ANNUAL REPORT

2009 - 2010

University of Nebraska Lincoln | OFFICE OF RESEARCH & ECONOMIC DEVELOPMENT

http://research.unl.edu

University of Nebraska Lincoln | OFFICE OF RESEARCH & ECONOMIC DEVELOPMENT

Table of Contents

On the Cover

At UNL, discoveries, knowledge and new technologies grow from great ideas for addressing today's complex challenges. Producing enough food with limited water supplies as the world's population almost doubles in the next 40 years is one of the most critical of these challenges. The University of Nebraska's new Water for Food Institute is a global research, education and policy analysis institute committed to innovative solutions that will help the world sustainably grow more food using less water. Read more on page 2.

Planting Seeds for the Future

Chancellor Harvey Perlman (left) and Vice Chancellor Prem Paul

This is an exciting time at the University of Nebraska–Lincoln. We're seeding major new initiatives, growing our research enterprise and nurturing strategic partnerships to address 21st-century challenges.

Research funding at UNL has increased 180 percent since 2000, and we're building on this momentum with an eye to the future. We are cultivating collaborations across disciplinary, institutional, state and national boundaries to solve global challenges, address national needs and enhance our state's economy.

The University of Nebraska's new global Water for Food Institute epitomizes this approach. Established in 2010 with a visionary $50 million gift from the Robert B. Daugherty Foundation, this international, multidisciplinary center for research, education and policy analysis focuses on the global challenge of producing more food with less water. Our international Water for Food conferences in 2009 and 2010 drew experts from around the world, and we are expecting more global participants at the third annual conference May 1-4, 2011. This report details our aspirations for this institute and features some of UNL's research strengths in water and agriculture.

We also are expanding our international engagement through research agreements, faculty exchanges and student learning opportunities in India, China and beyond.

For example, a transportation workshop in India, jointly organized by UNL and an Indian university, and sponsored by the Indo-US Science and Technology Forum, laid groundwork for future collaborations.

We are building partnerships with business, industry and entrepreneurs to ensure that UNL research becomes an even bigger driver for Nebraska's economy. Our most ambitious undertaking is Nebraska Innovation Campus. This private-public research campus being developed adjacent to UNL will offer a collaborative, synergistic environment where businesses and entrepreneurs work closely with our faculty and students. In the past year, we also established NUtech Ventures, a nonprofit university affiliate, to commercialize the discoveries from UNL research and foster R&D partnerships involving researchers and the private sector.

From green building and alternative energy to nanoscience and human health research, this report highlights some of our successes. I invite you to envision the power of UNL research to solve problems and create opportunities for our state, our nation and our world.

Prem

Prem S. Paul
Vice Chancellor for Research
and Economic Development

New Institute Focuses on Water for Food

Water for Food Conference

Helping the world efficiently use its limited water resources to ensure the food supply for current and future generations is the vision of the University of Nebraska's new global Water for Food Institute.

A $50 million founding gift from the Robert B. Daugherty Charitable Foundation in 2010 made the institute possible. Daugherty, an Omaha, Neb., native, founded Valmont Industries, the world's most successful irrigation company, and remains committed to efficiently and sustainably using water to feed a growing world population.

The Water for Food Institute is an integrated, interdisciplinary center for research, education and policy analysis on agricultural water use. Headquartered at UNL, the institute will build on the university's strengths in agriculture, water and natural resources. It will involve researchers from around the world by forging strong partnerships with international institutions focusing on food and water issues.

"We have the experience and opportunity to build a global center in Nebraska, leveraging the knowledge and resources of the University of Nebraska and other leading institutions to help alleviate human suffering and food insecurity," said NU President James B. Milliken. "The implications for individuals, families and nations are tremendous."

Jeff Raikes


James B. Milliken

A search is being conducted for an internationally regarded expert in water and agriculture to serve as founding director for the new institute.

The university has hosted two international Water for Food conferences, with the third planned for May 2011. The 2010 conference drew more than 300 participants from 13 countries. Thirty speakers, including scientists, farmers and representatives from industry, government and non-governmental organizations, discussed critical issues and advances in research, policy and education related to agricultural water use. The conference was supported by the Bill & Melinda Gates Foundation, the Robert B. Daugherty Charitable Foundation and Monsanto Co.

"I think the Water for Food Institute is going to be an important leader in addressing a crisis in producing food to feed the world," said Jeff Raikes, a Nebraska native and CEO of the Bill & Melinda Gates Foundation, who was involved in discussions leading to the institute's creation and serves on its board of directors.

Learn more at **waterforfood.nebraska.edu.**

Probing the Evapotranspiration Equation

Reducing agricultural soil evaporation through better irrigation and other practices would help save precious water.

To better study agricultural water loss, Suat Irmak, UNL soil and water resources engineer, has developed a network of advanced monitoring systems throughout Nebraska that continually measures evapotranspiration, the combined water lost to soil evaporation and through plant leaf surfaces.

"On a worldwide scale, 60 percent of the total precipitation goes back to the atmosphere by evapotranspiration," Irmak said. "In Midwestern states like Nebraska, it's 90 percent. We have to measure evapotranspiration so we can have a good handle on what is happening to our water resources."

Irmak and his team travel the state to download data collected throughout the year by sophisticated equipment at 12 sites. The Nebraska Environmental Trust, Central Platte Natural Resources District, UNL Extension, the Nebraska Rural Initiative and others help fund this work.

These data enable Irmak to study how and when it's possible to stress plants with less water without hurting yields. He also uses the information to research the effect of tillage, rotation, different crops and irrigation practices on evapotranspiration rates to develop water-saving management strategies.

In addition, farmers can use the real-time data to know how much to irrigate or adjust their practices to reduce water use. Appropriate irrigation, zero or reduced tillage and other management practices reduce evapotranspiration rates, making more water available for other uses, such as municipal water supplies and wildlife habitat.

Watershed managers and state policymakers can use accumulated data to better allocate water resources and develop effective water and agricultural policies.

Irmak's evapotranspiration network is receiving attention from agriculturalists and the water resources community worldwide. "Evapotranspiration is critical for everything we do in water resources," he said. "We are one of the best institutions that has good quality resources in this research arena."


Suat Irmak

Yield Potential Key to Food Security

Crop yields aren't increasing fast enough to meet the world's projected food needs, which are expected to double by 2050 as the population increases and becomes wealthier.

Knowing how much food each acre of land can produce is essential to increasing global food capacity without significantly expanding farmland, said Ken Cassman, UNL agronomy professor and director of the Nebraska Center for Energy Sciences Research.

Cassman and graduate student Justin van Wart are developing a transparent, science-based method to measure yield gap, the difference between average and potential crop yields. Identifying underperforming areas where yield could easily be increased could help prioritize research and inform agricultural policies.

"This work will be critically important to mobilize global resources for food security," Cassman said. It follows previous work on biofuels and food security with UNL biological systems engineer Adam Liska.

Using crop simulation modeling and geographic information systems technology, researchers are creating an atlas that shows yield potential for cropland in all countries that can provide data on crop, soil type and climate.

Atlas users will be able to compare an area's potential yields with actual yields. Having detailed, field-level information will help researchers and policymakers strategize ways to help producers close the gap.

Cassman also envisions using the gap analysis tool to measure water productivity, the amount of water used to produce a crop. He and graduate student Patricio Grassini recently worked with Nebraska's Tri-Basin Natural Resources District to estimate water productivity of corn.

Results showed the potential to reduce water used to irrigate corn by 33 percent while maintaining yields through adopting conservation tillage more widely, replacing surface irrigation with pivots and fine-tuning limited irrigation. These findings can help inform irrigation and water-use policies in the face of increasing competition for water resources.

"These are powerful tools to establish research priorities and inform agricultural policies at the global, national and regional levels," Cassman said.

Above: Ken Cassman (left) and Adam Liska
Right: No-till soybean field

"Knowing how much food each acre of land can produce is essential to increasing global food capacity without significantly expanding farmland."

Water-smart Sensors Going Underground

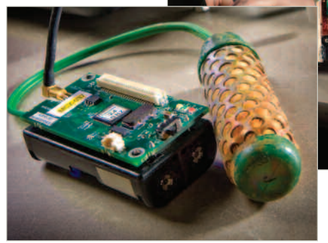
Deciding when and how much to irrigate is critical for farmers working to conserve water, save money and maximize crop production.

UNL computer engineer Mehmet Can Vuran wants to give producers more information to make those decisions. He's developing wireless underground sensor networks to provide precise, real-time data about soil moisture and other changing conditions.

Wireless underground sensor networks consist of hundreds of sensors buried in the soil to collect data about moisture and composition, temperature and atmospheric changes. The idea, Vuran said, is to let the soil tell producers how much and when to water.

He estimates that underground sensors could reduce irrigation up to 25 percent depending on soil conditions and crop type, which would have significant economic and environmental benefits.

"Integrating wireless sensor network solutions with agriculture has huge potential to improve crop yields and decrease irrigation costs significantly," Vuran said.



Above: Mehmet Can Vuran
Left: Wireless sensor and transmitter

He also is designing network protocols that could enable the sensors to transmit information directly to a center pivot irrigation system, which would determine when to turn on the water and how much to apply.

Vuran's project has potential to transform wireless communications. Underground operation is the challenge. Wet soil limits the sensors' transmission power. He's working to create network protocols and communication devices that adjust to variable soil, temperature and water conditions. His work could expand wireless underground sensor networks to applications such as monitoring underground oil pipes, mines or tunnels and even underwater operations.

Vuran earned a five-year, $418,760 National Science Foundation CAREER Program award, which supports outstanding pre-tenure faculty, to expand this research. The grant also provides support for a wireless networking solutions workshop for teens.

"We want budding farmers to see how they can use computer science and engineering to solve agricultural problems," Vuran said.

Lakes Showing Signs of Warming Climate

The gradual effects of global warming on the earth's ecological systems make it challenging to study. But UNL hydroclimatologist John Lenters believes he's witnessing its impact in action.

Lenters studies how lakes respond to climate change. Whether a lake is frozen in the Arctic or fed by water percolating up from an aquifer in Nebraska's Sandhills, Lenters is finding the influences of a warming climate.

As the planet warms, the consequences to lakes often mean decreasing water supplies for people, wildlife and ecosystems.

Normally, sediments on lake bottoms draw heat out of the water during the summer and release it in the winter in a heat-flux equilibrium. In the Arctic, however, Lenters found lakes drawing heat into the permafrost most of the year. The National Science Foundation funds this study of changes in Arctic lake dynamics.

"We are witnessing the thawing of permafrost in action in just a year's worth of data," Lenters said. "As the climate warms, the lake sediments take a lot longer to respond and are out of whack. They're trying to readjust."

In the Sandhills, lakes draw water from the High Plains Aquifer. Sunny, windy and dry conditions increase evaporation, further taxing the aquifer, a vital resource for agriculture, communities and wildlife.

"We're measuring the highest evaporation rates of any of the lakes we're looking at," Lenters said of the Sandhills research. "It seems like this region could potentially be very sensitive to slight variations in climate."

On an island in Lake Superior, Lenters is beginning to measure evaporation rates on the world's largest freshwater lake.

Although Lenters is primarily collecting field data, he's also combining lake measurements, such as ice thickness in the Arctic and salinity in Nebraska, with weather and other climatic data to create models to help predict global warming's impacts on lakes over long time periods.

Top: John Lenters (left) and graduate student Nathan Healey in the Arctic
Above: Researchers deploy a data buoy to monitor conditions

"The virtual community allows the user to make better informed decisions before our community is built in real life."

Jonathan Shi

Informed Choices – Assessing Green Features

Want to know the effect of adding solar panels to your home before you buy? Soon, virtual reality will allow you – and builders or community planners – to explore the costs and benefits of energy-saving green building features before investing.

UNL engineers are creating computer-simulated environments to analyze costs, energy savings and social and environmental benefits of green technologies before replacing traditional building components or starting construction. Their goal: provide this decision-support software as a Web-based tool for researchers, students, architects, builders, planners and others interested in green building.

They're also developing real-life energy-efficient technologies that reuse energy and water at the site rather than sending the water to centralized treatment plants. A five-year, $1.25 million grant from the U.S. Environmental Protection Agency funds these projects, conducted in partnership with the National Association of Home Builders.

Nationwide, water treatment infrastructure is deteriorating while demand for water is increasing. Additionally, buildings account for about 40 percent of U.S. energy consumption, so improving efficiency in homes, offices and centralized water treatment facilities has a major impact.

To reduce water and energy demands, the team is developing technology to recover energy and reuse drinking and wastewater in homes and communities. For example, researchers have designed a heat pump that taps the energy given off by hot water as it cools after use.

"In the virtual environment, you can try out all kinds of these technologies first," said project leader Jonathan Shi, professor of construction management in the College of Engineering's Charles W. Durham School of Architectural Engineering and Construction. "In real life, they would be very costly to do."

Community planners also will be able to use the virtual green world to test alternative technologies or even to create entire communities from scratch, mixing and matching to see how the technologies will work together.

"The virtual community allows the user to make better informed decisions before our community is built in real life," Shi said.

Preparing for Green Jobs

A green economy hinges on skilled workers. UNL engineers are teaming with the Nebraska Department of Labor and others to train Nebraskans for green jobs.

The state labor department received a three-year, $4.8 million State Energy Sector Partnership grant from the U.S. Department of Labor through the American Recovery and Reinvestment Act, including $1.25 million to UNL.

UNL expertise factors into the partnership's three focus areas: renewable wind, biofuels energy and energy-efficient green building technology. Kevin Grosskopf and Jonathan Shi in The Durham School of Architectural Engineering and Construction head UNL's efforts.

UNL will coordinate training and help develop training materials to meet green industry standards. In 2011, UNL and partners will begin training instructors to, in turn, teach participants. The program is expected to train more than 700 Nebraskans. Partners include several state agencies, workforce development groups, community colleges, construction groups and unions, and energy companies and cooperatives.

"We want to enable our state to take advantage of the economic and environmental benefits of emerging green industries," Grosskopf said, especially wind, biofuels and green building.

Powering Roadways with Solar and Wind

Gas guzzlers aren't the only roadblock to greener transportation. Basic infrastructure such as streetlights, signs and traffic signals also consumes considerable energy.

UNL energy and transportation experts are teaming to develop a wind and solar hybrid power system that generates, stores and distributes electricity for transportation infrastructure. The goal is to create "energy-plus" roadways that produce more electricity than they consume.

The transportation industry has experimented with solar power for roadway infrastructure, but combining it with wind power is almost unheard of, said Jerry Hudgins, the UNL electrical engineer who leads the three-year project, funded by a $999,504 U.S. Department of Transportation grant.

A hybrid system promises a clean, continuous source of power that reduces energy consumption and costs, protects against electrical blackouts and feeds excess energy to the power grid to help offset transportation system expenses.

Civil engineer Anuj Sharma is determining how to plug the system into the power source of existing transportation infrastructure. UNL's system contains a solar panel and a wind turbine, each collecting energy that is converted into electricity to power the traffic signal, roadway sign or light on which it's installed.

But what happens on a cloudy day?

Electrical engineer Wei Qiao is creating a smart control system that senses how much power each source produces depending on the weather, traffic volume and other factors. If it's cloudy, the system would compensate by using more wind power or switching to the main power source.

Hudgins envisions local networks of hybrid power systems connected by smart controls, creating a "microgrid" in an intersection or even across several blocks. Individual systems would communicate with each other and shift power where it's most needed, such as a busy street during rush hour.

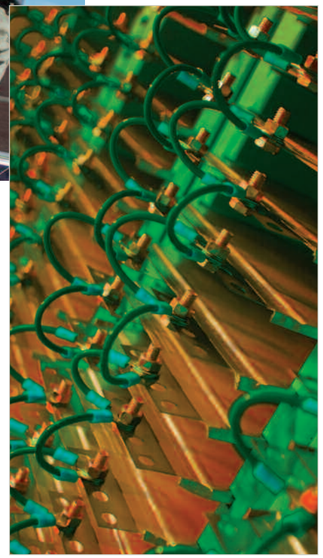
Civil engineer Elizabeth Jones with UNL's Mid-America Transportation Center is coordinating the team's partnership with the city of Lincoln, Neb., for prototype testing in 2012 and possible future implementation.

"This could have a significant impact on the next generation of smart electric grids," Hudgins said.

Above: Wei Qiao, Elizabeth Jones, Anuj Sharma and Jerry Hudgins
Above right: Interconnected bank of batteries

Improving Sustainable Energy Technologies

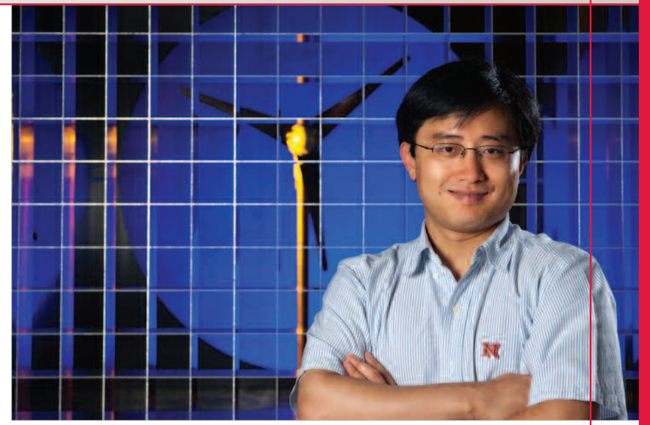
Wind turbines and solar panels may be the public faces of alternative energy, but engineers working behind the scenes are developing less celebrated technologies to enable widespread green energy use.



From smarter power grids to remote-controlled turbine condition monitoring systems, UNL electrical engineer Wei Qiao's research aims to make alternative energy more efficient, reliable and cost effective.

Maintaining the reliability and security of the nation's complex power network requires a balance between power generation and use. Unlike today's primary energy sources of coal and oil, alternative power sources such as wind and solar are intermittent and harder to control.

To optimize use of these sustainable sources, Qiao is developing computer models and optimization and control tools to help create the next-generation power grid. A smarter power grid will improve the system's stability, reliability and economic efficiency. He's also working on ways to store excess energy for future use, which would greatly improve the power grid's energy efficiency and reduce the risk of power failures. Qiao received a $399,999 National Science Foundation CAREER Program award, which supports outstanding pre-tenure faculty, for this research.



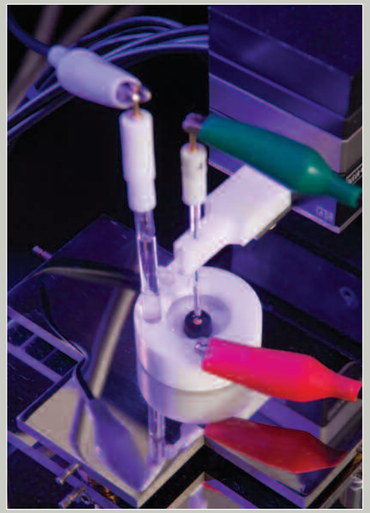
He's also developing remote wind turbine monitoring systems to improve reliability and reduce maintenance costs. Workers now must travel to remote areas and scale the turbines to monitor components. Existing monitoring technologies require additional sensors and expensive equipment that sometimes contribute to turbine system failures.

Qiao is using signal-processing techniques to develop methods that use wind turbine electrical signals to remotely monitor the turbine's condition and quickly detect problems. A two-year, $380,398 grant from the U.S. Department of Energy funded by the American Recovery and Reinvestment Act supports this research.

"Nebraska and adjacent states are among the top states in the nation with wind energy resources," Qiao said. Results of his green energy research should help the region capitalize on this potential.

Above: Wei Qiao

Biosensor Work Aims for Simple HIV Test



A cheaper and quicker way to detect HIV would be invaluable in fighting the HIV/AIDS epidemic worldwide. UNL chemist Rebecca Lai's research on electrochemical biosensors may one day lead to developing a simple device for identifying HIV.

Lai's strategy for detecting the virus is to look for the presence of HIV antibodies, proteins the immune system produces to identify and neutralize the virus by binding to viral molecules called antigens.

Many antigens change shape when they interact with antibodies. By developing a method that monitors the structural change of the antigen, Lai can detect the presence of the antibody. In the case of HIV, the presence of antibodies to HIV indicates infection with the virus.

She labels the antigen with methylene blue, a tracer molecule that accepts electrons when a specific voltage is applied. If antibodies are present, they interact with the antigens, causing a structural change and preventing the methylene blue from accepting electrons. The sensor will detect a large decrease in current in the presence of HIV antibodies. The current remains the same if no HIV antibodies are present.

"Our biggest goal is to make a handheld biosensor similar to the glucose sensor, but for the specific detection of HIV."

"Our biggest goal is to make a handheld biosensor similar to the glucose sensor, but for the specific detection of HIV," Lai said.

Electrochemical sensing has the potential for diverse applications, ranging from cancer detection to finding toxins, explosives or drugs in the body and in the environment.

Lai recently earned a $455,000, five-year National Science Foundation CAREER Program award, which supports outstanding pre-tenure faculty, to continue her research.

Educating young people in science and being a role model for young women and minorities in science are important facets of Lai's career. The CAREER award also will take her into Nebraska's classrooms. She plans to develop hands-on summer workshops in biosensing technologies for Nebraska high school teachers. The first workshops will be in summer 2011.

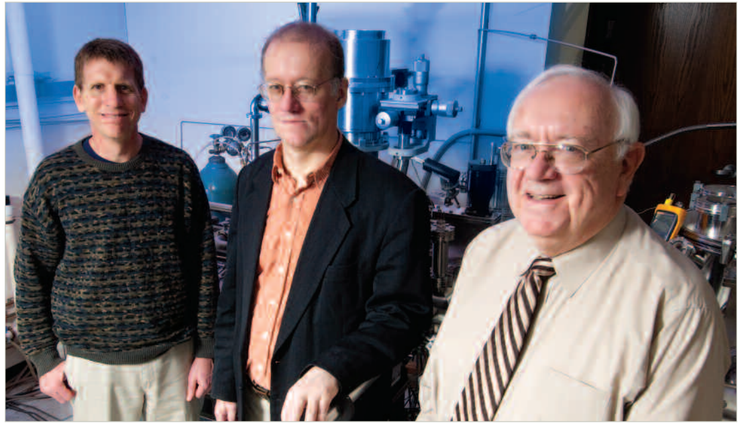
Above left: Electrochemical biosensor
Right: Rebecca Lai (left) and graduate student Jennifer Gerasimov

Developing Stronger Nanomagnets

Building better hybrid cars, wind turbines and computers reduces global warming, but the nanomagnets used in these devices require rare earth metals. Experts in UNL's Nebraska Center for Materials and Nanoscience (NCMN) aim to change that.

As partners in a $4.5 million Advanced Research Projects Agency-Energy grant from the U.S. Department of Energy led by the University of Delaware, UNL researchers collaborate with several universities, laboratories and companies to improve nanomagnets. The grant is funded through the American Recovery and Reinvestment Act.

Many clean energy and electronic devices rely on magnetic materials made from rare earth metals that, despite the name, are common in the earth's crust. However, nearly all of the world's supply of rare earth metals comes from China. Demand for these metals is skyrocketing, China is restricting exports, and the extraction process is an environmental concern.



From left, Jeff Shield, Ralph Skomski and David Sellmyer

"There's huge interest in energy research and development now. Our country definitely needs to get better at creating energy for all kinds of power applications," said physicist David Sellmyer, NCMN director.

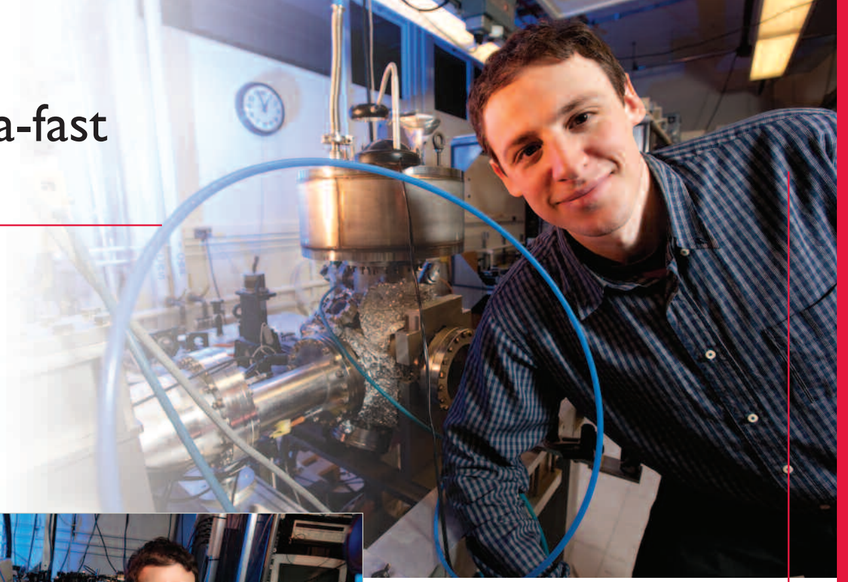
Sellmyer, physicist Ralph Skomski and materials engineer Jeff Shield are developing materials with stronger magnetic properties that do not contain rare earth metals. Stronger magnets produce more energy for powering wind turbines and hydroelectric generators. They also reduce the size and power consumption of everything from hybrid and electric cars to computer memory.

To better manipulate the magnetic properties, researchers are building materials at the atomic scale. The ability to precisely position every atom in a nanoparticle allows full control of the material's magnetic properties.

This is high-risk, high-reward research. "The best magnets that we've got now were discovered in 1985 or so," Sellmyer said. "We've made advances, but nothing that's a big quantum leap. That's what we want: a home run rather than a single."

NCMN is home to one of the nation's leading magnetism research groups and is largely funded by National Science Foundation, Department of Energy and Department of Defense grants.

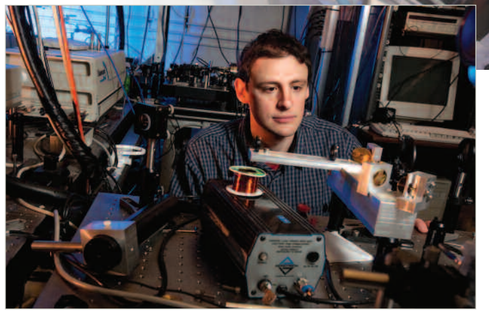
Peering into Ultra-fast Molecular World



It's well known that sunlight fuels plants. But exactly how plants convert photons of light into energy is unknown. Unlocking the mystery could lead to better green energy sources.

The first molecular step in conversion takes less than one-trillionth of a second, far too fast for scientists to see the process. But UNL physicist Martin Centurion has discovered a way to peer into that ultra-fast molecular world.

"This could help to get a better understanding of how to convert energy light from the sun into chemical energy," said Centurion, who received a $600,000 Early Career Research Program award from the Department of Energy to support his work.



When a photon of light hits a molecule, whether on a plant's leaf or in a human eye, for example, the molecule undergoes structural changes to turn that photon energy into chemical energy. For a plant, that energy becomes fuel for growth and reproduction. Eyesight depends on the converted energy traveling to the brain.

To see a structural change that lasts just one-trillionth of a second, Centurion hits gas molecules with a laser pulse, a source of photon energy, to start the molecular change. The laser also triggers a burst of electrons. When the electrons hit the molecules, they scatter. By analyzing the electron scatter, Centurion can recreate a molecule's structure at that moment, like taking its picture.

By lengthening the timing between the laser pulse and the electron snapshot, Centurion can create a movie of the changes occurring in the molecular structure. Being able to see those structural changes will provide insight into the molecule's function.

Understanding how the molecule converts energy may one day help scientists develop alternative energy sources.

Above: Martin Centurion

"We're trying to understand how much and which kinds of fatty acids we really need to be eating for optimal health."

Getting the Skinny on Dietary Fat

Dietary fat often takes the heat for an epidemic of obesity, diabetes and related diseases. But the picture is much more complicated, UNL biochemist Concetta DiRusso says.

By studying the roles different types of fatty acids play in both causing and preventing disease, DiRusso is helping expand understanding about what constitutes a healthy diet. Her research also may lead to treatments for obesity-related diseases.

Optimally, adipose tissue, commonly known as body fat, absorbs fatty acids – whether ingested or synthesized from carbohydrates by the liver – to store for energy. As adipose tissue ages, however, fatty acids can end up in other places, like the pancreas, where they kill insulin-producing cells, causing diabetes, or in the heart, causing heart failure.

With a $371,250 National Institutes of Health grant, DiRusso tests compounds for their ability to inhibit fatty acid uptake into different cell types, such as liver, intestinal and pancreatic cells. She's discovered compounds that inhibit uptake into the pancreas, which may lead to diabetes drug treatment.

In another study, DiRusso found that all omega-3 fatty acids, known for their heart-healthy attributes, are not created equal. Rodents fed diets containing omega-3s from plant sources, such as flax seed and canola oil, showed as much fat accumulation in the liver as those whose diets contained lard.

"It's the omega-3 found in fish oil (DHA) that you want to increase in your diet," DiRusso said, citing benefits such as preventing blood coagulation and promoting nerve growth. "The American diet has very, very low amounts of DHA fatty acids."

DiRusso also collaborates with other UNL researchers, investigating dietary fatty acid effects on gene expression and metabolism in the liver and gut.

Studying fat buildup in the liver has become particularly important because of the increasing prevalence of once-rare nonalcoholic fatty liver disease, now the No. 1 cause of liver failure leading to transplants.

"We're trying to understand how much and which kinds of fatty acids we really need to be eating for optimal health."

Left: Concetta DiRusso with postdoctoral fellow Elliot Jesch (left) and technician Zhigang Wang
Above: Robotic pipetting device for preparing samples

Novel Approach Targets Tuberculosis

Mycobacterium tuberculosis, the highly infectious bacterium that causes tuberculosis, is one of the world's most deadly pathogens. It strikes HIV-positive individuals particularly hard and is becoming increasingly resistant to antibiotics.

Two UNL School of Veterinary Medicine and Biomedical Sciences researchers – Ofelia Barletta-Chacon, physician and microbiologist, and Raul Barletta, biochemist and microbiologist – are taking a novel approach to develop new antibiotics and a vaccine against tuberculosis in humans, particularly people with AIDS, and in animals.

One-third of the world's population is infected with TB, which kills nearly 2 million people annually. Multidrug-resistant and extensively drug-resistant strains are much deadlier.

Most antibiotics target a single enzyme to inhibit TB so a single mutation can render treatment ineffective. The researchers' goal is to develop antibiotics that target multiple enzymes to improve effectiveness. "We focus on pathways that have not been investigated to a great extent," Barletta said.

One challenge is that TB bacilli can remain dormant in people without symptoms until aging, HIV or immunosuppressive therapies, such as cancer treatment, activate them. "Eliminating latent bacilli is one of the hardest problems," Barletta said.

"But we think we can attack that with some of the metabolic pathways that we're studying."

This work, funded by National Institutes of Health grants, may also lead to a more effective vaccine.

Mycobacterial diseases, including Johne's disease and bovine tuberculosis, also infect cattle and can be economically devastating for owners of infected herds. These researchers hope their work leads to vaccines to prevent bovine TB and tools for more accurate, faster diagnoses in the field.

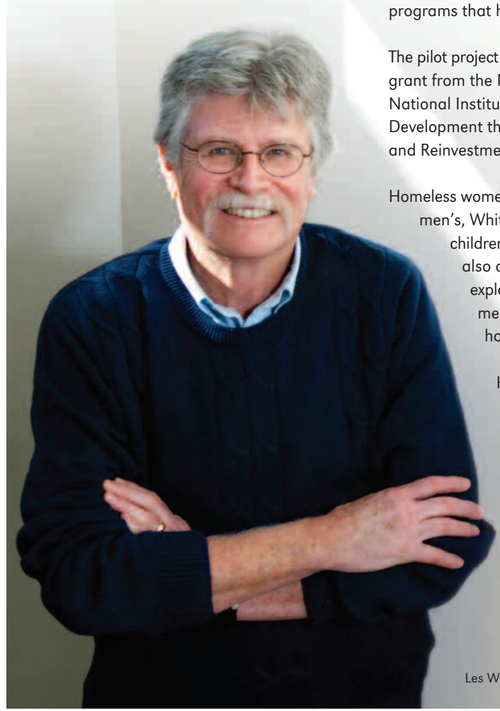
Their research also may eventually help combat other diseases, such as Crohn's disease in people, in which mycobacteria have been implicated as potential causative agents.

"We want to find an integrated approach to mycobacterial diseases in humans and animals so we can apply the knowledge of one to another," Barletta-Chacon said.

Above: Raul Barletta and Ofelia Barletta-Chacon

Pathways to Homelessness for Women

Women make up nearly one-third of the homeless population in the United States. Yet little is known about how they become homeless or how they live.



Les Whitbeck

UNL sociologist Les Whitbeck hopes his new research project surveying the lives of homeless women will lead to better understanding and to programs that help combat the problem.

The pilot project is funded by a $400,715, two-year grant from the National Institutes of Health's National Institute of Child Health and Human Development through the American Recovery and Reinvestment Act.

Homeless women's situations differ greatly from men's, Whitbeck said. Women often have children, which limits their options. They also are more vulnerable to sexual exploitation, may suffer from different mental disorders and become homeless for different reasons.

His goal is to understand the various pathways to homelessness and the long-lasting effect it may have on mental health and risks of HIV infection.

"The ultimate goal is to turn research into action by creating prevention programs to help women get off the street and to minimize the impact on children," Whitbeck said.

He's testing innovative new techniques for documenting pivotal life events and for diagnosing mental and substance abuse disorders, as well as methods for obtaining a truly representative sample. Because homeless women's situations vary tremendously, capturing that diversity is challenging.

Whitbeck will test his survey and sampling methods in Omaha, Neb., Pittsburgh, Pa., and Portland, Ore., before beginning a national survey. Validating his survey methods will help other researchers who are studying vulnerable and hard-to-reach populations. Hiring homeless women as interviewers will provide them with valuable work skills and help survey respondents feel more comfortable.

"We've allowed homelessness to become part of the urban landscape," Whitbeck said. "For years, we've just ignored it and actually criminalized it. This is an effort to increase our national consciousness."

Bison Books – 50 Years of Great Reading

In 1961, the University of Nebraska Press took a gamble that changed people's views of paperback books and made literature accessible and affordable to everyone from truckers to school kids.

UNP published eight paperbacks under its new Bison Books imprint. Selling for $1 to $1.50 each, these included poetry, history, literary criticism and *Old Jules* by Mari Sandoz. Editors selected books for their accessibility, popular appeal and lasting value. It was risky. Consumers were used to seeing pulp novels and dime-store Westerns on paperback racks, not serious literature.

"As it turns out, there was a hunger for affordable books with scholarly or literary merit," said UNP Director Donna Shear. "It was a bold move that continues to be successful."

In 2011, UNP celebrates the 50th anniversary of its popular imprint. Several classics will be re-released as anniversary editions, and excerpts from 18 classic Bison Books editions will be collected in *The Golden West: 50 Years of Bison Books*. This collection includes excerpts from Mari Sandoz's *Crazy Horse,* Elinore Pruitt Stewart's *Letters of a Woman Homesteader* and John G. Neihardt's *Cycle of the West,* all originally released in the early years.

Conceived in 1960 with first copyrights in 1961, Bison Books titles were immediately popular. By 1978, paperbacks constituted more than half of UNP's total sales, proving a medium-sized academic press could hold its own on paperback racks in dime stores and rest stops nationwide.

Bison Books, like UNP as a whole, is known for publishing Western fiction and history, military history, indigenous studies, sports history, memoirs and literary translation. Recently, Bison Books has released new editions of pulp novels and dime-store Westerns the imprint initially competed with.

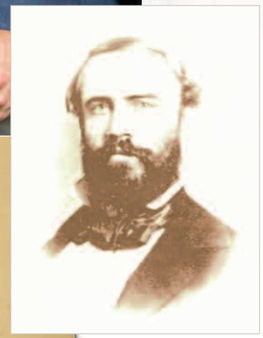
Bison Books has helped to keep Jules Verne's science fiction, Harold Lamb's fantastical stories and A.B. Guthrie Jr.'s murder mysteries in print and accessible to new audiences.

"The titles and genres we seek out continue to change and evolve," said Tom Swanson, Bison Books' manager. "But throughout the entire 50-year history, our mission of publishing affordable, quality, classic books has stayed the same."

Some of Bison Books' many titles

"But throughout the entire 50-year history, our mission of publishing affordable, quality, classic books has stayed the same."

Historian Weaving Western Family Saga



Digging into rarely used archives, UNL historian Andrew Graybill slowly pieced together the circumstances surrounding a small episode – a rancher's murder – and how it triggered a large, tragic event in U.S. history.

That event – the massacre of Blackfoot Indians in 1870 – and the Clark family at the heart of this frontier drama form the centerpiece for Graybill's forthcoming book, tentatively titled *A Mixture of So Many Bloods: A Family Saga of the American West,* to be published by W.W. Norton in 2012.

The book follows five members of three generations of a Montana family from about 1850 to 1950. The descendants of murdered rancher Malcolm Clark and his Blackfoot wife, Coth-co-co-na, like many mixed-blood people, were brokers between two worlds, helping to smooth relations between native peoples and Anglo newcomers. By the late 1800s, however, mixed-blood individuals became increasingly marginalized and pushed onto reservations.

Using a narrative style, Graybill hopes to bring the Clark family to life with vivid details gleaned from extensive archival and field research.

Although several family members went on to lead extraordinary lives, the family also represents the typical experience of mixed-blood families at a time when the West was being incorporated by the United States. Graybill said he hopes their story illustrates that once "there was a possibility for a more peaceful absorption of the West than this binary racial formulation that we've got today. There were people who lived quite well, for a time at least, before these much more hardened racial attitudes coalesced in the mid- to late 19th century and beyond."

Graybill received a prestigious National Endowment for the Humanities Fellowship to complete the book. His previous book, *Policing the Great Plains: Rangers, Mounties and the North American Frontier, 1875-1910,* was published in 2007 by the University of Nebraska Press.

Top: Andrew Graybill
Above: Malcolm Clark
Left: Clark family

Ecotourism's Economic Potential

The annual sandhill crane migration through central Nebraska's Platte Valley is an economic windfall as well as a world-class wildlife spectacle.

UNL economists Eric Thompson and Rick Edwards found that the crane migration has at least a $10.3 million annual impact on central Nebraska's economy. Their research highlights potential economic opportunities for rural areas across the Great Plains.

"One interesting thing about ecotourism is that it has research and educational components as well as tourism," said Thompson, director of the College of Business Administration's Bureau of Business Research.

They found that many people do more than just watch the cranes. Visitors often participate in "eco-engagement," volunteering or taking education programs and staying longer. Eco-engagement adds economic value and increases conservation awareness.

To calculate the cranes' total economic value, Thompson and Edwards estimated the impact of two of Nebraska's conservation and research centers that focus on the spring crane migration through the region. They assessed the centers' operational expenditures and additional spending by crane-watchers coming to the state.

Researchers found, for example, that the Audubon's Rowe Sanctuary, a nonprofit center near Gibbon, Neb., has an annual impact of $2.08 million on the region's economy – mostly from food, lodging and shopping purchases by visitors when they are away from the sanctuary.

Their findings hold promise for rural areas in Nebraska and beyond.

"There's potential to expand this type of activity to other natural environments where you gain a lot of revenue from tourists who do eco-engagement type activities," Thompson said, such as visiting grassland prairies to view prairie chickens, bison or wildflowers.

For example, ranchers who manage their land to enhance native ecological features, such as wildlife and plants, may earn added income from ecotourists to complement their traditional cattle operation, Edwards said.

A companion study of the nonprofit Cheetah Conservation Fund showed similar economic benefits for Namibia, where ecotourism already plays a major role in developing its economy.

Above: Eric Thompson (left) and Rick Edwards

"We're using computer technology to quantify small changes in speech production that are otherwise undetectable."

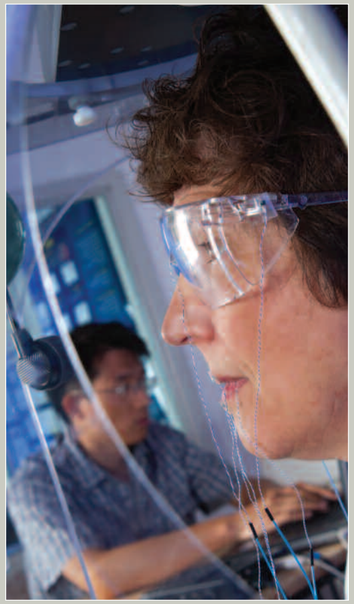
3-D Helps Detect ALS Speech Declines

The same technology used to bring King Kong to life in the movies is helping researchers better understand amyotrophic lateral sclerosis, or ALS, a neurodegenerative disease that attacks neurons and weakens muscles over time. About 30,000 Americans suffer from ALS, commonly called Lou Gehrig's disease.

UNL speech-language pathologist Jordan Green and colleague Yana Yunosova at the University of Toronto are using computer technology to study the decline in speech in ALS patients with a $2.37 million, five-year grant from the National Institutes of Health's National Institute on Deafness and Other Communication Disorders. Their work may lead to earlier diagnosis and aid in treatment development.

Currently, no tests can definitively diagnose ALS. Physicians must rely on observing weakening muscles and ruling out other causes, which often takes 18 months after initial symptoms appear.

For more than one-fourth of patients, symptoms begin with speech impairment, called bulbar symptoms. While bulbar deterioration impairs speech and swallowing, relatively few studies have focused on these symptoms.



Measuring muscles involved in speech is particularly difficult, which can delay diagnosis and treatment.

"To produce speech you need to coordinate the activities of between 30 to 70 muscles," said Green. "We're using computer technology to quantify small changes in speech production that are otherwise undetectable."

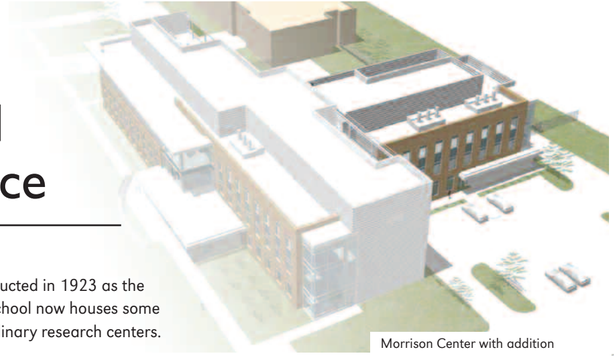
Green is following 100 bulbar-onset ALS patients at UNL and the University of Toronto to study progression of speech degeneration. He's using 3-D motion analysis to track facial movements in fine detail, electromagnetic equipment to track tongue motion and special equipment to evaluate speech breathing and voice.

Sensitive measurements of facial muscles will help determine abnormal muscle strength for early diagnosis, monitor disease progression and predict when patients will lose speech so they can better prepare.

Finely detailed measurements also will help in the search for effective treatments. "Outcomes measures in the bulbar system are fairly blunt," Green said. "They need sensitive measures to determine small changes, and that will expedite drug trials."

Left: Jordan Green in front of instrument that tracks facial movements in 3-D
Above: Lab manager Cynthia Didion (foreground) and graduate student Jun Wang

Construction Projects Add High Quality Research Space



Morrison Center with addition

UNL's research growth has increased demand for research space campuswide. Several major construction and renovation projects are easing the space shortage and providing state-of-the-art research facilities.

Jorgensen Hall
In 2010, UNL's physics and astronomy department traded cramped and outdated labs, classrooms and offices in three older buildings for new state-of-the-art space in Theodore Jorgensen Hall.

The four-story, 121,000-square-foot building features research lab and office space, two lecture halls, four teaching labs and eight classrooms. The $38 million building brings together more than 40 faculty, lecturers and emeriti, 26 postdocs, 60 graduate students and staff in one building designed for modern research and teaching.

It is named for the late Theodore Jorgensen, a Nebraska graduate whose distinguished faculty career at the university spanned nearly 40 years. Constructed with sustainable and energy-efficient features, it's expected to earn silver LEED certification from the U.S. Green Building Council.

Whittier Building
An historic building constructed in 1923 as the nation's first junior high school now houses some of UNL's major interdisciplinary research centers.

A $20 million renovation transformed the former school building into modern research space and the new UNL Children's Center. The renovation provides centralized laboratory, meeting and office space for several major multidisciplinary research centers. Initial occupants include the Nebraska Transportation Center, the Nebraska Center for Energy Sciences Research and, soon, the new global Water for Food Institute. For the Nebraska Transportation Center, the move means that most transportation research on campus is now under one roof.

Virology Addition
Nebraska Center for Virology scientists will soon have additional lab space, thanks to an $8 million grant to expand the Ken Morrison Life Sciences Research Center.

The grant from the National Institutes of Health's National Center for Research Resources is funded through the American Recovery and Reinvestment Act. It will enable UNL to construct a 26,000-square-foot laboratory wing. Construction will begin in 2011 with completion in 2012. Opened in 2008, the 68,741-square-foot Morrison Center was designed to accommodate future expansion. The addition will include up to seven research laboratories, lab support facilities, and office and seminar space.

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

Keim Hall
A $14 million renovation of Keim Hall provides updated laboratories, classrooms and offices for UNL's agronomy and horticulture department, the Nebraska Forest Service, the Center for Grassland Studies and USDA-Agricultural Research Service scientists.

Constructed in 1950, the 53,727-square-foot building needed extensive renovation. It was gutted and redesigned to meet today's research and teaching needs and to improve energy and water efficiency. It's expected to earn silver or gold LEED certification.

Nanoscience Facility in the Works

The more than 70 physicists, chemists and engineers who collaborate on UNL's nationally recognized materials and nanoscience research soon will share a new, centralized research facility.

The new Nanoscience Metrology Facility will provide much-needed research space for this interdisciplinary program of excellence, whose core facilities, equipment, labs and faculty currently are located in several campus buildings. The new facility will feature centrally located laboratories, research facilities and administrative space. Construction is under way with completion slated for 2011.

Construction was made possible by a $6.9 million grant from the National Institute of Standards and Technology (NIST), funded by the American Recovery and Reinvestment Act, to cover nearly half of the $14.8 million cost. Private donations and university funds will finance the rest. NIST is a non-regulatory agency in the U.S. Department of Commerce.

The 32,000-square-foot building is being constructed adjacent to the new Theodore Jorgensen Hall, which houses the physics and astronomy department. It is designed with flexible, multi-use research space to facilitate interdisciplinary collaboration. It will provide a low-vibration, temperature-controlled, low-electromagnetic field environment and clean rooms necessary for world-class research and measurements.

"It will provide modern central facilities for nanofabrication, electron microscopy and other synthesis and characterization laboratories," said David Sellmyer, director of the Nebraska Center for Materials and Nanoscience. "Also, it will permit new collaborative research that cannot be pursued in our present ... buildings and laboratories that are scattered across campus."

UNL is home to one of the nation's top nanomagnetism research groups. Materials scientists, nanoscientists and engineers from across UNL collaborate through the Nebraska Center for Materials and Nanoscience, and in UNL's National Science Foundation-funded Materials Research Science and Engineering Center focused on nanomagnetics and spintronics.

Above: Drawing of Jorgensen Hall (left) and adjacent Nanoscience Metrology Facility (right)

Powerful Microscope Will Aid Research

Sophisticated equipment in UNL's Nanoscience Metrology Facility will include a new transmission electron microscope to characterize the structure and properties of nanoscale materials and devices.

Such state-of-the-art equipment is important "so that you can do the best science," said physicist David Sellmyer, director of the Nebraska Center for Materials and Nanoscience. The center received a $1.3 million Major Research Instrumentation grant from the National Science Foundation through the American Recovery and Reinvestment Act for the microscope, which should be installed in early 2011.

The powerful microscope can characterize nanomaterials such as thin films, patterned surfaces, particles and wires. It can map structure, composition and properties and provide 3-D analysis. UNL researchers currently must travel out of state to use such equipment.

"Knowing the structure of nanomaterials is extremely important," Sellmyer said. "When you make particles that small, they can have structures that don't exist normally. You can't clearly understand how the particles are functioning without knowing the structure."

Nebraska Innovation Campus Plans, Prep Moving Ahead

Plans for Nebraska Innovation Campus are moving forward with a new leadership board overseeing development of the private-public research community.

The campus is being developed on about 250 acres adjacent to UNL and near downtown Lincoln. It's planned as a premier private-public sector, sustainable research campus that capitalizes on UNL's research and faculty expertise. Businesses and entrepreneurs will work closely with faculty and students in an innovative environment. The long-term project is designed to strengthen Nebraska's economy, build public-private collaborations and stimulate job creation.

The University of Nebraska Board of Regents in April named representatives to the Innovation Campus Development Corp.'s first board of directors. Private business and university representatives on the nine-member board will guide development and advise regents. Private sector members are: Tom Henning, CEO of Assurity Life Insurance Co.; Dana Bradford, president of McCarthy Capital Corp.; Matt Williams, president of Gothenburg State Bank; Tonn Ostergard, president and CEO of Crete Carrier Corp.; and JoAnn Martin, CEO of Ameritas Life Insurance Corp. University representatives are: James B. Milliken, University of Nebraska president; Harvey Perlman, UNL chancellor; Prem S. Paul, UNL vice chancellor for research and economic development; and Ronnie D. Green, NU vice president and vice chancellor for the Institute of Agriculture and Natural Resources.

UNL took ownership of the property, formerly home to the Nebraska State Fair, on Jan. 1, 2010. Initial site preparation is under way.

Over the next 20 to 25 years, private companies and the university will develop the campus. Development is expected to be two-thirds private and one-third public and will include private, university and government research and office space, retail and recreational space, residential living and perhaps a hotel.

Consultants estimated that when fully developed Nebraska Innovation Campus could create 5,525 new jobs and grow Nebraska's annual payroll by $267 million.

Illustrations: Artist's renderings of Nebraska Innovation Campus

Expanding Collaborations

UNL is bolstering its industry relations and technology development efforts, expanding opportunities for the university and private companies to collaborate.

Since its launch in 2008, UNL's Industry Relations Office has established or broadened partnerships with numerous state and national companies, including Boeing, LI-COR Biosciences, Teledyne Isco and Lincoln Industries. The office is the "front door" for companies interested in working with the university, connecting them with faculty, facilities or students.

UNL's Nebraska Innovation Campus will create new opportunities for companies and entrepreneurs to work closely with UNL faculty and students, said Ryan Anderson, director of Industry Relations. Fostering these relationships is a priority.

Industry Relations and NUtech Ventures, the organization responsible for commercializing university research, work closely. Together, they offer companies a range of options, from consultations with faculty to licensing and start-up opportunities involving UNL-developed technologies. Recent collaborations with an Omaha company provide one example:

In spring 2010, Streck Inc., which manufactures clinical laboratory products, acquired Philisa Technology Corp., a start-up company owned by UNL's Hendrik Viljoen, chemical and biomolecular engineering professor; Joel TerMaat, a doctoral candidate; and Scott Whitney, a postdoctoral fellow. They had developed a portable, high-speed polymerase chain reaction instrument that rapidly extracts and replicates small segments of DNA.

This deal included intellectual property owned by Philisa, NUtech Ventures and UNeMed, the University of Nebraska Medical Center's technology development organization. UNL worked with everyone involved to facilitate the acquisition.

Connie Ryan, Streck's president, said the acquisition wouldn't have been possible without UNL's cooperation.

In another collaboration, Industry Relations arranged for UNL virologist Charles Wood to conduct sponsored research for Streck on its Cyto-Chex® blood collection tubes, which preserve samples from HIV patients longer than traditional vials. Wood found that the stabilizing agent in the tubes inactivates HIV within 24 hours, enabling safer handling of samples.

NUtech Ventures Leads Tech Development

NUtech Ventures is betting that strong partnerships are the best way to move university research discoveries from lab to marketplace.

The metamorphosis is more than a name change, said David Conrad, NUtech's executive director. "It's allowed us to foster an entrepreneurial culture."

NUtech is the new nonprofit corporation responsible for commercializing discoveries and products from university research. Established in September 2009 by the University of Nebraska Board of Regents, NUtech was formerly UNL's Office of Technology Development.

NUtech is independent of the university and structured much like its private company clients. A board of directors made up of business people and three UNL representatives oversees operations. Some of the most successful university technology operations have long used this nonprofit corporation structure.

"It's made it easier for us to partner with the business community and removed roadblocks to joint ventures," Conrad said.

Partnership-building is at the heart of NUtech Ventures' business model. NUtech staff work to match industry, entrepreneurs and investors with university researchers based on mutual interests. Conrad said building long-term business relationships is the best way to commercialize the products of university research.

During NUtech's first year, invention disclosures from UNL faculty increased about 25 percent and licenses and options increased 20 percent. NUtech mainly serves UNL faculty but also works with faculty on other NU campuses.

In 2011, NUtech will focus on creating start-up companies based on university-developed technologies and products. That fits well with its overall goal of generating income for the university and spurring economic development for Nebraska.

"We specifically measure our performance by the number of companies, products and jobs for Nebraska created by university research," Conrad said.

Learn more at **nutechventures.org.**

Above: NUtech Ventures' office in downtown Lincoln, Neb.

Enhancing Campus Culture, Diversity

ADVANCE-Nebraska continues to improve UNL's culture and ensure that all science, technology, engineering and mathematics (STEM) faculty thrive. UNL's program focuses on recruitment, promotion and retention of women in STEM fields.

In 2010, Prem Paul, vice chancellor for research and economic development, was named principal investigator of ADVANCE-Nebraska, which was funded in 2008 by a five-year, $3.8 million grant from the National Science Foundation.

"ADVANCE-Nebraska is transformational at UNL. We're seeing enhanced collaboration and a stronger and more broadly inclusive culture. I'm proud that our faculty members' engagement with this important program continues to grow," Paul said.

Mary Anne Holmes, the geoscientist who directs ADVANCE-Nebraska, added, "We're delighted that ADVANCE-Nebraska has been instrumental in hiring six dual-career couples in STEM departments at UNL."

Sociologist Christina Falci leads a team that has applied social network analysis to explore connections in STEM departments at UNL, in a study funded by a seed grant from ADVANCE-Nebraska and the Office of Research and Economic Development. Falci surveyed faculty in 15 STEM departments and found that women and non-white men tend to have fewer social connections within their departments than white men. Non-white males also are less likely to be connected to "well-connected" faculty in research and social networks. Being outside the networks can mean that females and non-white males have less access to information and less influence within their departments.

Falci and co-authors – sociologist Julia McQuillan, sociology doctoral student Megumi Watanabe and Holmes – have submitted their findings to the American Sociological Association. They will launch the second phase of their study in spring 2011.

Above: Julia McQuillan (left) and Christina Falci

Research Aims to Improve Wildfire Prediction

David Peterson's fascination with storms brought him to UNL to study meteorology. But now the former storm chaser is using his knowledge of storms to pursue even bigger prey.

The UNL geosciences graduate student is combining meteorological data with NASA satellite images to study wildfires caused by lightning strikes to better predict where fires will occur. This innovative work may one day lead to improved fire weather forecasting. Peterson completed his master's degree in 2009 and won a prestigious $90,000 NASA Earth and Space Science Fellowship to continue his doctoral research at UNL with atmospheric scientist Jun Wang, who earned the same fellowship in 2004.

The Indiana native credits a summer 2008 trip to NASA's Goddard Space Flight Center in Greenbelt, Md., for spurring his interest in satellites.

Peterson and Wang saw an opportunity to combine Peterson's meteorological background with Wang's research using satellite data. Wang studies the effect of particulates from fires and volcanic eruptions on air quality, visibility and climate.

Forest fires behave differently depending on local weather patterns, land features and climate. Current forecasting models cannot account for these variations. By combining ground and satellite data, Peterson hopes to improve the models' forecasting capabilities. His research focuses on the boreal forest in Canada and Alaska.

"I use the meteorological data that's already available. But to actually know where the fires occur, you need satellite technology," Peterson said. "Otherwise, you have to rely on someone on the ground spotting the fire, which isn't nearly as reliable as looking at it from space."

Peterson will use these techniques to look at other fire behavior characteristics, such as how they spread.

"Dave has really come along at the right time," Wang said. "We lack an expert who knows both meteorology and satellite sensing. What he's learning will be needed by many agencies."

The work dovetails with Wang's current research on the impact of smoke from jungle-clearing fires in Central America on air quality, clouds and precipitation in the U.S., funded by a $300,676 grant from NASA's New Investigator Program in Earth Sciences.

Above: Jun Wang (left) and David Peterson

Students Get Taste of International Journalism

From left, UNL students Sarah Tenorio and Elizabeth Gamez and interpreter Viktoria Perederiy head to an interview

The reactions Kyle Bruggeman got when he told people he had studied photojournalism in Kazakhstan illustrated why he needed to go.

"Everybody asked, 'Oh, where is that?'" said Bruggeman, a senior news-editorial major in UNL's College of Journalism and Mass Communications.

Kazakhstan is a central Asian country bordered by Russia to the north and China to the east. Freed from the Soviet Union in 1991, the young nation's international influence is burgeoning because of its vast oil, gas and mineral resources and growing economy.

Yet it's still a nation of contrasts between the haves in cosmopolitan cities and the have-nots in industrial and rural areas, said Bruce Thorson, associate professor of news-editorial. He and news-editorial professor Joe Weber mentored eight UNL students who spent three weeks documenting Kazakhs' lives through photos, videos and stories.

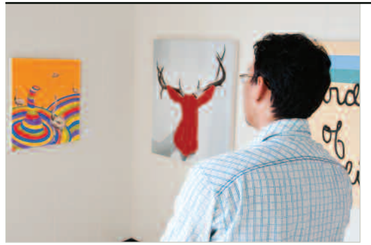
The experience gave Bruggeman and other students a realistic look at the challenges of international journalism, such as using interpreters and finding sources willing to speak with Americans, Thorson said.

They also got a deeper perspective on what Kazakhs value. Even the poorest families are content if they're healthy and able to put food on the table, he said.

Students will launch a multimedia website this fall and publish a book in late 2010. The project is supported by a gift from renowned photographers Howard Buffett, Thomas Mangelsen and Joel Sartore that enables UNL student journalists to travel to an emerging country where there is great human need. Previous groups went to South Africa and Kosovo.

"I hope our stories and photos give readers a glimpse into what life in Kazakhstan is about," Thorson said. "The students and I found a greater appreciation for this type of lifestyle, which is something you cannot get when you're in the U.S."

Connecting Art and Nature



"Tagged and Collected" exhibit

From amphibians to mammals, the University of Nebraska State Museum's extensive zoology collection inspired "Tagged and Collected," a 2010 student art exhibit.

Patricia Freeman, museum curator and professor of natural resources, and Aaron Holz, associate professor of art and art history, teamed to allow Holz's beginning painting class to view the research collection typically kept behind closed doors at the state's premier natural history repository.

Each artist decided which specimens to portray, combining details biologists notice, such as species, geography and history, with the artistry of textures, colors and shadows. The project helped students refine their observational skills and examine connections between art and nature. Further collaborations are in the works.

New Leaders Join UNL


Ronnie D. Green


Susan Poser


Donde Plowman


Gary Kebbel


Eddy M. Rojas

Several new administrators joined UNL in 2010, bringing diverse expertise to the university.

IANR Vice Chancellor
Ronnie D. Green, an animal scientist with extensive academic, private sector and federal research experience, became the Harlan Vice Chancellor of the Institute of Agriculture and Natural Resources and University of Nebraska vice president.

Before joining UNL in July, Green was senior director, animal genetics global technical service, for Pfizer Animal Health. Previously, he was national program leader in Food Animal Production at USDA's Agricultural Research Service and vice president of cattle operations and assistant vice president and director of genetic operations for Future Beef Operations. He was an animal science professor at Colorado State University and assistant professor of animal science at Texas Tech University. Green earned his doctorate from UNL, a master's from Colorado State and a bachelor's degree from Virginia Tech, all in animal science.

College of Law
Law professor Susan Poser became College of Law dean in May. Poser joined the College of Law faculty in 1999. She was chief of staff and associate to UNL's chancellor from 2007 until 2010. Poser also is director of UNL's Robert J. Kutak Center for the Teaching and Study of Applied Ethics. She is on the Women's and Gender Studies faculty. Poser earned her law and doctoral degrees from the University of California, Berkeley, and her bachelor's degree from Swarthmore College. She is a member of the Pennsylvania and Nebraska bars and serves on the Nebraska State Bar Association's ethics committee. She practiced law in Philadelphia and was the Zicklin Fellow in Ethics at the University of Pennsylvania's Wharton School.

College of Business Administration
Donde Plowman became the dean of the College of Business Administration in July. She previously was the Ralph and Janet Heath Professor of business and head of the Department of Management at the University of Tennessee. Earlier, she was a professor of management at the University of Texas at San Antonio, serving as associate dean for graduate programs and research and director of the College of Business doctoral program. Plowman holds a doctorate in strategic management from the University of Texas, a master's in higher education administration from the University of North Texas and a bachelor's degree from Southern Methodist University.

College of Journalism and Mass Communications
Gary Kebbel became dean of the College of Journalism and Mass Communications in July. Kebbel previously was journalism program director for the John S. and James L. Knight Foundation, where he directed the $25 million Knight News Challenge, which funds digital news innovations. Earlier, he was director of AOL News, founding editor of USAToday.com and Newsweek.com, a graphics editor at USA Today and a newspaper editor. He was an adjunct instructor at the University of Maryland in College Park, Northern Illinois University and Adirondack Community College. Kebbel has a bachelor's degree from Illinois State University, master's degrees in journalism and political science from the University of Illinois and a master's of social work from the Catholic University of America.

Durham School
Eddy M. Rojas became director of The Charles W. Durham School of Architectural Engineering and Construction in March. He joined UNL from the University of Washington where he was a professor of construction management and director of the Pacific Northwest Center for Construction Research and Education. Rojas holds doctoral and master's degrees in civil engineering and a master's in economics from the University of Colorado. He completed undergraduate studies at the University of Costa Rica. The Durham School, part of UNL's College of Engineering and headquartered at Omaha's Peter Kiewit Institute, is the nation's only program that combines architectural engineering, construction engineering and construction management in one school.

U.S.-India Collaboration Tackles Transportation

In India, where bullock carts, bicycles, motorcycles, cars, trucks and 1.2 billion people vie for space on jam-packed roads, managing transportation is a critical concern.

"Emerging Trends in Intelligent Transportation," a workshop co-sponsored by UNL and the Indian Institute of Technology-Madras (IIT-Madras) in Chennai, India, in February 2010 tackled these issues.

Intelligent transportation systems (ITS) integrate advanced information and communications technologies to monitor traffic flow, weather and other factors affecting transportation. These data can be used to manage traffic flow and congestion through real-time traveler information systems, emergency networks, automated highways and other applications.

"The great part about the workshop was that it brought together key Indian and U.S. representatives from the private sector, public sector and academia to discuss critical transportation issues. While India and the U.S. face similar problems, such as safety, congestion and pollution, we use different components of ITS to address these issues so the conference provided tremendous benefits in learning about key successes in our different countries," said Larry Rilett, director of UNL's Nebraska Transportation Center and workshop co-organizer with Lelitha Devi Vanajakshi from IIT-Madras.

The workshop featured 27 ITS experts from the U.S. and India, including Rilett and UNL colleagues Anuj Sharma and Elizabeth Jones, and more than 100 Indian and American participants. One outcome was a mechanism enabling student and faculty exchanges between UNL and IIT-Madras to work on complementary research projects. Also in development is a proposal for an Indo-US Joint Centre of Intelligent Transportation Systems involving UNL, Purdue University, IIT-Madras and IIT-Mumbai.

The workshop was sponsored by the Indo-US Science and Technology Forum, with the support of executive director Arabinda Mitra and Michael Cheetham, director of the Forum's U.S. Secretariat.

Above: Arabinda Mitra

Credits

The 2009-2010 Annual 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:

Prem S. Paul
Vice Chancellor for Research and Economic Development
301 Canfield Administration Building
University of Nebraska–Lincoln
Lincoln, Nebraska 68588-0433
(402) 472-3123 • ppaul2@unl.edu

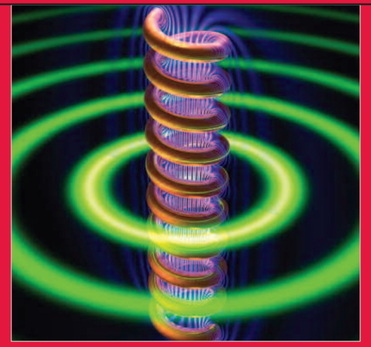
Writers/Editors:
Vicki Miller, Monica Norby, Ashley Washburn, Elizabeth Banset, Office of Research and Economic Development

Contributing Writers:
Gillian Klucas, Kim Hachiya, Cara Pesek
Some articles are based on earlier stories from University Communications and IANR News Service and written by Kelly Bartling, Troy Fedderson, Sara Gilliam, Sandi Alswager Karstens, Daniel R. Moser, Judy Nelson, Tom Simons, Steve Smith, Carole Wilbeck

Photography/Illustrations:
Joel Brehm, Brett Hampton, Craig Chandler, Alan Jackson/Jackson Studios, Greg Nathan, Bruce Thorson, Robert Cope, Laurence Smith
Historic photos, page 22, courtesy Joyce Clarke Turvey

Design: Sym Labs

Research Highlights



Explaining a Rare Phenomenon
Research by UNL physicist Herman Batelaan helped answer questions about a little-understood quantum physics phenomenon – the Aharonov-Bohm effect – whereby electrons can be affected by electromagnetic potentials without coming in contact with actual force fields. Predicted by Yakir Aharonov and David Bohm in 1959, the theory was received with skepticism. But many questions were answered by experiments in Japan and at UNL. A 1986 Japanese experiment showed the action-at-a-distance effect is real. Batelaan's 2007 experiment showed there is no force acting on the electrons. The findings were featured on the cover of the September 2009 issue of *Physics Today,* along with an article by Batelaan and the Japanese scientist reviewing research into this phenomenon.

Digital Railroad History
Historians, computer scientists and geographers are teaming on digital research tools to correlate, analyze and visualize the development of railroads and their transformational impact. Historian William Thomas and UNL computer scientists are collaborating with faculty at the University of Portsmouth, U.K., and Canada's University of Victoria and McGill University. A nearly $100,000 grant from the National Endowment for the Humanities' Digging into Data Challenge funds this work. The project is creating new software and tools to compare, analyze and correlate diverse railroad-related data across time and space. The work supports UNL's "Railroads and the Making of Modern America" digital history project, which integrates historical information from digital repositories – such as time schedules, newspaper stories, payrolls and maps – with other data, such as county-level census figures. **Web: railroads.unl.edu**

Perceptions of Cheating
Most high school students have cheated on tests and homework. In some cases, they don't consider their actions inappropriate, a study led by UNL educational psychologist Kenneth Kiewra found. An anonymous survey of 100 high school juniors showed students generally understand what constitutes cheating but do it anyway if they think they won't be caught. Attitudes are connected with effort; for example, most students believe sharing test answers is more dishonest than divulging test questions. Students also perceive in-class cheating, like providing answers to a classmate during a test, to be more dishonest than misdeeds outside class, such as doing homework with a partner. *Mid-Western Educational Researcher* published the study, which shows teachers need to clearly spell out what constitutes cheating and vigilantly police it.

Century of Ag Research
UNL's Panhandle Research and Extension Center marked 100 years of agricultural research during

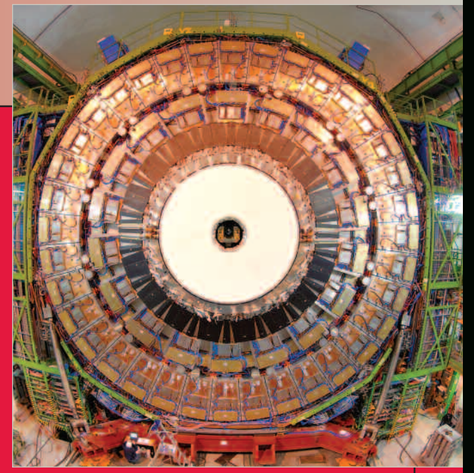
its 2010 centennial. The Scotts Bluff Experimental Substation was established on 160 acres near Mitchell, Neb., in 1910 to research how to successfully farm newly irrigated land in the state's arid Panhandle. Over the years, it expanded and moved, eventually becoming the Panhandle Research and Extension Center. The original site – now known as the Mitchell Station – remains an integral part of the university's research program focusing on the region's agriculture. It includes the Knorr-Holden Continuous Corn Plot, which has been planted to corn since 1912 and is the oldest irrigated corn research plot in North America.

Women and Pregnancy
A nationwide study led by UNL sociologist Julia McQuillan showed that nearly one in four women is ambivalent about pregnancy. In a study of 4,000 sexually active women ages 25 to 45, 23 percent responded they were not trying to conceive or prevent a pregnancy. The findings challenge the assumption that women of childbearing age are always trying, one way or another, to get pregnant or prevent pregnancy. Accurate measures of women's intentions are important for estimating the unmet need for contraception, building more effective family planning programs, promoting infant health and improving maternal and infant well-being. *Maternal and Child Health Journal* published the findings.

Green Building Training for Vets
Construction management faculty in The Durham School of Architectural Engineering and Construction are developing an online curriculum to train U.S. veterans for jobs to make buildings, especially healthcare facilities, more energy efficient. The training emphasizes reducing energy use and improving air quality in aging commercial buildings and healthcare facilities, which are among the most energy-use intensive buildings. A $405,741 grant from the U.S. Department of Energy funds this project through the American Recovery and Reinvestment Act.

Cracking Soybean's Code
Successful sequencing of the soybean genome is opening doors to improving this important legume for food and fuel production. UNL soybean geneticist Jim Specht was among the 45 researchers who published a complete draft of the soybean genetic code in *Nature*. This achievement resulted from a nationwide collaboration involving 18 institutions, including universities, the U.S. Department of Energy Joint Genome Institute and USDA's

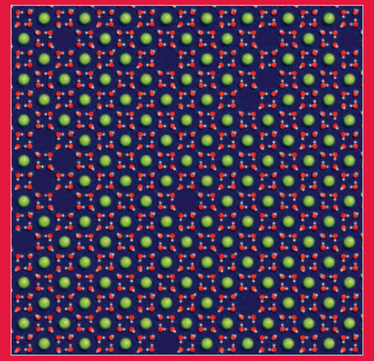
Agricultural Research Service. The DOE, National Science Foundation, USDA and United Soybean Board funded the research. Availability of the soybean genetic code will significantly speed up breeding to enhance the crop.



Analyzing CMS Data
Since the first particle collisions occurred at the Large Hadron Collider at the European Organization for Nuclear Research near Geneva, Switzerland, in November 2009, UNL's high-energy physics team has been capturing and analyzing data. UNL physicists are involved in one of the two largest experiments, the Compact Muon Solenoid, a particle physics detector designed to investigate a wide range of questions, including the search for the Higgs boson, extra dimensions and particles that could comprise dark matter. UNL's team leads management for the U.S. CMS Tier-2 project, a collaboration of seven U.S. universities selected to capture and analyze the vast volumes of data generated by the international Large Hadron Collider project experiments.

Research Highlights

Ice Discoveries
Recent discoveries by UNL chemist Xiao Cheng Zeng's team are expanding understanding of how materials – especially water – behave on the molecular scale at extremes of temperature,



pressure and confinement. Using a computer simulation, they discovered a two-dimensional ice clathrate. A clathrate is a molecular cage, usually three-dimensional, in which molecules of one substance are enclosed in the crystal structure of another. Their simulation revealed a flat, single-layer ice clathrate. As the two-dimensional ice formed under negative pressure, it developed into an interlocking pattern of small square-shaped openings and larger octagonal-shaped openings. Hydrophobic argon atoms used in the experiment filled the octagonal "cages" in the ice clathrate. The team reported this and related discoveries in the *Proceedings of the National Academy of Sciences.* The Department of Energy funded this research.

Bancroft Prize Winner

History professor Margaret Jacobs received the 2010 Bancroft Prize, one of the highest honors for American history writing, for her book *White Mother to a Dark Race: Settler Colonialism, Maternalism, and the Removal of Indigenous Children in the American West and Australia, 1880-1940,* published by the University of Nebraska Press. Jacobs describes white women's roles in removing indigenous children from their families and assimilating them into American and Australian cultures. The book also describes what motivated these women – often surrogate mothers and teachers – to separate indigenous children from their families and how this practice affected the children and the culture as a whole. Columbia University annually awards the Bancroft Prize to authors of distinguished works in American history or diplomacy.

Small RNA Quality Control
Humans and other organisms produce millions of small RNAs (ribonucleic acid) that regulate gene expression and ensure proper development of healthy cells to protect against viruses. Until recently, no one was sure how biology weeded out the defective from normal RNAs. A UNL team, led by biologist Heriberto Cerutti, and University of Delaware colleagues identified two enzymes in a green alga that operate as quality controls, eliminating malformed small RNAs. The discovery of a quality-control mechanism is especially relevant for crops and humans because many viruses that attack plants and humans are RNA-based. The findings were published in the *Proceedings of the National Academy of Sciences.*

Tools for Ecological Questions

Duckweed, a tiny floating pond plant, is helping biologist Chad Brassil better understand how temperature fluctuations affect food webs – the relationships among species in an ecosystem and what they eat. About the size of a pencil eraser, duckweed is important to the wildlife food chain. Brassil wants to create better models for predicting how climate change may impact food webs. He's testing predictions that temperature variations reduce indirect ecosystem interactions, relationships involving species that are connected through an intermediate species. These dynamics are harder to study than direct relationships between species and prey, but vital to an ecosystem. A five-year, $531,141 National Science Foundation CAREER Program award, which supports outstanding pre-tenure faculty, supports his research. He's also launching an outreach program to give elementary and college students hands-on experience creating their own duckweed community research projects. Their findings will inform Brassil's research.

Consortium Expands Student Options
UNL is partnering with three other Nebraska universities to expand educational opportunities for students through the Great Plains National Security Education Consortium. Funded by a five-year, $3 million grant sponsored by the Office of the Director of National Intelligence, the consortium is part of the Intelligence Community Centers of Academic Excellence. The consortium gives students with diverse interests and backgrounds the academic, research, cultural immersion and outreach experience necessary for national intelligence work. It's a partnership among UNL, University of Nebraska at Omaha, Creighton University and Bellevue University.
Web: gpnsec.org

UNL Research Fair
The campus celebrated faculty and student achievements in research, scholarship and creative activities during the 2010 UNL Research Fair. The first-ever University-Industry Day, hosted by NUtech Ventures, kicked off the event and featured presentations on commercializing technologies and public-private collaboration. The eighth annual fair included recognition events, visits with federal agency representatives and collaborators, discussions with ADVANCE-Nebraska advisory board members and student poster sessions. Featured speakers were Arabinda Mitra, Indo-US Science and Technology Forum; Anthony Boccanfuso, the National Academies' University-Industry Demonstration Partnership; Jennie Hunter-Cevera, RTI International; Jennifer Rice and Jason Lilly, Neogen Corp.; and Alan Christensen and Vikram Jaswal, National Science Foundation.

Top: Research Fair guests and speakers
Middle: Anthony Boccanfuso
Bottom: Graduate student poster session

Research Highlights

Nebraska Lectures
An HIV/AIDS researcher and a Dead Sea Scrolls scholar shared their expertise during the 2009-2010 Nebraska Lectures: The Chancellor's Distinguished Lecture Series. In his fall lecture, virologist Charles Wood, director of UNL's Nebraska Center for Virology, outlined the history of HIV/AIDS and treatment breakthroughs in "HIV/AIDS Epidemic: What Have We Learned in the Past 28 Years?" In her spring lecture, Sidnie White Crawford, Willa Cather professor and chair of classics and religious studies, presented "The Dead Sea Scrolls After 60 Years: What Have We Learned?" She discussed the discovery, study and controversies related to these manuscripts. The Office of the Chancellor, the Research Council and the Office of Research and Economic Development co-sponsor these lectures featuring prominent faculty.

Faculty, Programs Recognized
David Forsythe, professor of political science, was general editor of *The Encyclopedia of Human Rights,* which won the American Library Association's Dartmouth Award for the best reference source of 2009.

David Wishart, professor of geography, coauthored *Great Plains: America's Lingering Wild,* which won a 2009 PROSE Award from the American Association of Publishers for best book in biological and life sciences.

Elizabeth Theiss-Moore, professor and chair of political science, wrote *Who Counts as an American? The Boundaries of National Identity,* which won the American Political Science Association's 2010 Robert E. Lane Award as the best book in political psychology in 2009.

Biochemistry professor **Donald Weeks** was elected a Fellow of the American Association for the Advancement of Science. He was recognized for distinguished contributions in the field of plant biotechnology in developing a novel and innovative approach to engineering herbicide-resistant crops.

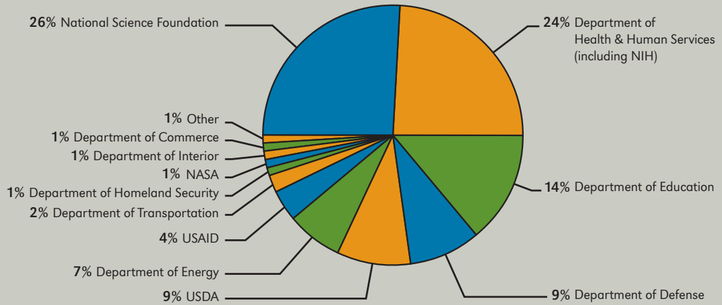
Thomas "Jack" Morris, professor of biological sciences, and **Cheryl Bailey,** assistant professor of biochemistry, were named National Academies Education Fellows in the Life Sciences for 2010-2011. They represented UNL at the 2010 National Academies Summer Institute on Undergraduate Education in Biology, which involved teams of faculty from 18 research universities that focused on enhancing undergraduate education.

The Society of Actuaries named UNL's **Actuarial Science Program** among its first Centers of Actuarial Excellence, one of 13 universities in the U.S. and Canada to earn the designation.

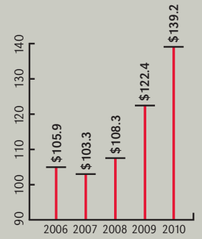
UNL's **Midwest Roadside Safety Facility**, directed by civil engineering professor **Dean Sicking,** earned a Roadway Safety Award for developing the Midwest Guardrail System, a highway guardrail that improves safety in crash situations. UNL's was one of 14 programs to receive the biannual award from the Roadway Safety Foundation and the Federal Highway Administration.

Financials

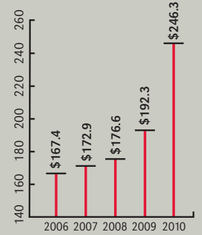
FY 2010 Research Funding by Federal Agency



Five-Year Total Research Funding
(in millions)



Five-Year Total Sponsored Programs Funding
(in millions)



Record Research Funding
UNL faculty earned a record $139.2 million in research funding during the fiscal year that ended June 30, 2010. Funding increased nearly 14 percent from $122.4 million a year earlier. More than $94 million of 2010 research funding came from the federal agencies shown in the chart above. Total external funding for sponsored programs, which include research, teaching and public service activities, reached a record $246.3 million, up from $192.3 million the previous year. These awards included 70 grants totaling $40.2 million from the American Recovery and Reinvestment Act.