# Seek

RESEARCH MAGAZINE FOR KANSAS STATE UNIVERSITY

*FALL 2023*

FEATURED INSIDE:

**Everyday science**
K-State research lives in our daily lives

**Improving the framework**
Researchers build on infrastructure investment

**A statewide movement**
K-State 105 helps counties across Kansas

## Three-dimensional education

Engineers at the Kansas State University Technology Development Institute in the Carl R. Ice College of Engineering work with researchers in the College of Veterinary Medicine to design and develop new tools for teaching.

Using 3D-scanning technology, irregular shapes such as this horse skull can quickly and accurately be put into software and manipulated in a manner that allows for various features to be modified for training aids. In the model in this photo, the teeth were redesigned to be removable and a life-size version of the skull was then 3D-printed to be used as an educational tool.

See page 32 to learn more about work that involves the Technology Development Institute.


**On the cover:**
*K-State experts across disciplines — from behavioral science to water quality to transportation — are working together to combine resources, resulting in models that help both rural and urban communities across Kansas thrive. Read more on page 20.*

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KANSAS STATE UNIVERSITY

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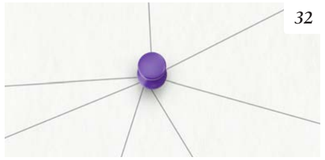

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### A statewide movement

K-State 105 helps counties across Kansas

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### Seek more

Seek is Kansas State University's flagship research magazine and invites readers to "See" "K"-State's research, scholarly and creative activities, and discoveries. Seek is produced by the Office of the Vice President for Research and the Division of Communications and Marketing.

Find Seek online at *k-state.edu/seek* or at Kansas State University's New Prairie Press, *newprairiepress.org*.

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"We take pride in celebrating our researchers' work and promoting its impact.

We are pleased to share our latest issue of Seek, Kansas State University's award-winning research magazine. Research is core to our mission as a great land-grant university, a public research university and a university dedicated to learning, discovery and innovation. We take pride in celebrating our researchers' work and promoting its impact. We invite you to learn more through the pages of this beautiful magazine.

This issue celebrates a wide range of research at K-State, from research on grand challenges, large-scale systems and the health of our planet and its populations, to everyday science on the farm, in the community, in our homes and on the kitchen table. From discovery deep in the disciplines, advancing the state-of-the-art, to transdisciplinary research that cuts across traditional fields of study to create entirely new ones, advancing our state-of-understanding, K-State research is innovative and impactful.

We also feature a story about K-State 105, one of the four pillars of K-State's bold **Economic Prosperity Plan** for Kansas launched in 2021. K-State 105 is connecting K-State research and expertise to the needs of communities in Kansas to build economic opportunity and the core elements that support it: child care and early childhood education, health and well-being, housing, transportation and infrastructure, small business development, food security and statewide connectivity.

By focusing on the **people** conducting research at K-State and the **impacts** of their work — locally, nationally and globally — we hope our magazine and the research being highlighted inspires both curiosity and pride. Thank you for your interest, support and engagement with K-State research.

Go 'Cats!
David V. Rosowsky, Ph.D.
Vice President for Research

### Understanding economic prosperity

Throughout the magazine, look for these icons to learn more about the four areas of K-State's Economic Prosperity Plan and to read more about research in each area.

- Food and agriculture systems innovation
- Digital agriculture and advanced analytics
- Biosecurity and biodefense
- K-State 105

Read more about the Economic Prosperity Plan. *k-state.edu/economic-prosperity*

ENGAGEMENT

# Next-Gen K-State plan reimagines educational access and opportunity

Kansas State University is leaning into its land-grant heritage and mission with its Next-Gen K-State strategic plan.

Built from input from more than 10,000 students, faculty, staff, alumni, donors and other university stakeholders — including the 2,457 Kansans who participated in last academic year's regional community visits across the state — the plan outlines how the university will transform to serve new kinds of learners, solve grand global challenges and contribute to the economic prosperity of the state.

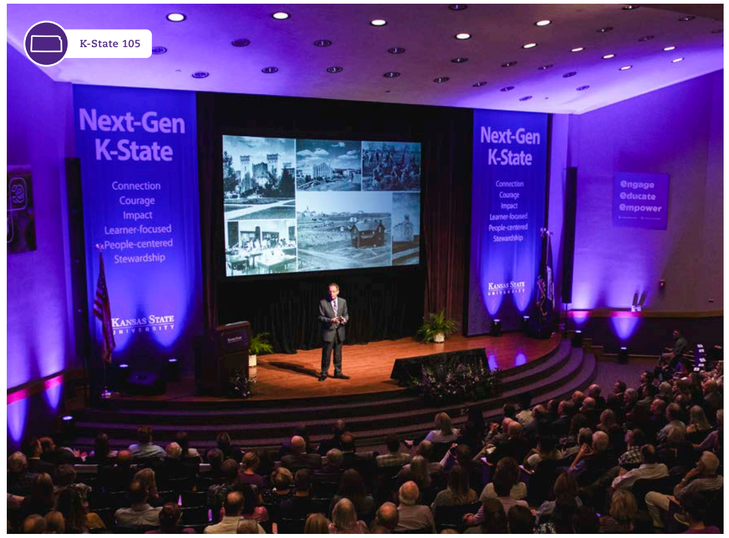
"Being a next-generation land-grant university requires us to renew our commitment to the land-grant mission, which is all about access and opportunity," said Richard Linton, K-State president. "But access and opportunity today means something different than it did in 1863 — we must evolve to meet the needs of today's learners who are seeking different kinds of training and education, and we must embrace our responsibility to serve the state, nation and world through research and engagement in new and exciting ways."

The plan, which outlines key priorities for the institution, four distinct opportunity areas for interdisciplinary focus, and 17 relevant measures of success, will guide the university through the year 2030. Specific goals around student enrollment and retention, academic innovation and applied learning experiences, research growth and impact, and engagement and economic impact will define the future of the university.

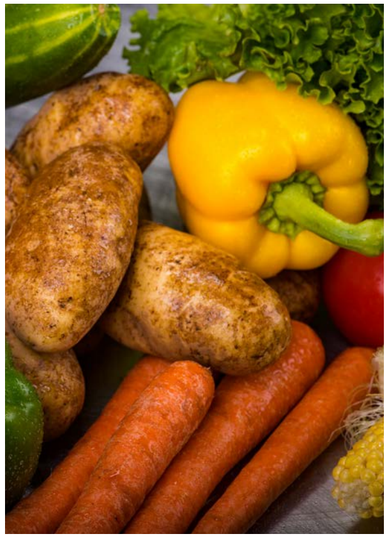
"As the nation's first operational land-grant university, we view it as our responsibility to redefine what that means in modern-day contexts — and by delivering unmistakable value to all who wish to learn, grow and prosper, we will set the standard for what a highly engaged, people-centered, and learner-focused university can and should be," Linton said.

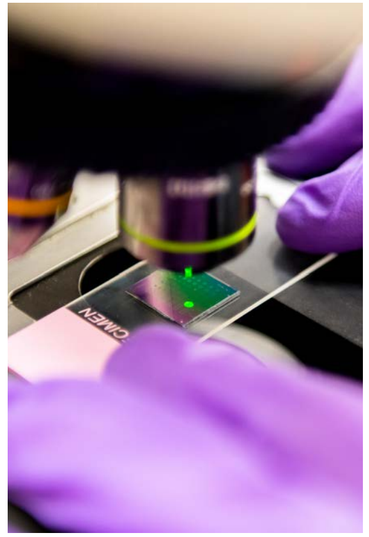
## Growing research and setting the K-State opportunity agenda

When it comes to the research arm of the university, the strategic plan outlines a goal of increased annual research expenditures and growing the university's research enterprise by this measure to $300 million by 2030.









K-State has both an opportunity and an imperative to bring resources and expertise together in a way that respects the university's unique structure and challenges historical norms.

The university also has identified four interdisciplinary areas of focus where K-State is uniquely positioned to serve: community health and well-being, sustainability, global food security and biosecurity, and enabling technologies. These four areas make up what the university is calling the K-State opportunity agenda.

### Community health and well-being

This focus area encompasses understanding physical, social and cultural features of a community; researching social dynamics and cohesion within a community; identifying and addressing factors that drive health disparities, including social determinants of health and health care policies; and identifying and enhancing the structures, policies and practices that impact accessibility to education.

### Sustainability

This focus area includes considerations of water and resource management practices, the natural and environmental factors that impact resource usage, our health, environment and society; the conservation and restoration of biodiversity; and economic policies and cultural practices and their impacts on human ecology.

### Global food security and biosecurity

Relevant work in this focus area includes practices for increasing food production and the impact of social, political and environmental policies and factors on production, as well as strategies for preventing and controlling infectious diseases and environmental factors that contribute to their prevalence. Other areas may include communication and human impact, supply chain considerations and the interactions between policy and economics that affect food access and security.

### Enabling technologies

This focus area considers how to advance and understand the implications of natural language processing and machine learning, as well as integration of technology across foundational elements of modern human life. It also includes the opportunity to consider the ethical and societal impacts of these integrations.

### Seek more

Learn more about Next-Gen K-State.


SUPREM DAS


BALA NATARAJAN


ELENI PLIAKONI


PASCAL HITZLER


ROMULO LOLLATO

### GRIP-funded projects

PROJECT: "Science and technology center for greenhouse gas smart-sensing and mitigation for Kansas climate and agriculture (GHG SmartSense STC)"

LEAD RESEARCHERS:
**Suprem Das**, assistant professor and Jeffrey and Joy Lessman — Carl and Mary Ice Keystone research scholar in the industrial and manufacturing systems engineering department

**Bala Natarajan**, Clair N. Palmer and Sara M. Palmer professor of electrical engineering and Steve Hsu Keystone research scholar in the Mike Wiegers Department of Electrical and Computer Engineering

PROJECT: "Development of resilient urban food systems that ensure food security in the face of climate change"

LEAD RESEARCHER:
**Eleni Pliakoni**, professor of urban food production and postharvest handling at K-State Olathe

PROJECT: "Towards a global food systems data hub: Seeding the Center for Sustainable Wheat Production"

LEAD RESEARCHERS:
**Pascal Hitzler**, professor and Lloyd T. Smith Creativity in Engineering chair in the computer science department

**Romulo Lollato**, associate professor of agronomy

**Seek more**
Read more about GRIP.

INTERDISCIPLINARY RESEARCH

# Game-changing research

The Kansas State University Office of the Vice President for Research has selected 10 research teams — three fully funded teams and seven finalist teams that are receiving seed funding — to receive inaugural awards from the Game-changing Research Initiation Program, or GRIP.

GRIP supports innovative and groundbreaking research by catalyzing teams of K-State faculty across departments, colleges and campuses to address complex challenges that require a transdisciplinary solution.

"The goals of GRIP are twofold," said David Rosowsky, vice president for research. "First, to enable teams of investigators that self-assemble from across the university to work together toward a major and sustained research effort in a timely, relevant and important area for our state. And second, to begin building a culture that recognizes, supports and celebrates transdisciplinary activity at K-State."

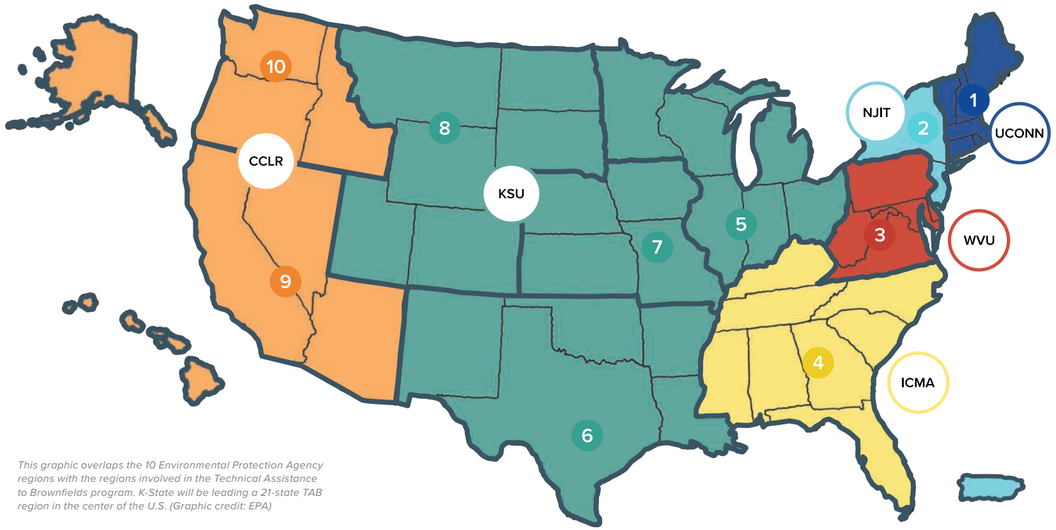
The three funded teams will receive a total of $950,000 per project. The seven other finalist teams are receiving GRIP seed grant funding that will enable them to keep their teams together, advance their ideas and prepare for future solicitations from federal agencies.

Altogether, the 10 teams receiving GRIP funding this year include K-State faculty from the Manhattan and Olathe campuses as well as seven colleges — the College of Agriculture; the College of Architecture, Planning & Design; the College of Arts and Sciences; the College of Business Administration; the Carl R. Ice College of Engineering; the College of Health and Human Sciences; and the College of Veterinary Medicine.

GRIP is driven by funding from many areas of the university: the Office of the President, the Office of the Provost and Executive Vice President, the Office of the Vice President for Research, the Kansas State University Foundation and academic deans.








*This graphic overlaps the 10 Environmental Protection Agency regions with the regions involved in the Technical Assistance to Brownfields program. K-State will be leading a 21-state TAB region in the center of the U.S. (Graphic credit: EPA)*

ENGINEERING

# EPA supports K-State work to revitalize brownfields

The Environmental Protection Agency has awarded $23 million to the Center for Hazardous Substance Research at Kansas State University to expand the Technical Assistance to Brownfields, or TAB, program that works to revitalize environmentally distressed properties.

These properties, known as brownfields, are often underutilized or blighted pieces of land that are not chosen for redevelopment for a variety of reasons, including potential or real environmental contamination.

The TAB program helps property owners, developers and community leaders create an economic or community development plan, address the environmental issues and reuse the properties.

Blase Leven, director of the Center for Hazardous Substance Research, said the EPA funding would help the program expand and complete more projects in its 21-state region, including Kansas and other states from the Great Plains, Rocky Mountain and Great Lakes regions. K-State is also the national leader for working with five other TAB providers that serve the western and eastern regions of the U.S.

The TAB program operates through the Carl R. Ice College of Engineering and collaborates with a variety of K-State units, including the Tim Taylor Department of Chemical Engineering; the Department of Landscape Architecture and Regional & Community Planning in the College of Architecture, Planning & Design; and Engineering Extension. The program also works alongside 35 universities and contractors throughout the region.


**CORE LEADERSHIP:**

Kansas State University · BIOKANSAS · Manhattan Area Chamber of Commerce Kansas · Manhattan Tech, Manhattan Area Technical College

INNOVATION AND ENGAGEMENT

# An innovation engine for the region

A Kansas State University regional partnership has received $1 million from the U.S. National Science Foundation's Regional Innovation Engines, or NSF Engines, program.

The partnership — called the Advancing Biosecurity, Biodefense, and Biomanufacturing Technologies project — includes core leaders K-State, Manhattan Area Technical College, BioKansas, K-State Innovation Partners and the Manhattan Area Chamber of Commerce as well as many regional and industry partners.

The project is among more than 40 unique teams to receive one of the first-ever NSF Engines Development Awards, which help partners collaborate to create economic, societal and technological opportunities for their regions.

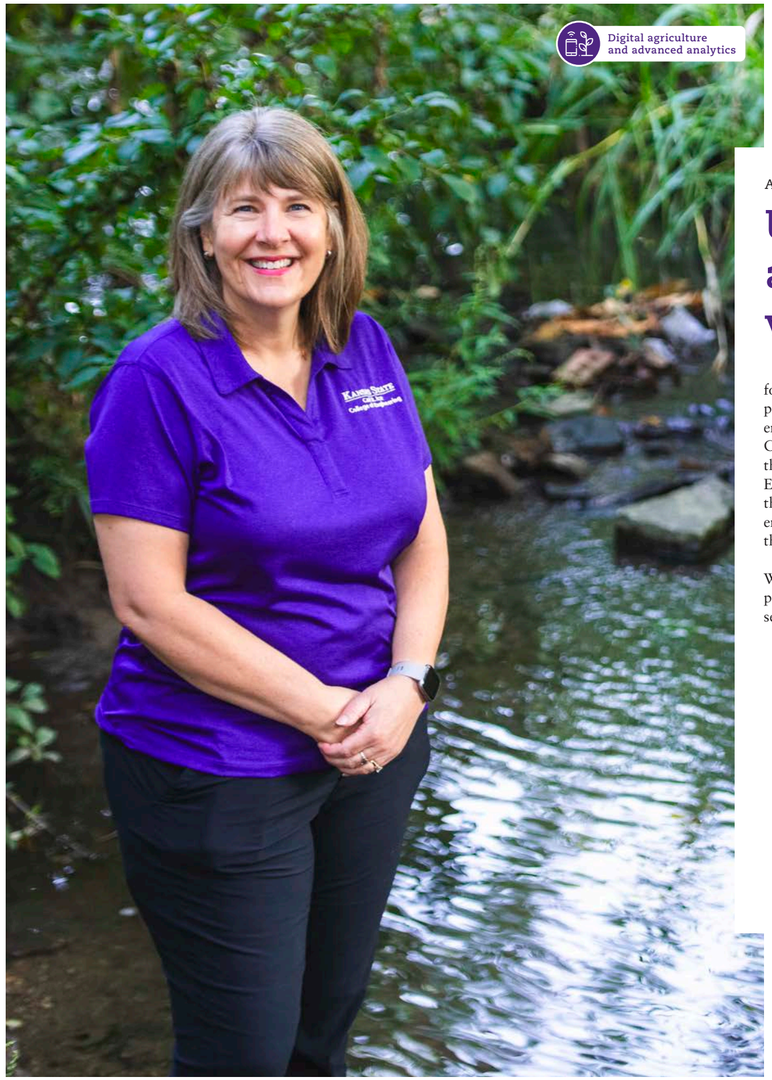
"The region of northeast Kansas and northwest Missouri is home to significant activity in the domain of biosecurity, biodefense and biomanufacturing, including academic and government research and the private sector," said Beth Montelone, principal investigator and senior associate vice president for research at K-State. "Partners in the region aspire to build upon this activity to make northeast Kansas and northwest Missouri a hub of research, education and manufacturing in biosecurity, biodefense and biomanufacturing."

**Seek more**

Learn more and how to partner with the development engine.








AGRICULTURE

# Understanding and addressing water security

Stacy Hutchinson, associate dean for research and graduate programs and professor of biological and agricultural engineering in the Kansas State University Carl R. Ice College of Engineering, is the chair of a thematic task force of the Engineering Research Visioning Alliance that recently released a new report on engineering research priorities to address the complex issue of water security.

The report, "Engineered Systems for Water Security," identifies critical research priorities related to engineering and water security:

- Develop, test and implement a water management framework that considers the nexus between engineered, natural and human systems.
- Build/create new, resilient, scalable and adaptable infrastructure with the flexibility to opportunistically integrate legacy systems.
- Improve data gathering and analysis and leverage predictive modeling and data-informed operations.

***Left:*** *Stacy Hutchinson is leading research efforts focused on water security.*


AEROSPACE AND TECHNOLOGY

# Imagining a new spatial computing studio and learning center

Kansas State University Salina Aerospace and Technology Campus, in partnership with Pure Imagination Studios, the Salina Airport Authority and the state of Kansas, is establishing a $41 million, one-of-a-kind spatial computing studio and learning center.

The Kansas Advanced Immersive Research for Emerging Systems, or K-AIRES, is the most significant investment in the campus's infrastructure to date. This project will add a new three-story, approximately 55,000-square-foot facility that will bring with it more than 100 new jobs to the Salina area and propel the community to the forefront of the spatial computing industry. The headquarters for Pure Imagination Labs also will be on the K-State Salina campus.

The studio and learning center at K-State Salina will feature state-of-the-art equipment and immersive technology to transform the education experience and establish new frontiers. Faculty and researchers will be able to leverage immersive environments to reimagine what 21st-century education should be: The hands-on application of embedded industry projects with collaborative, multidisciplinary problem-solving driving the learning experience.

"K-AIRES brings world-leading simulation and artificial intelligence capabilities to the major industry sectors of Kansas, with a heightened focus on aerospace, advanced manufacturing and defense," said Alysia Starkey, K-State Salina CEO and dean. "Once complete, this facility will provide exciting and engaging ways to educate and train students in the enabling technologies of the future. We also expect large-scale research grants, sponsored research projects and targeted industry partnerships to support the growth of local and state workforce and economic development."





AEROSPACE AND TECHNOLOGY

# K-State Salina unveils new extended reality lab

The Kansas State University Salina Aerospace and Technology Campus now has a highly advanced educational space that uses ultramodern technology: a new extended reality, or XR, lab space.

The Immersive Technology Classroom combines virtual, physical and augmented reality technology. The facility features an immersive video wall showing multiple views from several different devices and an in-room immersive audio system to provide a much more functional space.

XR has a wide range of applications in various fields, including education, entertainment, health care, engineering and many more. It allows users to experience and interact with virtual objects and environments naturally and intuitively, leading to new possibilities in education, training and research.

Michael Pritchard, associate dean of research and graduate studies at K-State Salina, said the space will not only be utilized as a classroom where students learn about the theory behind the technology, but it will also be a space where applied projects lead to real-world products.

"This space is used to push the boundaries of cybernetic and cyber human systems research," Pritchard said. "The new lab and equipment have expanded our ability to develop cognitive processing research across a variety of human-to-machine teaming scenarios. We are engaged with industry on multiple cyber human systems projects, which illustrates that our work in the new XR lab sets our campus apart from many of our counterparts."

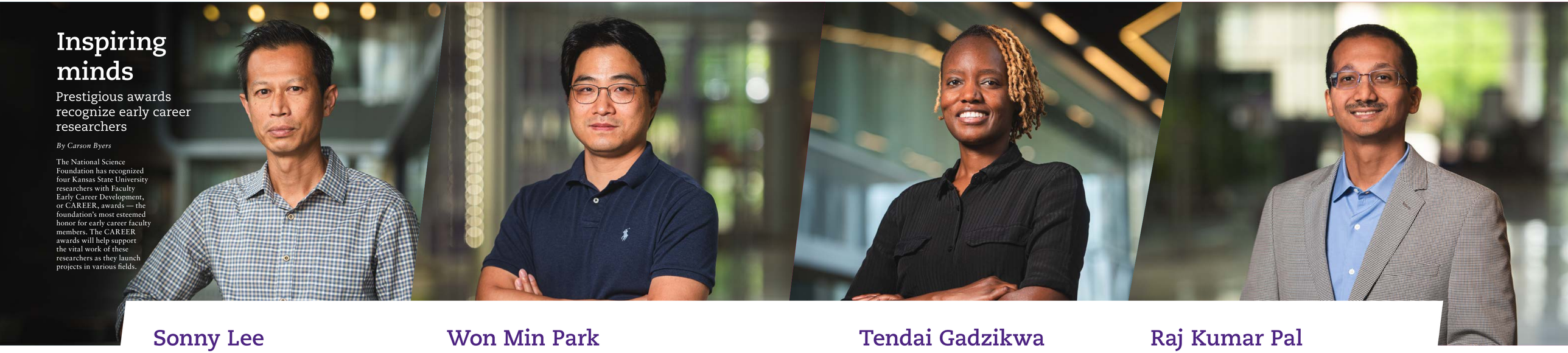
See Faculty Focus

# Inspiring minds

## Prestigious awards recognize early career researchers

*By Carson Byers*

The National Science Foundation has recognized four Kansas State University researchers with Faculty Early Career Development, or CAREER, awards — the foundation's most esteemed honor for early career faculty members. The CAREER awards will help support the vital work of these researchers as they launch projects in various fields.



## Sonny Lee

Assistant professor in the Division of Biology
College of Arts and Sciences

**AREA OF STUDY:** The interactions among plants and their soil microbiomes

**AWARD:** Nearly $901,000 NSF CAREER award

**PROJECT TITLE:** "How do rhizosphere associated microorganisms and plant host interact to regulate soil microbial processes"

**PROJECT DESCRIPTION:** This project will link plant gene diversity to rhizosphere, or soil, microbial composition and determine how the rhizobiome affects plant function and resistance to drought stress. The work will allow Lee and his team to better understand how plant-rhizobiome interactions influence ecosystem sustainability, which is critical for anticipating ecosystem responses to environmental change. Lee will integrate education with research and will collaborate with students and citizen scientists to determine this mechanistic interaction and how that affects fitness and drought resistance.

**FROM THE RESEARCHER:** "We are excited to identify the potential mechanism in which the plant and its associated microbes can work together to become more resilient under climate change conditions," Lee said. "We are also thrilled to be working holistically with our citizen science partners and collaborators to extend our research to the public and students."

## Won Min Park

Assistant professor in the Tim Taylor Department of Chemical Engineering
Carl R. Ice College of Engineering

**AREA OF STUDY:** Protein biomaterials engineering

**AWARD:** $550,000 NSF CAREER award

**PROJECT TITLE:** "Modular protein origami to build genetically programmable biomaterials"

**PROJECT DESCRIPTION:** Park will develop a simple, modular and versatile technology to direct the folding and assembly of protein biomaterials using a molecular version of origami. This project will examine the genetic programming of complex functionalities into the biomaterials created from this process. Additionally, Park will produce educational activities that will train students in protein biomaterials engineering.

**FROM THE RESEARCHER:** "This project will focus on understanding the process of nanoscale origami using the building blocks of engineered proteins," Park said. "The technology of modular protein origami will create next-generation tools for the advancements in biomanufacturing and health care."

## Tendai Gadzikwa

Associate professor in the Department of Chemistry
College of Arts and Sciences

**AREA OF STUDY:** Molecular reactions

**AWARD:** Nearly $780,000 NSF CAREER award

**PROJECT TITLE:** "Confinement effects and emergent behavior in multifunctional MOF-based catalysts"

**PROJECT DESCRIPTION:** Gadzikwa's lab studies, designs and synthesizes porous materials that are known as metal-organic frameworks. These materials have physical and chemical structures modeled after the active sites of enzymes, which are the most efficient catalysts known to researchers. This project will better understand the molecular origins of unexpected reactivity and confinement effects within these materials so researchers can design and construct efficient catalysts.

**FROM THE RESEARCHER:** "Emergence occurs when a system displays behavior that would not be expected given the properties of its constituent parts," Gadzikwa said. "Such surprising behavior, which no one can yet explain, is exciting to observe because it suggests we are on the verge of discovering something that could transform how chemists think about reactions in confined spaces."

## Raj Kumar Pal

Assistant professor in the Alan Levin Department of Mechanical and Nuclear Engineering, Carl R. Ice College of Engineering

**AREA OF STUDY:** Elastic wave energy trafast

**AWARD:** $504,000 NSF CAREER award

**PROJECT TITLE:** "Guiding and confining nonlinear elastic waves in moiré metastructures"

**PROJECT DESCRIPTION:** Pal's research will address a major challenge of wind energy generation. He will explore new architected metamaterials to provide vibration protection of large-capacity wind turbine blades. The project will focus on the application of these engineered materials, called moiré metastructures, which are able to guide and confine elastic wave energy in a new, innovative way.

**FROM THE RESEARCHER:** "The project will train and expose our graduate and undergraduate students to cutting-edge research in vibrations, support international study exchange with our collaborators in France and result in novel devices for wave control," Pal said.

# EVERYDAY SCIENCE


## K-State research lives in our daily lives

*By Michelle Geering*

From the moment our alarm goes off and we hit the snooze button — invented by Kansas State University alumnus Herbert Dimond — science is at our fingertips.

Science makes our complex, everyday actions simple: turning on a light with the flip of a switch, getting water from a faucet inside our home, refrigerating food to keep it cold, driving vehicles with enhanced safety features, using a phone as a small computer, shopping online … the list goes on.

It's not just the natural sciences that affect our everyday lives. Social sciences help us better understand the world around us: how the economy grows, why people behave in certain ways, what influences our decision-making, how we embrace cultural differences, what makes people happy and the many other ways that influence how we interact with others.

Research drives society forward. K-State researchers are passionate about making the world a better place and helping us understand our society. Continue reading to learn how you experience K-State research every day.

# MONEY

Talking about money can be difficult, but financial planners help people discuss the all-too-uncomfortable topic to reach their personal goals.

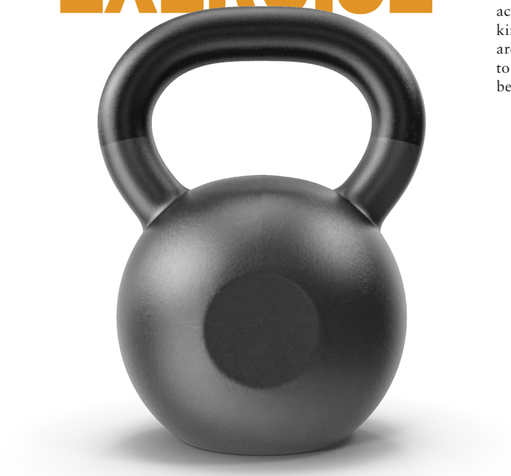
The personal financial planning program in the College of Health and Human Sciences specializes in financial therapy, which combines financial planning with marriage and family therapy and psychology. The program's research explores money's relational, behavioral, cognitive and emotional elements.

- Martin Seay, professor of personal financial planning and department head, examines how different personalities interpret financial events and the resulting decisions or actions. For financial planners, it is essential to understand how clients view a situation and make financial decisions.
- Megan McCoy, assistant professor of personal financial planning, has been part of a collaborative study examining financial anxiety, which is persistent, excessive worry about a financial situation. The study found that financial anxiety is prevalent in Americans lives, even when access to money is not an issue.

**Seek more**

Learn about K-State's free student-to-student financial well-being program.

# EXERCISE



Daily physical activity is key to improving mood and brain health, strengthening bones and muscles, reducing the risk of disease, managing weight and improving physical function.

The CDC recommends 150 minutes of moderate-intensity activity and two days of muscle-strengthening exercise weekly. Many kinesiology researchers in the College of Health and Human Sciences are evaluating how the body responds to physical activity and how best to promote physical activity so people of all ages can experience its benefits.

- Emily Mailey, associate professor of kinesiology, studies workplace interventions to increase physical activity and well-being. Her recent study using height-adjustable desks and an online behavioral support program reduced the number of hours participants sat daily and improved mood, fatigue, focus and productivity.
- Peter Stoepker, assistant professor of kinesiology, focuses on increasing physical activity in youth to prevent diabetes and other noncommunicable diseases. His current project assesses physical activity in before- and after-school programs to create a more active environment.
- Aspen Streetman, doctoral student in kinesiology, studies the relationship between promoting and improving access to strength training and women's empowerment. Early findings show a positive correlation between becoming physically stronger and physical, mental and social health.

**Seek more**

Explore more physical activity and public health research projects.



# WATER

Parts of the U.S. are currently experiencing drought, while other areas have seen abundant snow or rain, causing flooding and other challenges. The climate extremes affect water availability and can influence the ecology of bodies of water.

Trisha Moore, associate professor in the Carl and Melinda Helwig Department of Biological and Agricultural Engineering in the Carl R. Ice College of Engineering, examines the water quality of runoff, rivers and reservoirs. She studies the connection between water quality and urban flooding.

Moore, also a Peggy and Gary Edwards Cornerstone teaching scholar, works with municipalities to develop partnerships with upstream land managers to implement practices that improve water quality and availability throughout the watershed. These practices help retain soil, nutrients and moisture on the landscape where it is needed to produce our food while protecting our downstream waters from harmful algal blooms and sedimentation. That way, communities throughout the watershed have access to needed water.

**Seek more**

Read how K-State water research is helping Kansas farmers manage risk.

# FOOD SAFETY

Every year approximately 48 million people get sick from foodborne illnesses, according to the Centers for Disease Control and Prevention. Food safety scientists continue to develop best practices and ways to prevent these incidents and outbreaks.

Valentina Trinetta, associate professor of food safety and microbiology in the College of Agriculture, is studying how pathogens enter the food system to develop interventions that can reduce and control pathogens in raw and processed foods.

With funding from the U.S. Department of Agriculture and specialized commodity groups, Trinetta primarily studies microorganisms such as listeria, E. coli and salmonella. Her lab is working with the tree fruit industry to understand how common sanitizers control bacteria found on wood, nylon and plastic — the materials typically found in fruit-picking bins and harvesting bags.

**Seek more**

Read more about the food safety research projects.

# BAKED GOODS

The greatest thing since sliced bread is even better bread. And better bread comes from understanding the role of each ingredient.

Researchers in the College of Agriculture's grain science and industry department are exploring how to best use Kernza grain — a perennial wheatgrass and a cousin to wheat — in food production. This grain is low in gluten with good fermentation properties. The study includes grain handling, processing, pest control and market use.

Elisa Karkle, assistant professor of bakery science and management, is testing how to use the grain in foods. Her work is determining why the grain ferments so well and what advantage, such as greater volume or longer shelf life, this brings to bread or other baked goods.

**Seek more**

Learn how baking techniques affect the taste and smell of bread.

# CYBERCRIME

Spam calls, phishing emails and malware are common phrases these days. These cybercrimes result in the loss of money, fraud, harassment or sexual exploitation.

Criminologist Kevin Steinmetz, professor of sociology, anthropology and social work in the College of Arts and Sciences, studies the intersection of technology, crime and crime control. His work in online fraud has found that contemporary online fraudsters use the same techniques of pre-internet criminals: psychological and emotional triggers as well as deception strategies.

In his new book, "Against Cybercrime: Toward a Realist Criminology of Computer Crime," Steinmetz explores the need to implement broad, systemic changes and social policies to reduce criminal opportunities without creating a surveillance state.

**Seek more**

Read how K-State researchers are tackling cybersecurity.

# CONSUMER BEHAVIOR

Big or small, purple or gray, this or that — the average adult makes thousands of decisions every day. Social scientists across disciplines seek to understand how and why we make these choices.

Buying decisions are sometimes apparent, while others are made on a whim. Understanding a consumer's decision-making process is a research focus of Janis Crow, instructor of marketing in the College of Business Administration.

To better understand why fewer girls choose to enter the science workforce, Crow is examining the role that STEM toys play in career paths. While many factors influence a child's career choice, parents may have direct or indirect influence because of the types of toys they purchase. Crow also examines what influences a parent when buying a toy for a son or daughter.

Her evaluation has found common influences are cultural norms, marketing and packaging differences by demographic, and perceived entertainment value by the parent.

**Seek more**

Learn how K-State helps companies with product evaluation and analysis.

# ERGONOMICS

The comfort of a chair, the functionality of an electronic device or digital app and the feel of a tool in your hand are the results of industrial designers' meticulous attention to detail.

Byungsoo Kim, assistant professor of interior architecture & industrial design in the College of Architecture, Planning & Design, particularly is interested in ergonomics because of its role in enhancing product usability. Ergonomic design enhances the well-being of users by mitigating muscle fatigue, improving posture or increasing performance.

Kim is working with students in his Human Factors in Industrial Design class to evaluate the feasibility of personalizing everyday objects, such as tools or kitchen gadgets, to fit the user's hand size and enhance usability, functionality and satisfaction.

**Seek more**

Read about other projects involving the College of Architecture, Planning & Design.



# ENERGY

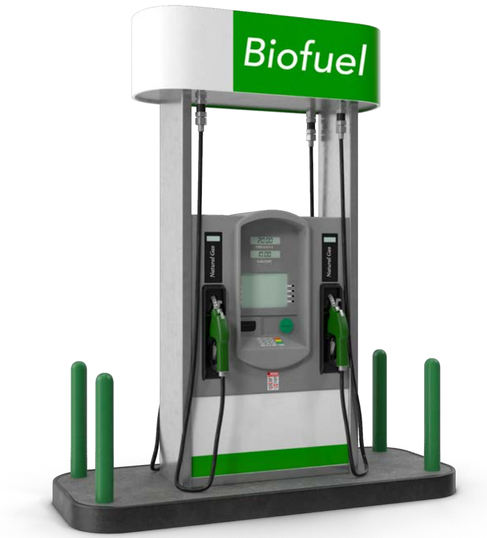
With the push of a button, flip of a switch or turn of a key, electricity powers our world. Electricity provides quality of life. Researching new ways of generating, storing and distributing energy will help with future needs.

Solar energy could become the cheapest resource for generating electricity, researchers say, but current distribution systems are not designed to handle electricity generated by consumers. Anil Pahwa, Logan-Fetterhoof chair and university distinguished professor of electrical and computer engineering, seeks ways to integrate large-scale adoption of solar energy into the distribution system.

With funding from the National Science Foundation and the U.S. Department of Energy, Pahwa is working on multiple projects to advance solar energy in rural Kansas and is studying how solar energy enhances the resiliency of rural communities under extreme climate events. His work in the Mike Wiegers Department of Electrical and Computer Engineering in the Carl R. Ice College of Engineering will provide pathways for a sustainable future, increased quality of life and new economic opportunities.

**Seek more**

Learn more about K-State research focused on the power grid.




# BIODIESEL

As you drive down the road, you may not think about your car's fuel source. Most fuels on the market are petroleum-based, with ethanol blends being one alternative fuel option. Biodiesel is another very common fuel used in almost every gallon of diesel fuel sold in Kansas.

K-State researchers, such as Edwin Brokesh, assistant professor in the Carl and Melinda Helwig Department of Biological and Agricultural Engineering in the Carl R. Ice College of Engineering, are exploring ways to best reduce dependence on fossil fuels, from modifying nonfood crop oilseeds to produce large amounts of oil to understanding the best practices for biodiesel use and distribution.

The K-State Biodiesel Initiative, a student-led organization that Brokesh advises, is reducing K-State's dependence on petroleum-based fuels by converting used cooking oil from the universtiy's Housing and Dining Services. From collecting the used cooking oil, cleaning it in preparation for the reaction process, running the transesterification reaction and delivering the finished fuel, students are involved in the entire production process. See page 40 to learn more about transesterification.

The biodiesel is blended with conventional diesel to fuel K-State Recycling Center utility carts and recycling trucks, while the glycerin is used as compost material or soap product.

In addition to the production, students learn how the biodiesel works in engines and help educate the public on its potential uses.

**Seek more**

Find out more about K-State biofuel research.

# Improving the framework

## Researchers build on infrastructure investment

*By Grant Guggisberg*

By its very nature, infrastructure is often overlooked. Most of the time, it is only when a system fails that infrastructure gets the attention it deserves. Bridge collapses, boil advisories and damaging severe storms serve as periodic reminders that life is much harder when the power is out or roads are closed.

But breakdowns aside, it doesn't take close examination of the way our society is built and functions to quickly realize how critical infrastructure is to a thriving civilization. It is a reality that many Kansas State University researchers know and understand.

It's a reality that has generated congressional attention, too. The Bipartisan Infrastructure Investment and Jobs Act passed in 2021 included nearly $550 billion to rebuild America's roads and bridges while delivering clean water and building robust broadband networks in communities that previously lacked access. The Inflation Reduction Act of 2022 provided another $500 billion to boost the green energy sector and reduce the nation's carbon footprint.

Combined, the two laws represent a level of investment in the nation's infrastructure not seen since since the Federal-Aid Highway Act of 1956, which created the country's interstate highway system.

But this newest funding isn't just for use on bridges and roads. Some of the money is allocated toward research that could change the way we build things, the way we travel and even the way we make decisions. That's where the Carl R. Ice College of Engineering at K-State is ready to step in.

## The challenge of Kansas infrastructure

Anyone who has driven on Interstate 70 from Wyandotte County all the way to Sherman County knows that Kansas is not a small state. With more than 81,000 square miles for a population of fewer than 3 million people, Kansas ranks as the 13th largest state by area in the U.S., but has the fourth highest number of miles of road behind the much more populous states of Texas, California and Illinois. The state also ranks among the top five in number of bridges, many of which are in desperate need of repair, researchers say.

> One of the things that's unique about what we do is it's very applied research. It's about delivering fast, deployable results for Kansas — many times without the traveling public even knowing.
>
> - ERIC FITZSIMMONS

"It goes back to the U.S. Public Land Surveying System — a grid system," said Eric Fitzsimmons, George Yeh — Carl and Mary Ice Keystone research scholar and Hal and Mary Siegele professor in engineering. "Kansas land is still made up of squares, so almost every mile of land has a road surrounding it, whether it's dirt, gravel or paved. So, Kansas has more than 140,000 miles of roadways, 126,000 of which are in rural areas, which ranks No. 2 in the country.

"The challenge is that you have a significant amount of infrastructure and a limited tax base for funding the repairs through state funds."

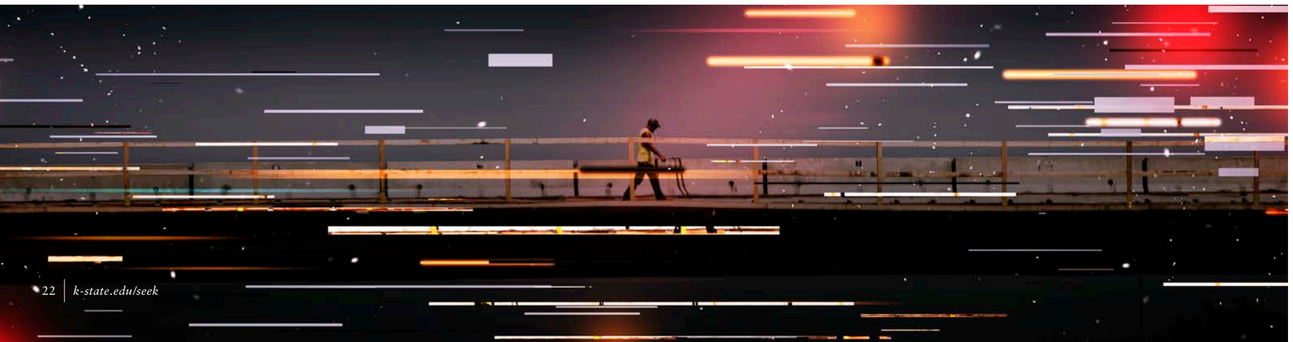
*Eric Fitzsimmons, associate professor of civil engineering, is working on a variety of projects to improve motor vehicle safety on Midwest roadways.*

Fitzsimmons and his colleagues in the civil engineering department are addressing this challenge by finding better ways to build bridges and roads, from improved design to more economical materials, all on actionable timelines.

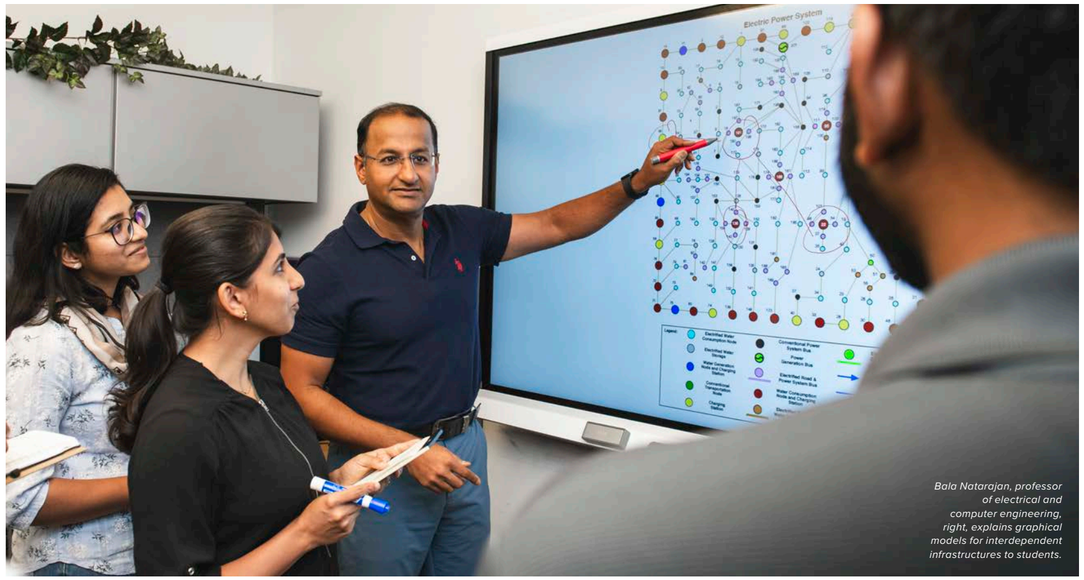
"One of the things that's unique about what we do is it's very applied research," Fitzsimmons said. "It's about delivering fast, deployable results for Kansas — many times without the traveling public even knowing."

Fitzsimmons also focuses on highway vehicle safety. He's working with Doina Caragea, Don and Linda Glaser Keystone research scholar and professor of computer science, on a project that uses machine learning to determine the underlying factors that affect the likelihood of commercial motor vehicle crashes in Kansas.

"If you can predict commercial motor vehicle crashes, you can direct the Kansas Highway Patrol on where to enforce and allocate resources," Fitzsimmons said. "Using advanced tools and the vast amounts of data collected by multiple agencies in Kansas, we are hoping to save the time and resources of police officers."








*Bala Natarajan, professor of electrical and computer engineering, right, explains graphical models for interdependent infrastructures to students.*

Additionally, Fitzsimmons and his colleagues at the K-State Olathe campus received funding from the U.S. Department of Transportation's Federal Motor Carrier Safety Administration to host the second Midwest Commercial Vehicle Safety Summit in Kansas City, Missouri, in November 2023. The summit brings together a diverse group of transportation stakeholders, the federal government and academic researchers who all share the same interest of seeing increased safety and fewer crashes involving large trucks and buses on Midwest roadways.

## Infrastructure resilience

For Bala Natarajan, the challenges of the COVID-19 pandemic also provided an opportunity.

Natarajan, the Clair N. Palmer and Sara M. Palmer professor of electrical engineering, had an idea for a research project focused on infrastructure resilience that also considered the human element of these decisions.

But he needed a team. So, stuck at home like everyone else, he picked up the phone and began cold calling academics across the state, asking for 20 minutes of their time and pitching his idea to anyone who would listen.

"When I started thinking about resilience from this holistic standpoint, I didn't know anyone working on this," said Natarajan, also a Steve Hsu Keystone research scholar in the Mike Wiegers Department of Electrical and Computer Engineering.

His strategy led to a project titled "Adaptive and Resilient Infrastructures driven by Social Equity," or ARISE. The project is funded through a National Science Foundation Established Program to Stimulate Competitive Research, or EPSCoR, RII Track-1 grant. The final $24 million award involves 17 institutions, including the University of Kansas, Wichita State University and many other four-year and community colleges throughout the state.

Seven K-State researchers are collaborating on the project, including Natarajan; George Amariucai and Lior Shamir, both from computer science; Husain Aziz, civil engineering; Anil Pahwa, electrical and computer engineering; Vaishali Sharda, biological and agricultural engineering, and Jason Bergtold, agricultural economics.

> This is unprecedented. We are not going to see again, in our lifetimes, an investment like this from the federal government on infrastructure.
>
> - BALA NATARAJAN

*Chuancheng Duan, assistant professor of chemical engineering, studies a tubular protonic ceramic electrochemical cell, which could be used for power generation, mitigating emissions and hydrogen production.*

The project centers on advancing the resilience of various forms of infrastructure across Kansas by creating tools that support the most vulnerable, while also helping communities use these tools to make informed decisions on investment and management of infrastructure in the future.

Natarajan said the group was focused on social equity because the most socially vulnerable people often live and work in the most physically vulnerable locations that typically receive less attention from an infrastructure perspective.

The researchers are already a year into developing various models and simulations to help solve these problems and have worked with several communities to help guide their decision-making, with more expected in the coming months and years.

The researchers are working with partner communities that are diverse and face different challenges related to disaster resilience. The partner communities include Ford, Finney and Seward counties in southwest Kansas and Wyandotte and Johnson counties in the east.

In this way, the timing of the federal government's generational investment into infrastructure couldn't have been better.

"This is unprecedented," Natarajan said. "We are not going to see again, in our lifetimes, an investment like this from the federal government on infrastructure. The question is how do we help our communities get some of it?"

While the ARISE program isn't contributing capital to fund building projects or repairs, it is partnering with local governments and leaders to capitalize on funding opportunities from the two congressional bills.

"I realized that we, as universities, can partner with these communities and help them write grants and proposals to actually implement the ideas that we are developing through the project," Natarajan said.

The team's size and diversity are some of its strengths. Experts across disciplines — from behavioral science to water quality to transportation — work together and combine resources, resulting in models that help both rural and urban communities across Kansas thrive. Since the data is from real communities, the group is creating a synthetic city that combines all of the team's research, which creates accurate and realistic models and allows the results to be published in academic journals and other outlets.

"Since this is actual critical infrastructure, we can't reveal much of the community data publicly," Natarajan said. "But we want to do fundamental research that can be published. The synthetic city is something we're still in the process of building. That portion has been a pretty interesting experience on its own."

## Reducing emissions, powering the future

Chuancheng Duan, assistant professor in the Tim Taylor Department of Chemical Engineering, has been busy since his arrival at K-State in 2020.

> "This kind of technology will be very important for the future. That's why the Department of Energy is investing almost $8 billion into hydrogen technology."
>
> - CHUANCHENG DUAN

Duan's Materials Research Laboratory for Sustainable Energy aims to create materials and devices that convert and store energy with the goal of addressing critical energy and environmental issues. He has been awarded more than $5 million in research funding from a variety of organizations and industry partners, including the U.S. Department of Defense and NASA. In the last year alone, he's secured more than $1.7 million in funding from the U.S. Department of Energy for his work. Duan studies a variety of devices that increase efficiency or create new high-value chemicals as part of emissions reduction in large industrial engines, such as those used in power plants.

Think of a catalytic converter in a vehicle, but on a much larger scale. The engine exhaust material is fed through the converter, which reacts with the catalysts inside and results in a less-damaging fume that is then released into the air through the exhaust pipe.

Duan is designing devices that operate similarly but on large-scale industrial combustors fueled by natural gas. One project focuses on cutting waste related to stranded natural gas, which is fuel that has been discovered but is economically unusable because of the expense of additional pipelines or other forms of transport. This fuel is often burned because of a lack of better options. Duan's device would take that exhaust and create electricity from the burning of the natural gas, and also create liquid fuel that is far simpler and more efficient to transport and use.

"We use the natural gas, we don't release carbon dioxide and we produce high-value chemicals all at once," Duan said.

Similarly, Duan's largest project focuses on creating a device that functions like a catalytic converter and can be attached to existing natural gas-powered engines. The goal is to increase efficiency and reduce the amount of methane released into the atmosphere by converting the exhaust into hydrogen and carbon dioxide. The carbon dioxide is a less potent greenhouse gas for environmental purposes, while the hydrogen created is a valuable commodity.

"This kind of technology will be very important for the future," Duan said. "That's why the Department of Energy is investing almost $8 billion into hydrogen technology, and I think in the next five to 10 years, there will be significant change to the hydrogen economy in the U.S."

Duan's lab also is researching the development of fuel cells that could replace battery technology in a variety of devices, from electric vehicles to whole-home generators to a mobile power source used by soldiers on long field missions.

One of his projects, partially funded by the U.S. Army Research Laboratory, looks at the mobile power source issue.

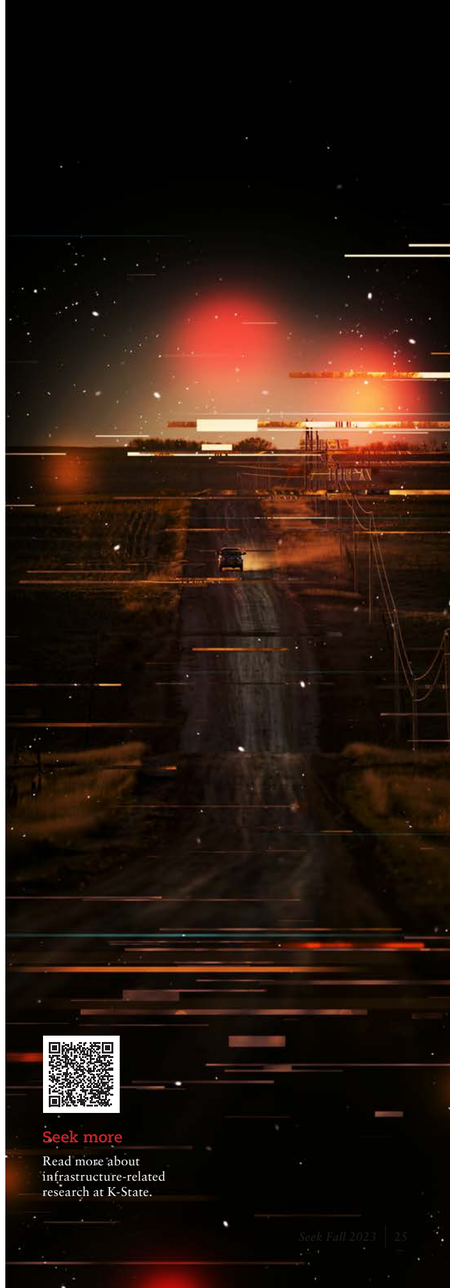
"A big battery also works, but it's extremely heavy," Duan said. "Gasoline-powered generators create too much noise, but the fuel cells we're developing are quiet and can create power from electrochemical reactions and can be powered from a variety of fuel sources, like a small propane tank you'd use for a barbecue. It can provide reliable, efficient electricity for the military."

But Duan also is interested in the development of vehicle fuel cell technology. Vehicles fueled by hydrogen are already on the road in a limited capacity in California, but the lack of a network of fueling stations makes these vehicles impractical for widespread adoption nationwide. Duan has several projects funded by Nissan Motor Co. Ltd. and Nissan North America Inc. to bring his fuel cell technology into production for potential use in its fleet.

"The materials that are catalyzing inside of the fuel cell are compatible with many kinds of fuel," he said. "It can use ethanol, natural gas, propane or even gasoline. You can go to the same gas station as always to fuel, but using a fuel cell powered vehicle, you're going to see significantly increased efficiency, something like 50 miles per gallon instead of 20."

So, will the electrical charging network infrastructure being developed for electric vehicles be made obsolete by fuel cell powered vehicles that use hydrogen or other types of renewable fuels in the future? Duan says no.

"All you need to create hydrogen is water and electricity," he said. "The infrastructure being built for current electric vehicles can also be used to produce hydrogen in the reversed mode of a fuel cell, which is the electrolysis cell." k



**Seek more**

Read more about infrastructure-related research at K-State.

Food and agriculture systems innovation

# TRANSFORMATION ACROSS THE GLOBE

## How K-State research feeds the world

*By Jarrett Whitson*

For 160 years, Kansas State University has been feeding the world. As the nation's first operational land-grant university, K-State continues to improve lives with global food systems research and service. Learn more about K-State people and projects that go beyond the boundaries of academic disciplines and the borders of countries.

> "We think that in three years there could be more than 1 million acres in India planted with varieties that have been selected by and passed through this collaborative work."
>
> - JARED CRAIN

*Jared Crain is improving lives in Southeast Asia through wheat genomics research.*

## Worldwide crops

Several K-State laboratories are focused on improving and protecting important worldwide crops, including millet, wheat, rice and maize.

Tim Dalton, director of K-State's Global Collaboration on Sorghum and Millet, or GCSM, studies how to increase food system productivity and add value to sorghum and millet products.

One collaborative innovation with scientists in Niger involves the pearl millet seed ball. This innovation can increase yields in the Sahel region of Africa, which includes harsh farming conditions such as poor soils, excessive heat and low and erratic rainfall. Seed balls are made of easily accessible products — soil, wood ash, seeds and some nutrients or pesticides — and are a low-cost, low-risk technology with potential for improved yields and farm profits.

*Tim Dalton leads the Global Collaboration on Sorghum and Millet, which works to improve and protect crops.*

"Across multiple years and thousands of farmers in Niger, we've seen yields between 20 to 30% and even higher in bad years," said Dalton, also a professor of agricultural economics in the College of Agriculture. "Profitability has increased at a similar magnitude. This innovation creates more food and more income because of higher yields."

Dalton has continued this important international work through GCSM, which was announced in June 2023. One of the collaboration's first efforts is developing the national sorghum plan in Madagascar, where researchers say climate change is negatively affecting the production of two of the country's most important crops: rice and maize.

But K-State scientists also are researching a worldwide crop closer to home.

Jared Crain, research assistant professor of plant pathology, is studying wheat genomics. He was director of the Feed the Future Innovation Lab for Applied Wheat Genomics from May 2022 until its completion in August 2023, but has been involved with the lab since it began at K-State in 2013.

Crain partners with the International Maize and Wheat Improvement Center, which is based in Mexico but performs work across the world, including work in India and other Southeast Asian countries. The center extracts DNA from approximately 19,000 plants per year and ships them to K-State. Crain and his team process and sequence the DNA, then analyze it for elite traits, such as yield and resistance to heat, drought and disease, as well as desirable qualities for products that millers, bakers and consumers use.

"Based on how the varieties being released are scaling up, we think that in three years there could be more than 1 million acres in India planted with varieties that have been selected by and passed through this collaborative work," Crain said.

The wheat grown in Kansas is important worldwide, too. According to Allan Fritz, one of K-State's wheat breeders and professor of agronomy, approximately 75% of wheat harvested in Kansas can be traced to K-State varieties. Until recent economic disruptions, such as the Russia-Ukraine war, Fritz estimated that Kansas exported approximately 50% of its wheat outside of the U.S. — proof that K-State work in the breadbasket of America also plays an important role in global wheat production.

*Vara Prasad examines corn, which is an important crop in the U.S. and around the world.*

*Allan Fritz and other K-State researchers study global wheat production.*

> "At the end of the day what we do must impact people — it's about lives and the livelihoods of people."
>
> - VARA PRASAD

## Increasing food production

Across the world, K-State researchers are changing lives through agricultural innovation.

Vara Prasad directs the Feed the Future Innovation Lab for Collaborative Research on Sustainable Intensification, or SIIL, at K-State. He recently was named to Clarivate World's Influential Researchers 2022 list, which recognizes the world's top 1% of highly cited researchers.

Under Prasad's leadership, SIIL has four consortiums, four centers of excellence and many research projects in 13 different countries. The lab's goal is to increase food production from existing farmland without damaging the environment. This involves crop management, agronomy and genetics, which includes developing new varieties, as well as socioeconomic intensification, which includes human and institutional capacity, environmental policy and product markets.

One of SIIL's focus countries is Bangladesh, where researchers are identifying new crops — sunflowers, sesame or legumes such as mung beans — to grow between rice crops. One issue is a shortage of labor and the increased price of labor, which creates a need for mechanization.

"If we are able to achieve more efficient planting and harvesting methods, that will save farmers time and allow for another short-duration crop to be planted and harvested in the 60 to

90 days between rice crops," said Prasad, also a university distinguished professor of agronomy and the R.O. Kruse professor in the College of Agriculture.

Prasad is proud that SIIL has trained around 230 students and many now work at universities, research centers and in industry worldwide.

"At the end of the day what we do must impact people — it's about lives and the livelihoods of people," Prasad said.

> We want people to have food, but it must be safe. We can produce food all day long but if it's not safe, people can get sick from it and might not be able to sell it.
>
> - LONDA NWADIKE

## Importance of safe food

Londa Nwadike has a lengthy career conducting food safety research, including work in developing countries through the United Nations Food and Agriculture Organization as well as project collaboration on food safety in markets in Cambodia and Bangladesh.

In her role as extension associate professor of food safety for K-State and the University of Missouri, Nwadike is working with refugees from across the world who are living in the Kansas City area. She is helping them understand food safety requirements as they participate as both growers and consumers in local farmers markets.

Through her research and K-State Research and Extension work, Nwadike is a strong advocate for the importance of food safety to the global system.

"We want people to have food, but it must be safe," said Nwadike, who works at the K-State Olathe campus. "We can produce food all day long but if it's not safe, people can get sick from it and might not be able to sell it. Neither having no food nor having foodborne illness are good situations."


*Londa Nwadike works with K-State Research and Extension to improve food safety awareness and practices.*

## Challenges with conservation

An important piece of the global food system is conservation, biodiversity, land use and land cover change — all areas that interest Marcellus Caldas, professor of geography and geospatial sciences in the College of Arts and Sciences.

Caldas has been involved in multiple projects in his home country of Brazil, including recently published research in the journal Science with colleagues from Brazil and Spain.

The research looked at how conservation policies in Brazil, such as the Forest Code and Native Vegetation Protection Law, have positively affected areas like the Brazilian Cerrado. The area is a tropical savanna southeast of the Amazon rainforest that is rich in biodiversity, but a significant portion of the land has been converted to use for crop production and cattle ranching. The researchers found that private protected areas accommodate up to 14.5% of threatened vertebrate species ranges, which increases to 25% when considering the distribution of remaining native habitat.

*Marcellus Caldas studies land use and cover change to understand the importance of conservation to the overall global food system.*

While the laws seem to be helping biodiversity, Caldas said farmers don't receive any compensation for doing this, which has led to pressures to change the law. He said offering incentives to farmers could be a solution, and gave the example of the U.S. Department of Agriculture Conservation Reserve Program, which offers a yearly rental payment to farmers for removing environmentally sensitive land from agricultural production.

"In a place that is considered a breadbasket such as the Cerrado, farmers are going to want to put more land in production," said Caldas, also the assistant provost for international faculty collaboration and educational programs in the Office of International Programs at K-State. "If you want to convince the farmers to set aside their land then you must create incentives for them to do so."

## Making acceptable food makes a difference

We've all begrudgingly eaten or tried food that we're not sure about — maybe we eat vegetables to be healthier or perhaps we try a new dish outside of our comfort zone.

Edgar Chambers IV, university distinguished professor of food, nutrition, dietetics and health in the College of Health and Human Sciences, wants to make food more acceptable to consumers across the world.

"Sensory analysis and consumer behavior are important because people don't eat or use products they don't like," said Chambers, who also directs the K-State Sensory Analysis Center. "In one study, we literally saw children spit out food and refuse to eat more because it didn't taste good. Parents refused to take more of it even when it was offered for free."

In another study, Chambers examined how different cultures accepted insect-based foods. The results showed that people in Mexico and Thailand were more willing to accept them than people in the U.S., Japan, Spain and Australia. In another similar study, he found that adding 10-20% of insect powder into chocolate chip cookies was liked as well as a regular cookie in the U.S. and Spain, and it was preferred in Mexico when the insect powder's presence was unknown.

"This told us that it was not a matter of bad flavor, texture or appearance, but rather of perception of eating a product containing insects," Chambers said.

Another project in Tanzania has aimed to develop a sorghum-based porridge to be used in feeding programs for young children, many of whom are malnourished. The researchers have stories of young children who are now living healthy lives and of families who have been reunited through the program.

"The results of the project were good in terms of creating an appropriate, good-tasting food from sorghum, but the human impact was much greater than that," Chambers said.

> If you want to convince the farmers to set aside their land then you must create incentives for them to do so.
>
> - MARCELLUS CALDAS

### Seek more

View additional resources and websites that detail K-State's work across the globe.

# A statewide movement

## K-State 105 connects research and innovation to Kansas communities

*By Jennifer Tidball*

> Through K-State 105, we are fulfilling our land-grant promise of economic prosperity for all Kansans.
>
> - JESSICA GNAD

The work of K-State 105 is best told through stories that you can find across the state.

Consider the stories of new early childhood care and education centers in Leoti in Wichita County or Hillsboro in Marion County. In both communities, K-State Research and Extension agents have worked with Kansas State University researchers in the College of Health and Human Sciences to improve child care access.

Or look at Ogden in Riley County or St. John in Stafford County, where Net Positive Studio researchers in the College of Architecture, Planning & Design are working on affordable and sustainable housing.

Then there are stories of important economic development work, such as a K-State partnership with Fort Hays State University, NetWork Kansas and the Innovation Center to expand the Kansas Small Business Development Center in northwest Kansas.

Those are just three examples. The stories of K-State 105 spread across all 105 counties of Kansas, touching each corner and each region of the Sunflower State.

As the nation's first operational land-grant university, K-State has always been in every Kansas county. But as a next-generation land-grant university, K-State is embracing innovative ways to serve and connect with Kansans.

That's called K-State 105.

"Through K-State 105, we are fulfilling our land-grant promise of economic prosperity for all Kansans," said Jessica Gnad, K-State 105 director. "We're bringing people and partners together across the state because we are the university for Kansans."

While K-State 105 is a pillar of the university's Economic Prosperity Plan, it is also a key piece of the Next-Gen K-State strategic plan. K-State 105 leverages academic research and resources from all of the university's colleges and campuses in partnership with corporations and small businesses to deliver economic prosperity in all 105 counties, delivering solutions direct to Kansans through the statewide K-State Research and Extension network.

It's a mission that the Kansas Legislature has supported, too, when it provided $10 million in state funding for the K-State 105 initiative in fiscal years 2024 and 2025. The university is using that funding to collaborate with statewide partners, regional partners and project partners to address child care, affordable housing, health care and other elements that affect prosperity in Kansas.

"The challenges facing communities and businesses are complex," said Tim Steffensmeier, K-State assistant vice president and director of engagement and outreach. "For instance, early childhood education, affordable quality housing and rural health care require the expertise, resources and creativity of our Kansas higher education colleagues and nonprofit and industry partners. Weaving together a network of resources and services is our best path forward."

## A sample of stories

The many stories of K-State 105 expand across academic disciplines and regions of the state. Learn more about some of the projects in different focus areas.

## Affordable and sustainable housing

"I truly believe that affordable housing is the problem of our generation," says Michael Gibson, associate professor of architecture. "Today's housing crisis is affecting the livelihoods of everyday, middle class, working families."

Gibson is the creator and leader of the Net Positive Studio, which is a research-based studio for students in the Master of Architecture program in the College of Architecture, Planning & Design. Students design affordable and net-zero energy homes that offset energy use through renewable energy generation.

The Net Positive Studio has collaborated with local community organizations to build affordable housing success across Kansas.

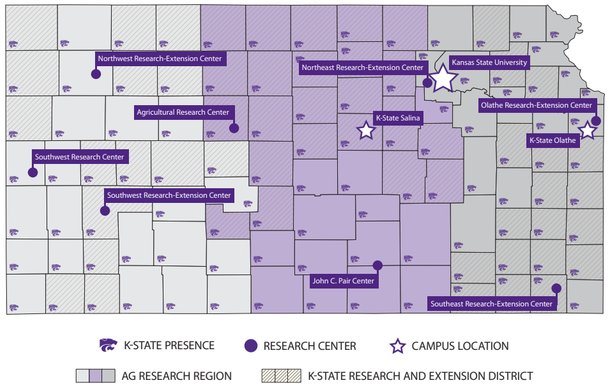
- Students designed and built a home in St. John, completed in 2021, and Stafford County Economic Development secured financing to build at least 10 additional homes based on the student-designed prototype.

***Above right:*** *Students in the Net Positive Studio have worked on affordable and net-zero energy homes throughout the state.*

***Below:*** *K-State 105 is elevating the statewide K-State Research and Extension network and making resources accessible to every Kansan.*

- In Ogden in Riley County, the Net Positive Studio has twice partnered with Manhattan Area Habitat for Humanity as part of the Workforce Solar Housing Partnership, a group that includes Flint Hills Job Corps, Fort Riley's Home Builders Institute, Manhattan Area Technical College and Flint Hills Renewable Energy and Efficiency Cooperative. The K-State students have designed and prefabricated net-zero homes and the partners have completed the homes on-site.
- In 2021, the students designed a net-zero prototype home for SENT, a Topeka nonprofit community organization that subsequently secured financing to build four iterations of the home.
- The Net Positive Studio worked with Friends of Johnson County Developmental Supports to create a net-zero home design for a Merriam neighborhood. The work helped the organization raise enough money to start building the home in fall 2023.

Gibson estimates that more than $3 million in grants and financing has been raised to build the projects in the last five years.




## Child care collaborations

Bradford Wiles has a challenge: Go find a Kansas community where access to quality, affordable early childhood care and education is not an issue.

Wiles, associate professor and extension specialist in early childhood development in the College of Health and Human Sciences, sees a possible solution: Partner university researchers with K-State Research and Extension.

Wiles has worked with K-State Research and Extension agents on community needs assessments so that agents and community leaders can pursue federal, state and philanthropic support to help existing child care providers or build new early childhood care and education centers.

Success stories throughout Kansas prove that this approach works, such as Leoti's Grow and Learn Childcare Center Inc. in Wichita County and the Hillsboro Community Child Care Center in Marion County. Other successful collaborative child care projects have happened in Kinsley and Lewis in Edwards County and Onaga in Pottawatomie County.

But Wiles is clear: He doesn't do the work alone.

"It is the agents who advance this work on the ground in their communities," Wiles said. "At the end of the day, applied research is supposed to make a difference in people's lives. A land-grant university is supposed to make a difference in people's lives. I daresay we're doing it."

## Technology for economic development

For more than 30 years, the K-State Technology Development Institute, or TDI, in the Carl R. Ice College of Engineering has supported economic development in Kansas.

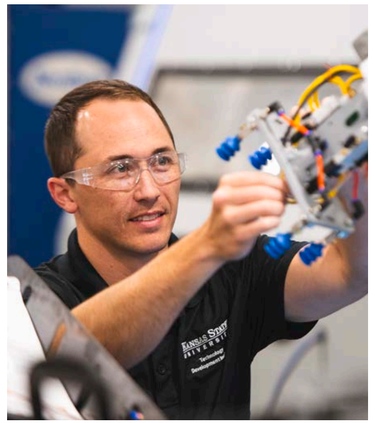
TDI, a U.S. Department of Commerce Economic Development Administration University Center, helps businesses, entrepreneurs and researchers with product design and development, machining and prototyping as well as business and intellectual support services.

"We believe that you should be able to be globally competitive wherever you choose to live in Kansas," said Jeff Tucker, TDI executive director. "Our K-State land-grant commitment to equal access and to helping people where they are — in their physical location and in their journey — is really important. That's in our DNA."

Some of TDI's recent success stories highlight entrepreneurship and research collaborations.

- A TDI partnership with GO Topeka helped a local inventor create the Pars A Par surfacing tool, which removes the scuffs and other damage from golf balls.
- TDI worked with Lawrence-based Leander LLC, which produces chiropractic tables, to redesign parts to improve manufacturability, increase quality and reduce costs.
- TDI also collaborated with the University of Missouri to create a water disinfection demonstration trailer for farmers in Kansas and Missouri.

"Everything that K-State 105 embodies is what we do here," said Bret Lanz, TDI commercialization director. "From a technology development standpoint to grow the economic balance within the state, I think it's a great opportunity to try and make those connections."



***Below left:*** *Child care provider Cheisa Myles helps children learn the alphabet.*

***Below right:*** *Jacob Picolet, TDI senior engineer, provides automation support to help companies meet demand while coping with labor shortages.*

## Building partnerships

The ambitious work of K-State 105 requires a network of statewide and regional partners to advance the economic prosperity of Kansas. These partners include other higher education institutions, state agencies, nonprofits and businesses.

"Few know the needs of the people of Kansas and their communities better than our extension agents," said Gregg Hadley, director for extension with K-State Research and Extension. "With offices in each county, they live in the same communities as the people they serve. Because of this, they are able to assist business owners, local coalitions and community leaders in finding the needed expertise to allow their communities and local economies to flourish."

Statewide partner NetWork Kansas is collaborating with K-State to advance community vitality, increase small business startups, expand existing businesses and increase direct investment in Kansas counties. NetWork Kansas has a network of 71 entrepreneurial communities across the state.

Regional partners, called Learn Together community partnerships, are working with K-State to address urban and rural challenges across the state. These partners include the Innovation Center, which provides economic and entrepreneurial assistance to businesses in 26 northwest Kansas counties, as well as GO Topeka, which is creating economic success in Shawnee County.

An early example of K-State 105 partnership success is expanding the Kansas Small Business Development Center, which operates as a network of eight regional economic development and business consulting centers that serve all 105 counties in the state. The partnership involves K-State, Fort Hays State University, NetWork Kansas and the Innovation Center.

"Simply put, K-State 105 is driving connections — connections to university research and to partners in economic development across the state. Together, we are poised to make a difference for Kansans," said Jessica Gnad, K-State 105 director.

**Seek more**

Read more K-State 105 stories.


***Above:*** *These photos show an aerial view of the Scoular processing facility near Goodland, Kansas. (Photo credit: Scoular)*

# Homegrown renewable fuel

## Scoular partnership creates opportunities for farmers

*By Dalsy Cupp*

It's nothing new to consider the state of Kansas a leader in grain production. Now through a new partnership, Kansas State University and Scoular are using grains for more than food production — they are expanding renewable fuel markets.

Scoular, an employee-owned agribusiness that buys, sells, stores, handles and processes grain and ingredients by leveraging global networks and expertise in international trade and transportation, is recommissioning a grain processing facility near Goodland. The company will renovate the facility to crush canola and soybeans to create fuel and produce animal feed.

Michael Stamm, a K-State agronomist who has extensive canola breeding expertise, has worked closely with Scoular, university colleagues and the region's farmers to evaluate the opportunities that the canola and soybean market can offer farmers. The facility will bolster economic prosperity in the state by adding 40 new jobs in the Goodland area and providing access to the renewable fuels market. Farmers will be able to participate in the biofuel industry in Kansas.

"I am proud to have been a part of the research that has supported the modification of this plant and am excited to see the opportunities and growth that a crush facility will make in the expanding renewable fuels industry," said Stamm, who researches in the College of Agriculture.

Scoular provides reliable solutions to farmers, grain processors, renewable energy producers and manufacturers of animal feed, aquafeed and pet food as well as food, beverages and supplements.

"Farmers and rural communities benefit when companies like Scoular and Kansas State University, with its land-grant mission, come together and think big," said Ed Prosser, Scoular's senior vice president of emerging businesses. "It's natural for Scoular to reach out to K-State for help when we bring new opportunities to the region's ag producers."

> "The Scoular facility is an example of how K-State can drive economic prosperity in all 105 counties in Kansas
>
> - DAVID ROSOWSKY

The efforts of Scoular and Stamm align with the goals of K-State and the university's Economic Prosperity Plan, particularly the K-State 105 initiative, which is K-State's answer to the call for a comprehensive economic growth and advancement solution for Kansas. See page 32 to read more about K-State 105.

"The Scoular facility is an example of how K-State can benefit the surrounding community and drive economic prosperity in all 105 counties in Kansas," said David Rosowsky, K-State vice president for research. k

**Seek more**

Learn more about the K-State 105 initiative and K-State's plans to bring even more economic solutions to Kansas.





# Engineering epidemiology

## Researcher models infectious diseases to understand their spread

*By Lindley Lund*

Imagine this research portfolio: $15.5 million in research funding, 114 journal publications and 49 invited talks.

Those impressive numbers have led Caterina Scoglio, Paslay professor in electrical and computer engineering and Steve Hsu Keystone research scholar in the Carl R. Ice College of Engineering, to become the first woman recognized as a Kansas State University distinguished professor in engineering.

"It was the universal laws behind physics, concerning in particular electricity and electronics, that made me want to originally study electronics engineering," said Scoglio, who researches in the Mike Wiegers Department of Electrical and Computer Engineering. "I thought that this degree would give me more opportunities to find an interesting position both in research, as that was my dream, but also in the industry."

Scoglio grew to become an industry pioneer who has opened the door for the next generation of women engineers while simultaneously becoming a research leader. She challenges electrical and computer engineering paradigms by combining them with a multitude of disciplines to solve diverse problems through network-based theoretical approaches.

The topic she most heavily researches is the spread of infectious diseases.

"I found at K-State a very relevant environment for this type of research," Scoglio said. "The study and the development of mitigation strategies against these diseases is a central theme."

Working with her research team, Scoglio has developed the now widely used Generalized Epidemic Model Framework, which is a software tool that simulates the disease spreading process. This tool allowed her team to forecast accurately the spread of 2019 Ebola cases in Uganda and COVID-19 in Wuhan City, China.

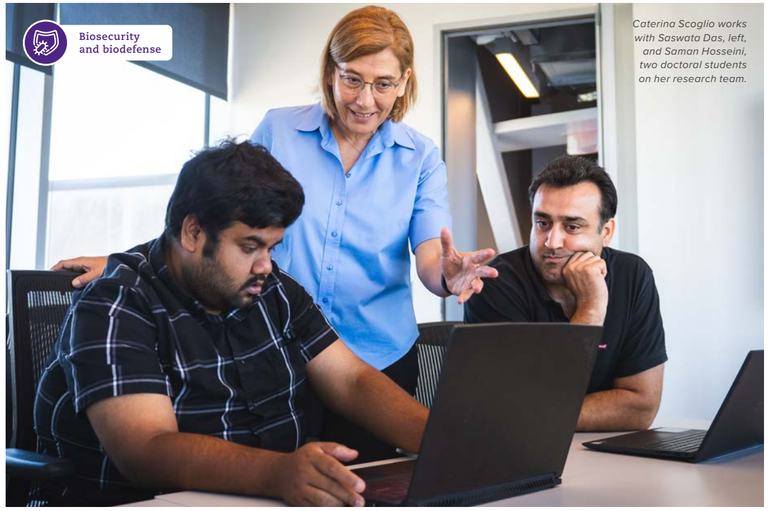
Scoglio's current research focuses on creating network-based approaches for vector-borne infectious diseases, which are transferred by infected insects, such as mosquitoes.

"These systems are more complicated. They have a lot of dependencies with climate, temperature, rainfall and vector abundance," Scoglio said. "Our goal now is to try to develop models for vector-borne diseases that can be as accurate as those for airborne transmitted diseases."

Despite Scoglio receiving national and international attention for her groundbreaking research, her true passion has been mentoring more than 40 doctoral and master's students.

"It's one of the most important and rewarding parts of my work," Scoglio said. "For all my work and publications, I must give much of the credit to them. I have had very good students and every one contributed in different ways." k

*Caterina Scoglio solves diverse problems through network-based theoretical approaches.*




*Caterina Scoglio works with Saswata Das, left, and Saman Hosseini, two doctoral students on her research team.*

# A scholar-practitioner

## Graduate student studies leadership to make change

*By Taylor Provine*

Graduate student Chibuzor Mirian Azubuike already has an impressive list of life accomplishments.

She's a public speaker and the author of two books: the bestselling "The Girl Who Found Water" and the children's book "My Birthmark, My Gift." She also has created a clean water nonprofit, the Haske Water Aid and Empowerment Foundation, and empowers others to seek scholarly and personal development opportunities.

But she's not stopping there.

Azubuike, from Nigeria, is pursuing her doctorate in the leadership communication program in Kansas State University's Staley School of Leadership. She is researching her passions of women's issues and leadership and is applying her life's philosophy to her work.

"I describe myself as a scholar-practitioner," Azubuike said. "A scholar-practitioner is one to me who not only does research but also implements the solutions in real-life situations. A scholar-practitioner is a change-maker who is actively involved in social change."

For her doctoral dissertation, she is studying the resilience of Indigenous women.

"Women have been studied a lot from a place of disposition and powerlessness, but I think women have been practicing leadership in many ways and there is a lot to learn from those daily practices of leadership," Azubuike said. "I'm looking at resilience and how women have been resilient over the years."

Azubuike conducted a pilot study that included interviews and a literature review of previous scholarly work on the resilience of Indigenous women. "The pilot study has shown the potentials of studying Indigenous women and people can learn a lot from that as pertaining to how to lead in difficult situations," she said. "The findings from this research will also be useful in creating a leadership model and programs for women."

Chibuzor Mirian Azubuike is researching her passions of women's issues and leadership.

> "Women have been studied a lot from a place of disposition and powerlessness, but I think women have been practicing leadership in many ways and there is a lot to learn from those daily practices of leadership. I'm looking at resilience and how women have been resilient over the years."
>
> - CHIBUZOR MIRIAN AZUBUIKE

A committed change-maker, Azubuike is the founder of the Haske Water Aid and Empowerment Foundation, which has provided clean water for more than 60,000 Nigerians.

For her commitment to women's issues, Azubuike was awarded the International Doctoral Degree Fellowship from the American Association of University Women. She also has received several awards and fellowships, including the Outstanding Researcher Award from the Staley School of Leadership, a Mandela Washington Fellowship, a Next Generation of African Scholars Fellowship from the Social Science Research Council, a Harry Frank Guggenheim Young African Scholar Award and many other awards.

Azubuike and her adviser, Andy Wefald, associate professor of leadership, recently received a mini-grant from the Association of Leadership Educators to facilitate a workshop for 30 women change-makers. The workshop was available in a hybrid format with an in-person option in Onitsha, Nigeria. The participants described the learning experience as new and transformational. k





# Preparing for outer space

## Student explores combined effects of gravity and cosmic radiation

*By Malorie Sougéy*

Matthew Culbertson is researching the effects of space from a lab on Earth.

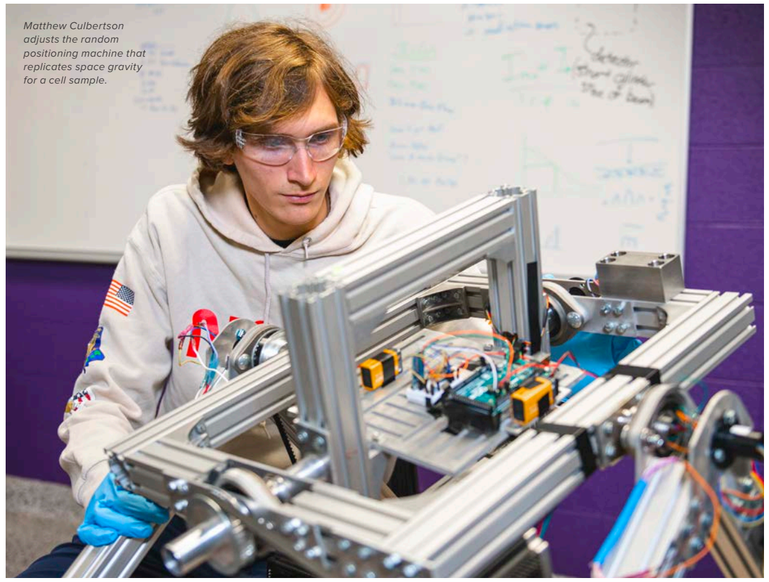
Culbertson, Kansas State University senior in physics and mechanical engineering, puts his studies in the College of Arts and Sciences and the Carl R. Ice College of Engineering to use conducting research. He is working with Amir Bahadori, associate professor, Steve Hsu Keystone research scholar and Hal and Mary Siegele professor in the Alan Levin Department of Mechanical and Nuclear Engineering. Their research sets the stage to characterize how human cells would react to being irradiated in partial gravity, which will give scientists a better understanding of what happens inside the human body in space.

Their research began with a project exploring active shielding — creating a charged electric field to repel highly ionized cosmic radiation particles.

"If we build a base on the moon or Mars, we'll want shielding there since there is no atmosphere to absorb radiation or magnetic fields to deflect the particles like we have on Earth," Culbertson said. "Active shielding around the base or spacecraft could repel the particles and reduce astronauts' absorbed radiation dose."

Culbertson has tested shielding setups using specialized software, including the Active Shielding Particle Pusher and COMSOL Multiphysics programs, to simulate individual radiation particles millions upon millions of times and see how the particles would react to active shielding. The simulated active shielding system moved radiation particles around the shield, indicating active shielding could be effective in space.

To test how cell samples react to space radiation, Culbertson customized and programmed a random positioning machine — a device consisting of two rotating frames, one inside the other, that operates on two axes. A pathing program directs the movement of the frames, which reproduces the conditions for zero or partial gravity for a cell sample.



Matthew Culbertson adjusts the random positioning machine that replicates space gravity for a cell sample.

"We wanted an on-the-ground analog for how a cell sample would react in space without spending millions of dollars on actually sending a sample into space," Culbertson said.

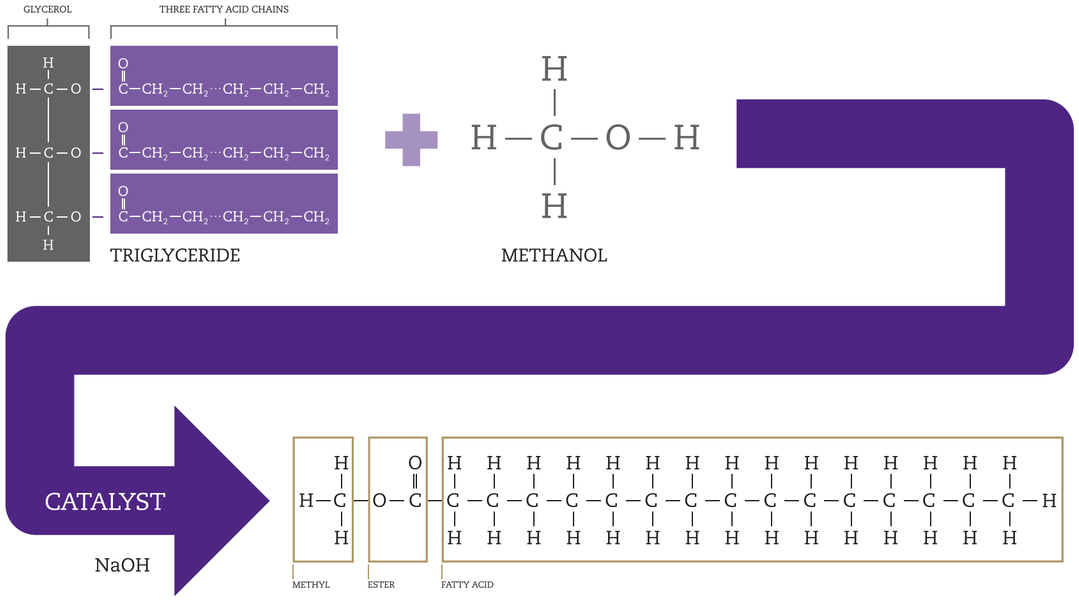
Working with a prototype created by a previous team, he revolutionized the pathing system to produce varied gravities — such as Martian and lunar partial gravities — and optimized the machine's efficiency.

The random positioning machine can be placed at the beam ports of K-State's TRIGA Mark II nuclear reactor facility, where high-energy neutrons are expelled directly toward the cell sample.

"The machine's frame is designed to limit how much radiation is blocked or deflected from the beams," Culbertson said. "You put the cell sample at the center of the machine and the beam port so the cell sample can be irradiated while it's on the machine, effectively replicating the desired gravity and radiation of space for the sample."

Culbertson received a prestigious Barry Goldwater Scholarship for his work with the random positioning machine and presented his research at the 2023 American Nuclear Society's annual conference. k

> "We wanted an on-the-ground analog for how a cell sample would react in space without spending millions of dollars on actually sending a sample into space."
>
> - MATTHEW CULBERTSON




# transesterification

**ˌtran(t)s-e-ˌster-ə-fə-ˈkā-shən)**

*Edwin Brokesh, assistant professor of biological and agricultural engineering in the Kansas State University Carl R. Ice College of Engineering, explains, in fewer than 100 words, what transesterification is and why it is important in the biodiesel production process.*

Transesterification is the chemical process where a triglyceride is combined with an alcohol in the presence of a catalyst to create a product called alkyl ester. Triglycerides are lipids commonly found in vegetable oils and animal fats. They are often present in food sources with larger protein content. A common reaction is to combine a vegetable oil, such as soybean oil, with methanol in the presence of sodium hydroxide, the catalyst. This reaction produces a Fatty Acid Methyl Ester, or FAME, and the byproduct glycerin. FAME is commonly available at many local filling stations as a fuel called biodiesel.

See page 14 to read more about K-State projects that involve transesterification and biodiesel and see page 36 to learn about a new partnership focused on renewable fuel.




1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# Remarkable women of K-State

Kansas State University is dedicated to the land-grant university mission of providing access to education. Women researchers and educators have long played key roles in the work of the university. Four scholars — Minnie Howell Champe, Nellie Sawyer Kedzie Jones, Mary F. Winston and Mary T. Harman — were among the women who pioneered the way in the first 50 years of K-State's history. Read more about these notable women in their individual captions. See pages 8, 37 and 38 to read about some of today's women research pioneers at K-State.

**1. Minnie Howell Champe was the first Black woman to graduate from K-State and was a member of the class of 1901. She taught public school in Topeka and Manhattan and later served as department head of home economics at Southern University and A&M College in Louisiana.**

**2. Nellie Sawyer Kedzie Jones was the first woman at K-State to become a full faculty member and hold the ranks of professor and department head. She was a faculty member from 1882-1887. Kedzie Hall is named after her.**

**3. Mary F. Winston served as the K-State mathematics chair from 1897-1900. She was also the first woman in America to earn a doctorate from the University of Göttingen in Germany.**

**4. Mary T. Harman taught in K-State's zoology and entomology department from 1912 until her retirement in 1948. She also served as president of the Kansas Academy of Science and authored more than 50 professional articles and several textbooks.**

*Photos courtesy of the Richard L. D. and Marjorie J. Morse Department of Special Collections.*

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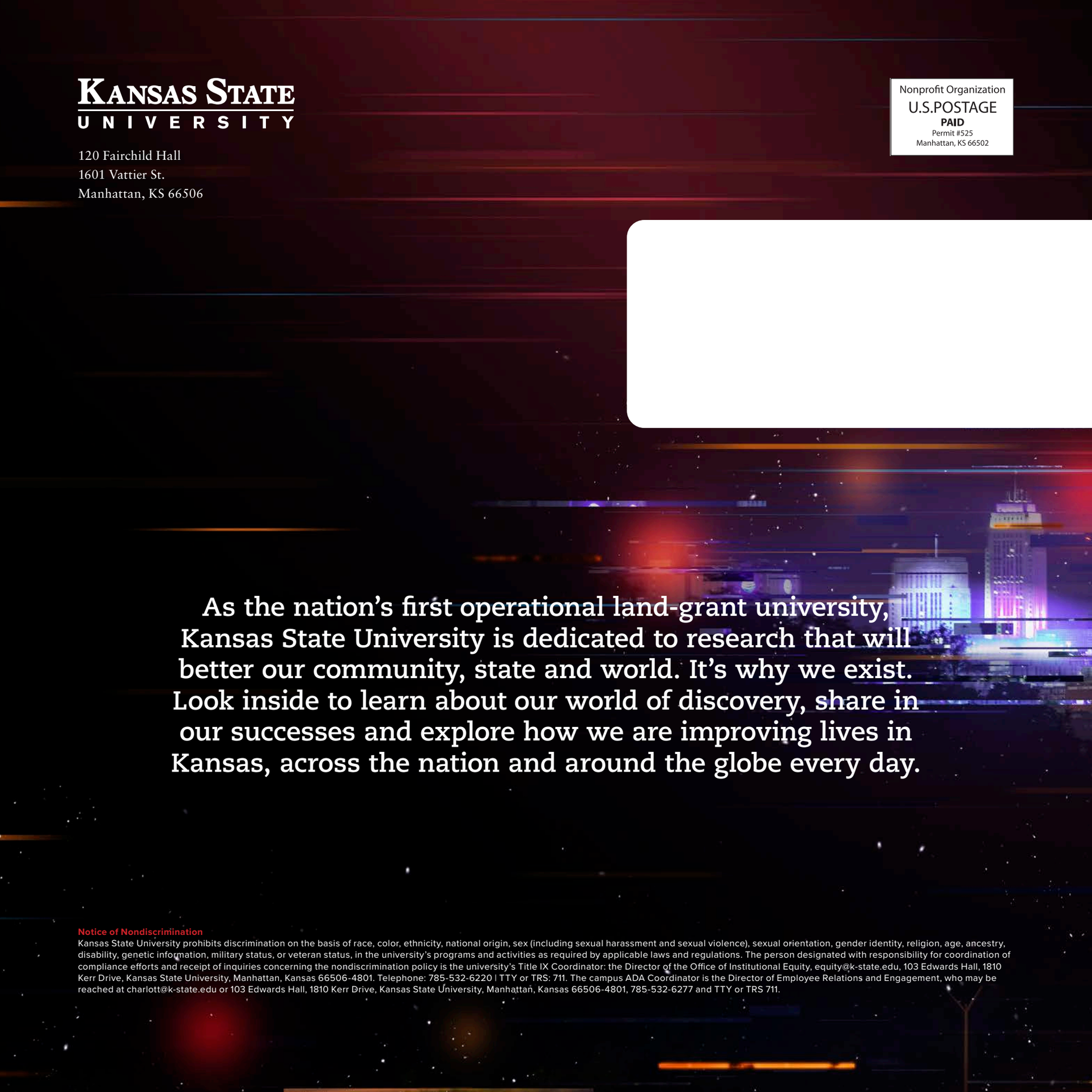

As the nation's first operational land-grant university, Kansas State University is dedicated to research that will better our community, state and world. It's why we exist. Look inside to learn about our world of discovery, share in our successes and explore how we are improving lives in Kansas, across the nation and around the globe every day.