed away November 21, 2019 after a long, private, and courageous fight with cancer.

Jim was a Bessey Distinguished Professor in the Center for Plant Science Innovation and the Department of Plant Pathology at the University of Nebraska-Lincoln (UNL), served as the Director of UNL's Undergraduate Microbiology Program, and was co-PI of the NSF EPSCoR-funded Center for Root and Rhizobiome Innovation (CRRRI).

He grew up in southern California and earned a Ph.D. in Microbiology at Washington State University, with postdoctoral training at Cornell University. After being an assistant professor at the University of Nevada, Las Vegas, he joined the UNL faculty and became a proud Husker.

For his many contributions to science and research, especially in his focus area of plant-microbe interactions, Jim was named a fellow in both the American Association of Advancement of Science, and American Academy of Microbiology in 2015.

He is survived by his wife, **Karin van Dijk** (also a UNL scientist with CRRRI), and daughter, Isabella Alfano.

A Celebration of Life was held December 15, 2019 at UNL's George W. Beadle Center. Donations can be made "In honor of James R. Alfano" to the Center for Plant Science Innovation Fund (Acct # 01131020) University of Nebraska Foundation, 1010 Lincoln Mall, Lincoln, NE 68508 or online at: <https://nufoundation.org/fund/01131020/>. Memories of Jim can be sent to jalfano1963@gmail.com and condolences at www.aspenaftercare.com. ◇



JIM ALFANO in his natural environments: inspiring students during research in the field, and interacting with colleagues (including CRRRI's Edgar Cahoon) for high-profile research.

CRR I'S OBATA GAINS 2019 NSF CAREER AWARD

A 2019 ADDITION TO CRR I, Nebraska biochemist **Toshihiro Obata** earned a National Science Foundation (NSF) CAREER Award to investigate a key component of metabolic regulation that will improve scientific understanding of metabolism and the many ways it can go awry.

With his five-year, nearly \$750,000 project, Obata will study multi-enzyme complexes in yeast responsible for the Krebs (also known as TCA) cycle involved in cellular respiration. His research team will manipulate enzymic interactions within multi-enzyme complexes to study the effects on metabolic activity, and how changes in metabolic activity affect the complexes' structures and interactions.

"Metabolism is very closely related to the performance of organisms," Obata said—and added that very little knowledge exists about regulating metabolism. "Maybe our research can elucidate a new regulatory step where the interactions of proteins play an important role." ◇



Gregory Pec is a new assistant professor with the University of Nebraska at Kearney (UNK) Department of Biology. After earning his Ph.D. at the University of Alberta, Pec was a postdoctoral associate at the University of New Hampshire. He also has a M.S. from California State Polytechnic University, an M.C.L.F.S. (Master of Chemical & Life Sciences) from the University of Maryland and a B.S. from Ramapo College of New Jersey. Joining the NSF-funded Center for Root and Rhizobiome Innovation, he applies his professional interests including community ecology, disturbance ecology, soil biology and biogeochemistry, and bioinformatics and molecular biology. ◇



Misty Wehling, an instructor who leads the Biotechnology program at Southeast Community College (SCC) in Lincoln, earned her master's degree at UNL while working with CRR I co-PI **Jim Alfano**. When CRR I offered funding for Small College Research Opportunities, Wehling applied and was selected. In summer 2019, Wehling again worked in Alfano's lab, while conducting research in the field, related to CRR I studies. Wehling also leads SCC's biotech offerings for Lincoln Public Schools' (LPS) Career Academy, where high schoolers spend part of their school days at SCC in hands-on learning toward future jobs: augmenting workforce development opportunities in Nebraska. ◇



(Agricultural Research) **RISE OF THE [^]ROBOTS**

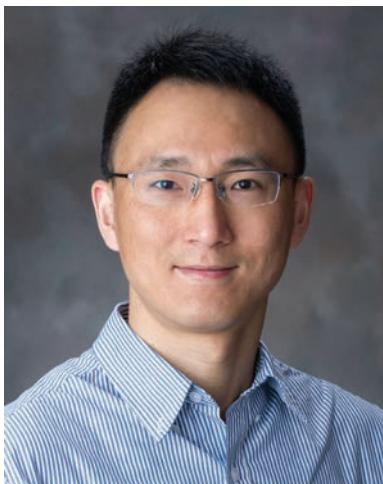
MULTI-TASKING TEAM MEMBERS INNOVATE NEBRASKA EPSCOR'S NSF-FUNDED CRRRI PROJECT

YUFENG GE, UNIVERSITY OF Nebraska-Lincoln associate professor of Biological Systems Engineering, said one research theme with Nebraska's Center for Root & Rhizobiome Innovation (CRRRI) is the interaction of how soil microbes affect plant physiology and metabolism, reflected in a plant's set of above-ground physical traits, or "phenotype."

Nebraska scientists and engineers have implemented a suite of robotic technologies that dramatically improves the throughput and capacity of plant phenotyping across multiple scales. These technologies include "Leaf-bot" (leaf scale robotics), an automated imaging greenhouse (single-plant scale) at Nebraska Innovation Campus, and a cable-suspended Spidercam system (field scale).

Ge said Leaf-bot, developed by 2019 Nebraska Ph.D. graduate **Abbas Atefi**, was funded by CRRRI and the US Department of Agriculture's National Institute of Food and Agriculture (USDA NIFA), and the field-based Spidercam system at ENREC (Eastern Nebraska Research and Extension Center in Ithaca, Nebraska) was supported by University of Nebraska, CRRRI, and NSF's BIO directorate.

As co-leader of CRRRI's Aim 4, focusing on plant phenotypic rhizobiome abiotic stress responses to variations in root exudates, Ge said robotic technologies enable the measurements of crop phenotypes with much higher speed, accuracy, and repeatability. CRRRI researchers use these trait measurements to understand and characterize plants' genetic control: basic research providing avenues for further, targeted crop improvement. ◇





CRRRI plant science research benefits from several scales of robotic data collection: from left, the Lemnatec system at NIC Greenhouse enables automated plant growth imaging; Leaf-bot measures leaf phenotype characteristics; Spidercam crop plots at ENREC earn attention from an NET video crew. (ABOVE) photo by Emily Haney, *Lincoln Journal Star*

From left to right are **CRAIG ALLEN**, **SIMANTI BANERJEE**, **DIRAC TWIDWELL** and **DANIEL UDEN**.

TRACK-2 **AG RESILIENCE EARNS FUNDING**

NEBRASKA LEADS COLLABORATION WITH MONTANA GENERATING PROACTIVE AGRICULTURAL RESILIENCE TOOLS

UNIVERSITY OF NEBRASKA-LINCOLN (UNL) ecologist **Dirac Twidwell** is the principal investigator for National Science Foundation-funded research titled “Resilience Informatics for the Convergence of Critical Capacities to Address Regional-scale Environmental Change.” The grant is through NSF’s Established Program to Stimulate Competitive Research (EPSCoR), and is a “Track-2 Focused EPSCoR Collaboration (FEC)” from August 2019 through July 2023. The project’s nearly \$4 million in funding will be shared with collaborators at the University of Montana.

As UNL reported, “Increasingly fueled by global environmental change, ecosystem shifts—from grassland to a cedar woodland or from fertile farmland to desert in a Dust Bowl-like scenario, for example—can cause community consequences ranging from reduced food and water security, to heightened wildfire risks, and more.”

Twidwell’s team will develop and implement first-of-their-kind screening tools that enable earlier, more precise detection of subtle changes that foreshadow destabilizing ecological transitions. They’ll also use cutting-edge, big data-based social science methods to identify groups most likely to adopt the tools.

The tools enable the researchers to identify changing landscape patterns that portend ecological disruption in sufficient time for land managers to make adjustments that will stop or mitigate the damage. The team aims for use of the tools to help flip agricultural resilience from a reactive discipline—where a problem is diagnosed, then treated—to a proactive one that curbs a problem before symptoms emerge.

“The approach is meant to mimic the philosophy of medicine, so we can start to nail down, as early as possible, where we see problematic changes



that we know carry a host of severe consequences to ecosystem services (similar to) people’s well-being,” said Twidwell, associate professor of agronomy and horticulture.

He terms the intended beneficial outcome “agricultural resilience.” In 2017, the same Nebraska team earned a \$3 million grant from NSF to launch a resilience-focused graduate training program focused on the Platte River Basin. Earlier this year, Twidwell was part of a multi-institutional team that received a \$10 million grant from the U.S. Department of Agriculture’s Agriculture and Food Research Initiative to foster a 20% increase in rangeland production.

Nebraska has also been forming the Center for Resilience in Agricultural Working Landscapes, or CRAWL, aimed at helping decision-makers use resilience theory to boost agricultural production and meet the increasing global demand for food, feed and fuel.

Twidwell’s Nebraska team includes **Craig Allen**, director of CRAWL and the Nebraska Cooperative Fish and Wildlife Research Unit; **Simanti Banerjee**, associate professor of agricultural economics; and **Daniel Uden**, postdoctoral research associate in agronomy and horticulture.

The project also includes training the next generation of leaders in agricultural resilience, providing support for a diverse group of postdoctoral scholars and graduate students at Nebraska and Montana, as well as creating a resilience-focused faculty position at Nebraska. ◇

DATA-DRIVEN DISCOVERIES

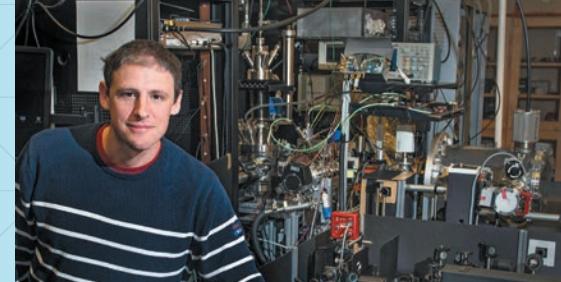
UNO COMPUTER SCIENTIST PART OF NSF-FUNDED, MULTI-STATE COLLABORATION

A four-year, \$6 million research project with scientists from three Midwest states will conduct a Data Driven Material Discovery Center for Bioengineering Innovation. This National Science Foundation EPSCoR “Track-2 FEC” (Focused EPSCoR Collaborations) team includes **Parvathi Chundi**, professor of Computer Science at the University of Nebraska at Omaha (UNO) as a co-principal investigator. Track-2 grants are required to involve investigators from two or more EPSCoR jurisdictions.

According to the project description: “microbes attached to surfaces, commonly known as biofilms, represent multi-million dollar challenges and opportunities in municipal water, marine, manufacturing and oil and gas sectors and a range of other engineering and medical applications. Study of biofilms at the cellular level, and study of materials at the atomic level, generate extremely large amounts of rich data,” where Chundi’s expertise applies.

To mine the data and establish connections between biofilm growth and material properties, this project will form a new collaboration between South Dakota School of Mines and Technology, Montana State University, the University of Nebraska at Omaha and the University of South Dakota to develop Biofilms Data and Information Discovery System (Biofilm-DIDS)--to collect and combine these large data sets using big data analytics tools, and use artificial intelligence to analyze and predict gene responses and biofilm characteristics influenced by surface properties of materials.

The Biofilm-DIDS will be developed, calibrated and validated to serve as a scientific platform for investigating nano-scale properties. This platform will help understanding of how the substrate crystallographic orientations and point defects in coatings affect gene expression, signaling pathways, metabolites, and structure formation controlling stress resistance, extracellular electron transfer, and biocorrosion mechanisms of biofilms. ◇



Ultrafast Forward

IMAGES OF MOLECULAR REACTIONS ARE FOCUS OF CENTURION'S \$2M DOE EPSCoR GRANT

The U.S. Department of Energy awarded a \$2 million grant to Nebraska physicist **Martin Centurion** to probe nuclear and electronic dynamics in ultrafast ring-conversion molecular reactions.

Centurion, Susan J. Rosowski Associate Professor of Physics and Astronomy, heads the University of Nebraska-Lincoln's Ultrafast Dynamics Laboratory. He also is affiliated with the Nebraska Center for Materials and Nanoscience.

His research interests include molecular imaging, ultrafast molecular dynamics, and ultrafast electron diffraction. He holds a doctorate from the California Institute of Technology and completed postdoctoral work at the California Institute of Technology and the Max Planck Institute of Quantum Optics. He has been on the Nebraska faculty since 2009.

His project aims to capture moving images of single molecules in chemical transformations triggered by light. He will focus on molecules with possibilities for industrial chemistry and for solar energy conversion and storage. The project will use multiple experimental approaches and theory to push the frontier of knowledge in this area and develop predictive models for a large class of reactions.

“We have assembled a team of scientists with complementary expertise who will provide different perspectives on the light-driven structural changes in molecules,” he said. “In combination, this will allow us to capture a much more complete picture than currently possible.”

Scientists from Kansas State University, Louisiana State University and Brown University also will participate in the project. ◇

CAREERS IN THE MAKING: (RIGHT) UNL's **REBECCA ROSTON** pursues research on how plants survive freezing; (BELOW) UNL's **JOE LOUIS** studies sorghum resistance to aphids. Both scientists earned FIRST Awards from Nebraska EPSCoR on their way to earning NSF CAREER Awards.

FIRST AWARDS

SPRING 2019 WAS A PRODUCTIVE SEASON FOR UNIVERSITY OF NEBRASKA-LINCOLN (UNL) EARLY-CAREER RESEARCHERS

UNL ENTOMOLOGIST **JOE LOUIS** earned a five-year, \$1.5 million Faculty Early Career Development Program (“CAREER”) Award from the National Science Foundation (NSF) for his research on ways to help sorghum naturally resist sugarcane aphids, the crop’s most damaging pest in the United States. And UNL’s **Rebecca Roston**, assistant professor with UNL Biochemistry, gained an NSF CAREER Award—for five years and \$850,000—for research to yield new knowledge toward strategies to engineer freezing tolerance in crop plants.

Along their paths to these honors, Louis and Roston prepped for success by pursuing and receiving FIRST Awards (both earned in 2015). Nebraska EPSCoR patterns its FIRST Awards after the NSF CAREER Award format, and provides funding plus expert reviews that help Nebraskans better shape their CAREER proposals.

In Roston’s research, “An enzyme named ‘Sensitive to Freezing 2’ (SFR2) is known to help plants survive freezing by changing the building blocks of chloroplast membranes. Although SFR2’s action is known, the way that SFR2 is activated to respond to freezing conditions and the way that its actions provide an advantage are only hypothesized. This project tests the hypotheses using a unique blend of genetics, biochemistry, and biophysical approaches, to aid in generating cold-tolerant crops and advancing research on

membrane temperature stability in other species and engineering systems. According to UNL’s Office of Research and Economic Development, her project will also support improved training of Nebraskan post-doctoral researchers



and graduate students in plant science, to include public communication and other convergent skillsets—which also benefit the state. Roston also led a group of university students “walking the talk”: hosting the 2019 Fascination of Plants Day at UNL’s East Campus.

Earlier in this decade, Louis saw that sorghum—a global food source with ability to withstand drought and heat—faced a challenge with sugarcane aphid populations proliferating in several Southern states. Aphids, which reproduce rapidly, feed on the plant’s leaves and stalks, depleting the plant’s nutrients. These insects also produce a sticky “honeydew” that causes mold to build up on leaves and clog harvesting equipment.

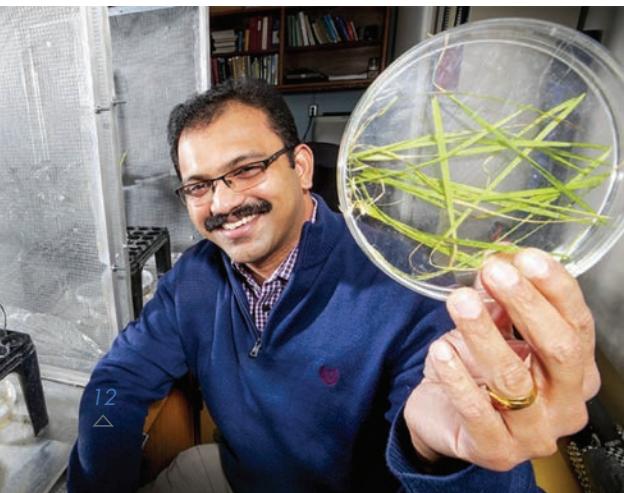
Louis’ CAREER research uses a blend of molecular, biochemical and electrophysiological approaches to better understand the genetic basis of sorghum resistance to aphids, which will help him determine what makes one variety more resistant to pests than another. With this information, breeders and molecular biologists will be able to develop sorghum varieties with these naturally resistant traits.

He believes this research will also provide insights into strategies to help other significant cereal crops, such as corn, wheat, rice and barley, which are also attacked by sap-sucking insects.

His project’s outreach activities aim to help teachers and students gain valuable research skills, as well as develop a deeper understanding of plant biology, genetics and entomology. He plans to bring teachers into the laboratory to gain research experience they can take back to their classrooms. Louis is also developing a 10-week summer residence research program for underserved minority undergraduate students, mainly from the University of Texas Rio Grande Valley. And with a Lincoln middle school he’ll give students hands-on experiences via plant-insect interaction experiments. ◇

“By promoting those innate plant defenses, we’re trying to reduce our dependence on toxic and harmful pesticides so we have a much cleaner and safer environment.”

— Joe Louis



SMALL COLLEGE AWARDS

2019 FIRST AWARD RECIPIENTS

Christos Argyropoulos,
Electrical and Computer
Engineering, UNL

Clay Cressler, School of
Biological Sciences, UNL

Nicole Iverson, Biological
Systems Engineering, UNL

Tiffany Messer, Biological
Systems Engineering, UNL

Brett Schofield, Dept. of
Biology, Doane University

Christine Wittich, Dept.
of Civil Engineering, UNL

NEBRASKA EPSCOR FUNDS 2019 RESEARCH AT STATE'S SMALL COLLEGES/UNIVERSITIES

TO INCREASE UNDERGRADUATE RESEARCH opportunities at Nebraska's smaller colleges and universities, Nebraska EPSCoR awards up to \$5,000 per project for collaborations in science, technology, engineering and math (STEM) areas. Faculty and students involved in the selected proposals report their project results to Nebraska EPSCoR and often present their research in scientific publications and at conferences. Recipients for 2019 were:

PAUL KARR

Wayne State College, Dept. of Physical Science
and Mathematics

*The investigation of bis-ADP systems and other novel
materials applicable as solar energy capture, storage,
and transfer devices*

JOHN KYNDT

Bellevue University, College of Science and Technology

*Devising molecular tools for genetic manipulation of
Galdieria sulphuraria, a microalga optimized for biofuel
production from waste sources.*

PHILIP LAI

University of Nebraska at Kearney, Communication Disorders

*Longitudinal study investigating the development of
communication in children with autism spectrum disorders.*

TYLER MOORE

Bellevue University, College of Science and Technology

ERK as a negative regulator of IRF3 and the antiviral response.

MICHAEL MOXLEY

University of Nebraska at Kearney, Dept. of Chemistry

*Pyruvate Dehydrogenase Complex: Post-translational
regulation and kinetic modeling*

DUSTIN RANGLACK

University of Nebraska at Kearney, Dept of Biology

Ecological differences in areas grazed by cattle versus bison

ALLEN THOMAS

University of Nebraska at Kearney, Dept. of Chemistry

*1,2,3-Triazole analogs of Ribavirin to probe the CNT2
binding site*

KATE TROUT

Peru State College, Department of Natural Science

*The feasibility and development of a technology-enabled
dengue control tool in Guanacaste, Costa Rica*



After a pilot study in March 2019 for preliminary data about factors that contribute to a Costa Rican area's high incidence of dengue and zika, Peru State College's Global Health Research Team developed a larger scale survey to help shape a dengue control tool (funded by Nebraska EPSCoR) for implementation in January 2020. Publications are forthcoming and, during visits to Costa Rica, PSC students also engage in local service activities, such as a free public health clinic, after school program with the non-profit Asociacion CREAR, and science and health demonstrations at a local school.



BRINGING PLANT SCIENCE TO THE PEOPLE

NEBRASKA EPSCOR'S NSF-FUNDED CENTER for Root and Rhizobiome Innovation wowed the crowds at the 2019 Nebraska State Fair and Husker Harvest Days events. Sharing the science from CRRI research were:

- **Paul Twigg** (UNK Biology Professor) and **Katelin Arndt** (UNK Biology Student), with a rhizotron (special planting that allows viewing of live roots) and other materials to convey the important exchange of information between root exudates and soil microbes; and
- **Abbas Atefi** (summer 2019 UNL Ph.D. graduate), who engineered a phenotyping robot to help automate plant measurement for better data collection and tracking.

CRRI representatives met hundreds of Nebraskans at settings including the Raising Nebraska experience (NE State Fair) and the UNL Institute of Agricultural and Natural Resources (IANR) tent at Husker Harvest Days, with enthusiastic science communication on the project's research to help world hunger and benefit our state's leading economic driver: agriculture.

In addition, CRRI graduate students added to the Fascination of Plants Day festivities at UNL East Campus, where more than 130 guests tried CRRI's plant root painting and other activities. These students applied simple strategies to communicate CRRI science: adjusting knowledge of complex soil and plant growth processes to fit their audiences' levels of understanding and interest. ◇

(TOP) At 2019 Husker Harvest Days, **ABBAS ATEFI** (in purple shirt) explains the plant phenotyping robot he built while earning his Ph.D. in the University of Nebraska-Lincoln Biological Engineering program. (RIGHT) For the 2019 Fascination of Plants Day, celebrated around the world, Lincoln had CRRI scientists including Doane University research technician **MICHAEL ISRAEL** (in black shirt) sharing root painting with guests at UNL's East Campus.



NEW YNS CAMPS ADD STEM OPPORTUNITIES

NEW FACES BROUGHT NEW IDEAS TO YOUNG NEBRASKA SCIENTISTS (YNS) CAMPS IN SUMMER 2019

AT NEBRASKA WESLEYAN UNIVERSITY, Biology Professor **Angela McKinney** led an Explorations in Biology Camp for high schoolers, with topics that included beekeeping (including demonstrations at an active NWU hive) and a focus on science careers for underrepresented minority youth. Several inner-city Omaha students enjoyed this camp's scholarship-funded opportunities at NWU's new Acklie Center for Science and NWU residence halls, with welcoming and mentoring from McKinney and colleagues.

At UNL, Nebraska Engineering's **Shudipto Dishari** (an assistant professor with the Department of Chemical and Biomolecular Engineering) initiated a Chemistry and Nanoscience Behind Renewable Energy Technologies Camp for high schoolers. Dishari, who has earned CAREER Awards from both the National Science Foundation and the Department of Energy, and her lab team led youth in hands-on STEM experiences including lab experiments and a visit with Tesla electric vehicles. ◇



(ABOVE AND RIGHT) Students at YNS Bio-Explorations camp learn about beekeeping at Nebraska Wesleyan University; (TOP RIGHT) Students at Renewable Energy Technologies Camp try hands-on STEM activities in UNL's Department of Chemical and Biomolecular Engineering.



UNO BIOMECHANICS GAINS RENEWAL OF NIH COBRE FOR \$10.3 MILLION

IN 2019 THE DEPARTMENT of Biomechanics at the University of Nebraska at Omaha (UNO) received a grant of \$10.3 million—the largest single research grant in university history—surpassing its own prior five-year funding record.

The award is Phase II of the Centers of Biomedical Research Excellence (COBRE) grant mechanism from the National Institutes of Health (NIH). Funds from the grant will enable UNO’s Biomechanics Department to establish three new research cores: the Movement Analysis Core, the Nonlinear Analysis Core, and the Machining and Prototyping Core.

The Movement Analysis Core will provide biomechanical testing and support for research within the center and the community. The Nonlinear Analysis Core will provide analysis of data and education in data interpretation. The Machining and Prototyping Core will provide design, consultation, manufacturing and prototyping services to the center and the community.

Research projects carried out in these cores provide biomechanics students with the unique opportunity to conduct cutting-edge research alongside senior clinical NIH-funded scientists. The grant also enables the department to bring additional funded investigators from various disciplines to UNO.

Investigators aim to use their findings within human movement variability research to treat and ultimately prevent movement-affected disorders. In Phase II of the grant, researchers study falls among patients with Parkinson’s disease; exoskeleton support for patients with Peripheral Artery Disease; movement variability among those using prosthetics; and stabilizing movements after slips – among a number of other impactful research projects already underway.

“(The project’s renewal) is a testament to the quality of our interdisciplinary researchers and their exceptional accomplishments,” said **Nicholas Stergiou**, Ph.D., Assistant Dean of the Division of Biomechanics

and Research Development. “We are here to make a difference not just through education, but also clinical and translational research.”

The COBRE Phase I grant, a \$10.1 million grant awarded to UNO in 2014, was previously the largest single research grant in UNO history. It led to the establishment of the Center of Research in Human Variability (MOVCENTR), with growth in research infrastructure and recruitment of leading researchers.

“This (renewal) award empowers the university to build on its research and strategic momentum, at the same time enhancing UNO’s reputation as a global leader in the field of biomechanics research,” said UNO Chancellor **Jeffrey P. Gold**, M.D.

Gold added that 2019 completion of the Biomechanics Research Building’s privately-funded expansion more than doubles the size of the original Biomechanics Research Building. In a study conducted by the UNO Economics Department, it was estimated that the MOVCENTR brought an economic impact of \$1.5 million to the Omaha metropolitan area just in its first two years of operation.

The grant funding was provided by the NIH’s National Institute of General Medical Sciences under Award Number P20GM109090. UNO will be eligible for Phase III of the award in 2024. ◇





Cutting the ribbon to celebrate the October 2019 opening of the UNO Biomechanics Research Building (BRB) addition are, from left: benefactor **BILL SCOTT**, Chair of Biomechanics **NICHOLAS STERGIU**, Ph.D, benefactor **RUTH SCOTT**, and Chancellor **JEFFREY P. GOLD**, M.D. Courtesy of the University of Nebraska at Omaha.



NASA Nebraska EPSCoR is committed to sustaining long-term, nationally competitive research capabilities. Its Nebraska Research Infrastructure Development (RID) program supports research activities addressing both NASA and Nebraska priorities. Funded research collaborations during 2019 involved NASA scientists, industry and academic partners, including:

- UNK Assistant Professor **Adam Jensen**'s participation as a steering committee member of NASA's Nexus for Exoplanet System Science (NExSS) research consortium; and

- UNL Assistant Professor **Jae Sung Park**'s industry collaboration with **Gary Reichlinger** of York, Nebraska's Reichlinger Business Services. Their collaboration seeks to manufacture new membrane materials for a novel refrigeration mechanism that will "cost less, weigh less, and use substantially less energy than contemporary units," Park said.



His research with UNL College of Engineering will generate performance data for new—and for some established membranes'—fluid streams not previously tested. Park aims to develop computational fluid dynamics models to simulate operation of a novel refrigeration device that could help improve refrigeration units for a variety of purposes: as drop-in replacements for compressors in home appliances such as refrigerators and freezers, as well as air conditioners and heat pumps (which could extend effectiveness of heat pumps in colder climates).

Several sub-grant recipient NASA NE EPSCoR researchers also secured non-EPSCoR funding to further their research. Work by seven seed grant researchers has impacted their universities and the state of Nebraska, as well as demonstrated strong NASA and aerospace-related applicability. ◇

CO-FUNDING

NSF EPSCoR Co-Funding for Nebraska

EPSCoR CO-INVESTS WITH NATIONAL Science Foundation (NSF) units in support of meritorious proposals from individual investigators and teams in EPSCoR jurisdictions. These proposals have been peer-reviewed and recommended for award, but could not be funded without the combined, leveraged support of NSF's EPSCoR and the Research and Education Directorates. Co-Funding leverages EPSCoR investment and facilitates participation of EPSCoR scientists and engineers in NSF-wide programs and initiatives.

In 2019, National Science Foundation co-funding brought \$2,431,958 to Nebraska; \$1,276, 811 of this annual total was from NSF EPSCoR. Recipients were:

JOE LOUIS, University of Nebraska-Lincoln (UNL) Dept. of Entomology | CAREER: Deciphering sorghum resistance mechanisms to phloem-feeding aphids

TOSHIHIRO OBATA, UNL Dept. of Biochemistry | CAREER: Establishing the Roles of Multi-enzyme Complexes in Metabolic Network Regulation

LIMEI ZHANG, UNL Dept. of Biochemistry | CAREER: Structural and Mechanistic Studies on a Iron-Sulfur Cluster-Based Nitric Oxide Sensor

HUIJING DU, UNL Dept. of Mathematics | Mathematical Modeling of Robust Spatiotemporal Dynamics in Epidermal Development

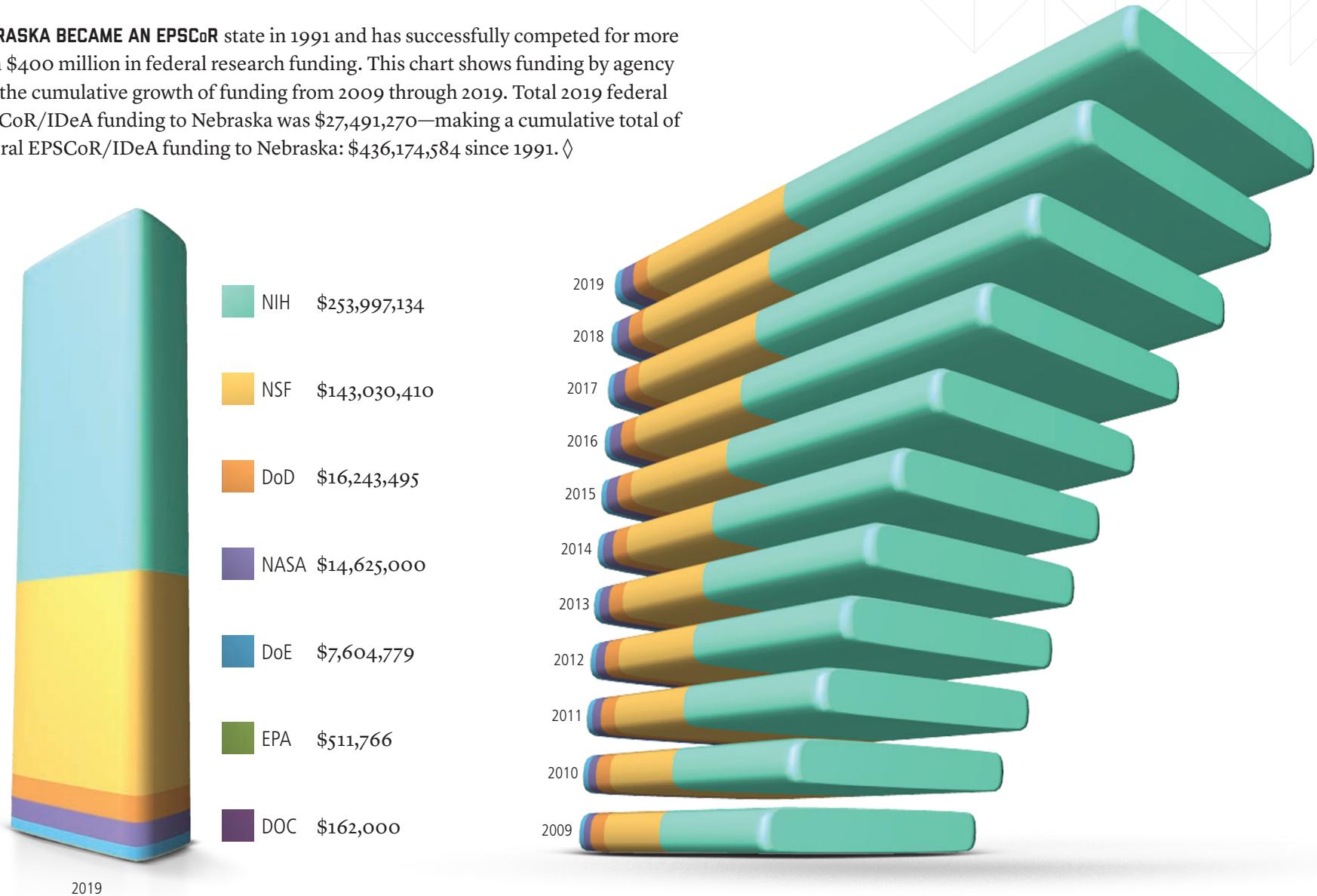
PRAHALADA RAO, UNL Dept. of Mechanical & Materials Engineering | CAREER: Smart Additive Manufacturing—Fundamental Research in Sensing, Data Science, and Modeling Toward Zero Part Defects

PETRONELA RADU & MIKIL FOSS, UNL Dept. of Mathematics | Higher Order Nonlocal Models in Continuum Mechanics

ALEXANDRA SECELEANU, UNL Dept. of Mathematics | Symbolic Powers, Configurations of Linear Spaces, and Applications

CUMULATIVE FEDERAL EPSCoR/IDEA FUNDING IN NEBRASKA

NEBRASKA BECAME AN EPSCoR state in 1991 and has successfully competed for more than \$400 million in federal research funding. This chart shows funding by agency and the cumulative growth of funding from 2009 through 2019. Total 2019 federal EPSCoR/IDEA funding to Nebraska was \$27,491,270—making a cumulative total of federal EPSCoR/IDEA funding to Nebraska: \$436,174,584 since 1991. ◇



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In 2020, the Nebraska EPSCoR team (from left: **MATT ANDREWS**, **NANCY SIMNITT**, **FRED GARTNER**, **NICOLE BUSBOOM**, and **CAROLE WILBECK**) invites you to visit their new office space at Nebraska Innovation Campus.

2019 State EPSCoR/IDeA Committee Members



Established Program to Stimulate Competitive Research
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