

2022

ANNUAL REPORT



IDEA
EPSCoR
NEBRASKA

Established Program to Stimulate Competitive Research

COVER IMAGE (and THIS PAGE): Research from Nebraska's Emergent Quantum Materials and Technologies (EQUATE) project, funded by the National Science Foundation's (NSF) Established Program to Stimulate Competitive Resources (EPSCoR), was featured in the journal, *Advanced Materials*. University of Nebraska-Lincoln physics professors **Peter Dowben** and **Christian Binek** collaborated with Professor **Jonathan Bird** at the University of Buffalo to investigate spin-dependent electronic transport in graphene for their studies of magnetoelectric antiferromagnetic thin film. They observed a large spin relaxation length, which is promising for developing new transistors—attracting international attention. Fundamental aspects of this work—such as quantum interference effects in the spin currents—are also investigated by EQUATE FRG 1 theorist **Alex Kovalev**.

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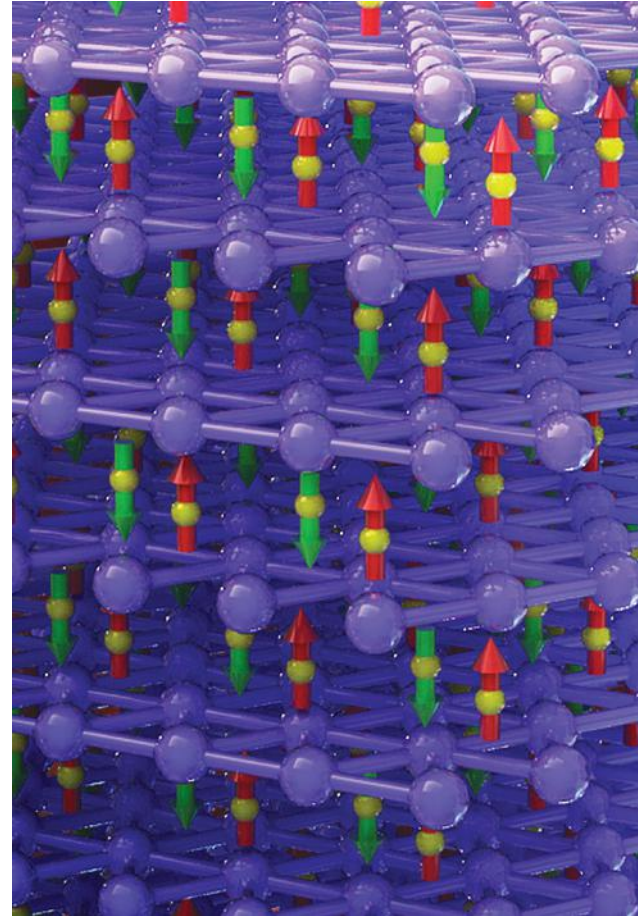
Established Program to Stimulate Competitive Research
Institutional Development Award Program

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DIRECTOR'S MESSAGE



ON AUGUST 9, PRESIDENT Biden signed the CHIPS and Science Act (CHIPS) into law. CHIPS is an acronym for Creating Helpful Incentives to Produce Semiconductors; but there is far more to this legislation than semiconductors alone. CHIPS is a congressional authorization that will also double NSF funding over a five-year period. In addition to doubling the NSF budget, CHIPS also provides an increase in the percent of NSF funding going to EPSCoR jurisdictions such as Nebraska. Therefore, the impact of this legislation

on “The Good Life” state is even greater because of EPSCoR-specific increases in NSF funding.

In fiscal year 2022, the EPSCoR amount in the NSF budget was approximately 12.6 % of research and related activities; but with the appropriation of CHIPS, this amount will increase over six years starting with 15.5% in FY23, ramping up to 20% in FY29. There is also set-aside funding for scholarships (including at community colleges), graduate fellowships and traineeships, and postdoctoral awards.

Another activity impacting Nebraska is the recent “Envisioning the Future of NSF EPSCoR” study that was conducted by 19 committee members from around the country. This “visioning committee” invited stakeholders to provide input online and via listening sessions so that the committee could make recommendations on investment strategies and opportunities to increase the future success of NSF EPSCoR. The committee made eight recommendations and 19 suggestions across the broad areas of Economic Development, Research and Infrastructure Capacity and Competitiveness, Education and Workforce Development, and Broadening Participation. Their final report is available at [nsf.gov/resources.nsf.gov/2022-08/Envisioning-The-Future-of-EPSCoR-Report.pdf](https://www.nsf.gov/resources.nsf.gov/2022-08/Envisioning-The-Future-of-EPSCoR-Report.pdf).

As 2022 draws to a close, the nationwide legislative and visioning activities described above paint a bright future for strengthening capacity and capability in science, technology, engineering, and mathematics (STEM) in Nebraska and beyond. We at Nebraska EPSCoR look forward to making this future a reality by continuing to grow Nebraska's STEM enterprise. I hope you enjoy reading about our STEM-based research, education, and outreach activities in this report. ■

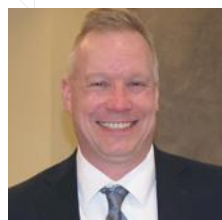


Nationwide legislative and visioning activities paint a bright future for STEM in Nebraska and beyond.”

STATE COMMITTEE

The Nebraska EPSCoR State Committee is a 19-member group, appointed by the governor, to oversee Nebraska EPSCoR's mission. In 2022, the committee noted several changes among its membership:

COMINGS & GOINGS



JON ANDERSON, PHD, MBA, departed Nebraska EPSCoR's State Committee after seven years as a committee member, including five as Committee Chair. His new position is Senior Product Manager with SomaLogic, based in Colorado.



JENNIFER LARSEN, MD, RETIRED as Vice Chancellor for Research at the University of Nebraska Medical Center, with 11 years of service on Nebraska EPSCoR's State Committee. Her successor in both roles is **Ken Bayles**, PhD, who previously served on this committee as Interim Associate Vice Chancellor for Research and Creative Activity at the University of Nebraska at Omaha.



WITH BAYLES' DEPARTURE FROM UNO, **Sara Myers**, PhD, was named UNO's Interim Associate Vice Chancellor for Research and Creative Activity. Previously, Myers was UNO's Assistant Vice Chancellor for Research (focused on STEM disciplines) and professor in the Department of Biomechanics.



CHARLIE BICAK, PHD, RETIRED from the University of Nebraska at Kearney after 13 years as Senior Vice Chancellor of Academic Affairs, and 13 on Nebraska EPSCoR's State Committee. He is succeeded by **Kristen Majo**, PhD, who previously held several dean positions with higher education institutions in Pennsylvania.

RE-APPOINTED

- **Jerry Hudgins**, PhD—Professor, University of Nebraska-Lincoln
- **Yuri Lyubchenko**, PhD—Professor, University of Nebraska Medical Center
- **Roni Reiter-Palmon**, PhD—Professor, University of Nebraska at Omaha
- **Juliane Strauss-Soukup**, PhD—Associate Vice Provost for Research and Scholarship, Creighton University

Thank you to all members of the Nebraska EPSCoR State Committee for your expertise and energy!

Martin to lead State Committee



AT THE ANNUAL MEETING of Nebraska EPSCoR's State Committee in November, Dr. **Tyler Martin** was unanimously elected by the group to serve as the committee's chairperson.

Martin grew up in Hebron, Nebraska, and has more than 30 years of experience in the biotechnology industry. After earning his bachelor's degree with honors from the University of Nebraska at Kearney, and an MD degree from the University of Nebraska College of Medicine, he was a resident in Pediatrics at the University of Nebraska Medical Center and a post-doctoral fellow in Molecular Microbiology and Pediatric Infectious Diseases at Washington University in St. Louis, where he was named the outstanding teaching fellow at St. Louis Children's Hospital.

Martin has led development activities to support more than 100 Investigational New Drug (IND) Applications and developed four drugs that eventually received FDA or EMA approval. He has held senior leadership positions with several successful biotech companies including Chiron, Sangamo, and Dynavax. He returned to Nebraska with plans to start a consulting practice and biotech incubator. Today, Dr. Martin is the Chairman and CEO of Great Plains Biotechnology, a consulting company with headquarters in Lincoln. He is currently Chairman & CEO of Aeolian Biotechnology Corporation, a private vaccine company developing an improved pneumonia vaccine.

He was appointed by the governor to the Nebraska EPSCoR State Committee in 2014. Martin also serves on the boards of the Vaccine Policy Advisory Board of BIO, the Biodefense Policy Advisory Board of BIO, UNeMed, and Adjuvance Technologies. ■

Key Performance Indicators for Nebraska EPSCoR

With 30 years since Nebraska EPSCoR began, metrics take shape...we aim to share these "KPIs" with the State Committee and this publication's readers:

RETURN ON INVESTMENT: FIRST AWARDS TO CAREER AWARDS

NEW NEBRASKA FACULTY IN the first four years of their initial appointment are eligible to apply for Nebraska EPSCoR FIRST Awards (see pages 8-9). These \$25,000 awards prepare the FIRST Award recipients to submit CAREER Award applications to the National Science Foundation (ranging from \$500K to \$1.4 million). During the span of Nebraska EPSCoR's FIRST Award program (2004-2021):

- **72 NSF CAREER awards** have been awarded to Nebraska faculty.
- Of those awardees, **42 percent received FIRST Awards**; and further, 18 percent of unfunded FIRST Award applicants still received constructive peer reviews to help them earn CAREER awards from NSF.
- All together, **60 percent of Nebraska researchers** who received an NSF CAREER Award **were provided reviews through the FIRST Award program**. Overall, fifty-four Nebraska researchers (75 percent) who received an NSF CAREER Award were involved in the FIRST Award process.

Source: Nebraska EPSCoR files, and NSF.gov

FIRST and CAREER Awards are a sustainable investment in Nebraska's STEM enterprise as awardees gain a foundation for longterm leadership in integrating education and research. ■

NSF RII TRACK-1: EQUATE

THIS SPRING, NEBRASKA'S EQUATE (Emergent Quantum Materials and Technologies) collaboration began its second year and made the first presentation to its External Review Panel (a requirement of the funder: National Science Foundation EPSCoR). Some of the key points included:

Christian Binek, EQUATE's science director, said the project had breakthroughs and collaborative achievements involving all of its FRGs. Highlights include:

FRG1 theoretical physicist **Evgeny Tsymbal** and his team investigated antiferromagnetic materials with non-spin-degenerate Fermi surface but globally spin-independent conductance. This work is published in *Nature Communications* (12:7061. 2021). Binek and **Peter Dowben** collaborated with Professor **Jonathan Bird** at the University of Buffalo to study materials that could lead to the realization of a new type of transistor, attracting international attention. Their work, published in *Advanced Materials* (34:2105023. 2022) includes a representation featured on the cover of this publication. FRG1 leader **Xia Hong** promoted EQUATE achievements on a National Nanotechnology Initiative podcast ([youtube.com/watch?v=GXWWSG3dTQg](https://www.youtube.com/watch?v=GXWWSG3dTQg)).

FRG2 saw major advances in nanophotonics. **Mathias Schubert**—in collaboration with the Fritz Haber Institute of the Max Planck Society in Berlin, Germany, the City University of New York, Vanderbilt University, and the University of Iowa—discovered a new class of materials with exceptionally low crystal symmetry allowing for quasi excitations that the researchers call hyperbolic shear polaritons. Schubert's research has implications for compact photonic devices with applications in quantum communication (*Nature* 602:595–600. 2022).

FRG3/FRG2's **Wei Bao**, in collaboration with researchers from UC-Berkeley, created exciton polaritons in semiconductor optical cavities and achieved Bose-Einstein condensation (BEC) of the quasi-particle gas, with the BEC supporting quantum emulation, a hallmark of FRG 3 research. Regarded as groundbreaking work in quantum information science, this research was published in *Nature Materials* (21:761. 2022).



A new assistant professor, funded by EQUATE, joined the physics faculty at the University of Nebraska at Kearney. **Aleksander Wysocki** earned his doctorate in physics at the University of Nebraska-Lincoln, then worked as a postdoc at the University of Iowa's Ames Laboratory, then as a research scientist at Virginia Tech University.

Two EQUATE graduate students, **Thilini Kumari Ekanayaka** and **Jia Wang**, were chosen to present their research at the 27th NSF EPSCoR National Conference, November 13-15 in Portland, Maine. ■



FRG1: QUANTUM MATERIALS

Led by **XIA HONG**, FRG1 includes theoretical physicists and chemists who focus on Thrust A (Topology, Spin-Orbit-Coupling, and Correlation-Driven Phenomena in Emergent Ferroic Materials), Thrust B (Magnetoelectric and Valley Control of Layered 2D Materials), or Thrust C (New Materials for Spin-Qubit Systems).

FRG2: QUANTUM TECHNOLOGIES

Electrical and mechanical engineers pursue this focus, including Thrust A (Quantum Sensing and Metrology) and Thrust B (Quantum Communications). **ABDELGHANI LARAOU** leads this team.

FRG3: QUANTUM INFORMATION PROCESSING

JONATHAN WRUBEL's team of experimental physicists explores this focus including Thrust A (Quantum Emulation) or Thrust B (Quantum Computation).

Nebraska EPSCoR and the Nebraska Center for Materials and Nanoscience (NCMN) outreach specialists engage EQUATE scientists in activities coordinated with Nebraska schools, statewide (*see pages 14-15 in this publication*). The outreach team is led by **REBECCA LAI**, EQUATE's associate director.

FRG3
Quantum
Information
Processing

EQUATE's organization structure is a pyramid, with three **Focused Research Groups (FRG)**.

FRG2
Quantum Technologies

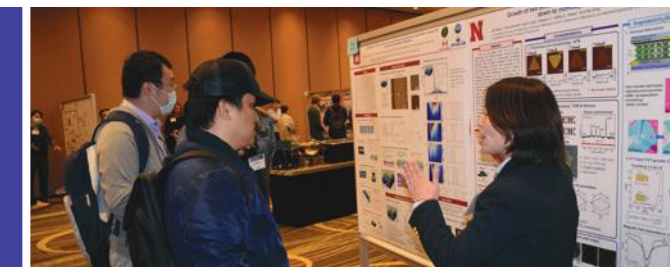
FRG1
Quantum Materials

After the death of EQUATE FRG1 physicist **RALPH SKOMSKI** in April, EQUATE's Management Team elected UNL Physics and Astronomy Assistant Professor **ROBERT STREUBEL** to the project. Skomski was a highly-regarded and prolific collaborator and writer, who specialized in theoretical physics research. Streubel is a past recipient of Nebraska EPSCoR's FIRST Award and has an active NSF grant, Magnetic Order in Disordered Dipolar Nanostructures. Streubel studied for his Ph.D. at Leibniz Institute for Solid State and Materials Research in Dresden,

Germany, and was a postdoctoral researcher at Lawrence Berkeley National Laboratory.



Part of EQUATE's strategic plan includes funding for Seed Grant Science: relevant research from additional Nebraska colleagues, especially rising early-career scientists and engineers. The first cohort chosen by the EQUATE Management Team includes: **YANAN WANG** and **SIAMAK NEJATI** from UNL College of Engineering, and **ALEXANDER SINITSKII** with UNL Chemistry.



EQUATE hosted the annual Nebraska Research & Innovation Conference (NRIC) in April, which gathered project participants from throughout the state. The event's theme was "Commercializing Quantum Technologies in Nebraska: From Research to Licensing." Speakers included physicist entrepreneurs as well as representatives from UNL's NUtech Ventures and the Nebraska Business Development Center. Each EQUATE FRG (and the Outreach team) will take a turn hosting the conference in the project's upcoming years.

▶ FIRST Awards Help Nebraska Early-Career Researchers Succeed

for these Finalists to be evaluated using NSF proposal review criteria by external experts in the relevant field. The Nebraska EPSCoR State Committee then selects FIRST Award Recipients, who are required to submit a CAREER Award proposal to NSF within the next award period. Nebraska EPSCoR's website lists FIRST Award details and deadlines. NSF's CAREER awards support pre-tenure faculty who excel at research, teaching, and the integration of those areas. FIRST Award recipients who progressed to earn NSF CAREER Awards in the past year are described below:

5-YR NSF CAREER AWARD
\$565,000



Creighton University's **Joel Destino**, Ph.D., earned a five-year, \$565,000 NSF CAREER award from the National Science Foundation (NSF). An assistant professor with Creighton's Department of Chemistry, Destino will investigate fundamental chemistry for designing novel nanoparticles that can be used to 3D print glass materials.

"From this research, we hope to identify generalizable design rules for fabricating glass by this alternative method," Destino said, "which could potentially transform specialty and advanced glass optical material fabrication."

With this NSF-funded project, Destino's also developing a learning community via modern materials science and discovery in classrooms and via research training opportunities. He aims to provide research training to aspiring high school and undergraduate researchers from diverse backgrounds. The funding enables him to hire Creighton students in the Educational Opportunity/TRiO programs (federally-funded outreach programs that offer academic, social, cultural and financial support for first-generation college students and under-served scholars), as well as summer undergraduate researchers. Students from local high schools will also join the project each summer through the Omaha-based Haddix STEM Corridor program. Destino's students will present their research to other scientists and the public at weekly scientific development workshops on campus.

Part of Nebraska EPSCoR's National Science Foundation funding (currently via the EQUATE project) supports approximately six FIRST Award grants per year; the awards are limited to \$25,000 each and require a one-for-one match. An assistant professor in a tenure-leading position at any of Nebraska's colleges or universities is eligible to submit a FIRST Award pre-proposal. The faculty member must be in his or her first four years of initial academic appointment at the time of submittal. Any project that potentially could be supported by a NSF competitive research grant is eligible. After pre-proposals are reviewed by a panel comprised of members of Nebraska's scientific community, selected proposals are invited to advance with submission of a full, NSF CAREER-like proposal. Nebraska EPSCoR arranges

Each year Destino will also engage two high school science teachers from Omaha public schools in a collaborative summer research/curriculum-building program, providing materials science research experiences and hands-on curricula development that integrate research concepts and skill-building—helping high school students gain awareness of STEM opportunities.

5-YR NSF CAREER AWARD
\$756,713

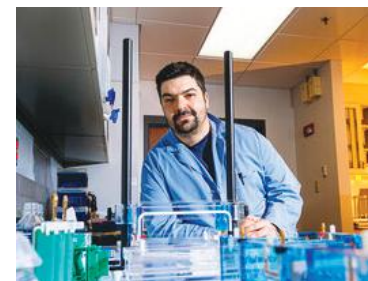


QUANTUM COMPUTING IS COMING, but today's simulators for those calculations at the nanoscale (or smaller) level require ultra-low temperatures. With a five-year, \$756,713 NSF CAREER Award, University of Nebraska-Lincoln's **Wei Bao** aims to develop such equipment that will operate at room temperature.

Bao, an assistant professor of electrical and computer engineering, is already an active collaborator with the NSF-funded EQUATE (Emergent Quantum Materials and Technologies) project via Nebraska EPSCoR. He

said his NSF CAREER Award research will help "lower the bar for a lot of researchers to access those quantum simulations."

Along the way, he'll engage Nebraska teachers and students as his team offers workshops and internships that explain quantum topics, especially for first-generation and other under-represented youth, plus he'll generate a graduate-level quantum topics course to aid workforce development in the state.



5-YR NSF CAREER AWARD
\$1.2 MILLION

A FIVE-YEAR, \$1.2 MILLION NSF CAREER Award supports **Joseph Yesselman**, assistant professor in UNL's Department of Chemistry, in his work on RNA structures. His NSF-funded project, titled

"Determining the Fundamental Rules of RNA Tertiary Contact Formation," could help advance scientists' understanding of how RNA functions—and equip them to work against viruses that harm people and other living organisms.

As the world learned from the recent COVID-19 pandemic, RNA research can shape vaccines that help protect against new viruses. Yesselman aims to produce a computational model that will help predict whether and how RNA sequences may connect, and the potential impact on other nearby molecules. He'll build on his prior work, software he developed that's called RNAMake, to analyze RNA strands as 3D structures. His next step will apply new algorithms to test and model the potential linkages.

Further research would prepare that new structure for Foldit, an online game where citizen scientists can help solve mysteries of RNA connection. A course Yesselman's preparing will also "gamify" the work, to bring along undergraduate and graduate students in this important research.

5-YR NSF CAREER AWARD
\$1.4 MILLION



AS 2022 ENDS WITH longer nights and cooler temperatures (in the northern hemisphere), **Katarzyna Glowacka** pays extra attention—specifically, to a family of grassy plants

called miscanthus and their non-photochemical quenching (NPQ) abilities. Glowacka, an assistant professor of biochemistry at the University of Nebraska-Lincoln, received a CAREER award from NSF; her five-year, nearly \$1.4 million project aims to show how the plants react to add protection from cellular damage in photosynthesis, the way plants gain energy from sunlight.

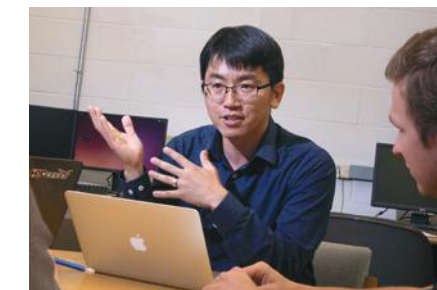
Her UNL research has the advantage of using the automated greenhouses' high-throughput phenotyping at Nebraska Innovation Campus. Glowacka is a first-

generation scientist who moved to the US from her home in Poland; after working at the University of Illinois, she was hired to UNL Biochemistry via funding from Nebraska EPSCoR's 2016-2021 NSF-funded Center for Root and Rhizobiome Innovation (CRRI). During her NSF CAREER award, she plans to draw on her background in attracting youth to the study of plants.

5-YR NSF CAREER AWARD
\$508,780

UNL'S **JAE SUNG PARK** gained a five-year, \$508,780 NSF CAREER Award. An assistant professor with UNL's Department of Mechanical and Materials Engineering, Park works on "Unraveling predictive and multiscale dynamics in turbulence for flow control." Finding patterns or orders in turbulent flows of gases and liquids, and then developing methods of exploiting those orders, could help mitigate their impact on the world.

"We can save billions of dollars in energy usage and possibly save lives by predicting cardiovascular events (such as strokes and heart attacks)," Park said, "or major weather events (such as tornadoes or hurricanes)."



2022 FIRST Award Recipients

MONA BAVARIAN, UNL Chemical and Biomolecular Engineering

MOHAMMAD GHASHAMI, UNL Mechanical and Materials Engineering

JAYNE JONAS-BRATTEN, UNK Department of Biology

GUADALUPE LEON, Doane University, Engineering and Physics

QIANG LIU, UNL School of Computing

JANE ROITSCH, UNK Department of Communication Disorders

YANAN WANG, UNL Electrical and Computer Engineering

Park focuses on both predictive and multiscale dynamics in turbulent flows to develop a more rigorous strategy for steering turbulence toward desirable states by predicting and controlling targeted vortices. On Park’s team, graduate and undergraduate students use mathematical tools and create computer models to better predict the probabilities of where and when turbulence creates a new vortex within the flow.

“Most of the energies we use for airplanes, even reducing turbulence by 5% might be enough to reduce (fuel) consumption by up to half,” Park said. “And if we can reduce air turbulence by even 1%, it’s been said we could save about \$2 billion per year in airplane fuel consumption.”

Another example he’ll pursue in this project is in collaboration with the university’s Food Processing Center on Nebraska Innovation Campus, seeking ways to reduce turbulence in piping systems that can lead to cost savings in food industries. This award’s funding will also help Park conduct outreach, teaching K-12 students about fluid dynamics in sports such as basketball and swimming.

5-YR NSF CAREER AWARD
\$550,000

NICOLE IVERSON, ASSISTANT PROFESSOR of biological systems engineering at UNL, earned a five-year, \$550,000 NSF CAREER award for her further research on carbon nanotubes’ potential as an innovative disease detection resource.

Iverson’s lab team studies nitric oxide as a key signaling molecule within the body that is associated with many inflammatory diseases, including cancer. Little is known about nitric oxide’s function in the body since it degrades very quickly. Her team works to develop and build platforms that allow for *in vitro* and *in vivo* carbon nanotube sensor use. They apply a technique they developed, pairing a nanotube that can detect hydrogen peroxide with another nanotube that detects both hydrogen peroxide and nitric oxide, to find their actual concentrations—challenging, amid a process that happens in less than a millisecond.

With this award Iverson will also share with the public how nanoscience—specifically, carbon nanotube research—can improve



medical care and human health. Advancing sensors for the body could, for example, yield an insulin detector placed annually in a human body, but offering continuous sensing (as opposed to cumbersome daily procedures).

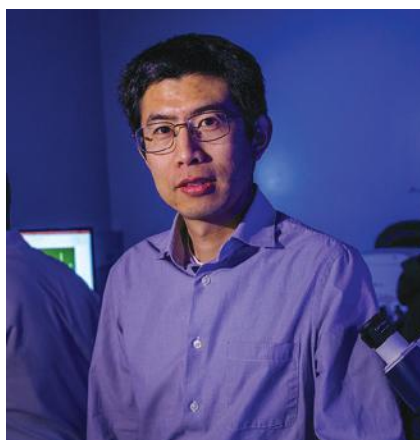
5-YR NSF CAREER AWARD
\$540,000

WITH A \$540,000 NSF CAREER Award, Ruiguo Yang, assistant professor of mechanical and materials engineering, explores how cell-cell bridges respond to strains of different magnitudes and rates. In Yang’s work at the intersection of biology and engineering, these junctions maintain tissue integrity and regulate cell-to-cell signaling; understanding their response to strain could reveal mechanics of diseases like cancer, genetic mutations in the heart, autoimmune skin conditions and more — and offer clues about how to effectively treat them.

“Our goal is to understand, when tissues are experiencing these strains, how do they respond?” Yang said.

The work builds on a paradigm-shifting study Yang’s team published last year in the *Proceedings of the National Academy of Sciences*. It recorded, for the first time, the biomechanical behavior of individual cell-to-cell junctions under defined strain — a feat made possible by the group’s fabrication of a microscopic apparatus that mimics the physiology of a cell-cell bridge. That platform is attached to an atomic force microscope, which generates displacements that replicate the strains faced by junctions in the human body.

For broader impact, Yang will engage Husker undergraduate students in his laboratory mentoring program that blends physical sciences, life sciences and engineering. Yang will include middle and high school students via use of joysticks or household gaming device controllers, to participate in various cell manipulation tasks. ■



These CAREER Award features include content from Creighton University and the University of Nebraska-Lincoln.

TRACK-2

Nebraska enters BioWRAP collaboration

A TRIO OF NEIGHBORING states’ colleges—Kansas State University, South Dakota School of Mines, and the University of Nebraska-Lincoln—received nearly \$6 million from the National Science Foundation’s Research Infrastructure Improvement Track-2 Focused EPSCoR Collaborations. This NSF RII Track-2 FEC award creates a partnership called Bioplastics with Regenerative Agricultural Properties (BioWRAP), to advance farm use of bioplastics.

The four-year project plans to connect natural and man-made systems, stopping harmful weed-crop-till cycles, and helping build green rural industries. The team will use lab and field trials, novel analytics and products, and links between people, farms, industries, and natural systems to help improve field crop sites—with an all-in-one system to better manage weeds, nutrients, soils, and water resources.

Chittaranjan Ray, director of the Nebraska Water Center, helped assemble the team. **Karina Schoengold**, associate professor of agricultural economics and faculty fellow of the Daugherty Water for Food Global Institute, leads BioWRAP’s Nebraska group, which includes **Erin Haacker**, assistant professor of earth and atmospheric sciences; **Christopher Proctor**, associate extension educator with agronomy and horticulture; **Daran Rudnick**, associate professor of biological systems engineering; and **Loren Isom** and **Mark Wilkins** with the Industrial Agricultural Products Center.

BIOWRAP’s leaders seek to reduce the use of conventional plastics, herbicides, and their associated environmental impacts in agricultural production via integrated thrust areas:

- develop bio-based polymers for use in agricultural production
- measure the agricultural effectiveness and associated environmental impacts of the technology
- estimate the potential social and economic impacts on communities and the agricultural economy of the proposed technology

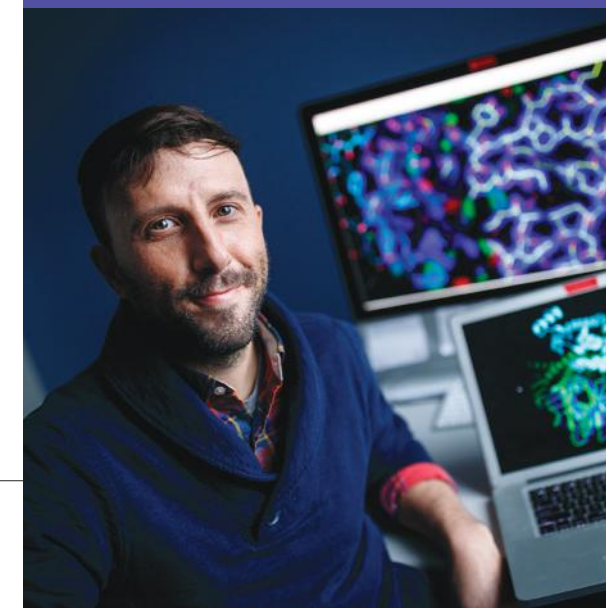
BioWRAP research includes: engineering biopolymers including functionalized PHA-based biopolymers, protein based sprayable biopolymers, and hybrid polymer systems; studying the impact of this technology on strengthening of agroecosystems by evaluation of biopolymer with respect to weed suppression and crop production efficiency, nutrient cycling, soil moisture retention and life cycle impacts along with environmental accounting; and assessing the broader impacts of the new BioWRAP technology using socio-economic analysis of product adoption and rural sustainability.

The project’s research activities aim to enable industry engagement and potential career opportunities for students in relevant industries. BioWRAP’s plan includes mentoring of early-career faculty plus students at graduate, undergraduate, and high and middle school levels, and interacting with rural communities via field days, surveys, interviews, and educational outreach activities. ■

TRACK-4

ALEX VECCHIO, assistant professor with the University of Nebraska-Lincoln Department of Biochemistry, earned an RII Track-4 fellowship award from the National Science Foundation’s (NSF) Established Program to Stimulate Competitive Research. With this \$219,836 in funding he works on “Structures of Membrane Protein Assemblies Resolved by Cryogenic Electron Microscopy.”

For this award’s two-year term, Vecchio and his team gain hands-on training in CryoEM (cryogenic electron microscopy) from experts at the Pacific Center for CryoEM (PNCC), part of the Oregon Health & Science University and the Pacific Northwest National Laboratory. After completing their training, Vecchio and his team will be CryoEM specialists, and visualize structures of the large membrane-embedded protein assemblies they study at atomic-level detail – plus share their expertise with other researchers and students across Nebraska. ■



Making a Difference at Nebraska's Small Colleges

Engaging undergraduates in research activities increases their interest in pursuing graduate and professional degrees, and helps grow the pool of potential students choosing careers in these areas. Supported by the National Science Foundation, Nebraska EPSCoR's Undergraduate Research Experience grant program adds opportunities for students in small public and private Nebraska colleges and universities that offer undergraduate degrees related to science, technology, engineering, and math. The award maximum is \$5,000 for a one-year project term.



ALLEN THOMAS, ASSOCIATE PROFESSOR of chemistry at the University of Nebraska at Kearney (UNK), liked an idea from psychobiology undergraduate **Mackenzie Hagemester** for a research project: making molecules that block the enzyme that produces melatonin in the human body's pineal gland. Hagemester aimed to regulate melatonin levels and decrease an over-supply in people with Seasonal Affective Disorder, including one of her family members.

Thomas framed the research as "Pyrophosphate bioisosteres as serotonin N-acetyltransferase inhibitors for treating circadian rhythm disorders" and proposed it for funding via Nebraska EPSCoR's Small College Undergraduate Research Experiences program. With this award, Thomas gained support

for salaries to pay the project's student researchers for the summer. Thomas advised the students' day-to-day work, and developed a proposal to take the research further, via funding from the National Institutes of Health (NIH). The NIH funded the project for \$395,000 and aligned mentoring from a Harvard University professor of medicine and biological chemistry and molecular pharmacology.

"The NIH award is designed primarily for undergraduate institutions like UNK," Thomas said. "A big component is student involvement and exposing undergraduates to research."

"It's very rare for a student to put forward an idea that becomes the basis of a grant proposal," he said. "Even at the graduate level it's probably not common, but at the undergraduate level I would say it's quite rare." ■

NEBRASKA EPSCOR PROVIDES EQUIPMENT FUNDING

For the second consecutive year, Nebraska EPSCoR's new "TRE" awards provide funds for Teaching and/or Research Equipment at the state's small public or private colleges with annual research expenditures of less than \$8 million. This TRE program emphasizes new, shared-use equipment and instrumentation that will enhance research and/or education activities for STEM (science, technology, engineering, and math) learning. Requests for TRE proposals (RFPs) are issued annually, with a limit of one request per institution. Each equipment request must not exceed \$50,000 total. The award pays 80% of the equipment's cost, with 20% coming from the requesting institution. TRE awards are supported by NSF EPSCoR funding, and the Nebraska EPSCoR State Committee decides the TRE proposals selected for funding. ■

- **Bryan College of Health Sciences**—Increasing autoclave capacity at Bryan College of Health Sciences
- **Doane University**—Enhancing Teaching and Research in Engineering at Doane University
- **Little Priest Tribal College**—Teaching Equipment for Little Priest Tribal College's New A.S. in Biology Program
- **Midland University**—Chemistry & Human Performance Equipment
- **Nebraska Indian Community College (NICC)**—Equipment for Bachelors in Environmental Science
- **University of Nebraska at Kearney**—Enhancing Learning and Research at UNK with Portable Eye-tracking

CCC's Gillespie Earns National Community College Award

LAUREN GILLESPIE, PH.D.—a biological sciences instructor at Central Community College-Columbus—earned the 2022 Dale P. Parnell Faculty Recognition Award from the American Association of Community Colleges. Gillespie received the honor at the AACC 2022 convention: April 30 - May 3 in New York City. Named for the former AACC President and CEO Dale P. Parnell, this award honors individuals going above and beyond to make a difference in the classroom. Dr. Gillespie was also recently selected as the Nebraska Community College Association's recipient of the 2022 Faculty Excellence Award.

A first-generation student from rural Maine, Gillespie joined the federal TRiO programs at age 11 years which put her on a path to not only college, but to her doctorate. She attended the University of Massachusetts-Amherst on a Division I field hockey scholarship becoming a nationally ranked scorer, and graduated with a bachelor's degree in science. After working as an avian research assistant for Texas Tech University and the Cary Institute of Ecosystem Studies, Gillespie pursued her doctorate in biology at the University of Southern Mississippi.

CCC President Dr. **Matt Gotschall** said that in the past five years Gillespie has co-led a significant National Science Foundation grant for the college and made connections with several other NSF projects, major research universities, and industry partners. Students benefit from her expansion of applied research in her courses and extracurricular activities and her help in applying for grants, writing papers, and presenting at conferences. She is campus faculty senate vice president and chair of the Equity Action Committee's sex and gender subcommittee and is working to create two LGBTQ+ support groups.

"Dr. Gillespie is someone we are proud to have on our faculty, not only for the expertise she shares with her students and CCC, but also for how it is regularly sought out, locally, regionally and nationally," Gotschall said. "As a first-generation college student herself, she is a positive mentor and role model for so many students at our community college. She also is an accomplished female scientist in a traditionally male-dominated field." ■



Q&A WITH LAUREN GILLESPIE

NE: How did your Nebraska EPSCoR-funded research engage CCC students?

LG: I was able to pay CCC students as research assistants as we studied partial leucism in a local population of cliff swallows (*Petrochelidon pyrrhonota*) and barn swallows (*Hirundo rustica erythrogaster*) and collected blood and feather samples from birds. We took feather samples to the Nebraska Center for Materials and Nanoscience where CCC students are trained in X-Ray Fluorescence Spectrometry to examine heavy metals in the birds.

NE: In the courses you teach, how do you make research approachable?

LG: Directly involving students in the research itself is a powerful tool. As Co-Director of a National Science Foundation S-STEM grant, I created an undergraduate research program at CCC. This has created a framework allowing for general biology students to help collect data, receive training in field biology techniques, and statistically analyze data.

NE: What's important to you in your role as a mentor?

LG: I share my authentic self with my students with the hope that they develop the confidence to do the same. A lifelong mentor of mine is a member of the LGBTQIA+ community and has been incredibly influential, as has open and honest dialogue with my students. This solidified for me how important representation is and inspired me to more openly express my identity and share my struggles and failures with my students.

How do we love STEM engagement? Let us quantum the ways...

NEBRASKA EPSCOR'S OUTREACH RAMPED up its activities to engage K-16 students with STEM (science, technology, engineering, and math) learning, and to broaden participation in STEM by under-represented groups – especially via Omaha's Girls, Inc. and the federally-funded "Educational Talent Search" programs and Upward Bound for first-generation college students and other minorities in STEM.

Nebraska EPSCoR's Young Nebraska Scientists (YNS) added two new summer camps—Food Science: How the Cookie Crumbles, and Engineering Plant Cell Walls—for high school and middle school students, respectively. YNS doubled the number of High School Researchers (HSRs) placed in paid summer positions in the labs of EQUATE researchers. Working with EQUATE partner NCMN (Nebraska Center for Materials and Nanoscience) and funder J.A. Wollam Co., the HSRs and REUs (Research Experiences for

Undergraduates, from other colleges/universities) enjoyed weekly lunches called "Science and a Slice" with pizza, sodas, and talks from physicists and engineers. The HSRs also toured Lincoln's J.A. Woollam Company, which manufactures most of the world's top ellipsometry equipment (for measuring thin film coatings in semi-conductor chips and more). The HSRs' end-of-summer research presentations, at UNL's Summer Symposium, were dazzling.

Several high school and community college teachers enhanced their capabilities in EQUATE placements: Research Experiences for Teachers and Remote Activities and Instrumentation for Nanoscience—with mentoring both lab-based and with NCMN Outreach Specialist **Steve Wignall**, a former high school physics teacher at O'Neill and Seward schools.

Nebraska EPSCoR Outreach Coordinator **Jodi Sangster**, Ph.D., expanded the slate of YNS Mobile Labs which include equipment, supplies, and instructions shipped for free to high schools around the state: soil science, food science, water quality, quantum, and wearable technologies are some of the new packages. More than 1,000 students at 19 Nebraska schools used YNS molecular biology mobile labs in the past year, and half of those students were first-time users.

Watch for new activities in citizen science, funded by EQUATE, to roll out in 2023—with topics including antibiotic discovery, mosquito tracking, dog genetics, and more. ■



YNS campers learn food science skills by testing samples for mycotoxins and microbial contamination at UNL Food Science and Technology.



CLOCKWISE FROM TOP LEFT: YNS High School Researchers begin work at UNL's Jorgensen Hall; Research Experience for Teachers (RET) participant **Kendra Sibbensen**, with Metro Community College, works in a Nebraska Engineering lab; Columbus-area youth try experiments while learning with UNL faculty; A poster by **Lali Raegassa**, a two-time YNS High School Researcher, earns smiles from her family visiting UNL's Summer Research Symposium.

Boys Town Adds COBRE for Pediatric Brain Health



BOYS TOWN NATIONAL RESEARCH Hospital (BTNRH) received \$12.5 million in COBRE (Center of Biomedical Research Excellence) funding from the National Institutes of Health (NIH). This grant establishes a new Center for Pediatric Brain Health, with funding at a similar level renewable for up to 15 years.

According to a BTNRH release, the Center for Pediatric Brain Health will be part of its Institute for Human Neuroscience. The Institute for Human Neuroscience at Boys Town National Research Hospital is one of the nation’s most cutting-edge neuroscience research facilities and the only site in the world with two next-generation MEG (magnetoencephalography) systems.

“This Center grant will lead to major breakthroughs in pediatric neuroscience and position Omaha, and particularly Boys Town, as an international hub for pediatric brain research and clinical care,” said **Tony Wilson**, Ph.D., Patrick E. Brookhouser Endowed Chair for Cognitive Neuroscience, Director of the Institute for Human Neuroscience, and principal investigator at the Center for Pediatric Brain Health. “These centers are not very common, and centers focused on pediatrics are even more rare.”

Initially, the Center will support four early-career researchers who will focus on different issues affecting pediatric brain health, including radon exposure, pubertal hormone levels, the impact of hearing loss on language processing, emotional dysregulation, and how the emergence of psychiatric traits is related to brain network reconfiguration.

The Center for Pediatric Brain Health is BTNRH’s second NIH COBRE. Boys Town’s Center for Hearing Research gained a 2014 COBRE grant to fund the Center for Perception and Communication in Children. ■

Above, from left to right: **Elizabeth Heinrichs-Graham**, PhD (Research Project Leader), **Brittany Taylor**, PhD (Research Project Leader), **Tony Wilson**, PhD (Center Director), **Gaëlle Doucet**, PhD (Research Project Leader), and **Max Kurz**, PhD (Associate Director).

RURAL DRUG ADDICTION RESEARCH COBRE HOSTS ONLINE CONFERENCE

In 2019, Nebraska’s Rural Drug Addiction Research (RDAR) Center at the University of Nebraska-Lincoln (UNL) was launched with a five-year, \$11.8 million grant from the National Institutes of Health’s (NIH) Centers of Biomedical Research Excellence (COBRE).

While urban drug issues draw much of society’s attention, RDAR gathers complementary research specialties that cross disciplinary boundaries—such as the neuroscience of substance use, cognitive implications of chronic drug use, the relationship between rural drug use and violence exposure, and simulation of drug-related disease epidemiology.

In November, Nebraska’s RDAR hosted an online Symposium on Substance Use Research (SOSUR) leveraging research, knowledge, and insight on substance use from across the country. With expert keynotes, panels, and research presentations on a wide variety of substance use topics, the event was open to the public, with no cost to attend. The conference was co-hosted with the COBRE on Opioids and Overdose, the West Virginia Clinical and Translational Science Institute (WVCTSI), the West Virginia INBRE (WV-INBRE) at Marshall University, and the COBRE Center for Addiction and Disease Risk Exacerbation (CADRE) at Brown University. ■

DOE EPSCoR Funds Two Nebraska Researchers

THE U.S. DEPARTMENT OF Energy (DOE) announced \$21 million in funding for 29 new projects through its Established Program to Stimulate Competitive Research (EPSCoR). Projects coupling innovative ideas from EPSCoR-eligible institutions with leading-edge capabilities at the DOE national laboratories were chosen based on competitive peer review under a DOE Funding Opportunity Announcement for Building EPSCoR-State/National Laboratory Partnerships. Two of the 29 awards went to Nebraska researchers:

- **Jongwan Eun**, associate professor with UNL Civil Engineering, receives \$750,000 for a three-year project: Building Partnership with Sandia National Laboratories in Development of Novel Engineered Barrier Materials for Geological Nuclear Waste Repository (Oak Ridge National Lab is also a partner).
- **Peter Sutter**, professor with UNL Electrical & Computer Engineering, gains \$747,387 for a three-year project: Tunable Few-Layer van der Waals Crystals and Heterostructures as Emerging Energy and Quantum Materials (Oak Ridge National Lab is also a partner).

Both projects began in September 2022. According to the DOE’s release, these awardees will build expertise and capabilities that help their institutions to compete more successfully for other federal R&D funding—advancing geographic diversity of researchers conducting competitive energy-related research. ■

▶ The U.S. Department of Defense EPSCoR program (DEPSCoR) awarded \$335,351.14 to **Samer Al-khateeb**, assistant professor with Creighton University’s Department of Computer Science, Design and Journalism. His three-year project, Building a Computational Model of Mobs Leveraging Social Science Theories, started in July 2022 and the partner institution is the University of Arkansas-Little Rock.

NASA EPSCoR

Space Tests Nebraska’s Surgical Robot

NASA AWARDED RESEARCHERS AT the University of Nebraska an opportunity to test a groundbreaking miniature surgical robot in space. The July 2022 – June 2025 grant included nearly \$100,000 to support a 2024 flight aboard the International Space Station through NASA’s Established Program to Stimulate Competitive Research (EPSCoR).

This project is co-led by **Scott Tarry**, associate dean for the College of Public Affairs and Community Service at the University of Nebraska at Omaha, and **Shane Farritor**, the David B. and Nancy K. Lederer Professor of Engineering at the University of Nebraska-Lincoln and co-founder of the medical device start-up company, Virtual Incision.

Robotic surgery could become important for space applications as NASA plans longer and more remote missions. MIRA (an acronym for miniaturized in vivo robotic assistant) was developed via several past NASA-sponsored grants. MIRA is being commercialized by Virtual Incision and is involved in an FDA-approved clinical trial. The robot’s two arms mimic human anatomy but each arm has its own surgical instrument. An endoscope camera resides between the two arms, providing good triangulation between the instruments and the camera.

During the zero-gravity experiment, MIRA will perform tasks simulating different aspects of real surgical procedures, all while enclosed in an ISS experiment locker about the size of a large shoebox. Determining the impact of weightlessness on MIRA’s precision and dexterity will be the primary goal of the exercises.

Interventional surgery will someday become necessary as humans travel farther and longer in space. This experiment will be an impactful first step to enable advanced medical treatment for long-duration spaceflight. ■



2022 NSF EPSCoR Co-Funding for Nebraska

NATIONAL SCIENCE FOUNDATION (NSF) EPSCoR co-funds specific 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 EPSCoR and the corresponding directorates. Co-funding leverages EPSCoR investment and facilitates participation of EPSCoR scientists and engineers in NSF-wide programs and initiatives. ■

For this term*, NSF EPSCoR Co-Funded projects brought \$4,032,975 to Nebraska; \$2,054,643 of this total was from NSF EPSCoR. Recipients were:

NICOLE IVERSON, University of Nebraska-Lincoln (UNL) Dept. of Biological Systems Engineering | CAREER: Extracellular Hydrogen Peroxide and Nitric Oxide Detection and Quantification Via Biocompatible Carbon Nanotubes.

ALEXEY KRASNOSLOBODTSEV, University of Nebraska at Omaha (UNO) Dept. of Physics | Collaborative Research: Exploring self-organization of functional nucleic acid supramolecular assemblies with stimuli responsive properties.

PHILIPPE MALCOLM, UNO Dept. of Biomechanics | Collaborative Research: Detecting Gait Phases with Raised Metabolic Cost using Robotic Perturbations and System Identification for Enabling Targeted Rehabilitation Therapy.

KEEGAN MOORE, UNL Dept. of Mechanical & Materials Engineering | Collaborative Research: Detecting Gait Phases with Raised Metabolic Cost using Robotic Perturbations and System Identification for Enabling Targeted Rehabilitation Therapy.

JEFFREY MOWER, UNL Dept. of Agronomy & Horticulture | Investigating recurrent cooption of mitochondrial cytochrome c maturation systems in Archaeplastida.

JEAN MARCEL NGOKO DJIOKAP, UNL Dept. of Physics & Astronomy | Strong-Field and Ultrafast Processes.

BRADLEY PARSONS, Creighton University Dept. of Chemistry | Singlet O₂ from van der Waals Complexes and the Competition Between Product Channels.

SOPHIA PERDIKARIS, Edith Gonzalez, Isabel Rivera-Collazo, and William Belcher, UNL School of Global Integrative Studies | IRES Track I: At the Frontier of Big Climate, Disaster Capitalism, and Endangered Cultural Heritage in Barbuda, Lesser Antilles.

XAVIER PEREZ GIMENEZ, UNL Dept. of Mathematics | Spanning Structures in Random Graphs.

ROBERT STREUBEL, UNL Dept. of Physics & Astronomy | Magnetic order in disordered dipolar nanostructures.

ERIC VILLA, Creighton University Dept. of Chemistry, | RUI:CAS:Reaction Dynamics of Anderson-Type Polyoxometalate Ions in Aqueous Solution: Relating Solid-State Structures with Solution-State Properties.

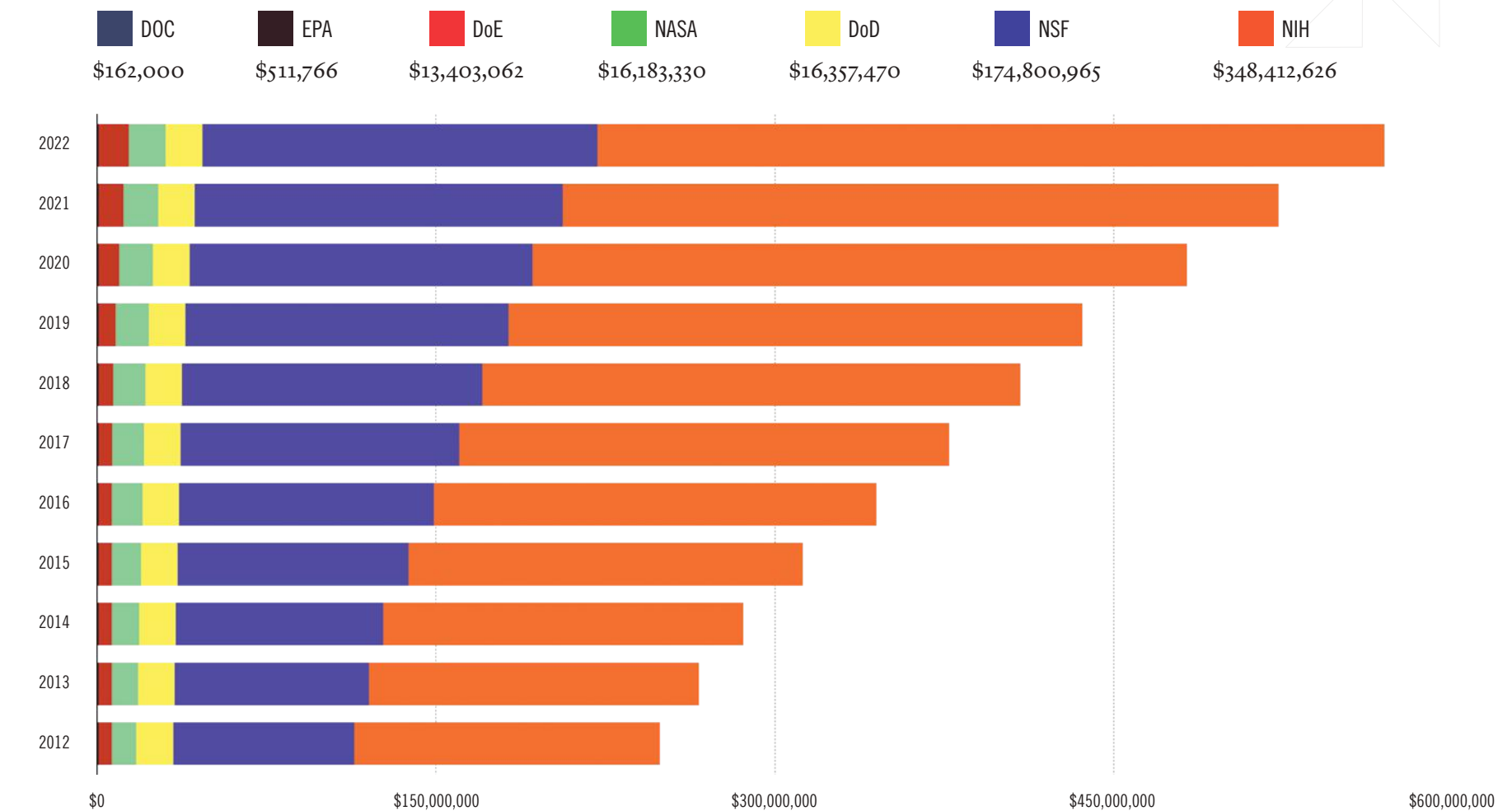
JOSEPH YESSELMAN, UNL Dept. of Chemistry | CAREER: Determining The Fundamental Rules of RNA Tertiary Contact Formation.

**In late 2021, the following co-funding award was made - which was not included in our 2021 listing:*

NICOLE ENGELKE-INFANTE (awarded Dec. 2021), UNO Dept. of Mathematical & Statistical Sciences | Identifying & Implementing Evidence-Based Online Tutoring Practices: Online Practices for Tutoring in Mathematics Using Meaningful Interactions.

Cumulative Federal EPSCoR/IDeA Funding in Nebraska

NEBRASKA BECAME AN EPSCoR state in 1991 and has successfully competed for almost \$570 million in federal research funding. This chart shows funding by agency and the cumulative growth of funding over time for the most recent decade: 2012 - 2022. ■



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