



Annual Report
2001/2002



UNIVERSITY OF
Nebraska
Lincoln | OFFICE OF RESEARCH
& GRADUATE STUDIES

Inspiring excellence



“Our 2020 Vision report recognizes the importance

of enhancing our **research efforts** to increase our stature among major universities and to expand our contribution to **Nebraska's economic development**. Every indication suggests we are succeeding. The extraordinary **talent** among our faculty for exploring **new frontiers** is being unleashed.”

Chancellor Harvey Perlman

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When I came to the University of Nebraska–Lincoln last year, I was not only impressed by the faculty and administration, but inspired by the potential to move UNL research to a new level of excellence.

In the past fiscal year, we’ve experienced exceptional growth. Our total sponsored programs awards grew 25 percent, which is a direct result of our strategic initiatives that provide new resources, leverage existing resources, develop grantsmanship skills and increase collaborations with other institutions.

New leadership and an influx of senior scholars and scientists are producing a wave of change and a renewed commitment to quality research and education. One example of this is the new alignment of Graduate Studies with the Office of Research.

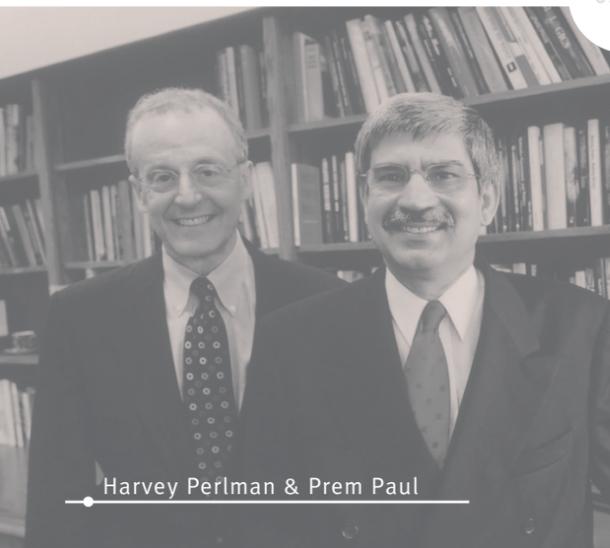
We are building outstanding programs in key areas, complementing the investments of our administrative leadership and the state of Nebraska. This focus on facilities and faculty recruitment and retention has produced world-class research facilities for biotechnology, structural biology, nanotechnology and biological processing – further enhancing our competitiveness for major federal funding opportunities.

In an effort to amplify our knowledge base and increase our funding opportunities, our multi-disciplinary research teams are partnering with institutions across Nebraska and the United States. These kinds of collaborations represent enormous growth potential for UNL research.

On the following pages you will see why I was inspired when I came to UNL and how the Office of Research & Graduate Studies is inspiring excellence.

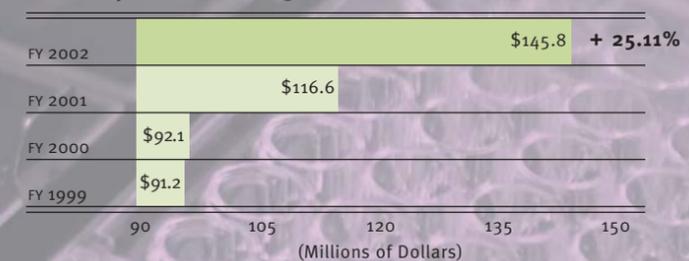


Prem S. Paul
Vice Chancellor for Research and Dean of Graduate Studies



Harvey Perlman & Prem Paul

Total Sponsored Programs



“Spintronics,” exploiting electron spin to create nano-sized switching devices, merges electronics and magnetic systems to produce devices with faster data processing speed, smaller size and decreased power consumption. In his NSF-funded research, physicist Bernard Doudin investigates the electric and magnetic properties of ferromagnetic wires only nanometers wide, fabricating ultra-small junctions in the wires to test the limits of miniaturization for future devices.

Ultrathin polymer films developed by physicist Stephen Ducharme and his colleagues with NSF funding have applications in nonvolatile computer memories, high-energy capacitors and data storage systems used for “smart cards,” laptops, cell phones and electric vehicles. Current research builds on their initial work as one of the first two groups in the world to make two-dimensional ferroelectric polymer films.

Seeking a fundamental understanding of what happens when things get very small,

Synthesis of the first magnetic polymer – “plastic magnet” – by chemist Andrzej Rajca and his NSF-funded team was reported in *Science* this year and has the potential to lead to lightweight and low-cost applications.

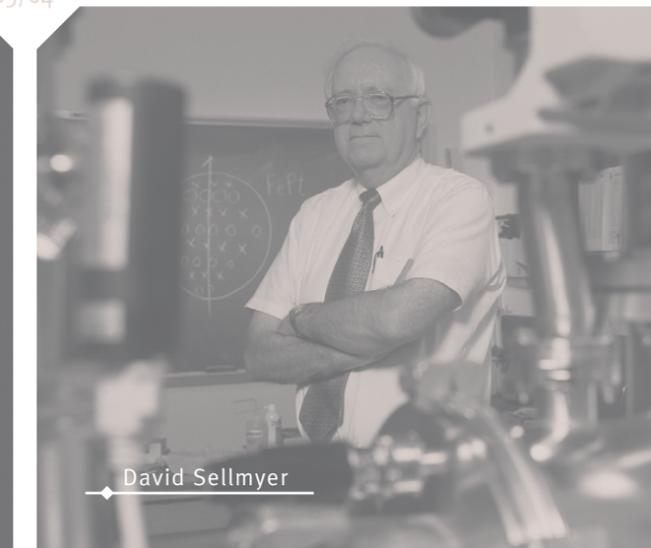
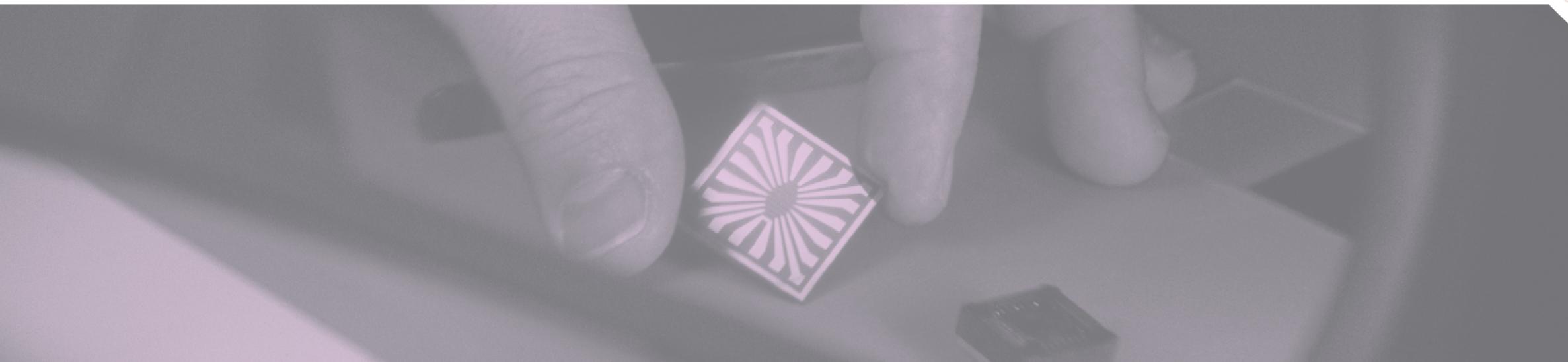
A novel fabrication process developed by engineering mechanics researcher Yuris Dzenis and his team produces ceramic nanofibers with diameters orders of magnitude smaller than conventional ceramic fibers. These nanocrystalline fibers hold promise for the development of revolutionary new ceramic materials with super high strength, toughness and flexibility for use in many manufacturing applications.

Physicist Diandra Leslie-Pelecky is fabricating nanometer-sized crystals and compacting them into ultra-small clusters of magnets with applications in magnetic recording devices, such as hard disks and floppy disks.

researchers in
Nanotechnology
discover the power of
the miniature, fabricating
materials measured in billionths of a meter.

Physicist David Sellmyer and his team are producing nanoscale magnetic materials – materials made from individual atoms and measured in billionths of a meter – that have the potential to radically change data storage. Nanomagnetic films being developed by the team with funding from the U.S. Department of Defense Office of Naval Research have the potential for data storage at very high densities, more than 100 times greater than present magnetic hard disks. Research on the fabrication of two phase nanomagnets has produced materials with near world-record energy products that have applications in motors, power systems and data storage.

03/04



David Sellmyer



Lily Wang

05/06

Two UNL researchers won prestigious National Science Foundation CAREER awards this year. NSF emphasizes that the

“The excitement at UNL about our research in agriculture,

grants recognize research and education “of the highest quality and in the broadest sense.” CAREER grants are

awarded only to untenured junior faculty and are unique in requiring a four-to five-year plan for the scientist’s

development as both a researcher and an educator. CAREER recipients and their

projects are: Lily Wang, Architectural Engineering/Peter Kiewit Institute, “Integrating Time-variant Source

Directivity into Architectural Acoustic Auralizations,” and Berthe Choueiry, Computer Science & Engineering, “Detecting Interchangeability Relations

in Constraint Satisfaction Problems.”

biological sciences and natural and human resources is heightened by the

value of the work we do for the people of Nebraska and the world beyond.”

John Owens

Vice Chancellor

Institute for Agriculture and Natural Resources

Geoscientist Sherilyn Fritz’s breakthrough discoveries about the Amazon Basin climate of 20,000 years ago are **challenging accepted scientific theories**. Layers of fossilized algae in mud cores Fritz and her research team take from deep in Bolivia’s Lake Titicaca reveal a clear record of climate change, showing a very wet basin during the last ice age, not the dry climate long hypothesized. This NSF-funded work and Fritz’s drilling project in Greenland are generating intense interest – she has published two papers in *Nature* and one in *Science* in the past two years.

Reducing CO₂ in the atmosphere by storing more carbon in crop land could **slow global warming**. A multi-disciplinary team led by agricultural meteorologist Shashi Verma and agronomist Ken Cassman has developed a unique, instrumented 480-acre laboratory at NU’s Agricultural Research and Development Center that continuously collects and feeds data to computers, measuring how CO₂ cycles through the air, plants and soil. These data will allow comprehensive comparisons of cropping systems, giving an understanding of how more carbon could be captured.

A simple, effective way to test pens of cattle for the **food-borne pathogen *E. coli* O157:H7** could help control the bacterium in feedlots. The test involves hanging pieces of rope in a cattle pen. Cattle chew on the rope, leaving traces of the organisms they’re carrying. The multi-disciplinary team led by veterinary scientist David Smith is refining the test as a research tool and strategy to reduce the chance of infected cattle leaving feedlots.

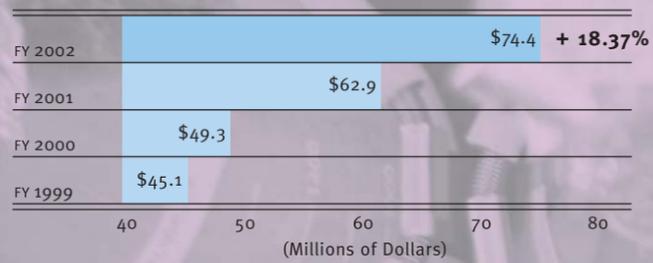
Historian Gary Moulton, editor of *The Journals of the Lewis and Clark Expedition*, 13-volume set, was honored at the White House on July 3, 2002. Published over 19 years by the University of Nebraska Press, the set includes all of **Lewis and Clark’s notebooks and writings** and places the expedition within its historical context, illuminated by new scholarship on geography, Indian languages, plants and animals.

The *Walt Whitman Archive* developed by literature professor Kenneth Price makes a **virtual library** of Whitman’s poetry, Whitman biographies, photographs and reviews accessible on the World Wide Web. A three-year National Endowment for the Humanities grant is helping Price and colleagues incorporate previously unpublished poetry manuscripts into the *Archive*.

UNL’s new PrairieFire supercomputer, the **eighth-fastest computer at an American university**, provides researchers with the power to analyze huge data sets and do complex modeling and simulations. PrairieFire is a key piece in an NSF EPSCoR-funded program led by computer scientists Byrav Ramamurthy and Jitender Deogun and plant scientist Sally Mackenzie to build informatics capacity at UNL.

Drought is more than lack of rain. Computer scientist Stephen Reichenbach is leading a multi-disciplinary, NSF-funded project aimed at collecting huge sets of data on wind, soils, crops, precipitation and other factors and using them to develop computer simulations that can spot patterns, help **predict droughts** and develop risk-management strategies.

Total Research Awards



Ruma Banerjee

07/08

Molecular virologist Charles Wood's studies of HIV, human herpesvirus 8 and related cancers reach from UNL to the front-lines of the battle against HIV/AIDS in Africa. Wood studies how HIV is transmitted from African mothers to their infants, seeking a way to block the virus. His work extends to research on HIV evolution and the genetics of virus replication and production of hybrid viruses for an **HIV vaccine**. Wood, Director of the Nebraska Center for Virology, also heads an NIH-funded program that brings Zambian scientists to UNL for training.

Attacking disease at the most basic level, biomedical scientists study the genes,

Proteins, which in myriad numbers drive all the processes of life, function according to their shapes. Chemist David Smith uses mass spectrometry to look at protein assembly and disassembly and how protein structures affect human disease. Smith studies protein involvement in cataracts, the structure of the protein envelope of the common cold virus and **why proteins mis-fold** to form the amyloid plaques associated with Alzheimer's disease. With NIH funding, his laboratory has developed new methods to study proteins as they fold to form their active structures.

Virologist Clinton Jones' discovery of a gene that controls latency in **herpes simplex virus 1** has important implications for the design of new treatments for the millions of people infected by the virus. Jones is conducting an NIH-supported functional analysis of the latency gene, using proteomic technology to identify novel proteins that the gene induces or encodes.

Chemical engineer Michael Meagher has developed a fermentation process using the yeast *Pichia pastoris* to express **recombinant proteins** used in vaccines and cancer treatments. Meagher and his team at the Biological Process Development Facility are developing fermentation, recovery and purification processes supported in part by funding from the U.S. Department of Defense to produce the quantity and quality of therapeutic proteins necessary for human clinical trials.

proteins and
metabolic pathways that
offer the **key** to
new therapies

for AIDS, cancer and heart disease.

Biochemist Ruma Banerjee's work is answering fundamental questions about the reaction mechanisms of vitamin B₁₂- and B₆-dependent enzymes and regulation of homocysteine metabolism. Elevated levels of homocysteine, a toxic sulfur-containing amino acid, constitute a risk factor for heart disease, neural tube defects and Alzheimer's disease. Banerjee's NIH-funded studies are providing insights into the chemical and regulatory mechanisms associated with disease-causing mutations in the genes that encode the homocysteine-utilizing enzymes.

Inconsistent messages, disciplinary chaos and confusing rules can be problems for children with a high risk for school failure. Mike Epstein and Ron Nelson, co-directors of the Center for At-Risk Children's Services, believe schools must focus on preventing, rather than reacting to, problem behaviors. The team, whose work is funded by the U.S. Department of Education, works closely with public elementary schools to develop and apply simple, effective procedures that reduce behavior problems and help children focus on learning.

Innovative programs reach out to Children and Families, pioneering novel approaches to Education and

developing new understanding of learning and behavior.

In a long-range study of runaway and **homeless teens** in the Midwest, sociologists Les Whitbeck and Dan Hoyt have learned that most leave homes marred by sexual abuse and family violence, a finding that gives clues to how the youngsters will fare as adults. Whitbeck and Hoyt also are partners with several Native American and First Nations peoples in NIH-funded projects that use interventions tied to traditional cultural values to prevent or delay alcohol use in school-age children.

Developmental psychologists Marcela Raffaelli and Lisa Crockett are combing a longitudinal data set for early clues to adolescent sexual **risk-taking**. In their NIH-funded project, they are the first to look at the role that self-regulation — the capacity to regulate one's own attention, emotions and behavior — plays in risk-taking. They propose that childhood experiences, particularly with parents, can shape a child's ability for self-regulation.

The Cosmic Ray Observatory Project, led by physicists Greg Snow and Daniel Claes, involves Nebraska high school students in a **high-energy physics** experiment, constructing simple particle detectors and mounting them atop their schools. The students collect and study the data gathered, gaining hands-on research experience. The NSF-funded project will eventually include 30 schools, linked by the Internet to create the world's geographically largest cosmic ray detector.

Project Fulcrum brings the excitement of scientific research to elementary and middle school classrooms to create the next generation of scientists. The NSF-funded project, developed by physicist Diandra Leslie-Pelecky and curriculum professor Gayle Buck, places UNL undergraduate and graduate science students in Lincoln Public Schools classrooms to partner with teachers to provide an **intensive science** experience for students.

Wonderwise, an award-winning program developed by Judy Diamond of the State Museum, teaches science through the life and work of **women scientists** to provide role models for students in grades 4-7. A new NSF-funded project links Wonderwise with Nebraska Cooperative Extension to develop Wonderwise 4-H, an out-of-school science education program for hundreds of thousands of youngsters involved in 4-H.

09/10



Ron Nelson & Mike Epstein



"As the problems we face become more complex and intertwined, we need the novel solutions generated when faculty from different disciplines come together. This intersection produces real innovation in research."

Richard J. Hoffmann
Dean, College of Arts & Sciences

In 2001, the Nebraska Legislature provided UNL and three other Nebraska institutions with an opportunity to enhance biomedical research capacity by appropriating funding for the **Tobacco Settlement Biomedical Research Development Fund**. The Office of Research awarded to faculty \$1.9 million in competitive grants from the fund for recruitment of key biomedical researchers, infrastructure and minority health research that will increase competitiveness for NIH funding and improve the health of Nebraskans.

Recognizing that arts and humanities funding is highly competitive and in short supply, in 2002 the Office of Research launched the **Arts & Humanities Research Enhancement Fund** seed grant program. Competitive grants totaling more than \$40,000 were given to six projects focusing on research, scholarship and creative activity in the arts and humanities.

The **UNL/UNMC Research Collaboration Grants** program was established in 2002 to increase collaborative projects and to generate NIH funding at the two institutions. Two competitive grants of up to \$100,000 each will be awarded to top proposals from collaborative research teams. The grants program builds on a workshop that attracted 125 researchers from UNL and the University of Nebraska Medical Center with interests in biomedical imaging/biomedical engineering, cancer and bioterrorism/infectious disease. Richard Swaja of the Institute of Biomedical Imaging and Bioengineering at NIH gave the keynote presentation.

In a two-day **Grantwriting Seminar** for faculty sponsored by the Office of Research, consultant Stephen Russell provided coaching in proposal preparation to some 200 faculty. Russell and colleague David Morrison also are conducting in-depth grantwriting workshops with six departments.

A new partnership between UNL and the **Madonna Rehabilitation Hospital Institute for Rehabilitation Science & Engineering** joins the expertise of UNL researchers with the resources of the nationally prominent hospital. The new institute, led by director Bill Shuart, is the nation's first devoted to studying comprehensive, holistic rehabilitation therapies. UNL researchers Sharon Evans, David Beukelman and Lance Perez are leading the institute's three centers of excellence.

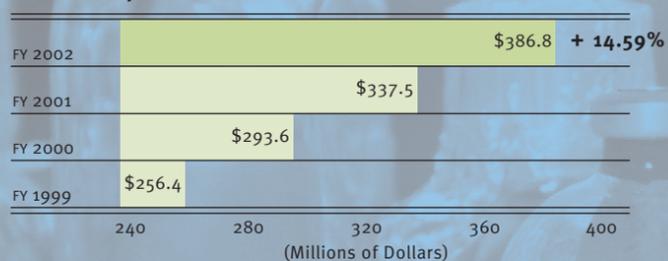
Offered for the first time in 2002, **Research Cluster Grants** funded through the Office of Research aim at building interdisciplinary collaborations. The program is funding Strategic Grants, with awards of up to \$50,000 per year for two years, and Planning Grants, with awards of up to \$5,000 per year for two years.

New resources and **Initiatives** inspire faculty to reach for the next level of excellence.

UNL RESEARCH ADVISORY BOARD

- Bruce Avolio, Management
- Atorod Azizinamini, Civil Engineering
- P. Stephen Baenziger, Agronomy & Horticulture
- David Baltensperger, Agronomy & Horticulture
- Ruma Banerjee, Biochemistry
- Judy Diamond, State Museum
- Stephen Ducharme, Physics & Astronomy
- Yuris Dzenis, Engineering Mechanics
- Jeff Elwell, Theatre Arts
- Michael Epstein, Special Education & Communication Disorders
- Sherilyn Fritz, Geosciences
- Gregor Henze, Architectural Engineering
- Daniel Pomp, Animal Science
- Kenneth Price, English
- Steve Reichenbach, Computer Science & Engineering
- Don Rundquist, School of Natural Resource Sciences
- David Smith, Chemistry
- Judy Walker, Mathematics & Statistics
- Les Whitbeck, Sociology
- Charles Wood, Biological Sciences

Total Proposals Submitted



Merida Grant



James Alfano



“Understanding complex 21st century issues requires the kind of interdisciplinary research teams found on UNL projects studying global climate change and food safety. This combined expertise produces new understanding of difficult problems.”

Darrell Nelson
Dean and Director, Agricultural Research Division

James Alfano studies the strategies bacterial pathogens employ to cause disease in plants. His team is studying the bacterium *Pseudomonas syringa*, seeking to understand the workings of

In the complex world of Functional Genomics

its system that secretes proteins and delivers them into plant cells, and how the delivered proteins favor parasitism once they are inside the plant cell. The team also is part of an NSF-funded consortium that is sequencing the genome of *P. syringa tomato* DC3000 and studying the complex interaction of this bacterium with plants.

sequencing genes is merely
the first step toward
elucidating the proteins
that drive the
processes of life.

Plant geneticist Michael Fromm and his team study drought and salt tolerance, focusing on how plants such as rice and corn regulate their response to reduced water availability. Current work involves identifying the protein kinases and phosphatases in the **stress signalling** pathway and the proteins with which they interact, then confirming their roles using RNAi “knockouts.”

Using genetically unique strains of mice developed at UNL by animal scientist Merlyn Nielsen, Daniel Pomp and his NIH-funded team are mapping the many genes that combine to dictate metabolism levels and the **predisposition for obesity**. Isolating these genes and gaining an enhanced understanding of how complex traits are expressed, regulated and inherited can lead to a greater knowledge of human obesity and potential treatments for the diabetes, cancer, heart disease and arthritis it promotes.

A new genetic fingerprinting technique developed by food microbiologist Andrew Benson enables researchers to pinpoint differences on the DNA of the potentially deadly bacterium *E. coli*. Using the technique, called octamer-based genome scanning, Benson and his team found two genetically distinct *E. coli* **0157:H7 populations** in cattle. The more common strain was non-virulent or not easily transmitted to people. OBGS offers a means for rapidly identifying and cloning key genes and possible development of a simpler, more sensitive test to identify *E. coli*-infected feedlot cattle.

Unique **wheat chromosome substitution** lines developed at UNL more than 40 years ago enabled plant geneticist P. Stephen Baenziger and his team to close in on a single major gene responsible for wheat yield. This finding runs counter to the long-held belief that many inseparable genes influence this complex trait. Once the single gene is clearly identified, the team will begin studies of how it functions to control yield.

Including the trace element **selenium in the diet** may help prevent cancer. In his NIH-funded research biochemist Vadim Gladyshev is determining the identities and function of all selenium-containing proteins. His work could help identify which cancers might be prevented by selenium supplements.



Charles Wood

A recent U.S. Department of Education grant to the **Center for At-Risk Children's Services** funded groundbreaking programs in behavior and reading, working with at-risk elementary school children in their homes and their schools. The Center conducts and disseminates research on children's issues in education and mental health aimed at empowering families, schools and communities.

The **National Center for Information Technology in Education**, brings together faculty and researchers from Teachers College, Nebraska Educational Telecommunications and the Department of Computer Science & Engineering to find new ways to use information technology to enhance learning. NCITE, established with U.S. Department of Education funding, conducts research on the use of information technology to improve student learning and assessment and develop and adapt technologies for education.

Established with funding from the National Endowment for the Humanities, the **Plains Humanities Alliance** will promote the humanities and encourage scholarly research and preservation collaborations in Nebraska, North Dakota, South Dakota, Kansas and Oklahoma. Educational and outreach programs will allow those in the region to explore local history, rediscover their roots and learn how their sense of place influences identity.

Established in 1997 with the donation of more than 900 quilts from the collection of Robert and Ardis James, the **International Quilt Study Center** encourages the interdisciplinary study of quilt making traditions and preservation of this tradition through collection, conservation and exhibition of quilts. NEH funding supports public humanities programming and study of quilt makers and the objects they have made.

The **Center for Advanced Land Management Information Technologies** is a national leader in remote sensing, geographic information systems, automated cartography and image processing. CALMIT's strong ties with regional universities and funding partnerships with NASA, the U.S. Geological Survey and the National Oceanic and Atmospheric Administration have produced major research projects in remote sensing of crops, surface water, soils and coral reefs; land cover assessment; precision agriculture and remote sensing/GIS commercial applications.

Research
Centers
form the axis for
collaborative work,
leveraging expertise
and resources in **diverse disciplines.**

The Nebraska Center for Virology conducts basic research addressing fundamental questions about viruses and other infectious agents that cause disease. The center links researchers at UNL, the University of Nebraska Medical Center and Creighton University who are making significant contributions to our knowledge of infectious disease. Center scientists are poised to make important discoveries, most notably in the understanding of the evolution and transmission of HIV and the genetics of herpes viruses.

“Our expanding research programs create wonderful new opportunities for graduate assistants to learn directly and powerfully by doing research at the frontiers of a discipline.

Combining the Office of Research & Graduate Studies takes full advantage of these connections.”

*Richard Edwards
Senior Vice Chancellor for Academic Affairs*

In a renewed commitment to excellence in graduate education, on July 1, 2002 the Office of Graduate Studies merged with the Office of Research and Prem Paul, Vice Chancellor for Research, assumed the additional title and responsibilities of Dean of Graduate Studies.

The new Office of Research & Graduate Studies brings UNL a step closer to full realization of “A 2020 Vision: The Future of Research and Graduate Education at UNL,” which envisions graduate studies that provide expanded competitive post-doctoral training and training grants in program areas of growing visibility and impact.

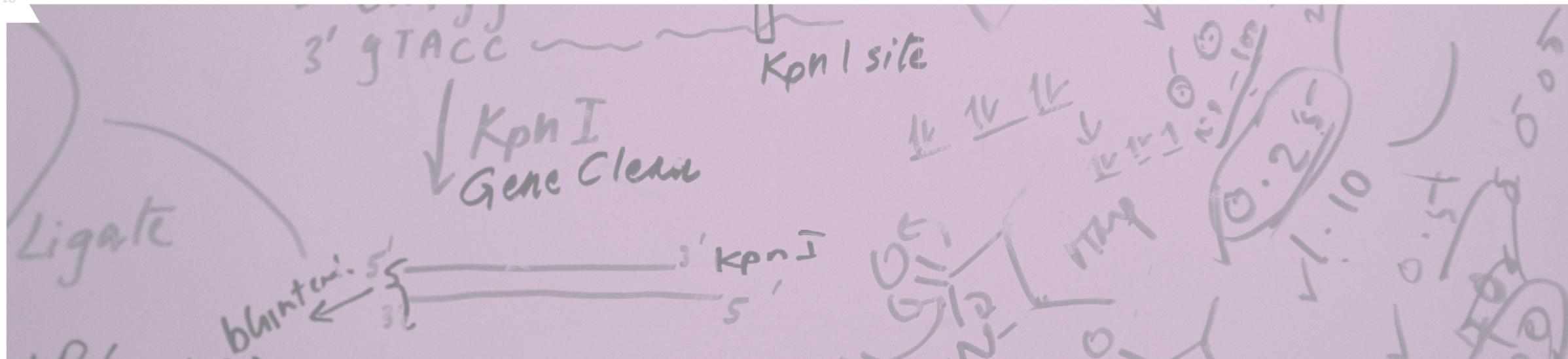
The realignment of research and graduate studies is a natural step because of the key roles graduate students and graduate education play in the university’s research enterprise. The Office of Research & Graduate Studies will enrich connections between faculty and graduate students and offer new opportunities for external funding of assistantships through training grants, which help attract under-represented minorities, bring more students to underpopulated disciplines and improve research productivity by adding graduate students and others to faculty research teams.

Ellen Weissinger, professor of educational psychology, was named Executive Associate Dean for Graduate Studies. Weissinger will administer the daily operations of Graduate Studies and serve as a member of the UNL research management team.

Merlin Lawson, Dean of Graduate Studies for the past decade, in January announced his intention to return to his faculty position in the Department of Geosciences. Lawson had a tremendous impact on graduate studies during his tenure, initiating programs such as the Multi-Cultural Teaching Fellowship Program, the Ronald McNair Program and partnership agreements with traditionally black colleges and universities that significantly increased UNL’s minority graduate student representation and enhanced the university’s academic and cultural offerings.



Merlin Lawson & Prem Paul



The mission of technology transfer at UNL is to maximize the value of intellectual property resulting from our research efforts to benefit the researchers, the university and the state. This is accomplished by commercializing inventions and technologies, creating economic development outreach efforts and nurturing entrepreneurial activity.

The UNL Technology Development Corporation, a not-for-profit affiliated company, was formed in 2002 to strategically link commercialization and economic development through the creation of new technology enterprises. UNL Tech's first joint product agreement is with an agricultural biotechnology company, incorporating recombinant genes developed by the company into UNL proprietary soybean lines.

Discoveries, inventions and intellectual property yield tangible products of research that benefit the university and the people of Nebraska.

Innovative technologies developed at UNL:

The Steel and Foam Energy Reduction (SAFER) system, an energy-absorbing wall barrier first installed at the Indianapolis Motor Speedway for the 2002 Indy 500 to reducing injuries from high-speed impacts.

A highly sensitive, hand-held neutron detection device, that holds great promise for reliable detection of hidden nuclear materials, monitoring of nuclear weapons storage, astrophysics research and nuclear medicine.

Starch-based extruded foam materials that are both water-resistant and biodegradable with applications in commercial and food products packaging.

Precast, prestressed concrete pole systems for erecting power and telecommunications towers in remote areas.

Top UNL-licensed technologies include:

- The underlying technology for rapid DNA sequencing with greater resolution and accuracy.
- Patented buffalograss cultivars with improved turf traits and drought and pest resistance that are being planted extensively on golf courses.
- Omega eggs containing Omega-3 fatty acids that protect against heart disease and stroke.
- The first university/USDA-associated line of swine released since the 1950s, yielding 30 to 50 percent greater output than conventional lines.
- Allergen detection technologies that help the food industry identify food product ingredients such as peanuts, milk and eggs that can cause life-threatening allergic reactions.





Diandra Leslie-Pelecky

The accomplishments of 2001/2002 reveal only a glimpse of what is to come for research and graduate education at UNL.

Collectively, we are **moving** the University of Nebraska–Lincoln into the future.

What were once just possibilities are now realities in the lab, in the classroom and for the State of Nebraska. We are redefining and building the foundation to support future growth and progress.

www.unl.edu/research

Inspired by
excellence.
Inspiring
excellence.

