Seek

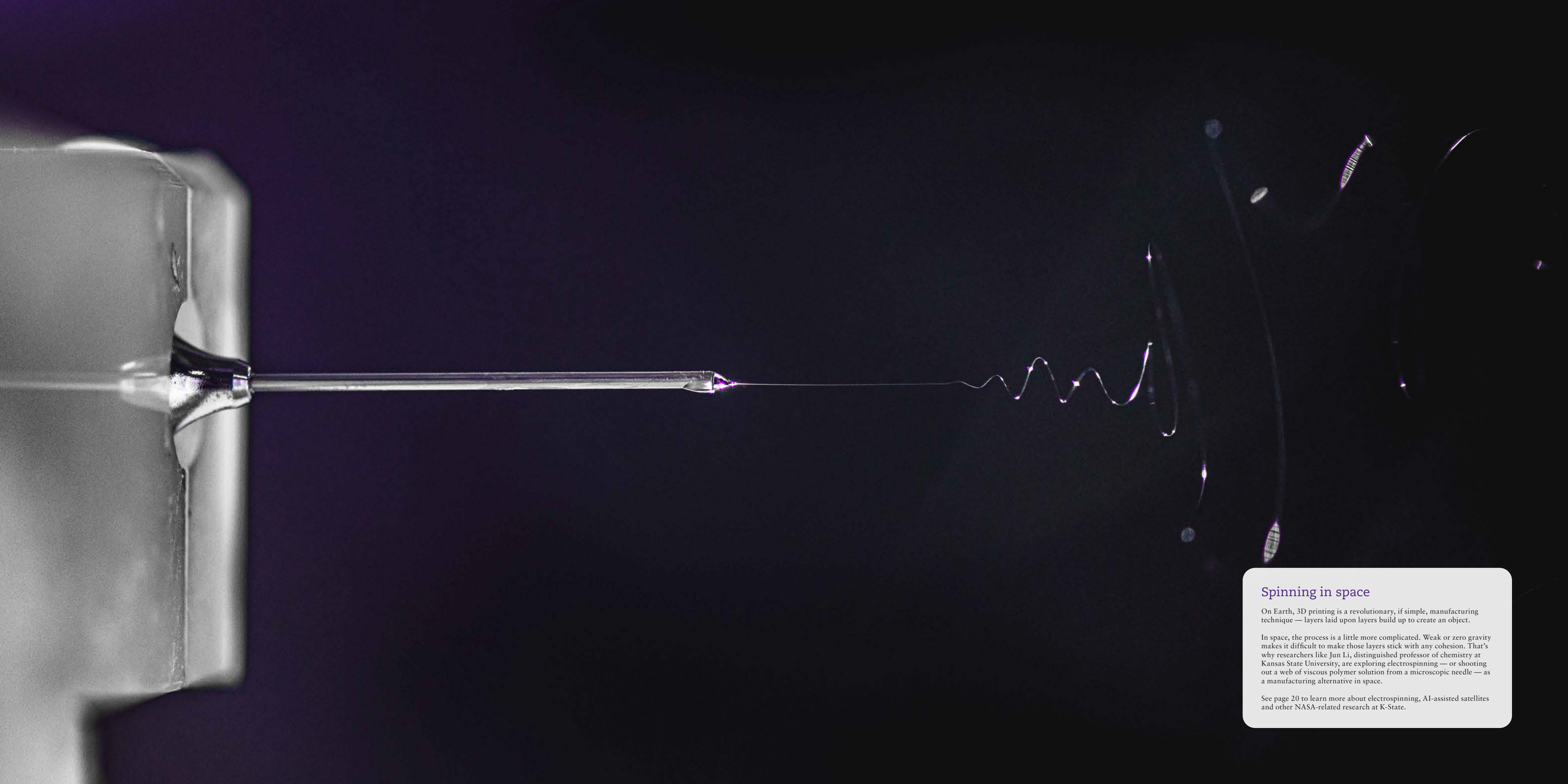
RESEARCH MAGAZINE FOR KANSAS STATE UNIVERSITY
SPRING 2024

FEATURED INSIDE:

Improving intelligence
Making AI smarter, safer

University for the universe
To and through the stars

Small and mighty
Farming's future includes nanotechnology



Spinning in space

On Earth, 3D printing is a revolutionary, if simple, manufacturing technique — layers laid upon layers build up to create an object.

In space, the process is a little more complicated. Weak or zero gravity makes it difficult to make those layers stick with any cohesion. That's why researchers like Jun Li, distinguished professor of chemistry at Kansas State University, are exploring electrospinning — or shooting out a web of viscous polymer solution from a microscopic needle — as a manufacturing alternative in space.

See page 20 to learn more about electrospinning, AI-assisted satellites and other NASA-related research at K-State.

On the cover:
K-State researchers choose the challenges of space not because they are easy, but because they define the excellence expected of a next-generation land-grant university.
Read more on page 20.

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KANSAS STATE UNIVERSITY

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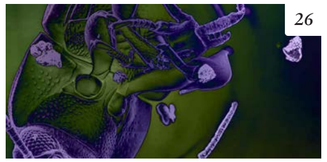

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Seek more

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.

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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*

"This is our land-grant commitment, and this is what it means to be a great public research university."

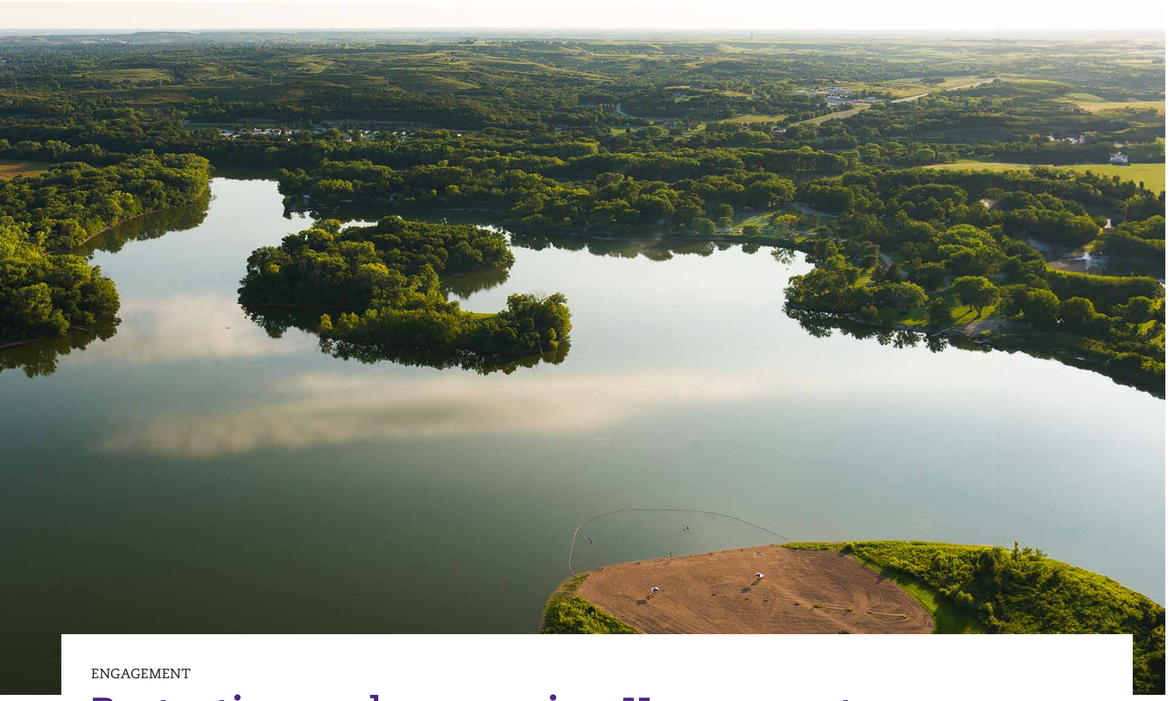
We are pleased to share the latest issue of Seek, Kansas State University's award-winning research magazine. This fall, Seek received five awards from the Council on Advancement and Support of Education, or CASE, for stories, photographs and design in the last year. I couldn't be prouder of our editorial and design teams for their continued great work on this magazine showcasing K-State research and connecting our discovery, scholarship and innovation to Kansas and to Kansans.

This issue comes at an exciting time for K-State as we have embarked on our Next-Gen K-State strategic plan, operationalizing and driving a bold and ambitious plan to become a next-generation land-grant university. Research growth is a big part of the Next-Gen plan, with several new initiatives launched recently. These initiatives aim to build and empower teams of researchers across disciplines, invest in existing and emerging research strengths, and support our faculty members' proposal development efforts.

In this issue you'll find feature articles on our NASA-funded research; the use of nanotechnology to combat mosquitoes; human health and health care; and the application of artificial intelligence, with topics ranging from personality inference to sustainable wheat production. Also in this issue are stories highlighting our new collaboration and partnership with Stormont Vail Health System at its new Manhattan facility and the work of Jesse Nippert, university distinguished professor of biology. Finally, as we do in each issue of Seek, we feature a graduate student researcher undergraduate student researchers and faculty researcher.

I hope you enjoy this issue of Seek, and welcome your feedback and suggestions. Our goal is to highlight the breadth of research and discovery taking place on our campuses, in our field stations, across the state and with our many partners. As I share often with legislators and others, our research is faculty-initiated and faculty-led, and it affects the lives and livelihoods of Kansans in all 105 counties. This is our land-grant commitment, and this is what it means to be a great public research university.

D. Rosowsky, Ph.D.
Vice President for Research



ENGAGEMENT

Protecting and preserving Kansas water resources

Kansas State University is taking the next steps toward a more sustainable future for Kansas by launching and leading the collaborative, multi-organizational Kansas Water Institute.

The new Kansas Water Institute is now a university-level priority at K-State to bring interdisciplinary university resources and expertise together to develop innovative solutions to today's water challenges. The institute will draw broadly upon expertise from many units at K-State, including all campuses and Research and Extension stations, to drive transformational discovery.

This will include research on novel irrigation and water management approaches, reservoir sediment reduction strategies, urban stormwater mitigation, risk factors for water contaminant-driven disease, social perceptions and behaviors around water use, and climate modeling.

"Kansas State University's launch of the Kansas Water Institute builds on our goal to generate a sustainable future for water throughout Kansas," said Gov. Laura Kelly.

The Kansas Water Institute supports the focus on sustainability and community health and well-being in the K-State Opportunity Agenda, part of the Next-Gen K-State strategic plan.

The Kansas Legislature is also working to provide Kansans with the framework, policy and tools — developed in concert with agency partners and stakeholders — to manage, secure and protect a reliable, safe, long-term statewide water supply through the Kansas House Water Committee.

K-State will partner with Kansas Board of Regents institutions as well as local, state and federal agencies and organizations, including the Kansas Department of Agriculture, the Kansas Water Office, the Kansas Geological Survey, the Kansas Department of Health and Environment, the Kansas Biological Survey and the U.S. Geological Survey.

AGRICULTURE

Food for the future

The U.S. Agency for International Development award of $22 million to Kansas State University is a vital step in improving lives around the world by making cereal crops more readily available to those most at risk for hunger and malnutrition.

The university will lead the Feed the Future Climate Resilient Cereals Innovation Lab, which includes U.S. and international partners aiming to advance the breeding of four major world crops — sorghum, millet, wheat and rice — through collaborative, interdisciplinary research and other related activities. The lab will work toward helping to sustainably double food production by 2050.

Much of the work includes applying current plant-breeding technologies — such as phenotyping with uncrewed aerial vehicles, next-generation DNA sequencing and genotyping, crop modeling and simulations assisted by artificial intelligence, speed breeding and more — to programs around the world. The research will help improve germplasm to be more resilient to stresses like drought, heat and disease, and meet consumers' preferences for safe and nutritious food.

"Kansas farmers and researchers are no strangers to harsh climatic conditions impacting cereal production," said Jagger Harvey, director of the lab and a research professor of plant pathology in the College of Agriculture. "This makes K-State the perfect home for this new initiative."

The Feed the Future Climate Resilient Cereals Innovation Lab is the fifth innovation lab award that K-State has received through Feed the Future, the U.S. government's global hunger and food security initiative. USAID has invested close to $128 million in K-State innovation labs for research.

ENGAGEMENT

Creating a biotech corridor

Kansas State University is part of a coalition that has been selected as one of 31 national Tech Hubs by the U.S. Department of Commerce's Economic Development Administration. The regional proposal — the Kansas City Inclusive Biologics and Biomanufacturing Tech Hub, or KC BioHub — will aim to build biomanufacturing capacity and add jobs and businesses in the Greater Kansas City area.

The KC BioHub is led by BioNexus KC and includes more than 70 partner organizations representing academia, corporations, government and more. Both four-year regional research universities and two-year community colleges will be involved in the hub.

The proposal includes hiring a regional innovation officer, creating a nonprofit contract development and manufacturing organization, establishing a workforce development council engaging biomanufacturing employers and developing the KC Health Sciences Innovation District.

The KC BioHub will join other Tech Hub designees in applying for awards of $50 million-$75 million to grow these innovation ecosystems over the next five years.

Biosecurity and biodefense

ENGAGEMENT

Award-winning engagement work

The Association of Public and Land-grant Universities, or APLU, has recognized Kansas State University's engagement efforts with a 2023 Innovation and Economic Prosperity Award.

The award, which K-State earned in the Place category, celebrates the university's public service, outreach and community engagement. The APLU's Innovation and Economic Prosperity Universities program is the leading certification process recognizing higher education institutions that have demonstrated a sustainable and institutional-level commitment to economic engagement.

Case studies highlighted in K-State's submission included development of the Edge Collaboration District along the northern edge of K-State's Manhattan campus, leadership promoting a hub for biosecurity and biodefense in the Kansas City Animal Health Corridor, and innovative solutions addressing affordable housing needs through sustainable design and construction practices.

The recognition represents more than a decade of collaboration and shared commitment to place-based initiatives, the land-grant mission and the alignment with the Next-Gen K-State strategic plan.

From left: Jane Schuh, Beth Montelone, Rebecca Robinson, Matt Casey and David Rosowsky.

K-State 105

AGRICULTURE

Better breads

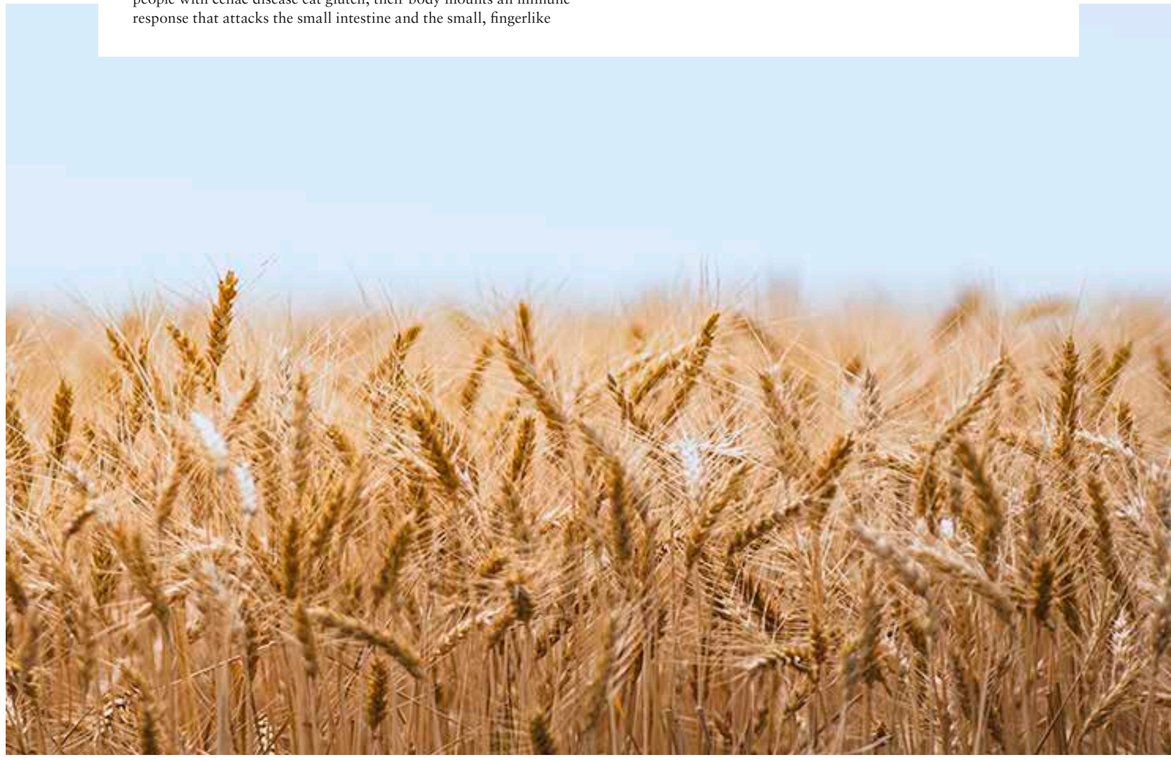
Kansas State University researchers have made a breakthrough in developing wheat-based foods that contain lower amounts of gluten.

Scientists from K-State's Wheat Genetics Resource Center and the USDA's Agricultural Research Service — in partnership with Kansas Wheat — successfully used a gene editing technique known as CRISPR-Cas9 to reduce the presence of two types of gluten-coding genes that produce proteins called gliadins that are known to be abundant in immunoreactive peptides. CRISPR-Cas9 is a genome editing tool that is faster, cheaper and more accurate than previously used methods.

Gluten is a protein often found in wheat, barley and rye. When people with celiac disease eat gluten, their body mounts an immune response that attacks the small intestine and the small, fingerlike projections known as villi that help the body absorb nutrients properly. According to the Celiac Disease Foundation, celiac disease affects 1 in 100 people worldwide, but only about 30% are properly diagnosed.

"We were very surprised that once we edited those genes, we reduced the immunotoxicity caused by gliadin genes in wheat by 47 times," said Eduard Akhunov, university distinguished professor of plant pathology and director of the Wheat Genetics Resource Center in the College of Agriculture.

"In our edited lines, we also found that while there was a reduction in toxicity due to lower levels of toxic gluten molecules, we did not have any reduction in the dough quality that is important for bread-making," Akhunov said.



ENGAGEMENT

Advancing agriculture

Explore the vision for bolstering capacities and competencies through the key pillars of the Digital Agriculture and Advanced Analytics, or DA3, mission: Teaching, research and engagement.

Teaching

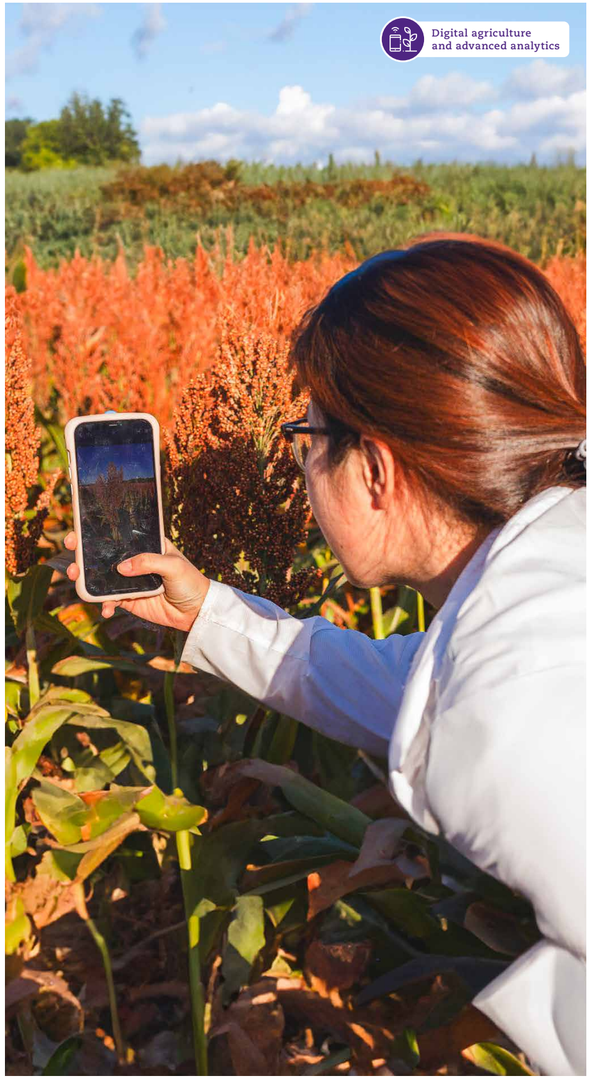
- Develop academic programs and other learning opportunities that will expand, diversify and strengthen the talent pool of students engaged in agriculture and the analytics required to feed a growing population.
- Provide opportunities that will include microcredentials, interdisciplinary DA3 courses, certificate programs and new transdisciplinary Bachelor of Science and graduate degree programs for on-campus and online students. Opportunities are also available for individuals in industry seeking professional development.

Research

- Create an environment where team members are empowered with the tools to better compete for and manage research funding from federal and state grants, industry partnerships and philanthropic gifts.
- Organize a universitywide DA3 symposium, develop annual ideation sessions with faculty and stakeholders, participate in faculty hiring committees across colleges and identify team members to participate in relevant K-State regional community visits.

Engagement

- Expand the K-State digital footprint within rural communities, namely via partnership through the K-State 105 initiative, to facilitate innovative and entrepreneurial ideas with research-driven expertise as it pertains to digital agriculture.
- Connect businesses with faculty and staff expertise and advance workforce development to propel digital agriculture solutions in Kansas and develop digital tools with producers to evaluate their data to address issues.
- Train extension professionals in the use of these tools and have them actively participate in developing a new benchmark for a next-generation land-grant university.



ARTS AND SCIENCES

Unique solutions for the bio-ag industry

The Protein and Biopolymer Analysis Core Lab provides integrated synthetic and analytical capabilities for biological materials, including proteins, peptides and glycans. The facility offers a wide range of sophisticated technical expertise and state-of-the-art instrumentation.

Beth Montelone, senior associate vice president in the Office of the Vice President for Research, oversees the core facility, which is in the Chemistry/Biochemistry Building. The co-directors are Ping Li, associate professor of chemistry, and Chris Culbertson, dean and professor of chemistry, both from the College of Arts and Sciences.

The lab is available to the K-State community and external customers worldwide. The core lab is committed to educating students and researchers and will work from initial experimental design through publication.

The lab provides the following services to K-State faculty and external customers:

- Mass spectrometry-based approaches for identification, characterization or quantitation of proteins and glycans from tissues, cells or other biological samples.
- Peptide synthesis and purification.
- Complete characterization of bio- and synthetic-based polymers.
- High-resolution fluorescent imaging of biomolecules in gels, plates and live cells.

VETERINARY MEDICINE

Paws-itive pain relief

Dogs need effective pain relief, too, and a new formula developed by a trio of Kansas State University College of Veterinary Medicine researchers is set to help.

Butch KuKanich, professor of pharmacology, Kate KuKanich, professor of small animal internal medicine, and David Rankin, clinical professor and head of veterinary anesthesiology, worked with third-party researcher Charles Locuson to develop the new pain relief formula, for which they received notice of their patent toward the end of 2023.

The formula combines the opioid methadone and another drug to enhance the effect and duration of pain relief, Butch KuKanich said. Another ingredient is naltrexone, which helps deter opioid abuse by humans.

Based on successful clinical trials, the researchers believe the formula could see widespread use for dogs who undergo surgical procedures, both in inpatient and outpatient settings.

"The ability to provide effective pain control for our canine patients is of utmost importance in companion animal medicine," Kate KuKanich said. "This novel opioid strategy shows great promise in helping us to treat our patients' pain, but also addresses the larger public health concerns of minimizing opportunities for opioid abuse potential in our communities."

ARTS AND SCIENCES

BY TRACI BRIMHALL

What if this time I don't begin with a requiem
or a memento mori with a split pomegranate
and a harem of flies? What if instead I tell you

a sleeping octopus changes colors while dreaming,
or how my gender is sable and softens with all
the gorgeous etceteras of age. No one guessed

a chameleon's tongue measured longer than
its body, but it unscrolled beyond tail, beyond
reasonable need. We wanted the mystery

of Mona Lisa, but a physician in line at the Louvre
stood staring so long he noticed her thinning hair,
her yellowed eye, and diagnosed her thyroid.

Sometimes it pays to wait. After all, love is
a syllabus of domestic chores with rolling
due dates and extra-credit candlelight. I once

loved someone who hated raspberries. That was
my first mistake. What if this time I love someone
like you who likes fur on a fruit, someone who's

better at suffering, who doesn't confuse their
sensitivity with goodness. What if this time
I think of Darwin, who saw a rare orchid

with a nectary a foot long and exclaimed
Good Heavens what insect can suck it. But he knew
that anatomy could not exist unless a moth

evolved a tongue alongside it, some unknown
species with a proboscis long enough to complete
this union. No one believed because no one

had seen it. Victorian women used belladonna
drops to widen their pupils—that Latin word
for little doll—and make their gaze a black mirror

so lovers could see themselves. You push me
back to study it, the best distance for beholding.
Always you lament, torn by this choice of look

or touch, but it's time, you say, and close your eyes.
I admit it's easy to spot a forgery with an X-ray—
brushstrokes too quick, rendering too clean,

the first draft the final one. Behind a masterpiece—
lavender swapped for gray, a lamb under the unicorn,
a hundred mistakes proving how difficult it is to

become something. You joke I'm the Isaac Newton
of feelings. I can predict failure's orbital speed,
can calculate the chess of silence and confession,

or even the path vines will take to injure the brick.
It's a gift from my last love, who made a study
of his wounds, made me balletic, a cat burglar

in a house of eggshells. But what if this time
I can't see it all coming—not the coup dressed
in Fahrenheit, not you dressed as Aphrodite,

not how I could ever trust your marble hands
cooling the twin crescents of sweat beneath
my breasts, marveling at this wealth of apples.

PREVIOUSLY PUBLISHED IN THE NEW YORKER.

The Kansas Creative Arts Industries Commission selected Traci Brimhall, professor of English and director of creative writing, as the 2023-2026 poet laureate of Kansas.

The architecture of aging

How one graduate student is bridging the gap between gerontology and architecture

By Lindley Lund

Growing up in a family of designers, Holly Ellis always knew that she wanted to be an architect, so when she enrolled at Kansas State University in 2019, the Master of Architecture program in the College of Architecture, Planning & Design felt like a natural fit.

It was a personal experience, though, that ultimately shaped Ellis' career and research trajectory.

"Both sides of my family have a long history of memory care problems," said Ellis, who often visited family in senior living residences as a teenager. "That's why I worked in a nursing home at the beginning of my college career."

During her time in those residences, Ellis observed the profound effect that physical spaces had on residents' health and quality of life. This realization inspired her to pursue research to improve seniors' living environments.

After connecting with Migette Kaup, professor and director of K-State's interior design program and gerontology faculty member with the Center on Aging, all in the College of Health and Human Sciences, Ellis added a minor in gerontology to complement her newfound interests.

"Holly and I got the opportunity to spend a whole semester really exploring her interests and the way in which she was considering the role of the built environment, as well as operational issues that happen in senior care," Kaup said.

Building on this foundation, Ellis embarked on her interdisciplinary research, identifying and analyzing various approaches to integrating amenity programs — activities that seniors can engage in to maintain their mental and physical health — into residences.

For instance, some residences may feature large multipurpose rooms for activities, while others designate specific spaces like a library or game room for these activities.

"It's wildly more important to residents' social and mental health than I thought to have these specifically designated spaces as opposed to big, empty rooms that you go to every once in a while," Ellis said.

As part of an internship program, Ellis worked with a client to design life-enriching senior residences. She applied her research when proposing design considerations and standards to the developer.

It's the kind of experience, Ellis said, that will help her become a better architect and improve the lives of seniors by reinventing norms in the realm of senior living.

"By having this interdisciplinary component early in my career, it gives me the opportunity to really focus in on what I want to do post-grad, and that brings a lot more meaning to my architecture curriculum," Ellis said.

> "By having this interdisciplinary component early in my career, it gives me the opportunity to really focus in on what I want to do post-grad, and that brings a lot more meaning to my architecture curriculum."
>
> - HOLLY ELLIS

On a molecular level

Undergraduate researcher investigates the potential of nanoporous materials

By Kate Kennedy

Erin Frenk fell in love with science during her first experiment at age 14. She loved gathering data, the uncertainty of end results and, most importantly, asking and answering her own questions.

Frenk, a Kansas native and junior in chemistry, said she initially set her sights on colleges across the country but ultimately fell in love with Kansas State University and the opportunities it presented.

"The programs are great and the faculty in the chemistry department are welcoming," Frenk said. "Chemistry was a perfect avenue because the curriculum allowed me to pursue many different research paths, and I knew I could start undergraduate research early."

Less than a year later, Frenk was introduced to an analytical chemistry lab run by Takashi Ito, professor of chemistry in the College of Arts and Sciences.

Ito's lab is developing methods that utilize electrochemistry, the study of electrical potential and chemical changes, to create and deposit nanoporous materials. These materials contain pores of nanoscale size and can detect and remove specific chemicals related to environmental and energy sciences.

Frenk utilizes a potentiostat — an instrument that controls electrodes — to apply negative voltage through an electrode in a solution and deposit a small film of metal-organic frameworks onto a surface. The metal-organic frameworks are uniform and cage-like structures formed by metal ions held together by organic linkers. Frenk specifically investigates the cathodic growth — a reaction where an electrode accumulates electrons — taking place when the metal-organic framework films are deposited onto a graphite slate.

"Literature has shown the preparation of uniformly thin metal-organic framework films with controlled thickness and crystal orientation to be difficult," Frenk said. "By controlling the applied potential, electrochemical methods have successfully been used to control the thickness of these thin films."

Frenk explained improving the methods of creating metal-organic framework films has gained recent attention, as they can capture carbon dioxide and remove toxic chemicals from water.

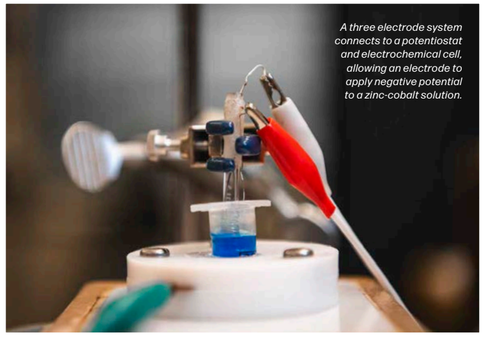
Frenk's goal is to one day work in environmental science.

"My research has many environmental applications, but right now, learning how to think like a scientist is the most important lesson I am taking from my research," she said. "I am passionate about taking care of our environment, but what I am doing right now is helping me develop a foundation to become a better researcher."

Frenk's passion for her work is made more evident by her academic timeline, as she is on track to complete a five-year accelerated program at K-State in just four years and graduate with a bachelor's in chemistry and a master's in business administration.

This summer, Frenk hopes to continue her work with researchers at Argonne National Laboratory and eventually join a graduate program to study environmental or materials science.

Erin Frenk deposits a cobalt chloride solution into an electrochemical cell.



A three electrode system connects to a potentiostat and electrochemical cell, allowing an electrode to apply negative potential to a zinc-cobalt solution.

IMPROVING THE INTELLIGENCE BEHIND AI

MAKING ARTIFICIAL INTELLIGENCE SMARTER, SAFER

By Ben Trickey

Just like a magician pulling a rabbit out of a hat, today's generative artificial technologies such as Midjourney and ChatGPT can seem magical by making a convincing image or wall of text appear in just seconds.

Helping to make this AI magic happen are faculty and student researchers at Kansas State University. They work to better understand the intricacies of generative AI systems and define both their applications and limitations so they are safe, efficient and accessible.

It's not only computer scientists and engineers who contribute to this research. Interdisciplinary collaboration at K-State has become integral to understanding how these models can help answer questions and solve complex problems in agriculture, applied psychology, data management, human health and more.

To coordinate their collective expertise across the university and beyond, these researchers have already begun working toward a better understanding of generative artificial intelligence technologies and their growing potential.

AI AND SUSTAINABLE AGRICULTURE

AI is often marketed as a tool for automating mundane tasks — virtual assistants to maintain your calendar, generative AI to draft your emails and self-driving cars to simplify your daily commute. These examples only scratch the surface of AI's time-saving capabilities.

Researchers in K-State's Center for Artificial Intelligence and Data Science, or CAIDS, in the Carl R. Ice College of Engineering study theoretical and applied data science, AI and the connections between them. Because AI is only as good as the data it relies on, research at the center includes developing more efficient strategies for data collection and analysis.

Pascal Hitzler, the director of CAIDS, Lloyd T. Smith creativity in engineering chair and professor of computer science, leads this research in the Data Semantics Lab, a part of the center. Hitzler and his students study and develop tools for data analytics, such as knowledge graphs.

Knowledge graphs are representations of data that use nodes and arrows to represent the relationships between concepts as formal logics. These graphs help contextualize and integrate data, especially for use in machine learning.

"Data scientists typically say about 80% of their work has to do with data management, and only the last 20% is the actual analysis, which then gives you the interesting outcome," Hitzler said. "Essentially, knowledge graphs are an intelligent way of organizing data — intelligent in the way that reusing the data for new purposes is much cheaper and easier."

These systems are already being applied to projects at K-State's Center for Sustainable Wheat Production in the College of Agriculture, an interdisciplinary initiative focused on integrating large datasets to inform more efficient and sustainable decision-making in wheat production.

Funded by one of three 2023 K-State Game-changing Research Initiation Program, or GRIP, awards, this project acts as the first step in creating a global food systems data hub. The data hub itself would use knowledge graphs to integrate and analyze big data and address the complexities of the global food system.

> "Data scientists typically say about 80% of their work has to do with data management, and only the last 20% is the actual analysis, which then gives you the interesting outcome."
>
> -PASCAL HITZLER

Digital agriculture and advanced analytics

Pascal Hitzler, director of CAIDS, is leading research to study and develop the knowledge graphs that make up the backbone of cutting-edge machine learning.

Hande Küçük McGinty, assistant professor of computer science, is working to leverage the power of AI among interdisciplinary research teams.

> "Sometimes different fields may hold nuances and different understandings of the same data. So how do you make sure that everybody's speaking the same language?"
>
> - HANDE KÜÇÜK MCGINTY

Hande Küçük McGinty, assistant professor of computer science and CAIDS faculty member, explains the additional role knowledge graphs play in interdisciplinary research.

"Sometimes different fields may hold nuances and different understandings of the same data," McGinty said. "So how do you make sure that everybody's speaking the same language? Knowledge graphs align our understanding of the same concepts."

The Center for Sustainable Wheat Production alone includes researchers in computer sciene, engineering, agronomy, geography and geospatial sciences, agricultural economics and plant pathology. Establishing working relationships among disciplines inspires further collaboration as researchers share data and explore real-world problems.

"Several different sciences are coming together with these projects, which is so exciting to see," McGinty said. "And it's also exposing us to all kinds of different new realms and new challenges."

The spirit of collaboration among data science, AI research and agriculture expands beyond wheat production. Hitzler and McGinty also contribute to the interdisciplinary Institute for Digital Agriculture and Advanced Analytics, or ID3A.

As ID3A's director, Hitzler focuses the interdisciplinary collective's efforts on using digital technology and analytics to support the goal of more sustainable agricultural practices.

"Agriculture has such tremendous opportunities for artificial intelligence to improve yield, decrease cost, projections, management decisions, etc.," Hitzler said. "And this for me is a really exciting area, in particular for K-State, because we can bring our AI and agriculture people together to move it forward."

Tianjun Sun, assistant professor of psychological sciences, is exploring how AI chatbots can help match employers with employees through workplace personality profiles.

DIGGING INTO DEEP LEARNING

If knowledge graphs are the unsung heroes of AI research, deep learning is the star of the show. Using artificial neural networks — AI systems modeled on the structure of the human brain — deep learning takes the project of automating human cognition to a new level.

Deep-learning models are trained to organize and interpret data to autonomously provide suggestions or make decisions with increasingly little human interaction. By design, these systems exhibit incredible versatility in applications from diagnosing cancer via medical imaging to identifying species of bees to developing workplace personality profiles.

In the study "How well can an AI chatbot infer personality?: Examining psychometric properties of machine-inferred personality scores," Tianjun Sun, assistant professor of psychological sciences in the K-State College of Arts and Sciences, and her collaborators explore how conversational agents, or chatbots, can help workplaces create better personality assessments for hiring, career counseling and guidance.

Rather than relying on a questionnaire or a traditional interview, the chatbot prompts potential employees to share stories about their lives and creates personality profiles based on their responses.

"It's pretty limited to evaluate personality based only on self-reports," Sun said. "So, we're looking at training systems or evaluating systems to recognize this more holistic picture of a person's personality."

Even as AI automates time-consuming processes, Sun's research suggests that the human element in guiding these programs and validating their outputs is essential to their efficacy.

"The human involvement in my line of research essentially is to validate the utility of the tools," Sun said. "Human samples really test how well the tools are working in terms of fairness, bias and other considerations."

As part of his work in CAIDS, Hitzler employs human oversight to better understand the function of these systems' internal decision-making processes.

"The hope of this is, of course, that we will get an understanding of what's happening inside, but also give us a possibility of actually saying why," Hitzler said. "It will tell us what the system was identifying — what was important for its decision and so on because we'd understand the internal structure."

In the past, the success of deep-learning programs was based on the statistical success of the models' outputs. However, in circumstances where the system is not working as designed, determining why the model has created an unsuccessful output requires significant time and effort. In many such cases, the user needs a fairly high level of expertise to identify an output as unsuccessful.

"Look at ChatGPT and the like. You can immediately see what the problem is if you try the systems out," Hitzler said. "They're extremely eloquent, but it may be completely confabulated. And the only way to know is if you're actually an expert in what it's talking about."

Inaccuracies may seem trivial with a chatbot, but identifying confabulations becomes crucial when deep learning has life-altering applications. Hitzler suggested safety-critical applications, like self-driving cars, or ethical questions, like what factors cause a mortgage application to be rejected by an automated system.

"Essentially, building trust in these systems is also a technical challenge that needs to be looked at," Hitzler said. "And I think this will still be important 10 years from now."

"The human involvement in my line of research essentially is to validate the utility of the tools. Human samples really test how well the tools are working in terms of fairness, bias and other considerations."

- TIANJUN SUN

"Essentially, building trust in these systems is also a technical challenge that needs to be looked at. And I think this will still be important 10 years from now."

- PASCAL HITZLER

ONGOING EDUCATION, CONVERSATION

Although the influence of data management and deep learning has garnered significant research at K-State, the conversations around AI and its application expand far beyond these topics alone.

In October 2023, K-State held the interdisciplinary symposium AI and the Future: Exploring the Intersection of Language(s), Science and Ethics, organized by faculty across the university, including Raelynne Hale, modern languages; Alice Anderson, Jason Coleman and Carol Sevin, all from K-State libraries; and Hitzler.

A diverse group of faculty, students and community members attended three days of presentations, panels and workshops about AI technology, its role in education and the ethical questions surrounding the applications of AI in daily life.

As more AI technology becomes available to the public at breakneck speed, these conversations about technological education and literacy have become a necessity.

In her role as a computer scientist working with interdisciplinary teams, McGinty has hope for continued growth in educating the public about the core ideas necessary to understanding computer and data science.

"Kansas is one of the pioneer states in this. We're already teaching and educating teachers in the computer science principles," McGinty said. "I think it is a wonderful step in the right direction, starting early and getting education starting from that perspective."

And although she believes in the growing potential of AI, McGinty weighs the promise of the technology alongside the importance of understanding its limitations.

"It's really important for people to understand this, that these systems are decision support, not necessarily decision-making," McGinty said. "So don't stop using your senses, don't stop using your intuition, don't stop using your own knowledge — and really challenge it." *k*

Seek more

Find out more about K-State AI research and events.

A UNIVERSITY FOR THE UNIVERSE

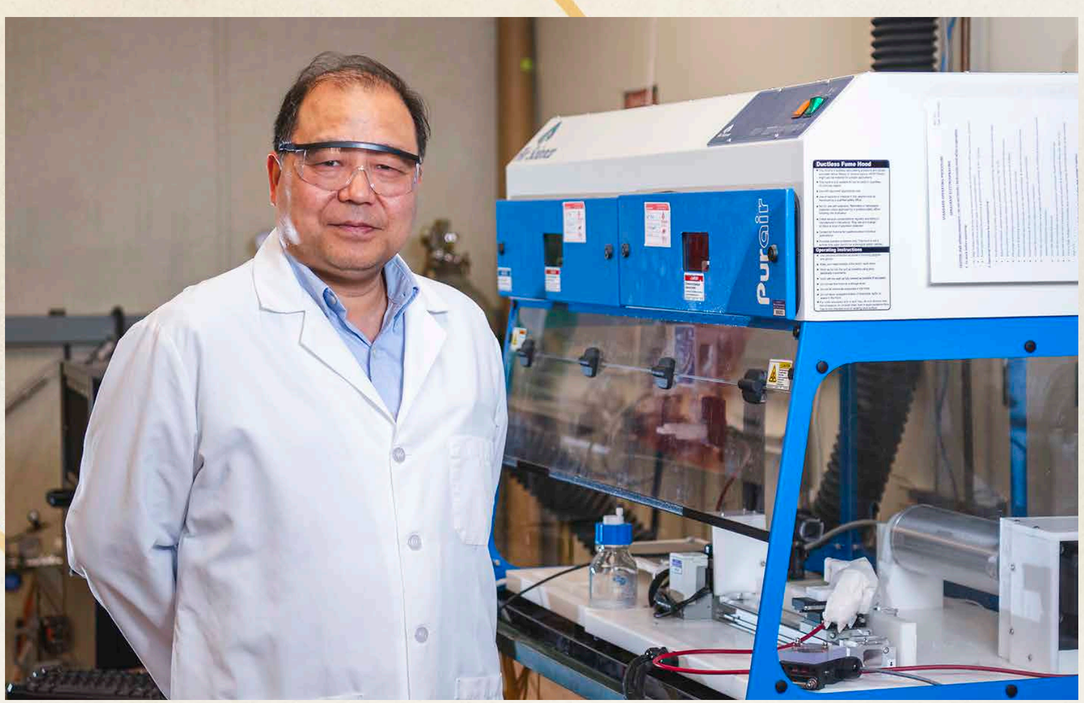
TO AND THROUGH THE STARS

BY RAFAEL GARCIA

In the cosmic heavens humanity finds some of its most considerable challenges in questions of time, distance and resources needed to explore and understand the universe.

Yet in these difficulties, humankind also finds its biggest opportunities to reach to and through the stars, and Kansas State University is meeting those obstacles head on.

K-State researchers choose these challenges not because they are easy, but because they define the excellence expected and demanded of a next-generation land-grant university — by Kansans, for Kansans and for the world.



Above: Jun Li, university distinguished professor of chemistry, is on a team of Kansas researchers testing electrospinning as a method of in-space 3D manufacturing.

Electrospinning in space

The terrible irony of space exploration is that for all the vast and almost limitless potential of worlds beyond our own, humankind is still limited by the relatively few resources it can send into space from Earth.

Every ounce of material launched into space costs tens of thousands of dollars in rocket fuel. Despite that, many of the mission-critical instruments and equipment require backups to be launched alongside them, which skyrockets the cost of missions.

But what if astronauts could create those items in space, as needed?

Jun Li, a university distinguished professor of chemistry in the K-State College of Arts and Sciences and former NASA physical scientist, and researchers from the University of Kansas and Wichita State University are using a $750,000 NASA award to study the potential of in-space electrospinning manufacturing.

Over the past decade, NASA has experimented with traditional 3D-printing techniques in space, which typically work by setting down several layers of a given material over each other. But while these techniques work for certain uses, the lack of gravity in space often leads to brittle, low-density items.

Electrospinning, on the other hand, works by shooting out extremely thin strands of a material — in this case a viscous polymer solution — guided by strong electrostatic forces to essentially weave a web, or membrane, of fibers between 100 and 500 nanometers in diameter. The tiny gaps between the fibers can act as a type of screen to let through smaller particles while blocking bigger ones. The high surface area also enhances the capture of specific toxic chemicals.

The best application for these membranes right now is as filters, such as for cleaning air or water. Such filters are also useful for tackling one of the biggest challenges to human and technology survival in space and on other planets: dust.

"On Earth, dust particles eventually fall to the ground because of gravity, but in space they remain floating around," Li said. "If you landed on the moon or Mars, the surface is covered in dust, and if you're walking around, you generate dust. As an astronaut, that doesn't interfere too much with your ability to breathe since you're wearing a mask with its own oxygen supply. But you don't want your specialized instruments exposed to the dust, particularly those tiny ones at nanoscales."

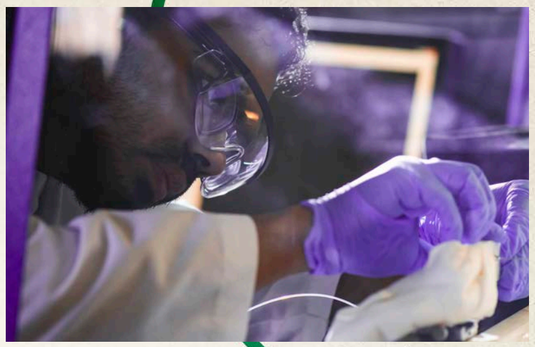
As part of the NASA award, the researchers are fabricating nanofiber membranes in Li's laboratory at K-State, testing physical properties at the University of Kansas and assessing and optimizing the manufacturing technique at Wichita State University.

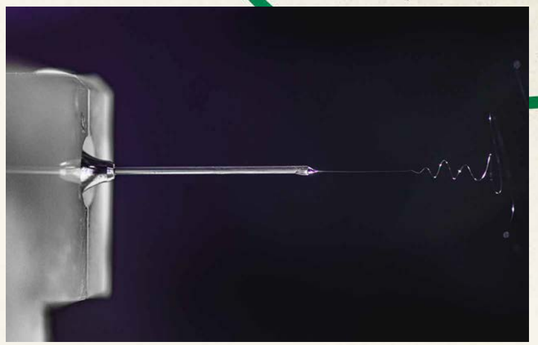
The research group also works with NASA research centers, national laboratories and private industry partners to explore other ways to use the electrospinning technique, including by integrating artificial intelligence in the manufacturing process as well as recycling previously created material.

Other potential applications could include the creation of sensors, actuators and solid-state batteries, which need thin layers of material as transducers or membranes to separate the electrodes that react to release energy.

Li imagines that such work could one day pave the way for directly making use of lunar and Martian dusts — or dust from any other celestial body we visit — to produce items using electrospinning.

"In principle, this is a low-cost technique," Li said. "You really just need to bring some material, in this case a polymer, and some solvent. Then you just decide if you want to use it as an air filter or potentially as a component for a battery, and you make it."





Above: Vijay Somasundaram, left, graduate student in chemistry, and Sabari Rajendran, top right, doctoral student in chemistry, work with the type of spinneret seen in the bottom right photo that is used in the electrospinning manufacturing technique. K-State researchers are exploring electrospinning as an alternative to additive 3D printing for in-space manufacturing.

Smarter satellites

It's not a hard equation to get into space. Enough thrust from a large enough chemical reaction — in this case, hundreds of thousands of gallons of rocket fuel — to get to enough velocity usually does the trick in escaping the pull of Earth's gravity. The trickier part is figuring out how to stay there and not crash down to Earth or careen into space.

We call this an orbit.

In the beginning of space travel, rooms full of humans derived, by hand, the calculations necessary to balance out that constantly fluctuating equation. Later, those number crunchers gave way to digital computers that could make those calculations much faster and more efficiently.

Still, as space exploration and communications advance and scientists maximize the amount of power possible from increasingly smaller satellites, the challenge is this: How do you teach satellites to maneuver into and keep themselves in the various stable orbits they'll need to be in over their lifetimes?

It's a problem K-State researchers like Arslan Munir are helping to solve by putting the power and knowledge of thousands of simulations into a small computer onboard these satellites to continuously determine the most efficient orbit paths and thrusts.

Munir, associate professor of computer science and director of the Intelligent Systems, Computer Architecture, Analytics and Security Laboratory, or ISCAAS, in the Carl R. Ice College of Engineering, is part of a team of Kansas-based researchers using a $750,000 NASA award to build and train those computer models, particularly onboard small satellites propelled by solar-electric thrusters. These types of thrusters use sunlight to generate small electric fields that give steady, but weak, thrust to the satellites — think the amount of force with which gravity pulls a slice of bread toward Earth.

Above: Arslan Munir, associate professor of computer science, is working with other researchers to design artificial intelligence that can get low-thrust, all-electric satellites into orbit in optimal time.

"Computation is often cheaper than communication in terms of power, and our work extends to orbits around the moon, too — the further you go, the more time it takes to communicate," said Munir, who is also a Daniel and Judi Burk — Carl and Mary Ice Keystone research faculty scholar. "Having an onboard AI-based system that can optimize your trajectory is better than traditional methods."

The strategy, deep-reinforcement learning, is a form of artificial intelligence that teaches the low-thrust, all-electric satellites to think their way into orbit using the insights gleaned from the results of prior trial-and-error training.

An onboard computer takes various parameters — such as thruster position, target position, angular momentum and orbital inclination and eccentricity — and determines the best settings for each to reach a stable, target orbit in optimal time.

The group's research is mostly theoretical at this point, with the models running on higher-end, but still consumer-grade computer hardware. But by proving the reliability of those computer models on Earth, NASA might one day rely on artificial intelligence to reach beyond the moon.

"Right now, cislunar orbits are the problem we're trying to solve, and if we can provide good solutions for that, it will be a great milestone for small electric-propulsion satellites," Munir said. "That's research that we can extend to Mars missions one day."

The last question

Millions and billions of years from now, after explorers overcome the constraints of our solar system, after humankind — perhaps in another galaxy — breathes its final breath and after the last star's fire fades, what will remain?

Astrophysicists and cosmologists don't have sufficient data for a meaningful answer, at least not yet. But they're hopeful that by looking into the past, they'll gain insights into how the universe came to be, why it continues and accelerates in its expansion and what might become of the universe in a distant future when energy dissipates and the atoms that make up our planets, stars and galaxies are too far apart to matter.

Lado Samushia, associate professor of physics in the K-State College of Arts and Sciences, is part of an international team of cosmologists that is helping design the parameters for collecting and evaluating the data that will be returned by the Nancy Grace Roman Space Telescope, NASA's next flagship mission to explore our universe, expected to launch by May 2027.

One of the biggest questions in cosmology right now is why the universe's expansion is accelerating," Samushia said. "We know that the universe is expanding, and it's getting bigger and bigger. Distances between distant objects are only becoming larger, and this expansion is accelerating, meaning its rate is increasing over time.

"With current physics, this is something that isn't easy to explain, because if anything, you would expect the expansion to slow down because everything tends to clump together under gravity," he said. "We observe the opposite of that, and it's an unresolved problem in physics."

The Roman Space Telescope, Samushia said, will help give clues to answer that problem by surveying wide swaths of space to determine how galaxies are distributed in space. Researchers like Samushia will then develop statistical methods to measure any patterns in how those galaxies are clustered or spread apart to get a better understanding of the history of expansion in the universe.

The research will also help better explain how and why the universe's expansion rate is accelerating, Samushia said, with dark energy widely believed to be the driving factor.

In the grand scheme of cosmology, or the study of the universe at the scale of billions of lightyears and millennia, there is little practical use to knowing the answers to these questions and problems that humanity can do nothing about.

But cosmology, like any other scientific discipline, is an innate reflection of humankind's drive to believe, to know and to understand, Samushia said — to reach to and among the stars, through any difficulties.

It is humanity at its best.

"This is what science is about — figuring out how things work," he said. "We, as humans, have this urge to know how things work. As children, we take toys and clocks apart. If that's the attitude you have to life and science, then this is a very interesting question because it's something we still don't understand at the fundamental level." k

Below: Lado Samushia, associate professor of physics, is working with an international team of physicists and astronomers to answer one of the biggest questions in cosmology.

NASA's next flagship mission

To study the rate of universe expansion from its furthest fringes, researchers need to use highly sensitive instruments that can detect the weak infrared light emitted by distant stars moving away from Earth.

That's why NASA is launching the Nancy Grace Roman Space Telescope, which will be equipped with the Wide Field Instrument to scan broad swaths of space for low-energy, tiny infrared particles.

Separately, the telescope's Coronagraph Instrument will serve as "starglasses" to filter out individual stars' light and reveal any potentially habitable planets hiding in their orbits.

Roman, like the James Webb Space Telescope, will orbit a point constantly in Earth's shadow to protect it from the sun's interference. Set to launch by 2027, it will have an expected mission lifetime of at least five years.

"Roman won't be the biggest telescope in space, but it will be one of the most important for NASA as its next flagship mission to survey the sky," said Lado Samushia, a Kansas State University associate professor of physics who is part of an international team helping design the parameters for collecting and evaluating the data the telescope returns.

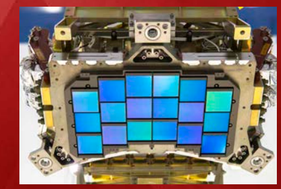


Photo courtesy of NASA.

Seek more

Learn more about the K-State researchers and labs included in this story.

Digital agriculture and advanced analytics

SMALL AND MIGHTY

Farming's future includes nanotechnology

By Pat Melgares

In late 2022, Kansas State University entomologists took a bold step in their quest to take on the pests that stunt the growth of agricultural crops: They entered the nanoworld.

> "We're starting to select and screen various green pesticides to see if there's any value of using products that we don't normally consider pesticides. At the nano level, they may be more easily absorbed or taken up by the target pest."
>
> - JEFF WHITWORTH

More specifically, they joined with U.S. Department of Agriculture scientists to launch a four-year project employing nanotechnology, a branch of science and engineering devoted to designing, producing and using particles of matter that are measured in nanometers or microns.

According to the U.S. government's National Nanotechnology Initiative, materials produced using nanotechnology are stronger, lighter, more durable, more reactive and better electrical conductors, among many other benefits. The National Institute for Occupational Safety and Health describes the technology as promising for such sectors as medicine, consumer products, energy, materials and manufacturing.

Nanomaterials are used in many well-known electronic devices, such as smartphones, laptops and televisions, improving the conductivity, strength and durability of those items.

In agriculture, scientists believe they can develop nanoparticles that use one-tenth or fewer pesticides while reducing crop losses due to pests — factors that will reduce pesticide use in the environment and ultimately help farmers make more money.

And K-State is leading that charge.

K-State entomologist Jeff Whitworth examines wheat seedlings infested by the Hessian Fly prior to treating the seedlings with a nanopesticide developed at K-State.

Targeting ag pests

Just over a year and a half ago, the USDA awarded K-State a four-year grant to create a new area of research focused on nanotechnology in crop pest management.

"Seed treatments, which protect seeds and seedlings from early-season pests and disease, came along 40 years ago, and then came genetically modified crops to help with that as well," said Jeff Whitworth, a field crop entomologist with K-State Research and Extension who leads the project.

"Well, in the next 20 years, we may lose those as effective ways to protect against pests and diseases, so we've got to come up with something new," Whitworth said.

In part, the USDA funds were used to hire Amie Norton, a former USDA employee who specializes in nanotechnology. Norton, whose background is in chemistry, said her job involves building nanoparticles in K-State laboratories that carry lower levels of active pesticide ingredients, and then applying those structures to crop fields.

"The advantage of nanotechnology is that you have a larger surface area to work with, and so more of the pesticide is applied even though we are using less material," Norton said. "The increased loading of pesticides onto the surface of nanomaterials and their ability to increase the bioavailability of ingredients to targeted pests results in the use of less active ingredients such as pesticides, which leads to lower costs for those using these products."

Whitworth said K-State's project is expected to explore treatments for such pests as the Hessian fly, corn rootworm, grasshoppers, termites and even mosquitos.

"We're looking at a wide range of medical, veterinary, household and agricultural pests," he said. "In most of these areas, we hope to do at least a cursory look to determine if there is potential for nanotechnology.

"By the end of our four years, we'll have an idea about whether there's a place for anotechnology in agriculture," Whitworth said.

K-State nano-entomologist Amie Norton, left, places a stub containing a red flour beetle treated with micro eggshell particles, shown enlarged at right, into a scanning electron microscope in order to get an image of the particles that are present on the beetle.

A disciplined approach

By definition, a nanometer is one-billionth of a meter, so small that it cannot be detected by optical microscopes. For perspective:

- A strand of human hair is between 50,000 and 100,000 nanometers thick.
- One sheet of standard copy paper is 100,000 nanometers thick.
- The period at the end of this sentence is approximately 1 million nanometers.
- One nanometer compares to a standard tennis ball wide in the same proportion that the same tennis ball compares to planet Earth.

The applications being developed at K-State require special knowledge and highly sophisticated equipment. That's where Norton comes in.

It took nearly a year just to acquire all the specialty equipment that now creates a steady buzz in Norton's modest basement-level laboratory.

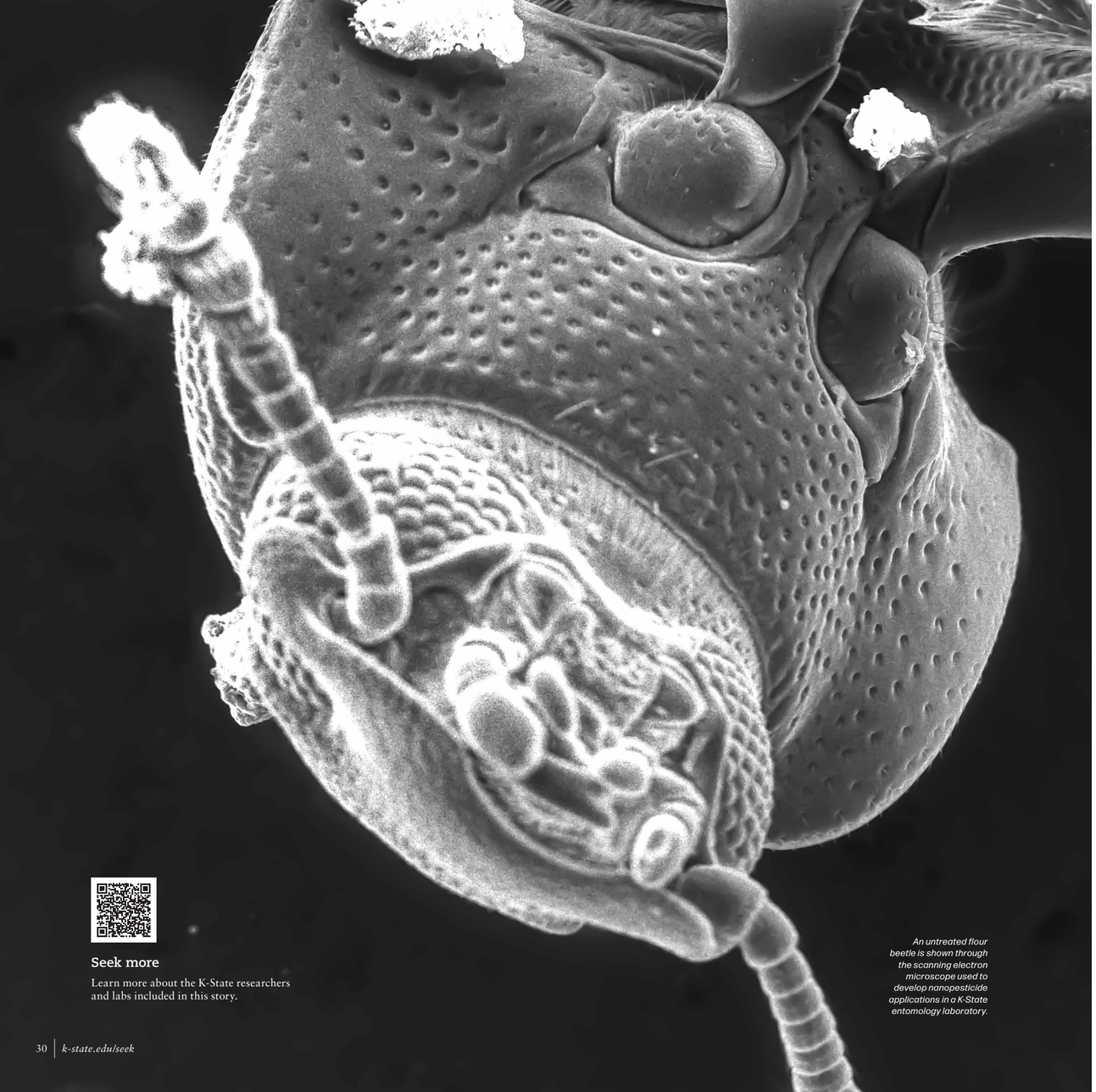
For certain, she is methodical in her approach. In a recent test, Norton combined stainless steel balls with eggshells — an agricultural waste product — to create a green pesticide, so called because it is derived from organic sources that are considered environmentally friendly.

Whitworth notes that many agricultural waste products could be useful in developing nanomaterials. Last fall, the team tested the effectiveness of post-Halloween pumpkins. They're also looking at postharvest residues of corn, wheat, sorghum and more.

"We're starting to select and screen various green pesticides to see if there's any value of using products that we don't normally consider pesticides," Whitworth said. "At the nano level, they may be more easily absorbed or taken up by the target pest."

Norton's test with eggshells made its way through a nanomill, where it was vigorously shaken for 30 minutes. Then it was on to an electric sprayer, where researchers can transform the liquid substance into fibers or small capsules.

> "The advantage of nanotechnology is that you have a larger surface area to work with, and so more of the pesticide is applied even though we are using less material."
>
> - AMIE NORTON



An untreated flour beetle is shown through the scanning electron microscope used to develop nanopesticide applications in a K-State entomology laboratory.

Seek more

Learn more about the K-State researchers and labs included in this story.

There is equipment to measure the concentration of material available, view it in ultraviolet, test it against a target and coat the material with minerals as gold, silver or copper.

"Every nanoparticle is made differently," Norton said, "depending on what you may want to accomplish."

She said that nanotechnology may one day allow farmers to use a product that performs multiple functions. "For example, if you need fertilizer and pesticide together, you can purchase a product that would be much cheaper than buying the two separately," Norton said.

In the future, Norton would like to investigate the possibility of layering, which would allow for the time-release of a pesticide.

"Currently, you put a product out there and it's consumed — it's gone," she said. "But if we could create a second layer, we could extend the lifetime of that pesticide."

Norton is also encouraged by the potential of creating safer products for unintended targets. One example could be through gating, which controls how the nanoparticle activates.

"Let's say the insect you're targeting has a stomach pH of three. Well, if a beneficial insect has a stomach pH of six, you can design the nanoparticle so that it only opens in an acidic environment," Norton said. "We could gate materials so that if a child were to accidentally ingest the product, it would be gated so that it wouldn't open into a human's digestive tract."

Early success

It took just about one year for K-State's team of entomologists, USDA scientists and Norton to develop and use their first nano product. In October 2023, the researchers reported findings of a study in which they coupled silver — a known antimicrobial — with a corn protein known as zein, which is typically a waste product.

Their target: mosquitos, the pesky, picnic-ruining, biting pest of summer.

K-State's team tested its nanopesticide in water, believing that as mosquito larvae filter food from water, they ingest the nanomaterial containing silver.

"We found that in mosquito larvae, silver gets into their mid-gut and kills the microbes that are necessary for mosquito larval well-being," Norton said.

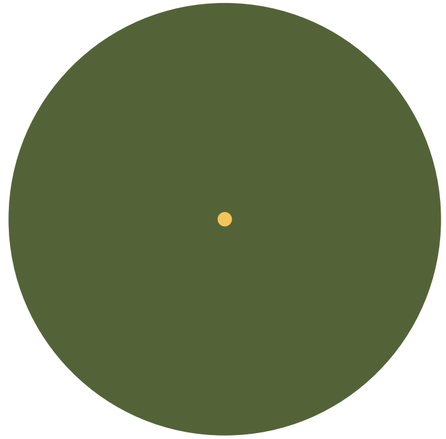
The concentration of pesticide in the newly developed nanomaterial is, by far, less than what would traditionally be used to combat mosquito populations. According to Norton, K-State's product included just 1 part per million pesticide — a proportion similar to one drop of water in a 10-gallon fish tank.

By comparison, more common pesticide concentrations range from 10 to 32 parts per million. In other words, K-State's product used at least one-tenth — and possibly as much as one-thirtieth — less pesticide than what is commonly used.

Whitworth said that while silver is not a typical pesticide used in mosquito control, future applications are expected to include spinosad, which is more commonly used. Scientists may also include methoprene, a growth regulator, so that what doesn't kill the mosquitoes will keep them from growing into adults.

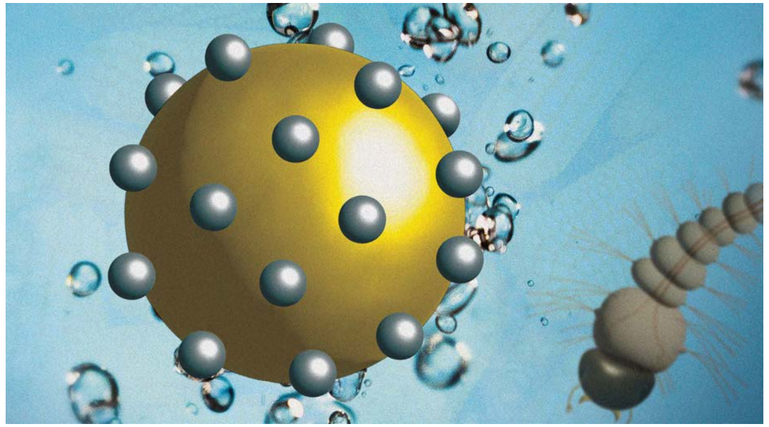
While not an application for agriculture specifically, the mosquito project was proof positive of the K-State team's ability to develop an application aimed at eliminating a real-world problem.

"We're just a year into this area of research," Whitworth said. "We are looking for ways to recycle agriculture waste and convert it into something useful. It's a step-by-step process; it takes a while, and we are learning as we go." *k*



Above: Visual comparison of normal pesticide amount used (green circle) vs new amount with nanotechnology (yelllow circle).

Below: A design by K-State entomology student Crystal Ly depicts zein, an agricultural waste product, coupled with nanoparticles – silver, an antimicrobial – while mosquito larvae close in to feed on the product. Ly's design was featured on the cover of the American Chemical Society's Omega Journal in fall 2023.



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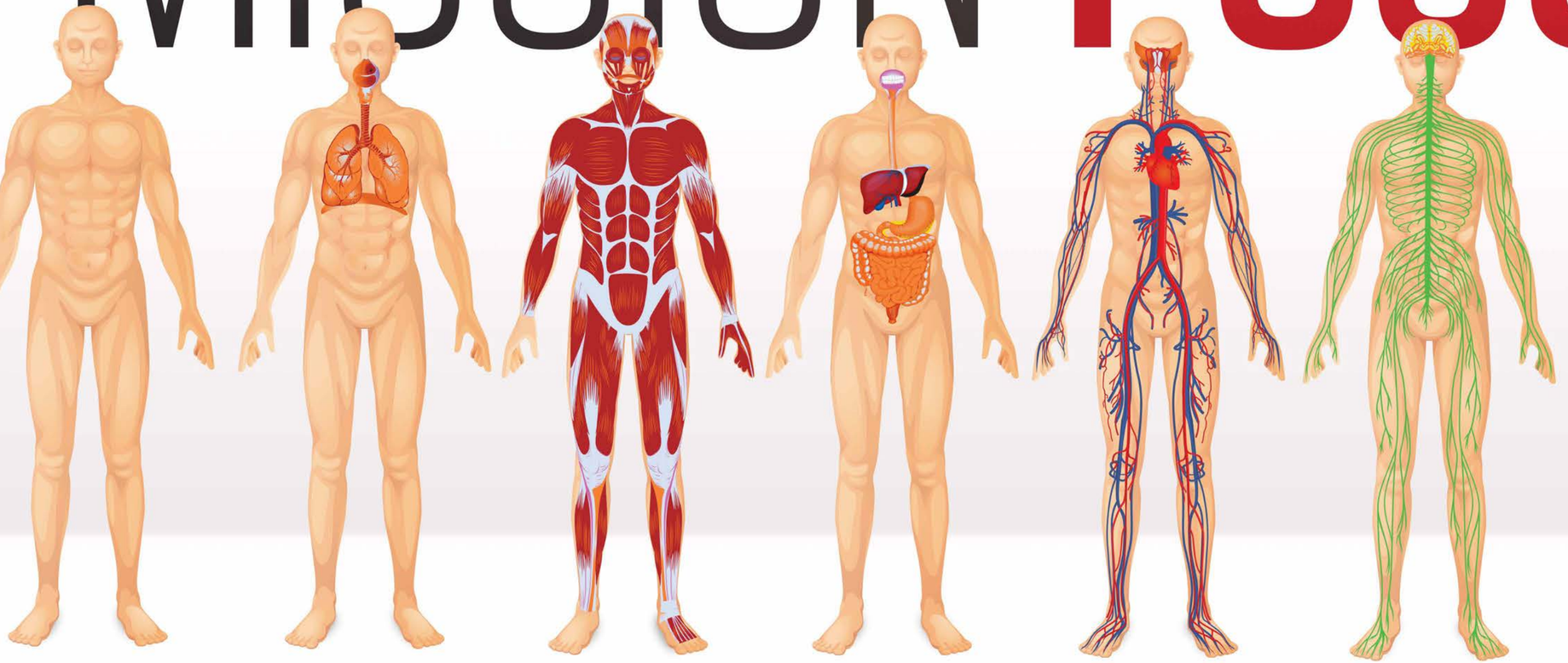

Researchers aim to improve human health

BY MICHELLE GEERING

While much is known about how the human body functions, plenty of questions remain, especially when the body doesn't function as it should.

Answering these questions is the mission and passion of researchers at Kansas State University. Continue reading to learn more about some of the health-related research taking place to improve people's health and quality of life for conditions such as cervical cancer, anxiety, PTSD, heart failure and peripheral artery disease.

Chemotherapy and cervical cancer

The human papillomavirus, or HPV, causes at least 90% of all cervical cancers. While screenings for early detection and licensed vaccines are available, the World Health Organization lists cervical cancer as the fourth leading type of cancer in women globally. This is where Nicholas Wallace, associate professor of biology in the College of Arts and Sciences and assistant director of the Johnson Cancer Research Center, aspires to do good through his research.

"Finding better solutions for cancer patients is what drives us," Wallace said. "Cervical cancer disproportionally affects those who do not have access to regular medical screenings. In my mind, this should not be happening. Academic institutions are positioned well to drive research forward and leverage the information to do good."

Wallace's research focus is on the role HPV plays in causing cancer. A current project is to better understand how HPV causes cervical cancer and use this information to enhance or improve patient care.

> "Finding better solutions for cancer patients is what drives us."
>
> - NICHOLAS WALLACE

With funding from the National Institutes of Health, Wallace and his students found that cervical cancer cells use a process called microhomology-mediated end joining to repair DNA. Non-cancerous cells, however, fix DNA damage in other ways. Armed with this knowledge, the lab is examining how to make cancer cells more sensitive to chemotherapy by blocking the cell's ability to use microhomology-mediated end joining to repair damage.

"The goal is to use a lower dose of chemo, which leads to fewer side effects and better quality of life for cervical cancer patients," Wallace said. "We want to take the harshness and brutality of chemo away yet keep the chemo working."

Wallace credits the student and postdoctoral researchers working in his lab for driving this research forward. The students receive hands-on experience working in a biomedical lab and on projects that have the potential to advance to human clinical trials in the future.

Seek more

Read about other K-State human health research.

Anxiety, PTSD and brain circuits

The brain, which only weighs 3 pounds, is what makes humans human. Different regions of the brain control the body's processes, including the way we behave and the way we feel, how we make sense of what we see and observe, and our memory.

While small, the brain is a complicated organ and scientists continue to hone their understanding of how each brain region functions and how health care providers should respond when a particular brain region is not responding as it should.

Maria Diehl, assistant professor of psychological sciences in the College of Arts and Sciences, studies the neural circuits in the brain that regulate fear and avoidance behaviors and how social behaviors affect learning to avoid danger. Her research advances understanding the brain circuits that are disrupted in post-traumatic stress disorder and other anxiety disorders.

As part of her work with K-State's Cognitive and Neurobiological Approaches to Plasticity Center, Diehl studies rat behavior to understand how they may actively avoid danger. Her team trains rats to learn about danger cues in the environment and how to avoid them safely. The scenarios observed model similar behavior patterns in humans with PTSD or anxiety. Rats have similar physiology to humans, including the same brain areas that are important for learning fear and avoiding danger. This helps researchers better understand human anxiety and related disorders.

In her lab, Diehl and student researchers found that female rats are more likely to avoid danger while males display riskier behavior. In a social setting with another rat present, cues are taken from partners to gauge potential danger. Additionally, her research suggests the brain's anterior cingulate cortex may be key to understanding the neural circuits of avoiding danger under social situations.

"This is basic science research to find the dysfunctional areas of the brain in maladaptive avoidance behaviors," Diehl said. "The next step will be to rescue those brain functions in hopes of using that as a translatable finding for human treatment of neurological disorders. By learning more about how the brain works and how people become vulnerable to extreme adversities, we can make an important contribution to improved human health."

Exercise and blood pressure

While daily exercise has many health benefits, exercise can be dangerous for individuals with cardiovascular diseases. Blood pressure naturally increases during exercise, but the blood pressure and heart rate increase with cardiovascular disease is exaggerated, which puts the patients at risk. It can lead to atrial fibrillation, stroke, heart attack or other cardiac issues.

Steven Copp, associate professor of kinesiology in the College of Health and Human Sciences, studies blood pressure control in heart failure and peripheral artery disease. Copp and undergraduate and graduate student researchers examine how blood pressure and heart rate respond to exercise to better understand cardiovascular function.

"Our goal is to understand why blood pressure is altered in these patients and by what physiological mechanism," Copp said. "Eventually, this can lead to a new therapy to help patients perform exercise safely and gain the benefits of physical activity. This will improve quality of life tremendously while reducing the risk of having a cardiovascular event."

Peripheral artery disease primarily affects the lower limbs and can cause pain when exercising. When skeletal muscles contract, sensory neurons are stimulated and send signals to the brain's autonomic nervous system, which coordinates the body's response to exercise, Copp said. In patients with peripheral artery disease, these neurons are hypersensitive, which causes a significantly larger increase in blood pressure and heart rate.

Copp, who directs K-State's Autonomic Neurophysiology Laboratory, received funding from the National Institutes of Health to better understand how muscle sensory neurons become hypersensitive in cardiovascular disease. The lab found that thromboxane receptors on sensory nerve endings play a role in increasing the activity of the sensory neurons in patients with peripheral artery disease. The identification of this receptor's role is just the beginning.

> "By learning more about how the brain works and how people become vulnerable to mental disorders following a traumatic event, we can make an important contribution to improved human health."
>
> - MARIA DIEHL

"We now continue following the signaling pathway downstream of thromboxane receptors," Copp said. "The receptor we identified is linked to intracellular signaling pathways that are very complex. We follow the pathway and do experiments at multiple steps along the pathway to see what mechanisms specifically might be playing a role in the exaggerated responses that are being produced during exercise."

Nicholas Wallace, right, studies HPV's role in causing cancer. Graduate students Abhineet Banerjee, far left, and Grant Brooke, center, assist in his research lab.

Maria Diehl, right, and sophomore Maya Anchondo, left, study brain circuits that regulate fear and avoidance behaviors.

Stephen Copp, left, and doctoral student Ashley Baranczuk examine how human body functions, such as blood pressure and heart rate, respond to exercise as part of research to better understand cardiovascular function.

Sustaining industrial growth

Researcher redefines global business strategies

By Erin Pennington

In the ever-evolving landscape of global business, Ike Ehie's research is offering insights that could reshape the way companies approach their supply chain strategies. Focused on the intersection of strategic alignment and investment decisions, Ehie's work is helping shape the future of global business.

Ehie, professor of management in the College of Business Administration, is researching the pivotal role of strategic alignment of supply chain decisions in the wake of the COVID-19 pandemic.

"In the years during and following the pandemic, many companies that were faced with supply chain disruptions relocated plants to the U.S. — a decision that was often driven by immediate concerns rather than long-term strategy," Ehie said.

This drove Ehie to seek the answer to a key question: Does strategic alignment moderate the relationship between plant investment decisions and operational performance of a manufacturing company?

By studying more than a thousand global companies through the Global Manufacturing Research Group, he sought to uncover the moderating role of strategic alignment on the relationship between plant investments and operational performance of manufacturing companies. Through examination of competitive priorities, strategic alignment measures and performance metrics, Ehie found a winning competitive position for companies that aligned their investment decisions with their overarching strategy.

"Strategic alignment is not just a buzzword; it's a determinant of success," Ehie said. "The results speak for themselves: Companies that align their investment decisions with their overarching strategy exhibit superior operational and financial performance."

Ehie was named a Fulbright U.S. scholar from January to August 2023 in Nigeria. He worked with a Nigerian university to assess to what extent companies in developing countries are embracing industry 4.0 and digitalization. Industry 4.0 refers to the current trend of automation and data exchange in manufacturing technologies, encompassing concepts such as the Internet of Things, artificial intelligence and cloud computing. Digital technology adoption involves integrating these advanced technologies into various aspects of business operations to enhance efficiency, productivity and competitiveness. The ongoing efforts to evaluate digital readiness will avail these countries with actionable insights that can drive meaningful improvements.

Ehie's research has been published in premier journals such as the International Journal of Production and Operations Management, European Journal of Operational Management, and OMEGA — The International Journal of Management Science. Additionally, his collaborative efforts with a diverse group of international faculty members underlines the global relevance and applicability of his findings.

Ehie's research group involves scholars from other universities in the U.S., as well as institutions in Ireland, Canada, China, South Korea and Japan. Each year, the group travels to one of its member's countries to discuss research findings and the framework for future data collection. The group's research is applicable to businesses across many industries. As managers make investment decisions to expand operations, their published work advocates for a careful consideration of strategic alignment.

"The goal is not just to address short-term profitability but sustained growth over time," Ehie said. "As managers make decisions for investments to expand their plants, they need to pay attention to the strategic alignment of such decisions to see growth."

Ehie's next steps involve submitting his research findings to the International Journal of Production Research and delving into supply chain resilience to deal with the widespread disruptions in supply chain. He hopes his exploration of industry 4.0 and digital technology adoption in developing countries will shed light on the evolving nature of global business. k

Backyard biology

Professor studies native plants in home state

By Taylor Provine

Jesse Nippert is studying grassland ecology at one of the most well-documented research stations in the world — and it's practically in his backyard.

Nippert, Kansas State University distinguished professor of biology in the College of Arts and Sciences, performs his research at the Konza Prairie Biological Station, about 10 miles south of Manhattan, Kansas. The 8,600-acre native tallgrass prairie, in the Flint Hills, is jointly owned by K-State and The Nature Conservancy. Nippert also is the principal investigator for the Konza Prairie Long-Term Ecological Research Program, which is funded by the National Science Foundation.

Nippert's lab studies how grassland systems function, how they have changed over time and how they are going to change in the future.

"We do a lot of work that focuses on understanding native plant species' anatomy and physiology — how the plant is built and operates influences its potential growth in the ecosystem," Nippert said. "For example, we try to understand why some species succumb to drought and other species don't."

One of the single biggest threats to the rangeland is the encroachment of woody plants in grasslands, Nippert said. His lab is also studying how the woody shrubs modify the soil, which could potentially change subsurface weathering patterns, infiltration of rainfall, stream flow and the entire water budget for the eastern Kansas rangelands.

"I'm hoping that in the next five years or so we're not just documenting the consequences of woody encroachment, but we're also providing meaningful solutions to try and fix the problem because it is serious," Nippert said.

In addition to his work at the Konza Prairie, Nippert has projects in South Africa studying everything from understanding how savannas form to successful mitigation strategies for their woody encroachment problem.

Nippert began working at K-State in 2007 as an assistant professor in the Division of Biology and director of the Stable Isotope Mass Spectrometry Laboratory. He was appointed as a university distinguished professor in April 2023. Nippert graduated from K-State with his bachelor's degree in park resource management and environmental sciences. He received his master's degree in forest resources from the University of Idaho. He received a doctorate in ecology from Colorado State University.

A native Kansan, Nippert is thankful for the opportunity to use the Konza Prairie for research. According to the National Park Service, less than 4% of the tallgrass prairie remains intact, mostly in the Kansas Flint Hills.

"Grasslands are without a doubt the most impacted and, in some ways, the most threatened ecosystem in the world," Nippert said. "There's a certain responsibility we have to learn what we can so that we can conserve them." k

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>
> - JESSE NIPPERT

Seek more

Learn more about the Konza Prairie Biological Station.

Next-gen health care

K-State 105

University partnership elevates health care collaboration

By Malorie Sougéy

Kansas State University's next-generation land-grant mission includes community health and well-being, and a revitalized partnership with a local health care system is part of that vision.

The Kansas State University and Stormont Vail Health Research Collaboration supports next-generation health care research, education, access and innovation by providing opportunities for K-State students and faculty to collaborate with Stormont Vail providers and patients. Stormont Vail Health is a nonprofit integrated health system.

Through this partnership, K-State experts — who are up to date on current trends, research and clinical trials — can carry out Stormont Vail practitioners' ideas for research, allowing the practitioners to focus on patient care.

Students also get the opportunity for hands-on research and can potentially help facilitate clinical trials, experiences that are typically only available to medical school students, while also learning from guest speakers sponsored by the collaboration.

Carl Ade, associate professor of kinesiology in the College of Health and Human Sciences and liaison between K-State and Stormont Vail, emphasized the significance of multidisciplinary teams in modern research.

"For many of us doing health care research, we need to expand into the clinical realm, whether that's access to patients, unique pieces of equipment, biosamples like blood or simply expertise. This partnership allows us to build these collaborative teams that advance research, teaching and patient care."

Patients from across Kansas can participate in clinical trials that they might not otherwise have access to, and they can see their providers and go to the clinical research space all at Stormont Vail's Manhattan campus.

Mary Martell, vice president and regional administrator for Stormont Vail, said the collaboration expands beyond the shared geography.

"The work has already become regional, and its impact will reach far beyond as we work together to accelerate health care innovation," Martell said.

K-State's College of Arts and Sciences, College of Health and Human Sciences, Carl R. Ice College of Engineering and College of Veterinary Medicine have proposed or ongoing projects with Stormont Vail, including a study focused on brain blood vessel health in cancer survivors and research to find better ways to diagnose peripheral artery disease.

While the partnership is still relatively new, there are already ideas to expand its reach in the future, Ade said, including a vision for addressing rural health care challenges.

"We want to find ways to take our research and our findings into rural communities with K-State Research and Extension in support of the K-State 105 initiative and the Next-Gen K-State strategic plan," Ade said

K-State 105 is the university's answer to the call for a comprehensive economic growth and advancement solution for Kansas. Combined with K-State and Stormont Vail's shared commitment to Kansan health and well-being — an area of focus in the Next-Gen K-State strategic plan — the momentum is building.

"As people are learning about this new capability, it's making them think about projects that in the past they didn't pursue because they weren't feasible," Ade said. "Because of this partnership, they can chase ideas and dreams they couldn't before."

Carl Ade, associate professor of kinesiology, is the liaison between Kansas State University and Stormont Vail Health in a revitalized partnership that will provide more opportunities for clinical health care research collaboration.

Notable numbers

University increases extramural funding for seventh straight year

Total extramural funding garnered by Kansas State University has increased for the seventh year in a row. Although the coronavirus aid bill funding received in FY 2020 and FY 2021 made the apparent totals for those years artificially high, the FY 2023 total of $225 million is the highest ever total for the university and represents a $43.3 million, or 23.8%, increase in actual external support relative to FY 2022 and a $72.6 million, or 47.7%, increase relative to FY 2021.

In FY 2023, K-State researchers obtained 1,097 awards. These awards include a 19.4% increase in federal funding relative to FY 2022, with the largest increase in funding coming from the U.S. Department of Agriculture.

Economic development and technology transfer are significant focus areas, as is growth in the number of strategic partnerships. K-State Innovation Partners, the university's technology commercialization, economic development and corporate engagement unit, facilitated more than $7 million in total licensing revenue in FY 2023 and 22 new license agreements. Additionally, over the last decade, 27 companies and 1,100 employees have been attracted to the region. K-State received the 2023 Association of Public Land-grant Universities Innovation and Economic Prosperity University Award, which recognizes exemplary and innovative case studies of economic engagement impact.

$225M in total extramural awards funding

1,097 total extramural awards

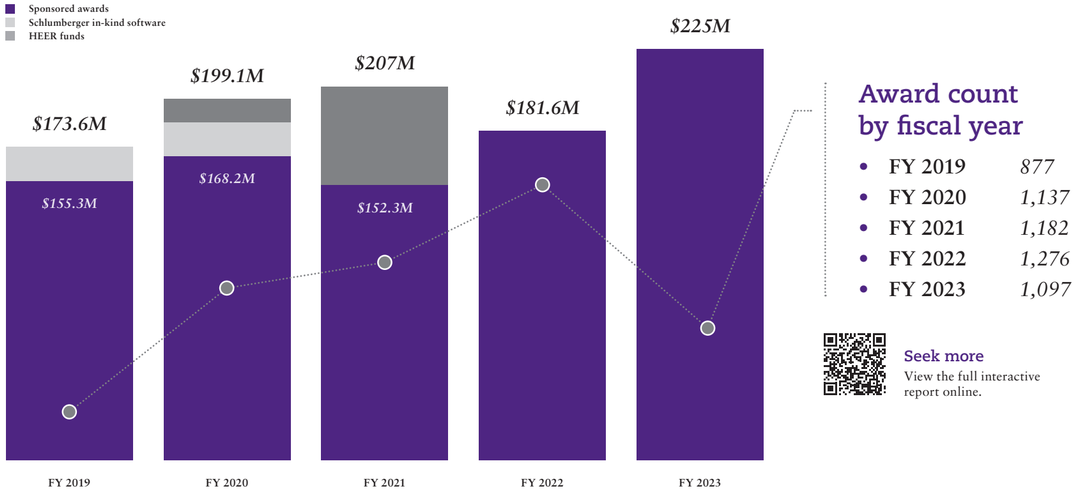
657 researchers funded in FY 2022

$7M FY 2023 licensing revenue

22 license agreements

74% net increase in research support since FY 2016

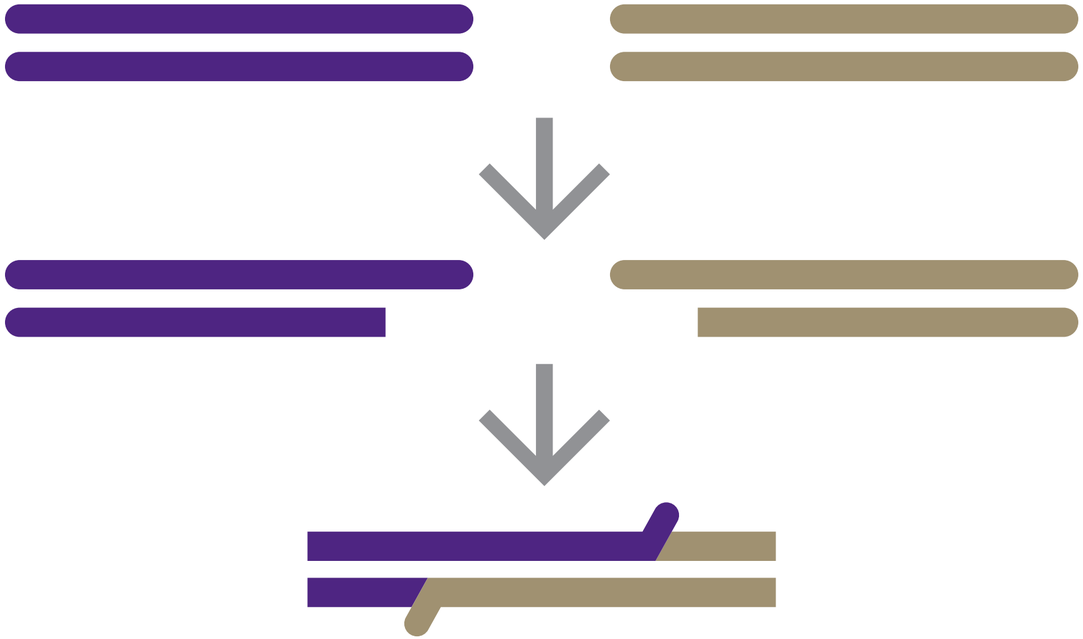
Total award amount by fiscal year



Award count by fiscal year

- FY 2019 *877*
- FY 2020 *1,137*
- FY 2021 *1,182*
- FY 2022 *1,276*
- FY 2023 *1,097*

Seek more
View the full interactive report online.



microhomology-mediated end joining

Nick Wallace, associate professor of biology in the College of Arts and Sciences and assistant director of the Johnson Cancer Research Center at Kansas State University, explains, in fewer than 100 words, what microhomology-mediated end joining is and why it is important in research.

All cells have redundant systems for repairing DNA. Microhomology-mediated end joining is one mechanism cells use to repair damage when both strands of the DNA double helix are broken. This repair mechanism is normally rarely used and always leaves an insertion or deletion in the DNA strand. However, cervical cancers use this repair system far more often than normal cells. Knowing how cancer cells repair themselves can lead to new treatments or treatments with fewer side effects.

See page 34 to learn more about microhomology-mediated end joining and other ways K-State researchers are working to improve human health.

Decades of gravity research

Kansas State University began NASA-funded research on the effects of gravity on living systems in the 1980s. In this photo from the early 1990s, Beth Montelone, K-State professor of biology and senior associate vice president for research, performs an experiment on the effects of brief periods of zero gravity produced by parabolic flight on single-celled yeast. The experiment tested whether the yeasts detected the change in gravity and responded as they would do to other stresses such as heat shock. See page 20 to learn about current NASA research being done at K-State.

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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.