



RESEARCH AT
NEBRASKA

2023-2024 REPORT

EXPLORE NEBRASKA RESEARCH

The 2023-2024 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/2024.

ONLINE EXCLUSIVES

DEFENSE: Safeguarding against acute radiation syndrome

TRANSPORTATION: Ensuring guardrails hold up against electric vehicles

PLANT SCIENCE: Helping crops survive cold snaps

STEM EDUCATION: Forging partnerships for biodiversity education

COMMUNITY PLANNING: Fortifying communities for future weather threats

K-12 EDUCATION: Supporting the next generation of teachers

STRONG COMMUNITIES: Nebraska holds Carnegie designation for engagement

MATERIALS SCIENCE: Laser accelerates advanced manufacturing capabilities

CLIMATE RESILIENCE: Lowering livestock's methane emissions

JOURNALISM: Gaming as a force for good

EMERGING MEDIA ARTS: Unique core facility fuses science, media arts

HEALTH EQUITY: Improving the lives of youth experiencing homelessness

ARCHAEOLOGY: Decoding ancient sphinx's mysterious message

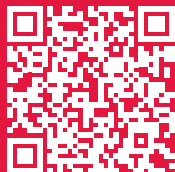
SCIENCE LITERACY: Wildlife conservation inspires National Geographic photo exhibit

NEBRASKA PRESS: Nebraska Press author named Pulitzer Prize finalist

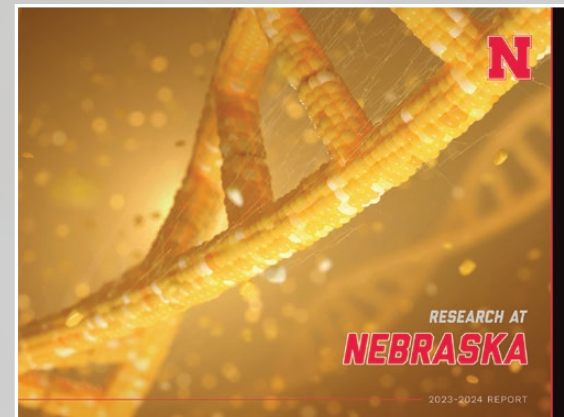
STATE MUSEUM: State Museum earns reaccreditation

AWARDS: Nebraska earns record nine CAREER awards

ECONOMIC DEVELOPMENT: NIC selected as outstanding research park



This report is available online:
research.unl.edu/annualreport/2024



ABOUT THE COVER

Nebraska plant scientist James Schnable is part of an international research team that created the first complete map of the corn genome. The cover artwork is an artistic interpretation of the crop's DNA. Read more about the project on page 2.



Accelerating research growth

Nebraska Research celebrates the prominence, excellence and impact of faculty, staff and students.

We are driven to seek solutions that improve lives, stimulate economic prosperity and deepen understanding of the world.

As the state's land-grant, Carnegie R1 institution and only member of the Big Ten Academic Alliance, the University of Nebraska–Lincoln has a unique role in advancing knowledge and transforming lives. The 2024 Research Report highlights some recent accomplishments in discovery, innovation and creativity.

Our stature is rising. Over the past decade, total research expenditures across UNL, the University of Nebraska Medical Center and the system's Office of the President have increased 53%. UNL's total sponsored research awards grew 58% during that time. For the seventh consecutive year, the University of Nebraska system is ranked among the

world's top 100 academic institutions receiving U.S. patents, rising five spots to No. 73.



Interim Vice Chancellor Jennifer Nelson

We invest in research. The CryoEM Core Facility houses the first cryo-electron microscope in the state and one of a few regionally – a major opportunity to advance the agricultural and biomedical life sciences. Faculty leadership and university-wide partnerships made the new research core possible (page 7).

Through the Grand Challenges initiative, Nebraska has committed \$40 million toward strategic goal-based solutions in seven focus areas. In addition to addressing pressing societal issues, the interdisciplinary effort has generated new collaborations and opportunities for faculty to make an impact (page 10).

We are looking ahead and preparing to strategically invest in areas where Nebraska has expertise to make major scientific advancements.

Our faculty is world-class. At Nebraska, we believe that people make the place. Nine Nebraska researchers earned National Science Foundation Faculty Early Career Development Program awards in 2024 – a new university record.

Husker researchers are earning top awards in their fields (page 11), while the number of faculty books, publications and creative works continues to climb.

When faculty across ranks and disciplines work together to solve real-world problems, Nebraska is unstoppable. I invite you to read more about the people and the work driving our research trajectory.

A handwritten signature in black ink that reads 'Jennifer Mize Nelson'.

Jennifer Mize Nelson
Interim Vice Chancellor for
Research and Innovation



ACHIEVING **EXCELLENCE**

Husker plays role in landmark mapping of corn genome

Surprising fact: There are more genes in a corn plant than in a human being. Corn's entire set of genes – its genome – is also more difficult to decode.

Nebraska agronomist James Schnable helped create the first complete map of the corn genome, a landmark achievement that enables advances in corn resiliency and productivity.

Corn's genome contains numerous repetitive sections. China Agricultural University researchers, who led the project, approached Schnable for his expertise in teasing apart the subtle genetic differences in corn varieties.

To increase productivity, scientists compare differences in the DNA of corn varieties thriving in disparate environments. Gaps in the known genome allowed only partial answers. The complete genome will help scientists uncover the role of individual genes, improving varietal comparisons.

In turn, plant breeders can better predict which new corn hybrids to pursue in a changing climate.

“At Nebraska, we are working very hard to be the best in the world in corn,” said Schnable, Nebraska Corn Checkoff Presidential Chair and professor of agronomy and horticulture. “This study is one example of people from the other side of the globe coming here because we have unique expertise.”

The study was published in *Nature Genetics*. Iowa State University partnered in this project.



James Schnable



Full story: <https://research.unl.edu/annualreport/2024/genome/>



Unraveling drug use and misuse in rural areas



Describing initial research discoveries as “eye opening,” scientists in the Rural Drug Addiction Research Center are building upon a strong foundation to develop partnerships with communities across Nebraska to address drug use and misuse.

RDAR, founded in 2019, earned a five-year, \$11,597,682 Phase 2 grant from the National Institutes of Health’s Centers of Biomedical Research Excellence program to continue its work through 2029.

The center’s first five years yielded a better understanding of community members’ issues, needs and concerns.

Its mission is to understand the causes and impacts of rural drug use and to inform novel interventions in Nebraska and the surrounding region.

“We’ve known for a very long time that drug use and misuse has been a major issue in rural communities,” said Rick Bevins, center director and the Mildred Francis Thompson University Professor of Psychology.

Among the challenges in rural America compared to urban areas: The stigma of

substance misuse is often greater in an environment where there’s less anonymity.

The nature of the drug issues in rural Nebraska also differs. While opioids get the most attention, methamphetamine is far more prevalent. Researchers also found strong links between homelessness and substance misuse, especially among women.



From left: Matthew Gormley, Devan Crawford, Stewart Haszard, Bergen Johnston, Patrick Habecker, John Joseph Karsk, Rick Bevins, Nicholas Hubbard, Lillianna Cervantes, Timothy Nelson, Rosemary Auma Onyango and Ken Wakabayashi

The center collaborates with Nebraska Extension, Rural Prosperity Nebraska and the University of Nebraska Medical Center to share its findings with community partners, whose priorities and concerns will drive the center’s research trajectories.

Full story: <https://research.unl.edu/annualreport/2024/rdar/>



Surgical robot takes journey to outer space

Nebraska engineer Shane Farritor makes little robots.

Yet he and his team are thinking big. In fact, their 2-pound robotic surgical arm, MIRA, recently proved its mettle in outer space.

MIRA – Miniaturized in Vivo Robotic Assistant – also became the only small robotic-assisted surgical device to receive U.S. Food and Drug Administration approval.

To bring MIRA to fruition, Farritor co-founded Virtual Incision in 2006. The Lincoln-based company employs more than 30 Nebraska graduates and has attracted over \$100 million in venture capital investment.

MIRA has arms small enough to perform surgery inside the body. Hospitals are buying the robot to assist surgeons with laparoscopic colectomies, for which it received FDA approval in February 2024. Ongoing research will soon expand MIRA's surgical range.

Additional potential lies in telesurgery, when the surgeon is far from the patient. With its transportability and simplicity, MIRA could one day help care for wounded soldiers or astronauts in health emergencies.



Michael Jobst, a colorectal surgeon, guides MIRA's first surgical cuts on the International Space Station from Lincoln.

In 2024, MIRA traveled to the International Space Station and successfully simulated surgical techniques guided by surgeons in Lincoln.

Telesurgery would also improve care in rural areas worldwide, allowing specialists to directly assist local doctors.

"We're on a strong mission here to improve patients' lives," said Farritor, Lederer Professor of Engineering.



Shane Farritor takes a turn using the surgical robot. Farritor and surgeon Dmitry Oleynikov, pictured in back, co-founded Virtual Incision.

Full story: <https://research.unl.edu/annualreport/2024/robot/>





Uniting around a shared history

Nearly 150 years ago, the Otoe-Missouria Tribe left southeastern Nebraska for an Oklahoma reservation. Today, Nebraskans are welcoming back the tribal nation.

Margaret Jacobs, director of Nebraska's Center for Great Plains Studies, and Christina Faw Faw Goodson, an Otoe-Missouria educator, historian and cultural linguist, co-lead a multifaceted project aiming to reconnect Otoe-Missourians with their homeland and to educate Nebraskans about the area's Indigenous history.

For both, it's an important step toward reconciliation.

The project, "Walking in the Footsteps of our Ancestors: Re-Indigenizing Southeast Nebraska," grew out of relationships that Jacobs, Charles Mach Professor of History, Goodson and others developed establishing Otoe-Missouria Day, a commemoration held every Sept. 21.

Connecting people remains at the project's heart. More than 50 Native and non-Native people support efforts to create land-based commemorations, build relationships, facilitate reconciliation and document the process.

A \$1.58 million grant from the Mellon Foundation's Monuments Project funds the project. It is the largest arts and humanities research grant in university history.

Goodson, an Otoe-Missouria Tribe member, said Nebraskans have been welcoming, partnering to design new trails, signage and ceremonial spaces.

The project is also educating communities through presentations, monuments and partnerships with schools and local organizations.

Goodson praises the project's lasting impact.

"This was the last place we were at before we were totally removed to Oklahoma," she said. "It's the last place we called home."



Full story: <https://research.unl.edu/annualreport/2024/monuments/>



Margaret Jacobs and Christina Faw Faw Goodson



Beautifying communities through street art

Sandra Williams' work seeks to facilitate social change by revealing a community's unique identity, often in partnership with others. Her art can be experienced as finely detailed paper cuts, imaginative paintings or sweeping murals.

Within these forms, her work interweaves interest in her Indigenous Peruvian roots, a love of animals, and the friction that results when humans and the natural world collide, among other themes.

As an associate professor of art, she may be best recognized for her classes in street art, a rare offering at universities. Street art embraces murals, graffiti and other forms.

"These impromptu works create opportunities for people to come together," Williams said. "During a period when we're spending more time with screens than with each other, forms of street art, like memorial walls, become meaningful for people."

They can also beautify. Williams and her students are creating murals to revitalize rural Nebraska towns. In the process, students learn both artistic and practical aspects, such as budgeting.

"I see muralism as an opportunity for conversations about our history and land acknowledgement and things, both positive and negative, that have happened across the state," Williams said.

Students in Williams' class painted a mural at a Beatrice, Nebraska, car dealership. Maddie Vanderbur, a Husker senior, designed the mural.



Her work can be found in museums or on walls from Peru to Key West to Oregon and many points in between.



Full story: <https://research.unl.edu/annualreport/2024/murals/>

Transforming biomedical, ag sciences research



The CryoEM Core Facility, Nebraska's newest research core, is revolutionizing understanding of molecular foundations and boosting expertise in the biomedical and agricultural sciences.

It houses the state's first cryo-electron microscope – one of a handful regionally. The facility's capabilities are expected to strengthen research ties with other University of Nebraska institutions and attract university, industry and national laboratory partnerships.

Cryo-EM microscopy is a powerful imaging technique for observing biological molecules, complexes and cells at near-atomic resolution. Biological samples are cooled to at least negative 153 degrees Celsius, preserving the specimens more effectively than traditional methods.

It is a leading research tool for drug discovery and development, plant biology, infectious diseases, pathology, animal science and more.

To bring cryo-EM to UNL, the Nebraska Center for Integrated Biomolecular Communication allocated funding from its National Institutes of Health Centers of Biomedical Research Excellence award. Soon, the project received support from four additional colleges and units.

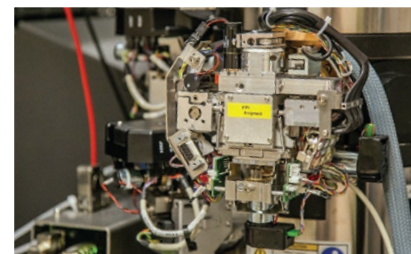
Nebraska researchers are leveraging cryo-EM to develop inhibitor drugs to treat the Ebola virus; design three-dimensional RNA nanostructures and nanomachines; study large biomolecular complexes; and investigate plant and animal health.

"We are paving the way for transformative discoveries and research that advance the state of Nebraska, the nation and the world," said Sherri Jones, former interim vice chancellor for research and innovation.

Full story: <https://research.unl.edu/annualreport/2024/cryoem/>



University leaders celebrate the facility's grand opening.



A close-up shot of the facility's equipment



Center director Eduardo Romero Camacho

ECONOMIC IMPACT

Backed by a robust ecosystem of innovation that supports faculty innovation and industry partnerships, Nebraska Research drives economic growth in the state and beyond. The growing roster of companies located at Nebraska Innovation Campus includes more than 70 private businesses and University of Nebraska entities.

Economic Development Activity

\$6.16M

Combined licensing income across the University of Nebraska-Lincoln and the University of Nebraska Medical Center, FY 2024

#73

University of Nebraska ranking among the top 100 academic institutions receiving U.S. patents; ranked for the seventh consecutive year

111

Student internships funded by businesses located at Nebraska Innovation Campus

An Ecosystem of Innovation

- Nebraska Innovation Campus
- NUtech Ventures
- UNL Industry Relations
- Nebraska Center for Entrepreneurship
- Engler Agribusiness Entrepreneurship Program
- Invest Nebraska
- NMotion startup accelerator
- Nebraska Department of Economic Development
- Industry partners
- The Combine



Full story: <https://research.unl.edu/annualreport/2024/#economicimpact>



Precision ag facility a hub for sustainable, resilient practices



The next era of agricultural innovation and discovery is underway at Nebraska Innovation Campus, with construction starting on the National Center for Resilient and Regenerative Precision Agriculture.

The center is a partnership between the U.S. Department of Agriculture's Agricultural Research Service, UNL and NIC. It will promote sustainable, resilient and highly efficient agricultural practices – and offer research-based solutions for real-world settings.

The first stage of the \$160 million laboratory will feature 15,000 square feet of greenhouses and 10,000 square feet of headhouse space, all connected to the Greenhouse Innovation Center at NIC.

The complex will be a hub for interdisciplinary experts, scientists and engineers who will collaborate with industry and producers to improve water and food security, promote resilient landscapes and enhance agricultural productivity.

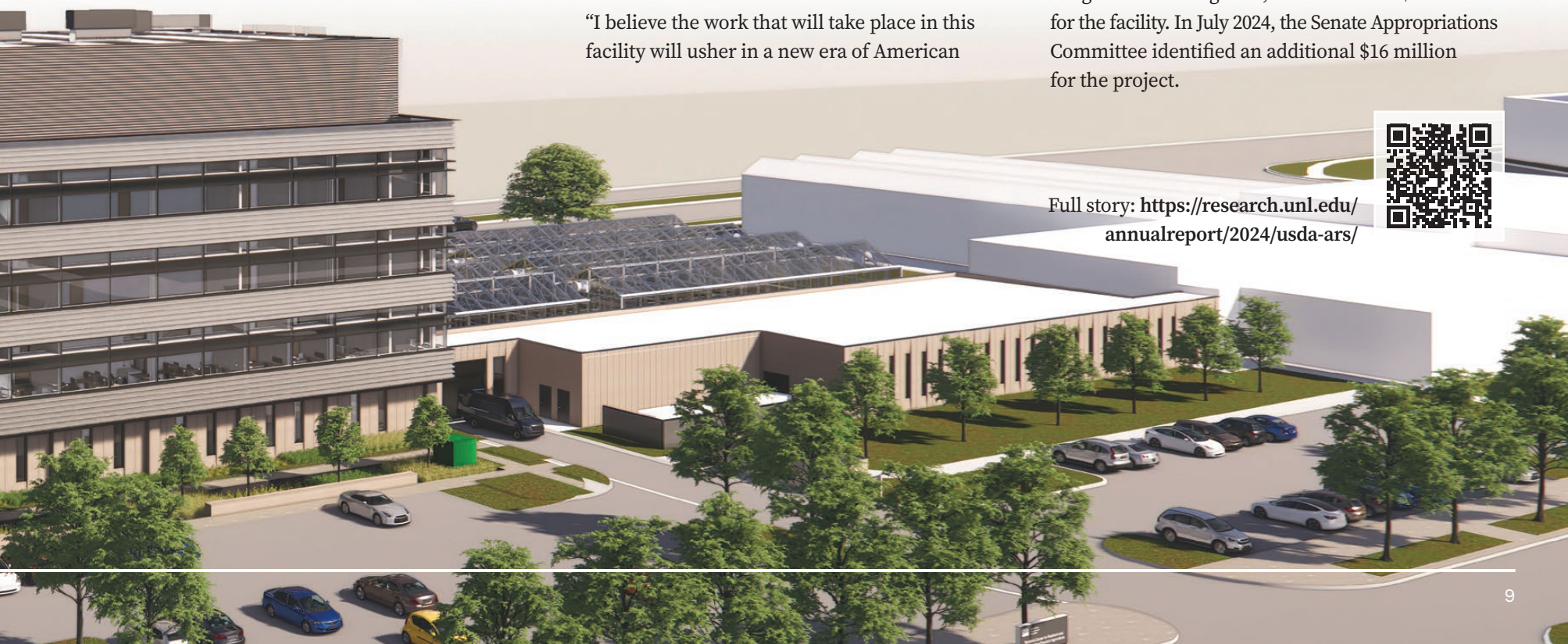
"I believe the work that will take place in this facility will usher in a new era of American

agriculture, and I'm thrilled that what happens next in agriculture will happen first in Nebraska," said Mike Boehm, vice chancellor for UNL's Institute of Agriculture and Natural Resources.

Federal, state and university partnerships have driven the project's momentum, including a long history of scientific innovation and collaboration between USDA-ARS and UNL.

The project received strong support from Nebraska's congressional delegation, which secured \$25 million for the facility. In July 2024, the Senate Appropriations Committee identified an additional \$16 million for the project.

Full story: <https://research.unl.edu/annualreport/2024/usda-ars/>

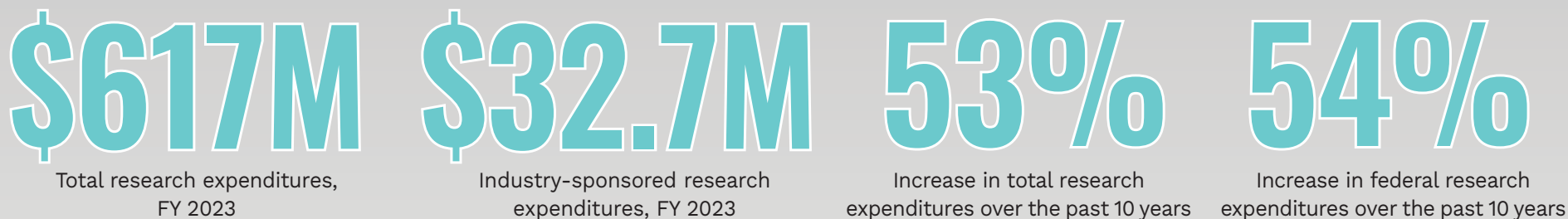


RESEARCH AT A GLANCE

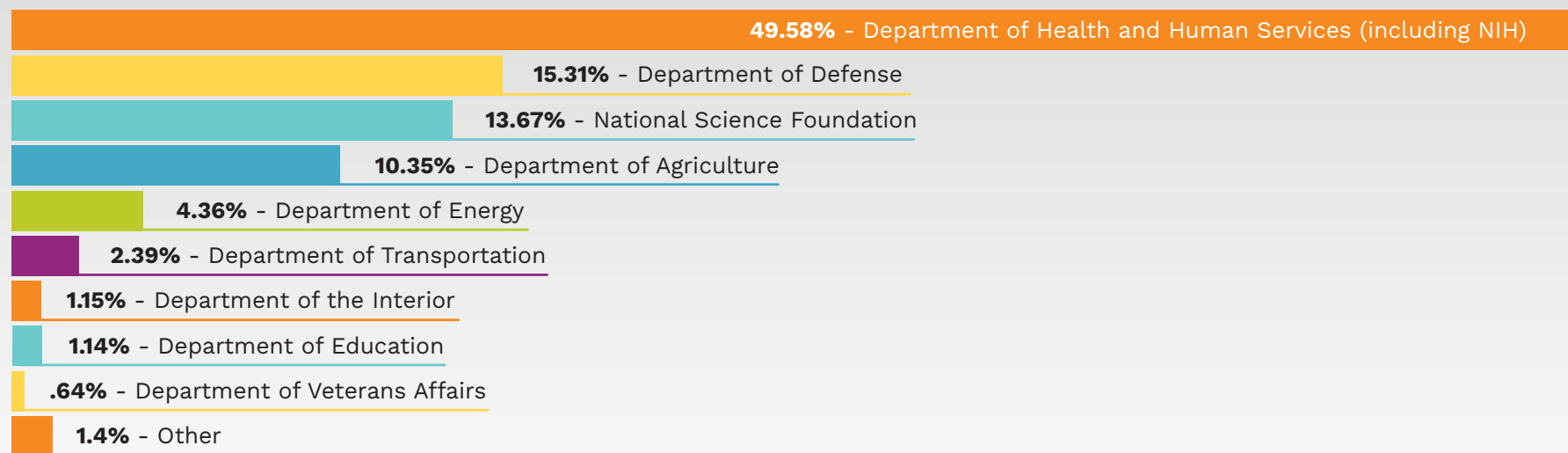
Prominence, excellence and impact drive the trajectory of Nebraska Research. Faculty across disciplines are improving lives across the state, U.S. and world through discovery, creativity and innovation.

The following information reflects 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, unless otherwise noted.

Research Growth



FY 2023 Federal research expenditures by agency



FY 2023 is the most recent year for which figures are available.



9

National Science Foundation Early Career Development Program awards earned by Nebraska faculty in the 2024 funding cycle, an institutional record.

#81

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

Scholarly Impact

Nebraska scholars published 265 books and 20,185 peer-reviewed articles between 2019 and 2023. These works were cited

550,000

times during that period, according to Academic Analytics data.

ACCOLADES



Award-Winning Faculty

The University of Nebraska-Lincoln has a strategic goal to increase the number of external honorific awards. The following list includes selected awards and accomplishments that Husker researchers earned in fiscal year 2024.

Rick Bevins, Mildred Francis Thompson University Professor of Psychology
Fellow, American Association for the Advancement of Science

Thomas Powers, professor of plant pathology
Fellow, American Association for the Advancement of Science

Daniel Ciobanu, professor of animal science
Fellow, National Academy of Inventors

Susan Sheridan, George Holmes University Professor of Educational Psychology and founding director of the Nebraska Center for Research on Children, Youth, Families and Schools
Elected Member, National Academy of Education

William Belcher, associate professor of anthropology in the School of Global Integrative Studies
U.S. Fulbright-Nehru Distinguished Scholar Award

Chun-Hsing (Jun) Ho, associate professor in the Durham School of Architectural Engineering and Construction
Fulbright U.S. Scholar Award

Kwame Dawes, George Holmes Distinguished Professor of English and Glenna Luschei Editor of Prairie Schooner magazine
Poet Laureate of Jamaica

Derek Heeren, professor of biological systems engineering
Heermann Sprinkler Irrigation Award, American Society of Agricultural and Biological Engineers

Mary Ann Johnson, professor of Nutrition and Health Sciences (emerita)
Fellow, American Society for Nutrition

Humberto Blanco, professor of agronomy and horticulture
Fellow, American Society of Agronomy

Liyan Qu, associate professor of electrical and computer engineering
Senior Member, National Academy of Inventors

Laila Puntel, adjunct faculty in agronomy and horticulture
Early Career Award, American Society of Agronomy

Ayse Kilic, professor of natural resources
Royce J. Tipton Award, American Society of Civil Engineers

David Berkowitz, Elmer and Ruby Cordes Professor of Chemistry
Fellow, American Chemical Society

Full story: <https://research.unl.edu/annualreport/2024/accolades/>



HIGHLIGHTS

Infrastructure improvements enhance research, teaching and outreach

From architecture to music, ag efficiency to museum exhibits and hospitality to engineering, facility improvements on campus will enhance experiences for faculty, staff, students and visitors.

Kiewit Hall

Opened in January 2024, Kiewit Hall was designed and built with an emphasis on career development for future engineers. The 182,000-square-foot, \$115 million facility is the university's hub for engineering education.



Morrill Hall

The largest renovation in the University of Nebraska State Museum's nearly 100-year history provides better protection for exhibits and research collections and expanded accessibility for visitors.



Westbrook Music Building and Kimball Recital Hall

The Glenn Korff School of Music plans to move into new headquarters in 2025. Westbrook Music Building, a blend of 75,000 square feet of new construction and renovated space, will include state-of-the-art facilities for musicians and audiences. Kimball Recital Hall also is undergoing extensive renovations.

Architecture Hall

HDR Pavilion, part of a phased renovation project of the historical Architecture Hall, opened in fall 2024. The addition includes the expansion and renovation of an existing lecture hall, plus 14 new studio spaces, adjoining classrooms, and indoor and outdoor collaboration spaces.





NFarms

The Nebraska Future Ag Research and Management Systems – NFarms – is a strategic initiative to expand research and outreach in precision agriculture. Construction on a 5,000-square-foot building in Mead, Nebraska, began in summer 2024 and is expected to be completed in early 2025.



Full story: <https://research.unl.edu/annualreport/2024/infrastructure/>

GRAND CHALLENGES



CLIMATE
RESILIENCE



QUANTUM
SCIENCE AND
ENGINEERING



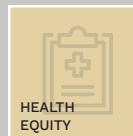
EARLY
CHILDHOOD
EDUCATION AND
DEVELOPMENT



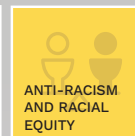
SUSTAINABLE
FOOD AND
WATER
SECURITY



SCIENCE AND
TECHNOLOGY
LITERACY
FOR SOCIETY



HEALTH
EQUITY



ANTI-RACISM
AND RACIAL
EQUITY



Year Three Summary

The University of Nebraska–Lincoln has committed \$40 million over four years toward strategic, goal-based solutions in seven thematic areas. The aim is to leverage Nebraska’s expertise and strengths to solve some of society’s greatest challenges. \$28.2 million has been invested so far using funds specifically earmarked for research.



\$8.2M

Investments made in the third year

9

Funded projects in 2024:
2 catalyst awards
7 planning grants

≈ 90

Members of the university
community involved in projects
funded during year three

9

All UNL colleges are participating
in at least one funded project.

CATALYST AWARDS

Bold and catalytic, representing significant new research, scholarly and creative activity.

\$3,832,145

Average amount
of a catalyst award

PLANNING GRANTS

Ideation and team building, used for developing project ideas around one or more themes.

\$74,154

Average amount
of a planning grant



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AND INNOVATION

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