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Research at the University of Nebraska–Lincoln: 2011-2012 REPORT

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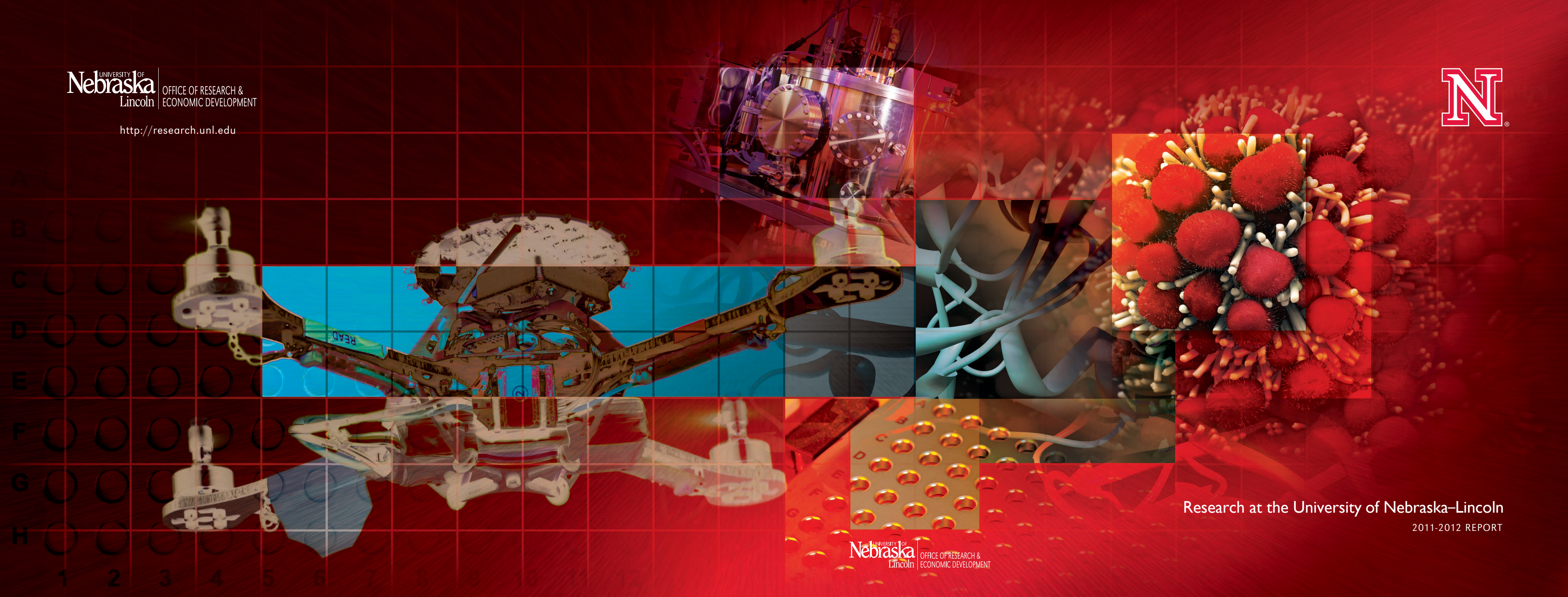
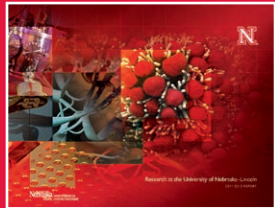


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On the Cover
From nanoscience and food safety to virology and unmanned aerial vehicles, these images represent some of the University of Nebraska–Lincoln’s diverse and innovative research. Top left: New Voelte-Keegan Nanoscience Research Center features state-of-the-art facilities (page 4). Right: Illustration of *E. coli* in a calf intestine; UNL leads major research to reduce dangerous *E. coli* strains (page 2). Center and bottom: Illustration of the molecular underpinnings of HIV prevention strategy, and PCR equipment, both part of the Nebraska Center for Virology’s research (page 14). Back cover: UNL researchers are exploring unmanned aerial vehicles’ potential (page 20).



On the Web
Explore the 2011-2012 UNL Research Report website for more photos, links and videos related to stories in this report: research.unl.edu/annualreport/2012

Building for the Future

At the University of Nebraska–Lincoln, we’re charting a course for growth.

UNL research has grown significantly in the past decade, our faculty’s research accomplishments have been remarkable, and we have forged private and public partnerships that span the globe. This report highlights some of these successes.

- Building on this momentum, we’ve set ambitious goals to expand research by 2017. Our vision:
- Enhance the quality and stature of UNL research, scholarship and creative activity.
 - Increase the number of faculty working with private-sector partners to translate research into innovations and jobs.

We’re capitalizing on our strengths and targeting new areas where we have significant expertise. This report highlights our research leadership in areas such as education and child development, entrepreneurship, digital humanities, food safety, water and food security, survey research, nanoscience and virology. It also features examples of emerging initiatives, including agriculture and natural resources policy and unmanned aerial vehicles research.

Research and discovery are well-documented economic drivers. Nebraska Innovation Campus,



the private-public research campus being developed at UNL, will ensure our research plays a bigger role in Nebraska’s economy. But our partnerships with business, industry and entrepreneurs are diverse and aren’t limited to NIC. UNL Industry Relations, NUtech Ventures and NIC work closely to forge strong, mutually beneficial partnerships.

We’re also thinking globally, expanding our international engagement through research, partnerships and student and faculty exchanges. You’ll find examples of our robust international collaborations throughout this report.

UNL also is making strides in developing state-of-the-art facilities essential to world-class research. The Voelte-Keegan Nanoscience Research Center, opened in 2012, is fueling UNL’s momentum in nanotechnology and materials science. And an addition to the Ken Morrison Life Sciences Research Center, home to the Nebraska Center for Virology, will be finished in 2013.

Also to be completed in 2013 is multidisciplinary research space that is part of the expansion of Memorial Stadium, home to Husker football. It’s central to a unique partnership between research and athletics that promises to expand understanding of the brain and concussions, enhance health and performance research and offer a national model for such collaborations.

At UNL, we’re building for the future to create the knowledge-fueled solutions essential to our state, our nation and our world.

Prem

Prem S. Paul
Vice Chancellor for Research and Economic Development

Vice Chancellor Prem S. Paul (left) and Chancellor Harvey Perlman



Reducing Health Risks from *E. coli*

As bacterial villains go, *E. coli* O157:H7 is among the best known. It's the culprit in numerous and sometimes fatal foodborne illness outbreaks. But it's far from the only bad guy.

O157 is just one of about 100 Shiga toxin-producing *E. coli*, or STEC, strains that sicken people and cause 265,000 illnesses annually in the U.S. UNL leads a major project targeting the eight most dangerous *E. coli* strains throughout the beef production chain. Funded by a \$25 million grant from the U.S. Department of Agriculture's National Institute of Food and Agriculture, this project involves 11 universities and other institutions.

"The long-term goal is to reduce the occurrence and public health risks from Shiga toxin-producing *E. coli* in beef, while preserving an economically viable and sustainable beef industry," said UNL veterinary scientist Rod Moxley, who leads the project. "This can only be accomplished by a multi-institutional effort that brings together complementary teams of the nation's experts, whose expertise spans the entire beef chain continuum."

Moxley and UNL food scientist Harshavardhan Thippareddi are on a team focusing on better detecting these dangerous strains. Both are

veterans in the fight against O157, and this project builds on years of research at UNL and nationwide that produced interventions to reduce the incidence of O157.

"We will look at these existing interventions and determine their efficacy against other Shiga-producing *E. coli* and also to develop other interventions as needed," Thippareddi said.

E. coli testing methods need to be improved because the organism spreads inconsistently in animals.

A key goal is developing a portable detection method that could be used in packing plants, Moxley said. Tests need to spot the eight STECs in areas such as cattle feces, meat, water, soil, feed, carcasses and hides.

Project partners will play important roles, Moxley said. For example, Kansas State University, a major contributor, has a state-of-the-art biosecurity research facility where scientists can infect animals and study them.

New vaccines for cattle also are a potential outcome.



Harshavardhan Thippareddi (center) and Rod Moxley

*"We will look at these existing interventions and determine their efficacy against other Shiga-producing *E. coli*."*

Above: *E. coli* O157:H7 in petri dish
Upper right: Illustration of *E. coli* in calf's intestine

Nanoscience Center Strengthens Research

UNL's new Voelte-Keegan Nanoscience Research Center strengthens UNL's capacity to address some of the nation's pressing problems through nanoscience.

Completed in early 2012, the 32,000-square-foot center houses the seven core facilities and two shared laboratories of the Nebraska Center for Materials and Nanoscience. It consolidates UNL's state-of-the-art nanoscience research facilities in a single, central location accessible to the more than 80 faculty affiliated with the NCMN.

The building also provides researchers access to specialized equipment, such as a National Science Foundation-funded transmission electron microscope and a high-tech clean room that eliminates dust particles.

"This truly puts us on the map," said David Sellmyer, NCMN director and George Holmes University Professor of Physics and Astronomy. "It makes for much greater ease of collaboration and a lot more efficiency."

UNL's Materials Research, Science and Engineering Center, funded by the NSF and focused on quantum

and spin phenomena in nanomagnetic structures, relies on these core facilities, said physicist Evgeny Tsymlal, MRSEC's director and a Charles Bessey Professor. Thanks to the facility's centralized services and new equipment, faculty are pursuing research that wasn't previously possible.

"The center will boost research and collaborations in nanoscience and create the infrastructure necessary to enhance our competitiveness," Tsymlal said.

Funding agencies increasingly are encouraging large collaborative projects that engage cutting-edge expertise and facilities worldwide to solve formidable challenges, Sellmyer said. The new center strengthens UNL's competitiveness for grants, both for individual researchers and for UNL's increasing participation in these large multi-institutional collaborative projects.

Improving UNL's nanoscience research facilities also benefits Nebraska, Sellmyer added. The center enhances collaboration with industries that also use these facilities and is an incentive for startup companies to locate here.

Major funding for the research center came from a \$5 million donation from UNL alumnus Don Voelte and his wife, Nancy Keegan, a University of Nebraska Foundation board member, and a \$7 million competitive federal grant from the National Institute of Standards and Technology through the American Recovery and Reinvestment Act.



"The center will boost research and collaborations in nanoscience and create the infrastructure necessary to enhance our competitiveness."

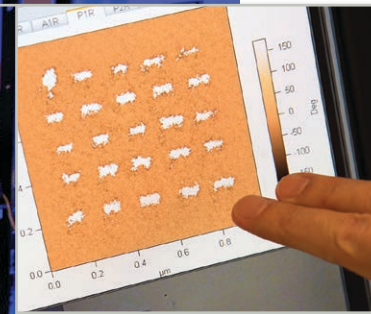
Expanding Data Storage Potential

Nanoscience is blazing new trails in making the technology of daily life – from computers to cell phones and memory storage devices – more powerful and efficient. Now, a UNL-led team's recent discovery is expanding possibilities for data storage.

A team led by physicist Alexei Gruverman, a researcher in UNL's Materials Research Science and Engineering Center and the Nebraska Center for Materials and Nanoscience, identified a way to store data significantly more densely than previously possible.

Gruverman's research on electronic materials is done at the nanoscale, where objects exhibit unexpected chemical and physical properties. Central to his research is the scanning probe microscopy technique, which uses a tiny physical probe to exert highly localized mechanical, electrical or magnetic influence on an object and then measure its response.

The probe's tip – invisible to the naked eye – can be used to electrically change the properties of the electronic or ferroelectric materials used in memory devices.



Data storage has always relied on electrical voltage. But Gruverman's team found that the same nanoscale-sized bit of data could be written simply by pressing harder against the ferroelectric material's surface without damaging it, working much like a nanoscopic typewriter.

The team was the first to demonstrate that mechanical force can be used to change an area's polarization. Gruverman, UNL graduate student Haidong Lu and researchers from Spain and the University of Wisconsin reported their findings in the journal *Science*.

"It's a completely voltage-free switching of polarization, which is what makes the results of this research unique," Gruverman said. The finding establishes a scientific basis for creating more powerful storage devices. The team hopes to build on the discovery by investigating other possible applications.

Grants from the U.S. Department of Energy and the National Science Foundation support Gruverman's broader research. NSF also funds UNL's MRSEC, which focuses on nanomagnetism.

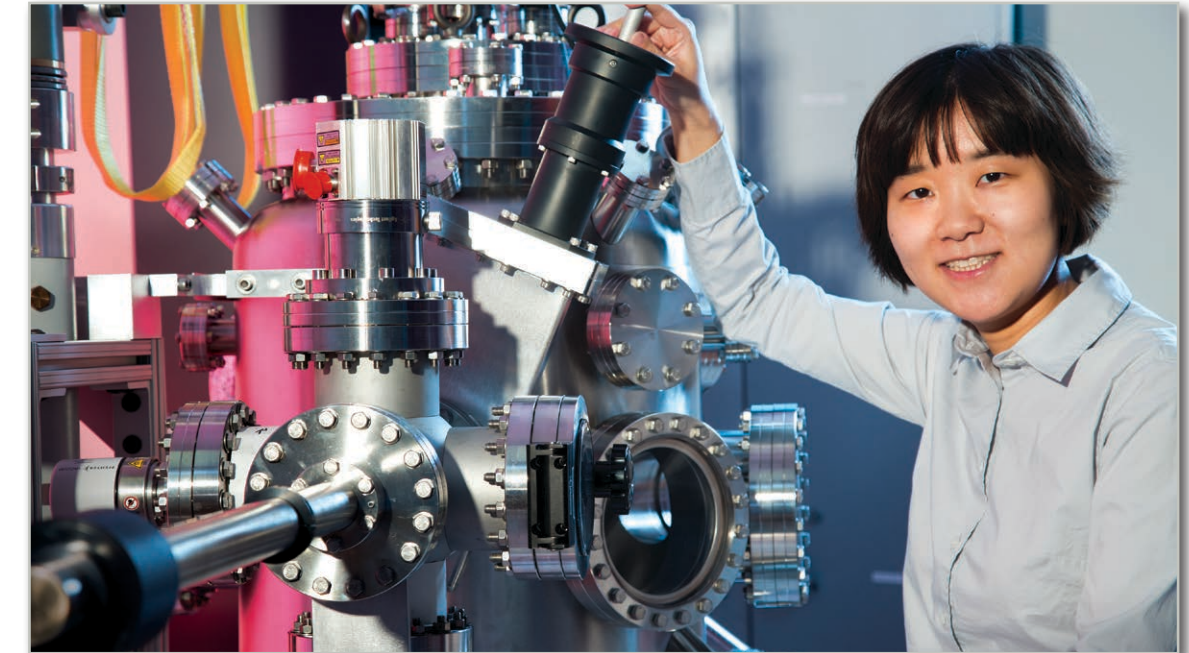
Designing New Nanomaterials

A key to making computers and other electronics smaller, faster and less expensive lies in overcoming the limitations of existing materials. UNL physicist Xia Hong's research into nanoscale materials may one day help break through current barriers.

For decades, scientists have been squeezing more power out of today's silicon-based electronics, which are approaching the material's fundamental limits. To continue advancing, researchers are exploring materials that exhibit unusual physical, chemical or biological properties at the nanoscale and fabricating new nanomaterials with multifunctional properties.

Hong is combining two oxides to create a nanomaterial with both magnetic and ferroelectric properties. Ferroelectric materials have positive and negative polarization directions. Applying electricity can reverse the polarization and control magnetism. Storing data with an electric charge alone or using electricity to manipulate magnetic signals would be more energy efficient and allow greater storage capacity in a smaller space.

Hong predicts it will take one to two years to fabricate the new nanostructure. She'll then study the material's



characteristics. Her research promises to advance the understanding of magnetoelectric coupling and could lead to novel materials and devices. Hong, a member of UNL's Materials Research Science and Engineering Center, earned a prestigious \$600,000, five-year National Science Foundation CAREER program award for this research.

The expertise of other MRSEC faculty and the center's focus on nanoscale magnetism and magnetoelectric interfaces aid her research,

Hong said. "My research is very complementary to the existing efforts here. There is a lot of collaboration."

The award also allows her to make physics accessible to young people, particularly girls, by using her drawing skills to develop educational cartoons.

"Many people think physics is very difficult," Hong said. "I thought it was a good idea to use a teenage girl's point of view to illustrate physics principles ... to make physics more likable."

Above: Alexei Gruverman
Inset: Checking data

Above: Xia Hong

Nebraska Innovation Campus Construction Under Way

Nebraska Innovation Campus is taking shape adjacent to UNL.

Construction began in fall 2012 on the first buildings for the 232-acre private-public research campus. It's being developed as a world-class campus that is a conduit for innovation – connecting companies, entrepreneurs and university researchers in a collaborative environment to help fuel Nebraska's economy.

"Engagement with the private sector on Nebraska Innovation Campus will enhance the application of university research and create jobs to absorb the talent of our graduates," said UNL Chancellor Harvey Perlman. "Innovation Campus is the logical next step in pursuing our two priorities of undergraduate education and research, based on the objectives of attracting talented young people to Nebraska and providing them with jobs when they graduate."

Four buildings being built or renovated in the initial construction phase will open in late 2013 and early 2014, providing about 280,000 square feet of space for diverse research and office needs.

The campus site previously housed the state fairgrounds, and NIC's design incorporates two historic structures, the 4-H Building and the Industrial Arts Building.

The renovated former 4-H Building and new companion wing will be completed first. This complex will feature a commons area and office, meeting and conference space.

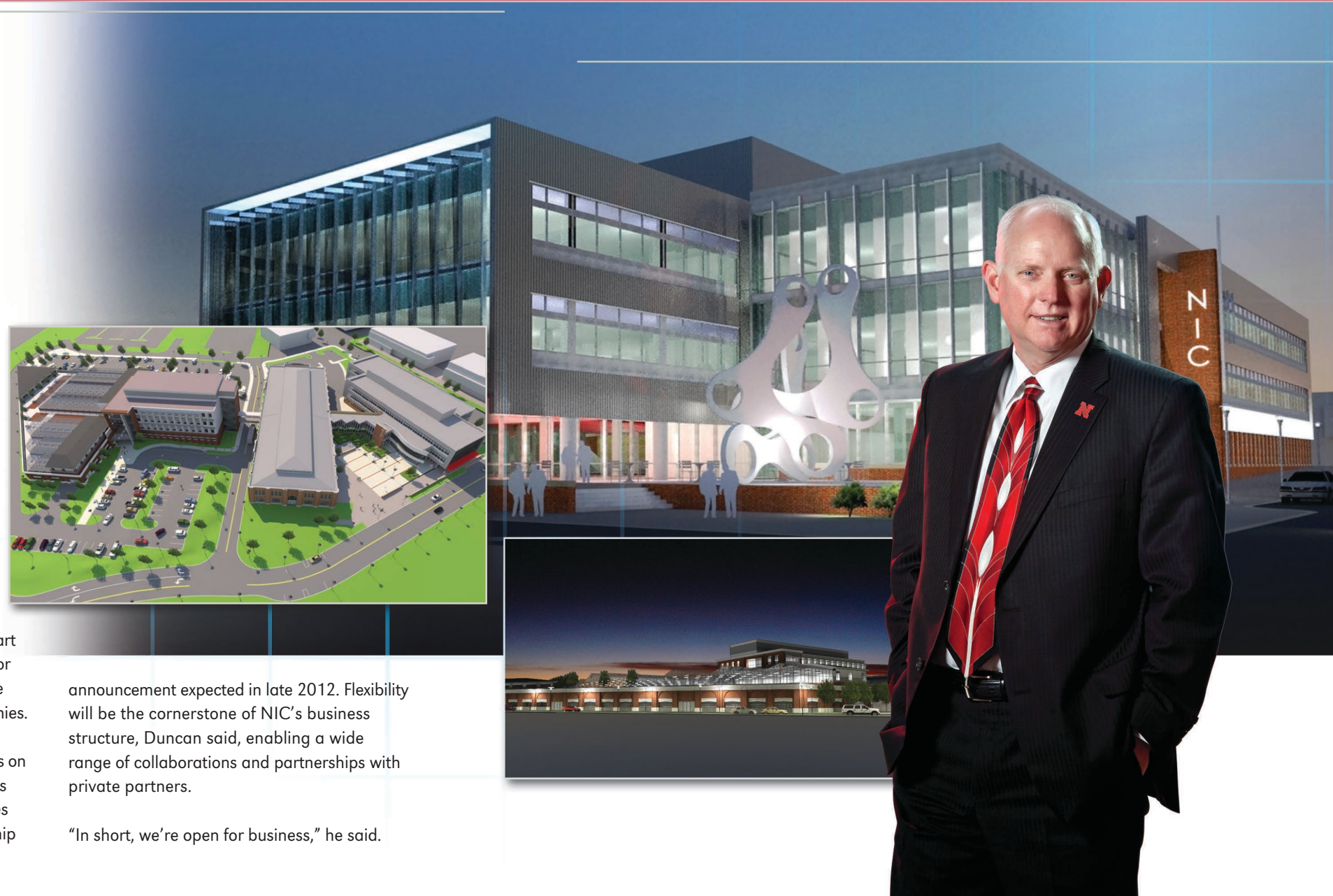
"This will be the front door to Nebraska Innovation Campus," said Dan Duncan, who became NIC's founding executive director in October 2011.

A life sciences collaboration facility will open next. It will consist of the repurposed Industrial Arts Building, including state-of-the-art greenhouses and other space, linked to a major life sciences research building with labs for the university, private industry and startup companies.

The past year also brought significant progress on the plans and business structure critical to NIC's success. Discussions with interested companies are ongoing, with the first corporate partnership

announcement expected in late 2012. Flexibility will be the cornerstone of NIC's business structure, Duncan said, enabling a wide range of collaborations and partnerships with private partners.

"In short, we're open for business," he said.



Inset above: Rendering of buildings in Phase I construction
Inset right: Illustration of life sciences collaboration facility, including repurposed Industrial Arts Building
Top: NIC companion building illustration

Dan Duncan

Building Private Partnerships

Whether it's a potential corporate partner for Nebraska Innovation Campus, a company seeking faculty research expertise or an entrepreneur launching a research-based startup, UNL takes a collaborative approach to building business relationships.

Industry Relations, NUtech Ventures and Nebraska Innovation Campus staff work closely to offer companies and entrepreneurs the widest possible range of partnership options.

Each group's distinct role strengthens overall efforts to expand private partnerships at many levels that benefit both businesses and the university, said Ryan Anderson, director of Industry Relations, which serves as the "front door" for companies, entrepreneurs and organizations looking to work with the university.

"We leverage each other's expertise," said Dan Duncan, NIC's executive director. "We want to be user friendly, whether a company is working with Industry Relations, NUtech or NIC."

The focus on building relationships is important, said David Conrad, executive director of NUtech Ventures, the nonprofit corporation responsible for commercializing UNL research. "By building trust and respect among companies and faculty, you greatly increase the likelihood of successful partnerships."

Partnership Tests Tomatoes' Potential

UNL researchers are testing the feasibility of growing processing tomatoes in Nebraska greenhouses thanks to a partnership with ConAgra Foods, a Fortune 500 company headquartered in Omaha, Neb.

The goal is to expand ConAgra's tomato research capabilities close to home. ConAgra's tomatoes are field grown in California, where harvests from July through October supply ConAgra with tomatoes for Hunt's canned tomatoes.

If Nebraska greenhouses prove promising for growing tomato varieties used in canning, ConAgra could conduct year-round research in Nebraska at every stage, from the growing season to developing products that become pantry staples.

UNL horticulturist Kim Todd leads a team of agronomists, horticulturists and food scientists that is experimenting with ways to mimic field conditions in the controlled environment of a greenhouse and breed tomatoes that meet ConAgra's standards for flavor, firmness and quality. Findings could provide insights about how to grow greenhouse tomatoes in mass quantities, harvest the crop at peak maturity and still hit production deadlines.

When raising field crops in a greenhouse, the smallest differences are often the biggest. Cool night temperatures and moderate humidity – the triggers for pollination and setting fruit – are tricky to consistently replicate indoors.

"It's been eye-opening for us to understand what it takes to grow tomatoes on a schedule that's driven by when a partner needs them," Todd said. "You have to build potential crop failure and other adjustments into the work process."

In addition to support from ConAgra, the project is partially funded by the Nebraska Department of Economic Development's Business and Innovation Act research development program that helps businesses develop new technologies that stimulate job growth. Todd's team is the first from UNL to receive funding through this program, said UNL Industry Relations Director Ryan Anderson, who helped facilitate the partnership.

Gordon Smith, ConAgra's vice president of research, quality and innovation, said, "Through collaboration with UNL, we are working to deliver products that meet consumers' needs in more effective ways."

From left: Kim Todd, Ryan Anderson, Mike Parker, ConAgra Foods, and Rhnissa Decker, Nebraska Department of Economic Development



Making Strides with ICARE

For people recovering from an illness or traumatic injury, learning to walk again is a major milestone.

Patients who use automated treadmills or robotic gait devices during rehabilitation often regain their ability to walk sooner because these machines provide stability, support and mass step repetition while patients rebuild strength.

But at \$300,000 or more, small hospitals and clinics can't afford these machines. A partnership between Madonna Rehabilitation Hospital in Lincoln, Neb., and UNL yielded an alternative.

Judith Burnfield, physical therapist and director of Madonna's Institute for Rehabilitation Science, conceived the idea for an elliptical machine that

offered the therapeutic benefits of standard gait devices at about one-tenth the cost.

She approached Carl Nelson, a UNL mechanical engineer, to help Madonna develop the Intelligently Controlled Assistive Rehabilitation Elliptical system, or ICARE. The ICARE system integrates sensing and actuation components that enable the machine to increase or decrease power depending on the amount of support a patient needs to maintain a natural walking gait.

"Nelson's leadership ensured that the technology adjusts to the unique rehabilitation needs of individuals with weakness, movement control and pain," Burnfield said.

Judith Burnfield and Carl Nelson beside ICARE

Madonna's Research Institute received a grant from the National Institute on Disability and Rehabilitation Research to support the ICARE's development. It is used at Madonna and other leading rehabilitation hospitals to help patients recovering from neurologic and orthopedic disorders.

Madonna partnered with SportsArt Fitness Inc. to manufacture and sell the device in 80 countries, including the U.S. NUtech Ventures, a nonprofit corporation that connects UNL researchers with businesses, helped commercialize the ICARE.

Rehabilitation experts recognize the device's potential. In fall 2011, the ICARE was a finalist for the annual international da Vinci Awards, which recognize new technologies that help people overcome physical limitations.

Nelson said teamwork between researchers and patient-care experts is essential.

"Without Madonna, I wouldn't have access to a patient population and rehabilitation scientists, and without us, they wouldn't be able to customize mechanical systems for these kinds of therapeutic uses," he said. "We need one another to solve problems like this."



Game-changing Research Sparks Startup

UNL chemist Stephen DiMagno was confident his research could revolutionize medical imaging with positron emission tomography, or PET scans. But was it commercially viable?

With help from two National Science Foundation programs designed to guide promising NSF-supported scientific discoveries into the marketplace and assistance from NUtech Ventures, a nonprofit affiliate that helps commercialize UNL research, DiMagno realized the answer was yes.

His new company, Ground Fluor Pharmaceuticals, develops imaging agents for PET scans. PET is a widely used diagnostic tool for detecting and managing certain cancers, heart disease and neurodegenerative disorders including Alzheimer's and Parkinson's diseases. This technology might also help companies develop new drugs.

A nuclear medicine imaging technique, PET relies on radiotracers to give information about the function and metabolism in the body's organs. DiMagno developed a technique to attach the radioactive isotope fluorine-18 to different carrier molecules. The isotope enables a PET scanner to detect a compound's metabolic fate.



"Our methodology allows us to create more potent imaging agents more rapidly, reliably and in high yield," DiMagno said. "Previously, these agents were unknown or very difficult to synthesize."

A \$50,000 NSF Innovation Corps award, or I-Corps, enabled DiMagno to meet with more than 100

potential customers, suppliers and distributors to gauge their interest in the technology. These meetings helped DiMagno revise his business plans and identify potential partners.

NUtech Ventures helped him license the technology and introduced DiMagno to Allan Green, a Boston physician, scientist and lawyer who became Ground Fluor's co-founder and chief executive officer. The company is based in Lincoln, Neb.

A \$150,000 NSF Small Business Innovative Research award supports the startup's activities, including hiring two scientists and expanding its network of academic collaborators. Ground Fluor is testing its method in labs across the country to ensure it can be replicated in a variety of settings.

This technology could increase the availability of existing experimental PET agents and support development of new ones, DiMagno said.

Left: Stephen DiMagno
Above: Pouring liquid nitrogen

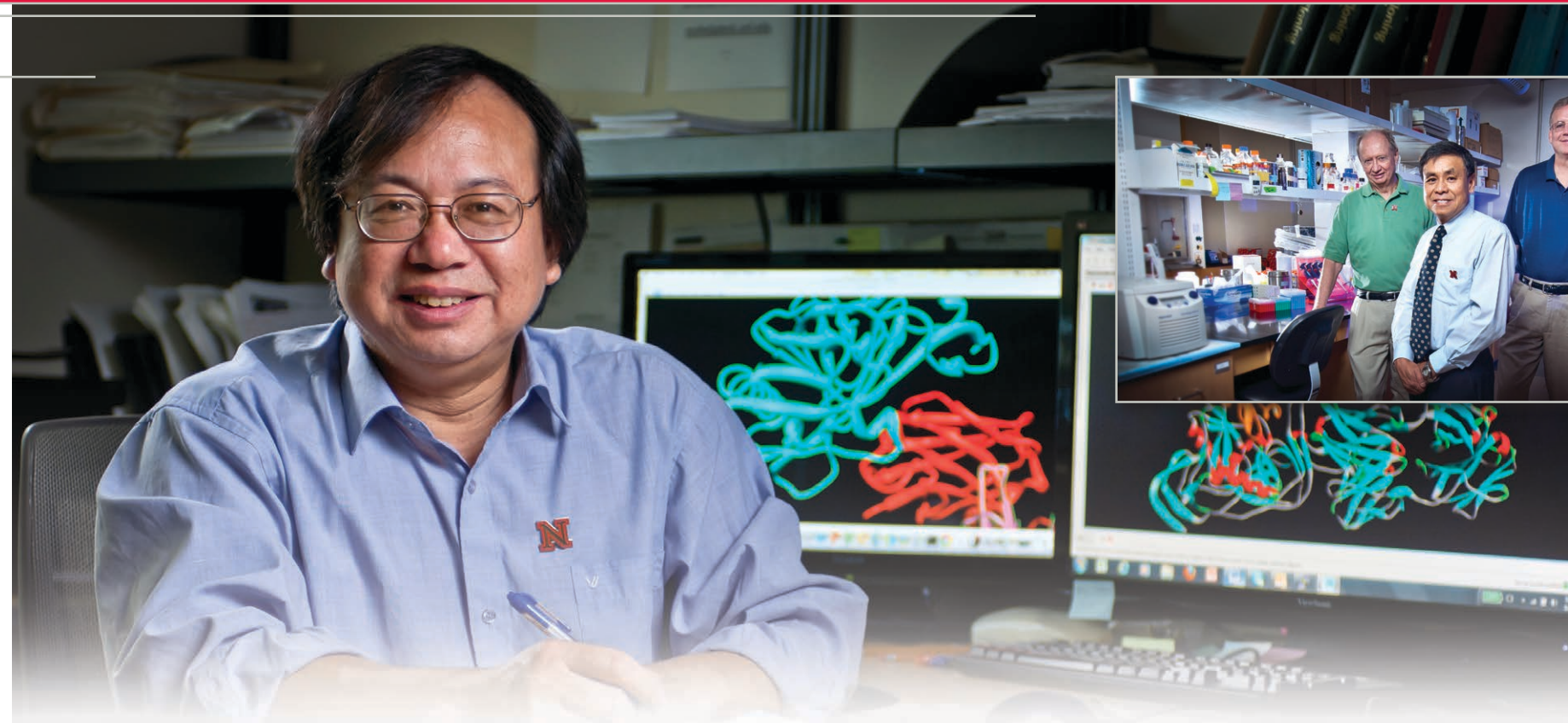
Developing HIV-blocking Bacteria

People with HIV, the virus that causes AIDS, are living longer, better lives through powerful drug therapies. But preventing HIV infections has lagged. UNL virologist Shi-hua Xiang is closing in on a promising prevention strategy that uses bacteria already living in our bodies.

“HIV infects 2.6 million people worldwide each year,” said Xiang, a Nebraska Center for Virology researcher. “Our long-term goal is to block HIV sexual transmission using a safe, cost-effective and easy-to-use method.”

During the infection process, HIV binds to an immune system protein called CD4. Xiang has engineered *Lactobacillus*, a common bacterium found in human genitals and the gastrointestinal tract, to produce CD4 on its cellular surface.

Inside the body, the engineered anti-HIV bacteria should act as decoys, enticing HIV to bind harmlessly to them and preventing it from infecting human cells.



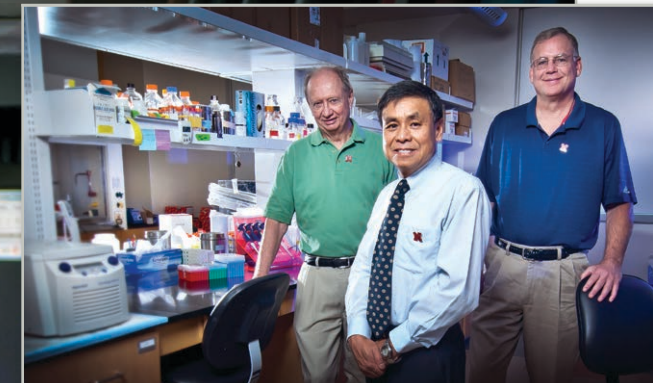
Shi-hua Xiang

Lactobacilli live naturally in mucosal areas where HIV enters the body, so anti-HIV bacteria should be safe for people and efficiently colonize to provide long-lasting protection. The *lactobacilli* could be taken orally, providing an effective preventive approach in low-resource settings like developing countries.

Earlier, Xiang demonstrated at the Dana Farber Cancer Institute that HIV binds to bacterial CD4 and blocks HIV infection in tissue culture. With a

\$611,000 Phase II award from the Bill & Melinda Gates Foundation’s Grand Challenges Explorations grant, he is testing his system in mice and, if successful, in non-human primates, before it moves to human clinical trials.

Grand Challenges grants are given to support innovative research that seeks solutions to major global health issues. Xiang said the Nebraska Center for Virology provided valuable



collaborations and state-of-the-art equipment that advanced his research.

NCV Director Charles Wood said Xiang’s work is an example of the significant, innovative research the center’s scientists are conducting.

“This also speaks to the translational and applied nature of our research that ultimately benefits human health and will save lives,” Wood said.

Virology Research Growing

Focusing on viral threats to people, plants and animals, Nebraska Center for Virology scientists target some of the world’s most devastating diseases.

Creating an internationally recognized center is the goal, said Charles Wood, NCV’s director and Lewis Lehr/3M University Professor of Biological Sciences. “We’re well on our way.”

Virologists at UNL, the University of Nebraska Medical Center and Creighton University collaborate through NCV, one of the university’s signature research programs. Established in 2000 as a Center for Biomedical Research Excellence with a \$10.7 million grant from the National Institutes of Health’s National Center for Research Resources, NCV earned a \$10.6 million renewal in 2005. In 2010, it earned a third five-year, \$5.56 million grant from NIH.

In addition to Shi-hua Xiang’s innovative HIV work, Wood cited examples of other significant NCV research:

- A pioneer in algal viruses, James Van Etten, National Academy of Sciences member, William Allington Distinguished Professor of Plant Pathology and NCV co-director, collaborates on UNL’s

algal biofuels research and with Johns Hopkins University colleagues to investigate a possible algal virus connection to human neurological diseases.

- Virologist Clinton Jones, Charles Bessey Professor and NCV associate director, studies dormancy in the herpes virus and is helping develop strategies to prevent herpes from causing disease.
- Veterinary virologists Fernando Osorio and Asit Pattnaik are developing a vaccine for porcine reproductive and respiratory syndrome, a viral disease causing significant pork industry losses.
- Virologist Qingsheng Li is identifying the earliest steps in HIV transmission, which may lead to anti-viral topical microbicides and a vaccine.

Wood said NCV’s global outreach to students, from schoolchildren to postdoctoral fellows, also contributes to the field. “We’ve really been doing things at all levels: training, education and research.”

NCV’s facilities are growing along with its research. A 26,000-square-foot, seven-laboratory addition to the Ken Morrison Life Sciences Research Center will be completed in 2013. An \$8 million grant from NIH’s National Center for Research Resources through the American Recovery and Reinvestment Act of 2009 funded the expansion.

Inset: From left, James Van Etten, Charles Wood and Clinton Jones

Differences Key to Ag Policy Analysis

All consumers are not the same. Neither are all agricultural producers. Yet ag policy analysis typically assumes they are, which can result in ineffective or inefficient policies. A UNL research effort aims to change that approach.

A new policy research group within UNL's Center for Agricultural and Food Industrial Organization will lead the effort, funded by a two-year, \$766,166 grant from the U.S. Department of Agriculture's National Institute of Food and Agriculture.

This research is an outgrowth of UNL's interdisciplinary Food, Water and Energy Resources Policy Initiative. That initiative aims to tap expertise from a broad range of disciplines, including law, political science, economics, agricultural sciences, social sciences and journalism, to analyze agricultural policy. Two campuswide symposiums in 2010 and 2011 identified interdisciplinary research opportunities and established a framework for this major initiative.

Traditionally, agricultural policy studies have imagined a "representative consumer" or "representative producer," said UNL agricultural economist Konstantinos Giannakas, who leads this research.



But there's really no such thing. Consumers respond to food policies in very different ways, driven by preferences, income and other factors. Producers' responses to ag policies vary, too.

"We're not all the same. We make different decisions based on where we're coming from," said Peter Calow, research professor with UNL's Office of Research and Economic Development and part of the research team.

Such distinctions potentially make a huge difference, and UNL's research aims to develop a policy analysis framework that accounts for them.

"This is novel. This has not been done in ag policy analysis," Giannakas said. This approach "will enable us to take any policy and see how it will affect different consumer groups and different producer groups."

The multidisciplinary research involves about a dozen faculty with diverse expertise as well as graduate students and postdoctoral fellows.

"We believe this will lead to improved policy design, enhanced efficiency, increased effectiveness and fewer policy failures," Giannakas said.

From left, Konstantinos Giannakas and Peter Calow, with agricultural economists Gary Lynne and Amalia Yiannaka

Improving Surveys, Census

Survey and polling results inform decisions large and small. From politics and government to business and social issues, sound choices depend on accurate information.

A team of UNL researchers is partnering with the Gallup Organization, a survey research industry leader, to improve the accuracy of survey data. They're focusing on computer-assisted survey methods, including the Internet and computer-assisted telephone interviews. Their goal is to improve data quality by finding ways to reduce errors and by developing better survey tools and approaches.

"This truly is a team effort," said Allan McCutcheon, the Donald O. Clifton Chair of Survey Science in UNL's Survey Research and Methodology Program/Gallup Research Center, who leads this project. UNL's team includes experts in statistics, psychology, sociology, survey research and methodology, and computer science.

Gallup will collect survey data and UNL researchers will analyze it. Gallup has an international reputation for its survey research and public opinion polling, and conducts surveys in more than 150 countries.

"Our unique partnership with this industry leader is invaluable and ensures we'll provide high-quality results," McCutcheon said.

Funded by a nearly \$3 million grant from the National Science Foundation in cooperation with the U.S. Census Bureau, the five-year project also aims to find more accurate, cost-effective ways to conduct the U.S. Census. The Census Bureau and NSF are looking for ideas to modernize the census and other federally mandated data-collection activities.

This is the latest collaboration in a long-standing relationship between Gallup and UNL.

"I hope this is just the beginning," Jim Clifton, Gallup's chair and CEO, said when the grant was announced. "We're dreaming up a lot of big things. I believe that the University of Nebraska and Gallup together with some new programs ... can change the world."



Top: Jim Clifton speaks via video feed during an announcement at Gallup's Riverfront Campus, Omaha, Neb. Middle: Allan McCutcheon Bottom: Research team, standing, from left, Phil Ruhlman, Gallup; Allan McCutcheon, UNL; Gale Muller, Gallup; and Leen-Kiat Soh, UNL. Seated, from left, Jolene Smyth, Robert Belli and Kristen Olson, all UNL.

Preparing Preschoolers to Succeed

Children living in poverty and other disadvantaged situations often enter kindergarten less prepared than their peers. Many never catch up academically, making intervention during preschool vital to their long-term success.

Susan Sheridan, George Holmes University Professor of Educational Psychology, sees parental participation as a critical component to successfully bridging the gap. Her research led Sheridan and colleagues to develop the Getting Ready intervention, a program to engage parents in their children's preschool lives.

"We feel very strongly about families and schools working together," said Sheridan, who directs UNL's Nebraska Center for Research on Children, Youth, Families and Schools.

Unlike other interventions in which parents are merely given recommendations, Getting Ready builds a partnership. Teachers trained in the

intervention encourage parents to participate in making decisions, setting goals and identifying solutions for their children.

Sheridan's team recently completed an initial large-scale study evaluating Getting Ready's effects. This research was funded by the National Institutes of Health Eunice Kennedy Shriver National Institute of Child Health and Human Development for the Interagency School Readiness Consortium.

They found participating parents showed greater sensitivity toward their children, participated in their learning and supported their curiosity and autonomy. Children improved their social and emotional skills, language development and early literacy.

Gains were greatest for children entering preschool with extremely low skills. They caught up with peers, demonstrating the potential of parents and teachers working

together to close the gap for even significantly underdeveloped kids.

With a \$3.2 million U.S. Department of Education grant, Sheridan's team now is implementing Getting Ready for the highest-risk children in preschools two years before kindergarten. Researchers will track children and families through kindergarten to evaluate the intervention's efficacy and long-term benefits.

"We're really building on family strengths and helping them identify within their own cultures and home environments how they can maximize their child's learning and development," Sheridan said.

With a \$700,000 U.S. Department of Education grant, Sheridan's team also is developing a knowledge base of published research to further understand how to improve family partnerships for all students.

"We feel very strongly about families and schools working together."

Right: The Getting Ready research team, from left, Christine Marvin, Brandy Clarke, Keely Cline, Lisa Knoche, Susan Sheridan, James Bovaird and Carolyn Pope Edwards



Smarter Unmanned Aerial Vehicles



Unmanned aerial vehicles have long been used for military purposes, including reconnaissance and targeted attacks. Recent technological advances have made these remotely controlled aircraft less expensive, smaller and easier to operate, expanding possibilities for UAVs in civilian life.

Potential uses include gathering intelligence, inspecting critical infrastructure and managing natural resources. But safety, reliability and autonomy remain barriers to widespread commercial use. Research by UNL computer scientists and engineers Sebastian Elbaum and Carrick Detweiler, co-directors of the Nebraska Intelligent MoBile Unmanned Systems Lab (NIMBUS), addresses those concerns.

Modern UAVs are powered by a sophisticated combination of computer hardware and software systems, including precise algorithms that guide the

aircraft to its destination. Elbaum and Detweiler are developing software and devices that could lengthen flight times, enable UAVs to fly in swarms or travel through obstacle-filled locations, such as forests, cornfields or mines. Reducing flight errors from unreliable signals, which often result in crashes, is key.

“Our goal is to make small UAVs that can, in essence, think for themselves,” Detweiler said.

Greater autonomy would make it possible to use UAVs for field research in remote locations. The lab hosted a multidisciplinary workshop in June 2012 to discuss the technology, applications and implications of UAVs. The workshop drew UNL faculty from a range of disciplines including engineering, agriculture and natural resources, journalism, political science and law, who want to incorporate UAVs in their work or study their impact.

NIMBUS already partners with UNL agronomists, who could use UAVs to capture aerial images and gather soil and water samples.

“We are just starting to scratch the surface of the lab’s capabilities for research collaborations,” Elbaum said.



Funding from the U.S. Air Force Office of Scientific Research and the National Science Foundation supports the NIMBUS Lab, unique in its capacity to blend research and technology in software and systems engineering, robotics and wireless sensor networks.

Chasing News with Drones

As unmanned aerial vehicle technology improves and federal airway regulations are refined, UAVs could become another tool for industrious journalists. UNL research has the potential to offer journalists guidance for navigating the practical, ethical and legal considerations of using pilotless aircraft for news reporting.

“Drone journalism” holds promise as a safer, more affordable way to capture news footage in locations where access is dangerous or difficult, including war zones and natural disaster areas. However, timeliness, reliability and privacy remain concerns.

UNL journalism professor of practice Matthew Waite is exploring these issues. In fall 2011, he founded the Drone Journalism Lab, which brings together faculty and students to study how journalists can safely and responsibly use UAVs for newsgathering. The lab’s goal is to study potential uses for UAVs and outline an ethical framework for drone journalism.

“We can help the journalism industry determine what are good uses and what are bad uses, so when it’s time to make a decision, it’s based on findings and research instead of ignorance,” Waite said.



Carrick Detweiler (left) and Sebastian Elbaum

Matthew Waite



Helping Companies Grow, Compete

Entrepreneurship is no longer just about starting a small business. Established companies also must stay nimble in today's competitive environment.

Theresa Welbourne, who joined UNL in 2011 as director of the Center for Entrepreneurship and FirsTier Banks Distinguished Professor of Business, leads the university's efforts to help companies expand through innovative research and by training tomorrow's entrepreneurs.

Welbourne has extensively researched fast-growth companies and initial public offering firms, studying factors that predict long-term success and performance, particularly employee relations and leadership.

She turned her research into a human capital technology and consulting company, eePulse Inc. Recently, Welbourne won the Distinguished Human Resource Executive Award from the Academy of Management, a leading professional association. She is the first woman and first entrepreneur to win.

"Good research helps everybody," Welbourne said. "The center is here to generate knowledge and then disseminate that knowledge to students and businesses, both locally, nationally and globally."

The center's increasing expertise in fast-growth companies aids its educational mission by giving students the skills to work not just at startups, but also at large firms looking for innovation.

"A lot of these companies are trying to be fast and agile right now, and they need a different kind of skill set," she said. "They're looking for entrepreneurship students to fill that need."

Under Welbourne's direction, the center is strengthening its educational offerings to give students an advantage with these companies, including a new curriculum and competitions through which students gain skills and recognition. An anonymous donor recently gave \$250,000 over five years to fund business plan competitions. Students also can now graduate with a concentration in entrepreneurship.

Many Nebraska companies are small or mid-sized, growth-oriented businesses. Thanks to the center, they needn't look far for the skilled talent necessary to expand.

"What really attracted me to Nebraska is the energy around growth. I think the state overall is very supportive of entrepreneurship."

Theresa Welbourne



Bureau Expands Economic Research

Predicting economic trends is complex and tricky. It's also exactly the sort of information that businesses need to plan and grow.

UNL's Bureau of Business Research is expanding its lineup of forecasts and indices to help businesses, policymakers and researchers better plan and evaluate economic influences.

"We're focused on factors that influence the long-run growth of the economy," said UNL economist Eric Thompson, the bureau's director. "The knowledge that we're developing – our findings – are useful not just in Nebraska but across the country."

For example, the bureau's State Entrepreneurship Index assesses the level of entrepreneurial activity in all 50 states to help measure state economic health. The index not only determines business formation rates, it also evaluates average income creation of new businesses. This helps states know how innovative they are at producing successful, high-value businesses.

In collaboration with UNL economist David Rosenbaum, the bureau recently began studying the economic consequences of weatherization and energy savings loan programs, looking at



such factors as job creation, pollution reduction and improved home fire safety.

To help strengthen Nebraska businesses, the bureau also began publishing Leading Economic Indicators in conjunction with UNL's Department of Economics. These forecasts project Nebraska's economy six months into the future to better understand factors affecting economic conditions and to help businesses plan. Soon, these reports also will include subregions, such as Omaha, Lincoln and several rural areas.

The bureau also is developing a State Human Capital Index to track how quickly states are building this key component.

Thompson said the bureau's research also benefits UNL's faculty and students. "It's not just that we're producing something cool about the economy, we're also doing the university's business of research and education."

Eric Thompson



Shannon Bartelt-Hunt

Probing Prion-Soil Interactions

Deadly prion diseases can devastate livestock herds or wildlife. What's worse, even quarantine and Mother Nature cannot eradicate these diseases because prions survive in soil, where they remain infectious for decades.

UNL civil engineer Shannon Bartelt-Hunt is shedding light on the complex interaction between soil and prion diseases, including chronic wasting disease, which attacks deer and elk; scrapie, which infects goats and sheep; and bovine spongiform encephalopathy, or BSE, which affects cattle. Her work could provide insights about how to control this environmental threat. A \$413,883, five-year National Science Foundation CAREER program award, presented to outstanding pre-tenure faculty, supports her research.

Prions are misshapen, infectious proteins that cause wildlife or livestock to lose body mass and develop neurological problems. Researchers know prion diseases spread to soil through blood, saliva, feces, urine and even antler velvet, but have limited understanding of how prions behave in the environment. Unlike chemicals, which break down relatively quickly in soil, prions are persistently potent.

"Chemical structures don't change after binding to soil, but protein conformation does,"

Bartelt-Hunt said. "We have evidence that if prion proteins attach to surfaces, like soil, that can affect their biological properties."

The way the protein binds to soil also may protect it from environmental conditions that may otherwise cause it to degrade. Bartelt-Hunt is testing how exposure to changing conditions, including heat and moisture, alters the protein over time. Her goal is to discover which factors slow the ability of prions to replicate.

Her research may offer clues about where to look for contamination or help farmers and wildlife managers safely dispose of soil after an outbreak, especially from BSE-contaminated herds. Though it's unlikely, BSE prions are transferable to humans, according to the U.S. Centers for Disease Control. Preventing prions from entering the water supply is another public health consideration.

Bartelt-Hunt said interdisciplinary collaboration with Nebraska Center for Materials and Nanoscience researcher Mathias Schubert, UNL electrical engineer, and Jason Bartz, medical microbiologist and immunologist at Creighton University, has enhanced her research.

Plants 'Remember' Drought Stress

Plants subjected to drought actually "remember" this stress from day to day, learning to adjust their responses to better cope with it.

This discovery by UNL plant scientists could someday aid development of more drought-tolerant crops.

Working with *Arabidopsis*, a member of the mustard family and model for plant research, plant molecular biologist Zoya Avramova, plant scientist Michael Fromm and postdoctoral fellow Yong Ding compared the reactions of previously water-stressed plants and unstressed plants. Previously stressed plants bounced back more quickly when they were dehydrated again the next day. Unstressed plants wilted and lost water from their leaves faster than previously stressed plants.

"The plants 'remember' dehydration stress. It will condition them to survive future drought stress and transplanting," Fromm said.

The team found that previously water-stressed plants respond to the next day's dehydration by increasing transcription of a certain subset of genes. During the evening when stress eases, transcription of these genes returns to normal levels, but the next day the plants remember



their transcriptional response to stress and induce these genes to higher levels.

"All of this is driven by events at the molecular level," Avramova said. "We demonstrate that this transcriptional memory is associated with chromatin changes that seem to be involved in maintaining this memory."

Arabidopsis "forgets" this previous stress after five days of watering, though that memory time may differ for other plants.

This is the first instance of transcriptional memory found in any life form above yeasts.



While promising, practical applications of these findings in agriculture are years away, Fromm said.

"We're just starting to get a basic understanding," Fromm said. "It's possible plants overreact to a first drought stress." Perhaps scientists can modify those instincts in plants to help maintain or improve productivity during drought, he added.

A \$705,000 grant from the National Science Foundation helps fund this research, which was reported in *Nature Communications*.

Zoya Avramova (left) and Michael Fromm

Global Project Targets Local Yield Gaps

As the world's population explodes to an estimated 9 billion people by 2050, farmers face the daunting challenge of making the most of every acre of suitable land while preserving the environment.

Increasing yields on existing farmland obviates turning to rainforests, wetlands and other unsuitable land.

"The critical question is: Where in the world do we have existing farmland with the capacity to produce much higher, stable yields?" said Ken Cassman, Robert B. Daugherty Professor of Agronomy at UNL.

To answer that question, Cassman and an international research team are developing a tool to identify areas around the globe where significant gaps exist between actual and potential yields for different crops. Yield potentials vary widely and often are difficult to measure.

Unlike other efforts to estimate yield potential, the team's Global Yield Gap Atlas uses a bottom-up approach. Working with colleagues at Wageningen University in the Netherlands, the team is recruiting agronomists worldwide to identify

key agricultural areas and collect data about local conditions and farming methods. These data will be scaled to the national, regional and global levels.

They also are developing the necessary methodology, such as accurately converting short-term weather data into long-term patterns and scaling up local yield estimates. All information and methodologies will be shared on the new public website www.yieldgap.org.

"The beauty of this project is that it is a global project but with local relevance," said UNL agronomist and co-investigator Patricio Grassini. The atlas will estimate global yield trends and food security but also help individual countries identify production potential to better strategize resource allocations and trade opportunities.

With a \$2 million grant from the Bill & Melinda Gates Foundation, the team is working in India, Bangladesh and 10 Sub-Saharan African countries. Grassini also has developed collaborations in Argentina and Brazil with funds from the University of Nebraska's Robert B. Daugherty Water for Food Institute.

Securing food for the future requires accurate information and decades of planning, Cassman said. "We need to do a better job than we have in the past, and that's what the Global Yield Gap Atlas will do."



Inset: Global Yield Gap Atlas website

Traveling the World

Nebraska native Justin van Wart hoped graduate studies at UNL would lead to something important. But, doctorate fresh in hand, he didn't expect to already be traveling the world to help solve a critical global problem.

As an agricultural economist, van Wart brings a large-scale perspective to the Global Yield Gap Atlas project. His doctoral work for UNL agronomist Ken Cassman included developing methods to scale local data to regional and global levels.

"It's going to have a huge impact on our ability to analyze national and global agriculture," Cassman said.

Now, as a postdoctoral fellow, van Wart finds himself in a new country almost every month, presenting his methods and helping build collaborations.

"It's amazing to work with internationally renowned agronomists," van Wart said. "It's kind of surreal to be shaking hands and talking directly with the person whose paper I was highlighting for a report just a few months ago."

He's also creating connections that will lead to future career opportunities.

"It's such an exciting field," he said of the yield gap research. "There's so much happening nationally and internationally."

"The beauty of this project is that it is a global project with local relevance."

From left, Justin van Wart, Patricio Grassini and Ken Cassman

Institute Connects Water, Food Concerns

The name of the Robert B. Daugherty Water for Food Institute perfectly encapsulates what is unique and vital about the University of Nebraska's new institution, said Roberto Lenton, DWFI's founding executive director.

While many people worry about future food security, the water needed to produce food – whether for crops, livestock or fisheries – gets less attention. Yet water will be a pivotal factor in producing enough food to feed a world population that is expected to double by 2050.

"The importance of this institute is connecting the concerns about food with the concerns about water," said Lenton, an international expert in water management and development who became director in 2012. The institute was established in 2010 with a \$50 million gift commitment from the Robert B. Daugherty Charitable Foundation.

Focusing on research, education and policy, DWFI involves faculty from all four NU campuses under the unifying theme of "more food with less water." By encouraging interdisciplinary collaborations around a central theme, Lenton hopes to inspire ideas that put NU at the forefront of solving this daunting global challenge.

Nebraska is the ideal location for the institute, Lenton said. NU's tradition of merging research with practice has led to much ingenuity at both the university and farm levels. Nebraska also

has more irrigated farmland than any U.S. state and most countries, and faces many of the same water challenges.

"When you have an institute like this, you really want to be located in the center of innovation, and that's what I think we have here," he said.



Lenton sees the institute as a way to connect international and NU researchers who'll learn from each other and work jointly. No single institution can solve the water for food challenge, so strong international collaborations are essential.

"That's the vision: that both Nebraska and the world benefit from the relationship."

International Partners Take Learning Afield

Shovels and clipboards in hand, students from developing nations around the world swarm a southeast Nebraska potato field, gleaned knowledge they'll someday use to enhance food production in their homelands.

The 17 students are the vanguard of an international education partnership between the University of Nebraska's Robert B. Daugherty Water for Food Institute and the UNESCO-IHE Institute for Water Education in the Netherlands, the world's largest international postgraduate water education facility. The partnership agreement includes developing a joint master's degree program in water and food, student and faculty exchanges, and research collaborations.

The students visited Nebraska in May 2012 for the inaugural field methods course, which UNL faculty developed in collaboration with their UNESCO-IHE counterparts. The course provides hands-on field experience with agricultural production and water resources management in Nebraska, drawing on UNL expertise in food production, irrigation and water management.

The joint master's program begins during the 2012-2013 academic year. Other educational offerings, including policy courses for officials in developing countries, are planned.

This is one example of the international collaborations DWFI is building to achieve its goals. Others include:

- **U.S. Agency for International Development:** NU and USAID agreed to collaborate on expanding research and development capacities related to water management in the Middle East and North Africa.
- **Jain Irrigation Systems Inc., India:** NU faculty will collaborate on research and education projects under a recent agreement.

- **Water Technology Centre at the Indian Agricultural Research Institute:** NU signed a letter of intent to partner with this public institute on research.
- **Global Water for Food Conference:** Hosted by DWFI and the Bill & Melinda Gates Foundation, the annual Water for Food Conference is becoming a leading international gathering for sharing ideas on water and food. The 2012 conference in Lincoln, Neb., drew about 500 people from 28 nations.



Roberto Lenton

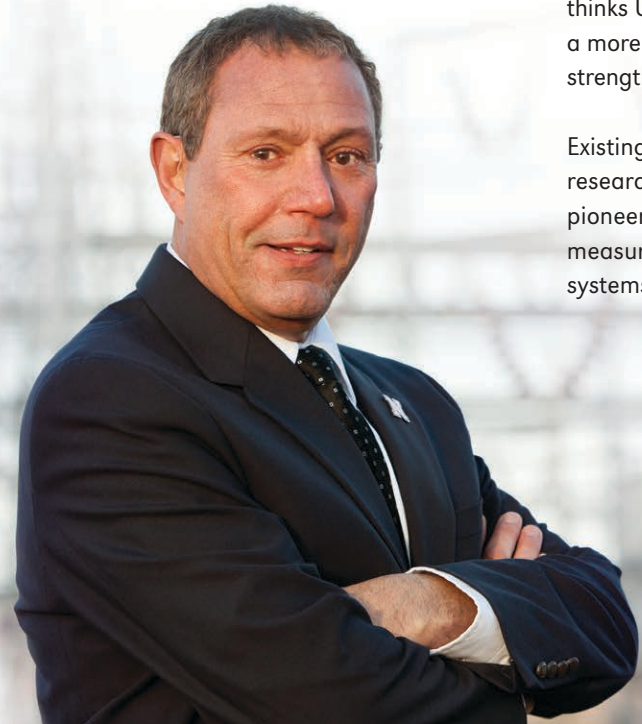
Above: Roberto Lenton at 2012 global Water for Food Conference
Right: Water for Food Conference Industry Leaders Panel with representatives from Monsanto, John Deere, Elanco and Pioneer Hi-Bred

UNL irrigation engineer Dean Eisenhauer and UNESCO-IHE students in the field

Bolstering Energy Research

UNL is poised to expand the breadth and impact of its energy research with the Nebraska Center for Energy Sciences Research as a catalyst.

“The university can play an even bigger role in solving energy problems for Nebraska and the nation,” said center director Mike Nastasi, who holds the Elmer Koch Professorship in Mechanical



Mike Nastasi

and Materials Engineering. An accomplished materials scientist, he joined UNL in 2012 from Los Alamos National Laboratory.

UNL is tackling both applied and basic problems to improve the energy outlook for Nebraska and beyond, he said.

“I see lots of innovation here,” Nastasi said. He thinks UNL can double its energy research through a more focused approach that builds on existing strengths and targets promising new areas.

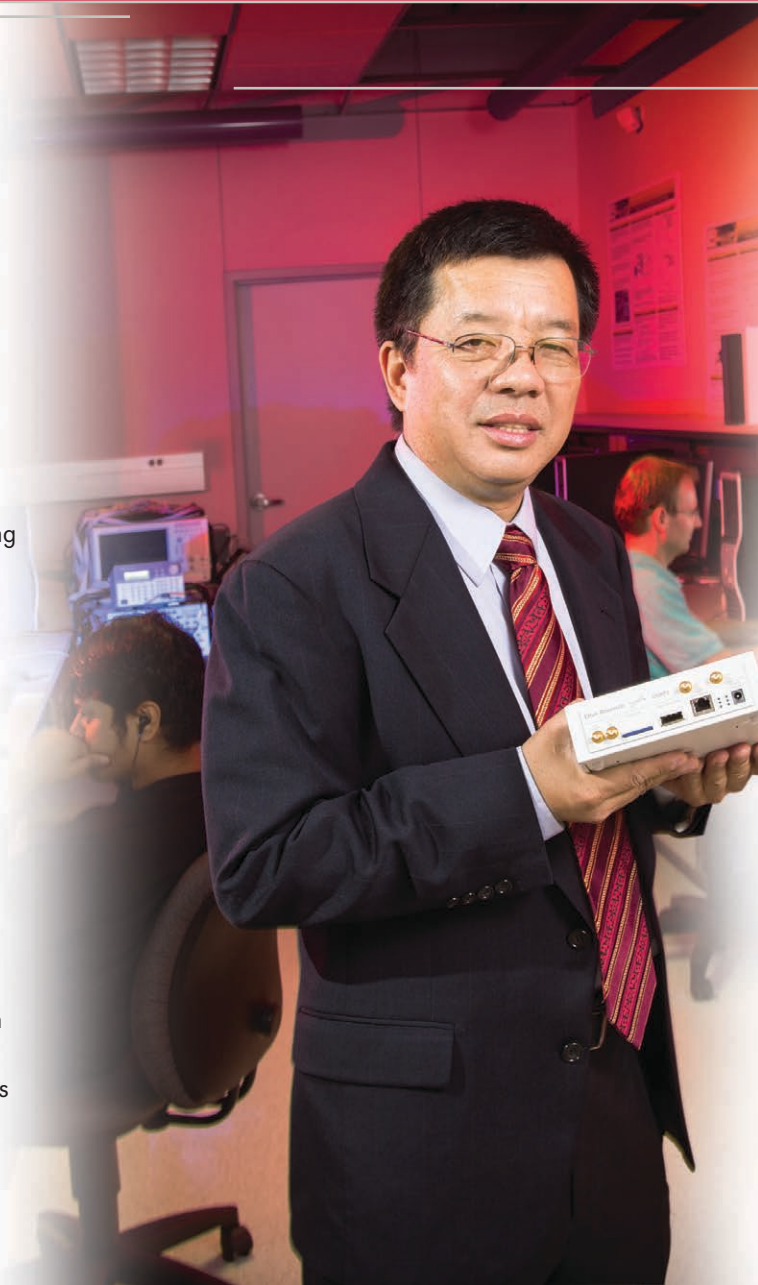
Existing strengths include biomass and biofuels research, from algae and switchgrass fuels to pioneering work on ethanol byproduct feeds and measuring performance of biofuel production systems. Other strengths include work on wind

and solar power, smart grid technologies and energy storage, and nanotechnology and materials science research to develop critical materials and tools for clean energy.

Several factors fuel Nastasi’s optimism. These include the center’s early successes and its strong partnership with the Nebraska Public Power District; UNL’s commitment to increasing enrollment and research; and the university’s plans for Nebraska Innovation Campus, a private-public research campus.

“Faculty are great at developing intellectual property, and Nebraska Innovation Campus is a way to get that intellectual property out to the world,” he said. “I see energy playing a major role there.”

Established in 2006, the Nebraska Center for Energy Sciences Research is a collaboration between the Nebraska Public Power District and UNL. It supports interdisciplinary research on renewable energy, energy efficiency and conservation to expand economic opportunities and improve the quality of life for Nebraskans.



Yi Qian

Enhancing Wireless Communications

Earthquakes and other natural disasters often devastate communications infrastructures just when they’re most needed to save lives.

A UNL computer and electrical engineering team at the Peter Kiewit Institute in Omaha is researching ways to improve wireless communications during emergencies. It’s just one of the ways researchers hope their Application-Aware Cognitive Multihop Wireless Network (AC-MWN) can be used to improve future communications systems.

AC-MWN combines two existing technologies: cognitive radio, which uses software to automatically adapt to network and user demands to find usable frequencies, and multihop wireless networks. Unlike cellphone signals, which jump to a cell tower that then transmits signals via antennas, multihop systems send signals “hopping” from node to node along a wireless network. Cognitive radio technology will allow the signal to find its path automatically and to apply other application-specific requirements.

For example, after an earthquake, a temporary AC-MWN can be quickly established exclusively for emergency responders.

Other applications include placing sensors in a forest to transmit a fire warning by sending a signal through an existing multihop network. In a city, sensors could monitor and send air pollution levels.

“Our research will significantly advance understanding in the field of multihop wireless networks, which will play a key role in the modern society,” said Yi Qian, the associate professor who heads this research.

With a nearly \$456,000 grant from the National Science Foundation, Qian and colleagues are exploring two challenging requirements for deploying AC-MWNs: enhancing network capacity by tapping into unused or underused frequencies and accommodating different applications’ requirements, such as coding a forest fire warning to preempt other network users.

Timothy Wei, dean of the College of Engineering, said the team’s work fits into the college’s long-range vision. “One of the broad focus areas that we’re looking at is the built environment for the 22nd century, and wireless networks are an important part of that environment.”

Harnessing Rural America's Potential

Rural America faces great challenges amid a changing world, but it also has the tools to survive and even thrive: strong work ethic, entrepreneurial spirit and the fact that it's home to much of the food production system needed to feed a growing world population.

The University of Nebraska's new Rural Futures Institute aims to bring together university and local expertise to harness this potential. Launched in 2012, the institute will tap faculty expertise across all four NU campuses for research, education and engagement involving partner organizations and rural communities across the Great Plains.

To help new ideas become reality, the institute is awarding seed grants to launch multidisciplinary research related to rural places and to develop educational programs.

Although agriculture was the foundation of rural America and remains critical to its economy, that's not all there is, said Ronnie Green, Harlan Vice Chancellor of UNL's Institute of Agriculture and Natural Resources and NU vice president.

"It's not just an economy of production," he told the inaugural Rural Futures Conference in

May 2012. "It's a natural resources economy. It's a knowledge economy."

More than 450 people from across the nation attended that conference, a major step toward establishing the institute. Conference discussions helped to inform the institute's agenda.

"I think we're at a time when the planets are aligning in a way that's really unusual," Green

said. "We have to figure out a way to make this landscape sustainable for the long term."

It's time to change the conversation from what's wrong with rural America to what's right, he added. "Rural America is about to experience a renaissance. I really believe that."

Web: ruralfutures.nebraska.edu



Rural Futures Conference



American Exchange Center Opens

Chinese students and faculty are getting better acquainted with American culture through a new American Exchange Center at Xi'an Jiaotong University, which deepens the University of Nebraska's collaboration with China.

Opened in April 2012, the center is an NU-wide effort to expose Chinese faculty and students to U.S. history, law, medicine, art, culture and government. It's part of the university's strategy to strengthen relationships with key nations that will benefit Nebraska and the world.

"The students in Chinese universities today will be the government and business leaders of China tomorrow, and cultural understanding is an essential ingredient to peaceful and constructive relationships," NU President James B. Milliken said.

Through the center, NU's four campuses will provide lectures, events, cultural performances and instructional courses at the university and in Xi'an and Shaanxi Province. It also will sponsor student exchanges.

"Our partner, Xi'an Jiaotong University, has created a physical space that is far beyond our expectations and will serve us well in the years ahead as we bring



American culture and perspectives to China," UNL Chancellor Harvey Perlman said. Perlman led NU's exchange center proposal, one of only 10 nationwide to earn U.S. State Department seed funding.

A leading research university, Xi'an Jiaotong has more than 30,000 students. Xi'an, population 10 million, is China's third "international city," but has had less exposure to American culture than Beijing or Shanghai. The center will host educational events that provide a broader view of U.S. history and culture than popular films or television.

The center operates much like UNL's Confucius Institute, another partnership with Xi'an Jiaotong, which promotes Chinese language, culture and history.

Harvey Perlman, UNL chancellor (left), and Zheng Nanning, Xi'an Jiaotong University president

New Beijing Office

An office in Beijing expands UNL's ability to work with China on agriculture, food security and natural resource challenges.

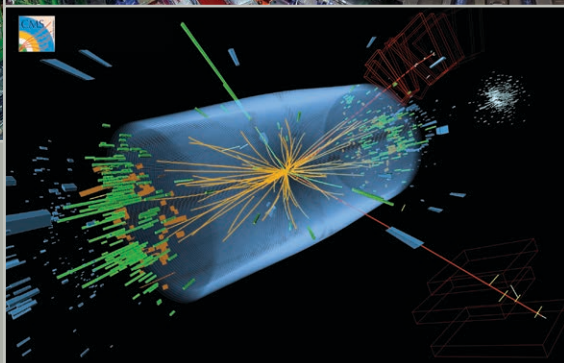
UNL's Institute of Agriculture and Natural Resources opened an office at China's State Administration of Grain, or SAG, in June 2012. An agreement with SAG provides greater access to Chinese universities for research collaborations in UNL's areas of strength, including agricultural biosciences, food science and technology, engineering, water and animal sciences. Student and faculty exchanges also are planned.

"This will provide a platform to work together on important agricultural problems in a coordinated and synergistic way," said Ronnie Green, Harlan Vice Chancellor for IANR and University of Nebraska vice president.

The agreement also strengthens the Nebraska Department of Agriculture's efforts to expand opportunities for Nebraska businesses in China.

"We have a vision of working side by side with the university to boost relationships for Nebraska companies," said Greg Ibach, Nebraska Department of Agriculture director.

Research Highlights



Collaborating on Higgs Hunt

UNL's experimental high-energy physics team celebrated the discovery of a new particle matching the long-theorized Higgs boson, a subatomic particle that may prove to be the final piece in understanding the nature of the universe. The team has been extensively involved in the Higgs hunt for nearly two decades, capturing and analyzing data in an international

effort to find the elusive particle using the atom-smashing Large Hadron Collider at CERN, the European Organization for Nuclear Research in Switzerland. UNL is one of seven Compact Muon Solenoid Tier-2 sites, and team member Ken Bloom coordinates the U.S. CMS experiment. If confirmed, the discovery promises to lead to a new realm of investigation. UNL's team includes physicists Bloom, Dan Claes, Aaron Dominguez, Ilya Kravchenko and Greg Snow, in collaboration with computer scientist David Swanson.

Above: Large Hadron Collider
Inset: Evidence of Higgs boson

Climate Change Shrank Early Horses

Roughly 55 million years ago, as the world warmed during the Paleocene-Eocene Thermal Maximum, about a third of mammal species shrank in size. Ross Secord, UNL earth and atmospheric scientist and curator of vertebrate paleontology at the University of Nebraska State Museum, and colleagues at the University of Florida showed that the temperature increase drove the evolution of *Sifrhippus*, the earliest known horse, which shrank from 12 pounds to 8.5 pounds during that period. Fossil measurements and geochemical analysis demonstrated, for the first time, that a progressive decrease in body size correlates to temperature change. The findings raise questions about how animals will respond to rapid temperature change in the near future from global warming. Researchers reported their findings in the journal *Science*.



Above: Modern Morgan horse and
Sifrhippus, earliest known horse



Rare Look at Slaves' Lives

Before the Emancipation Proclamation ended slavery across the South, the Compensated Emancipation Act freed all slaves in Washington, D.C. Signed in April 1862, the act produced rare documentation of the era: reimbursement petitions by former slave owners that included names and descriptions of 3,000 African Americans. With a \$220,000 National Endowment for the Humanities grant, a team of UNL scholars has transcribed hundreds of petitions and published digital versions on the Civil War Washington website. History, English and libraries faculty teamed on the interdisciplinary digital research project through UNL's Center for Digital Research in the Humanities.

The documents reveal the largely overlooked story of these slaves' lives and elevate the understanding of emancipation in real, human terms, said Kenneth Winkle, Sorensen Professor of American History and project co-leader. "And it is a remarkable story."

Web: civilwardc.org

Top: From left, Susan Lawrence, Kenneth Winkle, Katherine Walter, Kenneth Price and Elizabeth Lorang

Technology and Human Trafficking

An interdisciplinary team of UNL faculty is studying the role of technology and online advertising in child sex trafficking in the U.S. Researchers hope to combat domestic child sex trafficking by identifying the Internet's role and the clandestine language used in Web advertising to facilitate sex trafficking. They also plan to conceptualize intelligent software that can identify online advertising of child sex for sale. Anna Shavers, Cline Williams Professor of Citizenship Law, leads a team of faculty from marketing, advertising, journalism and computer science on this project, which is funded by a grant from Microsoft Corp.

Credit Card Smarts

Good credit card management doesn't come just from what you know about finance, but from what you think you know, according to a national study by UNL economists Sam Allgood and William Walstad. Using data that measured 27,500 Americans' actual and perceived financial knowledge, they examined how each trait affected credit card management, such as paying bills in full, paying late fees and exceeding credit limit. In all cases, respondents who perceived their financial knowledge as high had better credit card behavior than those who saw their knowledge as low, regardless of actual knowledge. For example, high self-perceivers were about 15 percent more likely to pay their credit card bills in full compared with equally knowledgeable low self-perceivers.



Winning Illustration

A scientific illustration of UNL nanotechnology research earned honorable mention in the illustration category of the 2011 International Science and Engineering Visualization Challenge, a competition sponsored by the National Science Foundation and the journal *Science* to recognize some of the year's best scientific illustrations, photos and videos. Joel Brehm, graphic and Web designer for the Office of Research and Economic Development, designed the award-winning 3-D image of variable diameter carbon nanotubes to help visualize research by Yongfeng Lu, Lott University Professor of Electrical Engineering, and his team. Brehm's illustration of the team's discovery, invisible to the naked eye, appeared in *Science*. It also appeared in journal articles, proposals, websites, presentations and posters.

Evolution of Political Ads

Like most things, campaign ads have changed in the past 60 years. The University of Nebraska Campaign Ads Project examined the evolution of presidential campaign ads since 1952, analyzing and categorizing hundreds of general election commercials. Researchers made the resulting database of ad characteristics publicly available on the Web in time for the 2012 presidential campaign, including a blog analyzing long-term campaign ad trends. The team, led by UNL assistant professor of political science Dana Griffin and assistant professor of communication studies Damien Smith Pfister, expect their dataset will aid interdisciplinary research on political communication. **Web:** unl.edu/unecap



AFOSR Director Visits

Thomas P. Russell, director of the U.S. Air Force Office of Scientific Research, visited UNL in May 2012 to make a presentation and learn firsthand about some AFOSR-funded projects and related programs. Russell made a presentation to faculty and staff, toured labs and facilities, met with faculty and administrators, and discussed possible future collaborations. The Office of Research and Economic Development hosted Russell’s visit. AFOSR interacts with leading scientists and engineers throughout the world to identify breakthrough opportunities and actively manages a \$510 million investment portfolio encompassing the best of these opportunities.

O’Connor Leads Fine and Performing Arts

Charles “Chuck” O’Connor is the new dean of the Hixson-Lied College of Fine and Performing Arts. He came to UNL in 2012 from Indiana University-Purdue University Fort Wayne, where he was dean of the College of Visual and Performing Arts. Previously, he held an administrative role at the Nevada Conservatory Theatre at the University of Nevada, Las Vegas, and was a UNL professor. O’Connor’s interests lie in the changing role of arts in higher education. He has led successful fundraising, program development and community partnership activities. O’Connor holds a Master of Fine Arts degree from the University of Southern California and a bachelor’s degree from California State University, Northridge.



Clutter Heads Ag Research Division

A geneticist with experience in academia and private industry joined UNL as Agricultural Research Division dean and Agricultural Experiment Station director. Archie Clutter came to UNL from Newsham Choice Genetics, where he was vice president for research and development. Earlier, he was a professor of animal science at Oklahoma State University and held research and development positions at Monsanto Co. Clutter is expanding ARD’s research capacity, building strategic partnerships and implementing best industry practices. He holds doctoral and master’s degrees in animal science from UNL and a bachelor’s degree in agricultural business from Iowa State University.



UNP Signs Pact, Names Editor

The University of Nebraska Press purchased the inventory and now handles publication, distribution and marketing of books released by The Jewish Publication Society under a collaborative agreement effective in January 2012. Director Donna Shear said UNP has a long history of publishing works of Jewish scholarship, and the partnership will further distinguish UNP in the field of Jewish studies. In July, Derek Krissoff became UNP’s new editor in chief. A veteran of trade and scholarly publishing, Krissoff joined UNL from the University of Georgia, where he was a senior acquisitions editor. He is active in the Association of American University Presses, has reached the all-but-dissertation stage toward a doctorate from the State University of New York at Buffalo and holds a bachelor’s degree from Wesleyan University.

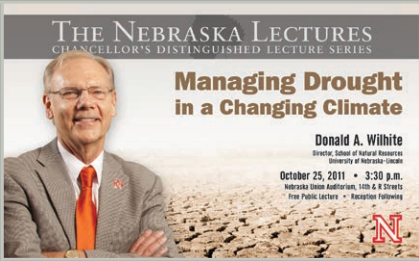


Citations of Excellence Award

Fred Luthans, George Holmes Professor of Management and a pioneer in the field of organizational behavior, received the 2011 Emerald Management Citations of Excellence Award, which recognizes exceptional papers. Luthans’ *Journal of Management* article, “Emerging positive organizational behavior,” is one of the top 50 most-cited articles in business journals since its 2007 publication.

New Home Design Tool

Many variables go into designing a functional, cost-effective and energy-efficient home. To assist homebuilders, Tim Hemsath, UNL assistant professor of architecture, and colleagues are developing HomeGener8, a home customization and design software tool that allows individuals to design a house tailored to their preferences and building site. While other home design software programs require an ability to negotiate different criteria, HomeGener8 uses algorithms that automate the process and provide myriad options. Site-specific customization also can take into account factors that maximize energy efficiency and minimize costs. Designers can use HomeGener8 to generate ideas, obtain information to aid in design or receive feedback on designs. Developers can use the software to reduce costs while creating uniqueness throughout a planned development. The Design Studio in the Jeffrey S. Raikes School of Computer Science and Management is collaborating on development. NUtech Ventures, the university’s technology development organization, has filed a provisional patent on this tool, which developers hope to commercialize.



Nebraska Lectures

The 2011-2012 Nebraska Lectures: The Chancellor’s Distinguished Lecture Series featured a notable climatologist and a legal authority. In his fall lecture, Donald A. Wilhite, director of UNL’s School of Natural Resources and founder of the National Drought Mitigation Center, presented “Managing Drought in a Changing Climate.” He discussed proactive, risk-based approaches governments can use to minimize the economic, environmental and social impact of droughts. In her spring lecture, Josephine R. “Jo” Potuto, Richard H. Larson Professor of Constitutional Law, presented “The NCAA: Who, What, When, Where, How and Certainly Why.” Potuto, the university’s faculty athletics representative to the NCAA and the Big Ten Conference, used the NCAA as an example of how process influences decision-making and fairness, especially in large organizations. The Office of the Chancellor, the Research Council and the Office of Research and Economic Development co-sponsor these lectures featuring prominent faculty.

Jacobs Wins ACLS Fellowship

Margaret Jacobs, Chancellor’s Professor of History, earned an American Council of Learned Societies Fellowship. The award supports Jacobs’ latest book, which will explore the post-World War II practice of non-Indian families fostering and adopting American Indian children. The project is a continuation of Jacobs’ Bancroft Prize-winning book, *White Mother to a Dark Race: Settler Colonialism, Maternalism, and the Removal of Indigenous Children in the American West and Australia, 1880-1940*.

UNL Research Fair

Faculty explored the university’s research priorities in greater depth, and students participated in professional development events at the biannual UNL Research Fair. The fall 2011 program included forums on university research parks and technology transfer programs sponsored by UNL, NUtech Ventures and Nebraska Innovation Campus; a panel discussion on competing for and managing National Science Foundation Small Business Innovation Research/Small Technology Transfer programs; a workshop on U.S. Department of Energy national laboratories; a leadership workshop for postdocs; and faculty recognition events. Featured speakers included Johnney Green Jr., Oak Ridge National Laboratory; Louis Infante, Ricardo Inc.; George Fenske and John Hryn, Argonne National Laboratory; Harold Strong and Robert Calcaterra, Association of University Research Parks; and Sharon Milgram, National Institutes of Health. The spring 2012 event focused on students, including sessions on building transferable career skills, planning for graduate school, and undergraduate and graduate student poster sessions and workshops.



Top: Thomas Russell (left) and electrical engineer Yongfeng Lu

Fall UNL Research Fair



Research, Athletics Partnership

A burgeoning partnership between UNL research and athletics promises to expand understanding of the brain and concussions, enhance health and performance research and create a national model for such collaborations. Nebraska Athletics and the Office of Research and Economic Development partnered to incorporate research space into the East Stadium expansion of Memorial Stadium. Slated for completion in 2013, the expansion includes space for the proposed Center for Brain, Biology and Behavior, which will use cutting-edge imaging technology to better understand the biological underpinnings of behavior and performance, and the Nebraska

Athletic Performance Lab, which will focus on research to improve performance and health. More than 100 people discussed opportunities for research collaborations during a 2012 retreat for faculty, athletics staff and private partners. The partnership provides “a bridge between athletics and academics,” said Nebraska Athletics Director Tom Osborne. “This will be a unique facility not duplicated anywhere else.”

Jewish Book Award Winner

Gerald Steinacher, assistant professor of history and Hyman Rosenberg Professor of Judaic Studies, won the 2011 National Jewish Book Award in the Holocaust category for his book, *Nazis on the Run: How Hitler's Henchmen Fleed Justice*. Established by the Jewish Book Council in 1948, this award program is the longest running program of its kind in North America. Released in 2011, Steinacher's book tells the story of how Nazis and Fascists escaped justice at the end of World War II by fleeing overseas.



Hibbing Named AAAS Fellow

John Hibbing, Foundation Regents University Professor of Political Science, was named a Fellow of the American Association for the Advancement of Science in 2011. He was cited for his distinguished contributions to applying biological knowledge and methodological techniques to study politics and for encouraging others. Known for his groundbreaking research on biology's role in shaping people's political leanings and social behavior, Hibbing is one of fewer than 20 political scientists among the AAAS ranks.

Nature Declines in Kids' Books

The built environment is crowding out nature in award-winning children's picture books, consistent with a growing isolation from the natural world, suggests a study led by UNL sociology professor emeritus J. Allen Williams Jr. The study examined nearly 300 children's books that won or received the Caldecott Medal from 1938 through 2008. Beginning in the mid-1970s, the number of illustrations depicting nature and animals has declined steadily as images of the built environment have increased. The decline suggests today's children aren't being socialized toward understanding and appreciating the natural world and their place within it. The study was published in the journal *Sociological Inquiry*.

Dawes Earns Guggenheim Fellowship

Poet and author Kwame Dawes, Chancellor's Professor of English and Glenna Luschei Editor of UNL's literary magazine, *Prairie Schooner*, received a 2012 John Simon Guggenheim Memorial Foundation Fellowship. The fellowship supports his work on the poem cycle, *August: A Quintet*, based on writings by August Wilson, a playwright and Pulitzer Prize winner whose work illustrates the African-American experience in the 20th century. An award-winning author of poetry, fiction, nonfiction, criticism and drama, Dawes' accomplishments include a 2009 Emmy Award for a multimedia documentary project on HIV/AIDS in Jamaica.



Teaming on Concussion Research

The Big Ten Conference and its Committee on Institutional Cooperation have teamed with the Ivy League to study head injuries in sports. The Big Ten was the first collegiate conference to establish a conference-wide concussion management plan in 2010, and joined forces with the Ivy League in 2012. UNL psychology professor Dennis Molfese leads the Big Ten/CIC Traumatic Brain Injury Research Collaboration. “The opportunity for collaborating on such a landmark series of studies with the Ivy League is unprecedented in sports medicine,” he said. Molfese, the Mildred Francis Thompson Professor of Psychology, also heads UNL's proposed Center for Brain, Biology and Behavior, a multidisciplinary brain imaging center and research collaboration.

Larkins Leads Life Sciences

Brian Larkins, a leading plant scientist and molecular biology pioneer, is UNL's first associate vice chancellor for life sciences. He leads the Life Sciences Initiative, a priority effort to create a comprehensive and collaborative life sciences program. A Nebraska native who earned his bachelor's and doctoral degrees at UNL, Larkins came from the University of Arizona, where he led a renowned research lab and held administrative roles. In 2007-2008 he took leave from Arizona to serve as UNL associate vice chancellor for research, focused on life sciences. Larkins said he returned to UNL in 2012 to finish what he started. A National Academy of Sciences member, Larkins holds the John F. Davidson, Ph.D., and Marian J. Fuller, Ph.D., Chair in Life Sciences. His research on the nutritional quality of corn and other cereal grains led to scientific advances, including new molecular biology techniques and a broader understanding of the molecular mechanisms regulating seed development and protein production in corn seeds.



Associate Vice Chancellors for Research Named

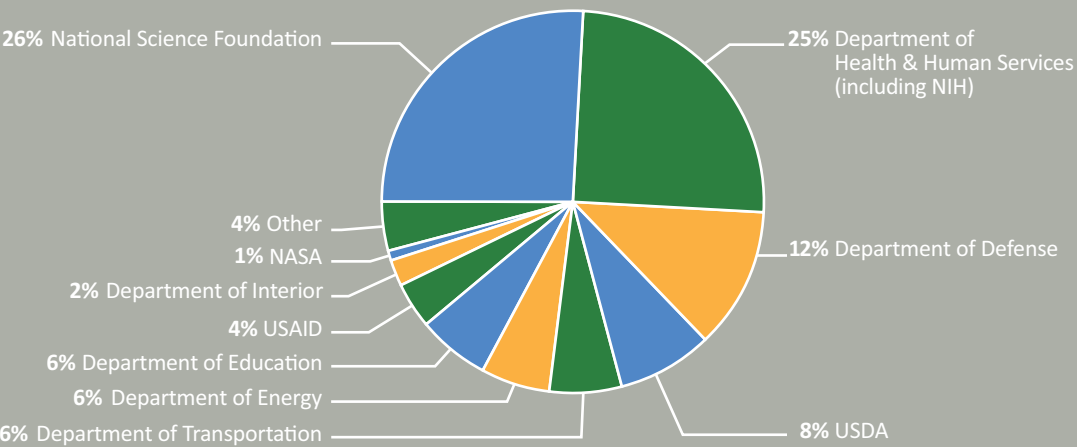
Kurt Preston and Regina Werum are new associate vice chancellors for research at UNL. Preston became associate vice chancellor for research focused on physical sciences and other defense-fundable projects in November 2012. He previously was division chief of the U.S. Army Research Office in Durham, N.C., overseeing the University Research Initiative Program and directing the Environmental Science Basic Research Program. Earlier, he was a program manager for the office. He also held several U.S. Army leadership roles. He earned a bachelor's degree in agriculture from the University of Georgia, master's and doctoral degrees in civil engineering from Purdue University and a Juris Doctor from North Carolina Central University. Werum assumes responsibilities for research development, growth and compliance in January 2013. She comes to UNL from Emory University where she is an associate professor of sociology and co-directed the Andrew W. Mellon Foundation Graduate Teaching Fellowship Program for five years. From 2010 through July 2012, she took leave from Emory to serve as program director for sociology in the National Science Foundation's Directorate of Social, Behavioral and Economic Sciences. She earned a bachelor's degree in language/arts from Hope College, and a master's in sociology and a doctorate in sociology and American studies, both from Indiana University.

Financials

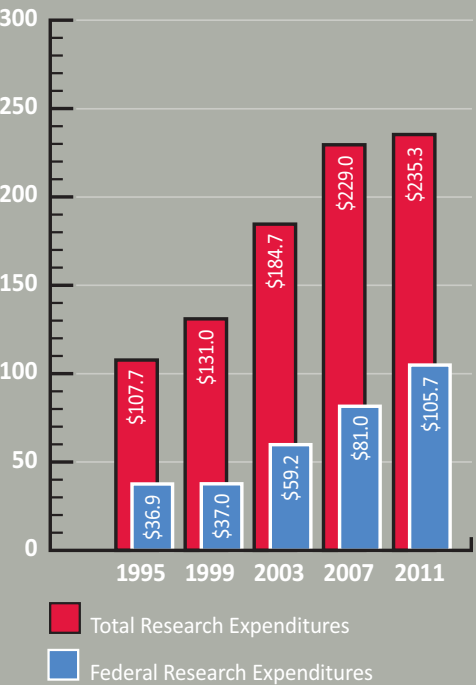
Research Expenditures

UNL’s research expenditures totaled more than \$235 million in 2011, the most recent fiscal year for which expenditure information is available. This total included nearly \$106 million in federal research expenditures. The National Science Foundation accounted for 26 percent of UNL’s federal research expenditures, followed by 25 percent from the U.S. Department of Health and Human Services, including the National Institutes of Health, and 12 percent from the Department of Defense. UNL’s goal is to achieve \$300 million in total research expenditures by 2017, with at least half coming from federal agencies.

FY 2011 Percentage of UNL Research Expenditures by Federal Agency



Total Research Expenditures (in millions)



Credits

The 2011-2012 UNL Research Report is published by the University of Nebraska–Lincoln Office of Research and Economic Development. More information is available at <http://research.unl.edu> or contact:

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