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Dr. Jugal K. Patel, Chair, 2018-2020, Nebraska EPSCoR/IDeA Program

Dr. Steven P. Wente, President, University of Nebraska System

2018 Annual Report
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.
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.

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 Marmelat, University of Nebraska at Omaha, Biomechanics — “Neural Mechanisms Underlying Sensorimotor Synchronization with Fractal Rhythms”
- Dr. Alexandra Secileanu, 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”

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

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
- 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
- Scott Snyder, former UNO Associate Vice Chancellor for Research and Creative Activity, Past Dean of the College of Science and Engineering at Idaho State University

Thank You to Departing Members of the Committee:

- Joe Fox, Nebraska Department of Economic Development
- Steve Goodard, former UNL Interim Vice Chancellor for Research and Economic Development
- Lyle Medendorp, who chaired Nebraska EPSCoR’s State Committee for 11 years and served on the committee for 24 years. An LS-COR Biosciences’ Senior Vice President and Chief Technology Officer, he led the meetings of the committee and represented Nebraska EPSCoR at several national EPSCoR/IDeA conferences.
- Terril Wasmien, formerly with Merck Animal Health

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CRRI 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 CRRI 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. CRRI 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 CRRI team. To broaden participation in STEM, CRRI 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 CRRI hosts. (See YNS and REU stories in this publication’s Education section.)
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 genome editing, a new assistant professor focused on the state-of-the-art LemaTec 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.”

In 2018 the team partnered with Alabama’s HudsonAlpha Institute for Biotechnology, an agricultural genomics research and education center, to investigate how sorghum responds to nitrogen-based fertilizer and how sorghum affects plant growth and development. As this Track-2 project’s work starts in Huntsville and Lincoln, the Nebraska team’s efforts include CRISPR—a new assistant professor focused on the genome editing, a rising plant geneticist connecting genotype and phenotype across multiple grass species, critical to the country’s agriculture sector of the economy.”

In addition to the genomic research, this biotech project is formed a team of Nebraska’s 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**, a Track-2 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 $758,282 grant (extended by NSF into 2019), the project published a multidisciplinary manual for 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, 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 leaders, the courses are poised to continue, Griep added, and the curriculum is being considered for implementation at other states’ tribal colleges.

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. Chemical Density
4. Liquid Density
5. Period Table of Elements
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 Biosay (using water samples brought by students)
10. Plant Pigments: Extraction, Chromatography, & Spectrometry
11. Endothermic and Exothermic Reactions—Heat & Cold Packs
12. Molar Mass of Butane in Lighters

**Framing the Chemistry Curriculum** PI Mark Griep shares project information at a Nebraska EPSCoR gathering.

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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.

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 systems, 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.
Beyond YNS, Research Experiences for Undergraduates (REU) students gain experience at CRRI 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 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.

YNS 2018 Program Locations

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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 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."

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"

Rate 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 Bonder
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"
This Center's investigators share a common belief that many diseases can be effectively targeted for prevention and cure by the discovery and validation of therapeutic effectors. The Center is organized to provide the resources and infrastructure to identify 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 molecular effectors, and enhance the research capabilities of the Institution, expand the translational capabilities of its faculty to define, validate, and develop potential therapies against molecular targets for clinically important diseases.

The Center and its investigators aim to: 1) Establish an Administrative Core to identify drivers and vulnerabilities from which will emerge unique therapeutic effectors as therapeutic targets, identify small molecules for their manipulation, and transform medicines and make them more effective in reaching their targets.

2) Establish critical infrastructure for the discovery and validation of molecular effectors critical to the discovery of the disease, deliver training and mentoring to promising new investigators willing and able to use that infrastructure to validate those effectors, develop novel 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 a Comprehensive and Supportive infrastructure for training and mentoring in the field of translational research. This includes the establishment of a comprehensive preclinical and clinical research program. 2) Establish a 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, develop novel small molecules for their manipulation, and create in vitro and in vivo preclinical models for their development as novel therapies.

This 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 to define, validate, and develop potential therapies against molecular targets for clinically important diseases.
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.

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