2015 ANNUAL REPORT

IDeA EPSCoR NEBRASKA

EXPERIMENTAL PROGRAM TO STIMULATE COMPETITIVE RESEARCH

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IDeA EPSCoR NEBRASKA

Experimental Program to Stimulate Competitive Research
Institutional Development Award Program

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(COVER AND ABOVE) *Nebraska images, cover and this page: Chimney Rock — courtesy of CR365, by photographers Sharon Henderson & Rod Russell — for daily photos of this western Nebraska landmark, see their project at facebook.com/CR365. Additional photos — courtesy of Nebraska Tourism Commission.*

Director's Message

NEBRASKA EPSCoR has long sponsored a range of activities along a workforce development pipeline, generating solid outcomes that benefit our state's economic future and the greater good.

Our Young Nebraska Scientists YNS camps provide middle and high school students hands-on science experiences working with scientists from our research grants—to grow young people's interest in science, for careers and as a facet of daily life. Because we methodically measure participants' attitudes about science before and after YNS camps, we know that our camps have high impact. Our 2015 evaluations showed that more than 95% of YNS campers felt "camp helped me understand science better." YNS has become a valued resource for Nebraska families statewide, and our partner universities and colleges are pleased to host prospective students aiming to advance STEM (science, technology, engineering and math) progress here in Nebraska.

For youth seeking in-depth opportunities beyond these programs, Nebraska EPSCoR offers YNS High School Researcher summer placements. Each year we connect more than a dozen ambitious young scientists with paid summer jobs in the labs of faculty at varied departments among our state's highly-regarded institutions—aiding both the young researchers and the host faculty.

Our workforce development support extends the growth of undergraduate and graduate students pursuing STEM in Nebraska, as Nebraska EPSCoR strategically sponsors events where nascent scientists can gain and demonstrate STEM knowledge and connect with colleagues for career networking. We sponsor occasions with high-profile speakers and active poster sessions that are impactful for young scientists' careers. And for early-career STEM faculty in Nebraska, our FIRST Award program provides funding and expertise to ready awardees for further advancement, via highly competitive distinctions such as National Science Foundation or Department of Energy CAREER Awards.

In all of these endeavors, Nebraska EPSCoR is mindful to ensure under-represented groups have paths and encouragement to access these key STEM opportunities. We work statewide to promote rural and urban participation; to recruit women, first-generation, Native, Hispanic and African-American participants to STEM experiences; and to include small colleges and universities on collaborative research projects. We are responsive to changes—for example, when the State of Nebraska built a research and development partnership program based largely on a similar offering Nebraska EPSCoR provided, we adapted to apply our resources in other targeted modes.

All this is important because—as we constantly learn in today's news—investing in science infrastructure attracts new and diversified job development aligned with technology growth in new economic sectors. Nebraska EPSCoR is committed to pursuing continuous improvement in workforce development, which means we consistently seek new perspectives for evolving our workforce development activities.

— F. Fred Choobineh

State Committee Update

A 19-member State Committee—comprised of leaders from Nebraska's industry, government and major research institutions and appointed by the governor—shapes the policies and priorities that guide Nebraska EPSCoR in advancing transformative research and workforce development.

Leaving the State Committee in 2015 were **Dacia Kruse**, former acting director of Nebraska's Department of Economic Development, and **Valery Forbes**, former director of the University of Nebraska-Lincoln (UNL) School of Biological Sciences. Nebraska EPSCoR thanks them for their service.

New to the State Committee in 2015:

Joe Fox—Business Recruitment and Innovation Manager for the Nebraska Department of Economic Development. He manages the department's business recruiters and the Business Innovation programs that are responsible for $7 million in annual state prototyping and R&D grants, SBIR matching grants, and commercialization investment. Prior to this work, Fox was an associate at PricewaterhouseCoopers (PwC) in their Healthcare Advisory practice, providing consulting and advising services. Before PwC, Fox served as director of Facilities and Institutions at the Indiana State Department of Health (ISDH). He holds a bachelor's degree in advertising from UNL and a Master of Business Administration degree in Marketing and Entrepreneurship from Indiana University.

David B. Berkowitz—Willa Cather Professor and Chair of the UNL Department of Chemistry. He obtained his B.S. in Chemistry from the University of Chicago, and his master's and doctorate degrees in Chemistry from Harvard University. His research is in the areas of chemical biology, synthetic organic chemistry and mechanistic enzymology. Berkowitz has served as national Director of the Division of Chemistry at NSF in 2015. His honors include election as an AAAS Fellow in 2015.

For a list of Nebraska EPSCoR State Committee members, see back cover.

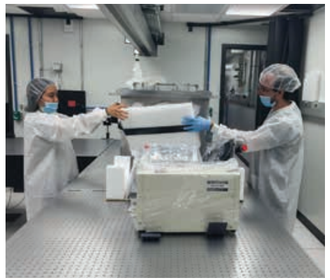
NSF EPSCoR RII Track 2 Advances

THE NSF EPSCoR Track 2 Collaborative Research Award—*Imaging and Controlling Ultrafast Dynamics of Atoms, Molecules, and Nanostructures*—made dramatic progress in its first year: augmenting Nebraska's research infrastructure, establishing new collaborations with Kansas researchers having complementary capabilities, and developing Nebraska's STEM workforce.

RESEARCH CLUSTERED around two thrusts. Thrust 1 probes imaging and controlling ultrafast dynamics of atoms and molecules using ultrashort pulses of electrons and light, ranging from the infrared to the hard x-ray part of the electromagnetic spectrum. Thrust 2 seeks to control electron motion in nanostructures using pulses of light. Interaction between electrons and light in the vicinity of nanostructures is important to integrate photonics and electronics.

First-year highlights involving University of Nebraska-Lincoln (UNL) Department of Physics and Astronomy faculty include:

- The Thrust 1 experimental groups of Associate Professor **Martin Centurion** and Assistant Professor **Matthias Fuchs**, with support from the theoretical group of Associate Professor **Bradley Shadwick**, designed, built, and installed an experimental end station at UNL's Extreme Light Core Facility (ELCF). With ultrashort electron pulses from ELCF's Archimedes high-power laser, the groups can probe changes in the structure of matter on an atomic scale, to better understand light-matter interactions.
- The Thrust 1 theoretical group of Professor **Anthony F. Starace** and Adjunct Associate Professor **Mikhail V. Frolov** (collaborating with experimental groups at Kansas State University and Louisiana State University plus theoretical groups in Nizhny Novgorod and Voronezh, Russia) demonstrated a way to extract detailed information on atomic target atoms by interactions with an intense laser light field having a small elliptical polarization. Typically, intense laser interactions with atoms are carried out with light fields having a linear polarization; previously, with linear polarization it was not possible to obtain complete information on the target atoms.
- The Thrust 2 experimental groups of Professors **Herman Batelaan** and **Timothy Gay** study ways to make extremely intense, ultrashort pulses of magnetically-oriented electrons, by using femtosecond lasers to ionize electrons from semiconducting crystals. These pulses advance understanding of atomic and solid-state magnetism on time scales corresponding to their natural motion. The physics these experiments will uncover help pave the way for new "spintronic" electrical circuits: faster and more compact than current technology allows.



UNL graduate student **ALEXANDRA HOTCHKISS** (left) and postdoc **MATTHEW ROBINSON** (right) unwrap the new experimental end chamber for use with UNL's Archimedes laser.

2015 REU Optics & Laser Physics students at UNL were **CAITLYN JOHNSON** (St. Olaf College), **EMILY KAPLAN** (Smith College) and **MICHAEL-ANGELO HUMM** (Georgia Institute of Technology).

- Professor **Timothy Gay** was elected to serve on the Board of Directors of the American Physical Society (APS), the 50,000-member professional society representing U.S. physicists. Gay also serves on the APS Governing Council, where he represents the APS's Division of Atomic, Molecular, and Optical Physics as well as the Topical Group on Quantum Information and the Topical Group on Fundamental Constants and Precision Measurements.
- The Track 2 grant's outreach efforts included a summer workshop for Nebraska high school physics teachers. Associate Professor **Bradley Shadwick** and Professor **Kees Uiterwaal** led the three-day workshop, which emphasized hands-on classroom activities. The workshop aimed to serve Nebraska high school teachers assigned to teach physics who had not yet obtained certification in that subject. The seven participants represented several rural school districts in Nebraska. The program continued during the academic year via an online forum involving UNL Physics and Astronomy Department faculty and students in the Society of Physics Students.
- This grant's outreach efforts also included mentoring of undergraduate physics students from across the U.S. in summer Research Experiences for Undergraduates (REU), sponsored by Nebraska EPSCoR. Three REU students (see photo above) worked in UNL Physics & Astronomy labs with Track 2 researchers. At summer's end, one described why she valued her time at the Extreme Light Lab: "I read many papers and had many discussions about the material. I assisted with [laser] alignment and overlap, and other small parts of the experimental set up, and I really liked how hands-on everything was. Overall, I had a very positive and educational experience this summer."

NRIC SYMPOSIUM GATHERS WORLD-CLASS SPEAKERS ON ULTRAFAST PHYSICS

Leaders from the world of ultrafast physics gathered in Lincoln, Nebraska on September 29 for a one-day symposium organized by Nebraska EPSCoR in support of the Nebraska-Kansas research consortium.

Physicists at work on the collaborative project, "Imaging and Controlling Ultrafast Dynamics of Atoms, Molecules, and Nanostructure"—NSF EPSCoR's Research Infrastructure Improvement (RII) Track 2 grant, 2014-17—widened their horizons with talks by speakers from Stanford University; University of California, Berkeley; Texas A&M University; and Georgia State University.

The event's 100+ attendees had the opportunity to interact with the prestigious speakers. More than 30 graduate students and postdocs presented research posters to conclude the program.

The 2015 Nebraska Research & Innovation Conference included an active poster session and valued plenary talks; the slate of highly-regarded speakers included (from left): **MARTIN CENTURION** (UNL), **PHIL BUCKSBAUM** (Stanford University), **STEPHEN LEONE** (University of California, Berkeley), **MARK STOCKMAN** (Georgia State University), **HUI ZHAO** (Univ. of Kansas), **TODD MARTINEZ** (Stanford University), **VINOD KUMARAPPAN** (Kansas State Univ.), and **ANATOLY SVIDZINSKY** (Texas A&M University).

NSF EPSCoR RII Track 1 (2010-2015) Extends Results

NEBRASKA'S $20 MILLION NSF EPSCoR Research Infrastructure Improvement (RII) Track 1 award earned a one-year extension with project teams developing further advances in nanomaterials and algal biofuels.

Area 1: Center for Nanohybrid Functional Materials (CNFM)

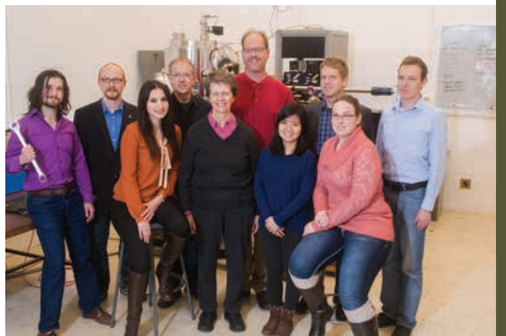
THE CNFM team seeks to combine the unique physical properties of highly-ordered 3D-nanomaterials with chemical and biochemical recognition elements, to develop new sensing and separation principles and provide the basis for new and more powerful sensors and separation devices.

The team's 2015 research efforts made advances on several fronts, which included developing:

- A new optical microscopy technique—optical anisotropy contrast microscopy—and its application in sensing, detection and separation
- Complex folding-based electrochemical sensors for applications at nanosurfaces
- Simple and effective passivating agents to prevent fouling of electrochemical sensors
- Ultrathin-layer birefringence imaging chromatography, a method for simultaneous separation and imaging of label-free analytes
- Gene delivery from nano-ordered materials to absorbed cells
- Controlled surface functionalization of nano-ordered surfaces derived from glancing angle deposition

In addition to CNFM's team science accomplishments in 2015, several of its researchers earned commercial and professional development success, including:

- **Philipp Kuehne** (Ph.D. graduate) received a 2015 Folsom Distinguished Dissertation Award, the highest distinction given annually by the University of Nebraska-Lincoln (UNL) among its graduating Ph.D. candidates.
- **Xiwei "Emmi" Zheng** (Ph.D. graduate) received the 2015 Young Investigator Award from the peer-reviewed journal Bioanalysis at the European Bioanalytical Forum's annual symposium in Barcelona, Spain.
- **Sean Knight** (graduate student with UNL's Department of Electrical and Computer Engineering) was a co-winner of the Spectroscopic Ellipsometry Focus Topic Student Award at the 62nd American Vacuum Society International Symposium and Exhibition in San Jose, Calif.
- **Mathias Schubert**, professor with UNL Electrical & Computer Engineering, received the title of Honorary Doctor of Technology from Linköping University, one of Sweden's larger academic institutions.
- Doane College Associate Professor **Andrea Holmes** was named one of seven recipients of the 2015 Henry Dreyfus Teacher-Scholar Award and received an unrestricted research grant with the honor.
- **David Hage** (professor with UNL's Department of Chemistry) accepted the Eastern Analytical Symposium's 2015 Award for Outstanding Achievements in Separation Science.
- **Yusong Li** (associate professor with UNL's Department of Civil Engineering), **Mathias Schubert**, and **Huilian Ma** (University of Utah, Department of Geology and Geophysics) received a three-year NSF Hydrologic Sciences award. The proposed work will take a multi-scale approach to investigate the retention of anisotropic colloids onto flat surfaces, at grain-to-grain contacts, and in porous media.



An NSF EPSCoR-funded CNFM team of faculty, students and staff developed the new optical anisotropy contrast microscope (OACM) technique. From left are **DARIN PEEV**, **TINO HOFMANN**, **NEGIN KANANIZADEH**, **DAVID HAGE**, **GLENDA MOORE**, **PAT DUSSAULT**, **HANH PHAN**, **MATHIAS SCHUBERT**, **ALYSSA MOCK** and **RAFAL KORLACKI**.

Team Science Takes a Closer Look:

RESEARCH FOCUS

CNFM Research Develops New Optical Microscopy Technique

Research in the Center for Nanohybrid Functional Materials (CNFM) benefits a range of life areas—from potential health advances to increased security via chemical detection. CNFM created a new research tool for stunningly closer looks into several of these areas.

WITH FUNDING through Nebraska EPSCoR from the National Science Foundation's Research Infrastructure Improvement Track 1 award *Nanohybrid Materials and Algal Biology*, CNFM students and faculty at the University of Nebraska-Lincoln (UNL) used their expertise with ordered nanomaterials to shape a new concept for optical microscopy.

The team generated **optical anisotropy contrast microscopes (OACM)**, a new class of instrumentation combining anisotropy contrast modulation with ellipsometric imaging principles. Anisotropy is an optical characteristic based on how reflection and transmission of light change with a material as light's polarization changes.

"It's a new paradigm in imaging," said **Mathias Schubert**, CNFM co-leader and UNL professor of Electrical and Computer Engineering. "With OACM, an object's image is differentiated against an anisotropic screen while in traditional imaging this screen is always isotropic."

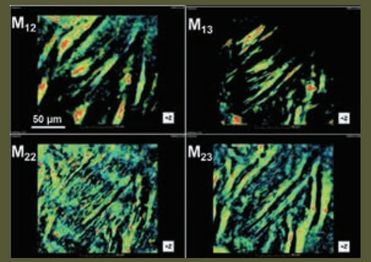
Its concept came from Schubert's background in ellipsometry, measuring thin films applied as coatings to materials' surfaces. In electronics these coatings control how a material can store data, display images on screens, or determine how well a solar cell converts light into energy. OACM applies this to innovate imaging from microscopes with contrast modulation via transparent or highly reflective anisotropic filters set within the instrument's object plane. The sample is illuminated as in traditional compact microscopes, but with OACM the light is controlled in its general polarization. Enhanced sample visibility is obtained through another controllable polarization filter, and registers at an array of charge-coupled devices. OACM's ellipsometric approach produces a set of fundamental images, called Mueller matrix images.

With OACM, Schubert said, "Up to 16 independent images of an object can be obtained with substantially enhanced contrast for extremely small samples."

"These images provide new insight into cell behavior, especially how cells interact with nano-engineered surfaces," said CNFM's **Angela Pannier**, associate professor with UNL Biological Systems Engineering. Her lab uses OACM to study three-dimensional images of mouse fibroblasts. Those cells are cultivated onto highly-ordered, three dimensional nanostructured thin films, as the anisotropic contrast filter within the object plane.

As Pannier's lab explores cell-nanostructure interactions, OACM adds comparative methods (for example, confocal microscopy with fluorescent labeling) to confirm the location of specific cell components imaged, such as cell nuclei, focal adhesions, actin distribution, and cell junction proteins. CNFM's **Amy Mantz**, a UNL bioengineering graduate student, used OACM to study interaction of living cells with the topography of the nano-engineered surfaces and saw that the anisotropy contrast images reveal cell structures suspected to aid interactions between the cells and the nanostructured substrate.

CNFM researchers found that nanosized substances in close proximity to the anisotropic microscope slide are made visible in the new microscope and can be detected. CNFM's graduate students observed a record sensitivity of 150 trillionths (0.000000000000000015) of a gram, or 150 attograms per square micrometer via the new technique.



Mouse fibroblast cells in four Mueller matrix panels; each panel reveals a different property of the cells (e.g., nucleus and other features). Source: CNFM graduate **TADAS KASPUTIS**, et al., as submitted to *Optics Letters*.

RII Track 1, Area 2: Nebraska Coalition for Algal Biology and Biotechnology (NCABB)

IN 2015 NCABB extended its expertise in developing algae for biofuels. Based at the University of Nebraska-Lincoln (UNL), this group explores lipid biosynthesis and regulation in algae: to maximize its potential use in applications for biofuels and biotechnology.

Biotechnological applications and the promise of sustainable production of biofuels and bioproducts from algae have motivated NCABB's basic research on microalgae, especially *Chlamydomonas*. Many of its most exciting novel insights have contributed to increased understanding of mechanisms in algae's primary metabolism and growth. Discoveries involving *Chlamydomonas* help answer important questions of wider interest—for example, how does metabolic/nutritional status of the cell affect its division? Recognizing these advances, a special issue on *Chlamydomonas* was published by the prestigious Plant Journal in May 2015, including a review article on 'Metabolism of acyl-lipids in Chlamydomonas reinhardtii' by **Yonghua Li-Beisson**, **Frédéric Beisson**, and NCABB's **Wayne Riekhof**, assistant professor in UNL's School of Biological Sciences. (See adjacent page for a Research Focus story about Riekhof and his work.)

The lab of **James Van Etten**, working with researchers at Johns Hopkins University, found—unexpectedly—DNA resembling an algae-native chlorovirus in throat swabs from healthy human subjects during a study on cognitive functioning. This discovery, published in Proceedings of the National Academy of Sciences, is the first documented case of chlorovirus gene sequences in the human throat. Van Etten, UNL's William Allington Distinguished Professor of Plant Pathology and this study's senior author, helped discover the existence of chlorovirus in green algae more than 30 years ago. He noted, "(Chlorovirus) are very common among inland bodies of fresh water such as lakes and ponds, but I don't know of many examples of viruses jumping from one kingdom to another" and called this new finding "quite rare and a total surprise." The virus appears to trigger inflammatory responses with factors that contribute to immune system weaknesses, including chronic inflammatory responses from macrophages (types of white blood cells at sites of infection).

Donald Weeks was named a fellow of the National Academy of Inventors (NAI), an honor given to esteemed innovators and inventors. Weeks, UNL's Maxcy Professor of Agriculture and Natural Resources Emeritus, was recognized for distinguished contributions in plant and algal biotechnology and efforts to translate research discoveries into solutions that benefit society. He was inducted in March at NAI's third annual conference in Alexandria, Va.

At the Agricultural Research Development Center in Mead, Neb., 11 algae ponds are home to testing of biomass-inducing compounds studied by NCABB's **WAYNE RIEKHOF** and colleagues.

(opposite page) **WAYNE RIEKHOF** (seated) works with his lab team, including: (from left) postdoc **SURABHI NAIK**, Ph.D. student **JITHESH VIJAYAN** and master's student **MAYA KHASIN**.

RESEARCH FOCUS

Bringing Nebraska's Algal Biofuels Research from Lab Bench to Local Test Beds

GROWING UP on a farm in Missouri, **Wayne Riekhof** found he enjoys pursuing science with an agricultural connection. Now as a lipid biochemist and assistant professor with the University of Nebraska-Lincoln's (UNL) School of Biological Sciences, he studies the metabolism of lipids—how they form and develop as an important component in cell structures, manage energy as a fuel source, and advance through their life cycle. His basic science research helps develop understanding of how lipid-derived compounds from algae—such as hydrocarbons for fuel, novel fatty acids for chemical feedstocks, and antioxidant pigments for cosmetics and nutraceuticals—can be reliably and predictably produced.

Funding through Nebraska EPSCoR's Track 1 award from the National Science Foundation helped bring Riekhof to UNL—where his expertise fits in "a complex puzzle that's an interesting mix of groups," he said, with collaborators among the Beadle Center's plant scientists and beyond.

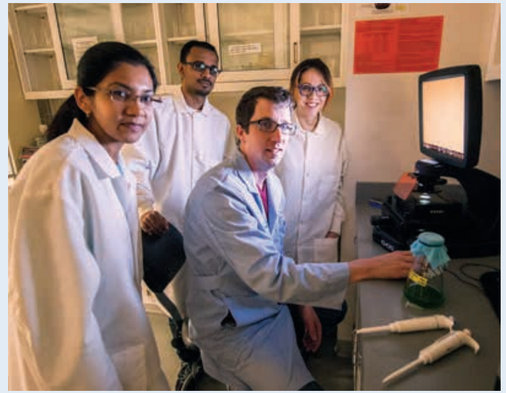
Extending NCABB's fundamental research, on a project funded by the Nebraska Center for Energy Sciences Research, Riekhof works with Track 1 colleague **Concetta DiRusso**, UNL George W. Holmes University Professor of Biochemistry; their "sandbox" is a set of open, shallow algae ponds at the SUPER Loop facility with UNL's Agricultural Research Development Center (ARDC) in Mead. ARDC's closed loop system integrates ethanol and cattle production with manure digestion to generate methane. Its waste streams from one system feed into the next system as valued input. Adding algae growth into the closed loop system can bring tremendous value, if proven viable, because water, heat, nutrients (N, P, K), and CO_2 can be used to grow algae rather than be discarded as waste. At 11 ARDC ponds, this project will test biomass-inducing compounds from DiRusso's work at four concentrations, Riekhof said, with duplicates to allow measuring and analyzing the variability within treatments.

"We're early in this NCESR grant's combination studies," he added. "The work is at the lab bench scale now, and will move outdoors (to ARDC) in 2016." The ARDC facility had a failure in its algal ponds environment in 2015, but Riekhof views such a "crash"—which happens often at established algae ponds in other states—as an intriguing part of the process.

"When something breaks, we want to know why and conduct forensic work to figure it out," Riekhof said, "Through samples we can determine what the driver was—pathogenic bacteria or blooms of predators, which may turn out to be more important. Algae has to grow—that's step one—and we're doing basic research on algal metabolism growth, so we can explore further."

Along with the work at ARDC, Riekhof also adds his perspective to a wastewater project for the city of Hastings, Nebraska. Algae are good at removing toxic metals (such as arsenic, lead and cadmium) from water, he said, and a team from UNL is addressing a challenge from Hastings' mayor, Vern Powers, that includes exploring the use of algae as a tool to abate the city's wastewater ammonia levels, if those amounts exceed EPA levels. With Hastings' wastewater samples collected at various stages of treatment, Riekhof's role will be downstream in the process: to use the effluent to feed algae, with hopes to enhance their biomass output.

"Not a new idea," Riekhof said, "it's practical yet problematic, and we're working to find ways to make the algae in this situation more efficient."



NSF EPSCoR RII Track 3

NSF-Funded Chemistry Curriculum Advances at Nebraska Tribal Colleges

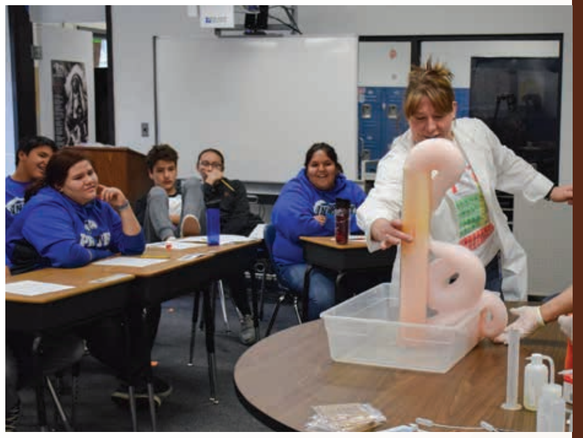
Framing the Chemistry Curriculum, a five-year National Science Foundation EPSCoR Track 3 award to Nebraska, strides forward in step with its tribal college communities.

AFTER AN initial year of planning and the resulting first courses offered in 2014-15, the Framing project's first Faculty Workshop was May 18-19 on the Nebraska Indian Community College's (NICC) Santee campus. The event gathered participating science and math instructors and teaching assistants from NICC and Little Priest Tribal College (LPTC). The grant's principal investigator, University of Nebraska-Lincoln (UNL) Chemistry Professor **Mark Griep**, began with a summary of the project's goals and a report from its external evaluator, **Elisabeth Roberts**. Discussion followed with enthusiasm; the participants focused on progress toward the established goals and ways to better achieve the goals. The workshop's second day centered on the courses' laboratory experiences and brought forth specific recommendations to connect them to topics of interest in the tribal communities.

The Framing project is one year ahead of its own schedule, and teaching methods have been shared from NICC to LPTC. Because the project also aims to spread its curriculum to other tribal colleges, Griep invited a representative from another tribal college to this Faculty Workshop, as a preview for logistics of arranging visitors from other tribal colleges at future workshops. He contacted Oklahoma's Pawnee Nation College (PNC), whose leaders are "very interested in learning about our method because they also have a low enrollment in their chemistry and science courses," Griep said. **James Cook,** one of PNC's three full-time faculty, attended the workshop and reported on it to the PNC president:

"I recommend that Pawnee Nation College become involved with the 'Framing the Chemistry Curriculum' project at the highest degree possible. I feel the introduction of chemistry courses at Pawnee Nation College would serve to enhance the curriculum currently offered. The benefit would not only serve at the local level but at the regional level as well. In order to defend our sovereignty, perpetuate and sustain our cultures, it is essential to redirect our energies and resources towards science fields for our students and the development of a new American Indian intelligence entrenched in tradition and committed to protecting our nations and making for a more harmonious coexistence with others."

At the Faculty Workshop, from left to right are: **JAMES COOK** (PNC), **JOHN SINGER** (NICC), **LAVONNE SNAKE** (LPTC), **SALENA SNAKE** (LPTC), **JODY WINGERT** (LPTC), **MARK GRIEP** (UNL), **BEV DEVORE-WEDDING** (UNL), **ELISABETH ROBERTS** (University of Arizona), **ASHLEY CORBETT** (lab teaching assistant with Track 3, from University of South Dakota), **JANYCE WOODARD** (LPTC), **HANK MILLER** (NICC)



(top) LPTC environmental science instructor **JANYCE WOODARD** (left) works with LPTC lab technician **LAVONNE SNAKE** and LPTC student **SALENA SNAKE** to present a chemistry demo to a Winnebago Schools class in May 2015.

(bottom) Winnebago students enjoy Track 3 chemistry demonstrations including the expanding foam reaction called "elephant toothpaste."

Small College Undergraduate Research Experiences

To increase undergraduate research opportunities at Nebraska's smaller colleges and universities, Nebraska EPSCoR offers funding up to $5,000 per project for collaborations in science, technology, engineering and math (STEM) areas. Faculty and students involved in the selected proposals report their project results to Nebraska EPSCoR, and often present their research in scientific publications and at conferences. The 2015 recipients were:

ALLEN THOMAS | Chemistry, University of Nebraska at Kearney (UNK) | "Probing Large-Neutral Acid Transporter 1 (LAT 1) to Identify Substrates for Drug Delivery"

FRANK FERRARO III | Psychology, Nebraska Wesleyan University | "The Effect of Nature or Urban Exposure on Circulating Cortisol Levels"

ANN BUCHMANN | Physical and Life Sciences, Chadron State College | "Roles of the Sirtuin Protein 3 in Mitochondrial Base Excision Repair"

JOHN HASTINGS | Computer Science, UNK | "Researching Exploits with Unmanned Aerial Vehicles"

GANESH NAIK | Chemistry, College of Saint Mary | "Can the Presence of Antioxidants Attenuate the Formation of Acrylamide in French Fries?"

Nebraska Involved in Three of NSF's Eight Track 2 FEC Grants Announced in 2015

In August, the National Science Foundation's Experimental Program to Stimulate Competitive Research (EPSCoR) announced a series of Focused EPSCoR Collaborations (FEC) grants, with Nebraska scientists involved in three of the eight four-year projects. The slate totals $42 million in funding for a range of topics aimed at fostering research collaborations among investigators and institutions across 12 states.

TONY WILSON is a co-PI with *Developmental Chronnecto-Genomics (Dev-CoG): A Next Generation Framework for Quantifying Brain Dynamics and Related Genetic Factors in Childhood*. An associate professor with the University of Nebraska Medical Center (UNMC) and faculty at the University of Nebraska Omaha (UNO), Wilson's work focuses on how brain networks enable cognitive processing. Specifically, Wilson's laboratory uses an advanced brain imaging method called magnetoencephalography (MEG) to identify how spatially separate brain regions communicate with each other during cognitive and emotional processing. On the $5.9 million Dev-CoG project, he heads the Nebraska team, including UNO faculty **Jeffrey French** and **Ryan Wong**, and collaborates with colleagues at New Mexico's MIND Research Network and Louisiana's Tulane University.

DevCoG's goal is to understand the rapid development of human brain connectivity that occurs during late childhood and early adolescence. The researchers use imaging methods with multiple time scales and develop novel mathematical algorithms for modeling and data analysis. The work involves several early career faculty, and engages students from middle school through graduate school in outreach and research activities.

Wilson said, "Nebraska brings expertise in MEG imaging, oscillatory analysis methods, and cognitive neuroscience that is not available in the other consortium states." He and his Nebraska team are "focusing on how healthy brain networks change and maturate as 9 year-old children develop into 14 year-old adolescents." Wilson said he looks forward to combining maps of brain structure and function, and evaluating whether they develop in parallel or whether specific structures become more established, allowing functional pathways to become precisely written on top.

The Dev-CoG project is central to a growing Nebraska neuroscience network that includes infrastructure and faculty across multiple organizations, including UNMC, Boys Town National Research Hospital, Creighton University, UNO and the University of Nebraska-Lincoln (UNL). Dev-CoG also includes a new training program in cognitive and computational neuroscience shared between UNMC and UNO, as well as an educational effort by UNMC's Munroe-Meyer Institute to inspire middle and high school students to become future scientists.

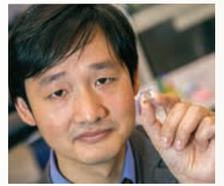
As an unmanned aerial vehicle (UAV) hovers, researchers gather to work on study of *Unmanned Aircraft Systems for Atmospheric Physics*, funded by NSF EPSCoR. From left are Nebraska team members: UNL's **MATTHEW VAN DEN BROEKE**, **LISA PYTLIK-ZILLIG**, **ADAM HOUSTON** and **CARRICK DETWEILER**.

ADAM HOUSTON, associate professor with Earth & Atmospheric Sciences at UNL, is the Nebraska team leader with *Unmanned Aircraft System for Atmospheric Physics*, a $6 million project involving Oklahoma State University, the University of Oklahoma and the University of Kentucky.

The project team will develop and test unmanned aircraft systems (UAS) to characterize and study physics in the Earth's atmospheric boundary layer. The interdisciplinary team includes researchers with expertise in robotics, autonomous control, unmanned aircraft systems, atmospheric physics, and numerical weather prediction. The devices will help the researchers explore thunderstorm initiation, storm-scale microphysics, airborne sensing of soil hydrology, infrasonic sensing of environmental phenomena, and local-scale temporal and spatial climate variation.

This project includes plans for education, outreach, and workforce development activities that include public education about UAS technology and its policy implications, workshops on locally specific applications of UAS technology, and rapid dissemination tools for communicating and responding to severe weather threats and hazards. The team's work aims to produce complete UAS system packages suitable for measuring wind, atmospheric chemistry, soil moisture, and thermodynamic parameters.

With Houston, UNL's **Carrick Detweiler** (Computer Science and Engineering), **Matthew Van Den Broeke** (Earth and Atmospheric Sciences), and **Lisa Pytlik-Zillig** (Nebraska Public Policy Center) had sought ways to collaborate on studying the public perception component of UAV research. The Nebraska faculty members plan to hire graduate students to work on aspects of this research. Houston said, "I'm excited to see what new understanding and technology can grow out of this multi-disciplinary and multi-university collaboration."



JINSONG HUANG, Susan J. Rosowski Associate Professor of Mechanical and Materials Engineering at UNL, is a co-PI with *Low-Cost, Efficient Next-Generation Solar Cells for the Coming Clean Energy Revolution.* On this $4 million grant, Huang works with Brown University's Nitin Padture to focus on the development of new kinds of solar cells containing crystalline perovskites grown from liquid solutions. The project includes materials research to understand structural, electrical, and optical properties of perovskites; develop non-toxic perovskite materials for use in solar cells; experiment to enhance power conversion efficiency; and explore scale-up processes for low-cost, high-efficiency perovskite solar cells (PSCs).

Huang had developed a low-temperature fabrication process designed to boost several properties of the perovskite cells, including crystallinity—to improve on perovskites' naturally good crystallinity and benefit the cells' solar efficiency. He said the process should also increase the size of perovskite grains, resulting in fewer barriers between them for enhanced electrical conductivity.

He added that fabricating perovskites in the form of a liquid solution should make the material more affordable and accessible. Huang envisions a future when efficient solar cells using solution-based perovskites could be printed readily, like the way today's computer printers or copy machines work.

Also working on the project are UNL's **Xiao Cheng Zeng**, Ameritas University & Willa Cather Professor of Chemistry, and **Xia Hong**, assistant professor with Physics & Astronomy.

The NSF-funded project includes graduate student training with courses on entrepreneurship, plus undergraduates and high school teachers will be engaged in summer research and camps. Rhode Island School of Design, another partner on the grant, will create SciToons for YouTube to increase public awareness of solar cell research for clean energy production.

Nebraska's Newest CAREER Award Recipients Include NE EPSCoR FIRST Award Alumni

To an early career scientist, pursuing a prestigious Faculty Early CAREER Development Program Award from the National Science Foundation is a way to dream big. The multi-year grants, known as CAREER Awards, are significant in launching pre-tenure faculty as teacher-scholars who lead in conducting integrated research and education.

Our state's rising star faculty can practice reaching for that dream by pursuing Nebraska EPSCoR's FIRST Award. FIRST Awards' competitive grants include $20,000 in funding and, perhaps even more valuable, expert reviews on the finalists' proposal submission—patterned after the NSF CAREER Award process.

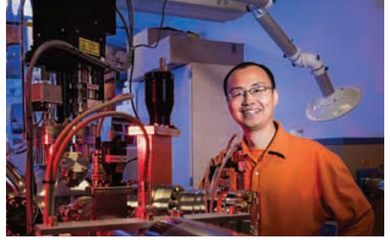
ALEXANDER SINITSKII, assistant professor of chemistry at the University of Nebraska-Lincoln (UNL), earned a five-year, $538,477 Faculty Early Career Development Program Award from the National Science Foundation to investigate graphene's properties.

MOLECULE BY molecule, he creates ultra-narrow bands of the one-atom thick sheets of carbon known as graphene. With his team, he developed a technique to create atomically precise graphene nanoribbons. They apply organic chemistry practices to join molecules with the ribbons for different edges and widths, and determine how these changes affect the nanoribbons' properties.

Scientists have theorized that physical properties of nanoribbons are shaped by their structural parameters. Sinitskii's work generates synthetic techniques to make those materials and test the predictions.

His advances could benefit electronics—where graphene's conductivity is currently hampered by challenges in controlling its electrons' movement—and fuel cells, where photovoltaics' chemical reactions could be manipulated to absorb photons from a wider range of the sun's energy wavelengths.

Sinitskii, who earned a Nebraska EPSCoR FIRST Award in 2013, works with the NSF EPSCoR-funded Center for Nanohybrid Functional Materials. With the CAREER Award, Sinitskii channels his discoveries into nanoscience courses and outreach activities to engage graduate, undergraduate and high school students in materials chemistry and nanofabrication.



XIAOSHAN XU, assistant professor with UNL's Department of Physics & Astronomy, received a 2015 NSF CAREER Award. For this five-year, $591,256 grant, he uses hexagonal ferrites to explore manipulating the electric and magnetic fields in these new materials, to improve the efficiency of electronics.

XU LED an effort at Oak Ridge National Laboratory that produced a pure, nano-thin version of a hexagonal ferrite. His goal at UNL is to better understand the underlying mechanisms in the nanomaterial, and apply its properties for use in devices. He earned a FIRST Award in 2014 to further develop his research.

Semiconductors in today's electronics rely on switching the polarization of magnetic materials and moving charge through circuits, functions which multiferroics can enhance. But temperature is a key factor in multiferroic capacity, previously enabled at minus 220 degrees Fahrenheit. At UNL Xu recently discovered a new class of room temperature multiferroic hexagonal ferrites.

"It's very promising," said Xu, who collaborates with UNL's NSF-funded Materials Research and Engineering Center and the Nebraska Center for Materials and Nanoscience. "It could make devices more energy efficient and compact. That's exactly what people are searching for."

He aims to integrate his research into educational activities that help undergraduate students learn physics basics via exposure to cutting-edge research, and engage K-12 students' interests in science.

Xu mentors undergraduate and graduate students and hosts high school students in his lab during summer programs. With CAREER Award resources, he plans to seek further opportunities to collaborate and improve his own teaching, especially to address the critical stage when students begin research and transition from learning to creating knowledge.

ALEXEY KOVALEV, assistant professor in the Department of Physics and Astronomy at the University of Nebraska-Lincoln, joined 43 national recipients earning 2015 Early Career Awards from the U.S. Department of Energy's (DOE) Office of Science.

DOE'S EARLY Career Research Program aids the nation's scientific workforce with funding for exceptional researchers launching their careers, in areas ranging from advanced scientific computing research to high-energy and nuclear physics.

Kovalev's DOE Early Career Award provides at least $150,000 a year for five years to cover summer salary and research expenses. His field is theoretical spintronics: the interplay of the spin, energy and charge transport in systems with topological defects, and the roles of magneto-electrical and magneto-mechanical interactions. As a member of the Nebraska Center for Materials and Nanoscience, his work has applications to many areas of information technology, data storage, computing, sensors, energy harvesting and more.

Kovalev, who earned a FIRST Award in 2014, said: "This is my chance to build my group and to do great science at UNL. Having funding for five years will allow me to work on more challenging, high risk projects, and build a more coherent research program."

FIRST Award Recipients' Paths Rise

Earning a FIRST Award from Nebraska EPSCoR puts Nebraska's early-career scientists on a path to greater glory. FIRST Award recipients in 2014-15 were:

- **Trenton Franz**, Natural Resources, UNL
- **Amanda Glass**, Chemistry, University of Nebraska at Kearney
- **Alexey Kovalev***, Physics & Astronomy, UNL
- **Joe Louis**, Entomology, UNL
- **Stephen Morin**, Chemistry, UNL
- **Massimiliano Pierobon**, Computer Science & Engineering, UNL
- **Brian Ricks**, Computer Science, University of Nebraska Omaha
- **Rebecca Roston**, Biochemistry, UNL
- **Sangjin Ryu**, Mechanical & Materials Engineering, UNL
- **Jeffrey Stevens**, Psychology, UNL
- **Eric Villa**, Chemistry, Creighton University
- **Xiaoshan Xu****, Physics & Astronomy, UNL
- **Qin Zhou**, Mechanical & Materials Engineering, UNL

*earned DOE CAREER Award in 2015
**earned NSF CAREER Award in 2015

NIH Extends Funding for Nebraska INBRE Program

IN 2015 the Institutional Development Award Program (IDeA) Networks of Biomedical Research Excellence (INBRE) program based at the University of Nebraska Medical Center (UNMC) received renewal of its National Institutes of Health grant, for $16.2 million spanning another five years.

Jim Turpen, Ph.D., associate vice chancellor for academic affairs and a professor in the UNMC Department of Genetics, Cell Biology and Anatomy, is this NIH grant's principal investigator.

"I believe the main reason the grant was renewed is because we are accomplishing the goals of the program," Turpen said. He cited benefits to date from the NE-INBRE project, including 324 undergraduate students from across the state who have participated as INBRE Scholars; Turpen added that 27 percent of the graduates have continued on to graduate school, 28 percent have entered professional schools and 20 percent have obtained jobs working in science.

"It's an honor for the program to be recognized for the value it brings to the scientifically educated and biomedical workforce in Nebraska," Turpen said.

Established in 2001, NIH's INBRE program was created to expose students to biomedical research, build a statewide biomedical research infrastructure between undergraduate and graduate institutions, strengthen the infrastructure of undergraduate institution, and increase the capacity of undergraduate institutions to conduct cutting-edge biomedical and behavioral research.

Upon recommendation by their college professors, selected students from Nebraska undergraduate colleges enter the program after completing their sophomore year of study. Those chosen as INBRE Scholars receive a two-year scholarship and spend 10 weeks each summer conducting research on either their home campus or at UNMC, the University of Nebraska-Lincoln or Creighton University. They also gain mentoring and training in the basics of research via workshops at the three Ph.D. granting institutions, and present their work at the annual meeting of the Nebraska Academy of Sciences.

INBRE also helps support multidisciplinary research teams of junior faculty members: "INBRE Associates," who work with INBRE scholars. INBRE Associates can access salary support for summer research and funding for updating essential equipment. Currently 86 faculty from three campuses are INBRE Mentors in 16 research areas. NE-INBRE adds resources in trending areas such as bioinformatics, genomics and proteomics. Support of core laboratories in these areas makes the technologies available on a no cost basis to investigators throughout the INBRE network.

(opposite page) Diversity, distinction and depth are prominent among the 2015 group of Nebraska's INBRE Scholars.

UNMC researcher **GLORIA BORGSTAHL** earned NASA EPSCoR funding to study the growth of certain crystals in microgravity. Her work could help advance enzymes in disease resistance.

NASA EPSCoR Grant Helps UNMC Researcher Explore Materials' Growth in Microgravity

Many Nebraskans look up in wonder at the starry night skies above our state. One Nebraska researcher scans the skies and thinks about how her experiments are progressing high above, aboard the International Space Station (ISS).

GLORIA BORGSTAHL, PH.D.—professor with the University of Nebraska Medical Center's (UNMC) Eppley Institute—received a three-year $750,000 grant from NASA EPSCoR in 2015. With this award, *Large Volume Crystal Growth of Superoxide Dismutase Complexes in Microgravity for Neutron Diffraction Studies*, her team studies large volume crystals with low mosaicity (indicating near perfection) that result from their growth in microgravity (μg).

In 2002, Borgstahl studied insulin crystals and found that those grown in microgravity were on average 34 times larger, had seven-fold lower mosaicity and diffracted to significantly higher resolution than their earth-grown counterparts. She then turned her attention to superoxide dismutases (SODs): antioxidants which protect cells against toxins, through an enzymatic mechanism that is not yet well understood. Borgstahl crystallized the Manganese Superoxide Dismutase enzyme (MnSOD) with PCAM (Protein Crystallization Apparatus for Microgravity) on the ISS and observed the MnSOD crystals grown in μg had an 80-fold increase in crystal volume compared to the largest earth-grown version, and high resolution diffraction indicating high quality crystals.

With this grant, Borgstahl's team of researchers at the University of Nebraska Omaha and UNMC is now growing MnSOD crystals in μg for further exploration. Partners include the Center for the Advancement of Science in Space, or CASIS, for SpaceX flights to ferry experiments to and from the ISS, and Oak Ridge National Laboratory, which applies advanced analysis capabilities.

Because mutations in SODs lead to degenerative diseases such as amyotrophic lateral sclerosis (ALS), diabetes, and cancer, Borgstahl's goal with this research is to structurally understand the reaction mechanism of MnSOD in atomic detail as well as the three-dimensional structure of its atoms, including hydrogen. She said, "A main outcome would be to identify the role of these hydrogen atoms in this enzymatic activity and mechanism more precisely than prior X-ray crystallographic models from Earth-grown crystals." Her work could aid protein engineering of disease-resistant properties into that enzymatic environment.

Nano Exhibit Tours State's Museums

UNDERSTANDING THE tiniest science sometimes requires a larger-than-life lesson. That was the motivation when a partnership between Nebraska EPSCoR and the Nebraska Center for Materials and Nanoscience (NCMN) brought a 400-square-foot exhibit from NISE Net (the Nanoscale Informal Science Education Network) to travel across this state's museums from 2015 to 2017.

"Nano" is an exciting exhibition for families to learn about the extremely small scale of science, technology and engineering—with a nanometer measuring one billionth of a meter. Interactions of materials at this miniscule level shape our world in powerful ways.

This traveling exhibit's schedule includes museums across Nebraska:

- **June–August 2015**: Strategic Air and Space Museum, Ashland
- **September 2015–January 2016**: Hastings Museum
- **February–April 2016**: The Edgerton Explorit Center, Aurora
- **May–August 2016**: Kearney Area Children's Museum
- **August–November 2016**: The Eleanor Barbour Cook Museum, Chadron State College
- **January–March 2017**: The Wayne State College A. Jewell Schock Museum of Natural History and the Fred G. Dale Planetarium

Funding from the National Science Foundation (NSF) enabled the Nano exhibit's development. It includes hands-on, interactive stations—interesting and informative for all ages—that invite exploration of nano phenomena and real world applications and implications.

"It's a great opportunity for families to find out about nanoscience as an area of science, technology, engineering and math (STEM)," said **Terese Janovec**, NCMN's assistant director and education/outreach coordinator.

Among aspects in the exhibit—with information in English and Spanish— is the *Small, Smaller, Nano* display, with magnets for hands-on exploration of how material behaves differently at various sizes. At the exhibit's *Build a Giant Carbon Nanotube* zone, guests can use foam construction pieces to make a large model of a tiny but amazing structure called a carbon nanotube. The *Where Can You Find Nano?* area lets visitors look, listen and touch to discover nano all around us.

The Nano exhibit's interactive panels provide information on nanoscale solutions to the world's big challenges. Entry to the Nano exhibit is included in any admission fees of the museums listed.

Families learn about nanoscience at a display that's traveling through Nebraska, thanks to Nebraska EPSCoR, NCMN and NISE Net.

Labs can be night or day, in a field or stream, at YNS camps.

YNS Camps' STEM Spans Range of Science Topics, Nebraska Locations

Middle and high school students "got their STEM on" at Young Nebraska Scientists' 2015 camps with hands-on learning in areas of science, technology, engineering and math. Campers were introduced to new friends and fun experiences at college campuses to consider for their future learning.

THE SEASON started with *Field Biodiversity*, a high school camp at UNL's Cedar Point Biological Station on the shores of Lake McConaughy in Ogallala. YNS campers enjoyed working with a range of research areas, including entomology, herpetology, and parasitology.

Light in the Nano World followed, with a camp for high schoolers at the University of Nebraska-Lincoln. A special moment for campers was touring behind the dashboard of Tesla vehicles shared by Nebraska Engineering Professor Don Cox.

Next were the middle school and high school *Algae for Biofuels* camps at Doane College, where building bioreactors was part of the plan. The field trips to Spring Creek Prairie Audubon Center's pond ignited interest in natural gases harnessed as fire on water in the groups' Volta Experiments.

The YNS camp season ended with *It's A Materials World*—a middle school camp that explored solar cells, polymers, crystals and more in the chemistry labs of the University of Nebraska at Kearney.

One of the 2015 YNS campers commented: "I loved YNS because it gave me a lot of opportunities to imagine myself as a scientist, as well as gave me a good taste of college life. I had a lot of fun and made a lot of friends at this camp. I would definitely go again."

With coordination through Nebraska EPSCoR and funding from the National Science Foundation, YNS makes its camps affordable and hands-on, to inspire STEM career paths for the state's youth.

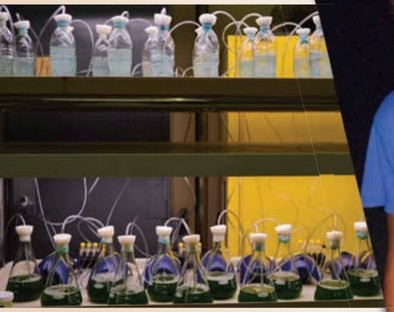
YNS camp registration begins in early spring; find information at **yns.nebraska.edu**.

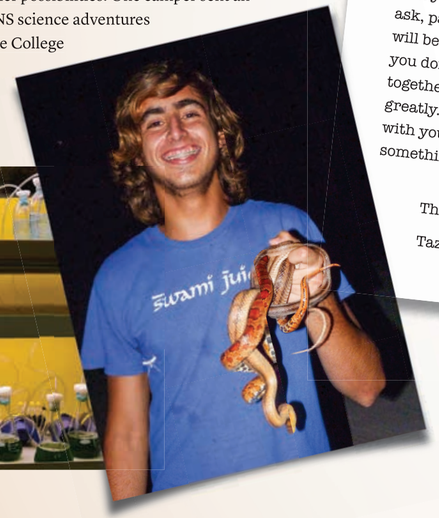
(below) **TAZ ROSENFELD** was among the YNS campers who learned how to set up bioreactors for generating algal biofuels; now he's building one at his school.

YNS Camper Continues to Pursue Science

One of the positive outcomes from Young Nebraska Scientist camps is generating excitement about future science interactions.

ANOTHER BENEFIT is the mix of campers, including a few who may not live inside the state but, through their Nebraska connections (perhaps spending the summer with Husker grandparents), connect with meaningful science experiences via YNS and inspire further possibilities. One camper sent an update on his post-YNS science adventures to **Brad Elder**, Doane College Biology department chair and leader of the YNS Algal Biofuels Camps.





Dear Professor Elder,

My name is Tasman Rosenfeld, and this past summer I was a participant of the Algal Biofuel camp at Doane with you. I was the kid from Florida who was really into herpetology.

Anyways, for a year-long project at school my team (under my direction) chose to make biofuels from local algae from the different marine biomes here in Florida, such as the mangrove brackish swamp, inland marshes, ponds, and lakes, and tidal marshes. I plan on trying with some macro algae and halophytes too. So, I'm writing you to thank you for teaching me some great information this summer, and inspiring me to engage in this field for my project this year.

A little background on the project:

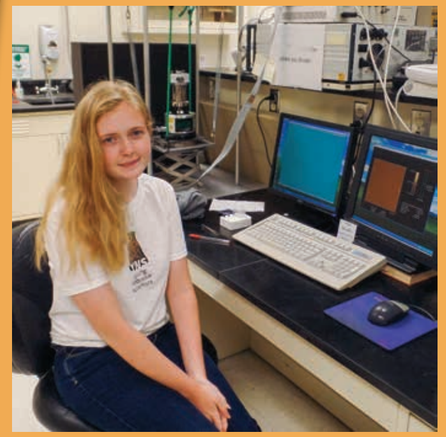
Our school has an Innovation Program ... and every student must participate in a Passion Project. Basically, we spend a year doing something we think is cool and are passionate about and try to produce something that can help the school and/or the greater community. I'd also like to ask you if your department has any necessary equipment that you could donate to our project? I know it's unlikely but I have to ask, particularly since gathering and paying for all of the equipment will be quite a chore for my team and we need all the help we can get. If you don't have anything you could send to us, do you think could you put together a list of the necessary equipment we will need? It would help us greatly. If you would help us out, then we would share all of our findings with you, and maybe we could even establish a research partnership or something to that effect.

Thank you so much for your time!

Taz

Elder responded to Taz with an offer of supplies, funding and space in the lab if he wants to come back. From a YNS middle school camp to greater science quests—this is how successful scientists get started.

KRISTIN SHERIDAN valued her time working as a YNS High School Summer Researcher in the UNMC lab of **YURI LYUBCHENKO.**



2015 YNS High School Summer Researchers

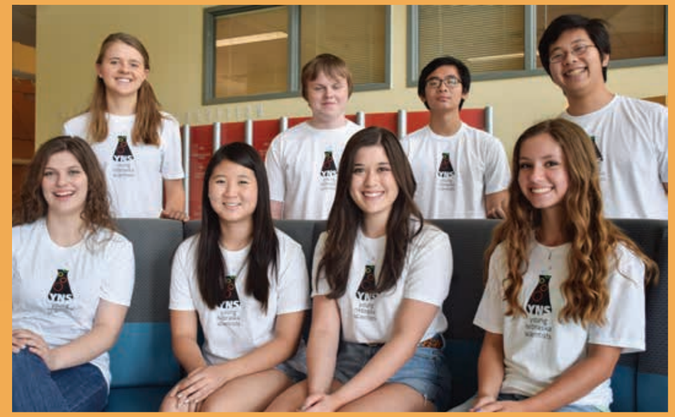
BEING A YNS High School Summer Researcher is no ordinary summer job. With multiple applications for each of the dozen placements, getting hired is highly competitive—but also very worthwhile. YNS High School Researchers earn salaries and expertise as they take early steps into Nebraska's scientific community. High School Researchers' work days— in labs at a Nebraska medical center or university campus—might focus on replicating plant DNA or software programming with lab groups including graduate students, postdoctoral researchers and faculty. Several of this year's High School Researchers described their 2015 YNS experience as opening doors to their futures, and giving them chances to apply what they'd learned at school.

Omaha high school student **Kristin Sheridan** was a 2015 YNS High School Researcher in the lab of **Yuri Lyubchenko** at University of Nebraska Medical Center.

"Working in Dr. Lyubchenko's lab has helped me understand what this career really is," Sheridan said. "I have found I like the community and work environment of a lab, in addition to the work done there, so it has encouraged me to continue pursuing a career in research based both on the interesting work and the small, encouraging work community."

"Being a YNS researcher allowed me to get a preview of what I want to do in the future," said Sheridan. "This has been one of the most amazing and fortunate experiences I've had so far!"

For more info about the YNS High School Summer Researcher program, see **yns.nebraska.edu/Research**.



YNS Summer 2015 High School Researchers included, from left to right: (standing) **EMILY GRAUL**, **DENIS KOMISSAROV**, **TONY LE**, **BAOLONG TRUONG**;(sitting) **KELLY BROAD**, **SOPHIA QUATTROCHI**, **HANNAH O'NEILL**, **LAUREN LESIAK**.

NSF EPSCoR Co-funding

In 2015, National Science Foundation co-funding brought $6.3 million to Nebraska; $1.73 million of that year's total was from NSF EPSCoR. Recipients were:

ERIC DODDS | Chemistry, University of Nebraska-Lincoln (UNL) | Gas-Phase Structural Analysis of Metal Cationized Carbohydrates

ANDREA HOLMES | Chemistry, Doane College | International Undergraduate Research Experience: The Development and Application of Novel Micro- and Nano-Sized Sensing Arrays Capable of Detecting Small Molecules

CHITTARANJAN RAY | Civil Engineering, UNL | IRES: U.S.-Czech Experience on Understanding Water and Chemical Transport in the Earth's Vadose Zone

DAVID SELLMYER | Physics & Astronomy, UNL | NNCI: Nebraska Nanoscale Facility (NNF)

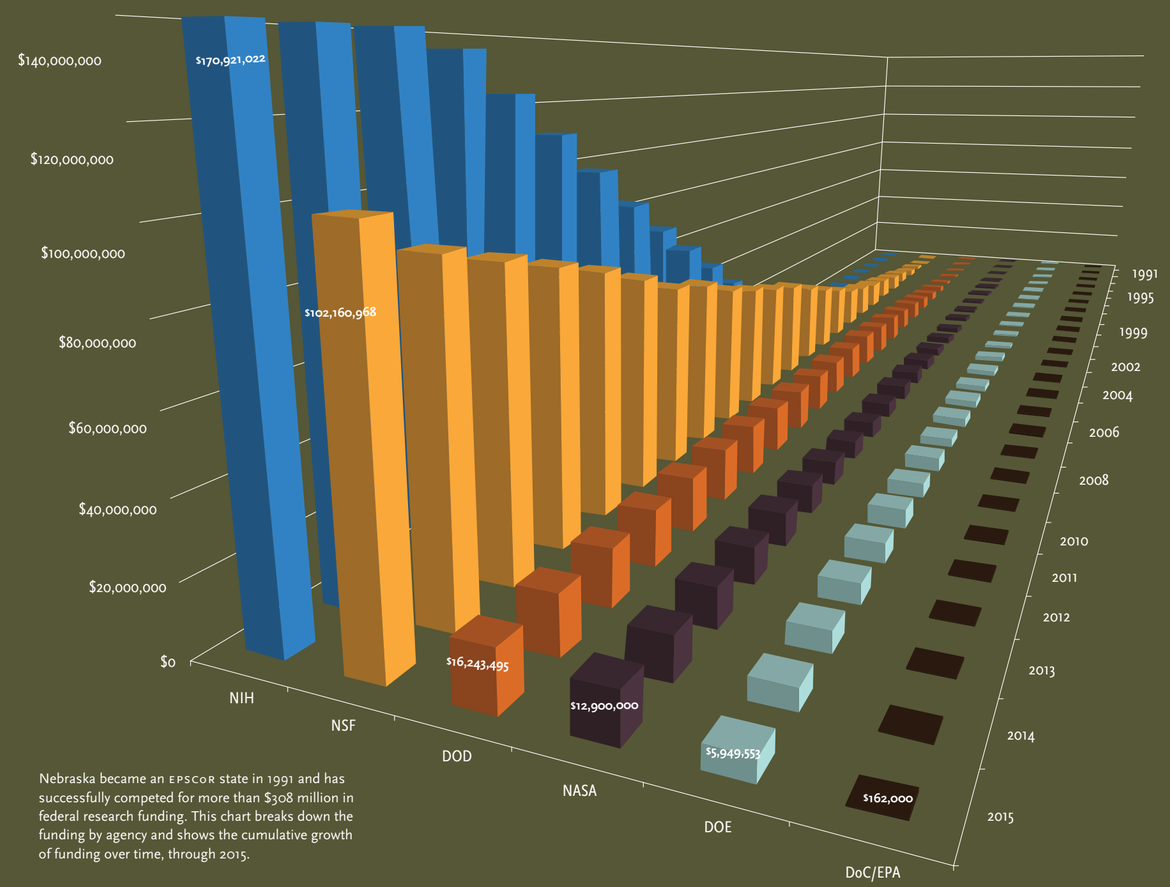
MINDI SEARLS | Earth & Atmospheric Sciences, UNL | GP-IMPACT: Building a Comprehensive Geoscience Learning Experience

ALEXANDER SINITSKII | Chemistry, UNL | CAREER: Narrow Graphene Nanoribbons with Tunable Electronic Properties

HONGFENG YU | Computer Science & Engineering, UNL | III: CGV: Small: A Scalable Visual Analytics Framework for Exascale Scientific Simulations

KIRK DOMBROWSKI | Sociology, UNL | REU Site: Social Network Analysis for Solving Minority Health Disparities

Total Federal EPSCoR Funding in Nebraska



Nebraska became an EPSCoR state in 1991 and has successfully competed for more than $308 million in federal research funding. This chart breaks down the funding by agency and shows the cumulative growth of funding over time, through 2015.

EPSCoR
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2015 State EPSCoR Committee Members

Experimental Program to Stimulate Competitive Research
Institutional Development Award Program

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Dr. Raymond Ward, *President*, Ward Laboratories, Inc. (Kearney)
Dr. Terri L. Wasmoen, *Associate Vice President* (ret.), Merck Animal Health (Elkhorn)
Senator Ken Haar, Nebraska Legislature (21st District)

Please see page 3 for members joining and departing the Nebraska EPSCoR State Committee in 2015.