RESEARCH AT NEBRASKA

2020-2021 REPORT

GRAND CHALLENGES

The University of Nebraska–Lincoln is committed to working strategically to deliver on its mission as the state of Nebraska's comprehensive land-grant institution. We are leveraging our expertise to positively impact these major societal challenges.

- ANTI-RACISM AND RACIAL EQUITY
- CLIMATE RESILIENCE
- EARLY CHILDHOOD EDUCATION AND DEVELOPMENT
- HEALTH EQUITY
- QUANTUM SCIENCE AND ENGINEERING
- SCIENCE AND TECHNOLOGY LITERACY FOR SOCIETY
- SUSTAINABLE FOOD AND WATER SECURITY

LEARN MORE:
research.unl.edu/grandchallenges

2020-2021 Nebraska Research Report

This report is available online:
research.unl.edu/annualreport/2021

Nebraska's Unwavering Momentum

As the pandemic reshaped campus norms, the University of Nebraska-Lincoln's momentum in research and creative activity was unwavering. We have many achievements to share and celebrate.

Nebraska went beyond fulfilling its land-grant mission during a challenging time. Our university looked toward new possibilities. I am incredibly proud of Nebraska's resilience.

- Research expenditures in fiscal 2020 totaled $320 million, a 43% increase over the past decade.
- For the fourth consecutive year, the University of Nebraska ranked among the top 100 institutions receiving U.S. patents.

Those accomplishments made headlines, but important progress also happened behind the scenes.

Chancellor Ronnie Green announced the seven Grand Challenges themes that will shape our research trajectory: anti-racism and racial equity; climate resilience; early childhood education and development; health equity; quantum science and engineering; science and technology literacy for society; and sustainable food and water security.

The themes grew from a collaborative process involving more than 500 faculty, staff, students and emeriti charged with identifying ways Nebraska can leverage its expertise to make a global impact.

Vice Chancellor Robert "Bob" Wilhelm

Addressing complex issues requires effective leadership. To develop the next generation of leaders, Nebraska Research launched a faculty leadership development program, the first in the Big Ten. The inaugural cohort included 15 researchers from 13 disciplines.

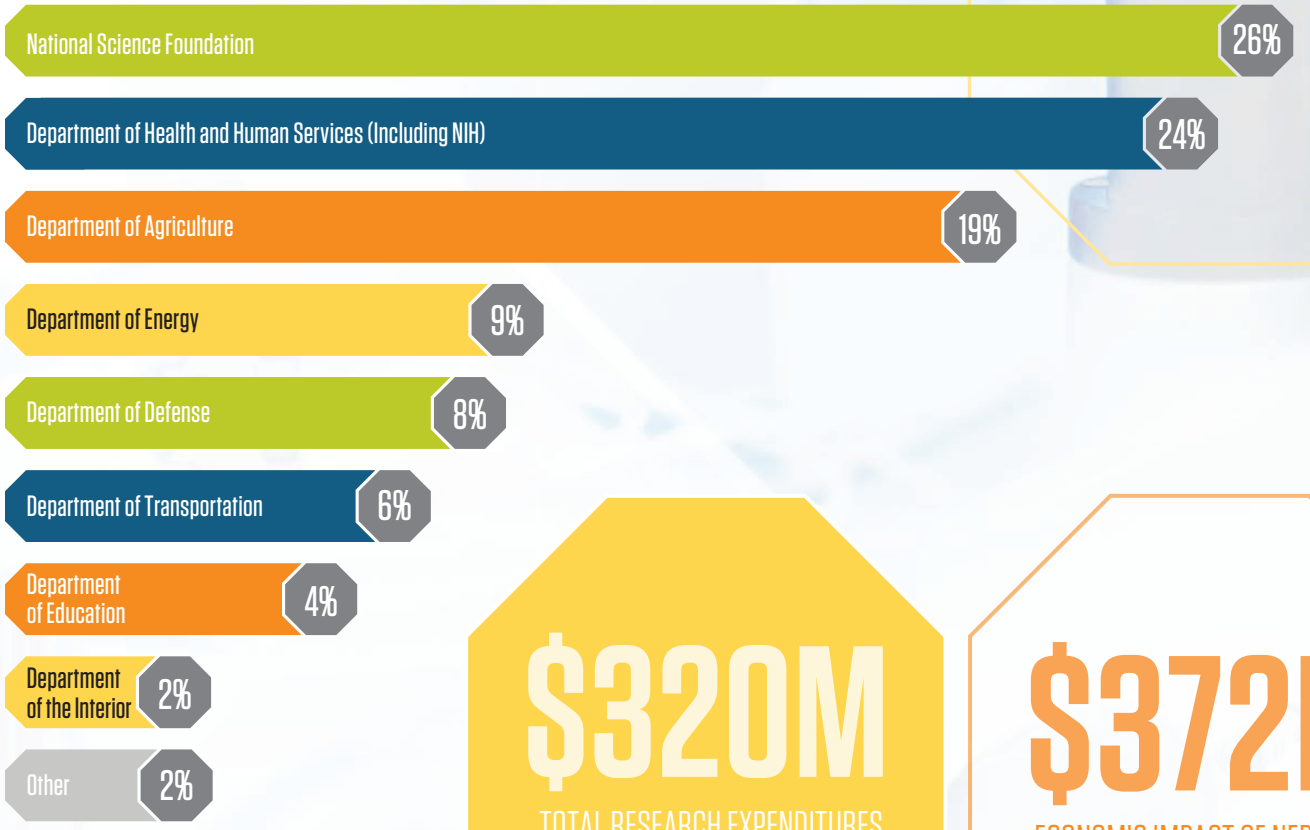
Our campus' continued journey toward anti-racism and racial equity is among our most important work, ensuring Nebraska is a place where all can find success.

I'm pleased to share our record of accomplishments with you.

Robert "Bob" Wilhelm
Vice Chancellor for Research and Economic Development

NEBRASKA RESEARCH AND ECONOMIC DEVELOPMENT AT A GLANCE

FY 2020 FEDERAL EXPENDITURES BY AGENCY



$320M
TOTAL RESEARCH EXPENDITURES FY 2020

$372M
ECONOMIC IMPACT OF NEBRASKA INNOVATION CAMPUS

1,948
JOBS CREATED STATEWIDE BY NEBRASKA INNOVATION CAMPUS

128
STUDENT INTERNSHIPS FUNDED THROUGH NEBRASKA INNOVATION CAMPUS

43%
INCREASE IN RESEARCH EXPENDITURES OVER THE PAST 10 YEARS

77
UNIVERSITY OF NEBRASKA RANKING AMONG THE TOP 100 ACADEMIC INSTITUTIONS RECEIVING U.S. PATENTS, RANKED FOR THE FOURTH CONSECUTIVE YEAR

1,508
SPONSORED RESEARCH AWARDS

$19.2M
EXPENDITURES SUPPORTED BY INDUSTRY SPONSORSHIP

1.5M
SQUARE FEET OF SPACE FOR RESEARCH

$6.48M
LICENSING INCOME IN FY 2021

Advancing the Second Quantum Revolution

First came advances in materials science and technology. Now emergent quantum materials and technologies are ushering in another wave of innovation. These developments could radically shift capabilities for information technology, medical technology and cryptography, which could enhance security measures in defense and banking.

A five-year, $20 million award from the National Science Foundation's Established Program to Stimulate Competitive Research is positioning the University of Nebraska and partnering institutions to lead a second quantum revolution. It creates the Emergent Quantum Materials and Technologies collaboration, a research and education cluster to boost the state's capacity and competitiveness in the field. A Research Infrastructure Improvement-Track 1 award supports the project.

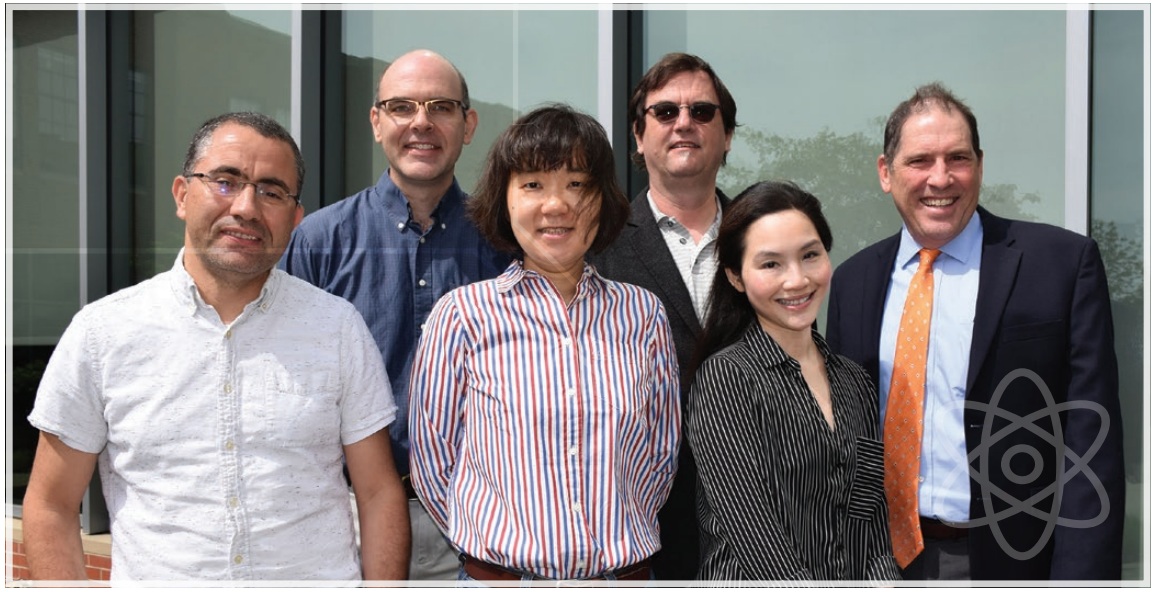
Nebraska's record of success in developing materials and nanoscience programs prepared the EQUATE team to tackle the next stage of quantum science and technology, a major federal priority area, said Matt Andrews, Nebraska EPSCoR director and principal investigator.

The 20-member team includes researchers from UNL, University of Nebraska at Omaha, University of Nebraska at Kearney and Creighton University. Their aim is to stimulate scientific discovery in quantum materials and systems design and implementation, which could revolutionize communication and information processing technologies.

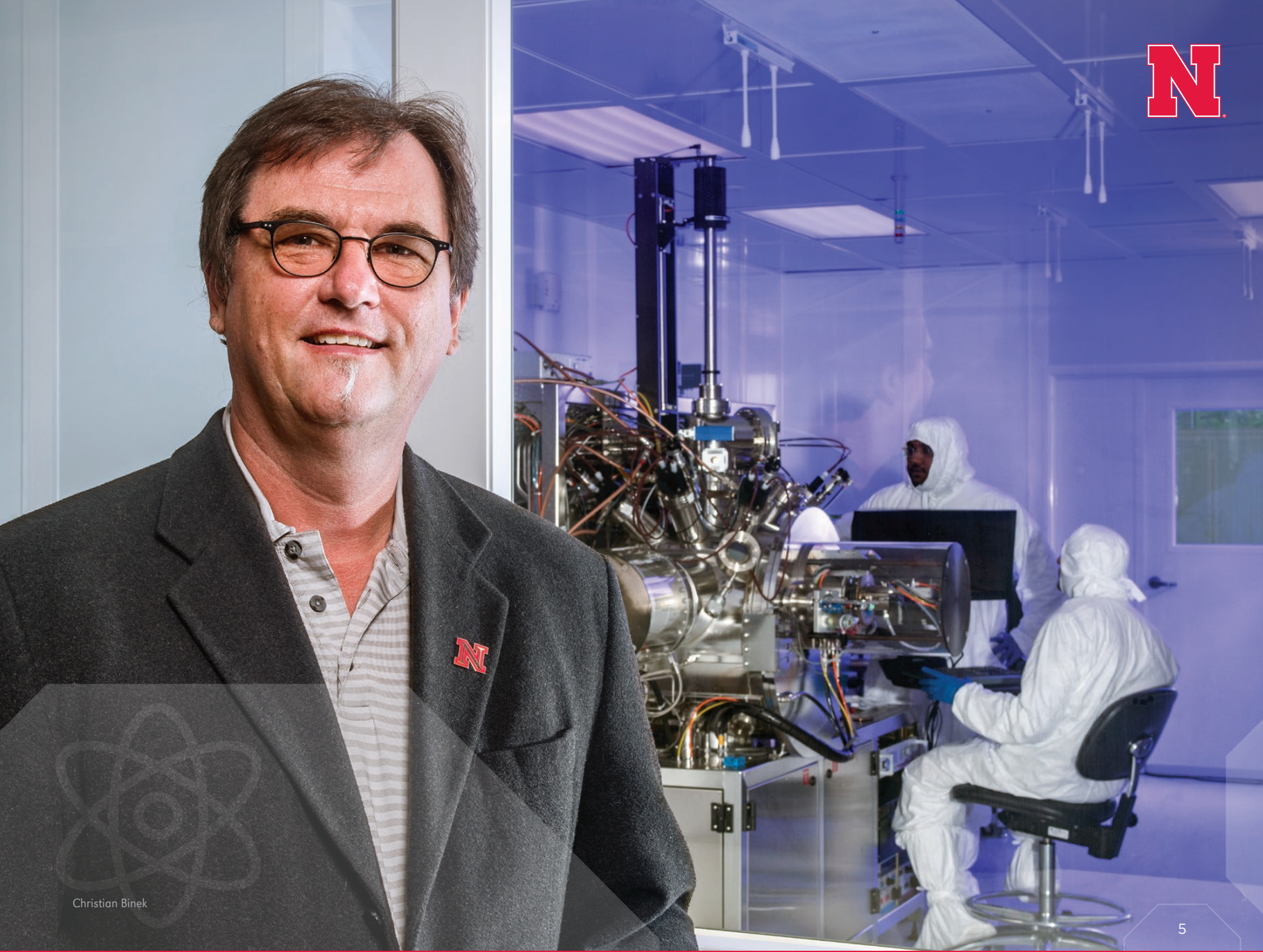
Expanding STEM education in Nebraska is another goal. Through a partnership with Little Priest Tribal College and Nebraska Indian Community College, students from Native American and rural communities will have opportunities to explore this growing field. Having this specialized knowledge in the state could be a boon to workforce development, said Christian Binek, EQUATE scientific director and Charles Bessey Professor of Physics.

The team also is establishing education and outreach programs for elementary and secondary students; investing in cutting-edge equipment; making strategic faculty hires; engaging local industry partners; and securing additional major research funding.

Nebraska knows how to accomplish these ambitious goals, Binek said. EQUATE has a model for effective research and education clusters in the Nebraska Center for Materials and Nanoscience, Materials Research Science and Engineering Center and the Nebraska Nanoscale Facility, all of which have been NSF-funded and are fundamental to the team's work.



From left: Abdelghani Laraoui, UNL; Jonathan Wrubel, Creighton University; Xia Hong, UNL; Christian Binek, UNL; Rebecca Lai, UNL; and Matt Andrews, Nebraska EPSCoR.



Christian Binek

Nanoscale Facility Supports Academic, Industry Scientists

The university continues to build on its expertise and leadership in nanoscience and nanotechnology with renewed funding for the Nebraska Nanoscale Facility.

The facility was established in 2015 with a grant from the National Science Foundation. The latest $3.5 million NSF grant ensures its continuation through at least 2025.

It's one of 16 centers created under NSF's National Nanotechnology Coordinated Infrastructure program, designed to advance the nation's nanoscience research by expanding the equipment and service capabilities of universities and industries.

"We can proudly say here in Nebraska that this is quite an elite club we are in," said Christian Binek, Charles Bessey Professor of Physics and director of the nanoscale facility. Providing this national infrastructure aims to ensure "the entire country is equipped with the tools and expertise to perform nanoscience and nanotechnology."

Nanoscience research has contributed to technological advances such as improving computing power and other electronics, environmental sensors, medical devices, solar and wind energy and national defense. Nebraska's infrastructure investments have helped solidify its standing as a leader in the field.

Over its first five years, the Nebraska Nanoscale Facility has helped academic and industry researchers throughout the region and from a variety of fields further their studies.

Rebecca Lai, associate professor of chemistry and the facility's assistant director, said the research hub greatly outperformed expectations in terms of

Above: David Zheng of Monolith Materials, an industry partner, prepares a sample for the Orisis scanning transmission electron microscope.

the number of both internal and external users, including industry, during its first five years.

"That's the goal of having this facility in the western part of the Midwest," Lai said.

Collaboration is an important byproduct of the facility, she said. As industry and Nebraska scientists work together, they foster relationships that might lead to additional partnerships.

Outreach and education also are key to the facility's mission. Its educational programs for students in kindergarten and up include traveling exhibits and collaborations with after-school programs and Nebraska 4-H. Lai said the nanoscale facility will expand its current outreach efforts and develop new ones.

Most Nebraska Nanoscale Facility laboratories are in the 32,000-square-foot Voelte-Keegan Nanoscience Research Center, completed in 2012, with others in the attached Jorgensen Hall, constructed in 2010.

Top: Lincoln Southwest High School intern Avery Florea inserts a sample into the microscope for imaging.

Extreme Light Lab Part of Laser Consortium

Nebraska's Extreme Light Laboratory plays a key role in the nation's high-intensity laser research. With renewed funding from the U.S. Department of Energy, the consortium to which it belongs is expanding.

DOE established LaserNetUS in 2018. Its $18 million funding boost in 2020, distributed among 10 partner institutions, extends the network for three years.

Nebraska's Extreme Light Laboratory, one of the LaserNetUS host institutions, is home to the powerful Diocles laser, able to generate the power of nearly 100 times the combined output of all the world's power plants but compressed and delivered in brief bursts. It can recreate some of the most extreme conditions in the universe. Experiments using Diocles enhance the basic understanding of physics and develop solutions for advanced manufacturing, national security and medicine.

"By greatly expanding research opportunities across a broad spectrum of laser science, I am confident that this investment will pay huge dividends for many years to come," said Donald Umstadter, Leland and Dorothy Olson Professor of Physics and director of the Extreme Light Laboratory.

Above: Extreme Light Laboratory researchers

All facilities in LaserNetUS operate high-intensity lasers, which have a broad range of applications in basic research, advanced manufacturing and medicine.

Other LaserNetUS institutions are: Colorado State University, Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory, SLAC National Accelerator Laboratory, The Ohio State University, University of Michigan, Institut National de la Recherche Scientifique, University of Rochester and University of Texas at Austin.

The U.S. has pioneered high-intensity laser technology. The network and future upgrades to LaserNetUS facilities will provide new opportunities for U.S. and international scientists in discovery science and technology development.

Helping High-Risk Groups Cope with COVID

The COVID-19 pandemic has illuminated health disparities stemming from diverse factors, including race, ethnicity and underlying health conditions.

Arthur "Trey" Andrews, assistant professor of psychology and ethnic studies, is examining two groups disproportionately affected by COVID-19: U.S. Latinos and people with histories of substance abuse. He's collecting survey information about their willingness to seek testing, treatment and vaccines; ability to obtain other types of health care; and access to mental health services for COVID-related distress.

Andrews' data helps state and local leaders develop public health interventions to reduce COVID-19 illness and mortality and guide people toward medical help. He hopes to shed light on the root causes of health disparities more generally – and help minimize future inequities.

"The idea is to understand the impact of not being able or willing to access services, testing, treatment or vaccination among high-risk groups," said Andrews, associate director of the Minority Health Disparities Initiative. "The lessons we learn will result in strategies that help diverse populations live healthier, longer lives, even beyond COVID-19."

Above: Trey Andrews

Latinos have been about three times as likely to contract the virus and twice as likely to die from it. These trends stem from distrust of the medical establishment, fears about facing immigration status questions, and employment and housing situations that preclude distancing.

People with substance abuse histories may not seek care to avoid legal trouble or judgment. They may face more severe COVID-19 outcomes, likely because of compromised cardiovascular function and marginalization of people with addiction problems.

Andrews is surveying about 200 members of each group every three months about their COVID-19 and health care experiences, including perceptions of discrimination. Their responses form the foundation of public health communication strategies encouraging evidence-based practices.

Andrews' efforts led to development of a state-funded collaborative data and outreach program with the Lincoln, Nebraska, nonprofit El Centro de las Américas. El Centro organized clinics where at least 600 Latinos in Nebraska received vaccines who otherwise would not have. Andrews and El Centro are also advocating for innovative pop-up vaccine clinics where Latinos frequently visit or work.

The Office of Research and Economic Development's COVID-19 Rapid Response Grant Program funded this project.

Linking Sexual Stigma and Dating Violence

Intimate partner violence, which includes physical, sexual and psychological abuse, carries enormous costs, including physical and psychological distress and increased school dropout rates.

Sexual minorities experience higher rates of intimate partner violence than heterosexual people. One explanation for this pattern is sexual stigma: negative attitudes and discrimination from individuals and institutions. This external stress can lead to increased alcohol use, failure to seek mental health services and heightened conflict in relationships – all risk factors for intimate partner violence.

In a first-of-its-kind study, Nebraska's Katie Edwards is exploring the ties between sexual stigma and dating violence for young adults enrolled at higher education institutions across the nation. By surveying nearly 12,000 heterosexual and sexual minority students and almost 4,500 faculty and staff, and pairing that data with objective measures of institutional policies, Edwards aims to paint a clearer picture of the effects of organizational practices.

"Essentially, we're trying to better understand how campus climate factors impact sexual minorities' experiences with intimate partner violence," said Edwards, associate professor of educational psychology in the Nebraska Center for Research on Children, Youth, Families and Schools.

The study takes a unique longitudinal, multi-informant, multicampus approach. Instead of deploying a one-time survey at a single institution, Edwards' team is collecting data at 20 institutions over an academic year for a more accurate snapshot across time.

Also innovative is the team's inclusion of objective information, such as the Campus Pride Index. That tool, and others like it, assess campuses' LGBTQ-related practices and policies.

Using the data, Edwards' team will develop interventions for universities and initiatives to help LGBTQ students cope in healthy ways with minority stressors.

Participating institutions will receive a tailored report to guide them in strengthening LGBTQ-related practices and policies.

Systemic change is the ultimate goal, Edwards said. Eliminating stigmas against sexual minorities would mitigate not only intimate partner violence, but other stressors that influence long-term health.

"Intimate partner violence is the outcome that we're focused on, but chronic stressors affect mental and physical health and even things like immunological functioning," Edwards said. "Minority stress is a leading cause of health disparities among sexual minorities."

She collaborates with Heather Littleton of the University of Colorado Colorado Springs.

The National Science Foundation supports this research.

Katie Edwards

Creating Global Access to African Poetry

Since 2017, the African Poetry Digital Portal at Nebraska has opened the work of African poets to readers and scholars around the world.

"The fact is that rich and sophisticated poetic practices and traditions have always existed in African societies and continue to thrive," said Kwame Dawes, George Holmes Professor of English, Glenna Luschei Editor of *Prairie Schooner* and editor of the African Poetry Book series published by the University of Nebraska Press.

"Unfortunately, racism and other forms of power dynamics have limited our understanding of this tradition in parts of the world that were exploited."

A free resource, the African Poetry Digital Portal documents the work and lives of African poets. It currently contains two major sections: Contemporary African Poets and African Poets and Poetry in the News.

An international team assembled by Dawes and co-principal investigator Lorna Dawes, associate professor of University Libraries, will expand the portal, using a three-year, $750,000 grant from the Andrew W. Mellon Foundation.

With expert assistance from Nebraska's Center for Digital Research in the Humanities, investigators will create a hub giving access to collections held by leading institutions worldwide, starting with these partners: University of Cape Town in South Africa, University of Lomé in Togo and University of Ghana; University of Oxford and Cambridge University in the United Kingdom; and Northwestern University, University of Michigan and the Library of Congress in the United States.

Lorna and Kwame Dawes

The portal will anchor new scholarly and creative activities, with Mellon Foundation funds supporting six doctoral research assistantships, three digital humanities research grants, 78 research stipends and a four-person technology team from the Center for Digital Research in the Humanities. They also will support undergraduate research stipends at collaborating institutions.

"Thanks to Professor Dawes' longstanding and visionary leadership, the English department at UNL has established itself over the last half decade as one of the absolute best places to study African poetics," said Marco Abel, Willa Cather Professor of English and Film Studies, and department chair. "With Mellon's support, this project is now poised for a massive institutional transformation."

Tracking Real-Time Physiological Reactions to Racism

Studies link the stress of racism to higher rates of chronic illnesses among people of color.

An interdisciplinary team of Nebraska and Texas researchers is one of the first to demonstrate the physiological responses connecting racism and health outcomes in real time.

"Our findings build on previous research and add to it by showing how racism affects the body's stress process in real time, in the real world," said Bridget Goosby, a University of Texas sociology professor who co-led the study while at Nebraska.

Bridget Goosby

The team measured the sympathetic nervous response – part of the body's fight or flight reflex – of college students who experienced race-based microaggressions, witnessed racism or ruminated on racism. The study involved 100 students: African Americans, Latinos, refugees and international students from Africa.

Researchers found all but refugees experienced elevated stress responses to various experiences related to racism.

Sympathetic nervous response is the first in a cascade of symptoms that lead to wear and tear on the body, Goosby said.

Over time, that physiological damage leads to chronic ailments, such as obesity, high blood pressure, diabetes and heart disease, many of which disproportionately affect minority groups.

When someone's fight or flight response kicks in, they sweat. For two weeks in fall 2016 and a week in spring 2017, students wore wrist sensors that measured changes in their skin's electrical conduction — how much they sweat. Participants also completed surveys throughout the day to report stress-triggering events, along with other measures like mood and social activities. The team matched participants' physical reactions to their experiences of racism.

Elevated stress responses occurred in African Americans and Latinos when they personally experienced racism, and in Latinos and African immigrants when they thought deeply about racial injustice.

African immigrants experienced an elevated stress response to witnessing racism, while Latinos had a suppressed response, possibly reflecting fatigue at the political rhetoric occurring at the time.

Refugee students were less likely to report negative emotions and race-related stress, possibly because belonging to a close-knit community is protective.

The study was published in *Proceedings of the National Academy of Sciences.*

Strengthening Support for Children with Disabilities

Parents of young children with disabilities face unique challenges and special stresses. So, too, do the personnel who help these families.

Coaching gives early childhood intervention workers tools and assistance to help them better meet the needs of the families they support, ultimately improving children's development.

Nebraska researchers partnered with the state to strengthen its coaching infrastructure and to guide coaches in how to better assist early intervention personnel. Ongoing support helps professionals incorporate what they learn into their everyday practice.

From left: Rachel Schachter, Sue Sheridan, Gwen Nugent, Lisa Knoche, all of UNL, and Sue Bainter, Nebraska Department of Education.

"Families rely on early intervention services to promote the healthy development of their children," said Lisa Knoche, project director and research associate professor in the Nebraska Center for Research on Children, Youth, Families and Schools. "The work is challenging. Professionals need support. Having a sounding board is really important to implementing what we know to be evidence-based practices."

The four-year project aims to develop a coaching model that can be expanded across the state and nationally. More than 3,200 infants and toddlers in Nebraska and nearly 400,000 nationally receive early childhood intervention services.

Researchers – in partnership with the Nebraska Early Development Network, which provides these services – are training state-level and locally based coaches to work with intervention personnel. Participants, including families, will provide feedback to help researchers evaluate and refine the coaching model.

The COVID-19 pandemic hasn't hindered the project. But it has highlighted the need for a strong coaching system, as caseloads skyrocket and family situations become more complex due to increasing strain and service interruptions, Knoche said.

Developing an important and nationally relevant program wouldn't be possible without the university's close relationship with Nebraska's Department of Education and Department of Health and Human Services, she adds.

"By working in close partnership with the state structure, our intent is to create a system that can be sustained. That's key. This is an example of how a solid research plan can come out of a strong, long-term partnership."

A $1.6 million grant from the U.S. Department of Education funds this project.

Helping Preschool Teachers Better Manage Stress

A restless child has trouble napping at preschool and seeks his teacher's attention. Two preschoolers battle over a toy in a busy classroom, sparking a conflict that ends in hitting or crying.

Countless similar scenarios unfold daily at child care centers nationwide, which enroll more than 60% of 3- to 5-year-olds in the U.S. How early childhood educators model self-regulation in the face of these daily stressors helps to shape children's ability to manage their thoughts and behavior – a critical skill linked to long-term well-being.

Carrie Clark and Holly Hatton-Bowers lead a team of Nebraska researchers working to support teachers in better managing their response to stress. They hope to develop techniques that enhance teachers' ability to regulate their emotions and stay attuned to students' needs, key components of high-quality early childhood education.

"We know from the research that children who are able to manage their own behavior – by stopping themselves from being impulsive or by identifying and managing emotions, for example – seem to do better in terms of social relationships, academic achievement and well-being across the lifespan," said Clark, assistant professor of educational psychology. "Teachers play a really big role in scaffolding that skill."

Holly Hatton-Bowers (left) and Carrie Clark (right) read to preschool students.

Hatton-Bowers, assistant professor of child, youth and family studies, said this study may inform efforts to implement biofeedback interventions promoting the use of deep breathing or other mindfulness strategies, such as an app that detects increased heart rate. Researchers are collecting survey and real-time physiological data from about 80 Nebraska preschool teachers to explore the interplay between perceived stress and its physical biomarkers.

This novel study collects physiological data, such as heart rate variability and levels of stress markers like cortisol, C-reactive protein and alpha amylase, while teachers are at work in the classroom – not in the laboratory.

It's also distinctive for exploring how these classroom factors combine with a child's family environment to contribute to children's self-regulation capacity.

"Sometimes researchers isolate parenting and family-level factors as if they're completely separate," Clark said. "It's exciting that this model accounts for both of these factors."

The National Institutes of Health's National Institute of Child Health and Human Development supports this research.

Center Focuses on Technology Governance

Technology has evolved at breakneck speed the last 150 years – from telephones, computers and the internet to recent breakthroughs like drones, genetic tools and mRNA vaccines.

But laws and regulations aren't keeping pace. That's why a technology like CRISPR, the gene-editing tool, has vast potential to cure diseases, but also to drive nefarious activity like weaponizing biotoxins, said Gus Hurwitz, associate professor of law.

Hurwitz is the Menard Director of the Nebraska Governance and Technology Center, an interdisciplinary initiative at the Nebraska College of Law exploring how law and technology affect each other and society.

Gus Hurwitz

"My vision is to create a cohort of faculty and students from across disciplines who are interested in how we can regulate technology to both develop incredible new things that make us all better off, yet remain cognizant of and able to manage the risks that technology brings," Hurwitz said.

The center's foundation is a partnership between Nebraska's colleges of law, business and engineering – what Hurwitz calls the "three legs of a stool" for technology development and commercialization. Problematically, they often work in isolation.

Engineers often don't communicate with entrepreneurs, so they fail to incorporate safety controls in their plans. Entrepreneurs don't consult lawyers about potential legal hurdles. Lawyers enter the picture later, after technology dissemination, to address poor design.

"All three must converse early in the process," Hurwitz said. "The center is in the business of breaking down these silos."

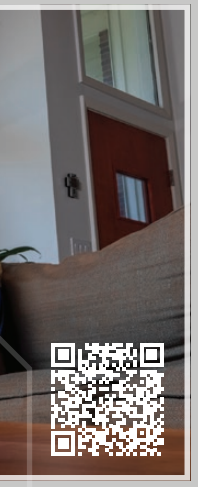
The College of Journalism and Mass Communications is another key partner, as journalists are integral to explaining and contextualizing new technology.

Changmin Yan and Valerie Jones

Since its 2020 founding, the center has hosted workshops, lectures and a fellowship program to foster collaboration and focus on technology-based problems like the rural digital divide. It's also funding relevant Husker research on artificial intelligence, social media, agricultural land and water use, among other topics.

It launched an interdisciplinary technology governance curriculum for students covering topics like cyberlaw, media and intellectual property. Hurwitz and colleagues produce a weekly podcast, "Tech Refactored," covering timely issues like Zoom school, the Texas power grid failure and spectrum regulation.

Gifts from the Menard Family Foundation, the Charles Koch Foundation and others help fund the center.



Interacting with Voice Assistants Eases Loneliness

"Good morning, Alexa."
"Good morning, Martha."

Interacting with personal voice assistants such as Amazon's Echo Dot, otherwise known as Alexa, can lessen loneliness in older Americans who live alone, according to a Nebraska study.

Loneliness – the perception of feeling disconnected – is so pervasive, especially among older people, that it's considered an epidemic with public health implications.

"We tend to think of loneliness as not really a big deal," said Valerie Jones, associate professor of advertising and public relations, who co-led the study. "But it's related to higher rates of depression, self-harm, self-neglecting behavior and mortality, things that are a big deal. We wanted to know if a device like Alexa could be useful to older folks living alone, as a companion of sorts."

To find out, an interdisciplinary research team trained 16 people over age 70 who live alone in an independent living facility to use an Echo Dot. Researchers monitored their interactions for two months.

Participants interacted with Alexa an average of 18 times a day the first month and 10 times the second month. Pre- and post-study surveys determined that their loneliness had decreased. The lonelier people were initially, the more likely they were to anthropomorphize the device, interacting with it like it's a person, such as greeting it.

The team recognizes the technology isn't for everyone or a replacement for human interactions. But voice-assisted devices are an easy-to-use tool to reduce loneliness as well as improve care, such as providing medication reminders, said Changmin Yan, associate professor of advertising and public relations, who co-led the study.

"As smart devices become more popular, this is one method to help people manage the aging process," he said. "I wouldn't be surprised if smart devices become standard in long-term living facilities in the next few years."

The COVID-19 pandemic limited the number of participants, but the team has begun a larger study to identify ways to improve the experience through personalization.

Jones and Yan collaborated with researchers at the University of Nebraska Medical Center and University of Nebraska at Omaha, through the College of Journalism and Mass Communication's Consortium for Health Promotion and Translational Research. The study will be published in *Frontiers in Public Health*.

Studying Nitrate News Coverage

For years, rural Nebraska communities have faced expensive water treatment overhauls due to groundwater contaminated with nitrates, primarily from fertilizer runoff.

Jessica Fargen Walsh, assistant professor of journalism, sought to better understand Nebraska's news coverage of this important topic. She teamed with East Tennessee State University to analyze articles published in Nebraska newspapers over nearly four years.

Researchers found 151 news stories containing the words "nitrate" or "nitrates" and "water." Just four articles were substantive coverage of nitrate contamination by bylined reporters. Most merely mentioned nitrates in a broader context, such as from covering a meeting.

"There's definitely room for more comprehensive coverage of this issue," Fargen Walsh said. One likely reason for the lack of coverage is far fewer journalists working in Nebraska, a national trend that's hamstrung the profession in recent decades, she said.

Fargen Walsh is exploring ways to increase coverage, and the team is expanding its study to look at coverage of other water issues in the Midwest.

Penguin Hemoglobin Evolved to Meet Oxygen Demands

Penguins are deep divers that can hold their breath for up to 30 minutes, giving them time to hunt for dinner. This ability is thanks, in part, to their distinctive hemoglobin, the body's oxygen courier that travels via the bloodstream.

Nebraska biologists uncovered hemoglobin's evolutionary trick that turned penguins into underwater specialists.

Jay Storz, Willa Cather Professor of Biological Sciences, and his team compared two reconstructed ancient hemoglobin proteins. One protein dates back roughly 60 million years to penguins' nondiving ancestor. The other protein dates to 20 million years ago, after penguins branched from albatrosses and other flying seabirds and evolved the ability to dive.

By identifying differences between the hemoglobins of early penguins and the nondiving penguin ancestor, Storz's team discovered evolutionary changes that occurred to accommodate long dives.

Researchers found that penguin hemoglobin evolved to better capture oxygen molecules in the lungs. At the same time, its greater sensitivity to acidic conditions, which occur during the physical strain of diving, induces hemoglobin to release oxygen at its destination.

This combination allows penguins to maximize the oxygen circulating in the body while they're under water.

Although the premise of comparing ancient hemoglobins was straightforward, resurrecting the proteins was not. Storz's team used a computer model to extrapolate ancient genetic sequences based on differences in the genetic codes among modern penguin species as well as with distantly related seabirds. The idea is similar to comparing differences in related modern languages to trace word origins.

The team genetically engineered E. coli bacteria to produce the resulting hemoglobins for experimental comparison.

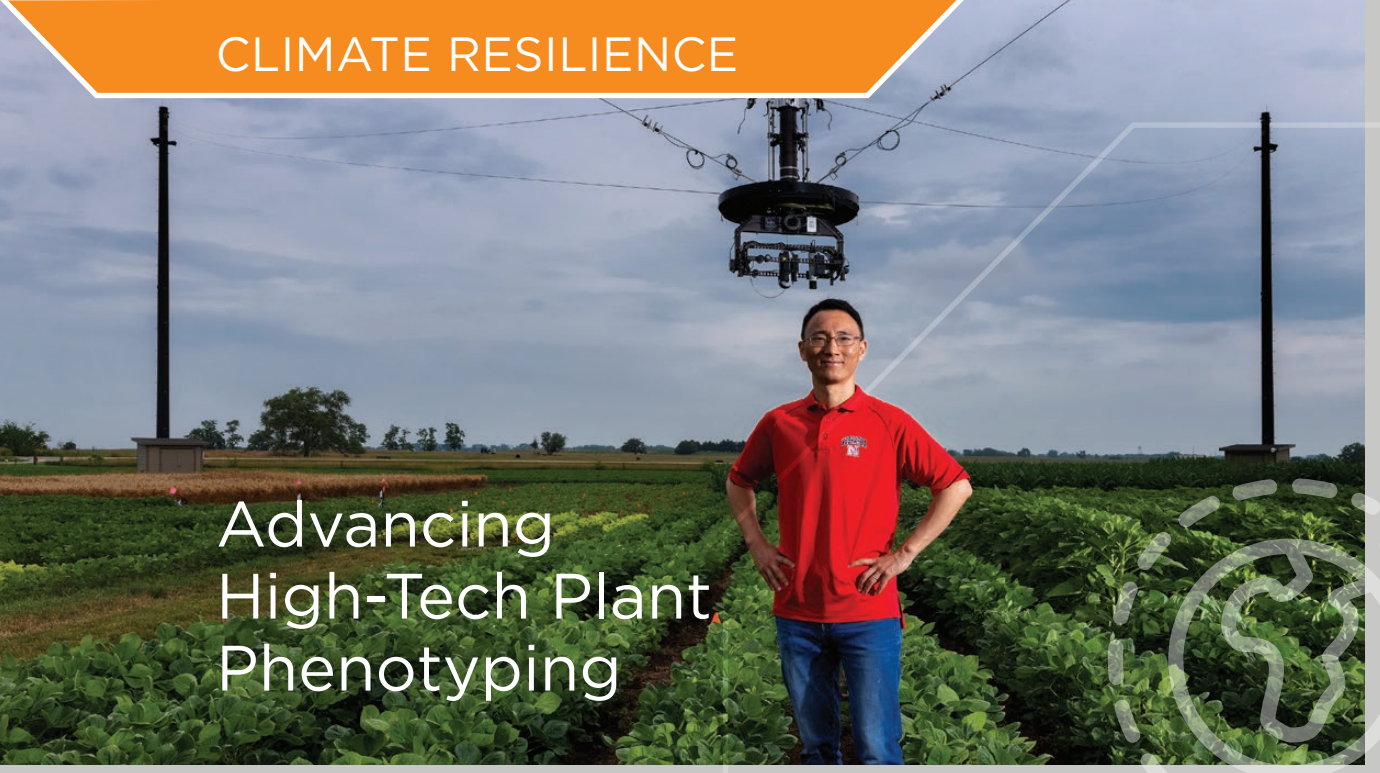
"We can learn things from animals that are adapted to extreme environments or that have evolved specialized lifestyles," Storz said. "These discoveries also have potential biomedical applications. A lot of research on the respiratory properties of blood are relevant to applications in transfusion medicine, for example."

The study was published in the *Proceedings of the National Academy of Sciences.*

The University of North Carolina Wilmington, Mississippi State University and SeaWorld San Diego participated. The National Institutes of Health and the National Science Foundation funded this research.

Penguins at Omaha's Henry Doorly Zoo

Jay Storz and postdoctoral researcher Anthony Signore



Advancing High-Tech Plant Phenotyping

Historically, plant breeders have chosen varieties to propagate by manually measuring and observing differences between plants. Today, technology can identify minute variations better and faster.

These advances allow scientists to trace desirable traits back to specific genes, opening new avenues to improving plant health and increasing yields.

But high-tech phenotyping, as it's known, is so new and generates so much data that science is still getting its bearings. Nebraska researchers are teaming with Texas A&M University and Mississippi State University to standardize the process. Ultimately, this work could pave the way for a nationwide phenotyping network to harness this technology's full potential.

Yufeng Ge

"Phenotyping is an important technology, but it's a bottleneck for our next breakthroughs in agricultural productivity," said Yufeng Ge, associate professor of biological systems engineering, who co-leads the overall project. "Phenotyping is where genotyping was 25 or 30 years ago."

This comprehensive project encompasses everything from data collection to analyzing and sharing data.

Nebraska's advanced phenotyping technologies include drones, robots, high-tech cameras and laser scanners to detect important variations in plants, such as nitrogen content and leaf temperature. But the technology is too expensive for use beyond research settings, so project engineers are developing affordable technologies for widespread use.

Inconsistent protocols, technologies and algorithms make comparing and interpreting phenotyping results difficult. This project is creating nationwide standards for collecting, cataloguing and analyzing data that will allow researchers to use data captured elsewhere.

To teach the next generation of plant scientists how to organize, understand and use the extensive information gathered by high-tech phenotyping, Ge's team is also creating a comprehensive curriculum.

Ge credits Nebraska's investments in state-of-the-art technologies, including a phenotyping greenhouse, for putting the state at the forefront of the next advance in agricultural production and, ultimately, improving global food security.

"It's an impressive, ambitious and very important project that could have a huge impact on how new crop lines are developed," said Archie Clutter, dean and director of Nebraska's Agricultural Research Division.

A three-year, $3 million grant from the U.S. Department of Agriculture's National Institute of Food and Agriculture funds this project.

Restoring Nebraska's Forests

Nebraska's forests are in trouble. Undesirable species are moving in, crowding out the oaks, elms and cottonwoods that signify a healthy Nebraska hardwood forest.

In the past, fires and floods scoured the forest floor, allowing for natural tree regeneration and removed uninvited cedars, basswoods and hackberries. Now it's up to humans.

To better manage the state's trees and forests, the Nebraska Forest Service has partnered with the state's Natural Resources Districts, the Nebraska Game and Parks Commission as well as the university.

The Nebraska Forest Restoration Partnership is working with landowners to increase the scale and pace of forest restoration statewide, primarily by removing unwanted tree species and expanding tree planting efforts.

The partnership is also financing landowners' efforts to replace their aging and declining windbreaks, which protect livestock, crops and homesteads. Many of these windbreaks were planted in the 1930s to quell severe erosion during the Dust Bowl.

Adam Smith

Landowner interest in both programs is high, said Adam Smith, Forestry and Fire Bureau chief of the Nebraska Forest Service.

The partnership aims to plant 1.5 million trees, manage 30,000 acres of declining forests, increase the health and resiliency of 7,000 acres of vulnerable forests and restore 250 linear miles of agricultural windbreaks.

"This partnership leverages all the expertise and capacity of these individual organizations to make a big impact," Smith said. "Having local natural resource experts involved in forestry in Nebraska is a significant bonus."

A five-year, $4.3 million grant from the U.S. Department of Agriculture's Natural Resources Conservation Service funds the restoration projects.

"This award benefits our state's forests, ecosystems, working agricultural landscapes and, most of all, the landowners who have invested so much into the stewardship and resiliency of their land," said Mike Boehm, Harlan Vice Chancellor for the Institute of Agriculture and Natural Resources and University of Nebraska vice president for Agriculture and Natural Resources.

The Nebraska Forest Service, part of Nebraska's Institute of Agriculture and Natural Resources, works with faculty, centers and departments on environmental stewardship, extension education and research.

Investigating Ecological Impacts on a National Scale

Burning fossil fuels, fertilizing crops and lawns, developing urban areas and other human activities are increasing environmental concentrations of essential elements such as carbon, nitrogen and phosphorous. All organisms need these elements to survive, but an imbalance alters water quality, biodiversity and evolution.

To equip researchers and policymakers to study, predict and manage this ever-changing balance of elements and its impact on ecosystems regionally and nationally, Jessica Corman is using a $6 million grant from the National Science Foundation's Established Program to Stimulate Competitive Research to build a first-of-its-kind national database that includes information from streams and lakes and the organisms that reside in them.

The database will unlock major potential in ecological stoichiometry, a framework that explores the mismatch between environmental elements available and what organisms need. The approach is useful in small-scale investigations, but larger-scope projects lack a comprehensive repository.

Nebraska is collaborating with the University of Wyoming, Central Arkansas University and Middlebury College to fill that gap.

"What's exciting about this project is that we're compiling new and existing datasets that are located in different places or collected by different institutions in order to ask broader-scale questions about ecology and evolution," said Corman, assistant professor of natural resources. "This is the first time this type of work is being done on a regional or national scale."

The open-source database, Stoichiometric Traits of Organisms in their Chemical Habitats, will include information on multiple scales, from the elemental composition of a single organism to that of the organism's entire environment.

Researchers will explore how elemental mismatches affect water quality, the food webs and other ecological processes.

A partnership with Nebraska's School of Art, Art History and Design will help better communicate the science of ecological stoichiometry.

Katie Anania, assistant professor of art history, will guide student scientists and artists in designing better methods of graphically communicating multivariable data.

To boost diversity in STEM, the team is collaborating with the Society of Freshwater Science's Instars and Emerge Program, which supports students from underrepresented groups who are interested in freshwater science.

NSF's EPSCoR Research Infrastructure Improvement Program: Track-2 Focused EPSCoR Collaborations funds this project.

Nebraska team members Steven Thomas, Jessica Corman, Katie Anania and Jennifer Clarke.

Cutline

Improving Business Models for Irrigation in Africa

Successful irrigated agriculture depends on more than farmers and technology. It also needs a robust business ecosystem. Nebraska researchers are building on established connections in Rwanda to study and support those ecosystems elsewhere in sub-Saharan Africa.

Researchers with the Daugherty Water for Food Global Institute are using a three-year, $1 million grant from the United Nations International Fund for Agricultural Development to advance access and education around smallholder farmer irrigation in the region.

Nicholas Brozović

Irrigated agriculture is an important pathway to improved food and nutritional security and resilient rural economies, which are critical to feeding a growing world population amid climate change, said Nicholas Brozović, DWFI's policy director and professor of agricultural economics.

In Africa, irrigation adoption has lagged behind other regions. Brozović, the project's leader, said this work represents a shift from getting technology into farmers' fields to addressing the supply and marketing chains that support agriculture.

"To understand scaling and sustainability of farmer-led irrigation, we must take the point of view not just of the farmer, but also of all the enterprises for whom farmers are customers and the enterprises supporting them," Brozović wrote last year in an article published on *Medium*.

"If we want farmer-led irrigation to scale and to be sustainable, then all parts of that larger entrepreneurial ecosystem must make enough money to provide decent livelihoods for the people involved. That includes, of course, the farmers themselves."

The university has a long-term engagement in Rwanda, including support of the new Rwanda Institute for Conservation Agriculture. DWFI has built on that engagement and has been working in Rwanda for several years.

This funding will enable the institute to expand to five other countries in sub-Saharan Africa: Ethiopia, Burundi, Senegal, Niger and Gambia.

Ultimately, three countries will be identified for a "deeper dive" involving more study and training. New irrigation business models will be tested and potentially scaled up for use in the region.

Turning Innovators into Entrepreneurs

Innovations are springing from labs and classrooms universitywide. To help launch these big ideas, NUtech Ventures hosts introductory entrepreneurship workshops. NUtech, Nebraska's technology commercialization affiliate, and its partners provide training and mentorship to help turn innovations and business ideas into marketable products and services.

The program, Nebraska Introduction to Customer Discovery, is modeled after the National Science Foundation's Innovation Corps, which seeks to advance technological commercialization and entrepreneurship.

"A lot of university technology, once it's developed and protected, needs additional validation and de-risking," said Brad Roth, NUtech's executive director. "We see N-ICD as one of the first steps that can provide support to aspiring university inventors and entrepreneurs."

During intense workshops, faculty, students and staff explore their innovation's potential market and think deeply about prospective customers. Interviewing stakeholders is key to validating the real-world viability of their ideas.

Participants measure success in different ways, from testing ideas to learning new skills and even thinking differently about their long-term research, said Joy Eakin, who coordinates N-ICD.

Daniel Schachtman

The program, in its third year, has worked with over 60 teams from all four University of Nebraska campuses in a variety of fields. To date, three teams have been accepted into NSF's I-Corps program.

One of those teams, led by George Holmes Professor of Agronomy Daniel Schachtman, is developing, with University of Missouri colleagues, environmentally friendly biofungicides to attack fungi that reduce crop yields. N-ICD helped the team identify the leafy greens industry, which is dealing with a vexing soil fungus, as an initial target market.

Schachtman said the program provides valuable access to additional resources, such as investors, I-Corps and Small Business Innovation Research grants.

"I'm really enthusiastic about the program," he said. "The support and network I've gained has really blown me away. I've made many contacts, and I know how to move forward. We have a pretty clear plan for the next steps to start this business."

NUtech's N-ICD partners include the Nebraska Business Development Center, UNL Center for Entrepreneurship, The Combine Incubator, National Strategic Research Institute and Invest Nebraska.

ECONOMIC DEVELOPMENT

Left: Graduate student Adan Redwine uses 3D printing equipment to create a neuron culture system.
Top: Nebraska Innovation Studio is a popular community makerspace.
Above: The Combine is a hub for agri-tech entrepreneurs.

Moving Innovations from Bench to Business

Nebraska Innovation Campus, the university's public-private research hub, has rapidly expanded since its 2010 founding. Now home to more than 55 partners, NIC created $372 million in economic impact and nearly 2,000 jobs in 2020.

The growth of NIC, located adjacent to the university, has included the addition of assets that provide faculty, staff and student startups the workspace, expertise and resources necessary to move their innovations from bench to business.

"We're proud to support campus innovators as they forge a path from the laboratory to the marketplace," said Bob Wilhelm, vice chancellor for research and economic development. "These NIC-based resources are intended to help translate university research into products and services that will help people in Nebraska and beyond, and support startups that will boost and diversify our state's economy."

The Biotech Connector, Nebraska's first wet-lab incubator, is housed in NIC's Food Innovation Center. It provides incubation space and services to bioscience startups and high-growth biotech and research-based businesses. Entrepreneurs can rent anywhere from 6 to 2,000 square feet of lab space with access to shared equipment, mentorship and commercialization support.

Food and agriculture innovators can tap into expertise and networking through The Combine, a statewide initiative targeting high-growth entrepreneurs. It offers incubation space in NIC's Rise Building and assistance with goal setting and idea assessment, capital readiness and partnership building with Nebraska producers.

Nebraska Innovation Studio, one of the nation's top makerspaces, is another valuable resource. Its rapid prototyping room – which houses equipment tailored for 2D and 3D materials – benefits startups that need a cost effective, efficient approach for prototyping or modeling. The studio also offers modeling software and equipment for woodworking, metalworking and other creative activities.

NIC is also home to The Suite Spot, a new incubator space where food companies can work closely with the university's Food Processing Center staff and equipment. The Landing Coworking space provides an address and work station for university-based companies that are working toward seed funding.

"All of these areas and more offer space, equipment and programming for startups, including faculty, staff and student startups," said Daniel Duncan, NIC executive director. "NIC is proud to be an asset and resource to university, local and statewide startup ecosystems."

Team Among World's Best in Pandemic Challenge

A team of researchers from three University of Nebraska institutions was among the world's best in developing an artificial intelligence-driven model to advise policymakers on how best to handle the COVID-19 pandemic. Their aim was to align medical recommendations with policy implementation.


Fadi Alsaleem


Alison Freifeld


Basheer Qolomany


Dan Piatkowski

The team was one of eight to receive an honorable mention in the $500,000 Pandemic Response Challenge run by the XPRIZE Foundation, which designs and operates incentive competitions to solve the world's grand challenges. Nearly 500 teams worldwide entered the competition.

Fadi Alsaleem, UNL assistant professor of architectural engineering and an expert on big data analysis, had assembled the team to tackle another pandemic-related project: predicting outbreaks across the state. He was joined by Alison Freifeld, University of Nebraska Medical Center professor of internal medicine and infectious diseases expert; Basheer Qolomany, University of Nebraska at Kearney assistant professor of computer science and expert in deep learning in support of smart services and disease progression; and Dan Piatkowski, UNL assistant professor of community and regional planning.

The team shifted its focus for the Pandemic Response Challenge, which aimed to harness data and artificial intelligence in equipping policymakers, health officials and business leaders with insights and guidance to implement public safety measures and safely deliver the COVID-19 vaccine, maximizing their ability to keep local economies open while minimizing potential virus breakouts.

The team's work and data focused on Nebraska but it applied its model globally. "To apply the model across the whole world and see that it's performing at least as well as other models is very gratifying. It was a good surprise," Alsaleem said.

Initially, the Nebraska model was noted for its accurate, stable predictions about where outbreaks were likely. The team then expanded the model to help predict how government interventions – such as closing schools or recommending employees work from home – could affect caseloads. This data-driven approach proved useful for responding to the COVID-19 pandemic and could be implemented in future pandemics.

"I think one of the strengths in this team, and across the NU system, is how quickly everyone jumped on board and was ready to provide perspectives and expertise from their own disciplines," Piatkowski said. "It's certainly nice to be competitive against such impressive teams, but it also underscores our strengths in both scientific excellence and collaboration here in Nebraska."

Abusive Bosses Often ‘Fake Nice,’ Seldom ‘Make Nice’

Abusive bosses – you know, the ones who seem to enjoy demeaning employees – are unlikely to change, even if they appear repentant, according to a Nebraska-led study.

Rather than making amends out of genuine contrition, most abusive managers engage in image control. Giving them a pass ultimately harms employee well-being and the organization over time.

“Organizational leaders or the abused employees themselves may overlook or even forgive the leader’s abusive behaviors, allowing them to get away with them and promoting a cycle of abusive leadership,” said the study’s leader, Troy Smith, assistant professor of management.

To better understand how abusive managers perceive and respond to their own behaviors, researchers surveyed supervisors across a variety of industries via an anonymous online platform. Supervisors admitted abusive behaviors that included emotional manipulation, invading privacy, gossiping and publicly demeaning employees.

Instead of expressing remorse, most supervisors worried about how other people viewed them. Following mistreatment, they engaged in superficial behaviors designed to improve their social image, such as self-promoting, doing favors, giving compliments or trying to appear busy.

The study demonstrates the futility of relying on abusive bosses themselves to change, Smith said. Instead, researchers recommended implementing and adhering to zero-tolerance policies. Past research has shown that sanctions for misbehavior effectively curtail abuse.

Ultimately, however, regaining credibility requires abusive bosses to understand their own motivations and behaviors and to seek sincere change. The researchers recommended bosses engage in daily self-reflection and an honest appraisal of their effect on employees.

“I want to understand the antecedents and effects of abusive supervision to help employees and leaders themselves be more productive and experience greater well-being in the workplace,” Smith said.

The study was published in *Personnel Psychology* and was featured in the *Harvard Business Review*. Researchers at the University of Wyoming, University of Iowa and Texas A&M University participated.

Troy Smith

Timothy Nelson

Brain Holds Clues to Obesity Interventions

Imagine getting a glimpse of a brain's reaction to the first sip of a delicious milkshake. Is it characterized by calm self-regulation – or overexcitement?

Nebraska researchers are using this and other data as they study factors that affect adolescents' and young adults' health, with an eye toward finding intervention strategies to head off obesity, one of the nation's most pernicious health problems.

Timothy Nelson, professor of psychology, received a five-year, $3 million grant from the National Institutes of Health's National Institute of Diabetes and Digestive and Kidney Diseases for this research, conducted through Nebraska's Center for Brain, Biology and Behavior.

At the center of this study is executive control, the brain's ability to direct attention and behavior. The study began about 15 years ago and tracked the behavior of about 300 young people, now in their mid- to late teens. The research focuses on the link between executive control and risky health behaviors that may cause weight problems.

That's where the milkshakes come in.

Cary Savage, the center's director and a principal investigator on the project, said the research uses equipment that delivers sips of milkshake to subjects while they're in a special scanner. Participants are given a cue to take a sip, then a cue to swallow. An MRI scanner studies the brain's function during this process.

By better understanding how the brain responds to this sweet reward, researchers think they can find ways to train the brain's executive control to help young people make better decisions about what they eat.

"Our primary hypothesis is that young adults with a history of poorer executive control will have a stronger response to the milkshake than those with stronger executive control abilities," said Savage, professor of psychology and Mildred Francis Thompson Professor of Social Sciences.

Researchers also are studying self-regulation, tracking brain activity as subjects look at pictures of appealing food and imagine eating it but then think about the potential consequences of eating it, Savage said.

Nelson said subjects will be asked to down-regulate their responses in order to exercise self-control.

"Individuals differ greatly in how well they can do that," he said. "In the scanner, we can capture the neural activity patterns. We're going to get these really interesting neural measures of response to food."

History Informs Artist's Ceramics Exhibit

Despite a long, dynamic history, ceramics is usually excluded from art history classes. When Nebraska ceramic artist Margaret Bohls sought to help her students appreciate ceramics as a historic art form, her research ultimately informed her own work.

That exploration led, most recently, to Italian Studies, a collection of three groupings of vessels Bohls created based primarily on pre-Roman Etruscan civilization. Her collection was exhibited in spring 2021 at the Museum of Nebraska Art in Kearney, Nebraska.

Italian Studies resulted from a 2018-2019 sabbatical. It included a residency at La Meridiana International School of Ceramics in Tuscany, travels throughout Italy, time in London to study Etruscan vessels and additional studio work during a residency at Red Lodge Clay Center in Montana.

Bohls' vessels aren't precise re-creations but are based on her understanding of the underlying architecture of Etruscan form and reflect her interest in Modernist-era formalist abstraction.

"The layperson looking at these objects may not get a full understanding of their historical background," said Bohls, associate professor of art. "But I hope they have an aesthetic reaction to them, and then I hope they begin to look at them as vessels and to create a narrative for themselves about how the forms convey information about culture and use."

Bohls is particularly interested in vessels created during the earlier, developmental stages of civilizations, as they usually exhibit greater variation in form.

"I began to understand my own work through the lens of history. There are ways in which we use materials that we don't always understand come from the history of that medium," Bohls said, citing examples such as material trade routes and wider cultural information.

Bohls' Etruscan work has generated much interest, from social media buzz to exhibition and presentation requests. Although the COVID-19 pandemic interfered, her calendar is reviving, including a rescheduled workshop at La Meridiana in Italy in 2022.

Margaret Bohls and her re-creations of Etruscan vessels

Cather and Lewis: Capturing a Creative Partnership

Melissa Homestead

After Pulitzer Prize-winning author Willa Cather, renowned for her depictions of prairie life, died in 1947, her life partner of 38 years was reduced to an inconsequential footnote.

Nebraska author Melissa Homestead restores Edith Lewis to her rightful place in Cather's life and literary legacy in her new book, *The Only Wonderful Things: The Creative Partnership of Willa Cather and Edith Lewis,* published by Oxford University Press in April 2021.

"They lived together for nearly 40 years, so it's hard to pretend she's not there," said Homestead, professor of English and director of the Cather Project. "It is easy to pretend that she's not what she was."

Scholars have disagreed on, or tried to bury, the importance of Lewis in Cather's life. But Homestead's meticulous research of surviving manuscripts, letters and other personal documents in Nebraska's collections and elsewhere reveals that Lewis substantially reshaped Cather's prose.

Homestead also dispels the myth that Lewis and Cather were isolated and secretive. The women, in fact, shared fulfilling, supportive lives together, traveling and socializing widely. A Lincoln, Nebraska, native, Lewis became a successful magazine editor and advertising writer.

The Only Wonderful Things captures a wider shift in American society that has largely been forgotten or ignored. Although Cather and Lewis lived together openly in the first half of the 20th century, Cather died just as Cold War panic tied homosexuality to communism.

Social tolerance turned to homophobia. And Lewis' role in Cather's life and literature was disclaimed, successfully erasing her for posterity.

"There's some correspondence where you can see that homophobia operating – even if they don't name it – to discredit Edith Lewis in some pretty extraordinary ways after Cather's death," Homestead said.

Although she visited many places hunting original documents or retracing the women's lives, Homestead's most valuable resource was close to home. University Libraries' Archives and Special Collections contains the world's largest, most substantial collection of Cather-related material.

"Willa Cather would have become a novelist if she hadn't met Edith Lewis, but I don't think she would have written the same books," Homestead said. "What would her style have looked like without Edith Lewis editing her?"

AFFILIATES

After months of pandemic limits or closures, the State Museum welcomed back in-person visitors during its 150th year.

Museum Marks 150 Years with Creative Outreach

The University of Nebraska State Museum's 150th year was unlike any other, but the unprecedented circumstances set the stage for the future.

The museum formally celebrated its anniversary in 2021, after reopening to visitors.

"It has been a spring of hope," said Susan Weller, museum director. "It's wonderful to have visitors back in the museum."

The museum was closed to visitors for months during the COVID-19 pandemic but continued meeting its mission. By embracing technology, museum staff delivered content and education virtually, reaching more than 902,000 people in all 50 states and in 72 countries in 2020.

While the museum has reopened to visitors, it continues to build its virtual outreach opportunities, said Weller, professor of entomology. In partnership with Nebraska Public Media, people will be able to tour all four floors of the museum from their home computer, tablet or phone.

"As much as we want people to come here and visit the museum, we are aware that Nebraska is a very large state and we need to meet Nebraskans where they live," Weller added. The online tour is available at museum.unl.edu.

2021 also marks the anniversaries of two museum affiliates – the 60th for Trailside Museum at Fort Robinson State Park and the 30th for the Ashfall Fossil Beds near Royal, Nebraska.

The museum, widely known as Morrill Hall to generations of Nebraska school kids, was founded in 1871 with a small teaching collection. Today, its active research collections have grown to include more than 13 million specimens and artifacts. The most famous museum attraction is "Archie," the world's largest fully mounted, composite Columbian mammoth fossil.

Bob Wilhelm, vice chancellor for research and economic development, said the museum serves an important role in inspiring children to pursue career paths that lead to discovery.

"This idea of exposing children early, to get them thinking about different opportunities in science, technology, engineering and mathematics is incredible," Wilhelm said. "It's important for our state's talent pipeline and for the impact that STEM has on economic growth for the state."

Press Hits Big with Baseball Books

If you think Nebraska is all about football fandom, you haven't seen what the University of Nebraska Press offers baseball fans.

Scan any list of must-read books on baseball, and you'll typically find multiple offerings from the university's press, one of the nation's major publishers of baseball books. The general interest books focus primarily on history and biographies.

"The authors are holding a mirror onto the larger culture in which the game is played or how the sport has evolved," said marketing manager Mark Heineke, citing topics such as desegregation, the game-changing 1920s and the golden years of the 1960s.

UNP's baseball expertise began in the 1990s, when then-director Daniel Ross reprinted several books that trade publishers had dropped. The books' success helped revive a readership in baseball history. By the 2000s, Nebraska was publishing original books, cementing its national reputation.

"It got to a critical mass and, not just baseball, but sports publishing became one of the categories the press is known for," said Rob Taylor, senior acquisitions editor in charge of sports.

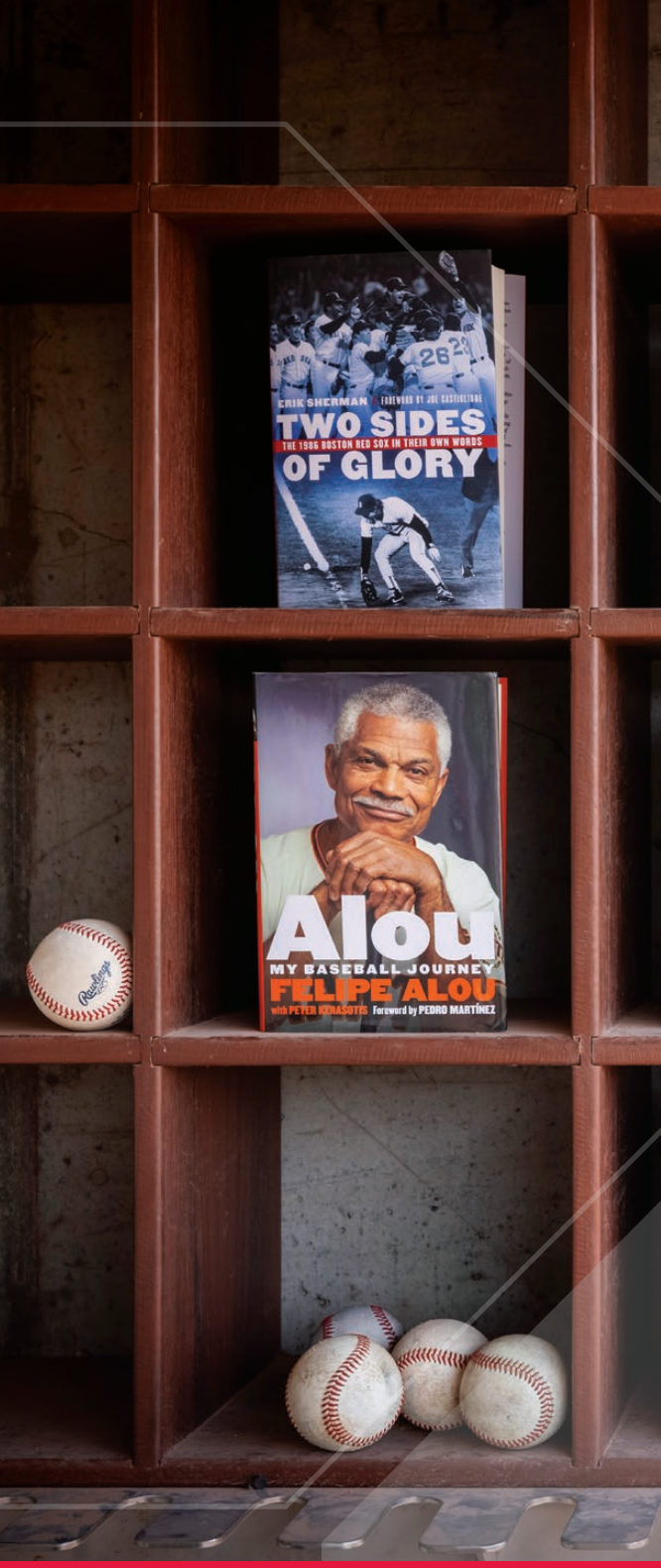
Today, Taylor oversees as many as 16 baseball books a year.

A recent highlight is *Oscar Charleston: The Life and Legend of Baseball's Greatest Forgotten Player* by Jeremy Beer. Published in 2019, the book won the prestigious 2020 Seymour Medal for the best baseball book of history or biography, UNP's 10th win. The book also won the 2019 CASEY Award for the best baseball book of the year.

It's one of many award-winning and popular books in the press' bullpen.

Taylor and Heineke credit the nonprofit publisher's ability to take chances on authors and topics that trade publishers won't. "We're pushing the boundaries of thought and debate," Heineke said. "We're not recycling the same old, same old here, whether it's a book on history or a collection of poetry or a baseball book. It's woven into our DNA.

"The cachet of the baseball list really sets the table for the rest of the list," Heineke added, noting the attention it brings UNP with reviewers and booksellers. "It's our calling card."



Right: A collection of UNP's baseball titles

UNP's Hall of Fame Baseball Titles

Recent University of Nebraska Press baseball titles have earned critical acclaim.

SABR Baseball Research Award

- 2021: Rob K. Fitts, *Issei Baseball: The Story of the First Japanese American Ballplayers.*
- 2020: Roberta J. Newman, *Here's the Pitch: The Amazing, True, New, and Improved Story of Baseball and Advertising;* César Brioso, *Last Seasons in Havana: The Castro Revolution and the End of Professional Baseball in Cuba.*
- 2019: Bill Nowlin, *Tom Yawkey: Patriarch of the Boston Red Sox.*

SABR Larry Ritter Book Award

- 2020: Jeremy Beer, *Oscar Charleston: The Life and Legend of Baseball's Greatest Forgotten Player;* Charles DeMotte, *James T. Farrell and Baseball: Dreams and Realism on Chicago's South Side.*
- 2018: Jim Leeke, *From the Dugouts to the Trenches: Baseball During the Great War.*

Publishing Awards

- Brad Balukjian, *The Wax Pack: On the Open Road in Search of Baseball's Afterlife,* Los Angeles Times monthly bestseller list and NPR's Book Concierge Best Reads of 2020.

Five Huskers Earn CAREER Awards

With support from the National Science Foundation's Faculty Early Career Development Program, Nebraska researchers are unlocking RNA's mysteries, advancing commutative algebra, improving drone performance, revolutionizing nanomaterials and studying magma's composition. In 2021, five outstanding pre-tenure faculty members earned these prestigious awards, totaling $3.2 million.

Unraveling RNA's Secrets

Catherine Eichhorn

Despite RNA's starring role in COVID-19 vaccine development, scientists are still unlocking the molecule's secrets. Better understanding how RNA contributes to cell function and gene expression could lead to treatments for a variety of ailments, including cancer, macular degeneration, high cholesterol, pain and organ diseases.

With a $1 million CAREER award, Nebraska's Catherine Eichhorn, assistant professor of chemistry, is investigating relationships between the structures and functions of RNA-protein complexes, called ribonucleoproteins, or RNPs.

She's focusing on an RNP known as 7SK, a key player in gene expression. Eichhorn uses powerful imaging techniques to develop high-resolution images of 7SK's structures and folding dynamics. The images help reveal how 7SK regulates activity within cells.

Her methods and discoveries may also lead to a deeper general understanding of RNA and RNPs.

Eichhorn is launching a laboratory to guide students through an innovative imaging technique that links a fluorescent molecule to 7SK in order to track its behavior inside living cells. The technique will give students the opportunity to develop and test hypotheses.

Advancing Research in Commutative Algebra

Jack Jeffries

Nebraska's Jack Jeffries studies mathematical misbehavior. That is, he studies singularities, points at which geometrical shapes don't behave well.

Jeffries, assistant professor of mathematics, received the mathematics department's first CAREER award. He'll use the $400,000 grant to advance his research in commutative algebra, a field of abstract algebra that focuses on polynomials, algebraic expressions with many variables.

"Systems of polynomial equations are ubiquitous throughout the sciences," Jeffries said. "Singular points are of interest because many standard techniques and algorithms can go haywire at those points."

He's also studying polynomial equations and singularities within atypical number systems. For example, computer data and arithmetic are built on systems of two numbers: zero and one. He aims to develop new tools to study the small-scale behavior of systems of polynomial equations of both familiar number systems and these atypical systems.

To encourage high school students to study mathematics, Jeffries is launching a math circle in which a mathematician leads students through an advanced math activity. At least one session per semester will be conducted in Spanish.

Nebraska is one of the nation's largest research clusters in commutative algebra and algebraic geometry and an international leader in these fields.

Improving Drone Performance

Justin Bradley

While drones can perform an impressive array of tasks, they can't think for themselves.

Nebraska's Justin Bradley, associate professor of computer science and engineering, is changing that with a nearly $500,000 CAREER award.

Bradley aims to give drones and other robots the ability to self-adapt to a changing environment. He's developing mathematical and computing foundations, analytical tools and algorithms that divert energy to important tasks while pausing lower-priority work.

The ability to allocate resources and optimize overall performance will help maximize the full potential of artificial intelligence and machine learning. Because AI consumes substantial resources, robots must be able to give and take computational power to AI to accomplish a range of tasks.

Ultimately, Bradley will create an autopilot system compatible with the widely used Robot Operating System and operable on common robotics hardware. He's seeking a provisional patent.

"This will be really useful for future missions that are complex and changing," Bradley said. "This will allow robotic aircraft to do longer and more efficient surveillance and reconnaissance missions where the environment is changing."

Building 3D Porous Organic Frameworks

Siamak Nejati

Improving 3D molecular structures could aid advancements in electronics, medicine and more.

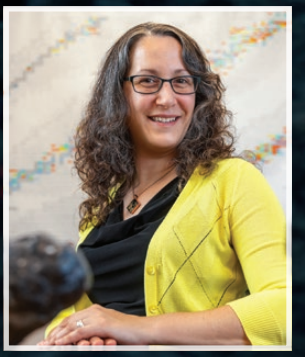
With a nearly $600,000 CAREER award, Siamak Nejati, assistant professor of chemical and biomolecular engineering, is developing an environmentally friendly and highly precise method of creating porous organic frameworks, versatile 3D structures made of light elements, such as carbon, nitrogen and oxygen.

He's using a molecular layer deposition process that doesn't require solvents to construct ultrathin, nanoporous films that feature a diverse and adjustable range of porosity. Porosity allows materials to trap, separate or filter.

By honing a vapor-phase approach, Nejati aims to enable integrating the films into energy-efficient, highly selective filters for gas and liquid separation as well as electrodes for energy conversion and storage devices.

Moreover, the proposed research pathway allows for studying the physical and chemical properties of the frameworks, essential for developing fabrication processes with low environmental impact and energy footprints.

Deciphering Magma Mysteries



Lynne Elkins

With a nearly $700,000 CAREER award, Nebraska geochemist Lynne Elkins is developing a tool to help illuminate processes governing volcanoes, particularly magma, the molten rock that erupts from deep within the Earth as lava.

Elkins is producing a publicly available, open-source computer modeling program that calculates the expected compositions of magmas, which result from partial melting of the Earth's mantle layer. The models focus on predicting trace quantities of uranium-series isotopes in lavas. This type of geochemistry measurement traces the nature and timing of Earth's melting processes.

A more comprehensive understanding of these processes will provide important clues about how magma generation is linked to plate tectonics, how the Earth's crust formed and, more generally, how the natural world works.

The tool also may advance a longstanding debate about the types of mantle rocks that melt to generate most magma.

"The fundamental question here is: How does the planet function?" said Elkins, assistant professor of earth and atmospheric sciences. "Developing better tools with computer coding makes the answers to this question more accessible to the broader scientific community."

Construction Projects Enhance Research and Learning

Despite the pandemic, Nebraska's plans for major capital improvements haven't wavered. The Gnotobiotic Mouse Facility – the nation's first to be associated with a university food science department – was completed in late 2020. Construction is underway on facilities for engineering, speech-language pathology, and education and human sciences. When completed, these investments will enhance student learning, expand research capacity and provide additional office space.

Gnotobiotic Mouse Facility

A cutting-edge, germ-free home for mice is boosting human gut research at Nebraska. The 10,000-square-foot Gnotobiotic Mouse Facility provides a sterile environment for laboratory mice. Researchers can raise mice free of all bacteria, transforming their gastrointestinal tracts into living but sterile mini-laboratories where bacterial species can be controlled, and their effects measured, at a pace and in ways that would be impractical with human subjects.

When Amanda Ramer-Tait, associate professor of food science and technology, arrived at Nebraska in 2012, colleagues already had been working with germ-free mice in about 1,200 square feet of noncontiguous space on East Campus. Demand grew and Ramer-Tait was able to expand available space, but more was needed. That demand for space became more pressing with the launch of the Nebraska Food for Health Center in 2016.

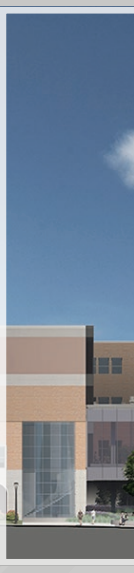
With $5 million in private donor support raised through the University of Nebraska Foundation, the Gnotobiotic Mouse Facility opened in late 2020.

Nebraska's is the only food science department in the country with a gnotobiotic mouse program, more typically found at medical schools.

"Our new facility can now house 50 isolators, plus specialized equipment. I would say this puts us in the top 15 around the world for footprint and scale," said Ramer-Tait, who directs the Nebraska Gnotobiotic Mouse Program.

Kiewit Hall

The largest academic facilities project in the university's 152-year history is underway. When completed in 2023, the $97 million Kiewit Hall will be the hub for undergraduate engineering education.



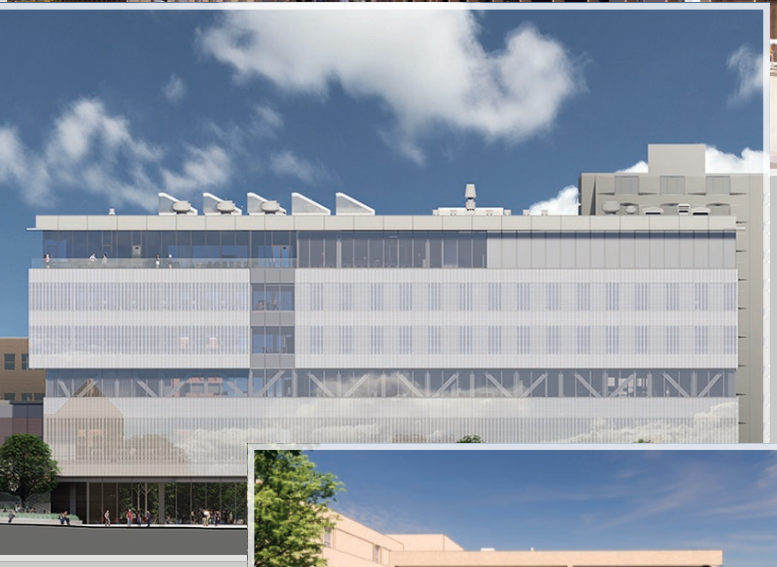
Ground was broken in summer 2021 for the privately funded project. Kiewit Corp. of Omaha contributed $25 million to the project. Other lead contributors are the Suzanne & Walter Scott Foundation, Abel Foundation, Peter Kiewit Foundation, Robert B. Daugherty Foundation and Acklie Charitable Foundation.

"As someone who has spent my career at this university, I can't tell you how gratifying it is to see this kind of investment in the College of Engineering," said Dean Lance C. Pérez, Omar H. Heins Professor of Electrical and Computer Engineering. "What matters is what's going to happen in this building. For the first time in over a generation, we will have a facility that is all about teaching engineering. It's going to be a game-changer for the state of Nebraska and the next generations of students."

Kiewit Hall will house Lincoln-based construction management programs. It will include classrooms, instructional labs, Engineering Student Services, makerspaces for engineering student organizations and a large outdoor plaza.

Once completed, Kiewit Hall will connect to Othmer Hall via a skyway, expanding the engineering complex that includes Scott Engineering Center, the Link and Nebraska Hall.

Kiewit Hall is part of the college's $170 million expansion and facilities transformation. Scott Engineering Center is being renovated along with the new Link building, currently under construction, that will feature enhanced spaces for research labs, graduate students and several academic departments.



From top: Artistic renderings of the new College of Education and Human Sciences building, Kiewit Hall and Barkley Memorial Clinic

College of Education and Human Sciences

When completed in 2022, the College of Education and Human Sciences' new home will enable the college to better connect its programs across City and East campuses with added flexibility to meet future needs of students.

The last beam was placed in April 2021 for the 126,590-square-foot, four-story building. It will feature classrooms, meeting spaces, offices, labs and a 400-seat auditorium, and will link directly to Teachers College Hall. The new building replaces Mabel Lee Hall, originally created as a women's physical education space.

The new facility is expected to open in summer 2022. The $46.5 million demolition and construction project will provide transformational learning spaces for students and allow the college to foster collaboration and innovative thinking, officials said.

"The modern, new space will inspire collaboration while elevating our efforts to provide students with innovative and engaging ways to learn," said Sherri Jones, dean and Velma Warren Hodder Professor in CEHS.

Barkley Memorial Clinic

A $10 million project will improve Barkley Memorial Center as a state-of-the-art training facility for students in the College of Education and Human Sciences' speech-language pathology and audiology programs.

The new Barkley Clinic space will feature three large, three medium and 13 small treatment and diagnostic clinical rooms. Specialized treatment rooms will be available for gross motor skills, smart room diagnostics, life skills, motor speech and augmentative and alternative communication. All clinical training spaces and specialized treatment rooms will be equipped with Video Audio Learning Tool software to improve training.

The expansion and renovation will also feature spaces for community partners including: RiteCare, Nebraska Autism Spectrum Disorders Network, Nebraska Stroke Association and a traveling clinician.

The project is to be completed by 2023.

Accolades

Craig Allen, Roch Gaussoin, Kristen Olson and **James Takacs** were named American Association for the Advancement of Science Fellows in 2020. Fellows are selected by their peers for scientifically or socially distinguished achievements that advance science or its application.

- Allen, professor of natural resources, was honored for contributions to resilience theory and its application to conservation and resource management.
- Gaussoin, professor of agronomy and horticulture, was recognized for contributions and service to the agronomic sciences.
- Olson, Leland J. and Dorothy H. Olson Professor of Sociology, was honored for contributions to survey research methodology.
- Takacs, Charles J. Mach University Professor of Chemistry, was recognized for contributions to synthetic organic chemistry.

Susan Weller, director of the University of Nebraska State Museum and professor of entomology, was elected a fellow of the Entomological Society of America. Fellow status honors individuals who have made outstanding contributions to entomology and whose career accomplishments inspire all entomologists. Weller was selected for her internationally known research on the evolution of arctiine moths and other Noctuoidea, as well as her administrative leadership in promoting entomology and science education. Weller is among a small number of women who have received fellow designation.

Carrick Detweiler, Susan J. Rosowski Associate Professor of Computer Science and Engineering, was elected a senior member of the National Academy of Inventors. The honor recognizes early-stage innovators whose success in patents, licensing and commercialization has the potential to benefit society. Detweiler is a nationally recognized expert on drone systems that enable safer, less costly approaches to fighting wildfires. He co-founded and co-directs the Nebraska Intelligent MoBile Unmanned Systems Lab, which develops drones that interact with the environment. In 2015, Detweiler co-founded Drone Amplified, a company that helps federal, state and local agencies reduce fire danger using its signature drone-based system, IGNIS.

Kwame Dawes, professor of English and Glenna Luschei Editor of the *Prairie Schooner,* received the PEN/Nora Magid Award for Magazine Editing. The biennial honor recognizes magazine editors whose high literary standards have, throughout their career, contributed significantly to the excellence of the publication they edit. Dawes was recognized for his efforts to revolutionize the 90-year-old *Schooner* by integrating technology into its processes, showcasing a more diverse array of poets and authors and establishing the journal's international presence.

William G. Thomas III, Angle Chair in the Humanities and professor of history, received the Mark Lynton History Prize for his book, *A Question of Freedom: The Families Who Challenged Slavery from the Nation's Founding to the Civil War.* The prize honors the year's best book-length work of narrative history on any subject that combines intellectual distinction with felicity of expression. It is one of four J. Anthony Lukas Prize Project awards given by the Columbia Journalism School and the Nieman Foundation for Journalism at Harvard University, all of which honor nonfiction writing excellence. Thomas' book traces the efforts of families in Prince George's County, Maryland, to challenge slavery's legitimacy through hundreds of lawsuits for their freedom.

Dawn O. Braithwaite, Willa Cather Professor of Communication, was named a Distinguished Scholar of the National Communication Association. The designation recognizes and rewards association members for a lifetime of scholarly achievement in the study of human communication. Scholars are selected to showcase the communication profession. Braithwaite, a nationally recognized expert in interpersonal and family communication, previously received the association's Becker Distinguished Service Award for contributions in research, teaching and service and the Brommel Award for Outstanding Scholarship or Distinguished Service in Family Communication.

James Le Sueur, Samuel Clark Waugh Distinguished Professor of International Relations and chair of the history department, earned the Feather Award for Best Documentary at the Karama Human Rights Film Festival in Amman, Jordan. The award honored his documentary film, *The Art of Dissent,* which explores the role of dissidents before and after the Soviet invasion of Czechoslovakia in 1968 and celebrates the resilience and power of artistic engagement in the country during that period. The documentary has won several film festival awards, including Best Feature Documentary at the Big Apple Film Festival in New York City and Best Documentary Feature at the Blackbird Film Festival in Cortland, New York.

Jessica Shoemaker, professor of law, was named a 2021 Andrew Carnegie Fellow. The program provides

philanthropic support to extraordinary scholars and writers for scholarship in the humanities and social sciences that addresses enduring issues confronting society. With the award, Shoemaker will pursue a project called "Remaking a Land of Opportunity: America's Rural Future," which focuses on the role of property law and land-tenure choices in shaping rural places and agriculture. She will work on a book, develop an interdisciplinary research initiative bridging the urban-rural divide and develop a graduate course on rural futures.

David Hage, the James Hewett University Professor of Chemistry, earned the 2021 ACS Award in Chromatography from the American Chemical Society. The honor recognizes outstanding contributions to chromatography, with particular emphasis on developing new methods. Hage is a leading researcher in an area of affinity chromatography that involves rapidly separating compounds from complex samples. His research team uses biological agents, such as proteins and antibodies, to separate and analyze complex chemical mixtures that range from clinical to environmental samples. In 2020, Hage joined a national team that worked to repurpose patented technologies to develop and manufacture a fast-acting COVID-19 antibody test.

Sarah Michaels, professor of political science, was named a Fulbright Canada Distinguished Research Chair in Environmental Science at Carleton University. She is spending the 2021 academic year at the Ottawa-based institution and is partnering with the Carleton community and other agencies on projects addressing environmental challenges.

2020-2021 NEBRASKA RESEARCH REPORT

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