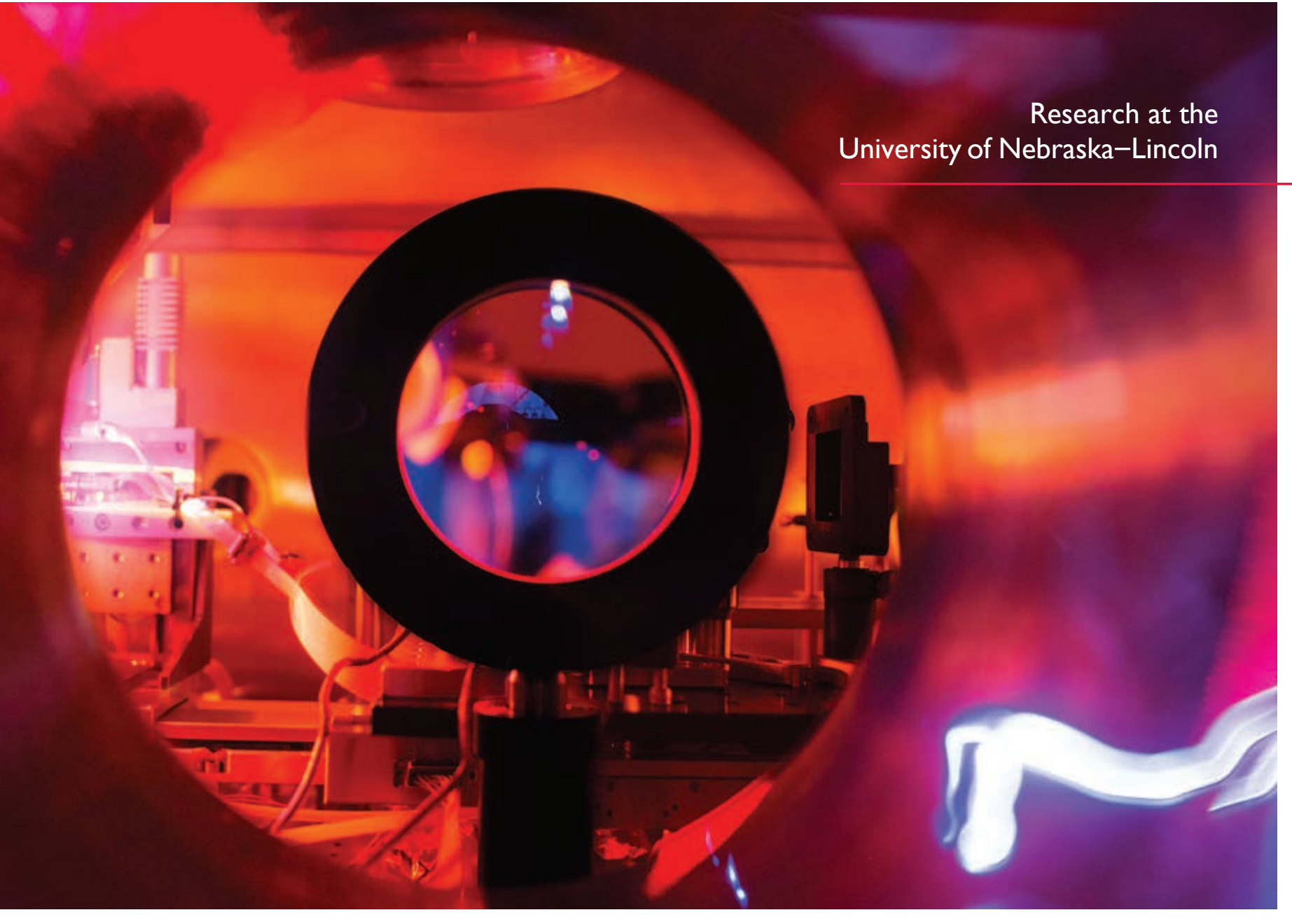
2014

Research at the University of Nebraska-Lincoln: 2013-2014 Report



Research at the University of Nebraska–Lincoln

University of Nebraska Lincoln | OFFICE OF RESEARCH & ECONOMIC DEVELOPMENT

2013-2014 REPORT

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On the Cover
A major breakthrough, a new specialized laser and expanded research space are advancing the University of Nebraska–Lincoln's laser science capabilities, a longtime research strength. Using UNL's powerful, compact Diocles laser, Extreme Light Laboratory scientists discovered a way to vastly shrink the space needed to produce synchrotron X-rays, expanding the potential uses for these high-quality X-rays. UNL laser research got a boost in 2014 with the opening of a collaborative laser lab housing Archimedes, a new specialty laser. The cover photo shows the Diocles laser's target chamber. The brilliant, colorful burst of light results from laser light interacting with nitrogen gas, which produces an electron beam. Read more on pages 2-4.

On the Web
Explore the 2013-2014 UNL Research Report website for more photos, links and videos related to stories in this report:

research.unl.edu/annualreport/2014

Gaining Momentum

Big things are happening at our Big Ten university.

At UNL we continue to grow our research enterprise, investing in big ideas, new faculty and new facilities, and our researchers have been focused on pursuing new opportunities. These investments of time, energy, creativity and dollars are paying off. This report highlights some of our successes.

UNL's high energy physics team is leading a project to upgrade a vital component of the Large Hadron Collider, the world's largest and most powerful particle accelerator. This instrument has helped answer fundamental questions about the nature of the universe, including finding the Higgs boson.

Our Extreme Light Laboratory made a major technological breakthrough, generating synchrotron X-rays using UNL's powerful and compact Diocles laser, and the lab has a new specialized laser and multi-user facility that will expand the experimental possibilities.

One of our biggest investments, Nebraska Innovation Campus, is a rapidly growing innovation hub that is attracting private sector partners who want to share research, students and facilities. NIC's first tenants have moved into the new Innovation Commons, and additional facilities under construction will enable our private sector scientist partners to work side by side with faculty and students.

UNL's newly funded Nebraska Center for the Prevention of Obesity Diseases through Dietary Molecules brings together experts in nutrition, genetics, biochemistry, food science, immunology and computer science to tackle one of society's biggest challenges. This National Institutes of Health-funded center exemplifies the innovative work growing from our decade-long focus on building interdisciplinary research.

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

Our 2014 faculty retreat focused on our current collaborations among the physical, biological, social, behavioral and computational sciences. We discussed strategies that have enabled these collaborations – transdisciplinary cluster hires, creating shared facilities and developing new centers around major challenges – and announced the Big Ideas Grants Program to support innovative research teams.

At UNL our momentum is growing and we want to engage with others who are pursuing big ideas.

I invite you to read this report and envision the power of partnerships forged from many disciplines and sectors. Together we can find solutions to the complex challenges facing our global community.

Prem

Prem S. Paul
Vice Chancellor for Research
and Economic Development

Shrinking Synchrotron X-rays Expands Potential

Combining breakthrough technology with the precision of scientific sharpshooters, UNL researchers are shrinking the massive space needed for synchrotron X-rays to the size of a tabletop. This promises to expand potential uses of these high-quality X-rays.

The team developed a unique way to generate synchrotron X-rays using UNL's powerful and compact Diocles laser.

"The X-ray source we developed is the first and only of its kind in the world and establishes an entirely new class of technology," said Donald Umstadter, Leland J. and Dorothy H. Olson Chair of Atomic, Molecular and Optical Physics and director of UNL's Extreme Light Laboratory. The team reported results in *Nature Photonics,* the top-ranked optics journal.

To produce the X-rays, researchers focused their laser beam onto a gas jet, creating a beam of relativistic electrons, then focused another laser beam onto the accelerated electron beam. This collision rapidly vibrated the electrons, making them emit a bright burst of synchrotron X-rays – a process called Compton scattering. The light's photon energy increased by a million-fold, yet the combined length of the accelerator and synchrotron was under an inch.

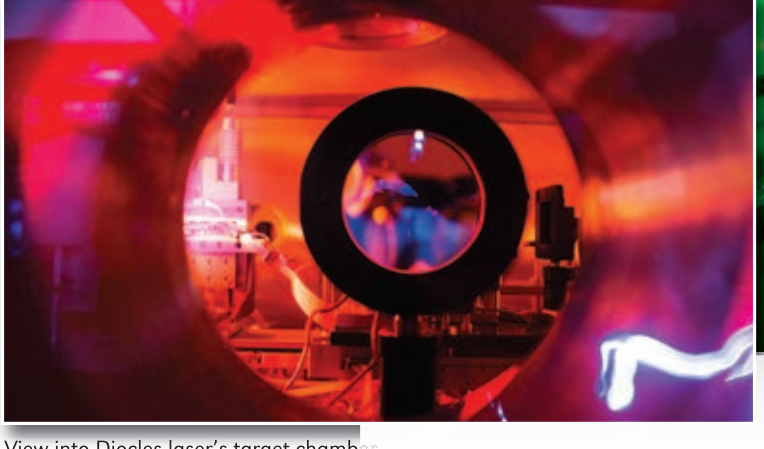
Colliding the micro-thin laser beams was key.

"Our aim and timing needed to be as good as that of two sharpshooters attempting to collide their bullets in midair, but our bullets travel at nearly the speed of light," Umstadter said.

Synchrotron X-rays, prized for clarity and lower doses of radiation, require huge, expensive devices larger than a football stadium. Diocles is a tabletop laser, small enough to fit in a large truck, yet delivering up to 1 petawatt of power. It's among the world's most powerful compact lasers.

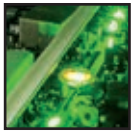
The breakthrough can expand the X-rays' availability and use to ultrafast science in the lab, medical imaging in hospitals and defense and security applications in the field.

The Department of Energy, Air Force Office of Scientific Research, Department of Homeland Security, Defense Advanced Research Projects Agency and the University of Nebraska's National Strategic Research Institute, a Department of Defense-sponsored University Affiliated Research Center, helped fund this research.



View into Diocles laser's target chamber

Laser specialist Jared Mills operates the Diocles laser in UNL's Extreme Light Laboratory



New Laser Lab Broadens Capabilities

A new specialized laser and a facility designed for multiple research teams are amplifying UNL's laser science capabilities.

The Archimedes laser, funded by the Air Force Office of Scientific Research, was powered up in March 2014. Archimedes complements the capabilities of UNL's Diocles laser, operating at higher repetition rates, which expands its range of experiments and applications.

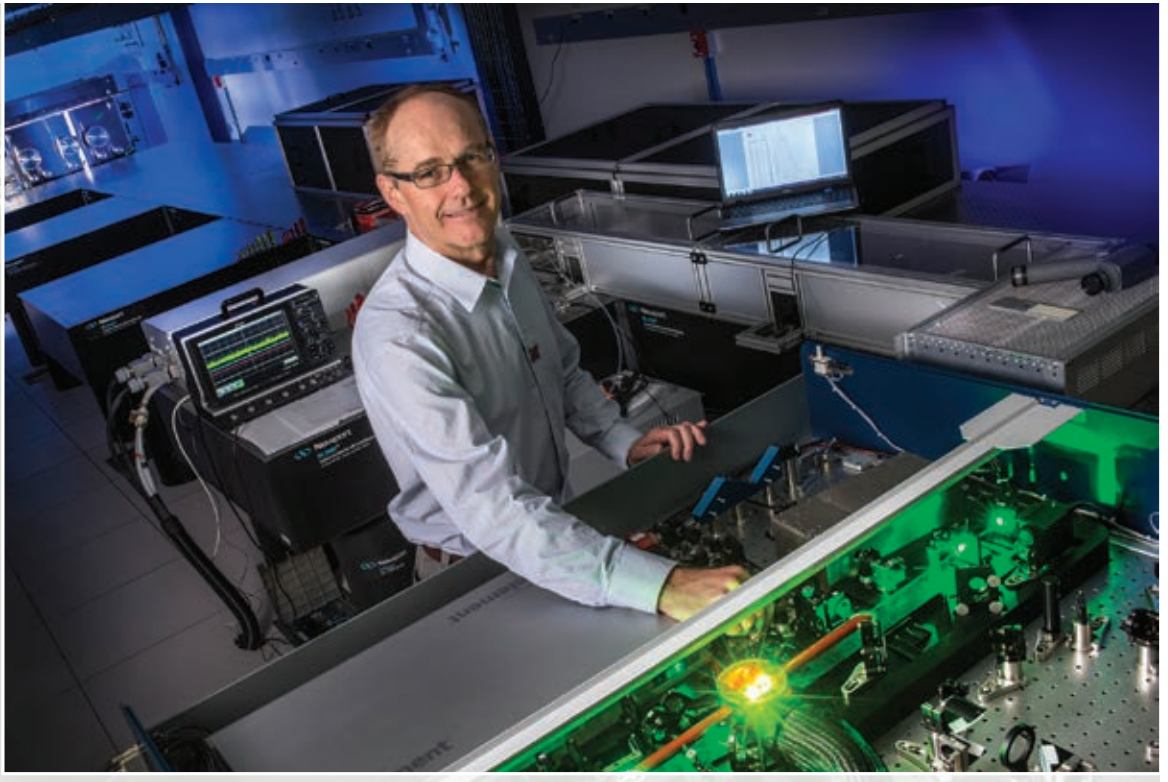
Housed in a renovated Extreme Light Core Facility, Archimedes will drive multidisciplinary collaborations. Its laser "beamline" can be delivered through vacuum pipes to three separate user stations, so several research teams can prepare experiments simultaneously. The National Science Foundation funded construction of the facility through the American Recovery and Reinvestment Act.

"This new facility will allow UNL scientists and colleagues at other universities to expand the range of research in an emerging field," said physicist Donald Umstadter, director of UNL's Extreme Light Laboratory.

The need for multi-user laser facilities like the core facility was one of the topics at the Future Directions in Extreme Light workshop hosted by UNL in May 2014.

More than 40 top laser scientists from universities and federal laboratories and key program managers from government agencies shared the latest research, information on high-peak-power laser sources and ideas about future research efforts.

Developing a long-term collaborative strategy for extreme light science was a workshop goal, Umstadter said. "The core facility helps put UNL and the U.S. in an excellent position to compete with top institutions internationally in all aspects of high power laser research."



Donald Umstadter with the Archimedes laser

Monitoring the Planet's Air

Accurately measuring and understanding air pollution requires a planetary vantage point. UNL atmospheric scientist Jun Wang uses satellite data to study the impact of aerosol particles on air quality and climate.

"Humans make lots of particles – from power plants, transportation, construction – that affect the climate," Wang said. "Once it's in the atmosphere, there are no boundaries. They just float across the globe. To look into this, ground level data are not sufficient."

Wang uses data provided by NASA satellites that monitor the planet's air. To make sense of the large amounts of information, he's developing algorithms to understand aerosol properties, including what the particles consist of, where they're from and how they disperse.

With several active NASA grants totaling nearly $1.4 million, Wang's team is investigating a number of applications, such as how to better detect wildfires from particles in the air. He's also analyzing how much and where pollution generated in Asia ends up in the U.S. That information, and a better understanding of atmospheric pollution throughout North America, will help U.S. policymakers improve emission standards and air quality regulations.

Wang's team also studies climate effects of man-made pollutants from sources such as industrial emissions, fossil fuels and large-scale land burning for agriculture in Africa and Southeast Asia. Initial findings suggest that smoke particles from fires reduce clouds and precipitation, increasing the severity of droughts.

They're also investigating irrigation's impact on climate and agriculture. During a severe central Plains drought in 2012, their analysis showed surface temperatures in irrigated areas were about 12 degrees Fahrenheit lower than in non-irrigated areas, which affected evaporation and clouds.

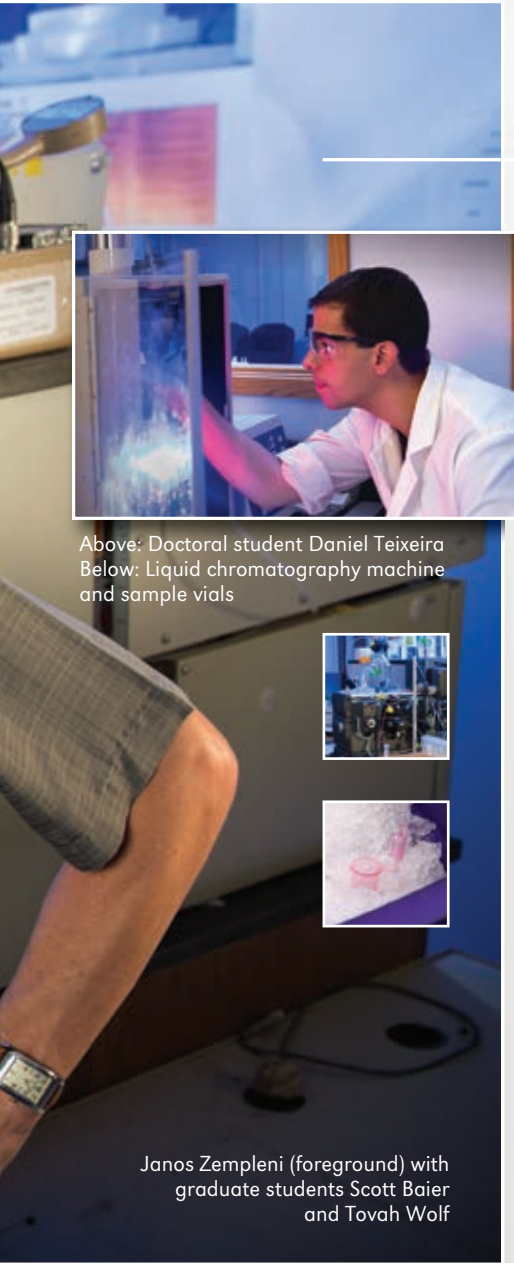
Wang hopes his research leads to better air pollution predictions, much like weather predictions today. He's using NASA's atmospheric data to create and improve on computer models.

"It's a very exciting area where you can do things globally and have good benefits for everybody."

Above: Jun Wang


"Through this center, we'll develop science-based strategies
using dietary compounds to improve human health."

New Research Center Targets Obesity at Molecular Level



Above: Doctoral student Daniel Teixeira
Below: Liquid chromatography machine and sample vials

Janos Zempleni (foreground) with graduate students Scott Baier and Tovah Wolf

Understanding obesity at the molecular level is a crucial first step toward curbing this national epidemic. That's the ultimate goal for scientists in UNL's newest research center.

Leveraging strengths in nutrition and health research, UNL established the Nebraska Center for the Prevention of Obesity Diseases through Dietary Molecules, or NPOD, in 2014. An $11.3 million, five-year grant funds this National Institutes of Health Center of Biomedical Research Excellence.

The long-term aim is for the center to become a leader in nutrient signaling and prevention of obesity and obesity-related diseases, including non-alcoholic fatty liver disease, cardiovascular disease and Type 2 diabetes, said center director Janos Zempleni, Willa Cather Professor of Molecular Nutrition.

"This combined focus makes NPOD unique in the U.S. and globally," he said. "Through this center, we'll develop science-based strategies using dietary compounds to improve human health."

Nutrient signaling research explores how nutrients initiate biochemical chain reactions that cause a cellular response, including fat storage and disease-causing inflammation. Many nutrient-dependent signaling pathways await discovery and are promising targets for consumer-friendly, cost-effective methods to prevent and treat obesity-related diseases, Zempleni said.

For example, researchers are studying how certain dietary fatty acids activate molecular pathways that turn fat-storing white cells into beige fat cells, which burn calories. Others are investigating how good fatty acids prevent non-alcoholic fatty liver disease and how diet contributes to gut microbial flora, which, in turn, inhibit inflammation.

The University of Nebraska Medical Center collaborates on the center, which aims to establish a community of nationally recognized researchers in nutrition, genetics, biochemistry, food science, immunology and computer science. To build research expertise, experienced faculty will mentor early career scientists. The center also is developing a research core facility in molecular biology, bioinformatics and biostatistics.

"Obesity is a national health crisis that costs the U.S. hundreds of billions of dollars annually in health care expenses and lost productivity," Zempleni said. "Our research will help address these issues."

UNL Home to New Research Data Center

In social or economic research, aggregate data provides a valuable broad view. But individual-level information is essential for exploring issues in greater detail. This sensitive individual information is restricted, available only to researchers with access to a secure research data center.

Researchers at UNL and partner universities now have easier access to this rich cache of restricted census and other federal information. In 2014, UNL became home to the new Central Plains Research Data Center, the region's only center of its kind and one of 19 across the U.S. A $300,000 National Science Foundation grant funds the center's establishment.

"We're joining an elite group of universities. From a research point of view, these centers are veritable gold mines," said John Anderson, Baird Family Professor of Economics and the center's executive director.

UNL is the data center's primary location, with a planned branch at Iowa State University. The regional consortium supporting the center also includes the University of Nebraska Medical Center, University of Iowa and University of South Dakota. Research Data Centers are partnerships with the U.S. Census Bureau's Center for Economic Studies that provide researchers access to restricted federal data from the Census Bureau and other federal sources, such as the National Center for Health Statistics, in a highly secure setting.

The new center is a cornerstone for UNL's new Social and Behavioral Sciences Research Initiative. Accessing individual-level data enables sophisticated analysis of social, economic and other issues to better address challenges facing the region and the nation. Psychologist Robert Belli, director of UNL's Survey Research and Methodology Program and Gallup Research Center, is the grant's lead investigator.

UNL faculty have identified a diverse range of potential projects using the center's data. For example, Anderson plans to tap confidential data to study income inequality, particularly how individuals move up and down the income distribution over time. Other potential projects include merging center and USDA data to study food distribution problems; integrating data from UNL's National Drought Mitigation Center to explore regional drought experiences; and researching minority health disparities to analyze disease incidence and treatment program effectiveness.

Above: John Anderson

Understanding Postpartum Depression

About 20 percent of U.S. women experience symptoms of depression after childbirth, yet little is known about what causes postpartum depression and other maternal behavior disorders.

UNL psychologist Ming Li studies the behavioral and biological mechanisms underlying maternal behavior. His aim is to better understand the psychological, environmental and biological factors involved in postpartum mental disorders. Findings could lead to better therapies for new moms struggling with depression and other behavioral problems.

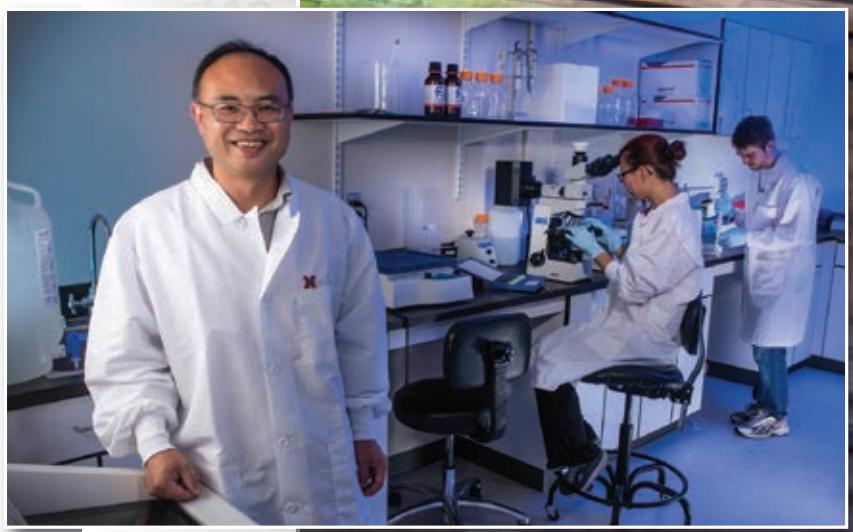
Studies show serotonin plays a role. It's a neurotransmitter, a chemical that transmits nerve impulses across a synapse to a receptor in a nerve, muscle or other structure. It's widely known to regulate mood and is a common target of antidepressant drugs.

With early grant support from the National Institutes of Health, Li's research focused on two types of serotonin receptors, 2A and 2C. His and others' research demonstrated that using drugs to increase or decrease serotonin activity at these two receptors disrupts maternal behavior in rats, a model for human maternal care. Mother rats whose serotonin neurotransmission is too high or too low spend less time tending and building nests for their young.

Now, with a nearly $1.5 million grant from NIH's National Institute of Mental Health, Li's team is investigating reasons for the behavior change. Possibilities include decreased motivation, increased anxiety, motor impairment or disorganized behavior. They also are studying how the drugs function biologically, such as where and how they act in the brain to change serotonin activity.

"On the one hand, our work can help us understand the causes of postpartum mental disorders, its physiology, such as depression, anxiety, psychosis or even memory impairment," Li said. "But another side is that we are studying drugs, and hopefully we will be able to provide some information for new drug therapies."

Li's research also may help scientists understand the psychology behind other serotonin-related mental disorders and how current psychotherapeutic drugs affect brain neuroreceptors.



Ming Li with graduate student Cindy Chou and lab technician Collin Davis

From left: Victoria Molfese, Ruth Heaton and Carolyn Pope Edwards

Fostering Early Math Learning

Playing with blocks may, like learning to count, help prepare preschoolers to succeed at math.

Giving early childhood educators tools to foster math learning in 3- and 4-year-olds' everyday activities is the aim of Math Early On. During the two-year pilot project, UNL researchers are devising and assessing professional development activities for preschool teachers at three Educare schools in Lincoln and Omaha, Neb. More than 700 Nebraska children attend Educare schools, which serve at-risk children from birth to age 5 and their families.

"We want to help teachers better understand the big math concepts that young children should be learning and how these ideas might play out in multiple settings, whether it's in the classroom or during outdoor play," said Ruth Heaton, project leader and Gilmartin Professor of Math Education.

Research shows rote counting and memorization don't help preschoolers develop the higher-level mathematical reasoning skills needed for later academic success. Young children should be learning to recognize patterns and shapes, understand quantity and develop number sense, Heaton said.

Lessons that feel like play – stacking building blocks, exploring shapes, using measuring cups, playing with recycled materials or exploring nature – can instill these concepts.

With a $528,071 grant from the Buffett Early Childhood Fund, Math Early On builds on what UNL researchers learned from their successful Primarily Math program for K-3 teachers.

Incorporating proven research is central to Educare's mission, said Carolyn Pope Edwards, Willa Cather Professor of Psychology and Child, Youth and Family Studies. Supported by the Buffett Fund, Educare aims to narrow the achievement gap through full-day, year-round educational programs. The University of Nebraska's Buffett Early Childhood Institute is an Educare Lincoln research partner.

Victoria Molfese, Chancellor's Professor of Child, Youth and Family Studies, said one goal is helping educators become more confident in recognizing math learning opportunities in their classrooms.

Researchers will assess teachers' and students' beliefs about their math abilities. The team hopes the project becomes a model for the nation's 21 Educare schools, including Educare Winnebago (Neb.), which opened in 2014 as the first to serve an American Indian reservation.

"We want to help teachers better understand the big math concepts that young children should be learning and how these ideas might play out in multiple settings."

Kristin Duppong Hurley

Evaluating Parental Support for Special Needs Kids

Kids with emotional and behavioral disorders are more likely to miss school, fail classes and drop out than students with other disabilities.

UNL researchers are evaluating a new program that uses parent-to-parent support to get families the help they need to keep kids in school.

With a $3.2 million grant from the U.S. Department of Education's Institute of Education Sciences, the team is assessing the Parent Connectors intervention to determine its effectiveness and viability on a broader scale. University of South Florida researchers developed this program.

The program connects participants with other parents who have guided their own special-needs children through the middle school years. The support parents are trained and, for one year, provide support though weekly phone calls to encourage participants to engage in their children's education and to access services.

UNL's evaluation team, led by Kristin Duppong Hurley, research associate professor of special education and communication disorders, randomly assigned participants from the Lincoln, Neb., area to either take part in Parent Connectors or receive services as usual. This year, they expanded the study to include several Omaha area suburban school districts.

By comparing the two groups, the researchers will determine the program's effect on parental engagement and benefits to children, including whether they miss less school or receive fewer suspensions. Better attendance and behavior at school should translate into academic improvement later.

Although results aren't in yet, the program has been well received by families and schools, Duppong Hurley said, adding that it has the potential to be implemented nationally. "Some programs are really expensive and require extensive training. This program is relatively easy to disseminate and to implement in the school districts."

Duppong Hurley collaborates with colleagues Michael Epstein, William E. Barkley Professor of Special Education and Communication Disorders, and Alex Trout, research associate professor of special education and communication disorders, in UNL's Center for Child and Family Well Being.

Illuminating Livingstone's Legend

Adrian Wisnicki was once a traditional literary scholar, digging into Victorian-era books and manuscripts. Then he came upon an unreadable 1871 field diary by British explorer David Livingstone and soon entered the modern world of digital humanities.

Five years later, the assistant professor of English is a spectral imaging specialist at UNL's Center for Digital Research in the Humanities. He's as likely to be solving 21st-century digital problems as he is contemplating Livingstone's 19th-century existence.

To read the 1871 diary, which ultimately exposed details of an African massacre that changed history, Wisnicki began collaborating with scientists who use spectral imaging to reveal hidden text. His quest eventually led to a consulting gig on a PBS "Secrets of the Dead" episode in 2014 about Livingstone that featured Wisnicki's analysis of the diary.

He collaborates with spectral imagists across the U.S. to investigate additional Livingstone documents. Spectral imaging uses wavelengths of light to illuminate things on the page invisible to the naked eye. In addition to text, it allows Wisnicki to study the manuscripts' histories, such as what the wrinkles and materials reveal about their creation and preservation.

"I look at what scientists do, and I think about how it can be pushed in different ways," Wisnicki said. "There's a point of collaboration where we have to understand one another, and that's where the creativity happens. It's really forensic literary studies."

He also leads Livingstone Online, livingstoneonline.org, a large multi-institutional project to update the digital home for Livingstone's manuscripts. Wisnicki and colleagues are collaborating with more than 30 archives worldwide, developing a sustainable digital platform, and conducting scholarship and outreach activities.

"From a scholar's point of view, my interest is Livingstone and African history. But from a digital humanist point of view, my interest is building these projects that are very collaborative and sustainable in the long term."

More than $430,000 in grants from the National Endowment for the Humanities fund Wisnicki's Livingstone work.

Spectral imaging reveals unreadable or invisible writing

Adrian Wisnicki

Innovative Approach to HIV Vaccine Promising

A vaccine against HIV has long eluded researchers, but a team of UNL chemists and virologists has devised a unique approach to overcome the deadly virus's tenacity.

"It's very hard to get an effective and also safe HIV vaccine, largely because once the virus is inside a human host, it may cause disease before the immune system can generate antibodies," said chemist Jiantao Guo, one of three scientists leading this research.

Guo's collaborators are synthetic biologist Wei Niu and virologist Qingsheng Li, a member of UNL's Nebraska Center for Virology.

Vaccines normally use an attenuated, or weakened, version of a pathogen that encourages the body's immune system to make antibodies in defense, which are then available when the pathogen attacks in the future.

But even weakened HIV evolves too quickly, overwhelming the immune system, so traditional vaccine approaches are ineffective.

To outwit HIV, the team alters a weakened virus's genetic code to prevent it from replicating without access to a specific chemical compound. The vaccine provides the compound, which sticks around long enough to enable the virus to replicate. The body reacts to the virus by forming antibodies. Once the compound is gone, the virus can no longer replicate, but the body now has the antibodies to defend against future HIV exposure.

The team has proven the vaccine works in laboratory cell cultures. Now, with a $1.9 million grant from the National Institutes of Health's National Institute of Allergy and Infectious Diseases, the researchers will continue developing the vaccine and testing it in mice.

"A chemist designing a new compound that can be used to trick the virus is great and quite novel," said

From left: Qingsheng Li, Wei Niu and Jiantao Guo

Charles Wood, director of the Nebraska Center for Virology. "We're encouraging more nontraditional HIV researchers into the field, so this type of cross-disciplinary collaboration is a great combination."

If effective, this technique should work on other pathogens that also resist traditional methods of creating vaccines, such as herpes simplex virus, Guo said.

Addition Boosts Virology Research Capacity

A new laboratory wing of the Ken Morrison Life Sciences Research Center expands research space and capabilities for the Nebraska Center for Virology.

The addition, completed in 2014, features seven research labs, support facilities, seminar rooms and offices. It adds 30,000 square feet to the 67,000-square-foot Morrison Center, home to most UNL virologists affiliated with the virology center, one of the university's signature research programs. An $8 million grant from the National Institutes of Health's National Center for Research Resources funded the expansion through the American Recovery and Reinvestment Act.

Charles Wood, Lewis Lehr/3M University Professor and center director, said the addition provides a central facility with state-of-the-art equipment available to center faculty and other on- and off-campus researchers for analyzing many kinds of cells and tissues. It also will enable the center to add up to six new faculty.

"The addition will allow the center to have one of the largest clusters of virologists conducting interdisciplinary study under one roof in the country," Wood said.

It also expands UNL's capability to develop translational research programs through industry partnerships, Wood said. Programs could include vaccines and anti-viral drugs.

The virology center, an NIH Center of Biomedical Research Excellence, links scientists at UNL, the University of Nebraska Medical Center and Creighton University who study viral threats to people, animals and plants.

Fabricating Graphene Nanoribbons

The nanomaterial graphene outshines silicon in many respects, promising significant advances in next-generation composites and products. But graphene, a one-atom thick sheet of carbon, conducts electrons so well, it's hard to control for use in electronics.

A team led by UNL chemist Alexander Sinitskii has developed a method to create a narrow band of graphene, or nanoribbon, that can effectively channel electrons and allow devices to control their flow.

Researchers have been trying to create nanoribbons of just a few atoms width by carving them out of larger graphene sheets. But producing precise nanoribbons with the clean edges required for effective conductivity has proved elusive.

Instead, Sinitskii and his team build the ribbons from the bottom up, using organic chemistry techniques to couple smaller molecules together. The process also allows scientists to fabricate nanoribbons in large quantities.

"We demonstrated that those ribbons have very high quality," said Sinitskii, a member of both UNL's Nebraska Center for Materials and Nanoscience and the university's National Science Foundation-funded Materials Research Science and Engineering Center. "We also demonstrated that they're semiconductors, as we expected."

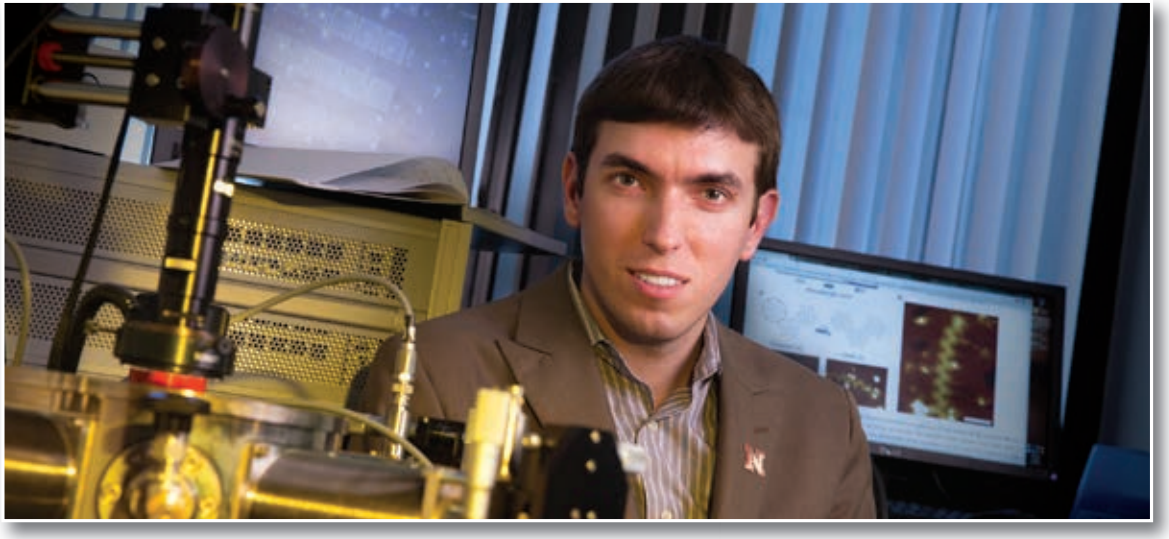
In addition to being more efficient conductors than silicon, graphene nanoribbons bring other benefits, he added. Unlike brittle silicon, graphene is flexible. Using graphene, future electronic devices may be more durable or even foldable. Imagine a cell phone you can roll up and put in your pocket.

Nanoribbons have silicon's photovoltaic properties and could one day lead to more efficient, smaller and flexible solar cells.

Sinitskii's team continues to experiment with creating nanoribbons of different widths and edge structures to explore changes – and possibly improvements – to the ribbons' properties. They also are developing prototypes of devices using graphene nanoribbons, in particular flexible transistors to use in electronics.

"Maybe we can make something that is even better than what we have right now," Sinitskii said.

In 2014, Sinitskii won UNL's Harold and Esther Edgerton Junior Faculty Award, which recognizes an outstanding junior faculty member who demonstrates creative research, extraordinary teaching abilities and academic promise.



Alexander Sinitskii

Digging Out: Managing Disaster Debris

Terri Norton in Japan following the 2011 Tohoku earthquake and tsunami, and in her lab at the Peter Kiewit Institute

Mountains of rubble are devastating trademarks of tornadoes, earthquakes, hurricanes and other natural disasters. They hinder recovery and stand as emotional reminders of loss.

Research on how best to deal with the debris is limited, but UNL engineer Terri Norton is working to fill the void. Her studies of disaster debris management and recycling are giving communities information to better plan for and rebuild after disasters.

"Disasters are affecting communities all across the globe," said Norton, an associate professor in the Charles W. Durham School of Architectural Engineering and Construction at the Peter Kiewit Institute in Omaha. "We need to understand ways in which we can help communities recover."

She's working with the U.S. Geological Survey as part of a team investigating what would happen if a large tsunami struck California's coastline.

Norton is developing models to determine how much and what types of debris would be generated and how best to manage it. She's primarily investigating anticipated debris in southern California residential areas and at the Long Beach and Los Angeles ports. She'll use the results to analyze existing emergency plans to determine if their debris management strategies are appropriate.

Not all debris requires disposal. Norton also is researching recycling debris for potential use in reconstruction. In one project she is examining the structural characteristics of concrete from damaged buildings and whether it can be used in concrete mixes to build temporary shelters. She's also studying rubber from tires as another potentially recyclable material.

In her travels to disaster sites, including the 2011 Japan earthquake and tsunami, Norton said she's come to appreciate her research's social aspects. Rubble may have personal value or cultural or religious significance, which also must factor in to debris management.

"For civil engineers, our key goal is human safety," Norton said. "So understanding how a disaster affects our community and improving how our community recovers and becomes more resilient after these types of events is what's important to me."

Tapping Breakthrough to Help African Farmers

Sally Mackenzie

Manipulating how plants express their genes promises higher crop yields and better performance under drought or other environmental stress. UNL plant scientist Sally Mackenzie is harnessing her breakthrough in epigenomics to improve crops important to developing countries.

Mackenzie discovered that using a transformation technique to turn off a specific gene found in most plants stunts the plant's growth. However, crossing this reprogrammed plant with an unmodified plant produces progeny with greatly enhanced growth, even when plants are stressed. This translates into up to 35 percent higher yields in many crops.

Importantly, those enhanced characteristics remain stable in subsequent generations without altering their genetic makeup. That's because switching off the gene in the parent changes the progeny's epigenetics – or how their own genes are expressed.

This technique requires significant resources to create an original transgenic plant, and some crop plants aren't amenable to transgenic transformation. With a nearly $3 million, three-year grant from the Bill & Melinda Gates Foundation, Mackenzie is exploring ways to tap this epigenetic potential to improve crops for low-resource African farmers.

"What we're doing is really quite novel," said Mackenzie, the Ralph and Alice Raikes Professor of Plant Sciences. "And it's in keeping with the spirit of the Gates Foundation: finding simple ways to expedite technology and getting it to developing countries."

She's testing the effectiveness of using a weakened virus to introduce the foreign gene that switches off the plant gene. She's also crossing epigenetically enhanced millet with African varieties and grafting a modified cassava rootstock to unmodified plants. These epigenetic techniques leave plant genomes unmodified, eliminating concerns about releasing transgenic plants.

Mackenzie expects to be able to provide crop material for distribution through collaborating institutions by 2016.

Her UNL team also collaborates with UCLA researchers to study changes that take place within the genome to cause the enhanced characteristics. Better understanding the underlying biological changes will help researchers improve crop breeding.

Better Drought Forecasting Tools for Africa

To combat increasingly severe droughts and widespread famines in Ethiopia and other countries in the Horn of Africa, UNL's National Drought Mitigation Center is leading an international effort to create better forecasting and risk-management tools for the region.

The interdisciplinary team will investigate the most appropriate prediction methods available for individual areas, particularly given an evolving climate, and will work with decision-makers to produce seasonal forecasts they can use. NASA funds the three-year, $1.6 million multi-institutional project. UNL's share is nearly $988,000.

"Most agriculture in the Greater Horn of Africa is rainfed, vulnerable to drought and floods," said project leader Tsegaye Tadesse, drought center climatologist. "So the information that they get is very important for their livelihoods as well as their food security."

The team will work with local citizens, disaster relief and food security representatives, extension agents and others. They'll identify tools currently being used and determine what's working and what's needed. To improve the ability to predict extreme events at the local level, they'll investigate the large-scale drivers affecting ocean, atmosphere and land circulation patterns that cause climatic extremes.

Tsegaye Tadesse

Tadesse said the project will extend beyond climate forecasting tools to include impacts on crops and communities. Economic and hydrological modeling will help decision-makers upgrade infrastructure and other approaches to better plan for droughts and floods. Anthropologists will evaluate how the tools are used and social changes resulting from the project.

Currently, food, money and other resources to deal with drought are provided only after drought is occurring.

"We want them to change from a crisis-management mode to risk management, so that they can save their economy as well as human life," Tadesse said.

The collaboration includes experts in economics, hydrology, remote sensing, climate and social sciences and involves several leading universities and U.S. agencies. UNL's team includes natural resources professors Guillermo Baigorria and Brian Wardlow, anthropologist Shimelis Beyene and drought center director Michael Hayes.

UNL Leads Supercollider Component Upgrade

After finding the final piece to substantiate the "theory of everything," what's left?

Plenty, says UNL physicist Aaron Dominguez. He leads a multi-institutional collaboration to upgrade a vital component of the world's largest supercollider that has helped answer fundamental questions about the nature of the universe, including finding the Higgs boson.

With a nearly $11.5 million National Science Foundation grant, a team of UNL physicists and collaborators at eight U.S. universities are improving the sensitivity of the Compact Muon Solenoid, one of two large particle detector experiments at the Large Hadron Collider at the CERN laboratory in Switzerland.

Capturing images of the explosion that occurs when superfast-moving protons collide requires a powerful digital camera, or pixel detector. UNL is building new modules for the pixel detector capable of taking 40 million images a second at a total resolution of more than 120 million pixels. Consumer digital cameras top out at about 12 million pixels. The images are used to create a movie of the particles' paths in less than 10-micron increments.

Aaron Dominguez

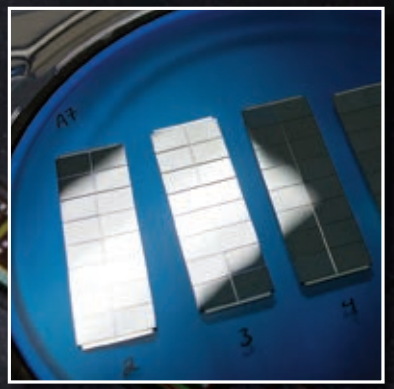
"This will be the largest, most precise pixel-tracking detector ever built," Dominguez said. "It should allow us greater sensitivity to see the Higgs boson and to see and discover new forms of matter."

The Higgs boson, whose discovery was announced in 2012, was the last missing piece predicted by the Standard Model, a theoretical framework that explains the fundamental structure of matter in the universe. Though often called the "theory of everything," the model is far from complete, leaving out phenomena such as gravity, dark matter and dark energy, Dominguez said.

UNL's Holland Computing Center also is one of seven U.S. CMS Tier-2 sites in the Worldwide Large Hadron Collider Computing Grid that process and store data from this massive research project. In addition to Dominguez, UNL's high-energy physics team includes physicists Ken Bloom, Dan Claes, Ilya Kravchenko, Greg Snow and Holland Computing Center director David Swanson.

Students Seth Kurfman and Jose Andres Monroy assemble detector modules with physicist Greg Snow (right).

Completed pixel-detector module, one of 500 UNL scientists will build



Silicon sensors with readout chips attached

Postdoc Frank Meier Aeschbacher

"It should allow us greater sensitivity to see the Higgs boson and to see and discover new forms of matter."

Background: Readout chips that are bonded to silicon sensors for the pixel-tracking detector

Boosting Grain Bin Safety with Robot

Grain bins can be death traps, and the auger that pulls grain from the bin's edge to the center is a key danger spot.

Sweep augers circle the bottoms of bins and are prone to clog with grain. That means someone has to enter the bin to make adjustments. Despite federal safety regulations about turning off equipment, violations are common and put workers at risk for serious injury or death.

Jeff Hawks

UNL engineers and a local manufacturing partner aim to boost safety for commercial grain bin operators and farmers. Jeff Hawks, UNL research assistant professor in mechanical and materials engineering, and Garner Industries Inc. of Lincoln, Neb., are developing a prototype for a sophisticated remote-control robot that allows workers to adjust sweep augers without entering bins.

For the robot's design, Hawks and UNL robotics expert Shane Farritor tap their personal backgrounds in agriculture, plus feedback from Garner, which manufactures the BinMaster® line of grain level controls.

Because farm workers have a strong "fix-it-myself" mentality, Hawks said it's essential to create a practical, robust product they're excited to use.

Aided by cameras and lights, workers will be able to stand outside the bin and direct the robot to lift the sweep auger, keeping grain flowing continuously.

"It has to be intuitive enough for the 60-year-old farmer and the 20-year-old grain operator who grew up playing Xbox," Hawks said.

UNL researchers are using advanced sensor technology to get reliable environmental feedback for optimizing the robot's operations. For example, sensors must be adaptable to dark, dusty conditions.

Size is another consideration. The robot must fit in a pickup bed and be light enough for two workers to lift.

UNL Industry Relations connected Hawks with Garner to fabricate the prototype. Garner introduced Hawks and Farritor to grain elevator operators, human resources representatives and farmers who offered important information about users' needs.

A prototype is expected to be ready for user testing by fall 2015. Through NUtech Ventures, UNL and Garner are pursuing commercialization potential.

"If people keep wanting to use it after two or three trials, we'll know we have a winner," Hawks said.

Top: Undergraduate engineering students Lukas Renker (left) and Colton Bailey

Agreement Aims to Improve Soybeans

George Graef

An agreement between UNL and industry leader Bayer CropScience aims to develop new soybean traits and boost yields to meet growing global food demands.

NUtech Ventures, UNL's commercialization arm, and Bayer announced a nonexclusive licensing agreement in August 2013, giving Bayer access to UNL's soybean germplasm, the genetic material used to develop new varieties. The agreement provides support for UNL research and education programs and an endowed professorship provided by the Nebraska Soybean Board.

The Nebraska Soybean Board, which has long funded UNL's soybean research, received a share of proceeds from the agreement. The board invested $3 million to create the Presidential Chair in Soybean Breeding at UNL. UNL soybean breeder George Graef, an expert in developing soybean germplasm and cultivars, is the first to hold this endowed chair.

"It is with support from the soybean growers through the Nebraska Soybean Board that we have been able to develop the high-quality soybean breeding program that we have today," Graef said.

UNL has a long record of releasing high-yielding varieties, said Chris Tinius, Bayer's global soybean breeding director. "By showcasing our traits in these super varieties, we hope to bring even greater value to soybean farmers across the Midwest."

Economic benefits for Nebraska could be substantial. In 2013, Nebraska produced more than 252 million bushels of soybeans worth over $3 billion, according to USDA's National Agricultural Statistics Service.

Nebraska Innovation Campus Welcomes First Tenants

Nebraska Innovation Campus is coming alive.

The NIC Conference Center opened in June 2014 in the Innovation Commons complex, the first two buildings completed on the new private-public research campus adjacent to UNL. NIC's initial tenants began moving in several months later. More people will move to NIC during 2015 as Phase I construction wraps up and two more major buildings open.

"It's great to see people going to work in the new Innovation Commons complex and using the conference space," said UNL Chancellor Harvey Perlman. "It's a big step toward our goal of creating an innovation hub where companies, entrepreneurs and UNL faculty and students work in a collaborative environment that helps fuel Nebraska's economy."

By April 2015, the 45,000-square-foot Greenhouse Innovation Center will open. Along with greenhouse and research support space, this center will house one of the world's few publicly available LemnaTec High Throughput Phenotyping Systems. The sophisticated digital imaging system enables researchers to comprehensively assess complex plant traits. It's generating much interest from companies, said Dan Duncan, NIC's executive director.

"One of our strategies is to either locate unique facilities at NIC or provide streamlined access to facilities on campus for partner companies," he explained.

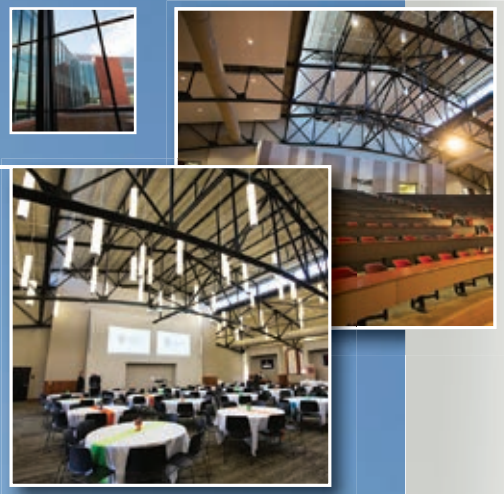
Next July, ConAgra Foods, NIC's inaugural corporate partner, along with UNL's Department of Food Science and Technology, will move into the Food Innovation Center. This center features 170,000 square feet of labs, classrooms, offices, pilot plants and prototyping spaces. UNL students will attend their first classes at NIC in fall 2015.

Construction continues. Next up are a highly secure certified Tier 3 data center, and an 80,000-square-foot mixed-use lab and office building with a skywalk to the Greenhouse Innovation Center.

When fully developed over the next 23 years, NIC will offer 2 million square feet of space and accommodate 7,000 people working on campus.

Talks continue with companies interested in locating at NIC, Duncan said. "Private sector interest remains strong."

Innovation Commons



Above left: Innovation Commons entrance
Above: NIC Conference Center

Roth Leads NUtech Ventures

Finding flexible, creative ways to move faculty innovations into the marketplace drives decisions for NUtech Ventures, the nonprofit corporation responsible for commercializing UNL's intellectual property.

Brad Roth

Building partnerships is central to this strategy. Licensing UNL discoveries to start-up or established companies helps meet partner businesses' product development needs and makes UNL research results publicly available, said Brad Roth, who became NUtech's executive director in late 2013.

From previous roles in business development and technology management at LI-COR Inc. and Pioneer Hi-Bred International, Roth brings a fresh perspective to NUtech. He said his experiences on "the other side" of business and licensing agreements showed him that being responsive and understanding companies' needs are key to working with industry in today's fast-paced technology markets. Roth also was a technology manager at the University of Illinois at Urbana-Champaign. He holds a doctorate in genetics from Iowa State University and a bachelor's degree in biology from UNL.

NUtech is working to commercialize technologies in agriculture, physical and life sciences and engineering. Roth is optimistic about potential opportunities in other disciplines, including education and human sciences, fine arts and social sciences.

"We're very sensitive to not having preconceived ideas about where technology with societal and economic benefits could come from on campus," Roth said.

NUtech, along with Industry Relations and Nebraska Innovation Campus, aims to make partnering with UNL a seamless process, whether it's licensing technology, connecting with researchers and students or locating at NIC.

"Our groups work closely to make it as easy as possible for potential partners to find the appropriate UNL contact," said Roth, who also is UNL associate vice chancellor for technology development.

Staff from NUtech, NIC and Industry Relations moved from separate locations to NIC's Innovation Commons in 2014.

Water-slurping Drones Have Broad Potential

Unmanned aerial vehicles, or drones, promise to help humans perform hundreds of jobs better, but most are limited to obtaining aerial views. UNL computer scientists Carrick Detweiler and Sebastian Elbaum are developing UAVs that interact with the environment, greatly expanding their potential uses.

Sending UAVs to collect water samples from lakes, streams and ponds is one potential application with far-reaching possibilities. Detweiler and Elbaum are leading a national research project to develop UAVs with water-sampling capabilities. It's part of the National Robotics Initiative, a collaboration of multiple agencies led by the National Science Foundation. A three-year, $956,000 grant from the U.S. Department of Agriculture funds this research.

"The tools we're developing will help scientists better understand our water systems, which are quite complex," said Detweiler, who co-directs, with Elbaum, UNL's Nebraska Intelligent Mobile Unmanned Systems Lab.

Water sampling often involves hauling equipment, boats and people to sites, sometimes hundreds of miles away. Sending UAVs to fly over the water, dip a hose and pump samples into a collection reservoir saves time and money. It also improves data collection by enabling scientists to sample otherwise inaccessible areas or to improve timing, such as collecting multiple samples at once or immediately after a rainstorm.

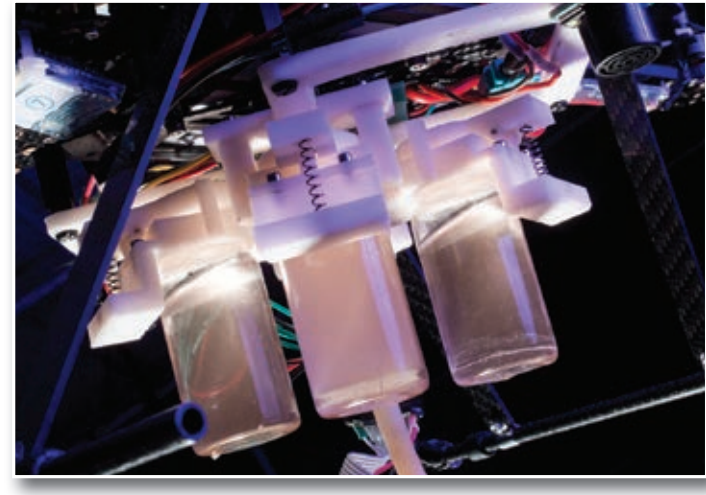
"It's hard to get people out there to collect all of this information," Elbaum said. "With the UAV, you can collect orders of magnitude more data, and quality data, very quickly."

Because the UAVs work in close proximity to people and water, the engineers are working to improve their safety, reliability and autonomy. They're collaborating with water scientists at UNL and the University of California, Berkeley, who will use the UAVs to better understand water movement.

Water-sampling drones also could help regulatory agencies better monitor water quality and quantity.

This work contributes to developing other interactive UAVs that can collect air samples, take leaf clippings, measure crop height and recharge environmental sensors, for example.

"With the UAV, you can collect orders of magnitude more data, and quality data, very quickly."



Drone's water collection reservoirs

Carrick Detweiler and Sebastian Elbaum

Water intake nozzle

Slowing Traffic Increases Protection

Preventing terrorists from entering U.S. military installations begins before they reach the gates. At bases worldwide, the military uses road design and traffic control devices to slow threatening vehicles and give security personnel time to protect the base.

UNL researchers at the Nebraska Transportation Center are helping the U.S. Department of Defense improve this defensive strategy by better understanding the delays that various devices and roadway designs provide. The project is part of the University of Nebraska's National Strategic Research Institute and its Department of Defense-sponsored University Affiliated Research Center, one of 14 such centers nationwide.

"The military wants their base access control points designed so that anyone with bad intentions can be stopped without jeopardizing the safety of military personnel or the public," said project leader Laurence Rilett, Keith W. Klaasmeyer Chair in Engineering and Nebraska Transportation Center director.

Security engineers use roadway design, obstacles and detection technology to slow traffic and increase warning time. Better understanding the effects of roadway curves, curbs, barriers and speed humps helps engineers design entry points that more effectively prevent unauthorized access.

UNL's research team is providing detailed information about the delays produced by traffic control devices including speed humps and curbs. They have developed sophisticated computer simulations based on tests of vehicles interacting with these devices.

This information will help the research sponsors – the Air Force Civil Engineering Center and the Military Surface Deployment and Distribution Command – improve the design of base entry control facilities.

"These designs are used on thousands of entry points at our military bases in the U.S. and around the world," Rilett said. "The team is excited to conduct research that will have a positive impact on the safety of our military personnel."

From left: Cody Stolle, Laurence Rilett and Ron Faller

Neihardt Classic Returns to Press

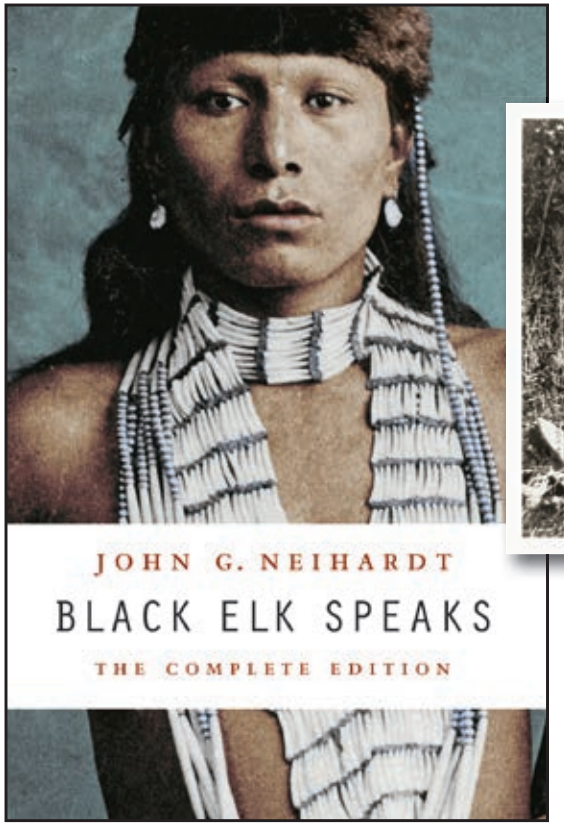
The latest edition of John G. Neihardt's best-seller, *Black Elk Speaks,* marks the classic's return to the University of Nebraska Press, its long-time publishing home.

Black Elk Speaks: The Complete Edition features a new introduction by historian Philip J. Deloria and preserves annotations by renowned Lakota scholar Raymond J. DeMallie. Essays by Neihardt provide background on this landmark work, along with pieces by Vine Deloria Jr., Alexis Petri and Lori Utecht. This edition includes maps, original illustrations and appendices.

It was released in early 2014 following the book's return in late 2013 as one of UNP's most important works. UNP previously published this foundational text of the American West and Native studies from 1961 to 2008.

"We are extremely pleased that *Black Elk Speaks: The Complete Edition* is available from the University of Nebraska Press," said UNP director Donna Shear. "It represents our proud heritage as one of the leading publishers of works of enduring significance in the fields of Native studies and the American West."

In 1930, Neihardt met Lakota holy man Black Elk, who told Neihardt about his life. These conversations led Neihardt to write *Black Elk Speaks*. First published in 1932, it became the world's most influential book about Native American culture and religion.



Above: From left, Enid Neihardt; Nicholas Black Elk, Lakota holy man; Ben Black Elk; Standing Bear; and John G. Neihardt
Left: John G. Neihardt

Neihardt, who died in 1973, wrote several classics, including *A Cycle of the West* and *Eagle Voice Remembers,* both available from UNP's Bison Books. Specially commissioned editions of these and other Neihardt books are in the works.

His writing is rooted in Nebraska and the Great Plains. He was named Nebraska's first poet laureate in 1921 and the nation's foremost poet by the National Poetry Center in 1936.

The largest and most diversified university press between Chicago and California, UNP is best known for publishing works in Native studies, history, sports, anthropology and geography, American studies and cultural criticism, and creative works.

Collaborative Culture Appeals to Francisco

Ask Joe Francisco, College of Arts and Sciences dean, what attracted him to UNL, and he'll tell you all about the university's research strengths, focus on interdisciplinary collaboration and commitment to workforce diversity.

Francisco, who became dean of UNL's largest college July 1, said the strong culture of interdisciplinary collaboration was a major factor in his decision to come to Nebraska. He came to UNL from Purdue University where he was a distinguished professor of chemistry and of earth and atmospheric sciences.

"There's a lot of discussion in higher education about working across disciplines," he said. "UNL is taking a leadership role in advancing innovative research at the cutting edge across multiple disciplines, and that is exciting."

Francisco is former president of the American Chemical Society and a member of the National Academy of Sciences. He's won several prestigious research and teaching honors, including an American Association for the Advancement of Science Mentor Award and a John Simon Guggenheim Fellowship. Francisco was president of the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers from 2006 to 2008.

Joe Francisco

He earned a bachelor's degree in chemistry at the University of Texas at Austin and a doctorate in chemical physics at the Massachusetts Institute of Technology.

UNL's sincere commitment to diversity appealed to Francisco.

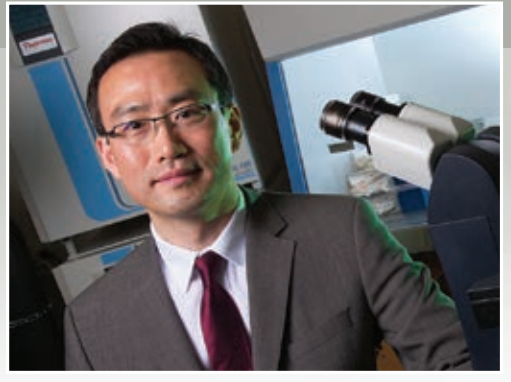
"This is part of my core values," he said. "I saw that as an opportunity where I could bring some leadership to the university and the college as well."

But he's been most impressed by the faculty's passion for their work and for educating students.

"Many important, forward-thinking programs and innovations have originated at Nebraska in the College of Arts and Sciences. I've had a lot of experience working across different platforms, and I see this as an opportunity to take some of that experience and do something creative and fun in new and exciting ways."

Tackling Health Issues with CAREER Support

UNL researchers are using engineering expertise to tackle health issues with support from National Science Foundation CAREER awards. These five-year awards support research by junior faculty who exemplify the role of teacher-scholars through outstanding research, teaching and the integration of education and research. Recent UNL winners are investigating obesity and antibiotic resistance.



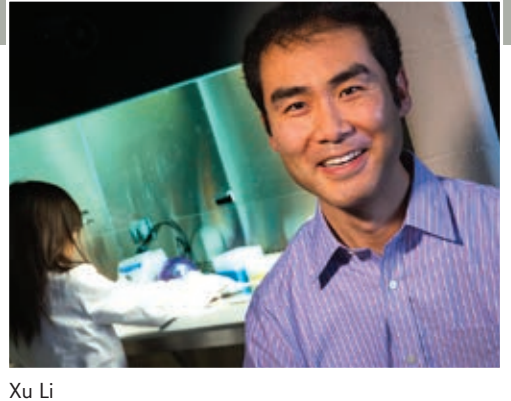
Jung Yul Lim

Understanding Cells' Link to Obesity

A type of stem cell that morphs into fat cells may hold secrets to reducing obesity. Mesenchymal stem cells (MSC) are capable of turning into various specialized cell types, including bone, skin and fat. One biological process contributing to obesity is an increase in MSC differentiation into fat cells.

With a $430,500 CAREER award, Jung Yul Lim, assistant professor of mechanical and materials engineering, is studying a mechanical method to inhibit the cells from morphing into fat.

Lim previously found that "stretching" the cells suppresses their differentiation into fat. Stretching mimics the motion that cells experience in the body. Now, he's exploring how different stretching conditions at various stages of MSC evolution affect fat production. Lim also is investigating the molecular mechanisms at work. Finding the proteins or genes responsible may lead to treatments for obesity.



Xu Li

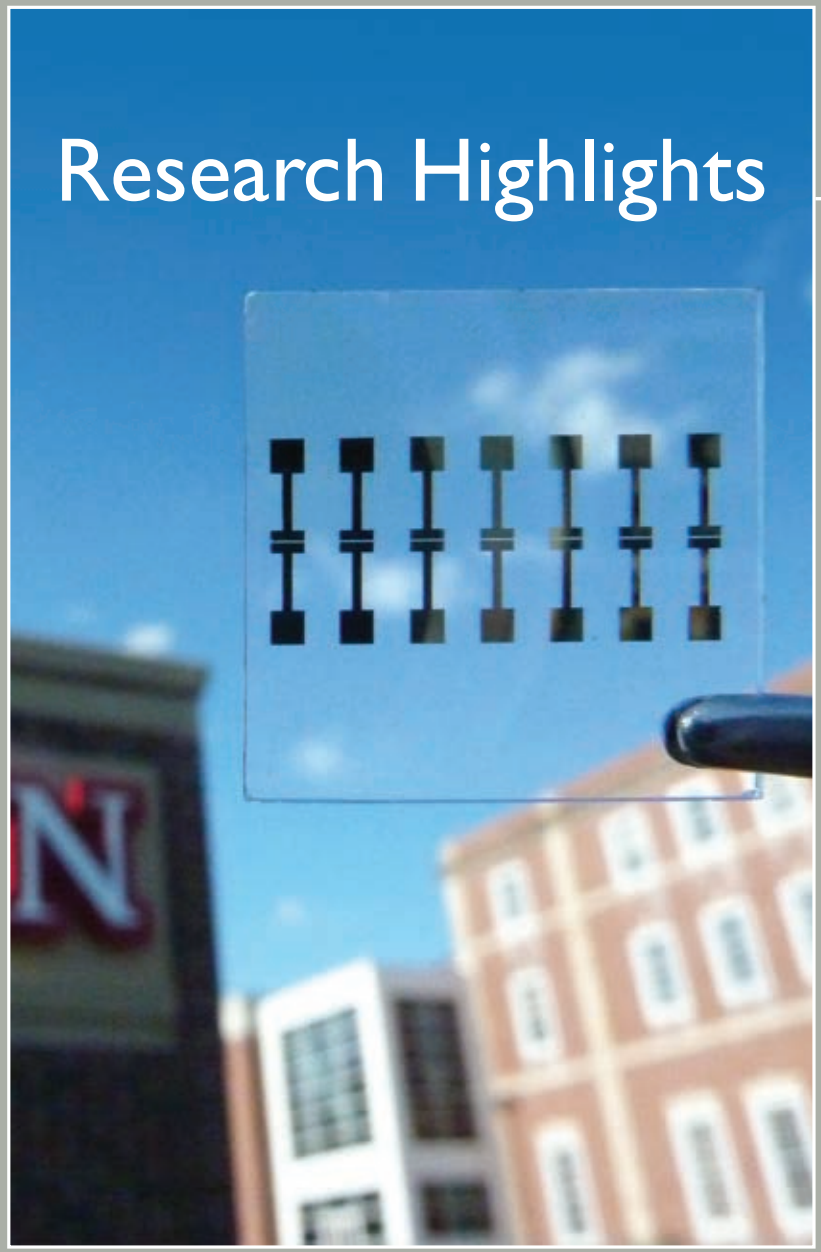
Tracking Proteins' Role in Antibiotic Resistance

To help combat the growing threat of antibiotic-resistant bacteria, Xu Li is studying methods to reduce both antibiotics in the environment and microbes' resistance to them.

Microbes interact with antibiotics differently whether in the gastrointestinal tract, water, soil or other settings. With a $400,000 CAREER award, Li, assistant professor of civil engineering, is investigating how antibiotics and microbes interact under different types and levels of nutrients.

Using quantitative proteomics and other techniques, Li is identifying and studying the proteins involved in resistance. Preliminary results suggest that some bacteria starved of nutrients respond similarly to the stress of antibiotic exposure. Therefore, bacteria already responding to nutritional stress may be better able to defend against antibiotics. In contrast, other bacteria break down complex environmental molecules for nourishment, which may include antibiotics. Understanding both types of bacterial responses may lead to waste management practices and other approaches to reduce resistance.

Research Highlights



Above: Transparent organic transistor array with electrodes

Collaboration Yields Fastest Organic Transistors

UNL and Stanford University engineers teamed to produce the world's fastest organic thin-film transistors. They're now working to refine their process, which promises to broaden the potential for using this experimental technology in a new generation of transparent electronic devices, such as TV and computer screens. Using less expensive organic polymers to create semiconductors that perform as well as traditional silicon-based transistors has long been challenging. Using their new process, UNL engineer Jinsong Huang's team and Stanford researchers created thin-film organic transistors that are more than five times faster than previously achieved with this technology. Their organic thin-film transistors perform comparably to silicon-based materials used in today's high-end electronics. They reported their findings in *Nature Communications.* The U.S. Defense Advanced Research Projects Agency, Air Force Office of Scientific Research and the National Science Foundation funded the research.

ANDRILL Team Discovers Ice-loving Sea Anemones

Researchers with the international Antarctic Geological Drilling (ANDRILL) Program serendipitously discovered a new species of sea anemone beneath the Ross Ice Shelf off Antarctica. Named *Edwardsiella andrillae* in honor of ANDRILL, this first anemone known to live in ice was found by a camera-equipped robot on its test voyage through the nearly 900-foot-thick ice shelf as part of ANDRILL's mission to study ocean currents and gather environmental data. The camera unexpectedly captured a unique ecosystem living under the ice shelf, including the small, white anemones burrowed into the underside of the ice shelf, their tentacles protruding into frigid water like flowers on a ceiling. The team reported their discovery in the journal *PLOS ONE.* The International Institute for Species Exploration named it among the top 10 species discoveries in 2014. UNL is home to ANDRILL's science management office.

Marron New Journalism Dean

Maria Marron is the new dean of the College of Journalism and Mass Communications. She joined UNL in July 2014 from Central Michigan University, where she had been chair of the journalism department since 2002. Marron's research specialties are journalism pedagogy, investigative journalism and health and aging issues in the media. She is editor of *Journalism and Mass Communication Educator* and former president of the Association of Schools of Journalism and Mass Communication. Marron earned a bachelor's degree and postgraduate diploma from University College Dublin, a master's degree in journalism from The Ohio State University and a doctorate in journalism and mass communications from Ohio University.

Sea anemones hang from beneath the Ross Ice Shelf.

Law Prof Co-authors Book On Mississippi River Tragedies

UNL law professor Sandra Zellmer co-authored a new book, *Mississippi River Tragedies: A Century of Unnatural Disaster,* which uses a series of stories to show that calling floods and other environmental catastrophes "natural" is misleading. Zellmer and co-author Christine Klein of the University of Florida uncover the larger story of how the law reflects and even amplifies ambivalent attitudes toward nature – people revere wild rivers and places for what they are, while working feverishly to change them into something else. Although acknowledging that human responsibility for unnatural disasters can lead to blame, guilt and liability, the authors conclude it can also prod people to confront the consequences of society's actions and, hopefully, avoid future disasters. Zellmer, the Robert B. Daugherty Professor of Law, specializes in water, natural resources and environmental law.

Anita Sarma and Gregg Rothermel

UNL Computer Scientists Aim to Improve Software Tools

Millions of software users are also programmers, writing spreadsheet formulas and creating websites. Errors are common, costing money and credibility. Tools available to help end users are cumbersome, allowing only linear backtracking, for example, and not allowing users to explore variations in designs or configurations. UNL computer scientists Anita Sarma and Gregg Rothermel, Dale M. Jensen Chair of Software Engineering, are using information-foraging theories from computer science and psychology to improve end-user tools as part of a multi-institutional project. They say reducing the likelihood of introducing error and expanding the ability to explore different versions and features will enable greater risk-taking and creativity, ultimately improving the experience and outcome. The collaborative project is funded by a $3 million National Science Foundation grant, of which UNL received $857,000.

Research Highlights

Tracking Virus-Heart Disease Link

Scientists believe a virus causes many myocarditis cases, which can lead to dilated cardiomyopathy, a heart disease that accounts for nearly half of all heart transplants. With $1.4 million from the National Institutes of Health's National Heart, Lung and Blood Institute, UNL immunologist Jay Reddy studies whether viral myocarditis is due to an autoimmune response and the mechanisms that lead the body to attack itself. Evidence suggests the body's immune system attacks both the virus and normal heart tissue, causing heart inflammation in people exposed to coxsackievirus. Sometimes the body continues to target normal tissue after the virus is gone, which can cause severe heart damage. Reddy, in the School of Veterinary Medicine and Biomedical Sciences, hypothesizes that the immune system's molecular targets, or epitopes, are similar in the virus and normal tissue, a phenomenon known as mimicry. Over time, healthy tissue continues to be attacked via a mechanism called epitope spreading. Understanding the underlying mechanisms could lead to immunotherapies to treat dilated cardiomyopathy, reducing the need for heart transplants.

Charles Wortmann in Africa

UNL Partners with African Scientists on Fertilizer

In sub-Saharan Africa, most crops are produced by small-scale farmers with limited capacity to invest in fertilizer. UNL scientists have partnered with African colleagues to help farmers target fertilizer use to maximize profits and raise incomes. The project builds on previous research by UNL agronomist Charles Wortmann and Ugandan colleagues. They developed a tool that uses information, such as costs and crop area, to calculate recommended fertilizer rates for local crops and the expected effects on yields. With $5.65 million from the Alliance for a Green Revolution in Africa, the effort has expanded to 12 additional nations. UNL received nearly $346,000, while national agricultural research institutes shared the rest. Other partners include Africa Soil Information Service, the UNL-led Global Yield Gap Atlas and the Grameen Foundation.

Narcissism and Leadership

Do narcissists make good leaders? Some studies suggest narcissism begets the confidence essential for success. But new research has found that, though narcissists are more likely to attain leadership positions, narcissism and successful leadership aren't directly related. The multi-institutional study, co-authored by Peter Harms, UNL assistant professor of management, reviewed existing literature and aggregated past and current research. It showed that bosses with extremely high or extremely low levels of narcissism are poor leaders. Those with moderate levels of narcissism achieve a balance of having sufficient self-confidence without manifesting the negative, antisocial aspects of narcissism that lead to exploitive or tyrannical behavior. Organizations should avoid hiring and promoting to cater to narcissists' strengths, Harms said, but also should not assume low narcissism levels make better candidates. The study was published in the journal *Personnel Psychology*.

Working with Tribal Colleges to Develop Chemistry Curricula

To make chemistry education accessible to Native communities, UNL chemist Mark Griep is working with Nebraska tribal colleges to develop chemistry curricula that incorporate locally relevant topics. The five-year project is part of a pilot program, funded through the National Science Foundation and the Experimental Program to Stimulate Competitive Research (EPSCoR), targeting underrepresented groups in science, technology, engineering and mathematics. Griep also collaborates with tribal elders, community leaders, the Nebraska Commission on Indian Affairs and others to create a list of relevant topics that can be connected to tribal college chemistry experiments designed to enrich student learning. Possible topics include water, wastewater treatment, organic farming and Type 2 diabetes. Classes will first be offered at Nebraska Indian Community College in Macy, Neb., then expanded to Little Priest Tribal College in Winnebago, Neb. Griep plans to share curricula with tribal colleges nationwide.

Schroeder Leads Rural Futures Institute

Charles P. "Chuck" Schroeder became founding executive director of the University of Nebraska's Rural Futures Institute in fall 2013. The Palisade, Neb., native is former president and executive director of the National Cowboy & Western Heritage Museum in Oklahoma City. Previously, he was CEO of the National Cattlemen's Beef Association, executive vice president and director of development at the University of Nebraska Foundation and director of the Nebraska Department of Agriculture. He also spent 30 years with his family's company, the Schroeder Cattle Co., the last 10 years as owner and president. He studied animal science and business and production options at UNL.

Research Highlights

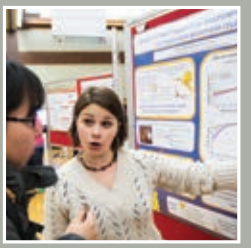
Book Features Sheldon's Paintings

The Sheldon Museum of Art's most impressive and widely known canvases are featured in a new book, *Painting from the Collection of the Sheldon Museum of Art*. The book, published by the University of Nebraska Press, features reproductions of 125 major works and highlights the artistic, cultural and geographic conflicts and events that shaped more than two centuries of American painting. Scholars contributed comments and interpretations. The book includes masterpieces from the 18th through the 20th centuries by such artists as John Singer Sargent, Edward Hopper, Georgia O'Keeffe and Andy Warhol. It also features work by emerging artists like Carmen Herrera. It was published in honor of the 50th anniversary of the museum's landmark Philip Johnson-designed building and the 125th anniversary of the Sheldon Art Association. Sheldon's comprehensive collection of American art includes 12,000 works in all media.

Partnering on Digital Lab for Manufacturing

UNL is a partner in the Digital Lab for Manufacturing, a first-of-its-kind advanced manufacturing collaboration that President Barack Obama announced in early 2014. UNL representatives worked with organizers on plans for the new lab. As collaborators, UNL researchers have opportunities to work with colleagues at other universities, as well as with industry, government, state and community partners in Nebraska and nationwide. The digital lab is funded by $70 million from the Department of Defense and $250 million in commitments from its partners to form the $320 million innovation hub. Led by UI Labs, a University of Illinois-affiliated research and commercialization collaborative, the lab is based in Chicago and linked to manufacturing research sites nationwide. The aim is to harness the nation's best research and technology to enhance American manufacturing's overall competitiveness.

Top: Retreat presentation
Inset: Srivatsan Kidambi



UNL Research Fair

The biannual UNL Research Fair offers an opportunity to explore the university's research priorities in greater depth, learn from national experts and engage in professional development. The fall 2013 event included symposia on defense-related research, bioproducts and biofuels, and supercomputing. The fair also featured sessions about serving on proposal review panels and professional skills development for postdocs. Featured speakers included Barry Sloane, Tyrone Mitchell and Michele McGuirl, National Science Foundation; Christopher Sarampote, NIH's National Institute of Mental Health; Bruce LaMattina, Rutgers University; Ed Tovar, InTechSys LLC; and Shirley Malcom, American Association for the Advancement of Science. The spring 2014 event featured poster sessions that showcased research and creative accomplishments by UNL graduate and undergraduate students.

Above: Graduate student showcase; Marie-Claire Chelini; Kurt Preston

Interdisciplinary Faculty Retreat

New faculty collaborations are emerging from UNL's 2014 Interdisciplinary Faculty Retreat. The event brought together more than 260 UNL faculty and administrators from 56 disciplines to brainstorm ideas for strategic interdisciplinary research, learn about each other's work and hear from nationally recognized speakers. Discussions covered three major thematic areas: signaling, sensing and imaging; integrating research and practice in the social, behavioral and educational sciences; and integrating big data into research. Featured speakers included Parag Chitnis, National Science Foundation; Rashid Bashir, University of Illinois at Urbana-Champaign; Kimberly Hoagwood, New York University School of Medicine; Colleen Gabauer, Purdue University; Henry VanBrocklin, University of California, San Francisco; Ian Fisk, Fermi National Accelerator Laboratory; and Eric Lyons, University of Arizona.

Strengthening Concussion Research

UNL's Center for Brain, Biology and Behavior, known as CB3, continues to bolster its research expertise. In July 2014, Arthur Maerlender, a concussion research expert, joined the center as associate director and research associate professor. Maerlender came to UNL from Dartmouth College's medical school. A board-certified clinical neuropsychologist, his research interests include sports-related concussions, traumatic brain injury and learning disabilities. At UNL, Maerlender heads CB3's concussion research program. He also works with Nebraska Athletics on concussion testing for student-athletes, and is research director for the Big Ten/CIC-Ivy League Traumatic Brain Injury Research Collaboration. Maerlender and CB3 director Dennis Molfese both were members of the National Academy of Sciences committee on sports-related concussions in youth that reported its findings in late 2013. CB3's state-of-the-art facilities and multidisciplinary environment enable diverse studies to expand understanding of brain function and its effects on human behavior. Maerlender holds a master's and a doctorate in psychology from Notre Dame, and master's and bachelor's degrees from Western Michigan University.

Nebraska Lectures

The 2013-2014 Nebraska Lectures: The Chancellor's Distinguished Lecture Series featured an educational psychologist and an English professor. Susan Swearer, Willa Cather Professor of Educational Psychology, presented "Creating a Kinder World: Empowering Youth to End Bullying." A nationally known bullying expert, Swearer discussed her research on the complex personal, social and cultural factors underlying bullying – and how to end it – during her fall lecture. Stephen Behrendt, George Holmes University Professor of English, presented "What Good Are the Humanities, Anyway?" His spring lecture addressed the value of imagination and how it inspires critical thinking and new ideas. The Office of the Chancellor, Research Council and Office of Research and Economic Development, in collaboration with the Osher Lifelong Learning Institute, co-sponsor these lectures featuring prominent faculty.

Accolades


Judy Diamond


Concetta DiRusso


Sherilyn Fritz


Alan Kamil


David Sellmyer


Charles Wood

Six UNL Faculty Named AAAS Fellows

Judy Diamond, Concetta DiRusso, Sherilyn Fritz, Alan Kamil, David Sellmyer and **Charles Wood** were named American Association for the Advancement of Science Fellows in 2013. It was the first time six UNL scientists were elected fellows in the same year. Diamond, professor and curator of informal science education at the University of Nebraska State Museum, was recognized for distinguished contributions to promoting scientific literacy. DiRusso, professor of biochemistry, was honored for advancing understanding of nutritional fatty acids and for education advocacy. Fritz, George Holmes Professor of Earth and Atmospheric Sciences, was recognized for distinguished contributions to paleolimnology and paleoclimatology. Kamil, George Holmes Professor of Biological Sciences, was recognized for distinguished contributions to research into animal behavior and cognition. Sellmyer, George Holmes Professor of Physics, was honored for distinguished contributions to the physics of magnetic materials and nanostructures and for his leadership as director of UNL's Nebraska Center for Materials and Nanoscience. Wood, Lewis Lehr/3M Professor of Biological Sciences and director of UNL's Nebraska Center for Virology, was recognized for significant contributions to molecular virology and HIV/AIDS epidemiology and to building global scientific capacity.

National Academy of Inventors Fellow

Biochemist **Donald Weeks** was named a National Academy of Inventors Fellow in 2013. The distinction is a high honor bestowed on academic inventors whose inventions improve quality of life, spur economic development and benefit society. Weeks, the Maxcy Professor of Agriculture and Natural Resources, was recognized for contributions in plant and algal biology, especially his novel approach to engineering herbicide-resistant crops. He holds 10 U.S. patents and 22 international patents. Weeks' selection marks the second year members of the UNL faculty have been named NAI Fellows.

Jefferson Science Fellow

Concetta DiRusso, professor of biochemistry, is a 2014-2015 Jefferson Science Fellow. DiRusso is known for her work to understand nutritional fatty acids and their impact on human health, including diabetes and other diseases commonly linked to obesity. The National Academies program gives fellows the opportunity to spend one year in Washington, D.C., as advisers on science and engineering policy issues to the Department of State and U.S. Agency on International Development.

Faculty Recognized

- The Fulbright Program offers UNL scholars opportunities to grow in teaching and research. **Carole Levin**, Willa Cather Professor of History, will spend the spring 2015 semester in York, England, studying the Celtic queen Boudicca's leadership style and her connections to modern female political leadership. **Wendy Weiss,** emeritus professor of textiles, merchandising and fashion design, received a Fulbright-Nehru Senior Scholar grant to travel to Gujarat, India, to study development and design of the ikat print. **Gary Kebbel,** professor of journalism, and **Sriyani Tidball,** assistant professor of practice in advertising and public relations, earned Fulbright Specialist grants. Kebbel is helping the U.S. Mission to the African Union, based in Ethiopia, draft a strategic communications plan. In January, Tidball will work with the Centre for Women's Research in Sri Lanka to form a communications strategy for helping migrant workers stay in touch with their families.

- **Tyler White,** professor of composition and conducting, won a Global Music Awards silver medal in composition for his opera *O Pioneers!* that reimagined the Willa Cather classic novel in musical form. He also was a finalist for The American Prize in Composition in opera/theater/film.

- **Xiao Cheng Zeng,** Ameritas University Professor of Chemistry, was named a Fellow of the United Kingdom's Royal Society of Chemistry. Zeng has made groundbreaking discoveries using computer modeling to reveal how matter behaves under extreme conditions, and in computer-aided molecular and materials design.

- **Gregg Rothermel,** Dale M. Jensen Chair of Software Engineering, earned 2013 Distinguished Scientist and Distinguished Member honors from the Association for Computing Machinery for significant accomplishments in computer science. Rothermel's research areas include application of program analysis techniques, software maintenance programs and end-user software engineering.

- Two UNL faculty members became American Mathematical Society Fellows in 2013: **John Meakin,** Milton Mohr Professor of Mathematics, and **Srikanth Iyengar,** Willa Cather Professor of Mathematics. Meakin was selected for contributions to semigroup theory and leadership in UNL's mathematics department. Iyengar has lent his expertise in commutative algebra to numerous international research collaborations. UNL has a strong tradition of mathematics excellence, with five researchers joining the inaugural class of AMS Fellows in 2012.

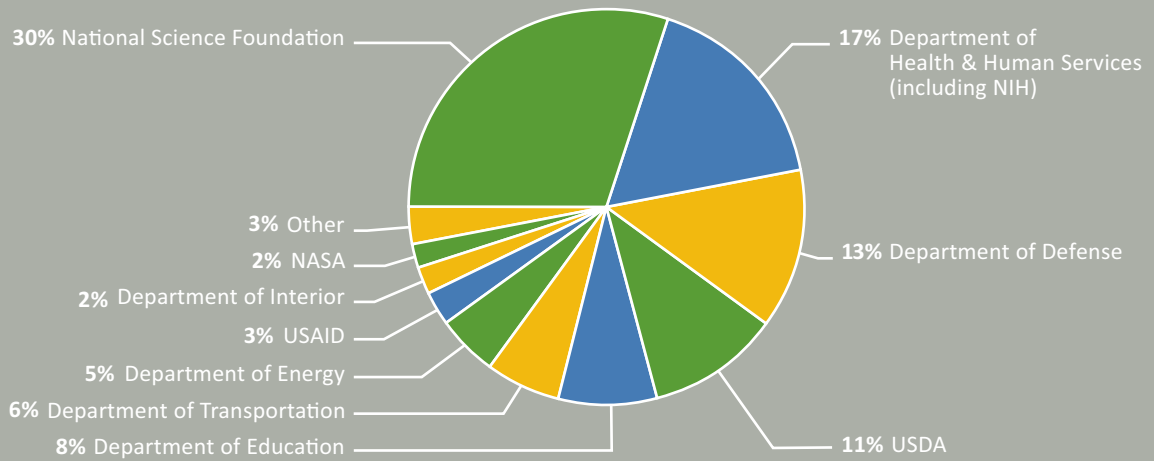
- **Cory Forbes,** associate professor of science education in the School of Natural Resources, received the 2014 Early Career Research Award from the National Association for Research in Science Teaching for his potential to significantly contribute to science education. Forbes has studied third-grade students' learning about biological structure and function and the hydrologic system, and teachers' implementation of curricula to help students learn about water and food systems.

Financials

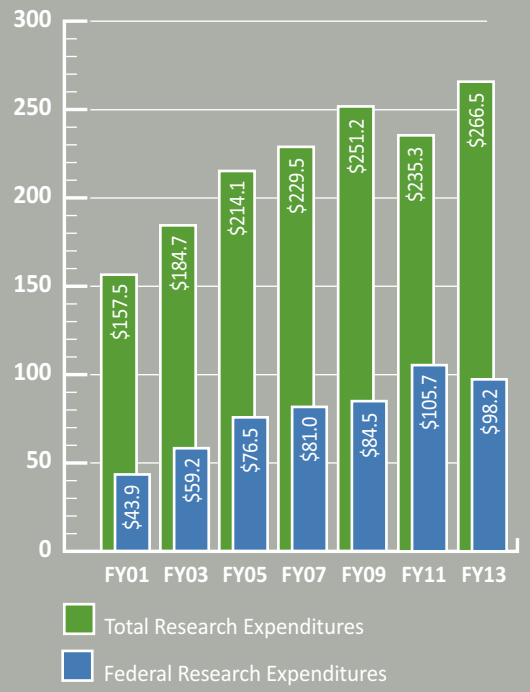
Research Expenditures

UNL's research expenditures totaled more than $266 million in 2013, the most recent fiscal year for which expenditure information is available. This total included more than $98 million in federal research expenditures. The National Science Foundation accounted for 30 percent of UNL's federal research expenditures, followed by 17 percent from the U.S. Department of Health and Human Services, including the National Institutes of Health, and 13 percent from the Department of Defense. UNL's goal is to achieve $300 million in total research expenditures by 2018, with at least half coming from federal agencies.

FY 2013 Research Expenditures by Federal Agency



Total Research Expenditures
(in millions)



Credits

The 2013-2014 UNL Research Report is published by the University of Nebraska–Lincoln Office of Research and Economic Development. For more information, go to http://research.unl.edu or contact:

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