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Established Program to Stimulate Competitive Research
Institutional Development Award Program

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Invest Nebraska Corp.

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Director, Great Plains Biotechnology

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University

Dr. Michael Nastasi, *Elmer Koch Professor*,
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Dr. Scott Snyder, *Associate Vice Chancellor for
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Nebraska at Omaha

Dr. Juliane Soukup, *Professor*,
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University of Nebraska at Omaha

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2018 Annual Report



Established Program to Stimulate Competitive Research

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Established Program to Stimulate Competitive Research
Institutional Development Award Program

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FAREWELL



DURING THE LAST 15 years serving as Nebraska EPSCoR director, I have been on a learning journey outside my own academic discipline. Together with skilled colleagues across the state—faculty, staff and community members—we have been able to enhance Nebraska’s scientific research community, be a change agent in fostering collaboration, and initiate new programs to accelerate workforce development. Any journey has an ending and the end of March will mark the end of my tenure as Nebraska EPSCoR director. As I say farewell, I would like to express my appreciation for the support that I have received and learning opportunities that I have encountered. My best wishes to those who keep Nebraska EPSCoR moving forward.



ffchoobineh

F. Fred Choobineh

STATE COMMITTEE GUIDES NEBRASKA EPSCOR POLICIES, PRIORITIES

New to Nebraska EPSCoR's State Committee:



NISHA AVEY
Business Innovation
Consultant, State of
Nebraska Department of
Economic Development



DAN HOFFMAN
Chief Executive Officer,
Invest Nebraska Corp



PHIL KOZERA
Executive Director,
Bio Nebraska



JUSTIN MOTT
Associate Professor
of Biochemistry &
Molecular Biology,
University of Nebraska
Medical Center
(UNMC)



BOB WILHELM
Vice Chancellor
for Research
and Economic
Development,
University of
Nebraska-Lincoln
(UNL)

Re-Appointed:

DAVID BERKOWITZ
Cather Professor, Chemistry, UNL

CHARLES BICAK
Senior Vice Chancellor for Academic & Student
Affairs, University of Nebraska at Kearney

SUSAN FRITZ
Committee Vice-Chair
Executive Vice President & Provost,
University of Nebraska

JENNIFER LARSEN
Vice Chancellor for Research, UNMC

J. TYLER MARTIN, SR
Chief Executive Officer,
Great Plains Biotechnology

JULIANE SOUKUP
Professor, Department of Chemistry,
Creighton University

Thank You to Departing Members of the Committee:

JOE FOX, Nebraska Department of
Economic Development

STEVE GODDARD, former UNL Interim
Vice Chancellor for Research and
Economic Development



LYLE MIDDENDORF,
who chaired
Nebraska EPSCoR's
State Committee
for 11 years and
served on the
committee for 24

years. As LI-COR Biosciences' Senior Vice
President and Chief Technology Officer,
he led meetings of the committee and
represented Nebraska EPSCoR at several
national EPSCoR/IDeA conferences.

TERRI WASMOEN, formerly with Merck
Animal Health

SCOTT SNYDER, former UNO Associate
Vice Chancellor for Research and Creative
Activity, who became dean of the College
of Science and Engineering at Idaho State
University

NEBRASKA EPSCOR FIRST AWARDS RECIPIENTS GAIN FUNDING, EXPERT REVIEWS

To help Nebraska's early-career scientists prepare to pursue prestigious research grants, such as the National Science Foundation's (NSF) CAREER Award, Nebraska EPSCoR conducts annual FIRST—For Inspiration and Recognition of Science and Technology—Awards.

EACH YEAR SEVERAL DOZEN CAREER Award aspirants submit pre-proposals to Nebraska EPSCoR's FIRST Awards competition, with a select group of these applicants meriting FIRST Award "Finalist" status. This year, 13 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 those submissions.

From the Finalists group, FIRST Award Recipients are chosen to receive \$25,000—an amount which must be matched by each Recipient's department—for their further national award submission efforts. This funding augments the valuable proposal reviews by members of the American Association for the Advancement of Science (AAAS), engaged by Nebraska EPSCoR.

SHUDIPTO DISHARI, a 2017 FIRST Award recipient from UNL Chemical & Biomolecular Engineering, earned an NSF CAREER Award in 2018.



In 2018, the Nebraska EPSCoR State Committee voted to approve these FIRST Award Recipients:

DR. BAI CUI, University of Nebraska–Lincoln, Mechanical and Materials Engineering — *“High-Temperature Deformation Mechanisms in Dispersion-Strengthened Alloys”*

DR. LYNNE DIECKMAN, Creighton University, Chemistry — *“Understanding Protein Interactions that Link DNA Replication and Nucleosome Assembly”*

DR. PEISI HUANG, University of Nebraska–Lincoln, Physics and Astronomy — *“Improving the Understanding of New Physics, from Particle Physics to Cosmology, at the LHC”*

DR. PHILIPPE MALCOLM, University of Nebraska at Omaha, Biomechanics — *“Dynamic Indirect Calorimetry: Measuring the Time-Profile of Metabolic Cost Within the Stride Cycle Using Robotic Perturbation Experiments”*

DR. VIVIEN MARCELAT, University of Nebraska at Omaha, Biomechanics — *“Neural Mechanisms Underlying Sensorimotor Synchronization with Fractal Rhythms”*

DR. ALEXANDRA SECELEANU, University of Nebraska–Lincoln, Mathematics — *“Homological Algebra for Geometric and Computational Applications”*

DR. RUIGUO YANG, University of Nebraska–Lincoln, Mechanical and Materials Engineering — *“Investigation of Cell Junction Mechanics and Mechanotransduction at Single Cell Level”*



TRACK 1

YEAR 3 PRODUCTIVE FOR NSF-FUNDED PLANT-SOIL RESEARCH

MIDWAY THROUGH FIVE YEARS of National Science Foundation (NSF) EPSCoR funding, Nebraska's Center for Root & Rhizobiome Innovation (CRRRI) is accomplishing its planned research objectives. In 2016, CRRRI earned a \$20 million NSF award to provide innovative and sustainable solutions to enhance Nebraska, US, and global crop production by probing the interface of root metabolism and the soil microbiome—to help better address the great challenge of feeding the world, even as increasing drought, disease and demand threaten food supplies.

CRRRI Aim 1, co-led by University of Nebraska-Lincoln's (UNL) **James Schnable** and **Etsuko Moriyama**, pursues a combination of transcriptomic, metabolite and root architecture data obtained from a maize diversity panel. These datasets help develop predictive models for transcript abundance and metabolite accumulation to simulate how changes in the plants' gene expression impact root metabolism.

Aim 2, co-led by UNL's **Daniel Schachtman** and Doane University's **Tessa Durham Brooks**, includes progress in developing several methods that are key to the success of the CRRRI project including: exudate detection from corn roots, identification of microbes that are ingesting exudates; and a ninhydrin root blotting methodology, which has engaged undergraduate and high school researchers at both universities.

Root exudate and microbial data collected in CRRRI Aim 2, coupled with Aim 1 models, helps to inform synthetic biology efforts and develop transgenic plants as part of Aim 3, led by CRRRI co-PI **Ed Cahoon** and **Tom Clemente** (both with UNL) to test the models.

CRRRI co-PI **Jim Alfano** and UNL's Schnable co-lead Aim 4, working to determine the impact of plant root exudate composition on both plant phenotypes and rhizobiomes under various growth conditions. This Aim's long-term cropping systems, nitrogen studies and undisturbed prairie are key assets, and its above-ground phenotyping work has progressed, along with microbiome analyses.



Augmenting the CRRRI team, two new hires arrived in 2018 and began work at Nebraska: UNL associate professors **Marc Libault** (*left*), a recent NSF CAREER Award recipient who previously worked at the University of Oklahoma, and **Katarzyna (Kasia) Glowacka** (*bottom, right*), formerly with the University of Illinois at Urbana-Champaign. CRRRI strengthened its expertises by inviting UNL engineers **Yufeng Ge** and **Rajib Saha**, biochemist

Toshihiro Obata, and plant scientists **Jinliang Yang** and **Brandi Sigmon** to join the CRRRI team. To broaden participation in STEM, CRRRI investigators—including **Paul Twigg** and **Julie Shaffer** with University of Nebraska at Kearney, and **Karin van Dijk** at UNL—led plant science-themed camps for Young Nebraska Scientists middle schoolers and high schoolers. Summer 2018 also provided three Research Experiences for Undergraduates (REU) students to learn with CRRRI hosts. (See YNS and REU stories in this publication's Education section.)



(Top) Students and faculty from Nebraska's Southeast Community College attend the 2018 Nebraska Research & Innovation Conference (NRIC) about microbiomes. (Middle) A speaker listens as a student shares her research. (Bottom) CRRRI colleagues (at right) discuss a root tube from their research in a media interview simulation.



CRRRI Conference Engages Researchers Across Microbiomes

A TWO-DAY SYMPOSIUM, “Microbiomes From Different Habitats: Soil, Water and Gut,” gathered more than 200 scientists, agricultural producers and media representatives: Oct. 16-17 at the Embassy Suites Hotel in downtown Lincoln. Speakers included The Atlantic's **Ed Yong**, plus researchers on microbial life; a special session added an interactive workshop on how scientists can succeed in media interviews.

In addition to the renowned microbiology experts, the 2018 NRIC welcomed students from across the Midwest region—including groups from Sinte Gleska University (a tribal college in South Dakota) and biotechnology students from Nebraska's Southeast Community College.

The 2018 Nebraska Research & Innovation Conference (NRIC) was the newest event in an annual series conducted by Nebraska EPSCoR and funded by the National Science Foundation (NSF). **Daniel Schachtman**, director of the UNL Biotech Center and an aim co-leader with the NSF-funded Center for Root & Rhizobiome Innovation, was this year's conference program chair.

TOM CLEMENTE, JINLIANG YANG, JAMES SCHNABLE and YUFENG GE are investigators on a multi-state NSF EPSCoR Track 2 project studying sorghum. They began working together on Nebraska's NSF EPSCoR Track 1 team, the Center for Root and Rhizobiome Innovation.

TRACK 2

NSF AWARDS \$3.9M EPSCoR RII TRACK-2 FEC PROJECT TO ALABAMA, NEBRASKA PARTNERSHIP



IN 2016 THE NATIONAL Science Foundation established the Center for Root & Rhizobiome Innovation (CRRI) here—researching interactions of soil, water and chemicals to advance agricultural yields to help better feed the world. To compete for an NSF RII Track-2 award, CRRI formed a team including University of Nebraska-Lincoln faculty: **Tom Clemente**—a leading expert in plant transformation and genome editing, **James Schnable**—a rising plant geneticist connecting genotype and phenotype across multiple grass species, **Yufeng Ge**—an engineer fascinated by using new and emerging technologies to image and quantify plants, and **Jinliang Yang**—a new assistant professor focused on the population genetics of corn

In 2018 these four began partnering with Alabama's HudsonAlpha Institute for Biotechnology, an agricultural genomics research and education center, to investigate how sorghum responds to nitrogen-based fertilizer and educate the next generation of scientists in agrigenomics. Announced in October, their four-year, \$3.9 million grant from the National Science Foundation (NSF) is a Research Infrastructure Improvement (RII) Track-2 Focused EPSCoR Collaborations (FEC) project, will conduct cutting-edge plant genomics research to better understand how nitrogen affects plant growth and development.

As this Track-2 project's work starts in Huntsville and Lincoln, the Nebraska team's efforts include CRISPR-Cas9 gene editing and automated phenotyping with the

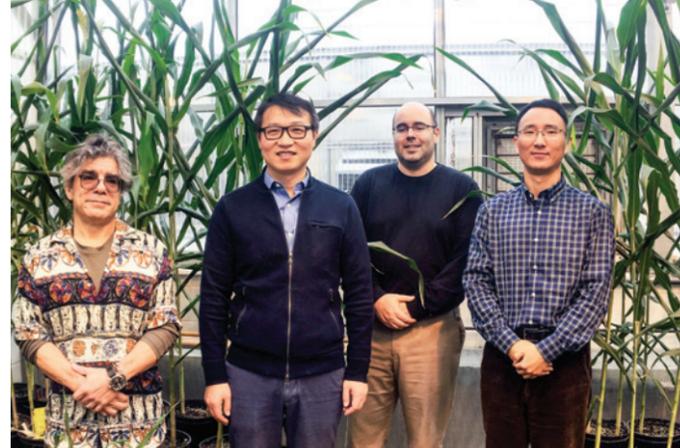
state-of-the-art LemnaTeC high-throughput system for imaging large plants at Nebraska Innovation Campus.

HudsonAlpha's **Jeremy Schmutz**, the project's principal investigator, said, "We need to find solutions that make our crops more efficient—for both food and biofuel sources."

"This multidisciplinary team brings together expertise in plant genetics, genomics, biotechnology, and engineering to address the grand challenge of improving nitrogen use efficiency in sorghum, a valuable feedstock in the bioeconomy," said Clemente. "Importantly, the outcomes of this project will have translational impacts on other plant species, critical to the country's agriculture sector of the economy."

"The thing to remember is that we still know so little about how plants perceive and react to change in their environments," Schnable added. "Helping plants use nitrogen more efficiently is beneficial, and any change in how these sorghum plants behave after a genome edit tells us more about the role of both individual genes and networks. Changes produced by each edit, whether expected or unexpected, get fed back into improving our models, so we're better able to choose and predict the next batch of edits to make."

In addition to the genomic research, this biotech project includes a workforce development component: a set of experiences promoting agrigenomic-related careers, a multi-week summer academy for high school students, undergraduate mentoring and internship opportunities.



TRACK 3

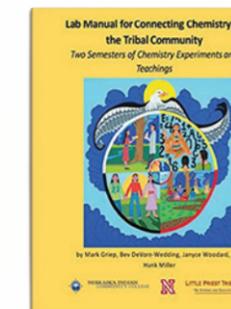
STEM "FRAMING" PROJECT CULMINATES IN CURRICULUM

FRAMING THE CHEMISTRY CURRICULUM, a Track-3 award from National Science Foundation (NSF) EPSCoR, funded a collaboration with Nebraska's tribal colleges to re-establish STEM courses with a Native American community focus.

In 2018, the fifth year of the \$749,285 grant (extended by NSF into 2019), the project published a multi-semester manual for its chemistry laboratory experiments that are adaptable for use by other tribal colleges and community colleges. The lab manual was developed to accompany a General, Organic, and Biochemistry course sequence.

Mark Griep, an associate professor with the University of Nebraska-Lincoln Department of Chemistry and the project's principal investigator, formed a team of Nebraska's tribal college science educators to develop chemistry curriculum relevant to tribal community topics. The labs—which include background information, community connections, a prayer, lab protocols and procedures, and suggestions for the lab report—can be performed by students alone or in pairs, and require about 2.5 hours to complete if the reagents and materials are ready.

Because of the Framing project, more than 20 students have taken a chemistry course in the past five years at Nebraska Indian Community College—with locations in Macy, Santee and South Sioux City. Little



THE MANUAL'S CONTENT INCLUDES THE FRAMING COURSE'S FIRST SEMESTER CURRICULUM TOPICS:

1. Safety, Equipment, and Measurement
2. Density (of seeds and beans of the "Three Sisters" crops)
3. Chocolate Density
4. Liquid Density
5. Period Table of Videos
6. Water Quality Analysis (of samples brought by students from home or elsewhere)
7. Water Purification
8. Soil Quality Analysis (of samples brought by students)
9. Herbicide Bioassay (using water samples brought by students)
10. Plant Pigments: Extraction, Chromatography, & Spectrometry
11. Endothermic and Exothermic Reactions—Hot & Cold Packs
12. Molar Mass of Butane in Lighters

Source: <https://amzn.to/2zFLZm>

Priest Tribal College in Winnebago has always offered a low-enrollment chemistry sequence; now it is attracting over six students a semester. The full-time enrollment at each college is between 150 and 180 students. A UNL College of Education and Human Sciences graduate student, Bev DeVore-Wedding, earned her doctorate degree in 2017 while working on the Framing project, and then helped publish related research as a postdoctoral research associate in Griep's lab.

Thanks to the committee of Nebraska tribal college science leaders, the courses are poised to continue, Griep added, and the curriculum is being considered for implementation at other states' tribal colleges.

"Framing the Chemistry Curriculum" PI **MARK GRIEP** shares project information at a Nebraska EPSCoR gathering.



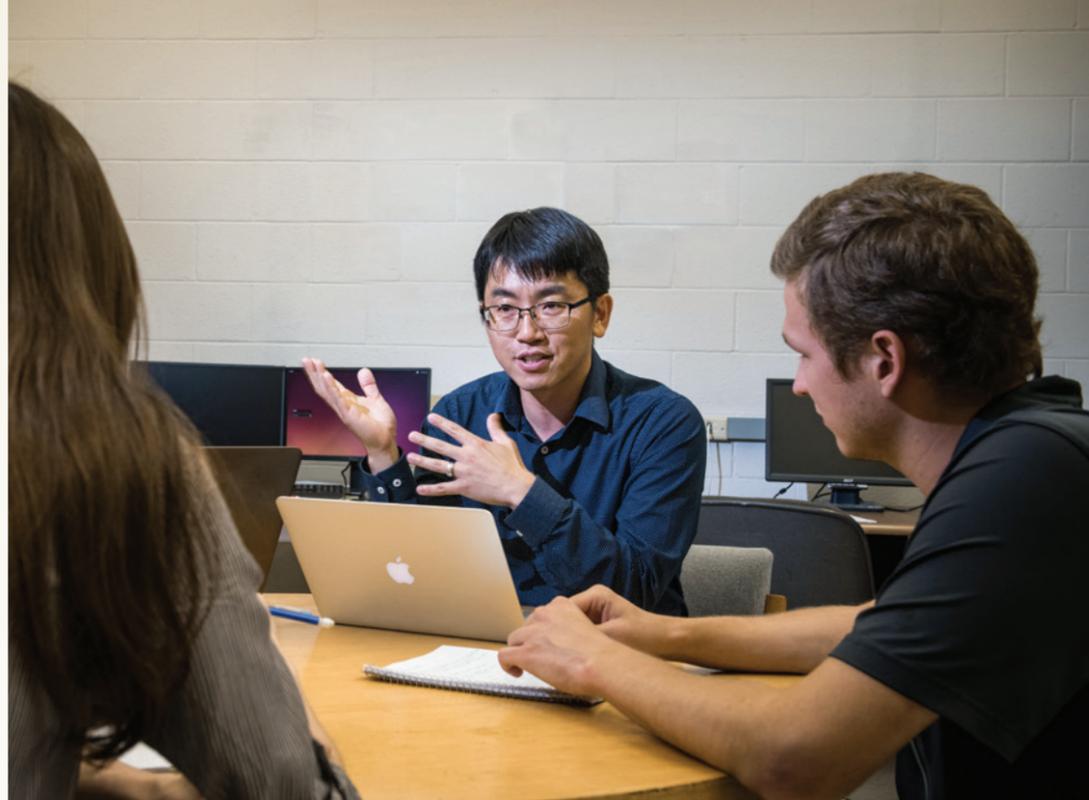
TRACK 4

NEBRASKA FACULTY GAIN NSF EPSCoR TRACK-4 FELLOWSHIPS



The National Science Foundation's Established Program to Stimulate Competitive Research (EPSCoR) promotes competitive EPSCoR Track-4 fellowships that provide opportunities for non-tenured investigators to further develop their individual research potential through extended collaborative visits to the nation's premier private, governmental, or academic research centers. During these visits, EPSCoR Research Fellows learn new techniques, develop new collaborations or advance existing partnerships, benefit from access to unique equipment and facilities, and/or shift their research toward potentially transformative new directions.

The experiences gained through these fellowships are intended to have lasting impacts that will enhance the fellows' research trajectories well beyond the award period. The benefits to the fellows are also expected to improve the research capacity of their institutions and jurisdictions more broadly.



(LEFT) UNL Assistant Professor **JAE SUNG PARK** meets with students in his lab.

UNL's Park Receives NSF Fellowship to Develop Turbulence Expertise at Nebraska Engineering

Nebraska Engineering's **Jae Sung Park** earned a \$177,433 fellowship opportunity over two years from the National Science Foundation (NSF), to collaborate with a leader studying turbulence in the field of fluid mechanics.

Park, an assistant professor with the University of Nebraska-Lincoln (UNL) Mechanical & Materials Engineering (MME) Department, will work with Dr. **Ellen Longmire** at the University of Minnesota (UMN). Park looks forward to applying his computational and mathematical approach to predict turbulent dynamics between ordered flow structures at UMN's state-of-the-art interdisciplinary research facilities, with cutting-edge experimental tools such as flying Particle Image Velocimetry.



With NSF EPSCoR Fellowship, University of Nebraska at Kearney Harner Studies and Shares River Science

WHEN **MARY HARNER** LOOKS to the future, a river runs through it. She has said, "Because rivers provide water that is essential for supporting human life and biodiversity, people are searching for ways to manage rivers to meet societal and ecosystem needs as human populations and demands for freshwater increase globally."

An associate professor at the University of Nebraska at Kearney, Harner earned a two-year RII Track-4 "EPSCoR Fellows" award for \$230,932: to study Integrative Multimodal Strategies for Advancing Ecosystem Monitoring and Science Communication with a focus on rivers.

According to Harner's project overview, communication among diverse stakeholders is necessary for solutions to utilize and protect freshwater resources. She aims to identify and share perspectives on river ecosystems with varied public audiences, improving both understanding of these complex systems and access to knowledge as people decide the future of rivers.

Fellowship activities will be conducted in collaboration with the University of New Mexico, where Harner and a trainee-level researcher will investigate influences on water-use decisions and develop approaches for applying digital technologies, like time-lapse camera systems and sound recorders, in creative ways to inform and connect within and across river systems.

Outcomes will help to establish a framework for understanding and conveying complex river science, increase public scientific literacy about ecosystem connections in river-floodplain systems, and provide people with a deeper connection to rivers and the coupled human-environmental systems they sustain.



YNS GROWS OPPORTUNITIES

NEBRASKA EPSCoR'S YOUNG NEBRASKA Scientists programs—camps, high school researcher opportunities, and mobile labs—help students' career interests take root in science, technology, engineering and math (“STEM”) fields.

Current YNS camps include:

- for middle schoolers: Soil & Plants in Agriculture Camp* (SPAC) and CyberCamp at University of Nebraska at Kearney (UNK), and Secret Life of Metals (chemistry) at Creighton University
- for high schoolers: Biodiversity at Cedar Point Biological Station, Life Underground: Unseen Power of Microbes at University of Nebraska-Lincoln (UNL), and CyberCamp at UNK.

YNS also provided paid placements for High School Researchers (HSRs) to work in Nebraska higher education labs.

YNS Mobile Labs provided advanced equipment themed with Nebraska schools' current secondary science curriculum. Teachers request mobile labs sets from Nebraska EPSCoR, which ships them (free of charge) to requesting schools throughout the state; when the unit is completed, teachers return the materials (also at no cost to schools). YNS Mobile Labs reach hundreds of ethnically, geographically and socio-economically diverse Nebraska students each year.



HSRs **DANNY SCHROEDER** (left) and **SAMI REESE** (right) work with graduate student **MICHAEL TROSS** at Doane University.



(Top) University of Nebraska at Kearney SPAC students bring local soil samples for analysis with **RAY WARD** at Ward Labs. (Bottom) University of Nebraska-Lincoln UNL Biochemistry Associate Professor **KARIN VANDIJK** leads Microbes campers.



Beyond YNS, Research Experiences for Undergraduates (REU) students gain experience at CRRRI labs and field sites. **CHLOE JENSEN** (College of Saint Mary), **KAMI KUCERA** (Nebraska Wesleyan University) and **ASHLEY FOLTZ** (University of Wyoming) gather at UNL's Summer 2018 Research Symposium, where Jensen's poster was awarded top honors.

New Outreach Coordinator Joins NE EPSCoR

NICOLE BUSBOOM JOINED NEBRASKA EPSCoR in August of 2018. She earned her Bachelor of Science degree from the University of Nebraska-Lincoln, where she majored in Nutritional Science & Dietetics and had a minor in Agriculture Leadership Education & Communication. She previously worked as EFNEP Extension Assistant with Nebraska Extension. She is currently pursuing a master's degree at UNL in Youth Development. With Nebraska EPSCoR, her work includes leading Young Nebraska Scientists in bringing STEM (science, technology, engineering and math) opportunities to students and classrooms throughout the state.



YNS 2018 Program Locations



Also, YNS Mobile Labs visit dozens of secondary classrooms throughout Nebraska each year.

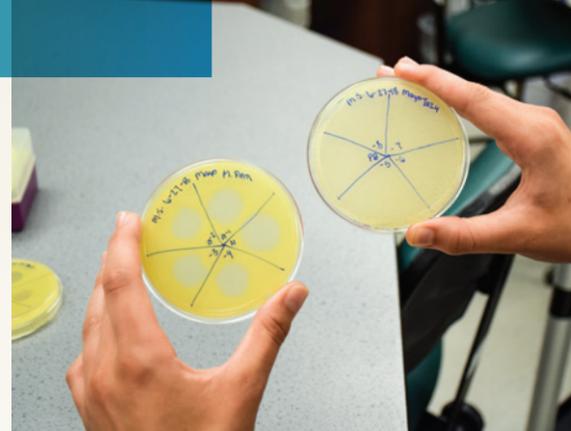
NWU STUDENTS GAIN SKILLS IN BIOLOGY SUMMER SEMINAR

Nebraska Wesleyan University (NWU) Biology Professor **Angela McKinney** had long hoped to lead an intensive summer research program for her students, and funding via Nebraska EPSCoR finally made it possible.

FOR THE MONTH OF June 2018, 10 NWU undergraduate students—who had just completed the introductory biological inquiry course at NWU and expressed interest in pursuing biology careers—were guided by McKinney and two upper-class students.

“Each student worked on three different projects all related to bacteriophage (virus that infects bacteria) biology,” said McKinney. “Students were exposed to different aspects of research that included making media, performing experiments, keeping a laboratory notebook, reading and discussing scientific articles related to the research, and communicating their findings in writing and orally.” The latter included forming 3–4 person teams and giving a formal presentation, plus generating research posters.

Students’ post-experience comments indicated they had gained confidence in their ability to work in a laboratory setting, learned valuable research skills, improved their critical thinking skills, made connections



(BELOW) **ANGELA MCKINNEY** (left) leads Nebraska Wesleyan students in biology study of bacteriophages. (LEFT) comparing research results.

between scientific literature and what they were doing in the laboratory, and developed experience in presenting their findings to others.

“Feedback from students about their experience was overwhelmingly positive,” McKinney added. “They were surprised at how much they were able to accomplish in such a short amount of time and how much they learned. Students also commented that the experience could have been 2–4 weeks longer.”

Nebraska EPSCoR made possible an “ideal mentoring environment for Dr. McKinney and her students, who worked side by side in a laboratory setting during the summer,” said NWU Provost **Graciela Caneiro-Livingston**. “Since the students were at an early stage in their education, this experience allowed them to reinforce their identity as future scientists. This program is a model for the type of mentoring our university seeks to provide for every student.”



UNK undergraduates **TRENTYN RUHL** (left) and **CAM GEIGER** test using corn waste in concrete, for a Nebraska EPSCoR-funded research project with Assistant Professor Mahmoud Shakouri.



SMALL COLLEGE AND UNIVERSITY UNDERGRADUATE RESEARCH AWARDS

MARC ALBRECHT

Department of Biology, University of Nebraska at Kearney

“Aquaponic Production in Nebraska Comparing System Design and Fish Food Made with Agricultural Products”

JOEL BERRIER

Department of Physics & Astronomy, University of Nebraska at Kearney

“Detecting Cosmic Confusion Noise From Merging Compact Objects”

NATE BICKFORD

Department of Biology, University of Nebraska at Kearney

“The Connection Between Land Use Change, Habitat Fragmentation, and Wildlife in an Agriculturally Dominated System”

DANE BOWDER

Department of Chemistry, Doane University

“Assessment of the Restrictive Effect of the IFITM Proteins on Small Ruminant Lentiviruses”

CHRISTOPHER HUBER

Department of Chemistry, Doane University

“Quantification of Small Molecule Blood Toxins via Surface Enhanced Raman Spectroscopy”

PHILIP LAI

Department of Communication Disorders, University of Nebraska at Kearney

“A Qualitative and Quantitative Study Investigating the Social and Affective Phenotype in Children With Autism and in Children with Early Unilateral Brain Damage”

BRETT SCHOFIELD

Department of Biology, Doane University

“Establishing a Timeline of Molecular Events Induced by Chromatin Architectural Proteins”

MAHMOUD SHAKOURI

Department of Industrial Technology, University of Nebraska at Kearney

“Effect of Corn Cob Ash on Corrosion-Resistance and Chloride Ion Permeability of Concrete”

LADAN GHAZI SAIDI

Department of Communication Disorders, University of Nebraska at Kearney

“Cognitive Control in the Presence of Interfering Noise: a Comparison of Monolingual and Bilingual Older Adults”



COBRE NEWS

IN 2018, THE UNIVERSITY of Nebraska Medical Center (UNMC) received an \$11 million grant from the National Institutes of Health (NIH) for a new COBRE (Centers of Biomedical Research Excellence) award.

The goal of this new Nebraska Center for Molecular Target Discovery and Development is to establish and expand physical and intellectual resources at the University of Nebraska Medical Center (UNMC) and the University of Nebraska system that will catalyze the ability of its faculty to define, validate, and develop potential therapies against molecular targets for clinically important diseases.

Rob Lewis, Ph.D., with UNMC’s Eppley Institute is the Center’s principal investigator. His new Center aims to maximize investment from both the COBRE award and UNMC to enhance the research capabilities of the Institution, expand the translational capabilities of its faculty, facilitate career advancement of promising junior faculty in the area of targeted therapeutics, and efficiently drive discovery and development for the improvement of human health in Nebraska and the nation.

This Center will create critical infrastructure for the discovery and validation of molecular effectors critical to the development of disease, deliver training and mentoring to promising new investigators willing and able to use that infrastructure to validate those effectors as therapeutic targets, identify small molecules for their manipulation, and create in vitro and in vivo preclinical models for their development as novel therapies.

This Center’s investigators share a common belief that many diseases can be effectively classified and characterized through detailed genomic, genetic, and molecular analyses to identify drivers and vulnerabilities from which will emerge unique therapeutic approaches. The Center and its investigators aim to: 1) Establish an Administrative Core and mentoring programs to support and enhance research in target discovery and development; 2) Establish a critical mass of investigators focused on the identification, validation and development of therapeutic targets for disease treatment; and 3) Increase research capacity through scientific cores for high throughput chemical, RNAi and computational screening; mass spectrometry; and target validation.

PAUL SORGEN, a professor of biochemistry and molecular biology at UNMC, worked several years with Turpen who retired in 2018 from being Nebraska INBRE’s founding director. Sorgen earned his bachelor’s and doctoral degrees in zoology and biochemistry and molecular biology, respectively, from the University of Florida, then gained an NIH postdoctoral fellowship and worked at New York’s Albert Einstein College of Medicine. After joining UNMC in 2003, Sorgen grew his research program that studies changes in connexin distribution, density and other characteristics of arrhythmic heart disease; he also served as an INBRE mentor.

Congratulations to **Tatiana Bronich**, Ph.D., UNMC College of Pharmacy: in 2018 she earned an NIH CoBRE “Phase III” award for \$1.14 million, that will continue to grow and develop the Nebraska Center for Nanomedicine, generating strategies to transform medicines and make them more effective in reaching their targets.

INBRE NEWS

PAUL SORGEN, PH.D. SUCCEEDED James Turpen, Ph.D. as program director / principal investigator for Nebraska’s Institutional Development Award (IDeA) Networks of Biomedical Research Excellence (INBRE) program, funded by the National Institutes of Health (NIH).

Since 2001, Nebraska INBRE has engaged our state’s students and faculty in developing medical research resources and relationships at the program’s nine participating undergraduate institutions (PUIs) statewide—with students accessing strong hands-on laboratory experiences in-state for their health research careers. Each year, summer months’ research experiences in Tier 1 host labs including University of Nebraska Medical Center (UNMC), Creighton University, and University of Nebraska-Lincoln. These scholars also work with mentors at their home campuses, and benefit from a two-year term—longer than most of the other 20+ INBRE states—including statewide journal clubs, presentations and networking.



UNO, UNL Collaboration Builds Device for NASA

A mechanical engineer, a biomechanics expert and a computer scientist meet in a lab...

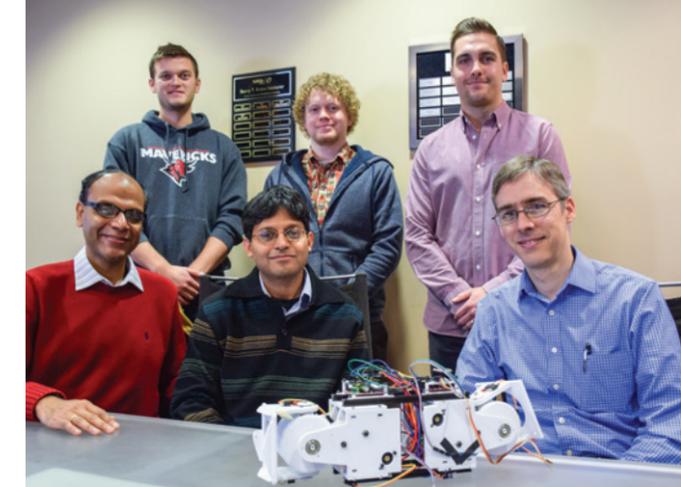
THAT’S NOT THE SETUP for a joke; it’s the premise for a collaborative Nebraska project that could help astronauts in space to have better exercise opportunities, easing their return to earth gravity.

NASA EPSCoR funded a Nebraska team for three years at \$750,000 (with an additional \$750,000 in matching funds from participating campuses) to develop a Modular Robotic Suit (MORS) for Muscular Rehabilitation.

Prithviraj (Raj) Dasgupta, professor of Computer Science at the University of Nebraska Omaha (UNO) is the principal science investigator for the grant, alongside investigators **Carl Nelson**, professor with University of Nebraska-Lincoln (UNL) Mechanical & Materials Engineering, and **Mukul Mukherjee**, associate professor with UNO Biomechanics. Together the MORS team is developing a wearable modular robotic system for assessing human movement and providing different types of exercises for the user.

Their MORS proposal was a top entry for Nebraska in the 2017-18 NASA EPSCoR competition, earning national funding among other eligible NASA EPSCoR locations. The design process started with data inputs from the biomechanics group, including Ph.D. student **Zach Motz** and master’s student **Kyle Brozek**, who applies his undergraduate learning from UNL Electrical and Computer Engineering to the project.

These inputs then inform Nelson’s group: Ph.D. student **Jay Chae** and master’s student **Mitchell Bruckner** to modify their model robot nicknamed “MARIO”—the size of a large loaf of bread, with articulated sections and docking port. MARIO was developed under funding from



the University of Nebraska’s System Science program with Madonna Rehabilitation Hospitals and shares some desired design features with MORS, but needs specialized sensor capabilities.

The computer scientists, including UNO undergraduate **Steven Belcher**, then generate artificial intelligence and machine learning-based algorithms that would enable MORS to perform its assigned tasks autonomously, without requiring continuous human intervention or supervision. Nelson said the multi-disciplinary teamwork and design-build opportunity make this an enjoyable creative experience—plus MORS may help improve health outcomes for its users.

In space, human perceptions (visual, vestibular and proprioceptive) can be distorted and unreliable; estimating and achieving accurate body movements based on such feedback is therefore more difficult in reduced gravity, Mukherjee said. With battery-powered MORS attached across the upper back, or reconfigured along an arm or leg, an astronaut’s exercise movements in space can be accurately measured and tracked. “(MORS) may provide resistance and assistance for the user, as needed,” Nelson explained.

The team intends that the MORS system will help not only astronauts who spend long periods of time in space and experience muscle atrophy, but will also serve people with sensorimotor problems such as strokes, Parkinson’s Disease, and cerebral palsy. The MORS team plans to pursue further funding to engage commercialization via small businesses in fulfilling that goal.

(ABOVE) MORS team members meet at UNO Biomechanics; the “MARIO” robot shown here is from a separate modular robotics project supported by NU System Science. From left are **RAJ DASGUPTA, KYLE BROZEK, MUKUL MULCHERJEE, STEVEN BELCHER, ZACH MORZ** and **CARL NELSON**.

NEBRASKA, TUSKEGEE FORM NSF-FUNDED MATERIALS RESEARCH PARTNERSHIP

IN ONE OF EIGHT PREM (Partnership for Research in Materials) projects announced across the nation in 2018, Alabama's Tuskegee University and the University of Nebraska-Lincoln (UNL) will work together to address critical issues in materials science research, education and outreach. This six-year, \$3.9 million collaboration, funded by the National Science Foundation (NSF), will engage faculty and students at both universities to work collaboratively on unique multiferroic polymer nanocomposites for structural, energy and sensing applications.

A goal of this partnership is to recruit, retain, educate and train the next generation of scientists and scholars in this multidisciplinary field, and specifically to grow the number of African American graduates in emerging fields of materials science and engineering, through exposure to Nebraska MRSEC (Materials Research Science and Engineering Center) facilities and educational activities.

Professor **Vijaya Rangari** with Tuskegee's College of Engineering, and principal investigator on the project, praised Nebraska EPSCoR for the initial contact. "At a national EPSCoR meeting, I met (Nebraska EPSCoR Director) **Fred Choobineh**, and mentioned Tuskegee was seeking a MRSEC partner for this PREM proposal with a short deadline," Rangari said. "Fred promptly connected me with **Evgeny Tsymbal** (who leads Nebraska MRSEC), and we were able to proceed very quickly and successfully." NSF EPSCoR is co-funding the project.

Rangari added that Tuskegee, a Historically Black College and University (HBCU), has had arrangements with MRSEC facilities at Cornell University and the University of Wisconsin, and Tuskegee leadership is pleased to add a new partner.



From left, Tuskegee University's **ALFRED TCHERBI-NARTEH**, assistant professor of Materials Science and Engineering, and **MARIA CALHOUN**, associate professor of Mechanical Engineering, joined **VIJAYA RANGARI** in visiting **JEFF SHIELD**, professor and chair of UNL Mechanical & Materials Engineering.

NSF EPSCoR CO-FUNDING

IN 2018, NATIONAL SCIENCE Foundation co-funding brought \$2,151,073 to Nebraska; \$1,084,670 of the year's total was from NSF EPSCoR. Recipients were:

LINDA KALBACH, PI; ROD DIERCKS, SHARMIN SIKICH, Co-PIs | Doane University: U.S. Dept. of Education | Developing STEM Educators with Resilience, Vision, and Expertise for Teaching in High-Need Schools

SHUDIPTO DISHARI | University of Nebraska-Lincoln (UNL) Dept. of Chemical & Biomolecular Engineering | CAREER: Confined Ionomeric Systems and Imaging of Ionic Distribution

MATHIAS SCHUBERT | UNL Dept. of Electrical & Computer Engineering | The Influence of Doping and Annealing onto the Lattice Dynamics, Band Structure and Free Charge Carrier Properties in Monoclinic Gallium Aluminum Oxide Semiconductor Alloys

LUCIA FERNANDEZ-BALLESTER | UNL Dept. of Mechanical & Materials Engineering | Nucleation Control of Conjugated Polymers through Melt-Crystallization and Self-Seeding

COURTNEY HILLEBRECHT | UNL Dept. of Political Science | Collaborative Research: Examining Compliance with Rights Regimes

KYUNGYONG LEE | UNL Dept. of Mathematics | Cluster Algebras, Quiver Representations, and Rigid Curves

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 over time, from 2008 through 2018. Total 2018 federal EPSCoR/IDEA funding to Nebraska was \$31,155,918—making a cumulative total of federal EPSCoR/IDEA funding to Nebraska: \$408,537,811 since 1991.

