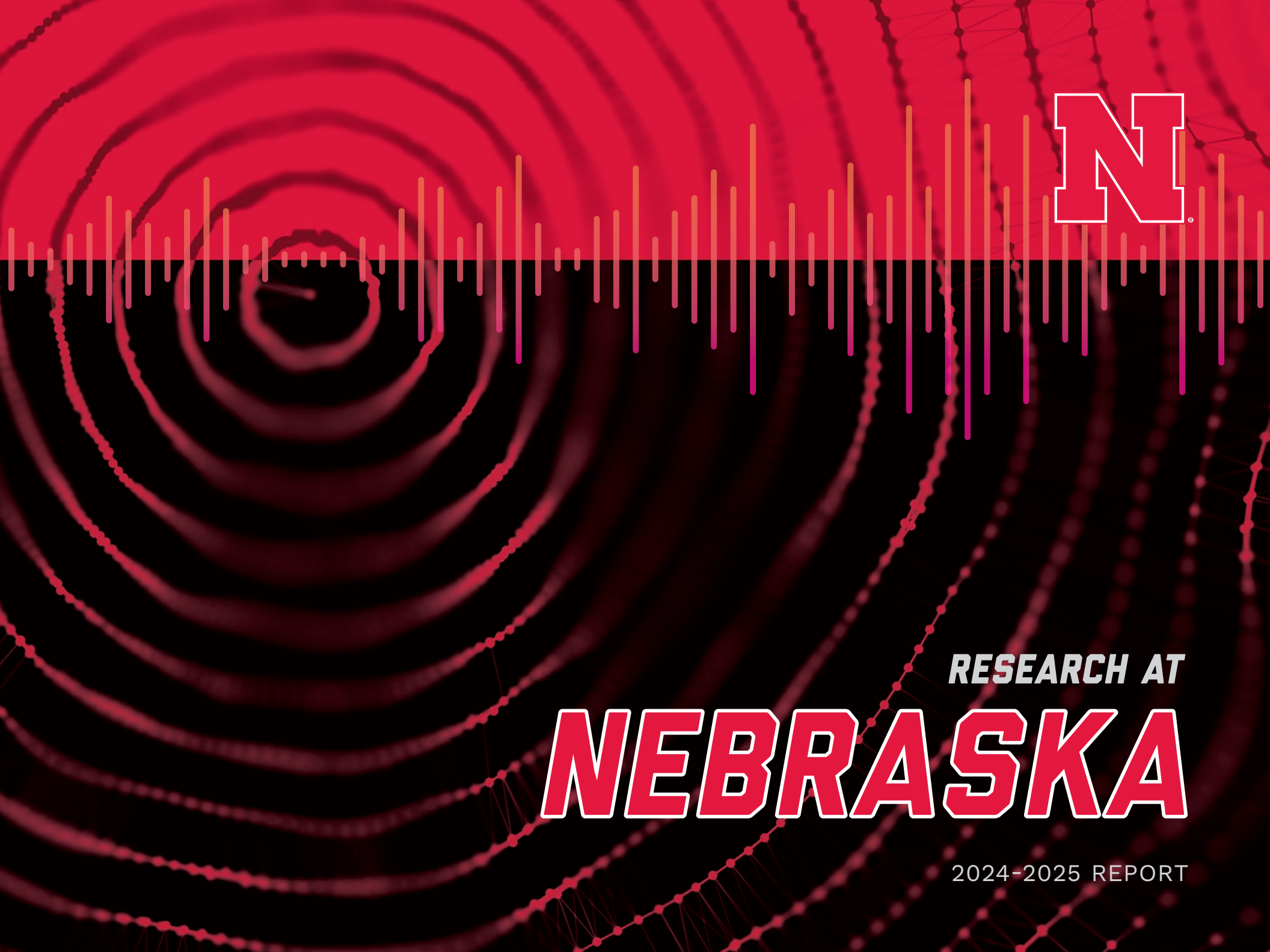


RESEARCH AT NEBRASKA

2024-2025 REPORT

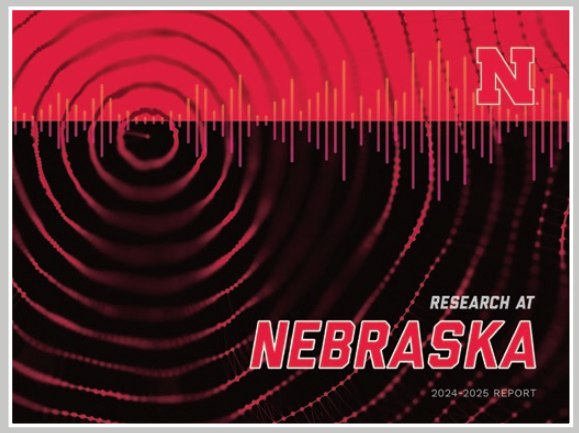
EXPLORE NEBRASKA RESEARCH

The 2024-2025 Research Report is a snapshot of discovery, innovation and creativity at the University of Nebraska–Lincoln. Full stories and multimedia are available at **research.unl.edu/annualreport/2025.**

ONLINE EXCLUSIVES

AGRICULTURE: Challenging current approaches to estimating crop yield potential
ARCHITECTURE: Expanding affordable housing in state's largest city
ART AND DESIGN: Exploring paper's evolution as an artistic medium
AWARDS: Nebraska ties record for earning early-career awards
BIOTECHNOLOGY: Preventing livestock disease outbreaks
BUSINESS: Study suggests purchasing organizations could reduce health care costs
EDUCATION: Boosting science education capacity in rural preschool settings
ENERGY: Discovery could unlock potential of sustainable bioenergy
ENVIRONMENT: Assessing risks of antimicrobial resistance
FOOD SECURITY: Exploring micro-irrigation as a solution to food insecurity
HEALTH: Improving patient care with groundbreaking stroke treatment
JOURNALISM: Digitally mapping Nebraska communities' news needs
NATURAL RESOURCES: Husker scientist illuminates species' ability to glow
STATE MUSEUM: 'Goliath' beetle exhibit showcases biodiversity
STRONG COMMUNITIES: Reducing teen, young adult homelessness in Nebraska

This report is available online:
research.unl.edu/annualreport/2025



ABOUT THE COVER

A Nebraska biology duo published one of the first studies showing that funnel-weaving spiders can change how they receive noise, depending on the environment. The cover artwork is an artistic representation of how the webs transmit vibrations in response to noise.

FROM THE VICE CHANCELLOR

Boldly transforming the future in Nebraska and beyond

The University of Nebraska–Lincoln has a bold vision to transform lives and become a world-leading land-grant institution. The Office of Research and Innovation is at the heart of this mission, working to advance research, creative and scholarly endeavors and fulfill UNL's promise to the people of Nebraska and beyond.

At Nebraska, faculty are encouraged to collaborate across disciplines to solve real-world problems. A biomedical engineer, for example, is developing wearable devices that provide earlier, more accurate detection of chronic disease exacerbations (page 7).

As a Carnegie R1 institution, UNL has the depth and breadth of expertise necessary for addressing complex societal problems, such as preventing at-risk youth from experiencing homelessness. The size and scale of UNL's research enterprise enables researchers to nimbly respond to changing circumstances like the increasing frequency and severity of drought (page 4).

Husker researchers work directly with Nebraskans to address issues that matter to them, including developing new approaches to healthy eating in child care settings, especially those serving rural children, who are 25% more likely to experience obesity (page 8). At the same time, a UNL irrigation engineer is developing micro-irrigation systems to improve food security in Nebraska and around the world (online edition).

The 2024-2025 Nebraska Research Report includes these examples and many others, from moving innovations from the laboratory to the marketplace (page 9), to creative endeavors that shape our culture (page 12).

I am also proud of our faculty who have earned prestigious and highly prestigious external honors and awards in the past year (page 13). Their accomplishments reflect the exceptional quality of research, scholarly and creative activity at Nebraska.

Total research expenditures across the University of Nebraska system continue to grow, reaching a combined total of $657 million in FY 2025. The NU System also climbed six spots to No. 49 nationally among institutions earning U.S. utility patents.

Even as the higher education landscape shifts, I am confident that UNL's research strengths will keep us steadfast in our pursuit of prominence, excellence and impact. We are nimble and resilient, ready to tackle tomorrow's opportunities.

Interim Vice Chancellor Jennifer Nelson

I invite you to read more about the inspiring individuals who exemplify Research at Nebraska.

Jennifer Mize Nelson
Interim Vice Chancellor
for Research and Innovation

ACHIEVING EXCELLENCE

Brandi Pessman and Eileen Hebets

Investigating how arachnids respond to noise

Humans have a toolkit for dealing with environmental noise, including headphones, white noise and more.

Husker research suggests that animals, too, intentionally manage noise. Biologists Eileen Hebets and Brandi Pessman published one of the first studies showing that one type of animal changes how it receives sound when faced with human-generated noise.

The duo demonstrated that funnel-weaving spiders' webs transmit vibrations differently in response to noise. The architect's background mattered, too: Rural and urban spiders reacted differently when exposed to loud vibratory noise during web construction.

Urban spiders' webs quieted their environment, likely to avoid excessive stimulation, accurately detect prey and protect their hearing. Rural spiders' webs enhanced incoming vibrations at a particular frequency, likely to amplify certain signals.

The *Current Biology* study serves as a novel example of how to analyze animals' sound reception without studying internal sensory structures. Spiders' external sensory mechanism – their webs – enabled the work.

"This study really highlights the role of receivers in overcoming environmental noise," said Hebets, George Holmes Professor of Biological Sciences. "It opens up entirely new avenues of research."

National Science Foundation funding supported this work.

Full story: **https://research.unl.edu/annualreport/2025/arachnids**

Background: An artistic rendering of a funnel-weaving spider's web overlaid with sound waves

ACHIEVING EXCELLENCE

Leading the world in drought monitoring, response

Drought is a "global catastrophe" that continues to tighten its grip, but it's still possible to mitigate its far-reaching impacts.

For 30 years, the National Drought Mitigation Center has been at the forefront of this effort with a mission that encompasses monitoring and early warning, vulnerability, and risk assessments and mitigation policy and planning, said center director Mark Svoboda.

Its approach is the global standard used by the United Nations and World Bank. The center also developed the stalwart U.S. Drought Monitor.

"It's just incredible how many places right now almost at the same time are feeling the brunt of this challenge of drought," Svoboda said.

In a report issued in July 2025, Svoboda and co-authors called the 2023-2025 period "a global catastrophe covering millions of square miles and affecting millions of people."

Nearly all states and some 80 nations have drought plans, but an ongoing challenge is getting governments to implement those plans effectively. The center provides research-backed information that pushes states and nations to be less reactive and more proactive about drought, Svoboda said.

Mark Svoboda

Background: A grain truck crosses the dry Platte River near Chapman, Nebraska.

From left: Images of a drought-swept landscape in Texas

Full story: **https://research.unl.edu/annualreport/2025/drought**

ACHIEVING EXCELLENCE

Markvicka's wearable device will measure multiple physiological parameters.

Wearable device could predict disease flare-ups

A Husker-developed device may help patients with chronic conditions stay ahead of disease flare-ups, which is key to improved outcomes and reduced mortality.

Engineer Eric Markvicka is developing a wearable monitoring device to detect exacerbations of chronic obstructive pulmonary disease and other conditions like asthma, heart disease and inflammatory disorders. By measuring multiple physiological parameters – including heart rate, respiration and gait – the device provides insight into holistic health and enables earlier, faster and more accurate identification of flare-ups compared to patient-reported questionnaires.

Eric Markvicka

The technology captures continuous, time-stamped data, enabling researchers to explore links between parameters and how variations in couplings may indicate health changes.

The device could enable remote patient monitoring, a major benefit for rural residents. It will also help everyday people monitor their overall health and attune to early warning signs.

“Our human physiology undergoes subtle changes much earlier than clinically recognizable symptoms, providing a window for early intervention,” said Markvicka, Robert F. and Myrna L. Krohn Associate Professor of Biomedical Engineering.

A National Science Foundation-National Institutes of Health initiative funds the research.

Full story:
https://research.unl.edu/device

Addressing childhood obesity in rural areas

Rural children are about 25% more likely than urban peers to experience obesity, a trend driven by limited access to nutritious food, higher poverty rates and more.

Dipti Dev leads a National Institutes of Health-funded project that helps rural child care programs foster healthy eating habits among young children through responsive feeding. The approach encourages children to self-regulate food intake and respond to hunger and fullness cues.

For the first time, the team is testing the online EAT (Ecological Approach To) for Prevention program – which Dev developed – in rural, home-based child care settings. A major goal is to train providers using EAT and provide them tailored coaching based on unique mealtime routines and children's eating behaviors.

The researchers are collecting data on food intake during child care, especially fruit and vegetable consumption, and evaluating children's self-regulation skills and BMI data.

"I envision Nebraska leading the way in this area, advancing best practices in responsive feeding to create healthier futures for rural children across the nation," said Dev, Betti and Richard Robinson Associate Professor of Child, Youth and Family Studies and Nebraska Extension specialist.

Full story: **https://research.unl.edu/annualreport/2025/obesity**

Dipti Dev

Improving human health through targeted drug delivery

A Husker researcher is commercializing a technology that could deliver targeted treatments to people with diseases both common and rare.

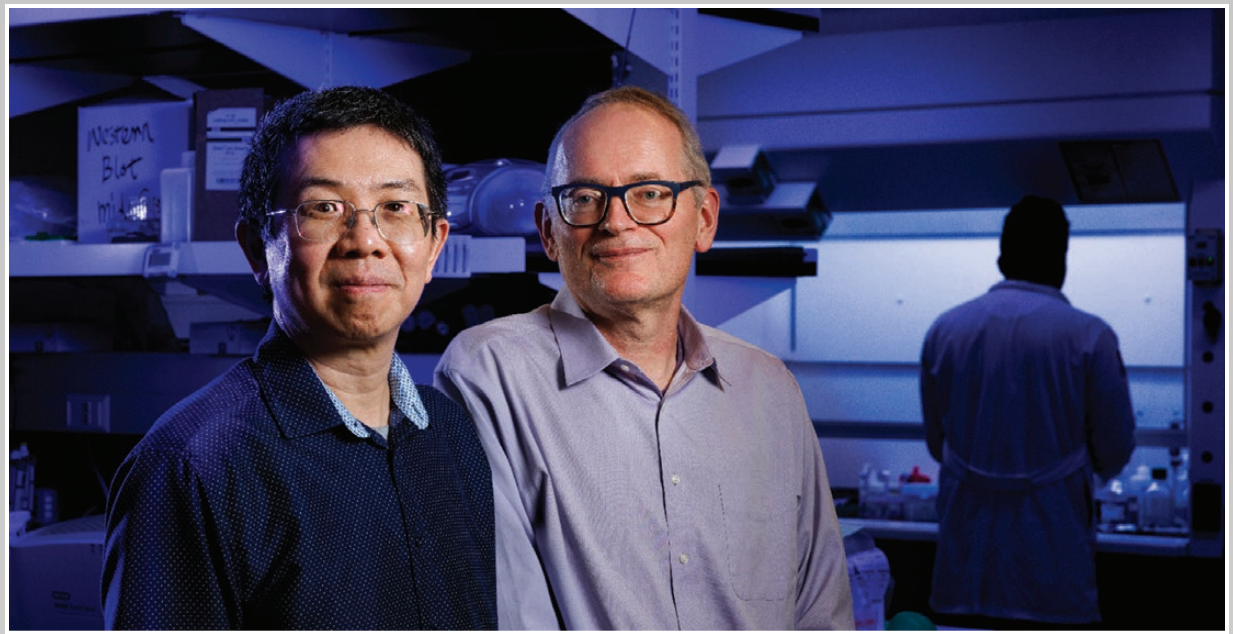
Janos Zempleni launched startup company Minovacca with the goal of commercializing designer milk exosomes – natural nanoparticles contained in milk – capable of transporting therapeutics, gene editing tools and more to targeted locations in the human body.

NUtech Ventures, the university's nonprofit commercialization affiliate, has filed two patent applications for the technology.

The approach is safe, flexible and promising for rare disease communities.

"Because our technology is so versatile, we can tailor it to a large number of rare diseases," said Zempleni, Willa Cather Professor of Nutrition and Health Sciences.

The strategy overcomes a major flaw of current drug delivery approaches: Therapeutics often reach cells beyond the targeted locations, causing adverse effects. The exosomes' precision is controlled by attached peptides, which guide the cargo to its intended destination.



Minovacca founders Jiantao Guo and Janos Zempleni. Guo, professor of chemistry, is an inventor on one of the patent applications focused on designer milk exosome technology.

Minovacca is licensing the technology through NUtech Ventures and acquired space at Nebraska Innovation Campus, the university's public-private research hub. Husker students will gain industry experience at the company.

Full story: **https://research.unl.edu/annualreport/2025/minovacca**

RESEARCH AT A GLANCE

Prominence, excellence and impact drive the trajectory of Nebraska Research. Faculty across disciplines are improving lives across the state, U.S. and world through discovery, creativity and innovation.

Information reflects FY 2024 combined activity across the University of Nebraska–Lincoln, the University of Nebraska Medical Center and the University of Nebraska system's Office of the President.

Research by the Numbers

$657M

Total research expenditures, FY 2024

$32.1M

Industry-sponsored research expenditures, FY 2024

57.5%

Increase in total research expenditures over the past 10 years

76.6%

Increase in federal research expenditures over the past 10 years

Scholarly Impact

Top 10%

Ranking of UNL's agricultural and natural resources programs among nearly 500 institutions worldwide, according to QS World University rankings

#81

U.S. News & World Report 2025 ranking among all public institutions in the U.S.

9

Number of National Science Foundation Early Career Development Program awards earned by Husker researchers, tying an institutional record

ECONOMIC IMPACT

The University of Nebraska–Lincoln drives economic growth across Nebraska, located at the heart of the Silicon Prairie. Backed by an ecosystem of innovation of university, state and local entities, UNL strives to support faculty innovators as they move ideas from the lab to the marketplace.

Economic Development Activity

$6.4B

Total annual economic impact of the University of Nebraska on the state's economy

$10.72M

Combined FY 2025 licensing income across UNL, UNMC and the University of Nebraska at Omaha

#49

The University of Nebraska system's ranking among the worldwide academic institutions receiving U.S. utility patents, rising six spots and earning a top 100 designation for an eighth consecutive year in 2024

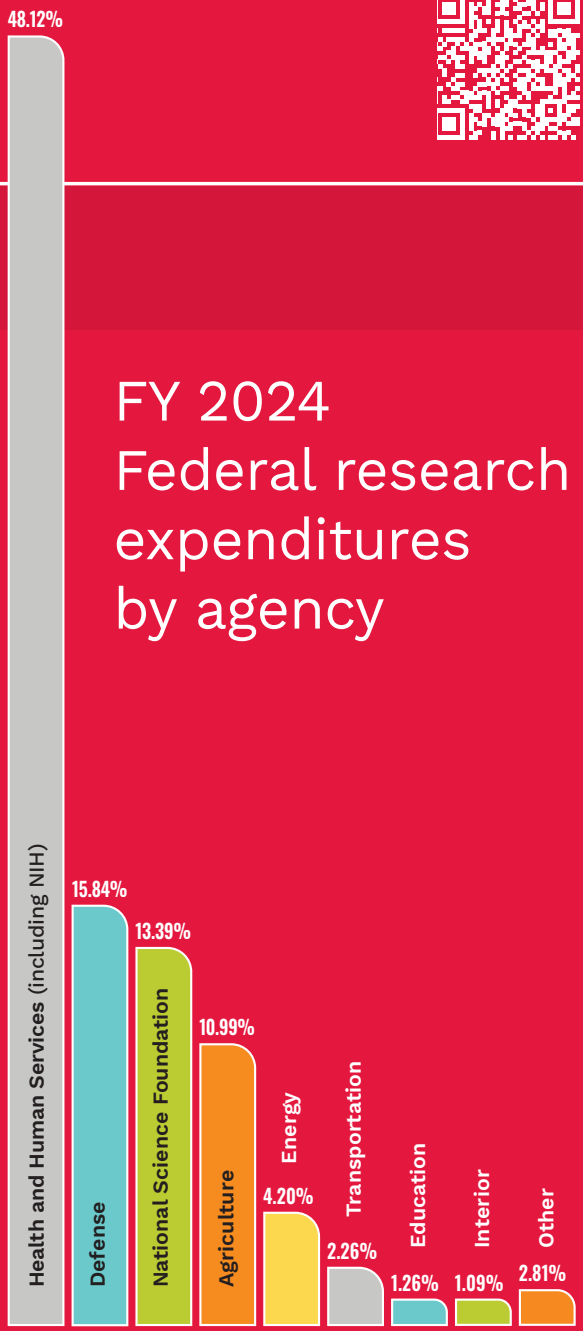
129

Student internships funded by entities located at Nebraska Innovation Campus

Sources:
Combined licensing income is reported by NUtech Ventures and UNeMed Corp., the technology commercialization affiliates at UNL and UNMC, respectively. Patent rankings are reported annually by the National Academy of Inventors.

Full story: **https://research.unl.edu/annualreport/2025/#economicimpact**

FY 2024 Federal research expenditures by agency



Information reflects FY 2024 combined activity across UNL, UNMC and UNOP.

Highlighting the humanity of making music

Nebraska's Robert Woody believes the heart of music lies in the human experience behind it.

An international leader in the psychology of music, Woody was recognized on the Stanford/Elsevier Top 2% Scientists List, a rare accomplishment for a music researcher. The list identifies the world's leading scientists by analyzing their impact, including how often other scientists reference their work.

Woody's research explores how music shapes and is influenced by human cognition, behavior and emotion. His research topics include learning, motivation, emotional expression, creativity and leadership as they relate to music.

Woody's research and classes are better preparing the next generation of music educators.

Among the tens of thousands of scientists on the Stanford/Elsevier list, Woody is one of only 78 music researchers. The 2024 list includes 180 Huskers.

"By making kids more musical, we are enriching their lives in a real, meaningful way," said Woody, Steinhart Foundation Distinguished Professor of Music. "Music is a human absolute, and it belongs to everybody."

Full story: **https://research.unl.edu/annualreport/2025/music**

Robert Woody

Award-winning Faculty

Increasing the number of external honorific awards is one of the University of Nebraska–Lincoln's strategic goals. The following list includes selected awards and accomplishments that Husker researchers earned in fiscal year 2025.

Sherilyn Fritz, George Holmes Professor in Earth and Atmospheric Sciences and the School of Biological Sciences
Member, National Academy of Sciences

Edgar Cahoon, George Holmes Professor of Biochemistry
Fellow, National Academy of Inventors

Lance C. Pérez, Fred Hunzeker Dean of Engineering and Omar H. Heins Professor of Electrical and Computer Engineering
Fellow, American Association for the Advancement of Science

Maital Neta, Carl A. Happold Professor of Psychology
Presidential Early Career Award for Scientists and Engineers

Ken Bloom, Willa Cather Professor of Physics and Astronomy; **Daniel Claes,** professor of physics and astronomy; **Ilya Kravchenko,** professor of physics and astronomy
2025 Breakthrough Prize in Fundamental Physics

Ng'ang'a Wahu-Mũchiri, associate professor of English
Fellow, American Council of Learned Societies

Amy Schmidt, professor of biological systems engineering
G.B. Gunlogson Countryside Engineering Award, American Society of Agricultural and Biological Engineers

Roger Hoy, professor of biological systems engineering
John Deere Gold Medal, American Society of Agricultural and Biological Engineers

Irina Filina, associate professor of Earth and atmospheric sciences
Fulbright U.S. Scholar Award

Daren Redfearn, professor of agronomy and horticulture
Fellow, American Society of Agronomy
Fellow, Crop Science Society of America

Jordan Soliz, professor of communication studies
Bernard J. Brommel Award for Outstanding Scholarship or Distinguished Service in Family Communication, National Communication Association

Janos Zempleni, Willa Cather Professor of Nutrition and Health Sciences
Distinguished Fellow, American Society for Nutrition

Mike Boehm, professor of plant pathology
Fellow, American Phytopathological Society

Oleh Khalimonchuk, Willa Cather Professor of Biochemistry
Fellow, American Society for Biochemistry and Molecular Biology

Beth Doll, professor of educational psychology
Nadine Murphy Lambert Lifetime Achievement Award, Division of School Psychology of the American Psychological Association

Full story: **https://research.unl.edu/annualreport/2025/accolades**

RESEARCH HIGHLIGHTS


James Schnable

Researcher helps launch digital twin of corn field

Virtual replicas, known as digital twins, enable companies to innovate rapidly and are revolutionizing industries from manufacturing and health care to ride-hail services like Uber.

Nebraska plant scientist James Schnable is bringing the technology to agriculture by helping to develop the first digital twin of a corn field.

The digital field will enable researchers to explore how corn with different properties would behave under varying conditions and quickly identify promising hybrids, without the time-consuming process of growing the corn.

Schnable, Nebraska Corn Checkoff Presidential Chair and professor of agronomy and horticulture, is collaborating with colleagues at Iowa State and Purdue universities.

Nebraska's state-of-the-art facilities play key roles in overcoming barriers to twinning crop fields. Its LemnaTec High-Throughput Plant Phenotyping System, housed at Nebraska Innovation Campus' Greenhouse Innovation Center, automates data collection and produces high-resolution data across a plant's life cycle.

Nebraska is a global leader in high-throughput phenotyping and corn quantitative genetics – two keys to achieving food security. It co-founded the AI Institute for Resilient Agriculture, based at Iowa State University, to build virtual replicas of crops and fields.

The National Science Foundation funds this project.

Press' baseball catalog gets another win

The University of Nebraska Press continues its winning streak in baseball literature, with another publication taking top honors for best baseball history or biography.

This marks the 12th time an NU Press book has earned the Dr. Harold and Dorothy Seymour Medal since 2006 and the 13th overall.

Historian Larry Gerlach, a Nebraska alumnus, won the 2025 Seymour Medal for "Lion of the League: Bob Emslie and the Evolution of the Baseball Umpire" (University of Nebraska Press, 2024). The medal is awarded annually by the Society for American Baseball Research, the nation's foremost group of baseball researchers and historians.

"When they recognize your books, you know you've published something important to those who know baseball history," said Rob Taylor, senior acquisitions editor in charge of sports.

Nebraska's baseball expertise began in the 1990s, when the press reprinted several books dropped by trade publishers. The success of those books – which included Ty Cobb's autobiography, "My Life in Baseball: The True Record" – led to publishing original baseball books that have cemented NU Press' national reputation.

A collection of the NU Press' baseball titles

Jamilla Teixeira

Plastic bags get new life in recycled roadway

A newly asphalted stretch of road in South Sioux City, Nebraska, may look like any other, but millions of plastic bags went into its construction.

Nebraska engineer Jamilla Teixeira partnered with the town to test a cutting-edge asphalt blend that incorporates recycled plastic bags.

It was a win-win collaboration, removing 2 million plastic bags from the environment while delivering a more durable road material.

"This is a pilot project, but it is an excellent opportunity to partner with a Nebraska community and test how the mixture will perform under the extreme weather conditions we have here," said Teixeira, assistant professor of civil and environmental engineering.

Teixeira's research focuses on sustainable infrastructure. She's one of four faculty to receive a College of Engineering Scholarship of Engagement Fellowship, which offers $4,000 stipends to assist with community projects.

Asphalt that incorporates shredded plastic has been used elsewhere, but this is Nebraska's first such project. It included paving an extension of the town's Al Bengtson Bicycle Trail.

The collaborative project included the Nebraska Department of Transportation, private companies and nonprofit organizations. The Nebraska Environmental Trust funded the work.

Makerspace names first robotics fellows

Nebraska Innovation Studio welcomed four Huskers as the inaugural class of its Robotics Fellowship Program.

Over 20 weeks, the fellows worked in the studio's makerspace to develop cutting-edge products in cattle ranching, surgery, language development and precision agriculture. The work positioned them to pursue commercialization, such as seeking funding or a patent.

The fellowship program aims to expand Nebraska's economy through robotics training, research and implementation. It's part of the Heartland Robotics Cluster, an interdisciplinary collaboration between the university, the College of Engineering, local leaders in entrepreneurship and innovation, and community colleges. A 2022 U.S. Department of Commerce Economic Development Administration grant established the collaboration.

The robotics fellows have access to cutting-edge tools and resources; guidance from a panel of experts; and a stipend for supplies. Events and classes provide networking and learning opportunities.

The cohort included Amlan Balabantaray, a doctoral candidate in biological systems engineering; Brooke Bode and Teresa Monsees, mechanical engineering seniors at the time; and Husker alum Riley Reynolds, a surgical robots engineer at Virtual Incision in Lincoln.

"Opportunities like these are what will elevate our tech communities to stand shoulder-to-shoulder with the best of the best in robotics," said John Strope, program coordinator.

Full story: **https://research.unl.edu/annualreport/2025/highlights**

RESEARCH HIGHLIGHTS

Students leverage virtual reality to animate history

Nebraska's Animating History Lab is giving students the opportunity to bring historical research to digital life.

Founded in 2016, the lab mentors students in filmmaking and guides them in producing their own digital projects, from creative spark to exhibition at Student Research Days.

The interdisciplinary nature of the projects helps students become well-rounded artists in their careers, said Michael Burton, the lab's founder and associate professor of textiles, merchandising and fashion design.

Each fall, Burton hires students through Nebraska's Undergraduate Creative Activities and Research Experience program, which pays students to work alongside faculty. Students initially collaborate on an Animating History film production. In the spring, they launch their own projects, researching primary sources and developing a short animation, virtual reality experience, or 3D clothing model or similar digital artifact.

In fall 2024, four students worked on "Perihelion," a short film examining risk-taking in astronomy. Individually, they created an animated short from Rachel Carson's 1962 cautionary environmental book, "Silent Spring"; a 3D digital dress worn by a late Nebraska philanthropist; an animated comic exploring an alternative version of the 1960s cartoon "The Jetsons"; and a video game telling the story of Atari, an early gaming company.

Emerging media arts student Kolby Hunt experiments with a VR headset.

Center broadens legal help for rural families

A new center in the University of Nebraska College of Law represents a major step toward improving legal assistance for vulnerable children and families, particularly in rural communities.

The Nebraska Children's Justice and Legal Advocacy Center is equipping attorneys with the knowledge, skills and support they need to become better advocates for children.

The center builds on Nebraska's success training attorneys to work in juvenile courts, part of an effort to improve access to legal expertise in rural areas. Only 7% of Nebraska's more than 5,500 attorneys practice in rural areas, a problem mirrored throughout rural America.

From left: The center team includes Terra Garay, Lori Miller, Michelle Paxton, Megan Harris and Hannah Cook

"The realities we experience in Nebraska are not unique," said assistant professor of law Michelle Paxton, the center's founding director. "Our programs have already shown tangible benefits in addressing Nebraska's need for high-quality counsel for juveniles in rural communities."

The new center is educating law students and attorneys on state and federal child welfare laws as well as on trauma, child development, substance abuse, domestic violence and mental health issues.

The center will be a centralized resource for information on juvenile attorney availability and quality in Nebraska.

By creating a framework for rural attorney education, the center will be a model for other states facing similar challenges.

Autonomy-supportive messages may boost interest in clinical trials

Clinical trials – a crucial step in medical research – require participants. Without them, treatments are delayed or may never reach patients.

Yet time constraints, safety concerns, lack of awareness and other challenges hamper recruitment. Social media content, especially short-form videos, is helping to overcome obstacles.

Husker Ciera Kirkpatrick's research suggests messages that give viewers a sense of agency or control lead to more favorable attitudes toward participating in the trial.

Kirkpatrick and her team surveyed more than 600 people who viewed recruitment videos.

Those containing autonomy-supportive messages incorporated into a personal story garnered the fewest negative emotions and the best attitudes toward participation. Personal stories without autonomy-supportive messages resulted in less favorable attitudes.

Tweaking messages on social media sites, such as TikTok, to include autonomy messaging is easy to do and has a large impact on how people perceive clinical trials, said Kirkpatrick, assistant professor of advertising and public relations.

Such messaging also improves engagement with the video through likes, shares and comments,


Ciera Kirkpatrick

boosting the video's viewership and, potentially, trial recruitment.

Health Communication published this study.

College develops first-of-its-kind space law manual

The University of Nebraska College of Law played a leading role in developing a groundbreaking manual for military interactions in space.


Jack Beard

The Woomera Manual on the International Law of Military Space Activities and Operations (Oxford University Press, 2024) is the first comprehensive examination of how earthbound laws will be applied in space.

As editor in chief, Nebraska's Jack Beard helped guide the manual's development alongside a team of space and military law experts in the United States, Australia and the United Kingdom.

Husker law students played an extensive role, providing research and editorial support and participating in editorial meetings at home and abroad, said Beard, Robert and Joanne Berkshire Professor of Law Emeritus and director of Nebraska Law's Space, Cyber and National Security Law Program.

The Woomera Manual provides an objective overview of existing international law applicable to military space operations. It's designed to assist military and civilian governments, space operators and policymakers and to advance peaceful cooperation in space.

Nebraska's program is recognized globally for its expertise in security, space and technology. Faculty consult with governments, nongovernmental agencies, military organizations and the private space industry.

Full story: **https://research.unl.edu/annualreport/2025/highlights**

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