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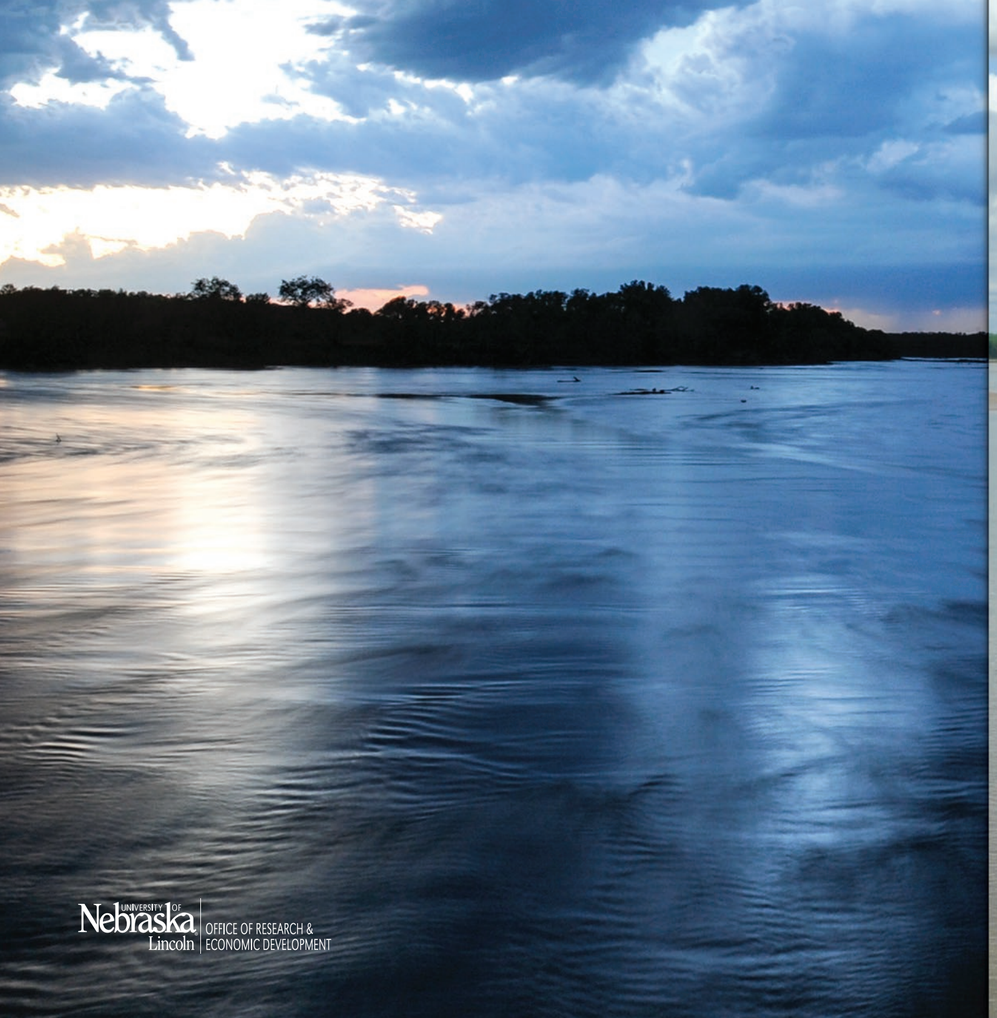
RESEARCH AT NEBRASKA
2017-2018 REPORT



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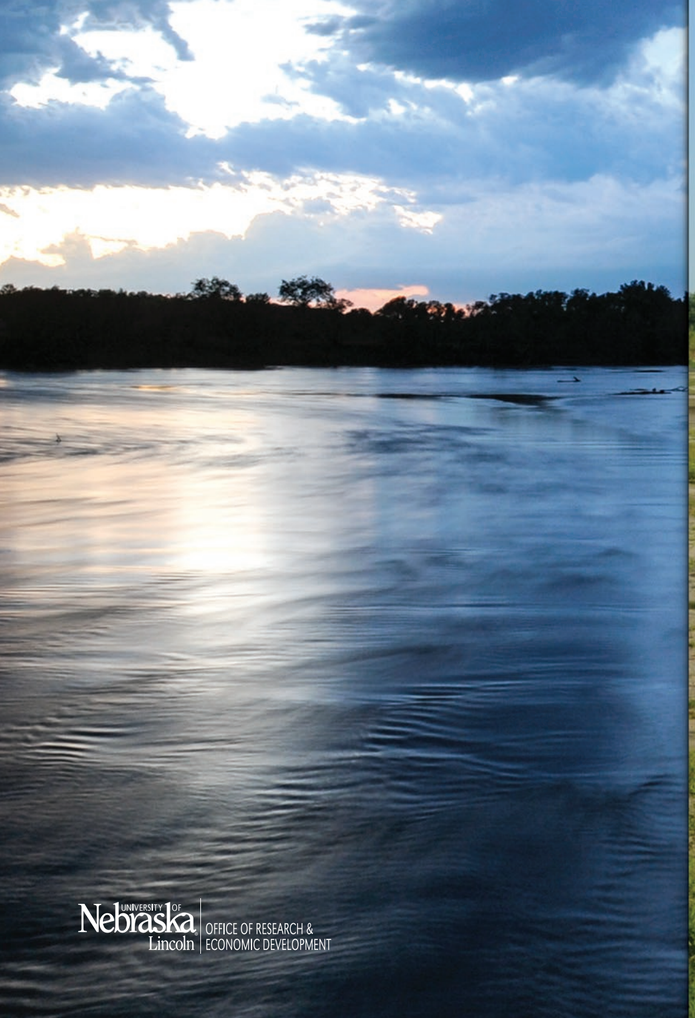

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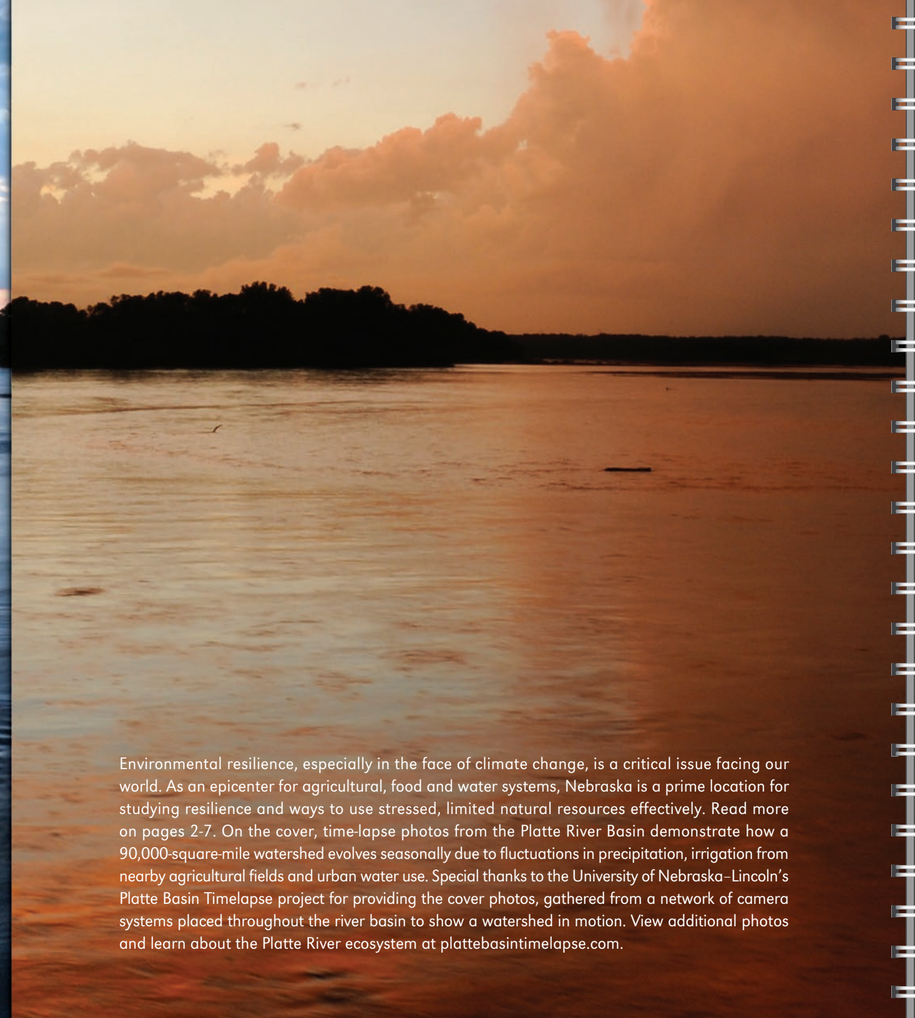

Environmental resilience, especially in the face of climate change, is a critical issue facing our world. As an epicenter for agricultural, food and water systems, Nebraska is a prime location for studying resilience and ways to use stressed, limited natural resources effectively. Read more on pages 2-7. On the cover, time-lapse photos from the Platte River Basin demonstrate how a 90,000-square-mile watershed evolves seasonally due to fluctuations in precipitation, irrigation from nearby agricultural fields and urban water use. Special thanks to the University of Nebraska–Lincoln's Platte Basin Timelapse project for providing the cover photos, gathered from a network of camera systems placed throughout the river basin to show a watershed in motion. View additional photos and learn about the Platte River ecosystem at plattebasintimelapse.com.

NEBRASKA

RESEARCH AT NEBRASKA
2017-2018 REPORT

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To view stories and additional multimedia features, visit the online edition: **research.unl.edu/annualreport/2018.**

Building **for the Future**

This is an exciting time at Nebraska's research university. We are focused on growth, building on strengths and making a significant impact in Nebraska and the world.

As the state's flagship and land-grant university, the University of Nebraska–Lincoln is integral to our state's economy, has the enthusiastic support of stakeholders statewide and beyond, and improves lives across Nebraska, our nation and our world. Research, economic development and creative activity are keys to success for our university and our state.

These qualities drew me to join this great university as vice chancellor for research and economic development in May 2018. I am working hard to learn more about the talents and expertise of our faculty, students and staff. The university's impressive partnerships offer significant opportunities for collaborative research and economic development.

As the university approaches its 150th year, we are collectively envisioning what we can be in the future and how we can deepen our capacity for discovery and innovation in the next 25 years. This report offers a glimpse at some of our recent successes as well as emerging research that holds promise for the future.

Our researchers are leaders in advancing the science of resilience in agricultural and natural ecosystems. Studies of resilience in the Platte River Basin, one of the world's most productive agricultural systems, will translate to best practices worldwide that help ensure food and water security. Other teams are developing crops resilient to higher nighttime temperatures brought by climate change and studying resilience of birds' social networks and climate-driven genetic adaptations.

Innovative social network analysis of rural drug users by Nebraska sociologists has the potential to improve prevention and treatment strategies in hard-hit rural areas nationwide. An award-winning short film created by a faculty team about the slave trade uses animation and powerful storytelling to offer insightful perspective on American slavery.

Donde Plowman, executive vice chancellor and chief academic officer; Chancellor Ronnie Green; Mike Boehm, vice chancellor, Institute of Agriculture and Natural Resources and University of Nebraska vice president; and Bob Wilhelm, vice chancellor, research and economic development.

Nebraska is reaching record highs in federal sponsored awards and continuing impressive growth in industry-sponsored awards. Nebraska Innovation Campus, our public-private innovation hub, is fueling growth with a new 80,000-square-foot building that is attracting local, national and international companies and entrepreneurs.

Whether treating pain without opioids, tightening cloud computing security or digitally publishing the complete letters of an iconic Nebraska author, our faculty are innovating for the future to benefit Nebraska and the world.

At Nebraska, we're building for the future and creating the knowledge-fueled solutions essential to our world.

Bob Wilhelm
Vice Chancellor for Research and Economic Development

RESEARCH AT NEBRASKA
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Resilience Training Tackles Food, Water, Energy Issues

- **409 parts per million of carbon dioxide in the atmosphere.**
- **18.7 million acres deforested annually.**

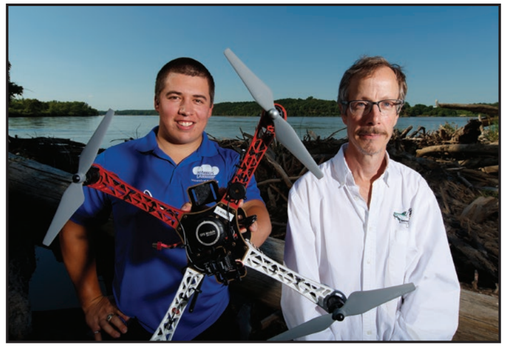
These and other numbers hang above Daniel Rico's laboratory desk – daily reminders of the urgent resilience and climate change problems he aims to tackle in his career. With support from a new National Science Foundation-funded interdisciplinary graduate training program, the Nebraska computer science and engineering master's student is gaining skills to do it.

"I'm a far more capable and better engineer because I'm learning to collaborate with people from other fields," he said.

A five-year, $3 million NSF Research Traineeship grant funds Nebraska's program, focused on agricultural resilience and vulnerability. Its goal is helping participants make informed decisions about using limited natural resources as demand for food, energy and water increases.

The program focuses on the Platte River Basin, where agricultural systems are among the world's most productive and efficient. But water shortages, demographic shifts, climate variability and land use changes threaten the basin and other landscapes worldwide.

"If we discover ways to make the Platte Basin more resilient, not only will we be able to maintain it long term, we can also replicate the model globally to help ensure local and global food security," said project leader Craig Allen, research professor and director of the Nebraska Cooperative Fish and Wildlife Research Unit. The project includes experts in environmental science, engineering, agriculture, computational sciences and social sciences.



Graduate student Daniel Rico and Craig Allen

Rico is developing networks of tether-powered drones to measure crops' responses to climatic changes, such as torrential rainfall. This information could reveal which crops respond best to adversity, enabling researchers to analyze those plants' DNA and develop crops with heightened resilience.

Rico is one of about 20 trainees and 15 management professionals participating in research, coursework, seminars and externships through the School of Natural Resources-based program.

The curriculum bridges existing graduate offerings in water and agricultural sciences, laying the foundation for a permanent resilience-focused graduate program at Nebraska. It's one of the nation's first to fully embrace panarchy theory, a social-ecological approach encompassing all system functions – large and small.

There's no better place for this type of training, Rico said, because Nebraska is one of the world's most vibrant agricultural hubs.

"If you're looking to study resilience, this is the place to be."

Workshops **Focus on Arctic Changes**

Nebraska researchers led workshops in Alaska and Nebraska to develop a highly interdisciplinary approach for enhancing Arctic resilience.

Supported by a new collaboration-intensive National Science Foundation program, the 2018 sessions united scientists, practitioners and stakeholders from the Arctic and mid-latitude locations like Nebraska. Participants devised strategies for managing rapid change in the Arctic, which is driven by climate change, ocean acidification and ozone depletion.

Arctic resilience is vital for that region's 4 million residents and has global implications, including the stability of mid-latitude food production.

"What happens in the Arctic doesn't stay in the Arctic," said workshop co-chair Martha Shulski, director of the Nebraska State Climate Office and associate professor in the School of Natural Resources. "For example, we know that warming in the North influences weather patterns here in Nebraska, affecting our crops."

At the first workshop in Fairbanks, Alaska, participants developed a foundation for exploring the Arctic's future. At the second, funded by the Office of Research and Economic Development, attendees gathered in Lincoln to examine tools for understanding Arctic resilience across the latitudes. At the third, in Anchorage, Alaska, participants merged the first two threads.

The workshops positioned attendees to launch high-impact research, influence policymaking and obtain external funding.

The project was among the initial 23 awards from NSF's Growing Convergence Research program, designed to merge knowledge from disparate areas to solve major challenges. Nebraska's team includes project leader Craig Allen, director of the Nebraska Cooperative Fish and Wildlife Research Unit, and Hannah Birge, adjunct professor in the School of Natural Resources.

Why Nebraska
Martha Shulski

"Nebraska is an ideal place to do this research because of the capacity we have to understand climate change, our expertise in resilience and our experience in engaging with users of information and decision-makers."

Arctic hills
Photo courtesy of Ned Rozell

Protecting Crops in a Warmer World

Higher temperatures caused by climate change aren't just increasing the number of daytime scorchers. Nights are getting warmer as well, stressing plants and decreasing yields of vital crops worldwide.

Nebraska plant pathologist Harkamal Walia aims to make wheat and rice, two major cereal crops, more resilient to the stress from higher nighttime temperatures. He and his team earned a four-year, $5.78 million grant from the National Science Foundation's Established Program to Stimulate Competitive Research for this work.

"Wheat and rice combined provide more of the calories that humans consume than all other plant-based crops globally," said Walia, associate professor of agronomy and horticulture.

For rice, every 1-degree increase in the average minimum low temperature decreases yields by 10 percent, he added. The impact on wheat is less known.

Walia's team aims to identify rice and wheat genes that help some varieties better withstand nighttime temperature stress.

The Nebraska team uses a sophisticated phenotyping system that takes high-resolution images of the plants as they endure simulated nighttime conditions. Software processes the images, detecting daily differences in each variety's physical characteristics, such as wilting, that are invisible to the human eye. Matching slight variations with differences in each plant's genetic makeup allows researchers to identify the genes responsible for heat tolerance.

This knowledge will help scientists develop rice and wheat crops better able to tolerate the effects of climate change.

The multidisciplinary project includes researchers from computer science and engineering, animal science, biochemistry, biological sciences and statistics.

"Nebraska is perfectly poised to lead research of this kind because we've invested in state-of-the-art plant phenotyping infrastructure," Walia said.

He's also collaborating with researchers at Arkansas State University and Kansas State University to study and test heat stress under field conditions.

Harkamal Walia and graduate research assistant Jaspreet Kaur Sandhu measure the amount of carbon that wheat expires at night.

Genetic Strategies Help Species Thrive Where They Live

As climate change leads to warmer winters, earlier springs and later autumns, many plants and animals are becoming out of sync with their environment. Some species may adapt, but will they adjust in time?

The answer lies, in part, with the connection between information encoded in a species' genes and the traits they evolved to thrive where they live.

To better understand that connection, Nebraska evolutionary biologists are investigating how genetically based adaptations have evolved in response to environmental challenges. Their studies are part of a collaboration with the University of Montana funded by a four-year, $4 million grant from the National Science Foundation.

Gaining clearer insights into the genetic basis of physiological traits could support efforts to help species threatened by climate change, said Jay Storz, Susan J. Rosowski Professor of Biological Sciences.

Storz's research focuses on identifying adaptations that allow species to survive low-oxygen conditions at high altitudes. He compares entire genomes of high-altitude species with their lowland cousins to identify the genes responsible. He primarily studies deer mice, but he recently found that songbird species living on the Tibetan Plateau have evolved specialized – and distinctive – genetic strategies to live at such an extreme altitude.

These genetic adaptations likely will prevent lowland species from reaching the plateau, Storz said. That's good news for alpine environments threatened with intruders, not so good for species seeking cooler climes.

The Nebraska team includes biological sciences associate professor Kristi Montooth and assistant professor Colin Meiklejohn. In Montana, collaborators lead projects investigating winter coat change in snowshoe hares and the western U.S. monkey flowers' local adaption to different soil conditions.

NSF funding allowed Nebraska to hire two postdoctoral researchers and to support multiple graduate students, including those from underrepresented groups.

"Our department has a real strength in evolutionary genomics," Storz said. "By answering questions about how evolution works, you gain relevant insights into conservation, agriculture and other applied questions."

Above left: Jay Storz, Kristi Montooth and Colin Meiklejohn
Above: U.S. monkey flowers and a snowshoe hare

CAREER Award RESILIENCE

Understanding **Population Turnover** and **Birds' Social Networks**

Birds of a feather may flock together, but the flock's makeup is always changing.

Population turnover – a universal process driven by birth, death, migration and dispersal – affects social networks of all kinds, from human to bird to cell. Yet many societies remain stable despite these demographic swings.

Understanding this network resilience is the focus of Dai Shizuka's five-year, $681,870 Faculty Early Career Development Program award from the National Science Foundation, the prestigious CAREER award given to outstanding pre-tenure faculty. He also is exploring how population turnover shapes social networks and the relationship between social structure and social behavior. His work marks the first comprehensive look at these phenomena.

Shizuka, assistant professor of biological sciences, examines these questions through the lens of ornithology – the study of birds. He is leveraging his ongoing field research on golden-crowned sparrows to study links between population turnover and social selection. He's also developing a model of network dynamics to simulate theoretical scenarios of population turnover.

Dai Shizuka

His work sheds light on how disease and information spread through populations, and how social relationships impact evolution. It also lays the foundation for assessing the stability of myriad social networks, from humans to other animals to genes.

Curbing **Rural Drug Abuse**

As the opioid crisis continues to plow through the Midwest, devastating rural communities, Nebraska sociologist Kirk Dombrowski has emerged as a leading researcher in rural drug use.

Because previous drug epidemics – '70s speedballs, '80s cocaine and '90s crack – were urban phenomena, research and treatment have concentrated on urban drug addicts. Dombrowski's focus on understanding the unique characteristics of rural drug use is helping inform prevention and treatment strategies in hard-hit rural areas.

Rural drug users have less access to drugs than urbanites so they tend to take whatever drug is at hand, be it opioid, alcohol or methamphetamine. This polysubstance use complicates prevention and treatment, said Dombrowski, John Bruhn Professor of Sociology and director of the Minority Health Disparities Initiative.

His team uses social network analysis to study how rural drug users' social lives influence the spread of drugs and associated diseases, such as hepatitis C and HIV, through needle sharing. Computers help analyze survey and other data to understand how drug users form social relationships and how their networks evolve over time, particularly in relation to risky behavior.

Stigma makes surveying drug users challenging, requiring novel methods. For example, to more accurately estimate population numbers, the team is surveying random Nebraska residents about their anonymous friends' and associates' drug use rather than their own. Statistical methods scale up the network data to provide state-level estimates.

They're also developing cellphone software that uses GPS and artificial intelligence to tailor study participants' questions based on responses and proximity to other users or known drug locations, providing much more data.

The team's counterintuitive findings suggest that rural people have much larger social networks than urbanites, granting them greater access to drugs. They also have fewer risk reduction options, such as clean syringes, overdose reversing drugs and treatment centers.

By identifying risky behaviors, affiliation characteristics and other social attributes, their research provides insight into how addiction and disease spread. Their work suggests the need to increase prevention services in rural areas to reduce overdoses and disease transmission, particularly in the Midwest.

"The Midwest's crisis is probably not that different than rural opioid use in a lot of places, but it's hitting a medical and policy scenario that's unprepared," Dombrowski said.

Kirk Dombrowski

CAREER Award BIOMEDICINE AND HUMAN HEALTH

Aging Brains Look on Bright Side

Even as your knees get creakier and your hair grays, chances are you're putting an increasingly positive spin on life.

Nebraska's Maital Neta, assistant professor of psychology, aims to understand why people interpret ambiguous everyday events (are they whispering about me?) more favorably as they age. Her research could one day help inform treatment options for depression, anxiety and similar maladies.

To study how brain wiring changes with age, Neta earned a nearly $757,000 Faculty Early Career Development Program award from the National Science Foundation, the prestigious award given to outstanding pre-tenure faculty.

Neta's team shows pictures of faces with surprised expressions to people undergoing functional MRI scans and analyzes the brain images. Surprise is one of few facial expressions that could indicate a positive or negative event.

Studies suggest that some people naturally assume the best (look, a gift!), some the worst (look out, a bus!) and most shift between the two.

In the brain, interpreting the meaning of surprised facial expressions resembles how it processes other ambiguous events, such as winks and vague comments.

As people age, they become more motivated to enjoy life and savor the relationships they have, said Neta, an affiliate with the Center for Brain, Biology and Behavior.

Maital Neta

Celebrating **Pioneering Virologist**

When an inventor revolutionizes an entire field, no gesture honoring that legacy seems grand enough.

Such was the case for Myron Brakke, a pioneering Nebraska plant virologist. In the 1940s, he codesigned a swinging-bucket rotor for the centrifuge, transforming research in virology and cellular biology. Changing the mechanics solved a major problem: keeping test tubes of sucrose upright, instead of shifting to one side as the sucrose stratifies in a spinning centrifuge. Sucrose layers enable researchers to separate viruses from destroyed cells or isolate cellular structures.

Brakke gave his prototype to colleagues when he retired in 1986, but they agreed a low-key display wasn't enough. Eleven years after Brakke's death, circumstances finally aligned to create a permanent exhibit.

Robb Nelson, a doctoral candidate in history, noticed the university didn't offer a museum exhibits course. He approached Judy Diamond, University of Nebraska State Museum professor and curator, about developing a course together.

Exhibits was first offered in spring 2018. When Nelson pitched the idea of honoring Brakke, students enthusiastically agreed. Fifteen students representing graphic design, anthropology, journalism, advertising and public relations developed a website and exhibit, using the rotor as a centerpiece.

Students researched Brakke's work, interviewed his friends and family, and designed and built the exhibit using tools at Nebraska Innovation Studio. It is displayed at the Ken Morrison Life Sciences Research Center, the Nebraska Center for Virology's home.

Graphic design students learned their skills can deepen public understanding of science and technology.

Myron Brakke

"I want our students to understand that they have the capacity to partner with people who are doing this very important work and use their skills as a visual communicator to help share that information," said Aaron Sutherlen, assistant professor of art.

As a paleontology student, Devra Hock used her information-mining skills to gather testimonials from Brakke's colleagues and loved ones, showing the depth of his personality. Now Hock is considering a museum career.

Nebraska virologists describe Brakke as a kind, humble mentor whose unassuming nature hid his outsize role in advancing science. He was the first Nebraskan inducted into the National Academy of Sciences.

Brakke wrote about 40 scientific papers in his career. Today his technology – a laboratory staple – is referenced in more than 40,000 publications.

Above: Judy Diamond and students in the Exhibits course
Above right: Art student Jinell Carslin checks the fit of the exhibit graphics.

Building the exhibit in Nebraska Innovation Studio

Anthropology student Steve Petty (left) and graduate research assistant Robb Nelson place a protective cover over Brakke's prototype.

Angela Pannier

Enhancing Nonviral **Gene Therapy**

Most gene therapies, a long-sought method for treating numerous medical conditions, have yet to achieve both safety and effectiveness. Nebraska biomedical engineer Angela Pannier's novel research is finding ways to overcome the technique's significant hurdles.

For her achievements, Pannier received a 2017 National Institutes of Health Director's New Innovator Award, an honor that supports exceptionally creative early-career researchers with the potential to transform their fields. She's the university's first researcher to earn this prestigious award.

Gene therapy introduces genetic material into patients' cells, often via viruses, to treat disease. Pannier, professor of biological systems engineering, researches ways to promote gene uptake using safer, nonviral methods.

She's already had success, discovering that a common steroid drug markedly improved nonviral gene uptake. The five-year, nearly $2.2 million NIH award allows her to ramp up her search for other beneficial drugs.

Pannier's team and Nebraska collaborator Tadeusz Wysocki, professor of electrical and computer engineering, are working to understand the biological mechanisms of gene delivery through mathematical modeling to further improve delivery strategies for gene therapy.

"We'll be able to understand the system on a much bigger scale and move forward into applications," Pannier said.

Preparing Nebraska's **Child Welfare** Workers

Deborah Porter assumed the university's training to prepare her as a state child welfare worker would waste her time. She'd already trained in another state and didn't think Nebraska could top it.

"Wow! It opened my eyes," said Porter, a child and family services specialist in Omaha. "There's so much more I know now. I came out of that training just amazed."

The university's Center on Children, Families and the Law won a $12 million award from the Nebraska Department of Health and Human Services to continue operating the state's Child Protection and Safety Training program, a role it's had since 1987. The new award extends the program for three years with the possibility of an additional two years.

For Porter, what makes Nebraska's 14-week training model special is four weeks of simulations, in which trainees role-play engaging with families and being cross-examined by a lawyer. A house used for simulations is available through a partnership with Lincoln's Child Advocacy Center.

"When you arrive at a home, you don't know what's on the other side of that door," Porter said. "The simulations teach us job skills to work through issues we're going to face."

To serve employees statewide, the training consists of webinars and online learning, followed by simulation training in Lincoln. Conducted about 10 times per year, the program trains more than 200 new child welfare employees annually, said center director Eve Brank, professor of psychology.

Eve Brank (front left) and the center's research team

Trainees learn to assess safety and well-being, engage positively with family members and understand the effects of trauma, among other topics.

Also key to helping Porter in her job is the center's ongoing support. A field training specialist is stationed in every DHHS service area statewide to coach new employees and accompany them on family visits, among other activities.

Porter said the training sent her into the field with confidence, and she loves her new career helping Nebraska's families in crisis.

"People ask me how I can do my job," she said, addressing the perception that it's stressful. "I'm like, are you kidding? Do you know how many times we get thanked for helping them?"

Helping Families Cope with Zika Syndrome

The Zika outbreaks in 2015 and 2016 grabbed headlines worldwide when evidence linked the virus to brain damage in babies whose mothers were infected while pregnant.

Media attention waned along with the epidemic. But for families and caregivers of children living with congenital Zika syndrome, a neurological condition associated with cognitive and physical disabilities, the challenges are just beginning.

"These families face the typical stressors associated with parenting young children, and must also manage numerous challenges that are specific to their child's medical and developmental needs," said Nebraska early childhood researcher Natalie Williams. "Supports that could help alleviate this burden and promote positive outcomes often are not easily accessible."

That's why Williams, assistant professor of child, youth and family studies, collaborates with Brazilian researchers at the Federal Rural University of Pernambuco, or UFPRE, to develop targeted, low-cost programs to support these families. Her team is surveying about 50 caregivers of Zika-affected infants and toddlers. Researchers are identifying a high-risk group – caregivers with anxiety and depression – and interviewing them about their daily routines.

They're also mapping family and community systems to identify support sources in Brazil and how families use them. This information, along with the interviews, will guide the team in designing effective support programs.

Their findings also may apply to early intervention programs in the U.S., which often overlook caregiver support.

Natalie Williams

"Providing support for children with disabilities is not a novel thing," Williams said. "But there is a need for early intervention programs in both the U.S. and abroad to address caregivers' functioning and well-being, which in turn can support children's development."

The project is part of the University of Nebraska-Lincoln/Brazil Early Childhood Partnership, launched in 2016 to enhance the lives of young children and families through global interdisciplinary research collaboration. In November 2017, the Nebraska contingent traveled to Brazil to train graduate students at UFPRE and meet participating families. In April 2018, the Brazilian contingent came to Nebraska for strategic planning.

The project receives funding from the university and Brazil's Maria Cecilia Souto Vidigal Foundation.

Partnering with Brazil to **Study Childhood Needs**

Their home bases are nearly 5,000 miles apart, but early childhood researchers in Nebraska and Brazil find common ground when it comes to enhancing opportunities for their nations' children.

"We're all focused on healthy children and optimal learning," said Susan Sheridan, director of the Nebraska Center for Research on Children, Youth, Families and Schools. "This partnership is the best of the best coming together to improve outcomes for all children."

Launched in 2016, the University of Nebraska–Lincoln/Brazil Early Childhood Partnership fosters collaboration around early learning, ecology of development and program quality. It began with a strategic meeting in São Paulo, Brazil, where researchers planned three pilot projects now underway.

Co-funded by the university and Brazil's Maria Cecilia Souto Vidigal Foundation, the projects focus on supporting caregivers of Zika-affected children, strengthening preschool science education and identifying developmental delays in young children. The work will produce evidence-based results applicable to real-life practice.

CYFS researchers Natalie Williams, Soo-Young Hong and Leslie Hawley each lead the Nebraska side of one of the pilot projects. Over the past year, all three traveled to Brazil and hosted Brazilian partners in Lincoln. This back-and-forth ensures the work is truly bilateral.

"Sharing our perspectives, ideas and expertise allows us to broaden our understanding and appreciate the diversity of experiences that characterize early childhood development," said Sheridan, George Holmes University Professor of Educational Psychology. "These types of interactions allow us to bring back an enriched knowledge base to positively impact our children right here in Nebraska."

Why Nebraska
Natalie Williams

"Nebraska has a rare combination of high expectations for excellence in research and teaching, and the support to help faculty meet these high expectations. It also offers unique resources and connections to become involved in international work."

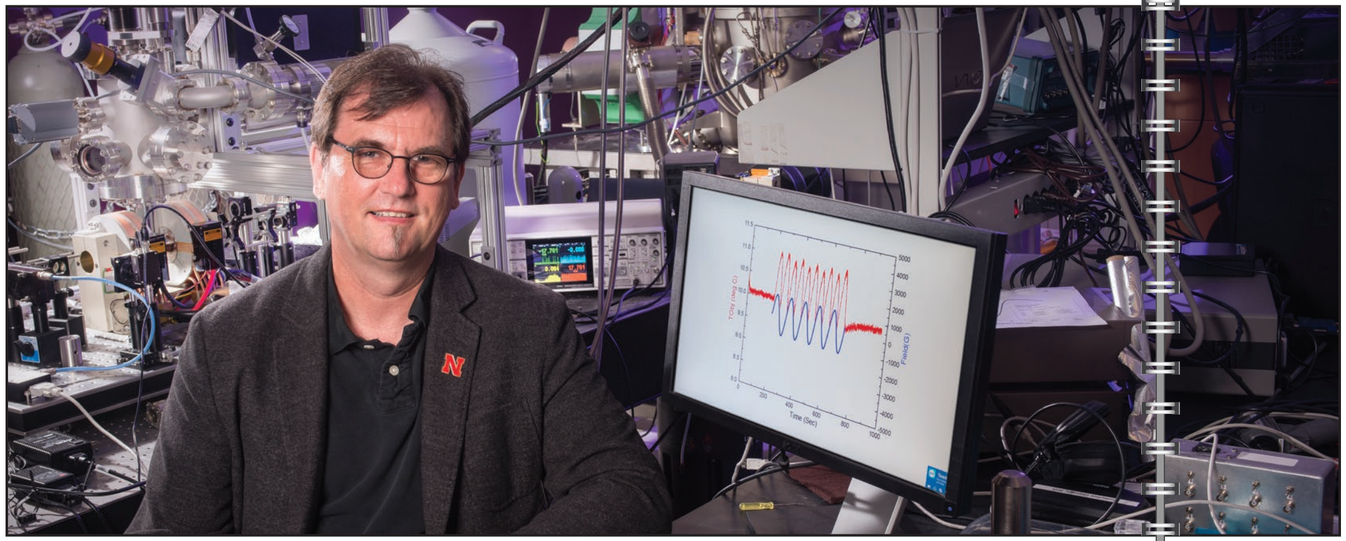
Controlling Elasticity with Magnetism

Insights into a thermodynamic duo could inform engineering decisions and improve the functionality of designs featuring elastic components.

Nebraska physicist Christian Binek found that, under certain conditions, the magnetism of certain materials can predict the relationship between their temperature and elasticity. His finding could allow engineers to control the elasticity of those materials by strategically designing their magnetic properties or applying a magnetic field to them.

Given how easily magnetic fields can be manipulated, Binek said, that could eventually mean tailoring elasticity in real time with the turn of a knob.

In the meantime, knowing whether and how elasticity will respond to temperature changes may help engineers better select materials for specific purposes. Binek cited the disintegration of the Challenger space shuttle – caused by the temperature-induced hardening and failure of an elastic O-ring on its rocket booster – as evidence of elasticity's importance in engineering design.



Christian Binek's computer monitor displays measurements of temperature variations, giving researchers insight into materials' thermal properties.

"So you can find materials that do not change (their) elastic properties with temperature," said Binek, professor of physics and astronomy. "You may find materials that change with temperature at will. And you may find materials where you can, at a given temperature, change the elastic properties by an external control."

It's long been known that the laws of thermodynamics encompass the properties of magnetism and elasticity. By deriving a new formula from existing ones, Binek showed that the elasticity-temperature relationship is basically encoded in a material's magnetism. The formula might even apply to ferroelectric materials, whose alignment of positive and negative charges, or polarization, can be reversed by an electric field.

"Rather than tuning the elastic properties by a magnetic field, you may be able to tune them by electric fields," he said. "Technologically, that could be even more interesting. There are certainly many applications that one could think of, and I think many of them can be useful."

Binek conducted his research through the Nebraska Materials Research Science and Engineering Center, funded by the National Science Foundation.

CAREER Award ENERGY AND MATERIALS

Cranking Up Fuel Cell Efficiency

Cars powered by hydrogen-based fuel cells have been environmentally friendly options for several years in California. But their hefty price tags are far less friendly, curtailing widespread adoption.

Shudipto Dishari

Nebraska engineer Shudipto Dishari aims to both reduce fuel cell costs and improve energy efficiency. She earned a five-year, nearly $600,000 Faculty Early Career Development Program award from the National Science Foundation, the prestigious award given to outstanding pre-tenure faculty.

"The fuel cell is a pretty cool technology. It produces electricity without creating harmful gases ... so it will help us reduce the global carbon footprint," said Dishari, assistant professor of chemical and biomolecular engineering.

Hydrogen fuel cells generate electricity through a chemical reaction between hydrogen and oxygen, producing water and the electrons used to power, say, a car engine.

Dishari studies proton exchange membrane fuel cells, or PEMFCs. In addition to cars, the green technology powers everything from warehouse forklifts to large data centers to space shuttles. Applications continue to expand.

But PEMFCs conduct charged particles poorly. Dishari seeks to better understand how the system works and design new materials that improve conductivity and cost less.

Her research also will improve the understanding of other energy conversion and storage device systems, such as lithium batteries.

Stealth Drilling Drone Could Help Military

Drilling a hole in the ground can be complicated. Especially when the driller is a stealth drone working undetected in unknown, far-off terrain.

And when it's for the U.S. Department of Defense, it has to work every time.

The Nebraska Intelligent MoBile Unmanned Systems, or NIMBUS, Lab is developing a drone system capable of delivering underground sensors to remote or hostile locations. It's a partnership with the University of Nebraska's National Strategic Research Institute.

Project leader Carrick Detweiler's team aims to help the U.S. military monitor enemy weapon caches and perimeters by sending drones to plant sensors. The sensors will wirelessly communicate movement, increasing surveillance capabilities and reducing risks to soldiers.

Drone with drill probe attached

"There's a lot of pieces in this project," said Detweiler, associate professor of computer science and engineering. "We've really had to focus on robustness and reliability at every stage of the system."

One major challenge was developing a drone and payload system light enough for long-distance travel yet capable of drilling, which requires downward force.

Clever engineering and optimized materials overcame a drone prone to spinning instead of drilling.

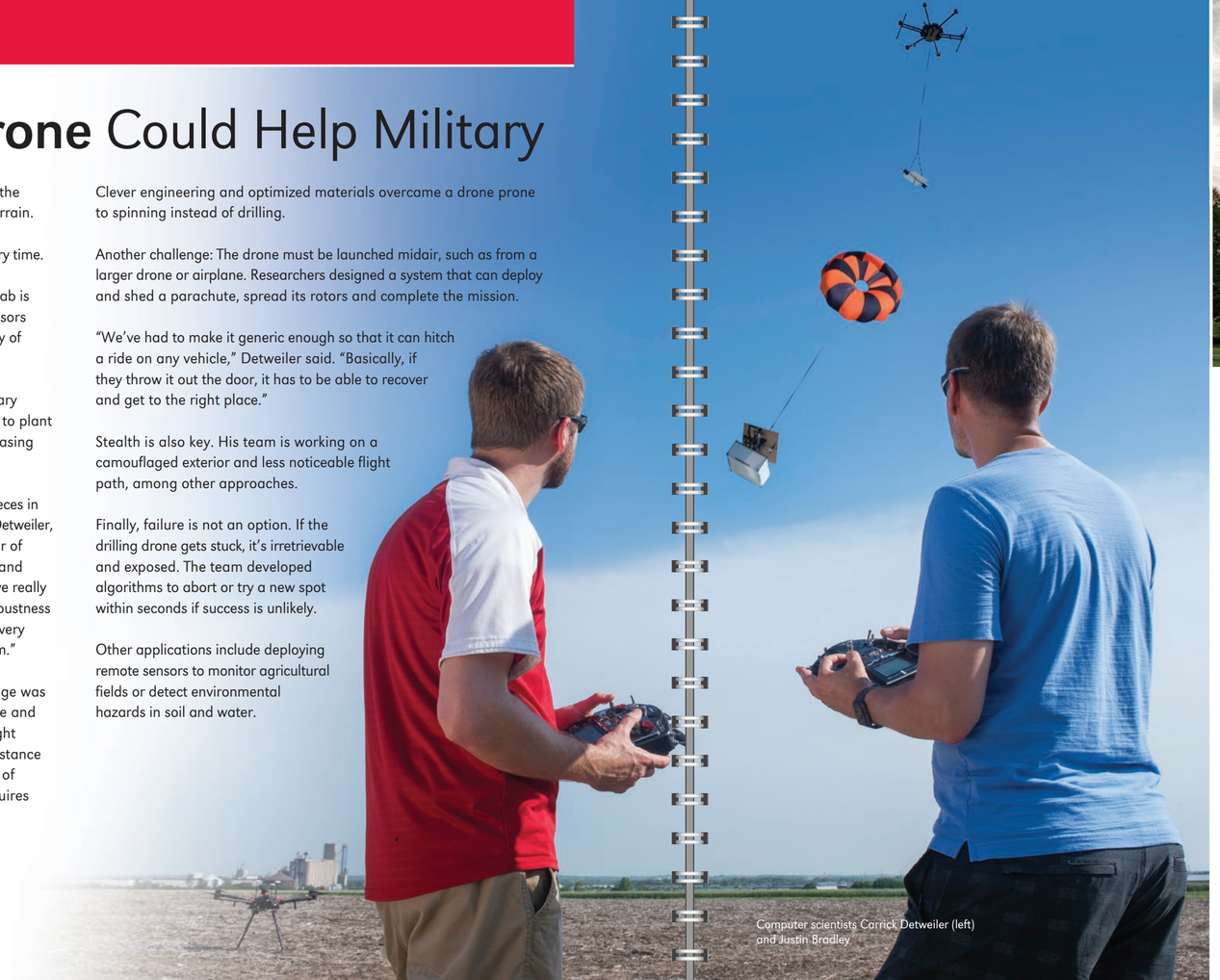
Another challenge: The drone must be launched midair, such as from a larger drone or airplane. Researchers designed a system that can deploy and shed a parachute, spread its rotors and complete the mission.

"We've had to make it generic enough so that it can hitch a ride on any vehicle," Detweiler said. "Basically, if they throw it out the door, it has to be able to recover and get to the right place."

Stealth is also key. His team is working on a camouflaged exterior and less noticeable flight path, among other approaches.

Finally, failure is not an option. If the drilling drone gets stuck, it's irretrievable and exposed. The team developed algorithms to abort or try a new spot within seconds if success is unlikely.

Other applications include deploying remote sensors to monitor agricultural fields or detect environmental hazards in soil and water.



Computer scientists Carrick Detweiler (left) and Justin Bradley

Remodel Strengthens Defense Research

Behlen Laboratory – once considered for demolition – has been transformed into a modern facility that amps up the university's national defense research.

The former physics building's flexible new design accommodates a variety of research disciplines. It was specially constructed to meet the high-level security needs of defense-related research, a key growth area for Nebraska research.

"Behlen Laboratory is Nebraska's new home to critical research that will contribute to efforts to protect our nation and armed forces," Chancellor Ronnie Green said.

Nebraska researchers participate in numerous defense-related research projects funded by the U.S. Department of Defense and private industry. Researchers affiliated with the University of Nebraska's National Strategic Research Institute, a partnership with U.S. Strategic Command dedicated to combating weapons of mass destruction, also will use Behlen Laboratory.

The 32,095-square-foot building includes six dedicated lab spaces, conference rooms and support areas. The six labs were designed for maximum flexibility to meet future research needs. Nebraska's Extreme Light Laboratory is in the basement.

Electronic card scanners secure the entire building, from the front door to individual labs, allowing access only to approved researchers, faculty, staff and students.

The renovation, which began in 2012, features a complete redesign of the interior and exterior, converting Behlen from a concrete monolith in the 1960s Brutalist style to a contemporary glass and metal building ready for the future.

In Her Own Words: Digital Project Gives Voice to Willa Cather

American author and Nebraska alumna Willa Cather gave voice to the lives and emotions of people her literary peers often ignored, such as pioneer women, farmers and Great Plains immigrants.

Seven decades after the author's death, Nebraska scholars are adding Cather's own voice to the chorus. In January, the team launched "The Complete Letters of Willa Cather," a digital edition of Cather's entire body of correspondence. The collection, supported by a National Endowment for the Humanities grant, contains 719 letters. By 2021 it will include all of the nearly 3,100 known letters.

Housed by the online Willa Cather Archive, a project of the university's premier Center for Digital Research in the Humanities, the collection is the first to offer open access to Cather's private correspondence. The author's will blocked publication of the letters, but the ban ended after her estate's ownership transferred following the 2011 death of Cather's nephew.

From left: Gabi Kirilloff, Emily Rau, Jessica Tebo, Andrew Jewell, Melissa Homestead and Kari Ronning

Penned to friends, family and colleagues throughout her life, the letters reflect Cather's inspirations, frustrations and doubts. They also shed light on her writing process and the real-life characters informing her books, said project director Andrew Jewell.

"The letters include thousands of details that were previously unknown," said Jewell, University Libraries professor and Willa Cather Archive editor.

A rich resource not possible in print, the digital edition includes original document images, annotations with photographs and other media, and sophisticated tools for searching and browsing hundreds of documents simultaneously.

"Our central goal is to make Cather's rich and varied correspondence available to readers of all kinds. Publishing freely online means all readers can find letters that are meaningful to them, often through unexpected pathways," Jewell said.

Each letter is intensively researched, and short biographies are written for each of the several hundred people Cather corresponded with or mentioned in her letters.

The large editorial team includes faculty, staff and students from the University Libraries and English department, as well as scholars from outside the university.

Film Exposes **Pain of Slave Trade**

Ann Williams jumped out the window of a Washington, D.C., slave jail in 1815. Some thought she attempted suicide because she'd been sold away from her family.

A new perspective on her wrenching story – and the problem of American slavery – is being shared with audiences through "Anna," an animated short film produced by Nebraska's Michael Burton, Kwakiutl Dreher and William Thomas.

The 11-minute film won the Best Animation award at the 2018 New Media Film Festival in Los Angeles and has been shown at other film festivals nationwide, including Atlanta's BronzeLens Film Festival, an Oscar-qualifying event.

"It shows us the human story of enslavement and how people built families and protected those families as best they could," said historian Thomas, John and Catherine Angle Professor in the Humanities. His research helped uncover Williams' survival and her later, successful petition for freedom.

Audiences have said they found the film haunting and emotional, unexpected qualities in animation, Thomas said.

The film's distinctive style was inspired by a famous early 19th-century etching of Anna's leap and honors the historic time period, said Burton, the film's director and assistant professor of practice in textiles, merchandising and fashion design.

Burton's team developed an innovative method of rotoscoped animation. Actors were filmed in costume. Student animators traced over each frame of footage with paint and overlaid the characters onto a painted background.

William Thomas, Kwakiutl Dreher and Michael Burton

Animation allowed the producers to achieve difficult effects, such as expansive, historically detailed settings.

Dreher's screenplay reached beyond typical portrayals of slaves to imagine Anna's emotional complexity and devotion to family.

"I create for Anna a legacy that moves beyond our popular notions about slavery," said Dreher, associate professor of English and ethnic studies. She gave Anna a background and story that allow for a more nuanced vision of the enslaved.

Building on the film's success, Burton, Dreher and Thomas are forming a production company to develop a series of animated films set in early Washington, D.C., that explore the moral problem of slavery. They hope the series leads to developing an animation industry in Nebraska.

Data-driven Economics Research Highlights **Gender Differences**

European male and female economists don't agree on key economic issues – including whether women have an equal opportunity to share their differing views, a Nebraska study found.

The authors surveyed economists in 18 European Union countries, providing the first systematic analysis of differences in views between male and female economists in Europe. Their findings suggest a lack of women participating in economic research and debates undermines policy outcomes.

Despite similar educations, European women are, for example, less likely than men to trust market forces over government intervention, more likely to favor environmental protections and less likely to believe women have equal career opportunities, particularly in academia. The Nebraska authors found similar differences among U.S. economists in an earlier study.

Men are much more likely to view women's job opportunities as equal to or more favorable than their own, the study found. The difference in viewpoint is wider in the U.S. than in Europe, perhaps due to European efforts to support female economists, said study author Ann Mari May, professor of economics. Mary McGarvey, associate professor of economics, and David Kucera of the International Labour Organization in Geneva, Switzerland, co-authored the European study.

"This is an important step in providing rigorous evidence that there are differences in views. So it does matter who we have involved in the public policy process," May said.

The economics profession is grappling with a shortage of women, both in senior positions and those entering graduate school, she added. Because women are significantly underrepresented, male views predominate in academia, government and publications.

"Economists move in and out of serving on boards and provide expert opinion and testimony," May said. "One sees the cumulative effects of having one set of voices represented and excluding another."

She and McGarvey are working with colleagues to dive deeper into gender differences and their consequences, such as analyzing the views of male-dominated journal review boards and investigating differences in views regarding environmental protection among economists.

The study appeared in the journal *Kyklos* in 2018. The U.S. study appeared in *Contemporary Economic Policy* in 2014.

Ann Mari May (left) and Mary McGarvey

Treating Pain Without Opioids

When you take an opioid pill for that painful back, your entire central nervous system mellows. Many people become addicted to that feeling or suffer other side effects.

To help blunt the opioid crisis and help millions of pain sufferers, Nebraska biologist Paul Blum and his team created a drug that targets pain at its source, leaving the rest of the nervous system, including the brain, alone.

Blum and former doctoral student Benjamin Pavlik co-founded Neurocarrus, a biotechnology startup company, to develop the drug, called N-001.

"Ben and I were highly motivated by the opioid crisis," said Blum, Charles Bessey Professor of Biological Sciences. "We thought we'd try to design something that only works on the neuron that's relevant. There are no drugs like that."

Blum studies proteins. His team's breakthrough came when they looked at *Clostridium botulinum*. These bacteria produce toxins used in medical procedures, such as wrinkle-reducing Botox injections, to freeze motor neurons and paralyze muscles.

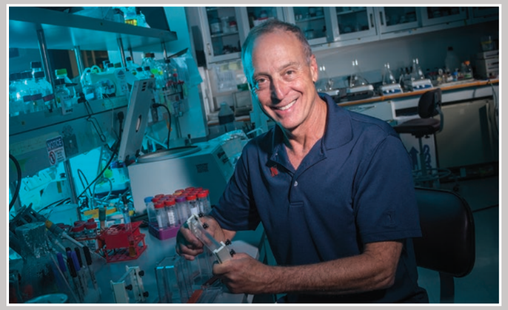
Instead of motor neurons, Blum's team investigated ways to essentially freeze sensory neurons, the nerve cells where pain originates. They developed a multifunctional protein that enters sensory neurons and blocks their signals from traveling to the brain, where pain is perceived.

N-001 works via a localized injection or topical cream. In animal studies, pain relief lasted three days, three times longer than with opioids.

Neurocarrus has a licensing agreement with NUtech Ventures, the university's technology commercialization arm. Domestic and foreign patents are pending for N-001. The company received seed money and entrepreneurial training from IndieBio, a biotech startup incubator in San Francisco. It also won a challenge grant from the National Institutes of Health's National Institute on Drug Abuse for N-001's potential to reduce substance abuse.

Blum said he hopes to begin U.S. Food and Drug Administration-approved testing in humans by the end of 2019. First, the company must entice venture capitalists to invest in clinical trials.

"Though pain is not treated as a disease, quality of life is also important," Blum said. "People shouldn't suffer."



Paul Blum holds a protein gel apparatus used to analyze proteins.

Why Nebraska
Paul Blum

"I feel strongly that I owe it to the taxpayer to transform basic science into useful things for society."

Why Nebraska
Bob Wilhelm

"The university provides an important connection between the state's economy and growth. Together, researchers, industry and state leaders can broaden economic opportunities in Nebraska," said Bob Wilhelm, vice chancellor for research and economic development.

Nebraska's Innovation Hub Fuels Growth

Nebraska Innovation Campus is reaping the rewards of thinking big. From supporting startups' expansion, to becoming a community destination and offering facilities that draw international attention, the public-private innovation hub is fueling growth.

A three-story, 80,000-square-foot building opened in September, creating more space after the first 380,000 square feet reached full capacity. The building is already attracting local, national and international companies.

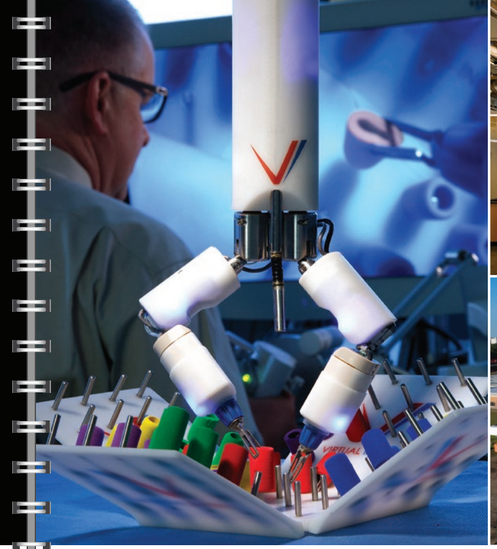
"The new space is drawing interest from companies in Nebraska and from around the world," said Dan Duncan, NIC's executive director. "The building was designed to foster the kind of collaborative culture between the private sector and university faculty and students that will help companies thrive."

It's home to the U.S. headquarters of Sunseo Omega 3, a South Korean agricultural company developing animal feed high in omega-3, which is beneficial to human health. Sunseo is collaborating with university animal scientists on research that will enable the company to launch a premium line of beef with high omega-3 content.

The Nebraska Department of Economic Development has been supportive in NIC's foreign company recruitment efforts, Duncan said.

Virtual Incision Corp., a biomedical company that joined NIC in 2016, plans to move into the building, which offers space for the faculty startup to expand its operations. The new facility will include Nebraska's first pilot manufacturing and prototyping facility as well as a simulated operating room and a pilot production facility for assembling the company's miniaturized surgical robots.

Above: Qinnan Yang, Nate Korth and Mallory Van Haute conduct research in the Nebraska Food for Health Center.



The Biotech Connector, the state's first wet lab incubator, also opened in 2018. Designed to boost Nebraska's biotechnology sector and create jobs, the 7,700-square-foot facility offers equipment, expertise and networking to startups.

The Connector, a partnership between NIC, the university, Bio Nebraska, Invest Nebraska and DED, currently houses five companies.

Established partners are expanding, too. Spreetail, an e-commerce company that moved to NIC in 2015, doubled its square footage this year to accommodate rapid growth. The space boosts capacity for the company's internship program, which employs more than 65 interns, about 50 percent of whom are Nebraska students.

NIC also is transforming into a community hub through initiatives that welcome people with diverse interests to participate in innovation. For example, Nebraska Innovation Studio, NIC's collaborative makerspace, hosts a woodturning program that helps veterans adjust to civilian life.

Above left: Faculty startup Virtual Incision joined NIC in 2016 and is expanding operations.
Top right: The Biotech Connector, the state's first wet lab incubator, opened in March 2018.
Bottom right: A new 80,000-square-foot building opened in September 2018.

Industry-Sponsored Research

$143M
ANNUAL ECONOMIC IMPACT

$21M
UNIVERSITY EXPENDITURES SUPPORTED BY INDUSTRY SPONSORSHIP

$2.1M
ANNUAL LICENSING INCOME

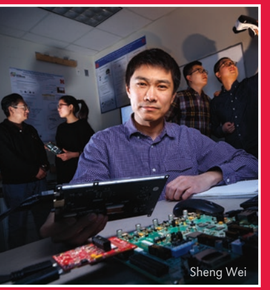
860
JOBS CREATED STATEWIDE

Source: Bureau of Business Research. Figures represent fiscal year 2017, the most recent year for which information is available.

CAREER Award ENGINEERING

Tightening **Cloud Computing Security**

Imagine sharing a backyard with your neighbor. Security concerns would abound, from unwanted visitors to missing tools and unruly pets.


Sheng Wei

Sheng Wei, assistant professor of computer science and engineering, said the perils of a shared backyard illustrate potential security challenges of a high-speed computing platform: the CPU-FPGA hybrid, an architecture that boosts cloud computing's speed.

He's tightening security with a $496,940 Faculty Early Career Development Program award, the National Science Foundation's prestigious award for outstanding pre-tenure faculty.

In CPU-FPGA systems, the computer's brain – its CPU – is placed alongside a field-programmable gate array – the FPGA – a customizable hardware chip. Together, these "neighbors" accelerate performance, with the CPU outsourcing tasks to the FPGA.

But this communication creates a vulnerable "shared yard" that attackers can exploit, wreaking havoc on cloud computing applications such as medical image processing and scientific computing.

To stymie attacks, Wei is building a hardware "fence" that physically separates CPU-FPGA components into secure and nonsecure domains. A secure agent embedded in the secure domain thwarts malicious communications between the domains.

He's also developing a programming tool that automatically slices secure versus nonsecure information, easing the burden for developers. It's the first of its kind for a CPU-FPGA system.

To test his technologies, Wei partners with Adobe Research, Visa Research and Nebraska's Holland Computing Center.

Easing People's **Discomfort with Drones**

Drone sightings are becoming more common, but many people are still apprehensive being around them.


Brittany Duncan

Nebraska computer scientist Brittany Duncan aims to ease discomfort by enabling drones to communicate their intentions, such as taking photos, and maintain comfortable distances. Communication also could make drones valuable coworkers.

Duncan, assistant professor of computer science and engineering, earned a nearly $550,000 Faculty Early Career Development Program award from the National Science Foundation, the prestigious award given to outstanding pre-tenure faculty.

She's developing software that equips drones to communicate through movement, such as bobbing. Movement, unlike speech, doesn't require additional battery-draining hardware.

Duncan's team is surveying the public to identify movements that are intuitively understood. For example, most people recognize that a drone spiraling downward is landing.

In workplaces, communication-enabled drones could lead forklift operators to inventory, direct agriculturalists to field problems or alert nursing home staff to a distressed resident, among other tasks.

She's also developing software to prevent drones from coming uncomfortably close depending on conditions, such as enclosed spaces and drone size.

General drone operators may eventually have access to the software, which already is available to prevent drones from flying near airports, a federal restriction.

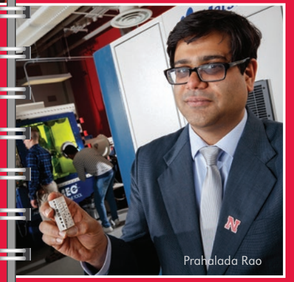
Engineering **Flawless 3D Printing**

Nebraska engineer Prahalada Rao envisions 3D printing no less than revolutionizing the world. But first the process must overcome a tendency to create flaws.

"People call it 'print and go.' I call it 'print and pray,'" said Rao, assistant professor of mechanical and materials engineering.

To produce flawless items every time, Rao is improving the 3D printing process, officially known as smart additive manufacturing. He's supported by a five-year, $500,000 Faculty Early Career Development Program award from the National Science Foundation, the prestigious award given to outstanding pre-tenure faculty.

Additive manufacturing is adept at creating complex parts from various materials, such as plastics and metals, quickly and with little waste. But its significant failure rate excludes mass production when safety is paramount.


Prahalada Rao

Working with titanium and other high-performance materials, Rao is developing algorithms that detect flaws during the printing process and automatically correct them. The technique requires adding sensors to a specialized 3D printer that both adds and subtracts material. Three such hybrid printers are uniquely available at the university.

Rao's technique could transform numerous manufacturing industries, from airplane parts to customized replacement knees. The military could one day 3D print a tank's replacement part and quickly send it back into service.

"Nebraska is positioning itself as a hub for additive manufacturing in a variety of industries, including agricultural equipment, defense manufacturing and biomedical," Rao said.

NEAT Labs Show Potential to **Transform Manufacturing**

A new, cutting-edge 3D printing laboratory is positioning Nebraska as a hub for additive manufacturing.


Graduate research assistants Haitham Hadidi and Cody Kanger use the Optomec Lens 3D Hybrid Machine.

Opened in spring 2018, the Nebraska Engineering Additive Technology Labs feature three unique hybrid 3D printers. They can add or subtract a variety of materials – from plastics to titanium – to create complex three-dimensional shapes using less material than conventional technology.

The labs enable researchers and students to create projects using highly reactive materials. This process accommodates creation of intricate geometries, such as lattice structures and complex internal cooling channels for aerospace applications.

The labs aim to provide a state-of-the-science regional hub for additive manufacturing technology, creating opportunities for collaborations among university researchers and industry. It is part of the Nano-Engineering Research Core Facility.

"If this research is successful, it will have a huge impact on how quickly and reliably we can turn around new products and design, spurring innovation in Nebraska," said Prahalada Rao, assistant professor of mechanical and materials engineering.

VIROLOGY

Uncovering **Zika Mutation**

Nebraska virologists have identified a Zika mutation that may help explain why the virus became more lethal during the Western Hemisphere's 2015 and 2016 outbreaks. The mosquito-borne pathogen evolved from a mild ailment to a deadlier disease that causes birth defects and neurological impairments. A multidisciplinary team affiliated with the Nebraska Center for Virology found that the mutated virus contains a sugar in its encapsulating protein that allows the virus to pass from the bloodstream to the brain in mice, where it's more likely to cause inflammation and death. The findings could help explain the outbreak's dramatic increase in microcephalic births, said Asit K. Pattnaik, professor of veterinary medicine and biomedical sciences. If the virus passes from mother to fetus, it could prevent fetal brains from developing properly. Other factors also have been found to contribute to Zika's increasing pathogenicity. The findings were published in the *Journal of Virology.*

Above: Asit K. Pattnaik (far right) and graduate research assistants Bikash R. Sahoo and Arun S. Annamalai

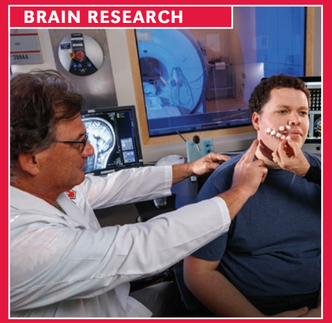
HEALTH

Promising **Flu Vaccine**

Nebraska Center for Virology researchers have developed a vaccine that may help lead to long-lasting immunity against influenza. Flu viruses mutate frequently, necessitating yearly vaccines that are less than 60 percent effective in a good year. Researchers developed a vaccine that combines multiple genes shared at the ancestral level of flu strains circulating today. The vaccine successfully protected mice against lethal doses of seven of nine widely divergent flu viruses. While too soon to say the approach would be successful in humans, it's a promising avenue toward a universal flu shot, said project leader Eric Weaver, assistant professor of biological sciences. An estimated 40 million Americans contracted influenza during the 2015-2016 season, resulting in nearly 1 million hospitalizations, according to the Centers for Disease Control and Prevention. The study was published in *Scientific Reports.* The National Institutes of Health funds this research.

Above: Eric Weaver (right), Amy Lingel and Brianna Bullard

BRAIN RESEARCH



Study Shows **Stroke Treatment Effective**

When a stroke hits, brain damage begins. Nebraska's Steven Barlow invented a device that noninvasively stops further damage. Barlow's team has published the first in a series of studies demonstrating its Galileo TAC-Cell Array's effectiveness as a potential emergency room treatment. The machine produces air pulses at supersonic speeds to create a nerve response. When applied to the skin in specific patterns and speeds, Galileo activates the brain's cerebral cortex and cerebellum and increases blood flow. The study, published in the journal *PLOS One,* establishes best practices for treating stroke victims by examining effects of Galileo stimulation in healthy adults. To gain U.S. Food and Drug Administration approval, Barlow has partnered with the University of Nebraska Medical Center to demonstrate efficacy in a clinical setting. Barlow, Corwin Moore Professor of Special Education and Communication Disorders, is associate director of the Center for Brain, Biology and Behavior.

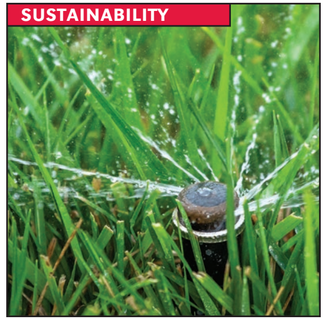
Above: Steven Barlow (left) attaches Galileo nodes to a research volunteer.

PERFORMANCE

Glass' "Annunciation" Premieres

A 24-year friendship between Nebraska's Paul Barnes and world-renowned composer Philip Glass brought the world premiere of Glass' new piano quintet "Annunciation" to Nebraska. It was part of a 2018 concert, "A Celebration of Philip Glass," at the Lied Center for Performing Arts. Glass attended the concert. Barnes and the Chiara String Quartet performed "Annunciation," which is based on a Greek Orthodox communion hymn for the Feast of the Annunciation. The concert included other Glass pieces, Byzantine chant performed by vocal ensemble Cappella Romana and a performance of Glass' Piano Concerto No. 2 "After Lewis & Clark" featuring Native American flute player Ron Warren and the university's Symphony Orchestra. Barnes, Marguerite Scribante Professor of Music, has collaborated with Glass since 1995. "Annunciation" originated from one of their earliest conversations. Barnes retains exclusive rights to the piece for two years.

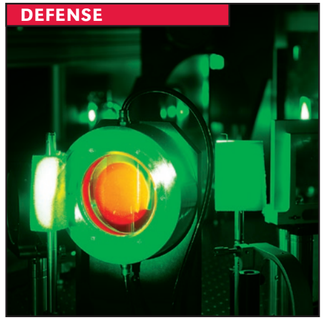
SUSTAINABILITY



Estimating **Urban Water Use**

As towns and cities grow, community planners need effective tools to manage urban water resources. Nebraska researchers and state natural resources experts have developed a novel method for estimating future residential consumptive water use – the water that isn't recycled. The method will help planners design more water-efficient and drought-resilient residential areas. The approach is faster and more cost-effective than is currently available, said project leader Zhenghong Tang, who holds the Hyde Architectural Professorship. To estimate urban consumptive water use in populated areas, the method pairs water use data with high-resolution aerial images gathered from geographical information systems. The images reveal landscape features that directly affect water loss. "It is critical to plan for population and industry growth in urban areas when developing integrated water management plans," Tang said. The study was published in the journal *Sustainable Cities and Society.*

DEFENSE



NSRI **Earns New Contract**

The University of Nebraska's National Strategic Research Institute received a new five-year, $92 million contract from the U.S. Air Force to continue researching methods to combat weapons of mass destruction and protect the nation and its allies. The contract allows NSRI, a partnership with U.S. Strategic Command, to expand research across all four Nebraska campuses. NSRI focuses on five core areas: nuclear detection and forensics, detection of chemical and biological weapons, passive defense against weapons of mass destruction, consequence management and other mission-related research. Since its founding in 2012, NSRI has engaged more than 241 Nebraska faculty, researchers and students from numerous disciplines on more than 80 research projects. The institute is one of 13 university-affiliated research centers nationally. "Our continued momentum and NSRI's unique focus are delivering results on behalf of Nebraskans and all Americans," said Chancellor Ronnie Green.

MEDIA

Testing Limits of **Virtual Reality Education**

Nebraska researchers, working with Nebraska Educational Telecommunications, are testing the limits of virtual reality education by merging VR with 360-degree video. The team is developing a mini walking tour of Lincoln's Centennial Mall, the first step in a project focusing on Nebraska history, VR and distance education. The work combines the expertise of Adam Wagler and Michael Hanus, assistant professors of advertising, with the resources and production quality of NET. They're using a drone to capture scans that provide a digital 3D model of Centennial Mall. The team will use the model to create a VR tour. Audio and video additions educate viewers about the mall's historic sites. NET is developing the walking tour into a user-friendly app. The team is assessing users' feelings about virtual tours and how they consume content. The project helps advance the VR industry.

SOCIOLOGY

Younger Americans More Tolerant

Younger Americans are more likely than older generations to support rights for stigmatized groups, according to a Nebraska study. It's a surprising result, said sociologist Philip Schwadel, the study's co-author. Previously, supporting civil rights broke along class lines, with more support likely as income and education levels rose. The study suggests social status no longer plays an outsize role in predicting political tolerance. Instead, it's diffused along generational lines. Researching nearly 40 years of data from the General Social Survey, Schwadel and his University of Science and Arts of Oklahoma co-author found income and education still play some role, but they have diminished considerably. Younger people growing up with more exposure to diversity through television and social media may explain the shift, Schwadel said, adding that political tolerance likely will grow as future generations come of age in a more progressive society. The study was published in *Sociological Forum*.

POLITICAL SCIENCE

Red or Blue – the Face Shows

Conservatives show less emotion than liberals, according to a Nebraska study that found a correlation between political ideology and facial expressivity. Previous research revealed that people could identify political affiliation from faces alone, but not why. The study found it's likely in part because liberals have more facial emotional expressivity, said study co-author Kevin Smith, Leland J. and Dorothy H. Olson Chair of Political Science. The study consisted of four components: a survey in which liberals self-reported as more emotionally expressive; measurements that demonstrate liberals activate their facial muscles more; and two studies in which participants viewed politicians speaking, without sound, that found emotional expressivity correlates with both perceived and actual political orientation. Politicians with more emotional facial expressions were perceived as more liberal. John Hibbing, Foundation Regent University Professor of Political Science, co-authored the study, which was published in *Politics and the Life Sciences*.

Above: Kevin Smith

ETHNIC STUDIES

Understanding **Multiethnic Experiences**

As the number of Americans with multiple ethnic or racial backgrounds increases, a Nebraska study helps improve understanding of how diverse backgrounds shape people's identities and interactions with others. Debunking common misconceptions, the study found many multiethnic and multiracial individuals have a strong sense of self. Connections to different races and ethnicities provide an awareness and enhanced understanding of others' experiences. But study participants also discussed feeling disconnected in some situations because of how they're perceived. Societal misconceptions, lack of knowledge regarding diverse backgrounds and absence of recognition adds a layer of difficulty and leads to a lack of role models. The study, led by Jordan Soliz, associate professor of communication studies, included interviews with 29 adults, ages 18 to 52. The research helps those working with diverse groups better understand the distinct experiences of being multiethnic, Soliz said. The study was published in the journal *Identity*.

ANIMAL CARE

University Earns **AAALAC Reaccreditation**

The university's animal care program has been reaccredited by the Association for Assessment and Accreditation of Laboratory Animal Care International, a nonprofit organization that ensures high standards of laboratory animal care and use. In addition to compliance with laws regulating the use of animals in research, AAALAC accreditation requires extra efforts to achieve animal care excellence. Kelly Heath, director and attending veterinarian for Nebraska's Institutional Animal Care Program, led the animal care team through the rigorous reaccreditation process, which occurs every three years. It requires updating a self-evaluative report submitted for original accreditation and a three- to four-day on-site evaluation of the institution's animal care and use program. The reaccreditation covers all 16 university-affiliated animal care sites statewide. Nebraska, which first earned full accreditation in 2014, is one of more than 980 AAALAC-accredited organizations worldwide.

COMMUNITY

Harnessing **Superfast Internet**

The university is helping Lincoln take advantage of superfast internet speeds to better address community needs. Lincoln is one of more than 25 national and international communities participating in US Ignite's Smart Gigabit Communities program. The goal of the nonprofit, funded by the National Science Foundation, is to help cities embrace next-generation internet technology to improve economic and social opportunities, such as education, workforce development, transportation and health. Nebraska computer scientists and engineers, along with the university's Holland Computing Center, are partnering with city officials, a local telecommunications company and other private entities to build a digital infrastructure that supports entrepreneurs. As a Smart Gigabit Community, Lincoln agreed to develop two applications or services using gigabit technology. The university is helping the city realize its first project: developing software that accesses unused wireless signals, allowing radios to broadcast on and listen to multiple frequencies.

TEACHING

Enhancing **Rural STEM Education**

Elementary school instructors teaching STEM in rural Nebraska face unique obstacles, including a lack of specialized training, professional leadership and mentoring. But robust instruction in science, technology, mathematics and education is critical for the state's K-6 students, as Nebraska ranks in the top fifth of the U.S. for increases in STEM occupations. To fill this gap, a Husker research team led by mathematics education expert Amanda Thomas is launching NebraskaSTEM. Through the program, 15 elementary teachers from high-needs rural schools will participate in a five-year Master Teaching Fellows program, receiving professional development opportunities, mentoring and salary supplements. Participants will earn either a master's degree or complete other graduate coursework through the program. They'll implement high-quality STEM instruction in their classrooms and serve as local STEM leaders. The project will impact approximately 1,500 K-6 students. The National Science Foundation's Robert Noyce Scholarship Program funds this project.

EARLY CHILDHOOD

Combating **Childhood Obesity**

Dipti Dev's work to combat childhood obesity was honored with an Early Achievement Award from the U.S. Department of Agriculture's National Institute of Food and Agriculture. The award recognizes early career extension professionals who are making strides through extension programs and whose influence and reputation extend beyond their state. Dev, the Betti and Richard Robinson Assistant Professor of Child, Youth and Family Studies and a Nebraska Extension specialist, was recognized for her policy and environmental approaches to decreasing childhood obesity. She is collaboratively developing the research-based, online Ecological Approach to Family Style Dining program, which trains childcare providers to improve the mealtime environment and improve children's diets. Dev also is developing a social media tool kit for extension professionals, enabling them to use social platforms to positively influence children's food choices.

LEADERSHIP

Carr Leads Graduate Education

Tim Carr became associate vice chancellor and dean of graduate education in June 2018. He had served as interim dean of graduate education since April 2017. Previously, Carr was the Jean Sundell Tinstman Professor of Nutrition and Health Sciences and department chair. He also served as acting associate dean of academic affairs in the College of Education and Human Sciences. Carr's research focuses on cholesterol transport and how dietary factors influence cardiovascular and metabolic diseases. He has consulted with the World Health Organization and private industry. He earned a doctorate in nutritional sciences from the University of Arizona and previously was a faculty member at Wake Forest School of Medicine and the University of Minnesota. As dean, Carr's responsibilities include setting the strategic vision for graduate education and the Office of Graduate Studies while working with other deans, department chairs and program chairs to advance graduate and postdoctoral education.

LEADERSHIP

Pérez Named **Engineering Dean**

Lance C. Pérez became dean of the College of Engineering in May 2018. As the College of Engineering undergoes significant growth in enrollment and faculty positions, Pérez is helping to define and implement a strategic vision and guide new facility construction and renovation. He served two years as interim dean and previously was associate vice chancellor for academic affairs and dean of graduate studies. A Nebraska faculty member since 1996, he is the Omar H. Heins Professor of Electrical and Computer Engineering. From 2008-2010, he was program director in the Division of Undergraduate Education at the National Science Foundation, where he worked on projects involving the National Academy of Engineering and the White House Office of Science and Technology Policy. Pérez's research focuses on wireless communications, informational processing and engineering education. He earned a doctorate from the University of Notre Dame.

LEADERSHIP

Savage **Heads CB3**

Cary Savage is the new director and Mildred Francis Thompson Professor of the Center for Brain, Biology and Behavior. He's impressed with the center's multidisciplinary approach and is working to raise CB3's national profile through increased funding and groundbreaking research. Savage joined the university in January 2018. Previously, he was a senior scientist at Banner Alzheimer's Institute in Arizona. He studies how the brain mediates health behavior with the ultimate goal of determining the best treatment options based on a person's brain function. Savage also studies traumatic brain injury and said he's especially excited to strengthen the partnership with Nebraska Athletics and enhance collaborative concussion research. Savage has held academic positions at Harvard Medical School and the University of Kansas Medical Center. He has a doctorate in clinical psychology from Oklahoma State University. Savage succeeds Dennis Molfese, the center's founding director, and interim director David Hansen.

LEADERSHIP

Two Join **Research Senior Team**

Deb Hamernik and Becky Zavala joined the Office of Research and Economic Development's senior leadership team in 2018. Hamernik became associate vice chancellor for research in October. She oversees faculty development, facilitates faculty networking opportunities with federal funders and collaborates with campus leaders to promote Nebraska's research mission. Hamernik, a professor of animal science, served as interim associate vice chancellor for research and in several capacities since 2011, and from 2009-2018 was associate dean of the Agricultural Research Division, part of the Institute of Agriculture and Natural Resources. Previously, she was the national program leader in animal physiology for the U.S. Department of Agriculture's Cooperative State Research, Education and Extension Service. Hamernik earned a doctorate in reproductive endocrinology from Colorado State University. Zavala was named assistant vice chancellor for research in January. She serves as ORED's chief of staff and oversees business and operations, including sponsored programs, research finance and information systems, events and outreach, and learning and development. Zavala previously served as director of research finance for six years. She holds a master's degree in business administration from Nebraska.

Above: Deb Hamernik (left) and Becky Zavala

Four Faculty Named AAAS Fellows

Roger Bruning, David Hage, Jim Lewis and **Jay Storz** were named American Association for the Advancement of Science fellows in 2017.

- Bruning, emeritus professor of educational psychology, was recognized for contributions to educational psychology.
- Hage, James Hewett University Professor of Chemistry, was honored for contributions to analytical and bioanalytical chemistry.
- Lewis, Aaron Douglas Professor of Mathematics, was recognized for contributions to mathematics and mathematics education.
- Storz, Susan J. Rosowski Professor of Biological Sciences, was honored for contributions to evolutionary biology.

A record number of Nebraska researchers are 2018-2019 Fulbright scholars, including the Distinguished Chair Award, the most prestigious appointment offered through the Fulbright U.S. Scholar Program.

- **Cory Forbes,** associate professor of natural resources, is collaborating with German researchers to analyze data from a 2015 global study of more than 28 million teenagers to gauge scientific literacy.
- **Jessica Shoemaker,** associate professor of law, is a Fulbright Canada research scholar and is investigating aboriginal legal and resource rights.
- **Jay Storz,** Susan J. Rosowski Professor of Biological Sciences, is working on a project in Argentina on the evolution of novel properties of crocodilian hemoglobin.
- **Yan Xia,** professor of child, youth and family studies, is Nebraska's first Distinguished Fulbright Chair. She is studying parenting during critical life transitions and comparing practices between China and Western countries.
- **Andrew Zimbroff,** assistant professor of textiles, merchandising and fashion design, is promoting innovative agribusiness entrepreneurship in Brazil.

Margaret Jacobs, Chancellor's Professor of History and director of women's and gender studies, was named Nebraska's first-ever Andrew Carnegie fellow in 2018. The program provides support for high-caliber scholarship that applies fresh perspectives from the humanities and social sciences to some of the most pressing issues of modern times. With the two-year, $200,000 award, Jacobs will research and write a book addressing how the United States can take responsibility for human rights abuses against indigenous children, their families and their nations during the resettlement of America's West by white Europeans. Jacobs was among 31 scholars selected from 270 nominees for the honor.

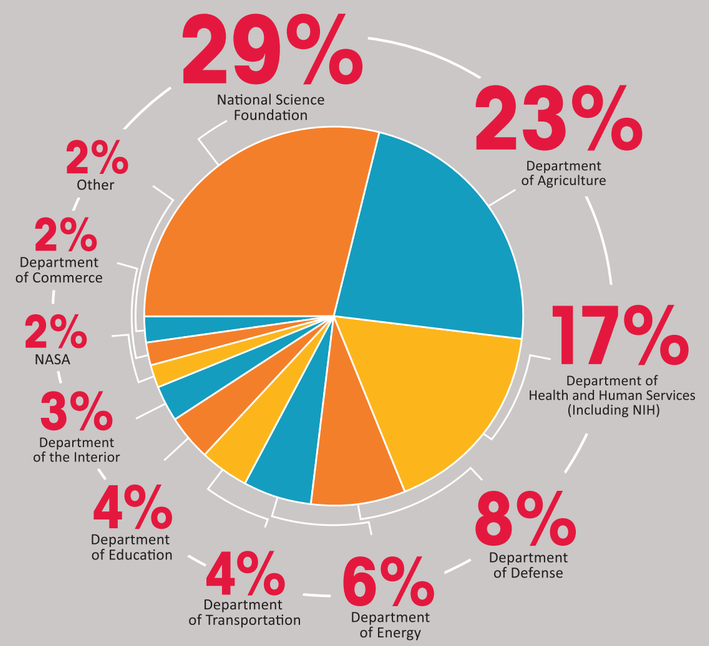
Two Nebraska faculty members received fellowships from the National Endowment for the Humanities in 2017. **Melissa Homestead,** professor of English and program faculty of women's and gender studies, is using her NEH Fellowship to work on a book illuminating the relationship between American novelist Willa Cather and her longtime friend and partner Edith Lewis. **Philip Sapirstein,** assistant professor of art history and digital humanities, and classics and religious studies, received an NEH-Mellon Fellowship for Digital Publication. He is using it to design an interactive virtual museum of the temple of Hera at Olympia, which will be the only modern, comprehensive architectural analysis of the structure. Both fellowships are among the most prestigious awards in the humanities, with a selection rate of 8 percent in 2017.

Dawn O. Braithwaite, Willa Cather Professor of Communication Studies, won the 2017 Samuel L. Becker Distinguished Service Award from the National Communication Association. The award recognizes a lifetime of outstanding service to the association and the profession through research, teaching or service. Braithwaite has served the organization in leadership roles since 1993, notably as a founding member of the Disability Issues Caucus and as a catalyst for ensuring gender equity in NCA awards. Braithwaite's research focuses on how individuals and families communicate, especially during challenging periods of change.

Mark van Roojen, professor of philosophy, was a Laurance S. Rockefeller Visiting Faculty fellow at Princeton University. During an academic year in residence, fellows devote time to researching and writing about topics involving human values in public and private life. He was one of eight fellows in 2017-2018 and worked on a book on moral rationalism. van Roojen also served as a book review editor for the journal *Ethics*.

Kristen Olson, Leland J. and Dorothy H. Olson Distinguished Professor of Sociology, was elected an American Statistical Association fellow in 2018. ASA members are awarded fellowships based on their contributions to statistical science research, teaching and mentoring, published works, leadership and service to the profession. Each year, no more than one-third of 1 percent of membership receives fellow status. Olson's research focuses on survey methods and why nonresponse, measurement and coverage errors occur.

Charles Wortmann, professor of agronomy and horticulture, received the 2018 International Agronomy Award from the American Society of Agronomy. The award recognizes outstanding contributions in research, teaching, extension or administration. The soil scientist's research and extension efforts focus on economical, environmentally safe methods for nitrogen and phosphorus management in Nebraska and soil fertility management in sub-Saharan Africa. This is Wortmann's second major honor from the organization, having become a fellow in 2011.



FY 2017 FEDERAL EXPENDITURES BY AGENCY

$302M
TOTAL RESEARCH EXPENDITURES FY 2017

23%
INCREASE IN RESEARCH EXPENDITURES OVER THE PAST 10 YEARS

1,406
SPONSORED AWARDS

25,897
STUDENTS

1M
SQUARE FEET OF SPACE FOR RESEARCH

2017-2018 NEBRASKA RESEARCH REPORT

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RESEARCH AT NEBRASKA
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