IDeA

EPSCoR

NEBRASKA

EXPERIMENTAL PROGRAM TO STIMULATE COMPETITIVE RESEARCH

ANNUAL REPORT

2011

MESSAGE FROM THE DIRECTOR F. FRED CHOOBINEH

Strategic support of transformative science and innovation is at the core of Nebraska EPSCoR's mission. We fund talented academic researchers from across the state; we promote education and outreach programs that broaden and nurture the pipeline of students in science, technology, engineering, mathematics (STEM) and biomedical research; and through our programs, we build bridges between university and industry that support economic and workforce development.

We were very pleased to see that the state of Nebraska initiated and funded its own versions of two economic development programs originated by Nebraska EPSCoR, the University-Industry Research & Development Partnership Program, and the Nebraska Engineering, Science, and Technology Program (NESTIP). Our R&D Partnership Program offers up to $25,000 in cost-share for collaborative STEM projects between a university researcher and a Nebraska business. NESTIP offers to pay half of the costs of STEM internships for undergraduate and graduate students at Nebraska businesses, up to $5,000. These successful programs provide critical support to students, academic researchers, and businesses.

The state's Talent & Innovation Initiative includes the Nebraska Applied Industry Research and Development Program and Intern Nebraska, both modeled on the principles that Nebraska EPSCoR established in our own economic development programs, but with expanded funding. It is highly encouraging that our proven programs are being replicated at a larger scale and higher level of funding.

In 2012, Nebraska EPSCoR is initiating a new grant program to enhance collaboration and increase national competitiveness by building on the existing strengths and strategic visions of the state's research universities. An indicator of national competitiveness is the ability to obtain peer reviewed, multi-million dollar federal research grants. The current trend is that large scale federal research grants are awarded to support transdisciplinary, multi-institutional research clusters. Through the competitive Transdisciplinary, Multi-institutional Research Cluster grant program, Nebraska EPSCoR will provide seed money for the successful creation of up to two such clusters over a one or two year period. Up to $300,000 per year will be awarded to each project. Successful proposals will be announced in April.

Nebraska EPSCoR continues to be a bold pioneer of programs that enhance the state's STEM research competitiveness and foster economic development.

ANNOUNCING NEW WEBSITE URL HTTP://EPSCOR.NEBRASKA.EDU

IDeA EPSCoR NEBRASKA

Experimental Program to Stimulate Competitive Research
Institutional Development Award Program

NEBRASKA EPSCOR

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Nancy Simnitt, Administrative Technician
Hanna Day-Woodruff, Communications Specialist
Fred Gartner, Accounting Technician

COVER PHOTO: The cover is a montage of images from EPSCoR research and activities. It includes images of nanostructures from Dr. Yongfeng Lu, UNL; a gold nanocluster from Dr. Xiao Cheng Zeng, UNL; and a photograph taken from a weather balloon launched by the students in the YNS near-space summer science camp.

Editor: Hanna Day-Woodruff
Graphic Designer: Clint Chapman

NEURON CONNECTION EXPANDING

Eight colleges and universities in Nebraska received vital upgrades to their connections to the Nebraska University Regional Optical Network (NEURON), thanks to a $1.17 million NSF EPSCoR RII Track C2 grant to Nebraska EPSCoR. NEURON is the fiber optic backbone ring that facilitates high speed data transfer and connects Nebraska institutions to the worldwide Internet 2.

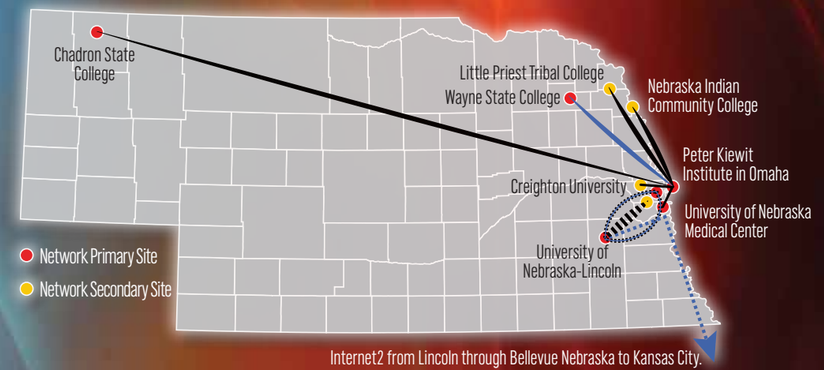
"Cyberinfrastructure is an unseen conduit for economic development," said F. Fred Choobineh, principal investigator and director of Nebraska EPSCoR. "By extending and broadening cyber access, we are making essential contributions to Nebraska's present and future prosperity."

The Creighton University connection to the network was upgraded to 10 gigabits, enabling collaborations with research universities in the state and enhancing Creighton's distance education. Advanced computational collaborations were further enhanced by an upgrade of the NEURON connection between the University of Nebraska-Lincoln, the Peter Kiewit Institute in Omaha, and the University of Nebraska Medical Center from 10 gigabits to 30 gigabits.

New 100 megabit high speed connections to NEURON became possible with the installation of new fiber cable for Little Priest Tribal College and Nebraska Indian Community College. NEURON connections to Chadron State College and Wayne State College were upgraded to 500 megabits.

Through strategic network upgrades, Track C2 aims to 1) broaden opportunities for advanced research and collaborations among academic institutions, and 2) facilitate access to distance education and specialized health care for rural Nebraska residents. Future investments will extend NEURON connections to western Nebraska and provide training for network engineers and other users to ensure that the expanded capabilities are fully utilized.

NEBRASKA UNIVERSITY REGIONAL OPTICAL NETWORK (NEURON)



ZENG, SCHUBERT EARN HIGH HONORS

XIAO CHENG ZENG

The American Chemical Society's St. Louis section recognized Xiao Cheng Zeng with the Midwest Award for his outstanding contributions to chemistry. Zeng is the Ameritas University Professor of Chemistry at the University of Nebraska-Lincoln and is a computational nanoscientist on Nebraska EPSCoR's NSF RII Track 2 grant. Zeng is the fourth University of Nebraska scholar to receive this annual award since its inception in 1944.

MATHIAS SCHUBERT

Due to the "transformative potential" of his research, Mathias Schubert was elected as a Fellow of the American Physical Society (APS). Schubert is an associate professor of electrical engineering at the University of Nebraska-Lincoln and is a co-director of the Center for Nanohybrid Functional Materials, which is funded from Nebraska EPSCoR's NSF RII Track 1 grant.

Fresh Faces on the State EPSCoR Committee

The governor-appointed State EPSCoR Committee provides critical guidance and oversight for Nebraska EPSCoR's strategic, collaborative research investments. Committee members serve 3 -year, staggered terms. The 19-member committee includes senior faculty and administrators from Creighton University and the University of Nebraska campuses, representatives from industry and the state's economic development agency, as well as the Nebraska legislature.

Nebraska EPSCoR welcomes seven new members and five reappointees as seven members depart the committee.

New Committee Bios:

Iqbal Ahmad, Ph.D., is a professor of ophthalmology and visual sciences, and an associate dean for postdoctoral education and research at the University of Nebraska Medical Center. Ahmad studies how stem cells are regulated and uses the emerging information to establish proof-of-principle of regenerative medicine for the retina. He received his doctorate from Kent State University in Ohio.

Vimla Band, Ph.D., is a Professor and Chair of the Genetics, Cell Biology and Anatomy department at UNMC. Her research focuses on breast cancers. She is on the editorial board of several cancer journals and is the principal investigator on a number of grants from the National Cancer Institute and the Department of Defense Breast Cancer Program, and she serves on numerous review panels. She received her doctorate from the All India Institute of Medical Sciences in India.

Catherine Lang, J.D., is the director of the Nebraska Department of Economic Development and the commissioner of labor at the Nebraska Department of Labor. With 30 years in Nebraska government, she has been the Nebraska property tax administrator and the deputy tax commissioner for the Nebraska Department of Revenue. Her law degree is from the University of Nebraska-Lincoln School of Law.

Valery Forbes, Ph.D., is the director of the School of Biological Sciences at UNL. Her doctorate is in coastal oceanography from SUNY-Stony Brook. Specific research topics include population ecology and modeling, fate and effects of toxic chemicals in sediments, and ecological risk assessment.

David Kennedy, Ph.D., is a management consultant serving the environmental, food safety, and pharmaceutical markets. He has over 40 years of experience in consulting engineering, contract analytical laboratories, and the manufacture of scientific instruments. His doctorate is in analytical chemistry from Iowa State University. Kennedy is the former president/general manager of Teledyne Isco in Lincoln, Nebraska.

Jennifer Larsen, M.D., was appointed vice chancellor for research at UNMC in July 2011. Her research spans evaluating mechanisms for immunosuppressant medication-induced diabetes and vascular disease in animal models, nontraditional risk factors of vascular disease in high risk populations, including organ transplant recipients, and community-based strategies to prevent diabetes and vascular risk. Her medical doctorate is from the University of Iowa.

Scott Snyder, Ph.D., is the associate vice chancellor for research & creative activity at the University of Nebraska at Omaha. His previous experiences include service as program director at the National Science Foundation and professor of biology at UNO. He received his doctorate in parasitology from the University of Nebraska-Lincoln. Snyder's research interests lie in parasite biodiversity and evolution of worms living in and on reptiles and amphibians.

Nicholas Stergiou, Ph.D., has faculty appointments with UNO and UNMC and is the director of the Nebraska Biomechanics Core Facility. He also maintains courtesy professorships with UNL and Creighton University. Stergiou serves as the coordinator of research and creative activity for the College of Education at UNO and directs a graduate program at the College of Public Health. His doctorate is in biomechanics from the University of Oregon.

Continuing Dedicated Service

At the Governor's behest, five Committee members agreed to continue their service through reappointment. We thank them for their commitment to Nebraska EPSCoR and for their past and future dedication. They are: **Clague Hodgson**, Ph.D., president, Nature Technology Corporation; **Lyle Middendorf**, senior vice president & chief technical officer, Advanced Research & Development, LI-COR, Inc.; **Prem Paul**, Ph.D., vice chancellor for research and economic development, University of Nebraska-Lincoln; **Linda Pratt**, Ph.D., executive vice president & provost, University of Nebraska; and **Terri Wasmoen**, Ph.D., head, US Biological Research, Merck Animal Health.

Served with Distinction

We'd like to thank the outgoing members for serving the Nebraska State EPSCoR Committee with distinction. These include: **Richard Baier**, former director of the Nebraska Department of Economic Development; **Judith Christman**, Ph.D., Stokes-Shackelford Professor, department of biochemistry and molecular biology, University of Nebraska Medical Center; **Marjorie Langell**, Ph.D., Charles Bessey Professor, department of chemistry at UNL; **Tom Rosenquist**, Ph.D., former vice chancellor for research at UNMC; **Scott Tarry**, Ph.D., director of the NASA Nebraska Space Grant and EPSCoR, and executive director of the Strategic Air and Space Museum; **James Turpen**, Ph.D., associate vice chancellor for academic affairs at UNMC and principal investigator of the Nebraska INBRE program; and **Ilze Zigurs**, Ph.D., professor and Mutual of Omaha Distinguished Chair of the department of information systems & quantitative analysis at the University of Nebraska at Omaha.

Federal EPSCoR Awards in 2011

NASA EPSCoR Funding

NASA EPSCoR funded two projects this year in Nebraska. The project director for both grants is Dr. Scott Tarry, director of NASA Nebraska Space Grant and EPSCoR programs. The awards are for $750,000 over three years.

- ***The Role of Tactile Sensation on Locomotor Adaptation in Astronauts Returning from Long Duration Space Flights;*** Principal Investigator: Nicholas Stergiou, Health, Physical Education & Recreation, University of Nebraska at Omaha.

- ***A Highly Dexterous Modular Robot with Autonomous Dynamic Reconfigurations for Extra-Terrestrial Exploration;*** PIs: Ras Dasgupta, Computer Science, University of Nebraska at Omaha; and Carl Nelson, Mechanical & Materials Engineering, University of Nebraska-Lincoln.

NSF EPSCoR Co-funding:

Co-funding through the National Science Foundation's EPSCoR program supplements available funds from other NSF programs, thus enabling more grants for meritorious proposals that come from EPSCoR states. The following seven awards received partial funding, totaling $1.1 million, from the NSF EPSCoR Co-Funding Program:

- ***Collaborative Research: Adaptive Sampling with Robots for Marine Observations;*** PI: Carrick Detweiler, Computer Science and Engineering, University of Nebraska-Lincoln; $249,971.

- ***GOALI: Module-Centric Approach to Integrated Adaptation of Assembly Products and Supply Chains;*** PI: Jeonghan Ko, Industrial & Management Systems Engineering, UNL; $202,770.

- ***A Novel Architecture for Application-Aware Cognitive Multihop Wireless Networks;*** PI: Yi Qian, Computer and Electronics Engineering, UNL; $439,999.

- ***Multi-Physics Modeling of Intense, Short-Pulse Laser-Plasma Interactions;*** PI: Bradley Shadwick, Physics and Astronomy, UNL; $342,000.

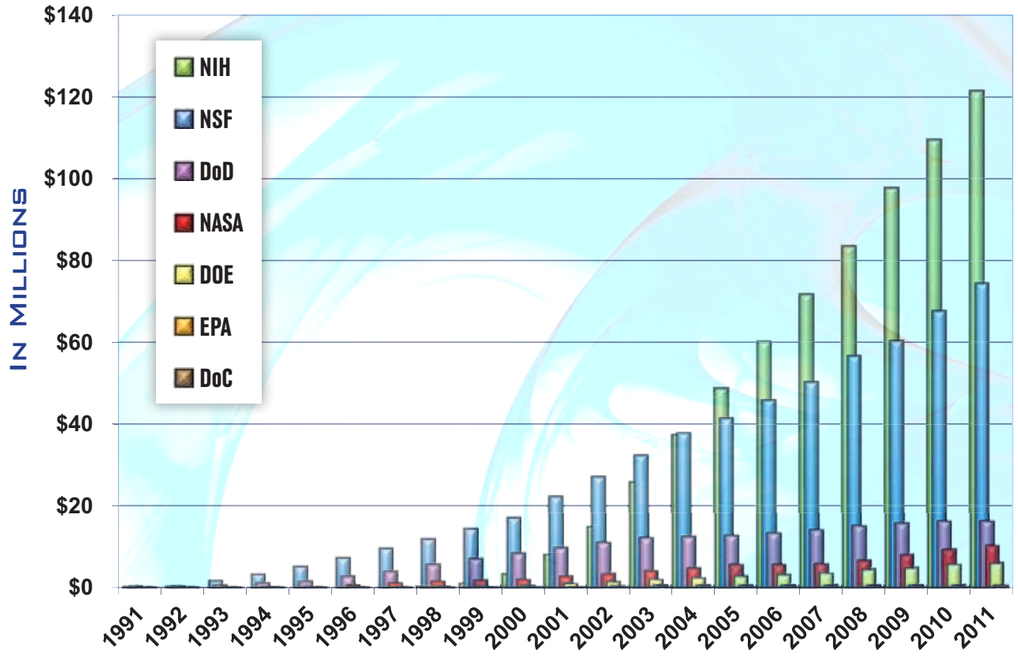
- ***CAREER: Smart Cameras Getting Smarter: Detecting High-level Events Across Battery-powered Wireless Embedded Smart Cameras;*** PI: Senem Velipasalar, Electrical Engineering, UNL.*

- ***Early Seed Development Under Stressful Environments;*** PI: Harkamal Walia, Agronomy and Horticulture, UNL; $557,708.

- ***Influence of Soil Particle Size Fractions and Environmental Conditions on Fate and Transport of Hormones in Soils;*** PI: Tian Zhang, Engineering, UNL; $300,000.

**Velipasalar left UNL in the summer of 2011 to accept a position at Syracuse University.*

Cumulative Federal R&D Funds Expended by Nebraska EPSCoR



2011 FIRST Awards

Nebraska EPSCoR sponsors several award competitions that are designed to offer unique support to researchers at different phases of their careers. One of the competitions is the FIRST Award, which offers $20,000 as a one-to-one match to early career, pre-tenured faculty in support of research that could lead to a National Science Foundation CAREER Award. Six grants were awarded in 2011.

FIRST Awardees

- **Interface Engineered Multiferroics and Nanoscale Phase Modulation in Complex Oxide Heterostructures**; Principal Investigator: Xia Hong, Physics and Astronomy, University of Nebraska-Lincoln.

- **Functional Assessment of Barriers to Learning: Linking Assessment and Treatment**; PI: Tiffany Kodak, Center for Autism Spectrum Disorders, University of Nebraska Medical Center.*

- **Poro-elastic Meta-materials for Noise Reduction: Research and Education**; PI: Siu-Kit Lau, Architectural Engineering and Construction, UNL.

- **Advanced Multiscale Modeling-Analysis of Nanoparticle Transport in Porous Media**; PI: Yusong Li, Civil Engineering, UNL.

- **Effects of Topographic and Hydrologic Network Complexity on Land-Atmosphere Exchange of CO_2**; PI: Diego Riveros-Iregui, School of Natural Resources, UNL.

- **Ecological Profiling of Phyllostomine Bats**; PI: Heather York, Biology, Doane College.

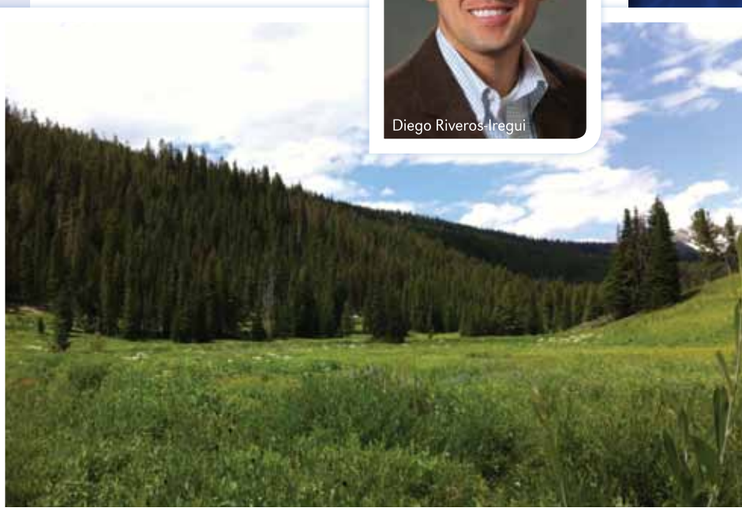
**In the summer of 2011, Kodak left UNMC to take a position at the University of Oregon.*

Research Spotlight:

Carbon Cycling in the Headwaters of the Missouri River

High in the Montana Rocky Mountains are the headwaters of the Missouri River, one of the largest sources of irrigation for the Great Plains. This forested, subalpine landscape also serves as a major sink for atmospheric carbon, as pine trees remove carbon dioxide from the air and transform it into biomass and organic carbon in the soil. Thus, these forests offer ecosystem services that are deeply important at local, regional, and continental scales.


Diego Riveros-Iregui



The new USDA grant will examine the relationship between watershed geomorphic form, drainage patterns, soil CO_2 concentration, efflux, isotopic composition, and soil microbial communities in subalpine forests of the northern Rocky Mountains, headwaters of the Missouri River. Diego Riveros-Iregui is the principal investigator of this grant.

Diego Riveros-Iregui, an assistant professor of watershed hydrology in the School of Natural Resources at the University of Nebraska-Lincoln, used the funds provided by a 2011 Nebraska EPSCoR FIRST Award for field work in Montana to study how surface water flow affects the decomposition of soil carbon. The ultimate aim is to understand how surface hydrology affects the capacity of these forests to sequester and retain atmospheric carbon. Data obtained from the field work supported a successful proposal with the United States Department of Agriculture, which will award $480,000 to Riveros-Iregui in 2012 to continue his research.

Research Spotlight:
Dietary Ecology of Leaf-nosed Bat


Heather York

Trachops cirrhosus (frog-eating bat)

Heather York, assistant professor of biology at Doane College in Crete, Nebraska, used her 2011 EPSCoR FIRST Award to support two Doane undergraduates, Rachel Gibson and Erin Stukenholtz, as collaborators on a study of the dietary ecology of a diverse group of Neotropical leaf-nosed bats.

The species-level effects of habitat disturbance on Neotropical bats, and, in turn, their contributions to forest recovery and restoration through pollination, seed dispersal, and predation on herbivorous insects, are poorly known. By studying habitat use and diet in these bats, York aims to gain a better understanding of bats' roles in ecological processes in the tropics.

Research activities included examinations of specimens housed at the University of Nebraska State Museum, the University of Kansas Natural History Museum and Biodiversity Research Center, and the Royal Ontario Museum. Preliminary results from these studies were presented by York's research team at the 2011 meetings of the Central Plains Society of Mammalogists and of the North American Society for Bat Research. The York team also has led educational programs about bats for Bader State Park in Chapman and for the Lincoln City Libraries and conducted a survey for Pioneers Park Nature Center in Lincoln.

In January 2012, York traveled with Gibson and Stukenholtz to Costa Rica for a 20-day field session to capture and sample bats at two sites, the Las Cruces Biological Station and the Bijagual Ecological Reserve. Follow-up laboratory work will continue this spring.

Expanding Undergraduate Research at Small Colleges

Studies show that undergraduates who participate in research are more likely to pursue graduate degrees in science, technology, engineering and mathematics (STEM). Nonetheless, funding opportunities for this purpose are limited at Nebraska's small colleges and universities. The Undergraduate Research Experience Award fills the gap by providing up to $5,000 to support undergraduate STEM research projects at these institutions.

This year's projects span a broad spectrum of topics in chemistry, biology, physics and biomedical research. Five academics at Doane College and the University of Nebraska at Kearney received this award: Tessa Durham Brooks, assistant professor of biology, Doane College; Haishi Cao, assistant professor of chemistry, University of Nebraska at Kearney; Mark Plano Clark, associate professor of physics, Doane College; Liubov Kreminska, assistant professor of physics and physical science, UNK; and Erin Wilson, assistant professor of chemistry, Doane College.

"The generous funding provided by Nebraska EPSCoR allows a student to earn good money while getting this valuable, career-building experience," said Wilson, whose student, Jordan Lintt, a junior at Doane College, studies protein-mineral interactions in bone.

IDeA in Nebraska: Biomedical Research and Education

The Institutional Development Award (IDeA) is a program of the National Institutes of Health to broaden the geographic distribution of the NIH biomedical and behavioral research funds. It operates through Centers of Biomedical Research Excellence (COBRE) and the IDeA Networks of Biomedical Research Excellence (INBRE).

Current Nebraska IDeA Awards:

The REDOX Biology Center
University of Nebraska-Lincoln
$10.8 million, August 2007-August 2012

Nebraska Center for Drug Delivery and Nanomedicine
University of Nebraska Medical Center
$10.65 million, September 2008-June 2013

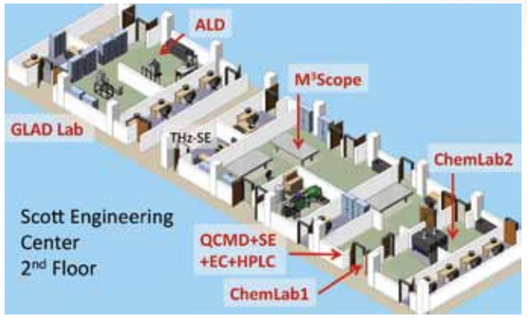
Nebraska Center for Cellular Signaling
University of Nebraska Medical Center
$9.8 million, July 2008-June 2013

Nebraska Center for the Molecular Biology of Neurosensory Systems
University of Nebraska Medical Center
$10.2 million, September 2009-June 2014

Nebraska INBRE Program
University of Nebraska Medical Center
$18.0 million, May 2008—June 2014

NSF EPSCoR RII Track 1 Update:
Center for Nanohybrid Functional Materials

New equipment, renovated laboratory spaces, and new faculty have enhanced the Center for Nanohybrid Functional Materials (CNFM), a multidisciplinary research group created with funds from the $20 million 2010 NSF EPSCoR Research Infrastructure Improvement Track 1 award. The Center merges the expertise of chemists and electrical engineers from five Nebraska universities and colleges to develop and explore three-dimensional nanomaterials for sensing and detection devises.



In its first year, the Center's infrastructure building activities included the renovation of the University of Nebraska-Lincoln's Engineering Center Research Core Facilities and the acquisition of essential equipment, including an Atomic Layer Deposition (ALD) system, an Excimer laser, and HPLC and nanofluidics systems. This equipment, particularly the ALD system, increases the capabilities of participating faculty and further secures the Center as a world class facility. Two new faculty members, Tino Hofmann and Alexander Sinitskii, added their expertise in optics and nanomaterials to the Center and have made an immediate impact on the CNFM team.

Nebraska Coalition for Algal Biology and Biotechnology

The Nebraska Coalition for Algal Biology and Biotechnology (NCABB), also funded from the NSF EPSCoR RII Track 1 award, works to add fundamental knowledge about algal biology in support of its use in biofuels; it has thirteen members from four Nebraska colleges and universities. NCABB made essential investments in infrastructure and new faculty to expand the capabilities of the group, while its members made significant research progress. Heriberto Cerutti, professor of biological sciences at UNL, identified genetic factors controlling lipid (oil) production in algal cells and altered them to increase lipid synthesis without limiting cell division (read more on page 10). A method for targeted gene knockout and gene replacement in yeast was developed by the laboratory of Don Weeks, Maxcy Professor of Agriculture and Natural Resources at UNL, in collaboration with laboratories at Iowa State University. His laboratory is working to extend this powerful new technology to higher plants and algal cells. The laboratory of Jim Van Etten, William Allington Distinguished Professor of Plant Pathology at UNL, collaborated with an international team to successfully sequence and characterize the entire nuclear genome of an important alga for studying pathogenic algal viruses. Extensive new greenhouse and laboratory algal growth facilities have been established to allow scientists across Nebraska access to first class algal bioreactors, harvesting equipment and expertise.

New Faculty Hires

Tino Hofmann is a research assistant professor in UNL's department of electrical engineering and a member of CNFM. He completed his doctoral work at the Department of Solid-State Optics at the University of Leipzig, Germany. Hofmann's current research focuses on the terahertz optical response of three-dimensional nanostructures for future sensor applications.

Alexander Sinitskii is a materials scientist and inorganic chemist who completed his doctoral work at Moscow University and is now an assistant professor of chemistry at UNL and member of CNFM. His work is in the chemical design of novel functional materials for applications in electronics, photonics, sensors and energy storage.

Jonathan Markham, assistant professor of biochemistry at UNL, joins NCABB from the Donald Danforth Plant Science Center in St. Louis, where he was a postdoctoral research associate. Markham investigates the cellular functions of sphingolipids, of a class of lipids that are found in eukaryotes, including algae.

Nebraska and Puerto Rico: Tackling New Energy Challenges Together

New technologies will be essential to satisfy rising energy demands, and nanoscale materials will be key components of those technologies. Computational nanoscience researchers at the University of Nebraska and the University of Puerto Rico are collaborating to develop novel materials for applications in energy technologies, such as next generation hydrogen fuel cells, low-power electronics, and light harvesting. Their research is funded by a jointly-awarded $6 million National Science Foundation EPSCoR Research Infrastructure Improvement Track 2 grant.

Members of the RII Track 2 External Advisory Panel discuss research with investigator Kirill Belashchenko. L-R, Mark Pederson, U.S. Department of Energy; Christine Aikens, Kansas State University; Derek Stewart, Cornell Nanoscale Facility, Cornell University; Ian Fisk, DOE Fermilab; Kirill Belashchenko, University of Nebraska-Lincoln; F. Fred Choobineh, director, Nebraska EPSCoR.

"Computational modeling makes it possible to design novel materials and structures, predict their functional properties, and understand the underlying physical phenomena," said Evgeny Tsymbal, co-principal investigator, Charles Bessey Professor of Physics and director of the Materials Research Science and Engineering Center (MRSEC) at the University of Nebraska-Lincoln. "Predictive computational modeling plays a critical role in energy-related disciplines by providing a route for efficient tests of new ideas that often guide experimental investigations."

Joint Workshops Strengthen Collaborations

Two joint workshops in 2011 allowed investigators to discover further areas for collaboration. Nebraska EPSCoR hosted the first joint workshop with almost 30 participants in conjunction with the external review panel site visit to Lincoln in June. Both Nebraska and Puerto Rico investigators presented their research progress and ideas and received feedback from the panel. The primary recommendation was to expand and accelerate opportunities for cross-jurisdictional collaborations, including additional workshops and student-researcher exchanges.

The second workshop, hosted by the University of Puerto Rico, was held in San Juan, Puerto Rico, with over 80 participants, including over twenty from Nebraska. Existing collaborations were strengthened, new research synergies were found between computational and experimental nanoscientists, and plans were made for future exchanges of researchers, postdocs, and students. The scope of the project was expanded to include light harvesting, in addition to the current research thrusts of energy-efficient electronics and nanocatalysts.

"There is a large overlap between the research pursued by scientists in the two jurisdictions; a great deal of potential collaboration was identified at the Puerto Rico workshop. Thus, we are poised to expand our collaboration and take advantage of new funding opportunities," said Julian Velev, investigator from the University of Puerto Rico.

The University of Nebraska's portion of the award, now in its second year, was $3.3 million. The principal investigator for Nebraska is F. Fred Choobineh, Blackman Professor of Engineering at the University of Nebraska-Lincoln and director of Nebraska EPSCoR. Co-PIs are Tsymbal and David Swanson, director of the Holland Research Computing Center at UNL. Manuel Gomez, director of Puerto Rico EPSCoR, is the principal investigator of Puerto Rico's portion of the award; co-PIs are Humberto Ortiz-Zuazaga, department of chemistry and director of the University of Puerto Rico High Performance Computing Facility, director of the Computational Nanoscience Resource Center for the Institute for Functional Nanomaterials and the Bioinformatics Resource Center for Puerto Rico's INBRE project; and Julian Velev, associate professor at the Institute for Functional Nanomaterials at UPR.

Exploring Algae for Biofuel

Algae, photosynthetic organisms found in diverse environments, show great promise as alternative sources of biofuels. The organisms produce triglycerides, a type of oil lipid that can be easily converted for use as a biofuel. Unfortunately, the conditions that accelerate lipid production to sufficient levels also terminate cell growth.

Heriberto Cerutti, professor of biological sciences, UNL

Edgar Cahoon, professor of biochemistry, UNL

This challenge is being tackled with promising preliminary results by Heriberto Cerutti, professor of the School of Biological Sciences at the University of Nebraska-Lincoln, and Ed Cahoon, professor of biochemistry at UNL. As members of the Nebraska Coalition for Algal Biology and Biotechnology (NCABB), a research group funded from Nebraska's NSF EPSCoR RII Track 1 Award, Cerutti and Cahoon seek to understand and improve the internal processes that regulate triglyceride production.

The lipid production conundrum makes growing and harvesting algae for triglycerides a laborious process; algae are first grown to a critical volume, and then transferred to a new growth medium that limits nitrogen, one of its key nutrients. Under nitrogen "starvation," algae stop growing and begin to accumulate triglycerides. Thus, high biomass production and lipid accumulation are generally mutually exclusive.

To begin to address this paradox, Cerutti and his graduate students Joseph Msane and Anji Reddy Konda altered the genetic makeup of a species in the *Chlamydomonas* genus to induce it to accumulate lipids under normal, nitrogen-abundant conditions, with lipid analyses done by the Cahoon lab. This accomplishment had a familiar setback, for the cells ceased reproduction, but it gave them vital information on gene expression and gene regulation. Next, they will test new genetic methods to induce algae to accumulate lipids and grow simultaneously in normal, nitrogen-containing medium. Current lipid production peaks at near 14% of the biomass; the more economical goal for biofuels harvesting would be to bring the lipid production up to 30-35%.

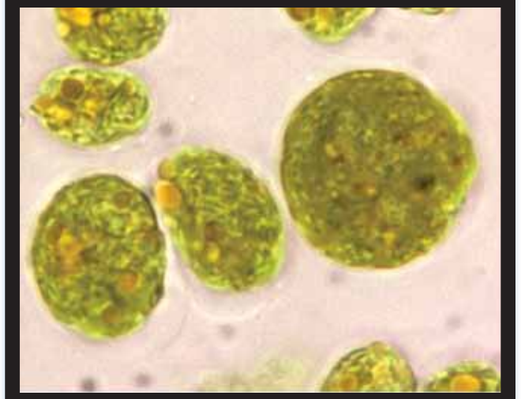
"We hope that by understanding the actual biology of the different pathways and how they work, and the different regulators that control the pathways, we can manipulate them and eventually devise a system that results in high lipid density and high biomass without changing the growing medium or doing any other type of manipulating," said Cerutti.

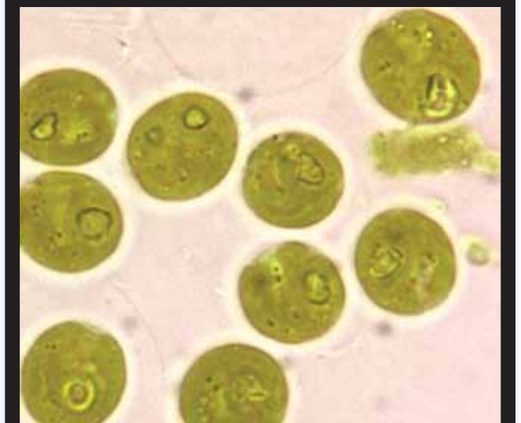
Chlamydomonas is not likely to be a commercial biofuel algae but Cerutti works with it because it, "is used as a model system to establish proof of concept that can then be used on other algal strains that could be better suited for production purposes."

NCABB is comprised of biologists, biochemists and agronomists at UNL, University of Nebraska at Kearney, Doane College and Creighton University. The researchers, including top experts in the world in their respective areas, are contributing vital knowledge about basic algal biology and lipid production needed by the larger algal biofuels community.

"The main goal of Track 1 is to develop new tools and new knowledge to eventually develop algae as a viable system for biodiesel production," said Cerutti. "We are mostly focusing on the biology; so we are not concentrating on the actual engineering side and the systems that you would need for production. We are trying to understand how lipid accumulation occurs in algae and understand the different components that are required for that, like environmental triggers."

Bright field microscopy images show the *Chlamydomonas reinhardtii* alga. The bottom image is the wild type algal strain; the top image is a genetically modified alga that accumulates lipids in a medium that contains nitrogen.





Research Flourishes at Doane College

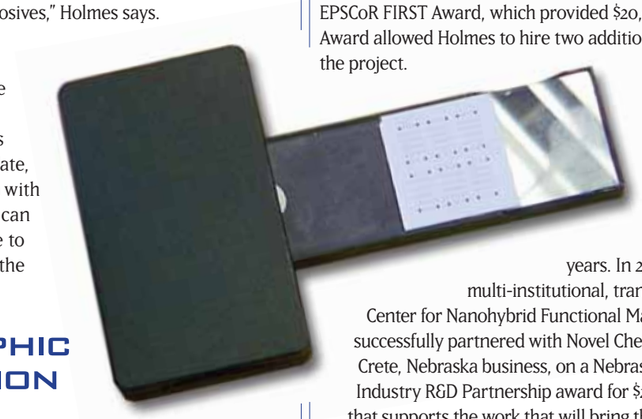
Three Nebraska EPSCoR Awards, a National Science Foundation CAREER Award, an NSF Research Infrastructure Improvement Award, two patents, and a flourishing public-private partnership have kept Andrea Holmes, associate professor of chemistry at Doane College, extremely busy over the past five years.

The focus of her time and these investments: the development of a unique chemical sensing device, called the DETECHIP, which precisely identifies substances at very small quantities.

DETECHIP is a small sensing array that contains different chemical sensing agents that change color or fluorescence when exposed to certain molecules. A color change, or its lack, is then coded as either a "1" or a "0" for each of the sensors, resulting in a binary code that is unique to each substance and can be used as a key if DETECHIP is used as a portable field device.

"It is the combination of the sensing materials that lead to the unique identification of substances of interest, like narcotics, drugs, or precursors to explosives," Holmes says.

Her goal is to miniaturize the assay and automate the detection, so that many thousand sensing elements can be spotted on a tiny plate, a photograph can be taken with a smartphone, and an app can analyze the color signature to reveal the binary code for the substance.



Demographic Distribution

The process of converting DETECHIP from the macro scale to the micro and nano scales is facilitated by collaborative partnerships she has made as a member of the Nebraska Center for Nanohybrid Functional Materials (CNFM), which is funded in part by the five-year, $20 million NSF EPSCoR Research Infrastructure Improvement Track I award. She is collaborating with another CNFM member, Mathias Schubert, associate professor of electrical engineering at the University of Nebraska-Lincoln. Schubert's lab, which includes several postdocs and graduate students, is one of the nation's best in assembling nanomaterials with defined three-dimensional shapes and characterizing them using optical spectroscopy.

Andrea Holmes of Doane College in Crete, Nebraska, works with her undergraduate student Shari Paquette on DETECHIP, a device that can detect substances at very small quantities. Credit: Allan Recalde, art director, Doane College

From Rags to Riches

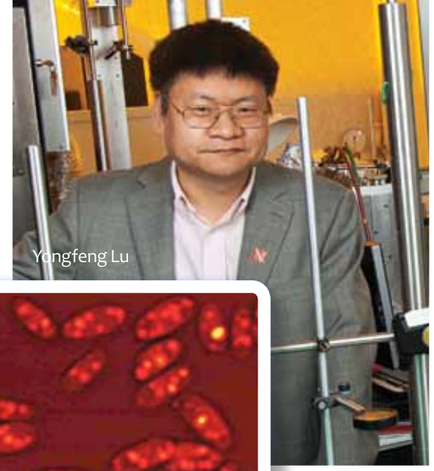
Andrea Holmes attributes DETECHIP's success to EPSCoR's investments over time. The project began in 2006, when a student approached her with an interest in designing a tool for detecting date-rape drugs. That research was funded through Nebraska EPSCoR's Undergraduate Research Experience $5,000 grant. It showed promise, and Holmes successfully applied for a Nebraska EPSCoR FIRST Award, which provided $20,000 in 2007. The FIRST Award allowed Holmes to hire two additional students to expand the project.

In 2008, Holmes leveraged the results from these two grants into a prestigious NSF CAREER Award for $525,000 over five years. In 2010, Holmes joined the multi-institutional, transdisciplinary Nebraska Center for Nanohybrid Functional Materials. She also successfully partnered with Novel Chemical Solutions (NCS), a Crete, Nebraska business, on a Nebraska EPSCoR University-Industry R&D Partnership award for $25,000 in matching funds that supports the work that will bring the DETECHIP from the laboratory bench to the market. Novel Chemical Solutions is a participant in the Nebraska EPSCoR's NESTIP program, which pays for half of a student's 6-month internship. Through this program, several of Holmes' students have moved from her lab to NCS to work on the DETECHIP and other NCS projects.

Now her team includes three postdoctoral fellows, three to five undergraduates, and several high school summer students. Their salaries, travel, supplies, and publications are all funded by the NSF EPSCoR RII Track I and the NSF CAREER awards.

"My research career has been made possible by Nebraska EPSCoR, whose initial and continued support has been essential to allowing me to grow my research and be competitive at the National Science Foundation," said Holmes.

3D Molecular Imaging to Monitor Lipid Production in Algae



Yongfeng Lu

Paul Black

Under normal circumstances, odds would be against Paul Black and Yongfeng Lu collaborating. With different fields that rarely overlap and offices far away from each other, they most likely would have been unaware of the other's research.

Black is Bessey Professor of Biochemistry and chair of the biochemistry department at the University of Nebraska-Lincoln. Lu is the Lott Professor of Electrical Engineering at UNL. But thanks to NSF EPSCoR's Research Infrastructure Improvement Track I Award and a little bit of kismet, Black and Lu discovered convergent research interests that could allow future growers of algae for biofuel to monitor lipid production in real-time without harming the algae cells.

"The collaboration was not something that was planned, but we both have technologies that are compatible to advance the science right on the edge of both disciplines to generate something very new," Black said.

A Meeting of Minds

The National Science Foundation's Research Infrastructure Improvement Track I Awards are large-scale and involve numerous researchers. In 2010, Nebraska EPSCoR was awarded $20 million to create two separate research centers, the Nebraska Coalition for Algal Biology & Biotechnology, and the Nebraska Center for Nanohybrid Functional Materials, with academics from the University of Nebraska-Lincoln, University of Nebraska Medical Center, University of Nebraska at Kearney, Doane College, and Creighton University.

At a strategic planning meeting involving both centers, Black and Lu recognized a collaborative opportunity and have since spun it off into a wholly new and innovative research direction with separate funding. They successfully applied for and received an NSF Major Research Instrumentation (MRI) award for $266,460 to build a multifunctional CARS (coherent anti-Stokes Raman spectroscopy) imaging system. They will build this instrument in the spring of 2012 and begin testing its capabilities on algae shortly thereafter. The spectroscopy is aided by a coating of nanogold on carbon nanotubes that increases the vibrational signals of lipids in the cells and enhances the Raman signal that can be detected.

Science on the Edge

Understanding and manipulating how algae synthesize fatty acids for triglycerides is part of Black's research, which focuses on the biochemistry of fatty acid transport and trafficking. He seeks to understand the metabolic events that result in triglyceride (oil) production and manipulate lipid metabolic pathways to produce the type and amount of fatty acids that would make algae viable as a source of biofuel. As current methods to image living algae cells are few and often require cells to be modified and destroyed, Black has been searching for an alternative.

"As biochemists, you tear things apart. You don't really know what's going on within specific compartments of the cell," Black said.

Optical spectroscopy, which is one of Lu's areas of expertise, produces images of cells with micro and nanoscale resolutions by detecting molecular vibrations and translating them into images. Together they are developing a method that uses optical spectroscopy to measure the growth of lipids in algae.

"The MRI is now going to allow us to visualize lipid metabolism in real time in living cells. In the process, we are developing a new method to monitor metabolism that goes beyond algae," Black said.

"I think it is a wonderful collaboration," Lu said. "If we didn't have this collaboration, I would be playing with these tools on imaginary problems, not real problems."

They hope to one day develop the technology to the point where it can be used as a cost-effective and efficient probe to measure the lipid content of large-scale algal cultures, letting the cultivator know when the cells are ready for harvesting. Beyond algae, they are looking to apply these real-time imaging technologies to address complex lipid metabolism in liver and other tissue types to further understand the mechanisms leading to lipid-related disorders including type 2 diabetes, non-alcoholic fatty liver disease, cardiovascular disease and some cancers.

Nanogold Clusters as Catalysts for Fuel Cell Production

Pure gold has a reputation as a stable and non-reactive element, but at the nanoscale – one-billionth of a meter – gold has a reactivity that could prove to be vital for alternative electricity generation.

In a recent publication in ACS Nano, scientist Xiao Cheng Zeng from the University of Nebraska-Lincoln collaborated with other scientists to predict the potential of pure gold nano molecules to aid in key reactions to produce hydrogen for fuel cells. Using complex computer modeling, they focused on gold clusters from 16 to 35 atoms in size. The results of the simulations are one piece of the puzzle for the grand challenge of meeting our energy needs from alternative sources.

Zeng's research was sponsored by a Nebraska NSF EPSCoR RII Track 2 award, which is a collaborative project between scientists at the University of Nebraska and the University of Puerto Rico that focuses on computational nanoscience for energy technologies. The project takes advantage of the University of Nebraska's supercomputer, allowing complex computations that would not be possible otherwise .

Purifying Fuel Cell Poison with Gold

Current methods of producing hydrogen gas for fuel cells result in the byproduct carbon monoxide. This byproduct can damage fuel cells – in fact, carbon monoxide is considered a fuel cell "poison." But gold nanoparticles have the ability to speed up the conversion of carbon monoxide to carbon dioxide, which is benign in fuel cells, thereby refining the hydrogen gas to a purity that can be used.

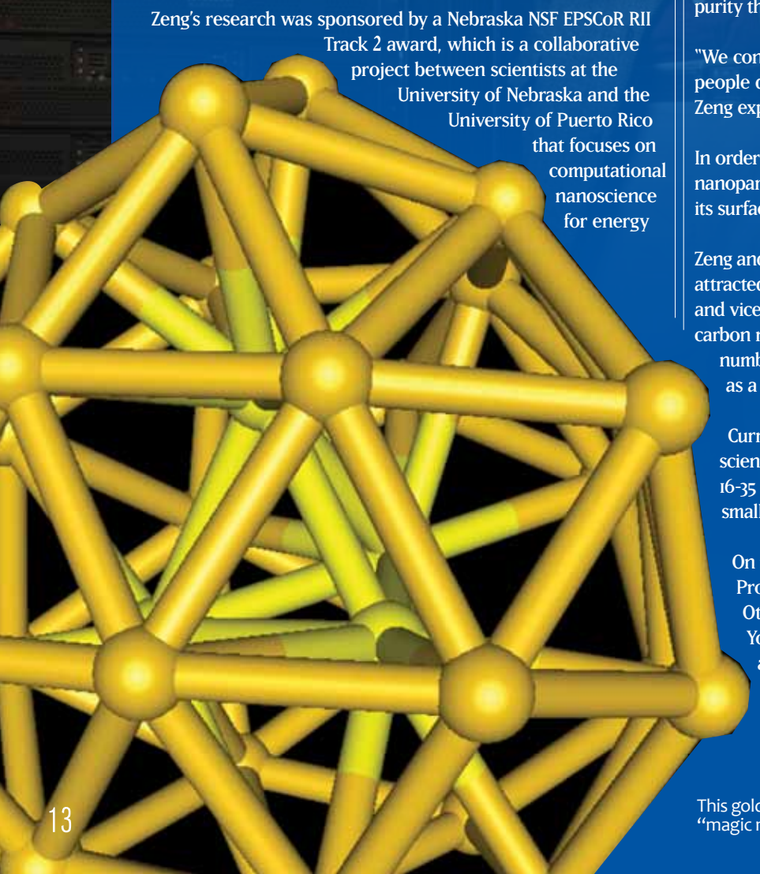
"We consider the catalyst like a date. When you have two people date, they both must like the place to have chemistry," Zeng explains.

In order to convert carbon monoxide to carbon dioxide, the gold nanoparticle must attract both carbon monoxide and oxygen to its surface, bringing them together to make the magic happen.

Zeng and his collaborators found that some gold clusters attracted carbon monoxide, but didn't attract oxygen as easily, and vice versa. Just a few clusters were found to attract both carbon monoxide and oxygen, and those are called "magic number clusters" – they offer the most potential to be used as a catalyst among the molecules that were studied.

Current nanogold catalysts are between 300-800 atoms. If scientists and engineers can synthesize molecules between 16-35 atoms, this could provide a tenfold savings by using smaller clusters to achieve the same catalytic effect.

On this nanogold simulation project, Zeng collaborated with Professor Zhongfang Chen at the University of Puerto Rico. Other collaborators include Zeng's former postdoc, Dr. Yong Pei, now a professor at Xiantan University in China, and current postdoc Dr. Yi Gao at UNL, as well as a former student of Zeng's, Dr. Nan Shao of the Oak Ridge National Laboratory.



This gold nanocluster has 34 atoms and is considered a "magic number" cluster for its catalytic properties.

Raj Dasgupta, center, and his C-MANTIC research group. They build robots for use by NASA for Mars or Moon explorations.

NASA EPSCoR Awards $1.5 million to Nebraska Researchers

Robotics and biomechanics projects supported by two 2011 NASA EPSCoR awards demonstrate the breadth of NASA-related research being conducted within Nebraska. **Nicholas Stergiou**, University of Nebraska at Omaha professor of biomechanics, **Raj Dasgupta**, UNO associate professor of computer science, and **Carl Nelson**, associate professor of mechanical and materials engineering at the University of Nebraska-Lincoln, are undertaking research into high priority areas directly related to the future of NASA's space operations and exploration programs. The awards are for $750,000 each over three years.

Helping Astronauts Adapt to Earth

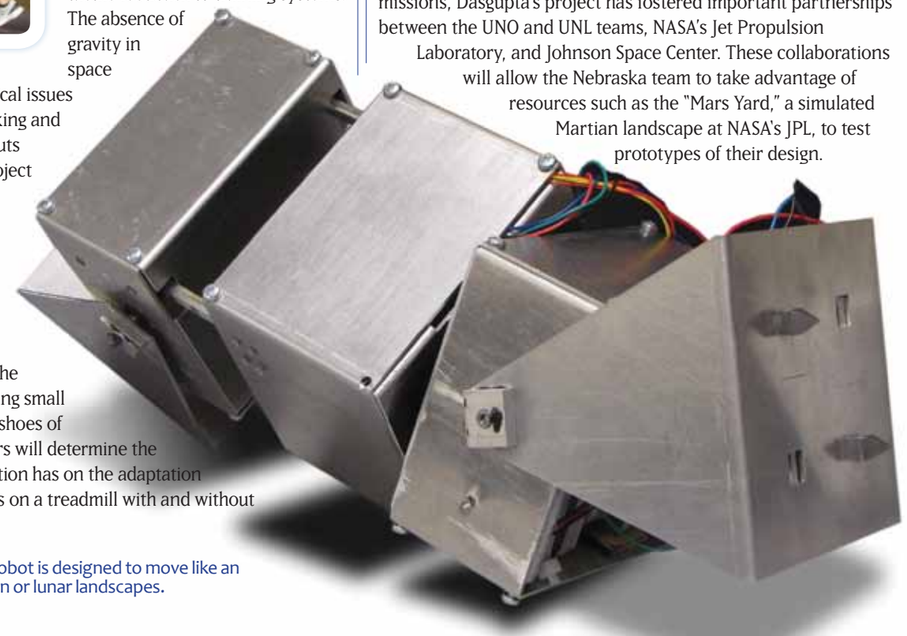
Stergiou's NASA EPSCoR project focuses on improving the recovery and rehabilitation of astronauts returning from space by introducing tactile feedback to training systems. The absence of gravity in space causes many physiological issues related to balance, walking and standing when astronauts return to Earth. The project builds on research that has demonstrated the positive influence that visual stimuli such as virtual reality environments have on the adaptation of and a return to normalcy by the affected astronauts. Using small vibrating insoles in the shoes of subjects, the researchers will determine the effect that tactile sensation has on the adaptation to specific walking tasks on a treadmill with and without virtual reality systems.

With additional research into the development of new training and rehabilitation tools for astronauts, this project will contribute greatly to the UNO biomechanics lab's partnerships with NASA's Johnson Space Center and the Wyle Integrated Science and Engineering Group.

Building Nimble Robots

Dasgupta and co-investigator **Nelson** received a NASA EPSCoR award to build a modular self-reconfigurable robot to improve the automated exploration of lunar and Martian surfaces. The research team seeks to improve existing robot designs by including more "degrees of freedom," which allow the robot to overcome obstacles. The second aim of this project is to develop a novel control system for the robot that allows the machine to monitor its own performance and dynamically alter its shape and gait. These improvements will allow the exploration robot to be more energy efficient and will allow missions to be completed more quickly than through human-controlled systems.

As these areas are of critical importance to future NASA missions, Dasgupta's project has fostered important partnerships between the UNO and UNL teams, NASA's Jet Propulsion Laboratory, and Johnson Space Center. These collaborations will allow the Nebraska team to take advantage of resources such as the "Mars Yard," a simulated Martian landscape at NASA's JPL, to test prototypes of their design.



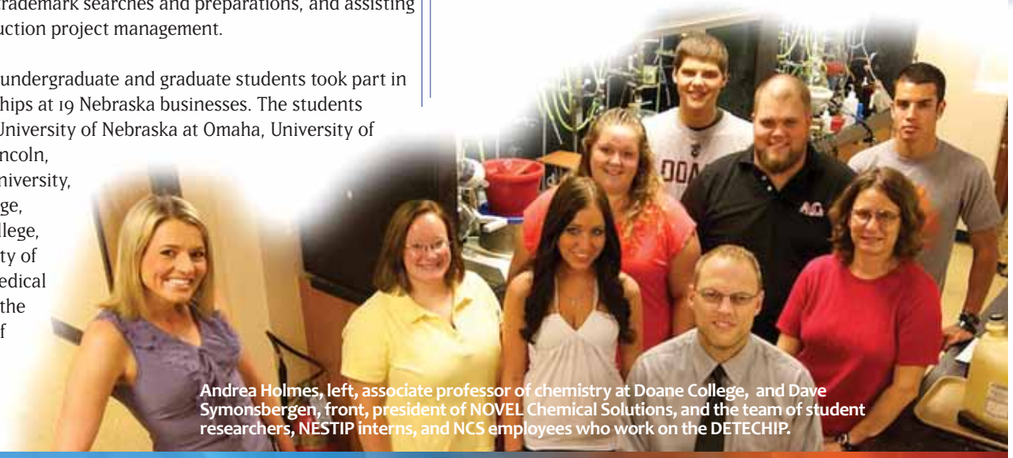
This modular, adaptive robot is designed to move like an inchworm across Martian or lunar landscapes.

NESTIP: Strengthening the Workforce Pipeline

Internships play a key role in providing students with critical job experiences while helping businesses achieve their goals. To encourage this interaction, the Nebraska Engineering, Science and Technology Internship Program (NESTIP) offers up to $5,000 with a 50% cost-share requirement for businesses that hire undergraduate and graduate students for project-based paid internships in science, technology, engineering and mathematics (STEM). Last year, interns worked on diverse projects such as the creation of a webinar for nurses, learning chemistry laboratory techniques, learning patent and trademark searches and preparations, and assisting with construction project management.

Twenty-five undergraduate and graduate students took part in paid internships at 19 Nebraska businesses. The students came from University of Nebraska at Omaha, University of Nebraska-Lincoln, Creighton University, Doane College, Hastings College, the University of Nebraska Medical Center, and the University of Nebraska at Kearney.

"As a startup biotech company in its infancy, NESTIP has assisted NCS to engage in outreach to Doane College science majors," says Dave Symonsbergen, president of Novel Chemical Solutions, a Crete, Nebraska chemistry production laboratory that participated in NESTIP for the first time in 2011. "We are able to give them a unique look at an industrial research lab while our company is still in the building phase; we have had three NESTIP students and this past May we hired one as a full-time chemist here at NCS. We really appreciate our collaboration with Nebraska EPSCoR."



Andrea Holmes, left, associate professor of chemistry at Doane College, and Dave Symonsbergen, front, president of NOVEL Chemical Solutions, and the team of student researchers, NESTIP interns, and NCS employees who work on the DETECHIP.

Bridging University Innovations and Private Enterprise

The University-Industry R&D Partnership Award forms a crucial bridge between university innovations and private commercialization. The program offers early-stage funding for promising collaborative research and development projects between university faculty and Nebraska businesses. Two funding levels are offered: Phase I provides $10,000 in matching funds to support new collaborations; Phase II provides up to $25,000 in matching funds for more mature partnerships.

"The ability to collaborate with private enterprise has enhanced our research environment, led to further collaborations with professional school faculty, and will result in a more robust research outcome," says Stephen Gross, associate professor of organic chemistry at Creighton University and award recipient. "We are confident that this research will lead to products that will have meaningful benefits for dentists and their patient's oral health."

Phase 1 - $10,000:

The Rainbow Mouse: Genetically Engineered Fluorescent Mouse Model for Tomorrow's Research; Principal Investigators: Channabassavaiah Gurumurthy, Genetics, Cell Biology and Anatomy, University of Nebraska Medical Center, and Michael Dixon, UNeMed Corporation, Omaha, Nebraska.

Phase II - $25,000:

Polymer Encapsulated Ionic Remineralizing Agents; Principal Investigators: Stephen Gross, Chemistry, Creighton University, and Mark Latta, GL Materials Research, Omaha, Nebraska.

Miniaturization of DETECHIP, a Novel Molecular Sensor; Principal Investigators: Andrea Holmes, Chemistry, Doane College, and David J. Symonsbergen, NOVEL Chemical Solutions, Crete, Nebraska.

7th Annual Nebraska Research & Innovation Conference on Information Sciences

Nebraska EPSCoR's signature event, the Nebraska Research & Innovation Conference (NRIC), drew over 200 participants to the CenturyLink Center Omaha in September to learn and network on information sciences.

"Information technologies are perhaps the most powerful force transforming the world in the 21st century. We see examples of political changes being driven by the ability to communicate, businesses having access to human talent and markets throughout the world, and education that can be delivered without the barrier of the classroom," said Dr. James Linder, senior associate to the president for innovation and economic competitiveness at the University of Nebraska.

The morning plenary session began with a talk by NU President James B. Milliken on the importance of regional leadership in encouraging innovation. Keynote speakers were Dr. Jacqueline Henningsen, director for Studies & Analyses, Assessments and Lessons Learned, U.S. Air Force; and Lynden Tennison, senior vice president and chief information officer of Union Pacific Corporation. Henningsen and Tennison shared insights into how information technology is used in the military and railroad industries.

The plenary session was followed by a panel discussion on innovative business models for industries that work with information technology. The panel included Paul Eurek, chief executive officer and chairman, Xpanxion; Joe Petsick, co-founder and chief financial officer, Proxibid; and Matthew Wegener, founder, president and chief executive officer, ISoft Data Systems, and co-founder and president of the Turbine Flats Project.

Eurek explained Xpanxion's cross-sourcing service delivery model, which outsources software development to Pune, India, but bases its quality assurance testing in rural parts of Iowa and Nebraska. Eurek told the crowd that this new model maximizes the strengths of each site while keeping labor costs down.

Petsick told the story of Proxibid, the largest online live auction marketplace in the world. Founded in 2001, Proxibid's disruptive technology globalized markets that were otherwise bound by regional auction centers. He and his co-founders hired an experienced CEO to help steer the company; their employees work in an open-office setting with no separate offices for management.

Wegener offered background on ISoft Data Systems, which creates inventory management software for the automotive salvage parts industry, and Turbine Flats, which styles itself as "an ideas community," with a mission, "to create a robust, self-sustaining, collaborative environment for small and start-up businesses to bring their products and ideas to market."

Turbine Flats began when ISoft Data Systems sublet office space to several start-up companies; this organically transformed into a supportive community that shares space, ideas, and employees.

"Suddenly we had an ecosystem of entrepreneurs who could really communicate with each other on a daily basis and in their own environment," Wegener told the audience. Turbine Flats renovated an aging warehouse located in central Lincoln, Nebraska and is now home to eleven successful businesses.

The afternoon included a luncheon talk from Congressman Lee Terry and five tracks on bioinformatics, cybersecurity/ information assurance, modeling & simulation, software engineering, and sustainable environments. The day ended with a reception that featured 74 research posters from UNL, University of Nebraska at Omaha, University of Nebraska at Kearney, the University of Nebraska Medical School, Doane College, and Creighton University.

"The Nebraska Research & Innovation Conference provides a fertile venue for collaborative exchanges between academia and industry while showcasing Nebraska research," said Dr. F. Fred Choobineh, director of Nebraska EPSCoR.

New Heights for Young Nebraska Scientists Summer Camps

Picture the view from 93,118 feet above the surface of the earth. This height, equal to the length of 258 football fields or 17.6 vertical miles, may be difficult to imagine, but it was not so difficult to reach for the 16 middle school students who used GPS to track a weather balloon on its journey beyond the clouds and back down to an Iowa pasture thirty-five miles away.

These near-space explorers were middle school participants of the Young Nebraska Scientist (YNS) summer camp, The Sky's Not the Limit: the Science and Design of Near Space Exploration, one of four camps offered by Nebraska EPSCoR last summer. This was the third year for the YNS near-space camp at the University of Nebraska at Omaha, but the first where the students were able to design their own experiments for a weather balloon, build the payload, and launch the balloon themselves, with a little technical help from Dana Richter-Egger, assistant professor of chemistry and director of the Math & Science Learning Center at UNO, and Michael Sibbernsen, program coordinator for NASA Nebraska EPSCoR Space Grant.

The balloon carried a light-weight load, including two cameras – one to view the balloon from the bottom up and the other to watch the earth shrink as the balloon climbed to the upper atmosphere. Four experienced and enthusiastic science teachers guided students' learning throughout the week.

"I love the way this camp integrates engineering, remote sensing, physics, photography, history and the outdoors," said Richter-Egger. "The campers adopt the lives of scientists for the week and see our earth as only astronauts, spy-plane pilots, satellites and campers with weather balloons can. It is a truly amazing experience for everyone involved."

In addition to the new balloon launch, the YNS program also had three new summer science camps hosted at the University of Nebraska-Lincoln: a dual themed nanoscience and algae camp for middle school students, a nanoscience camp for high school students, and a computer programming camp for high school students.

"Developing summer science camps on nanoscience and algal biology was a natural extension of our NSF RII Track 1 Award, which includes research based on those scientific themes. We were able to collaborate with Nebraska research scientists to develop curricula and offer learning experiences in advanced, real-life laboratories with faculty, postdocs, and graduate and undergraduate students," said Sarah Zulkoski-Benson, director of YNS and outreach coordinator for Nebraska EPSCoR.

The week-long computer programming camp introduced high school students to HTML, JavaScript, and Python, the most prevalent programming languages used for websites and internet applications. Students also toured numerous facilities around campus, including the Holland Computing Center, and heard from researchers who use computer science and engineering in their work.

"Computer programming is embedded in almost every economic and industrial activity, but learning to program is a life skill because it trains the user in logical thinking," said F. Fred Choobineh, director of Nebraska EPSCoR.

Nebraska EPSCoR recruits students of diverse backgrounds from across the state for YNS summer science camps and provides scholarships for students with financial need. In summer 2012, YNS camps will return to UNL and UNO, and new camps will be held at Creighton University in Omaha and Doane College in Crete.

Opportunities for Broader Impacts

The YNS program supports the efforts of university scientists to broaden the impact of their research by allowing them to use the resources developed by Nebraska EPSCoR to offer summer camps or research internships based on their chosen scientific theme. Scientists provide their expertise, facilities, and resources to capture the imaginations of Nebraska's youth and help prepare the next generation of STEM professionals. Contact Sarah Zulkoski-Benson, outreach coordinator for Nebraska EPSCoR, for more information.

Participants in the YNS near-space summer camp prepare to launch a weather balloon.

NanoDays Delights Adults & Children Alike

Nanoscience and engineering research is thriving in Nebraska, but much of the general public is unfamiliar with the nano-scale. In order to increase the public's understanding of this broad field, Nebraska EPSCoR sponsored NanoDays, a free public-outreach event in April that was attended by almost 200 people at the Westfield Gateway Shopping Center in Lincoln, Nebraska.

"Events like NanoDays provide direct channels to communicate nanoscience to the general public," said Barry Cheung, assistant professor of chemistry at UNL.

At the nanoscale - which is one-billionth of a meter, much smaller than the eye can see - molecules behave differently and exhibit unusual properties. It is these special properties that allow geckos to walk on walls, water to roll off a duck's back, and make a butterfly's wing shimmer. Scientists and engineers study these properties to make advances in numerous areas, including disease detection and treatment, energy production and storage, and data storage and transfer.

Activities included measuring participants' height in nanometers, demonstrations of waterproof cloth and sand created from nanotechnology, and demonstrations of the nanoscale forces that can defy gravity. The NanoDays demonstration teams included certified science teachers working alongside UNL undergraduates, graduate students, postdoctoral fellows and faculty members, including investigators from the NSF EPSCoR Track 1 and Track 2 grants.

Materials for the event were provided by the NISE Network, the Nanoscale Informal Science Education Network, which is sponsored by the National Science Foundation and led by a consortium of 14 museums across the country. The NISE Network aims to increase public awareness and knowledge about nanoscience; NanoDays is a NISE Network event that takes place annually in museums, universities and public spaces from Hawaii to Alaska.

The Nebraska event was co-hosted with the University of Nebraska-Lincoln's Nebraska Center for Materials and Nanoscience, and the Materials Research Science and Engineering Center. The two centers will continue to collaborate with Nebraska EPSCoR to offer NanoDays 2012 at the same location on Saturday, March 24.

Broadening Participation in STEM

Nebraska EPSCoR is committed to enhancing science, technology, engineering and mathematics (STEM) education in the state and broadening the participation of students from underrepresented populations.

We do this by managing a portfolio of diverse activities and collaborating with other organizations to sponsor worthy programs that align with our commitment to STEM education.

Our Portfolio

In addition to the Young Nebraska Scientists' summer science camps, the YNS program places high school juniors and seniors in university research laboratories for paid summer internships; we also fund exchanges for undergraduates, graduate students, postdocs and faculty between Nebraska and Puerto Rico. For the sixth year, we provided over one-thousand high school students with mobile laboratory equipment, advanced molecular biology experiments and instruction that were not available through their school districts. In 2012, these programs will continue, and a new mobile laboratory on algal biology will be developed and piloted.

Other Programs

We also provided partial funding for these enrichment activities:

- Women in Science Conference at the University of Nebraska-Lincoln
- Bright Lights Summer Learning Adventures, Lincoln
- Nebraska College Preparatory Academy – Summer Camps at UNL
- Avenue Scholars Program – Summer Camps at the University of Nebraska at Omaha
- Upward Bound Math and Science (UBMS) Program – Summer Camp at UNL
- ACM International Collegiate Programming Contest, Mid-Central US Region, at UNL
- Conference for Undergraduate Women in Physics at UNL

Each element of this varied portfolio is designed to impact students at different stages of the STEM pipeline, supporting future scientists, mathematicians, technologists, and engineers and a scientifically literate society.

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Advancing Nebraska Through Transformative Research & Workforce Development

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