Science and innovation are a priority for our state and are integral to its economy. Nebraska EPSCoR continues to play a key role in investing in collaborative science and technology programs and research infrastructure that make a difference in Nebraska.

Our current National Science Foundation (NSF) Research Infrastructure Improvement (RII) grant, Nano-Enhanced Epigenetics Research (NE2R) in Nebraska, is wrapping up and continues its focus on building Nebraska’s university-based infrastructure and research competitiveness in epigenetics research. Through this grant Nebraska EPSCoR has been instrumental in igniting Nebraska toward more collaborative initiatives in the biological sciences and engineering. We are planning to invest in new research directions important to Nebraska through a new $20 million NSF RII grant, NanoHybrid Materials and Algal Biology, which was submitted in October 2009. We should know its status by June 2010.

Our strategic efforts to promote and facilitate collaboration among the state’s top researchers are positively impacting Nebraska’s research capacity and enhancing the preparedness of the state’s future workforce for innovative technological and economic development. These efforts include events such as the 2009 Research and Innovation Conference, which showcased the latest developments in health science and technology and provided a venue for business leaders, policy makers, and researchers to network and exchange ideas. Our R&D Partnership program continues to support scientific and technological collaborations among Nebraska industry and universities through grant opportunities, and the Nebraska Engineering, Science and Technology Internship Program (NESTIP) helps support the placement of interns with Nebraska businesses to promote knowledge transfer and encourage applied research that is beneficial to Nebraska industry.

We continue to strive to enhance these and other initiatives to strengthen our state’s future research enterprise and innovation economy.

Through NSF funding, Nebraska EPSCoR also continued its support of junior high, high school and undergraduate students in 2009. The Scientist Initiative provided expanded summer STEM experiences for Nebraska’s top high school scientists and engineers. By providing them with a unique immersive experience, Nebraska EPSCoR is helping to strengthen the diversity of Nebraska’s STEM student body and encouraging continued participation of all citizens. These efforts are vital to engaging a robust pipeline of students with backgrounds underrepresented in STEM fields and we look forward with renewed optimism toward the promising developments in medical research and technology and their impact on the state’s health care capabilities and policies that were featured at the 2009 Nebraska Research and Innovation Conference at the Qwest Center in Omaha on September 29.

Gov. Dave Heineman and University of Nebraska President James Milliken welcomed more than 200 educators, researchers, business leaders, policy makers and entrepreneurs to the fifth annual conference. Presenters included Dr. Elaine Mardis, The Genome Center at Washington University; Dr. Bradley Olenderger, The National Human Genome Research Institute; Dr. Gail Naughton, Histogen, Inc.; Dr. Roger Geiger, Penn State University; Dr. Jim Lander, UNMC, and Coonan Ryan, Streck Laboratories.

Afternoon concurrent sessions focused on advances in cancer biology in Nebraska, the Center for Advanced Surgical Technology (CAST), the Nebraska Biomechanics Core Facility, regulatory challenges in drug development, and developing innovation through public policy. Student research poster presentations and high-tech business displays were also featured at the conference.

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STATE EPSCoR OFFICE STAFF
F. Fred Choobineh, P.E., Ph.D., Director Sarah Zulkoski-Benson, Outreach Coordinator Karla Roth, Administrative Assistant Nancy Stamm, Administrative Technician

COVER PHOTO: The Environmental Scanning Electron Microscope (ESEM), a new instrument in the Nanofiber Facility operated by Dr. Yura Davidie at the University of Nebraska-Lincoln (UNL), was acquired and activated with funding from Nebraska EPSCoR. The ESEM produces high resolution imaging of various biological and other materials and structures, including hybridized and non-conductive samples. It allows researchers to observe processes in a controlled environment. This background image shows end hybridized cells of three types: mammalian (mouse sperm), yeast, and plant (leaf).

State Committee Gains New Members

Governor Dave Heineman and University President James Milliken said farewell to two State Committee members in 2009. We are grateful to Ronald Balikes, who died September 5, and Pinnie Murray for their commitment and service.

The following two individuals joined the State Committee and were appointed by Gov. Heineman:

Greg L. Adams

Greg L. Adams is a state senator representing the 24th legislative district in the Nebraska unicameral. Elected in 2006, he chairs the legislature’s Education Committee and serves on a number of other committees. For 30 years he taught American government and economics at York High School and also served as York’s Social Studies Department chair. He continues to administer the school’s Washington, D.C. Close Up program. Adams’ civic leadership includes 10 years as a member of the York City Council and 10 years as mayor of York. He received a master’s degree in history from Wayne State College.

Charles J. Bickel

Charles J. Bickel is senior vice chancellor for academic and student affairs at the University of Nebraska at Kearney (UNK). He has served as chair of the Department of Biology at both California State University Bakersfield (CSUB) and UNK and as dean of Natural Sciences at St. Edward’s University in Austin, Texas. His research has focused on plant-ecosystem response to environmental stress, as well as enhancing student participation in scientific inquiry. His teaching interests include freshman biology to graduate courses in plant physiology, plant ecology and rangeland and wildlife management. He holds a Ph.D. in Range Science from Colorado State University.

ECONOMIC DEVELOPMENT
Grants Awarded in 2009

DOE EPSCoR Laboratory Partnership Grants

- Dynamic Optimized Advanced Scheduling of Bandwidth Demands for Large-Scale Science Applications; PI: Byrav Ramamurthy, UNL, $499,976.
- Heat Transfer; PI: Petronela Radu, UNL; ($137,054).
- Testing; PI: Myra Cohen, UNL; ($100,000).
- Points; PI: Thomas Marley, UNL; ($2,225,689).
- Networks of Biomedical Research Excellence (INBRE)
  - Enhancing NCRR Pilot Project Mechanism; $413,452.
- NSF Research Experiences for Students and Science Educators; $640,079.
- Supplements for Research Workforce Development and Dissemination; $398,855.
- Recovery Act Funds for Administrative Supplements for Administrative Support for Research Workforce Development and Dissemination; $1,368,585.
- Recovery Act Funds for Administrative Supplements for Enhancing NCRR Pilot Project Mechanism; $461,452.
- Metadata Organization for Improved File-System Performance and Augmenting traditional analytical modes, these new ellipsometry techniques align to not only advance scientific knowledge but also grow economic opportunities for local suppliers. The project’s enhanced focus and facilities benefit UNL faculty in departments ranging from Chemistry and Physics to Astronomy, who can leverage new research insights for further study and competitive research proposals, as well as UNL students, who gain skills while working on the development of commercial technologies.

In his proposal for Nebraska EPSCoR funding, Schubert cited the “long history of successful collaborative efforts” by Woollam and university partners, when “the Woollam company has developed new approaches … to address specific customer applications.” Schubert said a new product combining spectroscopic ellipsometry and quartz crystal microbalance measurement to innovate chemical and biochemical sensing in spectroscopic ellipsometry.

Together, the expertise of Woollam and Schubert aims to create a new generation of ellipsometers, potentially a new scientific instrument offering insight into the properties and growth kinetics of thin organic films, specifically their nano-structured surfaces. This faculty-industry collaboration is expected to greatly enhance the field’s capabilities, from energy materials development to environmental and homeland security monitoring.

Nebraska EPSCoR is making sure its training gains support through its University-Industry Add-Partnership Program: a cost-share program intended to foster new or strengthen existing partnerships between faculty of Nebraska research universities and state industries. The one-year grant for this endeavor provides $15,000 in funding from EPSCoR, matched with $15,000 from a Lincoln firm that now leads the industry in manufacturing automated spectroscopic ellipsometers.
**Extending the Reach of Nebraska Research**

University of Nebraska-Lincoln scientists are working to benefit NASA, with federal funding through the Nebraska NASA EPSCoR Program.

- Shane Farritor, associate professor of mechanical engineering, conducts design, simulation and testing of Miniature In Vivo Surgical Robotics for Long Term Space Flight.
- Erick C. Jones, associate professor in the Industrial and Management Systems Engineering Department, applies Radio Frequency Identification (RFID) to streamline astronauts’ inventory and logistics tracking onboard the International Space Station and other missions.

The grants are intended to promote university research in the areas of aeronautics, exploration systems, science and space operations, with results that can also benefit the general public.

Farritor, who advanced surgical robotics with NASA’s Extreme Environment Mission Operations (NEEMO), currently collaborates with Dr. Dmitry Oleynikov, associate professor in the Department of Surgery at the University of Nebraska Medical Center. They engage graduate and undergraduate students in exploring a technique called Natural Orifice Transluminal Endoscopic Surgery (NOTES). Their research shows that miniature robots can be introduced into a patient’s abdominal cavity through the mouth and esophagus for minimally-invasive surgery.

“Grants will allow us to build important prototypes to demonstrate our concept,” said Farritor, who hopes that in addition to aiding NASA missions, “our robots will reduce hospital stays and improve surgical outcomes.”

**Research and Development**

**The paper relates that a fundamental challenge of regulation of gene activity is the accessibility of DNA within nucleosomes because the DNA is tightly wrapped around the histone core.** Studies performed over the past decade led to the discovery of a class of proteins that unwind the DNA from the histone core to provide the access to the DNA regions inside the nucleosome. This led to the view in which nucleosomes themselves are considered rather stable particles with limited dynamics.

Recent studies performed with the use of various techniques, including single molecule approaches, led to the realization that nucleosomes are quite dynamic rather than static systems. The AFM images of nucleosomes that were obtained showed that nucleosomes are equal in some sense to static systems. The AFM images of nucleosomes in air revealed the structural heterogeneity of the nucleosome. To test this hypothesis and look directly at the dynamics of nucleosome in solution, they employed the AFM capability to perform imaging in aqueous solutions using time-lapse imaging of non-dried nucleosome samples.

**Funding and Grants**

**First Awards Help Launch Early Faculty Research**

Rebecca Lai, Chemistry, UNL, Disposable Peptide-based Electrochemical Biosensor for HIV Detection

Semen Velipasalar, Electrical Engineering, UNL, Peer-to-peer detection of user-defined and semantically high-level events spanning multiple camera views

Bin Yu, Biological Sciences, UNL, Dissecting miRNA metabolism in Arabidopsis thaliana.

For additional information on the program, please visit epscor.unl.edu/ programs/firstaward.shtml

**The 2009 First Award grantees and their projects are:**

- **Ming Han, Electrical Engineering, University of Nebraska-Lincoln (UNL),** High sensitivity, low-cost optical biosensor based on photonic crystal fiber
- **Stephen Hartke, Mathematics, UNL, Combinatorial Objects.
- **Bin Yu, Electrical Engineering, UNL,** Peer-to-peer detection of user-defined and semantically high-level events spanning multiple camera views

**First Awards**

- Nebraska EPSCoR selected six Nebraska researchers to receive its First Award grants in 2009.
- Funded by the National Science Foundation’s (NSF) infrastructure grant to Nebraska EPSCoR, the competitive First Award grants program provides assistance to tenure-track faculty in the first four years of their initial academic appointment. The grants are designed to help early career faculty initiate their research programs and compete more effectively for NSF CAREER grants.

First Awards are limited to $50,000 and require a one-on-one match. Grantees must submit a CAREER Award proposal to NSF or a similar grant to another agency within the grant period.

The 2009 First Award grantees and their projects are:

- **Ming Han, Electrical Engineering, University of Nebraska-Lincoln (UNL),** High sensitivity, low-cost optical biosensor based on photonic crystal fiber
- **Stephen Hartke, Mathematics, UNL, Combinatorial Objects.
- **Christine Kelley, Mathematics, UNL,** Algebraic design and analysis of graph-based codes using voltage graphs

**Research Paper**

**Lyubchenko’s Research Featured in Faculty of 1000 Biology**

Yuri Lyubchenko, Department of Pharmaceutical Sciences, University of Nebraska Medical Center, has selected a paper by Dr. Yuri Lyubchenko, Department of Pharmaceutical Sciences, University of Nebraska Medical Center, for inclusion in its online research service. The paper relates that a fundamental challenge of regulation of gene activity is the accessibility of DNA within nucleosomes because the DNA is tightly wrapped around the histone core. Studies performed over the past decade led to the discovery of a class of proteins that unwind the DNA from the histone core to provide the access to the DNA regions inside the nucleosome. This led to the view in which nucleosomes themselves are considered rather stable particles with limited dynamics.

Recent studies performed with the use of various techniques, including single molecule approaches, led to the realization that nucleosomes are quite dynamic rather than static systems. The AFM images of nucleosomes that were obtained showed that nucleosomes are equal in some sense to static systems. The AFM images of nucleosomes in air revealed the structural heterogeneity of the nucleosome. To test this hypothesis and look directly at the dynamics of nucleosome in solution, they employed the AFM capability to perform imaging in aqueous solutions using time-lapse imaging of non-dried nucleosome samples.

**Using time-lapse AFM imaging, researchers were able—for the first time—to observe spontaneous, protein-free unwrapping of the nucleosomes. The unwrapping occurs from the ends of the nucleosomes, allowing for exposure of DNA regions as large as dozens of base pairs and leading to a complete unfolding of nucleosomes.**

These studies highlighted the role of electrostatic interactions on the unwrapping process. The electrostatic interactions between positively charged histone octamer and negatively charged DNA are major contributors to the stability of the structure of nucleosomes. However, transiently unwrapped DNA segments can be trapped by electrostatic interactions with the positively charged surface outside the nucleosome. These trapped states increase the probability for the next unwrapping step, shifting the equilibrium of the unwrapping toward unwrapping that eventually may lead to full unwrapping of the nucleosome. The described scenario has been realized in the AFM experiments in which a positively charged surface was created. Based on this data the researchers hypothesize that interaction of chromatin with surfaces within the cell, including the surfaces of remodeling proteins, can contribute to the chromatin dynamics providing the accessibility to the DNA regions.
Young Nebraska Scientists Programs Expand Summer Opportunities

**Sumner Researchers**

As a part of Nebraska EPSCoR's statewide Young Nebraska Scientist Initiative (YNS), six Nebraska high school students experienced what it's like to be in STEM research and participated in research labs at UNL and Creighton University for eight weeks during the summer of 2009. These students received stipends as working members of a research lab where they contributed to research projects and participated in additional lab activities. The 2009 participants included:

- **Duc-Caing Bui** - senior, Lincoln Pius X High School (James Zempleni, UNL)
- **Spencer Farley** - senior, Lincoln Lutheran (Bin Yu, UNL)
- **Kateilyn Kolt** - senior, Wilber-Cлинavia High School (Jung You Lim and James Allano, UNL)
- **Forrest Paulssion** - freshman, UNL (Tom Clements, UNL)
- **Chelsie Basinger** - senior, Omaha North High Magnet School (Garrett Seawell, Creighton)
- **Blake Vajgrt** - senior, Seward High School (Tom Clements, UNL)

Applicants must be at least 16 years old by the start of their research experience and must not have graduated from high school. All stipends and lab costs are provided by Nebraska EPSCoR, participating institutions, and faculty grants.

Funds provided by a NSF Plant Genome grant

**NSCAMS**

Building wind turbines and solar cars, exploring natural wetlands and checking water quality, learning how water and energy use affect the environment, and exploring solutions to some of the biggest challenges facing the planet are just a few reasons why Young Nebraska Scientists experienced at 2009 summer camps.

Nebraska EPSCoR expanded its summer camp offerings in 2009, seeking to provide students from across the state opportunities to learn science through doing science and to explore the intersection of science, technology, and society with the guidance of scientific and educational experts.

The University of Nebraska at Omaha (UNO) hosted the water and water systems themed camp. Participants benefited from the expertise of Dr. Dana Richter-Egger, director of UNO’s Math-Science Learning Center and assistant professor in the Chemistry Department. Dr. Richter-Egger led a tour of the wetlands at Ahlone Prairie Preserve, a 160-acre re-established grassland research area, and took participants back to the lab where they participated in quality tests and analysis. Tawnya Blades, Giltnor, Terri Greenleaf, Winnebago, and Sara Yendrall, UNL facilitated the camp’s instructional activities, including tours of water and drinking water facilities, a water filter challenge, exploring personal water use and conservation, and building water rocketers.

UNL hosted two camps based on renewable and non-renewable energy resources. Chad Johnson, an education specialist with the Nebraska Public Power District, introduced students to energy concepts and how energy is delivered to homes. He also led design challenge activities requiring participants to think about energy conservation. Jerry Arnold, Valentin, Tawnya Blades, Giltnor, Sara Yendrall and Nicholas Defler, UNL; and Terri Greenleaf, Winnebago, facilitated the instructional activities aimed at educating participants about current energy use and resources and allowing them to explore alternative energy resources. Activities included visiting the Energy Farm near Lyons, an off-grid farm operated by Nebraska Renewable Energy Systems (NRES), building Mars rover robots, wind turbines, solar cars, and energy efficient model homes; and exploring and debating energy resources for electricity and transportation.

Nebaska College Preparatory Academy (NCPA) partnered with Nebraska EPSCoR to provide summer science activities for the Academy’s scholars. More than 10 Nebraska students from Grand Island Senior High and the Omaha North Magnet High School participated in two days of activities, including a bacterial transformation resulting in green glowing bacteria, analysis of student DNA using PCR, and tours of UNL STEM departments and facilities. Instructional activities were facilitated by Jack McCord, Lincoln Northeast; Kay Drobneke, Millard West; Rolando Negron, UNL; Patrick Pokusewich, Walsh; Josh Schmaatman, UNL; Nathan Seggerman, Millard West; and Alexandria Soman, Lincoln Southeast. NCPS scholars academically promising scholars (students) who come from first-generation and low-income backgrounds and prepares them to enroll in college. NCPS scholars receive support on various levels to adequately prepare them to be successful in high school and college.

"We want to inspire students to keep pursuing their interest in math and science in school,” Harris noted. “The more education you have, the more opportunities you will have.”

Harris said that nationally, about 70 percent of students finish high school, and that figure drops sharply for Black, Hispanic and Native students. Studies also show blacks hold just 4 percent of science and engineering jobs, and Hispanics hold 14 percent.

"We want to ensure students have the tools (education) to pursue their dreams. That’s what this camp is all about," Harris said.

One of the highlights of the camp was a raft experiment in which students competed to see whose aluminum-fold creation could hold the most pennies. The winning team’s square raft carried 227 pennies.

"I told the students at our opening ceremony that they were going to get to meet Dr. Bernard Harris and hear from him what it was like to walk in space," Zulkoski-Benson said. "I’ve always thought that a person couldn’t possibly be the same after being out in space, looking back at the Earth. I hope these students have a similar experience after this camp.”

Harris told students that although video games or sports camps may seem "cool" and some of their classmates may even call them geeks for being good in math and science, some day the campers will probably have their teasing classmates on their payrolls.

"Guess what?” Harris said. "Geeks rule the world. Be proud to be a geek."
The Nebraska INBRE network consists of seven undergraduate-institutions, three outreach institutions including two community colleges serving underrepresented minorities, and three Ph.D. granting institutions that serve the network as training and mentoring institutions. Participating undergraduate campuses and community colleges are Creighton University College of Arts and Sciences, Doane College, Nebraska Wesleyan University, the University of Nebraska at Kearney, the University of Nebraska at Omaha, Wayne State College, Little Priest Tribal College and Western Nebraska Community College. Additional outreach efforts to support promising students are in place at Chadron State College and the University of Nebraska-Lincoln. The Ph.D. granting institutions are the University of Nebraska Medical Center (lead institution), Creighton University Medical Center and the University of Nebraska-Lincoln.

Faculty and students at participating institutions receive support to develop and perform undergraduate-appropriate research projects. The goal of the project is to develop research capacity on the undergraduate campuses and to enhance research opportunities for undergraduate students at these baccalaureate institutions.

The scientific foci of INBRE are based on the strengths and scientific expertise on the research campuses and the alignment of research projects developed by undergraduate faculty with these areas on the research campuses. The scientific themes that bring the network together are cell signaling, infectious disease, and neuroscience. Collaborative arrangements between undergraduate faculty and research mentors are integral to the development of these focus areas and to increasing the research base and capacity for Nebraska.

INBRE outreach activities are aimed at increasing the participation of underrepresented minorities in the research enterprise and supporting disease specific initiatives related to these unique populations. The Nebraska Department of Economic Excellence (INBRE) program marked a milestone in May, receiving the Nebraska Institutional Development Award (IDEA) Networks of Biomedical Research Excellence (INBRE) program. The INBRE Scholars Program provides scholarships to undergraduate students for the first Ph.D. granting institutions, as well as research assistantships during the academic year. Scholarships are provided with numerous opportunities to present work at regional, national and international scientific meetings. Once admitted to a Ph.D. program, scholars receive support from INBRE for the first year of graduate studies. In 2009, Markovic became the first BRIN Scholar to graduate from the Ph.D. program at UNMC.

Development is also closely involved with INBRE, specifically with respect to the state’s emerging biotechnology industry.

The goal of the project is to develop research capacity on the undergraduate campuses and to enhance research opportunities for undergraduate students at these baccalaureate institutions.

Six INBRE undergraduate students from four Nebraska colleges and universities received the 2009 Richard Holland Future Scientist Award from the Nebraska Coalition for Lifesaving Cures (NCCS). Selected by INBRE faculty associates, the students received monetary awards from the NCCS totaling $2,700. The awards are named in honor of Richard Holland, an Omaha philanthropist and longtime supporter of biomedical research in Nebraska.

The Nebraska OBTA program is part of a nationwide award program coordinated by the National Association of Biology Teachers (NABT). Each year NABT seeks to recognize an outstanding biology educator (grades 7-12) in each of the 50 states, Washington, D.C., Canada, Puerto Rico, and overseas territories.

Axel Enders, UNL assistant professor of physics and astronomy, who hosted the event, said the occasion was open to men and women, but intended to encourage more female participation to “help balance the ratio.” He acknowledged that males typically outnumber females among students and faculty in most university science departments. He added that his goal is for 30 or 40 percent females in the sciences, for a less male-dominated field.

Enders’ wife, Susan, is a UNL assistant professor of engineering mechanics who presented a session titled “Get Attached.” She described attachment systems in nature (how a gosling can fly on the wall, how can I get a lot of shocked reactions) and expanded the concept to connect her audience to new ways of thinking.

UNL senior Maria Becker presented her research on measuring atmospheric conditions with laser radar systems. Becker who grew up on a farm in Hartington, said in an interview with the Daily Nebraska during the conference that she has always enjoyed science, starting with astronomy.

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She described attachment systems in nature (how a gosling can fly on the wall, how can I get a lot of shocked reactions) and expanded the concept to connect her audience to new ways of thinking. She said she hasn’t noticed discrimination within her program, but “outside of physics, I’m a girl who does physics,” she said, with her choice being unexpected “mainly because I am female.”

Susan Enders praised the interaction of men and women in physics because their “problem-solving techniques vary and add different elements to research. She added that women who study science should be encouraged, and in schools and at home.

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State EPSCoR Committee Members

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Mr. Richard Baier, Director, Nebraska Department of Economic Development
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