2020

ANNUAL REPORT

IDeA EPSCoR NEBRASKA

Established Program to Stimulate Competitive Research

COVER IMAGE: Two Seward High School students worked together in a cohort of Summer 2020 "Remote Researchers," studying the soil microbiome in their families' backyards throughout the state. When COVID-19 restrictions brought limiting changes to the Young Nebraska Scientists high school researchers program, faculty mentors worked with Nebraska EPSCoR to pivot plans for youth learning in #STEM (science, technology, engineering, and math). Read more on pages 14-15 about how YNS adapted and engaged Nebraska youth in hands-on research experiences.

TABLE OF CONTENTS

IDeA EPSCoR NEBRASKA

Established Program to Stimulate Competitive Research
Institutional Development Award Program

NEBRASKA EPSCoR STAFF

Matt Andrews, Ph.D. – *Director*
Nicole Busboom, M.S. – *Outreach Coordinator*
Fred Gartner – *Accounting Technician*
Nancy Simnitt – *Executive Assistant*
Carole Allen – *Communications Specialist*

Nebraska EPSCoR
418 FIC, Nebraska Innovation Campus
1901 N. 21st Street
Lincoln , NE 68588-6209

Phone: 402-472-8946
Fax: 402-472-8948
epscor.nebraska.edu
@NebraskaEPSCoR

EDITOR: Carole Allen GRAPHIC DESIGNER: Staci Nass

MESSAGE FROM THE NE EPSCoR DIRECTOR

AS 2020 ENDS I want to take this opportunity to update you on some of the Nebraska EPSCoR highlights from the past year.

A major highlight was that our office moved from its longtime home in Nebraska Hall to new space at Nebraska Innovation Campus. Shortly after our move, business as usual came to a screeching halt as COVID-19 became a new reality. For the first time the annual Nebraska EPSCoR/IDeA State Committee meeting was held entirely via teleconferencing on March 25.

Since that time the Nebraska EPSCoR office has conducted business by Zoom and email. In-person Young Nebraska Scientists (YNS) Programs such as Summer Camps, High School Researchers and Mobile Labs were either canceled or postponed due to COVID-19. However, the versatility of the Nebraska STEM community was on display as researchers in our Center for Root and Rhizobiome Innovation (CRRI) created virtual education and outreach activities such as our newly created Nebraska Remote Researchers—The Crop Root Microbiomes in Your Backyard.

This is just one of our stories from the past year. As you read this Annual Report you will see how Nebraska EPSCoR and our statewide partners successfully adapted to the challenges of the pandemic to turn 2020 into a productive year for Nebraska science! ◊

State Committee

NEBRASKA EPSCOR'S STATE COMMITTEE oversees the work of the Nebraska EPSCoR office. The committee is comprised of leaders from higher education, government, and industry with appointments to the State Committee issued by Nebraska's governor. In 2020, the committee membership had the following updates:

ADDITIONS]

Yuri Lyubchenko, Professor – Department of Pharmaceutical Sciences, University of Nebraska Medical Center

Roni Reiter-Palmon, Varner Professor of Psychology, University of Nebraska at Omaha

Daniel Schachtman, George Holmes Professor – Department of Agronomy and Horticulture and Director – Center for Biotechnology, University of Nebraska-Lincoln (UNL)

DEPARTURES

David Berkowitz, UNL

WHERE ARE THEY NOW?

DAVID BERKOWITZ, FORMER CHAIRPERSON of UNL's Department of Chemistry and member of Nebraska EPSCoR's State Committee, was named Division Director for the Chemistry Division at the National Science Foundation (NSF) in May. He plans to maintain his research program at Nebraska and continue efforts on the Nebraska Drug Development Pipeline, through the Independent Research & Development program during this appointment. Berkowitz previously spent three years at NSF as a program director, from 2010-13, followed by a brief stint as interim division director in 2015.

In his farewell message to the State Committee, Berkowitz wrote: "It has been an absolute pleasure to serve on the EPSCoR committee—I want to thank **Matt Andrews** for his excellent leadership and thank all of you for the opportunity to work with you on matters of importance to the State of Nebraska on research, infrastructure, education and broadening participation. The discussion has always been maintained at a high level; I think this team has overseen very nice growth in statewide research and creative activities." ◊

TRACK-1

CRRI Succeeds Amid Year 5 Challenges

NEBRASKA'S CENTER FOR ROOT & Rhizobiome Innovation research, led by University of Nebraska-Lincoln (UNL) Professor **Edgar Cahoon**, and funded by a National Science Foundation Research Infrastructure Improvement (RII) Track-1 award for $20 million, has spanned the lab-to-greenhouse-to-Nebraska fields, and brought together researchers with diverse expertise from four Nebraska university campuses to develop a fundamental understanding of the metabolism of corn roots.

The 2016-2021 research has tapped the immense genetic variation found in corn to understand how chemicals released by roots, known as exudates, shape both the microbes that associate with the root and also how root-microbe interactions are influenced by soil nitrogen and phosphorus levels. This information guides synthetic biologists to develop tools and strategies to engineer the production of root exudates that promote interactions with specific beneficial microbes for crops to more efficiently gain soil nutrients.

Conversely, CRRI microbiologists are also using the collected knowledge to develop microbial formulations that can be used as seed coatings and soil amendments to enable crops to maintain productivity with lower nitrogen and phosphorus fertilization. CRRI research to date has defined metabolic and gene expression responses of corn roots to low soil nitrogen and phosphorus, and how these responses differ across corn genetic variants or genotypes.

Computational biologists have used this information to model specific points in root metabolic networks that regulate these responses. These models, in turn, inform breeders and synthetic biologists for strategies to develop improved corn varieties. CRRI researchers have also established that different corn genotypes promote specific profiles of root-associated microbes, and efforts are now being directed at identifying the exudate types that are key to tailoring these profiles. CRRI researchers are also observing similar genetic differences in responses of corn varieties and root-microbe associations in field sites with low nitrogen or phosphorus levels.

CRRI research continued during the COVID-19 pandemic, and its investigators also innovated to conduct a summer outreach program that engaged 10 high school students throughout Nebraska (plus additional Alabama youth participants, with an NSF EPSCoR Track-2 project that includes some CRRI researchers) in backyard-based experiments to learn the importance of soil microbes in crop production. *For more about the "Remote Researchers" program, please see the Outreach section of this publication.* ◊

CRRI CENTER FOR ROOT AND RHIZOBIOME INNOVATION

A Root-associated Genes & Promoters Database (**crri.unl.edu/databases**) was generated by Nebraska's NSF-funded Center for Root & Rhizobiome Innovation (OIA-1557417).

CRRI ACCOMPLISHMENTS

AS CRRI REACHES ITS CULMINATING YEAR AS AN NSF-FUNDED PROJECT, THE TEAM'S RESEARCH NOW SERVES TO SEED NEW, RELATED OPPORTUNITIES THAT ACHIEVE EXTERNAL FUNDING AND EXTEND ITS IMPACT AND SUSTAINABILITY.

In 2020 **Daniel Schachtman** received a UNL George Holmes Professorship, and earned a US Department of Agriculture grant (from its National Institute of Food and Agriculture division) on The Role of Plant Root Exudates in Shaping Soil Microbial Community Composition. The three-year grant for $750,000 will build on CRRI research to further focus on how root exudates shape microbial community composition and soil functional properties—with emphasis on nitrification and nitrogen use efficiency, specifically by either using sorghum in rotations or by engineering maize to produce exudates that inhibit nitrification.

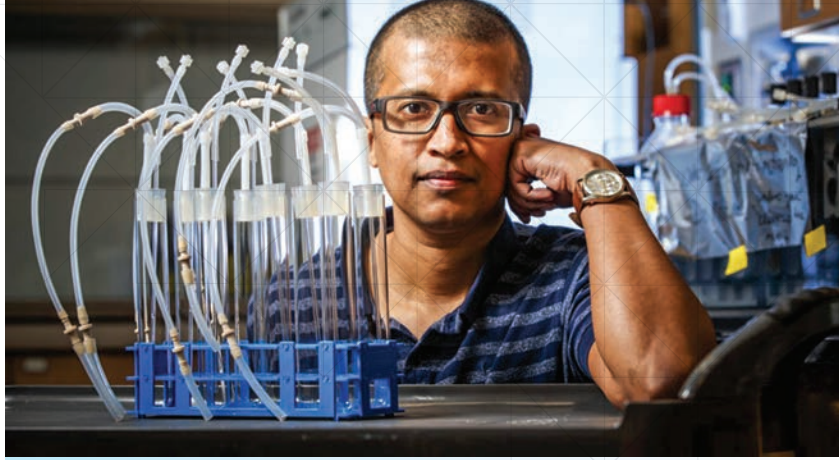
Yufeng Ge, UNL associate professor of biological systems engineering, gained a $3 million grant from the U.S. Department of Agriculture's National Institute of Food and Agriculture with a focus on phenotyping—understanding plant's physical characteristics—and linking that more accurately to factors such as soil nutrients or plants' genetic properties. Ge's team includes scientists from Texas A& M University and Mississippi State University, apply new technologies such as ground and overhead robotics, as well as data management tools and techniques—including many advances he helped develop at Nebraska. ◊

FURTHER HONORS FOR CRRI LEADERS ADD DISTINCTIONS TO THE PROJECT'S SERVICE AND SCHOLARLY EFFORTS:

- CRRI's principal investigator, **Ed Cahoon**, earned the University of Nebraska's 2020 Outstanding Research and Creative Activity (ORCA) Award. This honor recognizes individual faculty members for outstanding research or creative activity of national or international significance. Cahoon is UNL's George Holmes University Distinguished Professor of Biochemistry and is also director of UNL's Center for Plant Science Innovation. His research, which explores the biochemical and genetic bases for the immense chemical diversity found in plant lipids, has led to over 130 scientific publications and 34 issued US Patents. By combining biochemistry and functional genomics, he has solved the biochemical pathways and identified the associated genes for a wide range of unusual fatty acids found in seed oils. He has used these basic discoveries as the foundation for biotechnological efforts to improve the nutritional, industrial and biofuel properties of crops. Cahoon is a Fellow of the American Society of Plant Biologists and the American Association for the Advancement of Science.
- **Tomas Helikar**, University of Nebraska–Lincoln (UNL) associate professor of biochemistry, is part of a large-scale community effort to build an open-access, interoperable, and computable repository of COVID-19 molecular mechanisms — the COVID-19 Disease Map. An article at bioRxiv (https://www.biorxiv.org/content/10.1101/2020.10.26.356014v1) discusses the tools, platforms, and guidelines necessary for the distributed development of its contents by a multi-faceted community of biocurators, domain experts, bioinformaticians, and computational biologists. The group focuses on the role of relevant databases and text mining approaches in enrichment and validation of the curated mechanisms. The paper also includes the relevance to the molecular pathophysiology of COVID-19 and the analytical and computational modeling (Helikar's expertise) approaches that can be applied to the contents of the COVID-19 Disease Map for mechanistic data interpretation and predictions. It concludes by demonstrating concrete applications of the group's work through several use cases.
- **James Schnable**, was named UNL's Dr. Charles O. Gardner Professor of Agronomy. In 2019 he received the inaugural North American Plant Phenotyping Network Early Career Scientist Award during the Phenome Conference at Tucson,

Arizona in February 2019. NAPPN's Early Career Award seeks to highlight leaders in novel research, increasing the visibility of plant phenotyping (peer reviewed publications, presentations, social media, popular press and service), supporting research between public and private sectors, and developing (or following) data standard best management practices and/or transdisciplinary engagement.

- **Tessa Durham Brooks**, Doane University associate professor of biology, conducted CRRI-supported research about the pandemic's effects on university-level science teaching. In mid-2020, her team applied a Measurement Instrument for Scientific Teaching (MIST) tool in surveying 134 science teaching faculty members at 91 PUIs (Primarily Undergraduate Institutions) located in the Midwest and beyond. The study focused on how science faculty viewed remote learning (as necessitated by public health directives on COVID-19) versus F2F (face to face) learning, and how they adjusted their teaching during the coronavirus pandemic. The study team then analyzed its findings and prepared them for submission to multiple journal publications.
- Research by **Jinliang Yang**, assistant professor with the UNL Department of Agronomy and Horticulture, has begun to reveal how activating and deactivating genes, rather than swapping them out or rewriting them, may also have directed the evolution of maize. Yang's team set out to search the entire DNA of teosinte and (its modern relative) maize for patterns of methylation and demethylation: the addition and subtraction of molecules known as methyl groups. When methyl groups latch onto or depart from certain segments of DNA, they sometimes turn nearby genes off or on. Much like DNA itself, patterns of methylation can be passed down through generations, making the process a potentially powerful actor in an evolutionary story — and a potentially powerful secret to breeding better corn. The team — including colleagues from the University of Minnesota, the Chinese Academy of Science, Delta State University, and the University of California, Davis — detailed its findings in the journal Nature Communications. *ALSO: see page 15 in this publication for a story on CRRI Remote Researchers, a youth program developed by Yang and his UNL colleague,* **Karin van Dijk**. ◊



CRRI'S SAHA EARNS 2020 NSF CAREER AWARD

UNL engineer's plant science research studies how an unusually versatile bacterium can be harnessed to more efficiently break down plant waste to help transform it for new uses.

In Nebraska, where as much as 40% of corn left after harvest is waste material, **Rajib Saha** asked, "How can we make that waste useable?" The University of Nebraska-Lincoln assistant professor of chemical and biomolecular engineering leads a research team addressing that question. He's looking beyond ethanol production to determine what else may be possible.

According to UNL, Saha's National Science Foundation CAREER award—for $747,855 over the next five years—will focus on *Rhodopseudomonas palustris*, a non-sulfur bacterium (PNSB) first sequenced in 2004 and isolated from diverse sources such as marine coastal sediments, swine waste lagoons and earthworm droppings.

Versatile *R. palustris* can switch among different types of metabolism: growing with or without oxygen, or using light, inorganic or organic compounds for energy. It can acquire carbon from either carbon dioxide fixation or green plant-derived compounds, and it's also capable of fixing nitrogen for growth.

TRACK-2

Nebraska's Kravchenko Part of Track-2 Award on Energy Particles in the Universe

IN SEPTEMBER 2020, SCIENTISTS from Alabama, Alaska, Delaware, Kansas, Nebraska and South Dakota began four years of research to better understand sources of high-energy particles in space.

This $3 million NSF Research Infrastructure Improvement (RII) Track-2 Focused EPSCoR Collaborations (Track-2 FEC) project explores "how the data revolution can provide new insight into the universe and its extreme phenomena." A central question the project addresses is:

Where and how is the Universe producing microscopic particles that carry macroscopic energies?

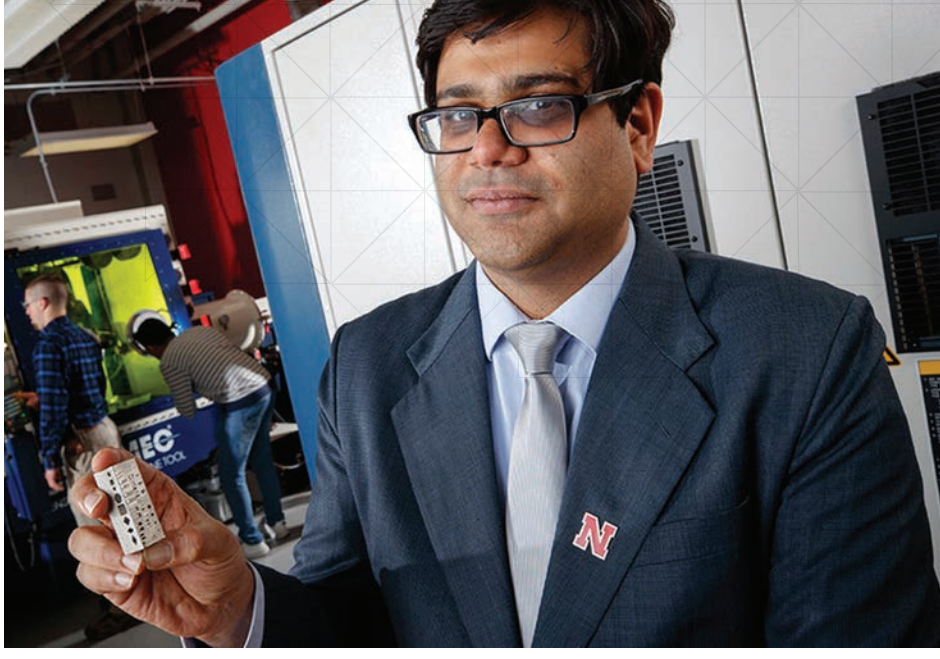
Ilya Kravchenko, project co-investigator and associate professor with University of Nebraska-Lincoln Physics & Astronomy, acknowledges the research team's starting point: Traditional astronomy has progressed from telescopes for visible light to include the full electromagnetic spectrum from radio to gamma-rays. Cosmic rays were discovered more than a century ago, but the sources of these high energy particles from outer space remain mysterious.

Kravchenko explains that recent technology such as LIGO, Virgo, and IceCube have opened new windows on the Universe, and observations via these cosmic messengers bring the era of Multi Messenger Astronomy (MMA). LIGO stands for Laser Interferometer Gravitational-wave Observatory, and the Virgo interferometer is another experiment on detection of gravitational waves from outer space. He adds that the IceCube project—a light detection array that's one mile across and embedded two kilometers deep at the South Pole (hence, an "ice cube")—measures subatomic particles called neutrinos from outer space. Its 5,000+ optical sensors, plus detectors on the surface, produce data at a rate of about 1 Terabyte/day.

With collaboration by Kravchenko and his EPSCoR colleagues, this six-state project aims to aid interpretation of the data to better discern discoveries from ample MMA-generated information. ◊

TRACK-4

UNL Engineer Rao Gains NSF Fellowship to Advance Metal Additive Manufacturing



PRAHALADA RAO, ASSOCIATE PROFESSOR of Mechanical and Materials Engineering, earned a two-year NSF EPSCoR Track-4 award for more than $148,000. He'll use this fellowship opportunity to focus on a challenge in metal additive manufacturing (AM) that applies thermal physics and computer simulation models to improve 3D printing for production lines.

According to Rao, 3D printing of metal parts could transform U.S. manufacturing, with metal additive manufacturing (AM) having the potential to reduce production time as well as increase fuel efficiency and power. However, quality consistency is currently a challenge — frequently due to flaw formation in metal AM from uneven temperature distribution inside the part during printing.

Trial and error studies are the current approach to ensure a steady temperature distribution inside the part, and practitioners currently experiment with different process settings and part designs — an expensive and time-consuming approach. Rao values a more efficient solution: applying the fundamental thermal physics of the printing process using computer simulation models.

"These simulation models can be used to identify and correct problems that can lead to an uneven temperature distribution in the part before it is built," said Rao, whose mathematical approach to predict the temperature distribution in AM parts takes less than one-tenth of the time required by existing techniques and has an error of less than 10 percent. "Rigorous validation of this concept with experimental data is the next step to scale this new concept to practice."

The NSF EPSCoR Track-4 fellowship will enable Rao to test his hypotheses via access to the Open Architecture Laser Powder Bed Fusion metal AM system at the Edison Welding Institute (EWI) in Columbus, Ohio. EWI's system has eight different sensors and allows the in-situ measurement of thermal signatures at scales ranging from 5 micrometer to 400 micrometers. Access to this unique apparatus will allow Rao to measure the instantaneous temperature distribution in a part, and track changes in its shape with unprecedented precision.

Rao intends to use data from experiments on the open architecture metal AM system at EWI to generate experimentally validated, physics-based tools to aid rapid optimization of process settings and part geometry, which in turn will shorten time-to-market for AM parts and reduce scrap rates by up to 80%. ◊

LATE-BREAKING NEWS: RAO LEADS TEAM GAINING DOE EPSCoR GRANT

Nebraska Engineering's Prahalada Rao is the Principal Investigator for a 2020 U.S. Department of Energy three-year award totaling $670,000 for Understanding the Thermal Physics and Metallurgy of Metal Big Area Additive Manufacturing.

FIRST AWARDS

Nebraska EPSCoR FIRST Awards Provide Funding, Expert Reviews for Selected Early-Career Faculty

TO HELP NEBRASKA'S EARLY-CAREER scientists prepare to pursue important large research grants, such as the National Science Foundation's CAREER Award, Nebraska EPSCoR conducts annual FIRST—For Inspiration and Recognition of Science and Technology—Awards.

Each year dozens of CAREER Award aspirants throughout the state submit pre-proposals to Nebraska EPSCoR's FIRST Award competition, with a select group of these applicants meriting FIRST Award "Finalist" status. For the 2020 cohort, 10 Finalists were invited to advance and prepare full proposals patterned after the NSF CAREER Award format; all FIRST Award Finalists gain expert scientific reviews on their submissions. From the Finalists group, FIRST Award Recipients are chosen to receive $25,000 for their further national award submission efforts (an amount which must be matched by each Recipient's department), in addition to the valuable reviews solicited by the American Association for the Advancement of Science (AAAS), engaged by Nebraska EPSCoR.

At the 2020 meeting of Nebraska EPSCoR's State Committee on March 25, the following FIRST Award Recipients were selected:

JAMES CHECCO
University of Nebraska-Lincoln (UNL)
Dept. of Chemistry
Chemical approaches to identify peptide-receptor interactions

CATHERINE EICHHORN
UNL Dept. of Chemistry
Mechanisms of ribonucleoprotein folding and assembly

JAE SUNG PARK
UNL Dept. of Mechanical and Materials Engineering
Theoretical and computational studies towards elucidating predictive dynamics in chaotic nature of turbulence for flow control

XINGHUI SUN
UNL Dept. of Biochemistry
Novel roles of long noncoding RNAs in the regulation of mitochondrial function and cell senescence

FABIO TORRES VITOR
University of Nebraska at Omaha Dept. of Mathematics
Multidimensional Search Algorithms to Solve Optimization Models

ASHLEY VOTRUBA
UNL Dept. of Psychology
Dispute Resolution: Psychological Determinants of Resolution Preferences

More information about Nebraska EPSCoR's FIRST Award program can be found at **epscor.nebraska.edu/programs/first-awards**, including past Recipients since the program began in 2004. Nebraska EPSCoR conducts this program with funding through its NSF EPSCoR Track-1 award (currently OIA-1557417).

CONGRATULATIONS

TO FIRST AWARD RECIPIENTS WHO EARNED NSF CAREER AWARDS IN 2020:

VITALY ALEXANDROV

UNL Chemical & Biomolecular Engineering (2016 FIRST Award)

Received a 2020 NSF CAREER Award for $520,244 to advance basic understanding of how nanocrystals dissolve in aqueous environments. This research could help scientists develop nanomaterials with better stability and more controllable chemical activity.

CATHERINE EICHHORN

UNL Chemistry (2019 FIRST Award)

Earned a 2020 NSF CAREER Award for $405,301 to research how dysfunctions in cellular machinery contribute to disease. She focuses on integrated structural biology, biophysical, and chemical biology tools to investigate the folding and function of regulatory RNAs and RNPs.

WHERE ARE THEY NOW?

Ryan Wong, an assistant professor in the Department of Biology and in the Neuroscience Program at the University of Nebraska at Omaha (UNO), received a 2020 CAREER Award from the National Science Foundation (NSF). Preparing for his pursuit of the NSF CAREER Award, Wong earned a FIRST Award from Nebraska EPSCoR in 2017, with funding and expert reviews to guide his CAREER Award application.

According to the UNO Office of Research & Creative Activity, Wong is the first UNO professor to receive an NSF CAREER Award. Wong's five-year $850,000 CAREER Award will support his research into how certain stress coping styles (animal personality types) can limit learning and memory capabilities—to shed light on our underlying neurobiological and genetic mechanisms.

Wong's CAREER Award also includes a required "outreach" component. Built into his plan are opportunities for UNO students and K-12 students in Omaha Public Schools to perform behavioral neurogenetics experiments, which will open doors to enhance scientific literacy and comprehension. Wong said one of the goals of the outreach portion of the grant will be to introduce fundamental principles of animal behavior, neuroscience and genetics to students through UNO's NE STEM 4 U program, in which UNO students will design educational activities for after-school programs for Omaha Public Schools students. Wong also plans to hire Young Nebraska Scientists High School Researchers to join his lab for summer experiences. ◊

SMALL COLLEGE AWARDS

Nebraska EPSCoR Awards Grants for 2020 Research at State's Small Colleges/Universities

TO INCREASE UNDERGRADUATE RESEARCH opportunities at Nebraska's smaller colleges and universities, Nebraska EPSCoR offers funding up to $5,000 per project for collaborations in science, technology, engineering and math (STEM) areas. Faculty and undergraduate 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 2020 were:

DR. MARIA BECKER
Nebraska Wesleyan University, Dept. of Physics
Acoustic Double-Slit Experiment: A Quantum Mechanical Analogue to Investigate Decoherence in Quantum Systems

DR. ERIN DOYLE
Doane University, Dept. of Biology
Incorporation of Transcriptome and Genetic Variation Into a Computational Prediction Workflow to Identify Disease Resistance Genes in Rice

DR. LAUREN GILLESPIE
Central Community College, Dept. of Biology
Partial Albinism Discovered in a Nebraska Barn Swallow Population

DR. NICK HOBBS
University of Nebraska at Kearney, Dept. of Biology
Effect of Food Availability on Anxiety and Gonadal Hormones and Their Receptors in Mice

DR. KATHERINE MOEN
University of Nebraska at Kearney, Dept. of Psychology
I Can't Forget You: Memory Stability and Motivated Forgetting

DR. JASON PRICE
Wayne State College, Physical Sciences and Mathematics
Constraining Timing of an Abrupt Increase in Phosphorus to Aquatic Ecosystems of the Loch Vale Watershed, Colorado During the Younger Dryas: an Analog for Present-Day Climate Change

Funding for these awards is provided through National Science Foundation support to Nebraska EPSCoR projects, including OIA-1557417. Upcoming funding opportunities in this annual competitive selection process are posted at Nebraska EPSCoR's Request for Proposals webpage (epscor.nebraska.edu/proposals).

WHERE ARE THEY NOW?

Early in her work with the Chemistry Department faculty at Doane University, **Andrea Holmes** accidentally found a letter from the Nebraska EPSCoR office addressed to a retired professor, inviting submissions for undergraduate research experience funding for small colleges. In 2005, she applied with her idea to include Doane undergraduates in her research on chemical sensors to detect narcotics, specifically club and date rape drugs.

After that initial grant for $5,000, Holmes pursued a FIRST Award from Nebraska EPSCoR and was awarded $20,000. This award helped her prepare to apply for a National Science Foundation CAREER Award proposal. In 2008, she landed that honor (the first NSF CAREER Award for a Doane faculty member) with $525,000 in funding for five years of research.

Holmes next joined a Nebraska team's proposal for a $20 million NSF EPSCoR "Track-1" collaborative grant. Her project, DETECHIP (short for Detection Chip), was included in the nanoscience research with that project (2010-2016).

As her Doane research and teaching progresses, Holmes recalls how Nebraska EPSCoR provided opportunities for many of her great leaps forward along the way. She also earned funding from the Department of Defense (DoD) for chemical warfare detection devices, and received the Henry Dreyfus Teacher Scholar Award in 2015, totaling up to several million dollars to support post-docs, students, and faculty.

Holmes now serves as a Senior Steering Committee member for Nebraska's National Institutes of Health INBRE (IDeA Networks of Biomedical Research Excellence) grant. Her research has led to three patents and nearly 40 peer-reviewed journal publications. Her current work focuses on cannabis chemistry and the cannabis industry. ◊

Programs Pivot to Sustain Mission Amid Pandemic

AS 2020 BEGAN, NEBRASKA EPSCoR had planned more STEM-themed summer camps and REU (Research Experience for Undergraduates) placements than prior years. These efforts carried the momentum of the Center for Root and Rhizobiome Innovation's (CRRI) Year 5 funding from the National Science Foundation (NSF).

By March, new camps in the Young Nebraska Scientists (YNS) program were forming at central Nebraska's Prairie Plains Resource Institute, at Bellevue University (south of Omaha), and other sites. Five REU students had committed their summers to CRRI from multiple universities across America, and their University of Nebraska-Lincoln (UNL) mentors eagerly awaited these summer-term additions to their labs.

When the coronavirus pandemic all but halted campus activities throughout the nation, many STEM outreach endeavors were stopped in their tracks—but Nebraska EPSCoR teams creatively pivoted to provide alternative offerings:

CRRI **REUs** and mentors shared their preferences, and all favored virtual experiences rather than cancelling placements. Zoom connections and adjusted research plans to accommodate remote participation were applied, to implement as many planned events as possible. CRRI was one of three REU programs at UNL that fulfilled its 2020 REU commitment; nine other REU programs could not make this shift. The REU students in CRRI's Summer 2020 cohort decided to conduct weekly online group sessions to discuss their learning across their areas—almost as if they were living in Lincoln as planned. UNL Graduate Studies convened online gatherings of its REU participants to share content—goal-setting, leadership training, and science communication—with an interactive workbook guiding their summer's professional development. The experience culminated in the REU students' individual presentations at UNL's Summer Research Symposium, in August 2020, with a poster session conducted via Zoom. Each CRRI participant conveyed their summer's research focus and growth, and the talk by **Cailin Smith** (from Indiana's Goshen College, and mentored by UNL Biochemistry's **Kasia Glowacka**) earned the judges' award for Top Presentation at the event.

Young Nebraska Scientists (YNS) **High School Researchers** typically work for a summer on-campus in the labs of CRRI scientists. Circumstances this year required using Zoom for mentoring and check-ins. Students were paired with UNL PhDs led by **Rajib Saha** (Chemical & Biomolecular Engineering), **Sabrina Russo** (Biological Sciences), **Chi Zhang** (Biological Sciences), **Jinliang Yang** (Agronomy and Horticulture), and **Toshihiro Obata** (Biochemistry). These teams completed tasks that included: utilizing a computational tool for Qualitative Genetic Circuit Design for Eukaryotic Organisms; exploring the correlation between prairie plants and soil microbes in the Sandhills of western Nebraska; enhancing the understanding of biological systems by designing complex and efficient models to integrate genome sequences and expression profiles in molecular interactions; and researching the potential of re-creating optimal plant microbiomes to yield larger crops in agriculture.

Even more innovative was a new set of YNS opportunities for high school students, Nebraska **Remote Researchers**: Crop Root Microbiomes in Your Backyard. This summer program was created by CRRI's investigators **Karin van Dijk** and **Jinliang Yang**, and led by CRRI PhD candidate **Michael Meier** and other grad students. These leaders developed kits including tools and protocols for growing maize and sorghum cultivars in 10' x 10' plots created and maintained by high school students throughout the state. Ten high schoolers from across Nebraska completed weekly Zoom calls and a final data workshop (analyzing microorganisms from

root samples the youths collected at their plots), and each earned a $300 stipend. These youth also gained hands-on experience amid experiments that served both CRRI and a related collaborative project (also NSF EPSCoR-funded) with the UNL Department of Agronomy and Horticulture, the Center for Plant Science Innovation, and Nebraska EPSCoR's Young Nebraska Scientists—along with several participants from Alabama, affiliated with the Hudson-Alpha Institute. ◊

"Realizing that we couldn't do business as usual, I am very proud of these CRRI researchers and grad students. They devised a novel experience to provide our Nebraska high school researchers with an interesting and important project that could be safely implemented in the COVID-19 era."

— Matt Andrews,
Nebraska EPSCoR Director

Remote Researcher and Pender High School junior Alexis B. commented on being a Remote Researcher:

Coming from a small town in Northeast Nebraska, I have spent my entire life surrounded by agriculture... (but) this research program shed some light on the more complex aspects of farming I had never given thought to. This entire research project centered around microbes in the soil, something that we can only marvel at through a microscope.

My agricultural education advisor, Mr. Bartlett, brought this opportunity to my attention. Living in a rural location often means that I am at a disadvantage in terms of opportunities to engage in research, camps, and other events at the university. Researching remotely allowed me to satisfy my hunger for knowledge with equipment and guidance provided by UNL. It was exciting to ask questions and work with knowledgeable faculty. I was able to complete the research on my own time while also collaborating with others. Most of what I learned during the project was based on research methods and how to properly use lab equipment and follow procedures. I could not have asked for a better mentoring relationship with all of the UNL professors and personnel.

The ability to engage in meaningful research was extremely exciting to me as I am eager to learn more about the field of scientific research. Before this project, I was pretty sure that I wanted to spend my career in a lab. But, I was never one hundred percent sure. I had no way to see if that type of work brought me joy. The rush of adrenaline and enthusiasm that I experienced on the day that I prepared and collected samples solidified my plans for after high school. My passions lie in learning about human nutrition and sustainable agricultural practices. I am now more motivated than ever to pursue research opportunities in college. Again, thank you for an outstanding research opportunity.

NIH IDeA

A team of medical research leaders from UNMC, University of Nebraska at Omaha, University of Nebraska-Lincoln, University of Nebraska at Kearney, Boys Town National Research Hospital, University of South Dakota, University of North Dakota, and North Dakota State University conduct Great Plains IDeA CTR programs for Nebraska and the region.

Nebraska-Based Great Plains IDeA CTR Engages Midwest States to Grow Medical Research

GREAT PLAINS IDeA | Clinical and Translational Research

THE GREAT PLAINS INSTITUTIONAL Development Award Clinical and Translational Research (GP IDeA-CTR) network, launched in 2016 with National Institute of General Medical Sciences (NIGMS) support, is dedicated to developing early career researchers into independent scientists, along with infrastructure and resources needed to support clinical and translational research.

Clinical Research is defined by NIGMS as 1) Patient-oriented research conducted with human subjects (or on material of human origin such as tissues, specimens, and cognitive phenomena) for which an investigator (or colleague) directly interacts with human subjects. Translational research converts basic research advances to practical applications in humans, and research aimed at the adoption of best practices in community healthcare.

Headquartered at the University of Nebraska Medical Center (UNMC) with partner institutions across Nebraska, North Dakota and South Dakota, the GP IDeA-CTR is part of NIH's larger IDeA initiative with five-year terms of $20 million in funding that can be renewed. GP IDeA-CTR's Principal Investigator, Dr. **Matthew Rizzo**, is Chair of the Department of Neurological Sciences at UNMC.

"Together, we successfully developed key resources, personnel, and processes to address pressing CTR and health needs across our underserved rural and urban communities," Rizzo said. "Under strong leadership we established a robust, networked research infrastructure to develop and guide our CTR investigators, promote resource sharing, and advance collaborations among CTR investigators and community members. We leveraged relationships with national NIH programs and other national organizations to share best practices and strategies for developing CTR. These accomplishments have advanced a network culture of team science, strengthened our ability to compete successfully for research awards, and strengthened our capacity to translate basic and clinical research to advance community health needs."

The GP IDeA-CTR includes several Cores: Administrative; Biomedical Informatics & Cyberinfrastructure Enhancement, Biostatistics, Epidemiology & Research Design; Community Engagement & Outreach; Professional Development; and Tracking and Evaluation, plus a Pilot Project program. These Cores are designed to promote collaborative CTR research across the region and increase resource access and utilization across partners to advance their research endeavors.

Key GP IDeA-CTR activities are offered online to participating researchers spanning varied backgrounds and sites. These include Seminar Series and web-based tools for implementing evidence-based interventions, a resources database, e-modules, research studios to discuss research ideas and grant submissions with experts, EHR data access training, consultation services, seed funding for research projects, and others. GP IDeA-CTR Scholar, Dr. **Soonjo Hwang** with UNMC, noted, "IDeA-CTR scholarship has been critical for me to become an independent researcher in the field of child and adolescent psychiatry. I cannot thank them enough." ◊

NIH IDeA Funds Neuroscience COBRE in Omaha

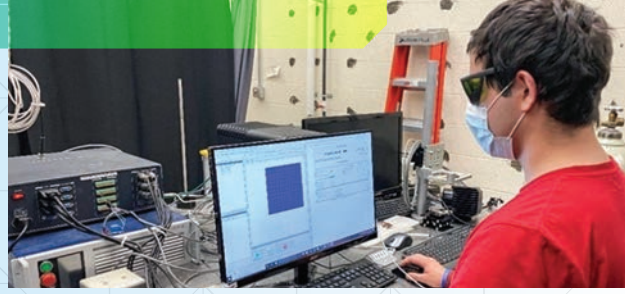
IN 2020, THE NATIONAL Institutes of Health (NIH) Center of Biomedical Research (COBRE) funded Nebraska's Cognitive Neuroscience of Development and Aging (CoNDA) Center. The five-year project is slated to receive $11,418,806 from the NIH.

Omaha's new CoNDA Center will focus on human neuroscience research across the lifespan. Plans for the center include a Neuroimaging Core facility, with state-of-the-art tools for neuroimaging and neuromodulation, plus research-dedicated MRI (magnetic resonance imaging) and MEG (magnetoencephalography) systems. The center will also support four primary COBRE junior research projects led by NIH-defined early-stage investigators, and an established cohort of senior investigators.

The center's administrative core will offer training opportunities, pilot projects and mini-grant programs, a seminar series, postdoctoral fellowships, internships for growing temporary and long-term laboratory staffing, and a participant registry to enhance recruitment.

The center will be based at the University of Nebraska Medical Center and its core facility will be led by UNMC's Dr. **Tony Wilson**, but its programs and supported members will include Boys Town National Research Hospital, the University of Nebraska at Omaha, and Creighton University. It aims to add positive impact throughout the state and the region. ◊

NASA EPSCoR



A Nebraska Engineering student in Bai Cui's lab works on research for NASA.

A NASA NEBRASKA EPSCOR Mini-Grant Research project regarding laser ablation patterning is being conducted by Dr. **Bai Cui** at the University of Nebraska-Lincoln, in collaboration with NASA scientist Dr. **Valerie Wiesner** at NASA Langley Research Center. Since the Apollo missions, the adhesion of dust from the lunar regolith to the surface of space suits, lunar rovers, and instrumentation have been reported as a major problem on the moon environment.

The barbed-shaped structure of lunar dusts allows them to fasten to the exposed surface, and the abrasive nature of the dust causes mechanical wear and damage on the sensitive robotics and other equipment. The novelty of this project is to develop a new laser ablation patterning technique that decreases surface energy of advanced ceramic materials, such as boron carbide and alumina, thereby reducing the potential of lunar dust adhesion. Expected outcomes include fundamental mechanisms of laser ablation patterning, and specific laser parameters for various ceramic materials to reach high lunar dust adhesion resistance.

The successful development of a laser ablation patterning technique will support NASA's moon programs, such as Artemis, for the exploration of the moon and building of future research stations on the moon. ◊

NEBRASKA INBRE EXTENDS ITS FUNDED TERM

Congratulations to Nebraska's INBRE Program for earning a five-year extension in funding (through 2025) from the National Institutes of Health for our state's IDeA (Institutional Development Awards) Networks of Biomedical Research Excellence. The Nebraska INBRE program is led by Dr. **Paul Sorgen** and based at the University of Nebraska Medical Center, with selected student scholars engaged at PUIs (Primarily Undergraduate Institutions) throughout the state. Three themes reflect the scientific foci of NE-INBRE: infectious diseases, cancer biology, and cell signalling. The program provides and expands research experiences, creating a pipeline of students to enter biomedical research and other health professions. NE-INBRE investments in faculty research projects and infrastructure at PUI sites generate opportunities for students to become involved in advanced biomedical research. ◊

2020 NSF EPSCoR Co-Funding for Nebraska

NATIONAL SCIENCE FOUNDATION (NSF) EPSCoR co-invests with 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 corresponding directorates. Co-Funding leverages EPSCoR investment and facilitates participation of EPSCoR scientists and engineers in NSF-wide programs and initiatives.

In 2020, NSF co-funding brought $1,380,613 to Nebraska; $801,864 of this total was from NSF EPSCoR. Recipients were:

Dr. **SOUPARNO GHOSH**; University of Nebraska-Lincoln (UNL) Dept. of Statistics | Collaborative Research: FET: Small: Machine Learning Models for Function-on-Function Regression

Dr. **JAE SUNG PARK** (PI) and Ruiguo Yang (co-PI); UNL Dept. of Mechanical & Materials Engineering | Nonlinear Electrokinetics at Polarizable Soft Interfaces: Implications for Cell Membrane Characterization and Nanopore Transport

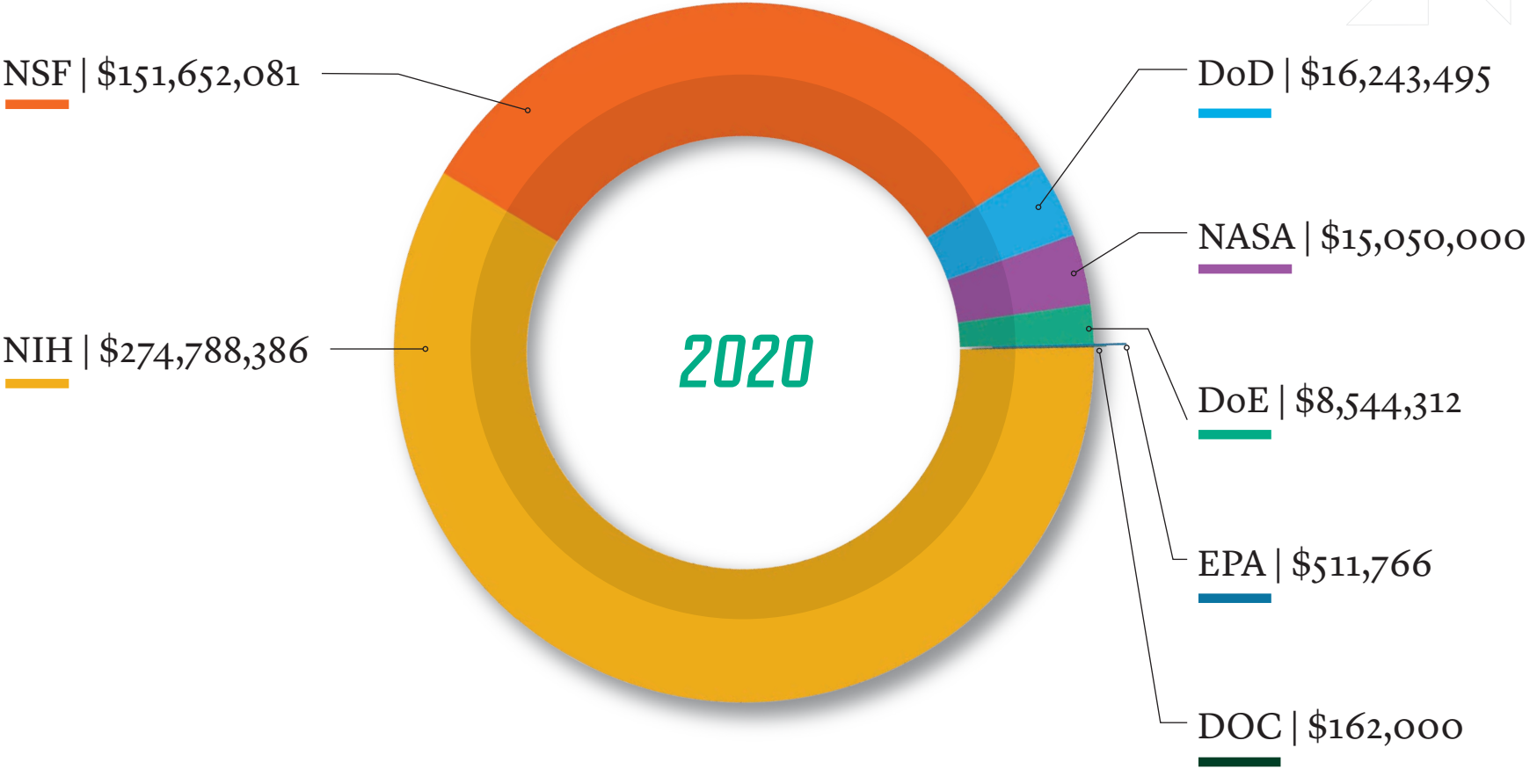
Dr. **HILARY RAIKES** (PI) and Erica Ryherd, Danae Dinkel, and David Dzewaltowski (co-PIs); UNMC Dept. of Health Promotion | SCC-PG: Smart & Connected Childcare

Dr. **RONI REITER-PALMON** (PI) and Joseph Allen (co-PI); UNO Dept. of Psychology | Collaborative Research: Creativity in Teams: Identifying the Role of Meetings in Fostering Effective Cognitive and Social Processes in Teams

Dr. **RAJIB SAHA**, UNL Dept. of Chemical & Biomolecular Engineering | CAREER: Dissecting a Metabolically Versatile Non-Model Bacterium's Lignin-Derived Compound Catabolism

Cumulative Federal EPSCoR/IDeA Funding in Nebraska

NEBRASKA BECAME AN EPSCOR state in 1991 and has successfully competed for more than $466 million in federal research funding. This chart shows cumulative funding by agency to Nebraska through 2020. ◊



Nebraska EPSCoR
University of Nebraska
418 FIC, Nebraska Innovation Campus
P.O. Box 886209
Lincoln NE 68588-6209

2020 State EPSCoR/IDeA Committee Members

IDeA EPSCoR NEBRASKA

Established Program to Stimulate Competitive Research
Institutional Development Award Program

epscor.nebraska.edu
epscor@nebraska.edu
Follow us on Twitter @NebraskaEPSCoR

Dr. Jon P. Anderson — Committee Chair, *Innovation & Technology Manager,* LI-COR Biosciences, Inc.

Ms. Nisha Avey, *Business Innovation Consultant*, State of Nebraska Dept. of Economic Development

Dr. Kenneth W. Bayles, *Interim Assoc. Vice Chancellor for Research & Creative Activity,* University of Nebraska at Omaha

Dr. David Berkowitz, *Willa Cather Professor*, University of Nebraska-Lincoln

Dr. Charles J. Bicak, *Senior Vice Chancellor for Academic & Student Affairs,* University of Nebraska at Kearney

Dr. Susan Fritz — Committee Vice Chair, *Executive Vice President and Provost,* University of Nebraska

Dr. Jerry Hudgins, *Professor and Dept. Chair,* University of Nebraska-Lincoln

Mr. Dan Hoffman, *Chief Executive Officer,* Invest Nebraska Corp.

Mr. Phil Kozera, *CEO,* MatMaCorp

Dr. Jennifer Larsen, *Vice Chancellor for Research,* University of Nebraska Medical Center

Dr. Yuri Lyubchenko, *Professor,* University of Nebraska Medical Center

Dr. J. Tyler Martin, Sr., *CEO*, Adjuvance Technologies, Inc.

Dr. Justin Mott, *Associate Professor,* University of Nebraska Medical Center

Dr. Thomas Murray, *Provost,* Creighton University

Dr. Roni Reiter-Palmon, *Varner Professor,* University of Nebraska at Omaha

Dr. Juliane Strauss-Soukup, *Professor,* Creighton University

Ms. Gloria Thesenvitz, *Founder & Board Chair,* Nova-Tech, Inc.

Dr. Robert Wilhelm, *Vice Chancellor for Research & Economic Development,* University of Nebraska-Lincoln