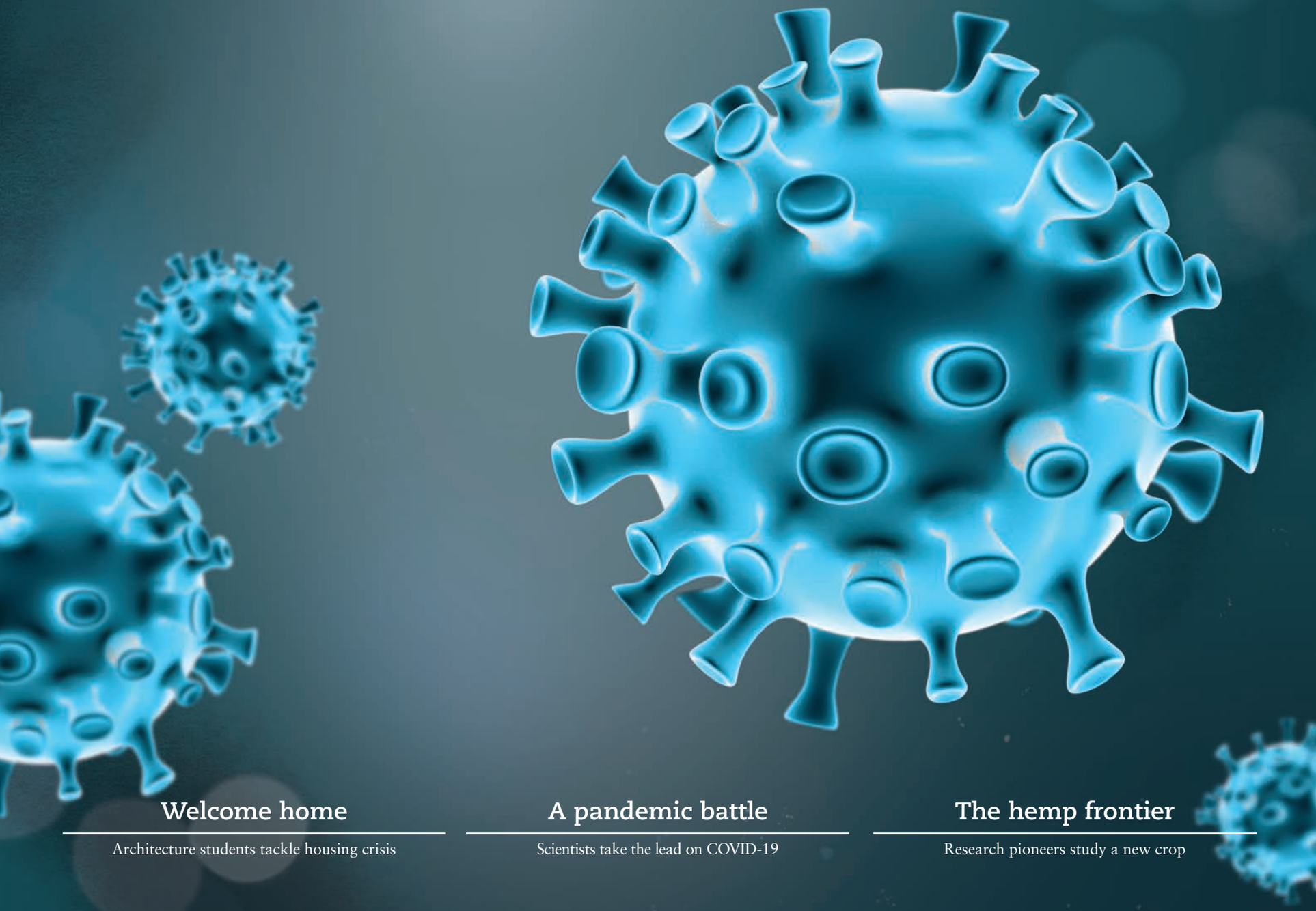
Seek

RESEARCH MAGAZINE FOR KANSAS STATE UNIVERSITY

2020



Welcome home

Architecture students tackle housing crisis

A pandemic battle

Scientists take the lead on COVID-19

The hemp frontier

Research pioneers study a new crop

A different vein

This close-up view of an industrial hemp leaf comes from a *Cannabis sativa L.* variety that is growing at the John C. Pair Horticultural Center, which is a K-State Research and Extension research center near Wichita.

Hemp is a broadleaf plant often grown and harvested for its fiber and grain. This makes it useful for a variety of potential products, such as food ingredients, biofuels and cattle feed.

While industrial hemp is related to marijuana, hemp is legal to grow because it contains low to no tetrahydrocannabinol, or THC. See page 36 to learn how Kansas State University industrial hemp research is helping farmers across Kansas learn how to grow this new crop.

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Seek more

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Editor's note:

Many of the photos in this issue were taken before the COVID-19 global pandemic and before face coverings and physical distancing became common practices. In the photos that have been taken during the pandemic, people are wearing face coverings and practicing physical distancing and other safety measures.

About Seek

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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KANSAS STATE UNIVERSITY

In a hotel ballroom in Washington, D.C., on February 25, 2020, I gave the following opening remarks to a meeting of university and government leaders and discussed CERES, the Coalition for Epi Response Engagement and Science, which is a collaborative group of scientists dedicated to bio- and agro-defense. Two weeks later, Kansas State University, like so many other colleges and universities worldwide, began shutting down operations because of a zoonotic disease that started a global pandemic.

From my remarks:

"This gathering is intended to share and learn about the current and future challenges associated with keeping American and global food supplies safe, reliable and plentiful. Although the economies of the world are intricately tied through global trade and supply, global peace and stability are connected to the most fundamental of all human needs: to be fed and to be healthy. Governmental policies are enacted to strengthen the binds that tie our investments and strategies to peace and stability, and it is through government and private sector investments in new discoveries and inventions that we, the scientists in the room, will provide new methodologies, reliable technologies and advanced countermeasures to achieve those ends.

"Before CERES was a coalition, she was the Roman goddess of grain. If you studied Roman or Greek mythology, you know that the gods were servant gods charged to ensure humans would survive and thrive. To accomplish this, Ceres realized that she needed to cooperate with the other gods and goddesses — sun, rain, seasons and so forth — to deliver her charge to provide ample grains for a growing and thriving population.

"Our CERES today recognizes the same: To deliver on agricultural biosecurity, we must be explorers, and we must collaborate and connect our talents in science and innovation that lead to action. Today, we are here to share our progress on our mission and to express the continued need to muster our forces, maybe even collaborate with the Greek god, Ares, to not only prepare for but to wage war on the unknowns: on plant, animal and zoonotic infectious diseases that threaten our very existence.

"We are at a critical crossroads today as we chart our course. With more than three times the population on earth today than were alive when I was born six decades ago, peace and prosperity across the human species are menaced by food, animal and human diseases, and losses. Rapidly evolving viruses and other zoonotic pathogens threaten our production plants and animals and now our own species. Uncoordinated responses that are reactive and not proactive confirm the philosophers' rule that history shows again and again how nature points out the folly of man."

As the last seven months have shown, we were not prepared. A new variation on a known severe acute respiratory syndrome virus, SARS, emerged and moved rapidly through an unprepared world. The existential threat of a zoonotic disease that impacts our lives has been demonstrated — again. Nevertheless, with some interruption in research while we worked to develop safe protocols for our researchers and secure adequate protective equipment, SARS-CoV-2 virus and COVID-19 disease research began apace at K-State by early April in our Biosecurity Research Institute. By the end of summer, more than $29 million in grant proposals were written, more than $3 million in contracts for COVID-19 research had been secured and a number of new technologies had been licensed to corporate partners to combat the disease. K-State research pivoted quickly, and we've dedicated a large portion of this Seek issue to those efforts.

K-State research isn't only about SARS and COVID-19, but so much of what we do is about improving people's lives and adapting to changing environments, changing landscapes and changing health. This issue shares some ways in which we improve people's lives. Change is inevitable, and we've had to adapt our Seek magazine publishing timeline to change as well — thank you for being patient.

This will be my final Seek magazine as the vice president for research at K-State. Life changes are also sometimes inevitable. As the year changes to 2021, I will have enjoyed serving five years as the VPR and four years as dean at K-State. It has been an honor and a pleasure to know the K-State family. The next chapter of our journey takes Carolyn and me to Ames, Iowa, where I will serve as the next VPR at Iowa State University. It will be a homecoming for us — I had my first job after my doctorate in Ames at the U. S. Department of Energy Ames Laboratory.

"We shall not cease from exploration
And the end of all our exploring
Will be to arrive where we started
And know the place for the first time."

— T.S. Eliot, "Little Gidding" from "Four Quartets"

Peter K. Dorhout, Vice President for Research

See *Shorts*

Polytechnic team awarded for innovation, economic engagement

The Kansas State University Applied Aviation Research Center and professional education and outreach team at the K-State Polytechnic campus have received an Innovation and Economic Engagement Award of Excellence.

The K-State award recognizes faculty and staff, centers, institutes and units engaged in work that advances innovation and the economic prosperity of the region and recognizes exemplary economic engagement in talent, innovation and place. The award was created in 2017 when K-State was named an Innovation and Economic Prosperity University by the Association of Public and Land-grant Universities.

The Applied Aviation Research Center offers professional unmanned aircraft training. This training provides access to the university's researchers and expands technology knowledge and utilization in communities across Kansas. Kurt Carraway, unmanned aircraft systems executive director of the Applied Aviation Research Center, and Kirsten Zoller, director of professional education and outreach, lead the team.

"The award winners are leveraging the resources that K-State offers in a unique way to grow the aviation industry," said Peter K. Dorhout, vice president for research. "Their work equips students with immediately impactful skills through providing accessible, practical learning in a manner in which industry professionals, entrepreneurs and fellow educators can benefit."

Making water, nutrients go further on the Great Plains

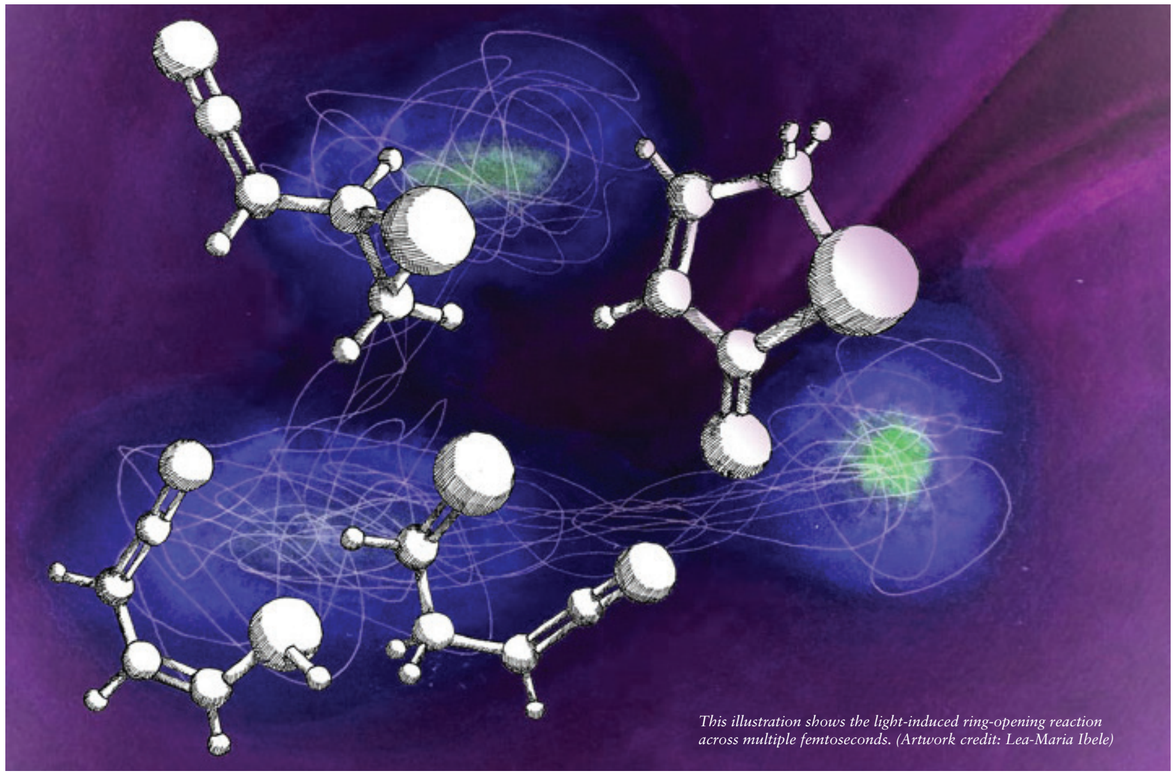
New research from Kansas State University and collaborators is boosting rain-fed agriculture. K-State is leading a multiagency team focused on improving water and nitrogen use efficiencies and improving soil health in the semiarid southern Great Plains.

Chuck Rice, university distinguished professor of agronomy in the College of Agriculture, is leading the nearly $10 million five-year research effort, which includes an interdisciplinary team from the U.S. Department of Agriculture Agricultural Research Service, Oklahoma State University and the University of Maryland. The USDA National Institute of Food and Agriculture is funding the work.

The long-term research goal is to sustainably increase the productivity of farms that solely rely on rainfall rather than irrigation in the southern Great Plains by improving the efficient use of water and nitrogen, Rice said. The team also is aiming to reduce yield losses from environmental stresses and to enhance soil health.

"Crop and food animal production in this region lags well below its potential, and 50% or more of the precipitation received by cropland is lost by evaporation from soil or is used by weeds," Rice said.

The interdisciplinary team includes researchers, educators and extension professionals with expertise in agronomy, crop production, soil science, modeling, economics and sociology.



This illustration shows the light-induced ring-opening reaction across multiple femtoseconds. (Artwork credit: Lea-Maria Ibele)

Lights, camera, action

Kansas State University physicists have taken extremely fast snapshots of light-induced molecular ring-opening reactions — similar to those that help a human body produce vitamin D from sunlight. The research has been published in Nature Chemistry.

"Think of this as stop-motion like a cartoon," said Daniel Rolles, associate professor of physics in the College of Arts and Sciences and principal investigator for the study. "For each molecule, you start the reaction with a laser pulse, take snapshots of what it looks like as time passes and then put them together. This creates a 'molecular movie' that shows how the electronic structure of the molecule changes as a function of how much time passes between when we start and when we stop."

Shashank Pathak, doctoral student and lead author on the paper, said the idea was to study the dynamics of how a ring opens in a molecule on the time scale of femtosecond, which is one quadrillionth of a second. The researchers used a free-electron laser to visualize how these reactions happen by recording electron energy spectra as the atoms in the molecule move apart.

"The ring-opening reaction is observed in nature quite a bit," Pathak said. "One example is the formation of vitamin D3 in our skin. When sunlight shines on our skin, we have big compounds that have these small ring structures that help with the absorption of UV light. The ring opens to form the precursor to vitamin D3 formation."

Teacher merit pay programs improve student outcomes

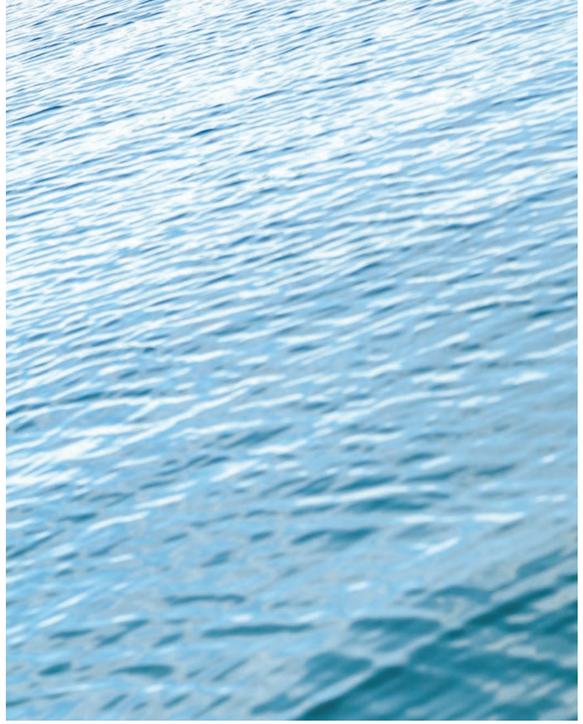
Do teacher merit pay programs improve student test scores? According to a Kansas State University College of Education researcher, the answer is yes.

Tuan Nguyen, assistant professor of curriculum and instruction, published "Teacher Merit Pay: A Meta-Analysis" in the American Educational Research Journal, one of the top and most respected journals in education research. His co-authors were Lam Pham, doctoral candidate at Vanderbilt University, and Matt Springer, associate professor of educational policy and leadership at the University of North Carolina at Chapel Hill.

Teacher merit pay, also called performance pay or differentiated pay, is a system of pay incentives meant to reward teachers with additional salary or a bonus based on performance and evaluation measures.

To determine if merit pay can raise student achievement, Nguyen and his colleagues examined the existing literature on merit pay with a particular focus on rigorous quantitative studies. They found, overall, merit pay programs can modestly raise student achievement, but the effect is strongly correlated with program design features such as opportunity of professional development, more sophisticated teacher evaluation systems and amount of pay.

"Merit pay can work, but there are important questions of how to fine-tune and experiment with better and more informed program designs to improve how merit pay works," Nguyen said.



Rural water wells show large increase in nitrate levels

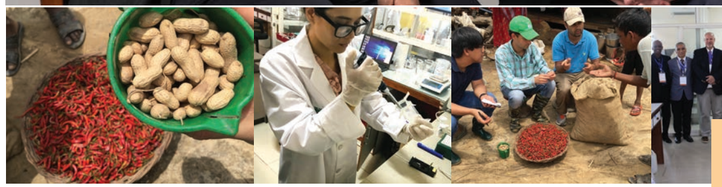
Kansas private well owners should test water quality annually, according to a recent Kansas State University study that revealed nitrate levels in shallow wells above U.S. Environment Protection Act standards.

"The changes we measured in the Great Bend Prairie Aquifer appear to be large relative to changes observed in a national study by the U.S. Geological Survey," said Matthew Kirk, associate professor of geology in the College of Arts and Sciences and the study's principal investigator.

The Great Bend Prairie Aquifer, a part of High Plains Aquifer, was the focus of a 40-year comparison study of rural water wells recently published in the Hydrogeology Journal. Kirk and Alexandria "Allie" Richard Lane, K-State 2018 master's degree graduate in geology, published the study along with Donald Whittemore from the Kansas Geological Survey; Randy Stotler from the University of Kansas geology department; and John Hildebrand and Orrin Feril, both with Big Bend Groundwater Management District No. 5.

"The Great Bend Prairie Aquifer is very vulnerable to contamination and if rural well owners don't know there is a problem, they obviously can't do anything about it," Kirk said. "Municipalities are required to test and provide safe drinking water for city residents but private rural well owners should take responsibility to test their wells at least every year."

From left: John Leslie, Jagger Harvey and Jeff Morris are addressing food supply contamination in Nepal.



Above: These photos show aspects of the K-State project to improve food security in Nepal.

Seek more

Find more information about the project in Nepal and see a full list of partners.
k-state.edu/seek

Collaboration for a safer global breadbasket

A Kansas State University team and collaborators are addressing food supply contamination in Nepal.

Jagger Harvey, director of the K-State Feed the Future Innovation Lab for the Reduction of Post-Harvest Loss, funded by the U.S. Agency for International Development, and several collaborating institutions recently finished a two-year project in Nepal.

The study found fungal toxins in several major food crops, including peanuts, corn, soy nuggets and chili peppers. Along with other partners, the Nepal Development Research Institute, the Nepal Academy of Science and Technology, and Helen Keller International led key components of the project, which established national capacity to address mycotoxin contamination in the food system. Jisang Yu, assistant professor of agricultural economics in the K-State College of Agriculture, led agricultural economics efforts.

"Twenty-five percent of Nepalese children are below the second percentile for growth on an international scale and a portion of this growth stunting is potentially attributed to naturally occurring mycotoxins in the food supply," said Harvey, also a research associate professor of plant pathology in the College of Agriculture. "In one region, previous work found 95% of pregnant women tested positive for exposure to aflatoxins, a category of mycotoxins."

To help Nepal plan a mitigation strategy, Harvey invited John Leslie, university distinguished professor of plant pathology in the College of Agriculture, to help host a multisectoral stakeholder workshop using the nominal group technique. Leslie has 30 years of experience leading workshops that use this discussion technique and has helped other developing countries with comparable issues.

According to Harvey, the nominal group technique helps stakeholders become invested in solving problems and helps guide their efforts. It works by dispersing people from a variety of backgrounds to formulate relevant local solutions to complex, multifaceted problems.

"The goal is to allow individuals to express what they see as a priority to solve the problem," Leslie said. "It's very democratic and in the end, you get both an excited and very empowered group and a diverse list of action items for addressing the problem."

Nepal now has a wet lab for food and feed mycotoxin testing and research to support the national planning and mitigation measures to remediate this food safety issue.

Collaboration and communication

Communicating across all entities is key in addressing food security. During the Nepal workshop, Jeff Morris, K-State vice president for communications and marketing, addressed the multiple difficulties of relaying scientific information to a general public without misconceptions that can cause irrational public concern and economic loss. As a result of this presentation, Morris and Leslie created a framework for communication about food security issues and published it in the December 2019 issue of Frontiers in Sustainable Food Systems.

Barbara Valent, university distinguished professor of plant pathology, has spent years studying wheat blast disease.

A K-State first: Plant pathologist named to National Academy of Sciences

Kansas State University plant pathologist Barbara Valent has earned membership in the prestigious National Academy of Sciences, or NAS. She is the first scientist at K-State to earn the honor for original research conducted while at the university.

As a member, Valent, university distinguished professor in the College of Agriculture, joins a group of scholars who are often sought out to provide independent, objective advice to national leaders on problems where scientific insights are critical.

"Being a member of the NAS is not just an honor but also an opportunity to impact scientific issues important for the well-being of the nation and the world," Valent said. "My expertise in fungal pathogens of important grain crops allows me to contribute to national and global food security issues including and beyond wheat blast."

Valent has worked on understanding blast disease, caused by a fungus known to scientists as *Magnaporthe oryzae*, for more than 40 years. In the last decade, her work has focused on wheat blast, a dangerous new disease in which the fungus is capable of taking out entire wheat fields.

Valent has led a research team that is driving the world's most comprehensive studies on wheat blast to keep it out of the U.S. Her team has worked in the K-State Biosecurity Research Institute, a biosafety level-3 facility, and the researchers were the first to discover a resistance gene called 2NS for wheat blast disease.

About the National Academy of Sciences

The National Academy of Sciences, or NAS, is considered the country's leading authority on matters related to science and technology. The academy was established by an act of Congress and signed by President Abraham Lincoln in 1863. Today, the academy has 2,405 members in the U.S. and 501 more internationally. Academy members are nominated and then elected in recognition of their distinguished and continuing achievements in original research.

Microplastics can be harmful to farm crops

A Kansas State University crop physiologist has found that plastic products, which are well known to cause negative impacts on fish and other aquatic animals, also have an adverse effect on land-based organisms, such as farm crops.

That fact should throw caution to such industries as agriculture in which plastic products are part of doing business, said Mary Beth Kirkham, university distinguished professor of agronomy in the College of Agriculture. She specializes in the relationship between soil, plants and water.

In a greenhouse experiment with wheat, Kirkham showed that the presence of tiny particles of plastic in soil caused water to pool up on the surface and the flooded conditions prevented oxygen from getting to a plant's roots. She also found that plastic serves as a vector, or vehicle, for plant uptake of such toxic materials as cadmium.

"Many plants died in the monthlong experiment," Kirkham said. "In the plants where cadmium was in the soil with plastic, the wheat leaves had much, much more cadmium than in the plants that grew without plastic in the soil."

Carnegie Foundation endorses K-State for community engagement

The Carnegie Foundation has named Kansas State University as one of 119 U.S. colleges and universities to receive the 2020 Carnegie Community Engagement Classification for the university's commitment to community engagement. K-State is one of 75 institutions to be reclassified by the Carnegie Foundation this year.

This classification honors higher education institutions that demonstrate dedication to collaborate at a local, state, national and global level to share knowledge and information. K-State first received this classification in 2010. A total of 359 institutions now hold the community engagement designation.

"Engagement is in the DNA of Kansas State University," said Charles Taber, provost and executive vice president. "It has been embraced since our founding as the first operating land-grant university and continues today through our numerous and varied community partnerships."

The university has more than 50 signature partnerships across its campuses and in numerous communities. The K-State Center for Engagement and Community Development enhances and broadens community partnerships and is responsible for reporting on community engagement for the university.

"I am so proud of K-State's administration, faculty, staff and students for daily efforts to work in partnership with our community partners to address the significant challenges faced by Kansans and communities worldwide," said David Procter, former director of the Center for Engagement and Community Development.

Researchers DEVELOP solutions through local watershed study

NASA and a collaborative Kansas State University team are working to understand changes to the Wildcat Creek watershed in Manhattan.

To help mitigate the risk of further flooding, Aida Farough, teaching assistant professor of geology in the College of Arts and Sciences, proposed a NASA DEVELOP program at K-State.

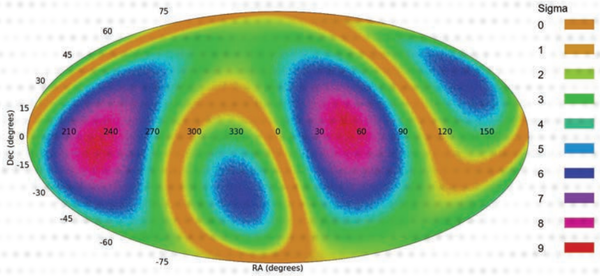
The program focuses on determining if changes in land use and land cover over the years have affected water runoff along Wildcat Creek. DEVELOP, part of the NASA Applied Sciences Program, supports research projects that address community challenges by applying data collected by NASA earth observatories.

Farough is collaborating with Trisha Moore, associate professor in the Carl and Melinda Helwig Department of Biological and Agricultural Engineering in the Carl R. Ice College of Engineering. Their team includes four student researchers selected competitively from across the U.S.

"Natural disasters are inevitable and we want our community to be more resilient," Farough said. "NASA already has this data. We just need to see what it can tell us."

The team that was hired by DEVELOP at Langley Research Center spent the summer analyzing data remotely. The findings will enable Manhattan-area community development officials to better understand the evolution of watersheds in Riley County and to make scientifically informed decisions to reduce the risks of future floods.

The researchers have provided results to the project's partner organizations, which include the city of Manhattan, the Riley County Department of Planning and Development, the Kansas Department of Health and Environment, the Kansas Forest Service and the Riley County Conservation District.



This image shows an all-sky mollweide map of the quadrupole in the distribution of galaxy spin directions. In this image, the different colors mean different statistical strength of having a cosmological quadrupole at different points in the sky.

Spiraling and spinning

An analysis of more than 200,000 spiral galaxies has revealed unexpected links between spin directions of galaxies. The structure formed by these links might suggest that the early universe could have been spinning, according to a Kansas State University study.

Lior Shamir, a K-State computational astronomer and computer scientist, presented the findings at the 236th American Astronomical Society meeting in June. The findings are significant because the observations conflict with some previous assumptions about the large-scale structure of the universe.

Since the time of Edwin Hubble, astronomers have believed that the universe is inflating with no particular direction and that the galaxies in it are distributed with no particular cosmological structure. But Shamir's recent observations of geometrical patterns of more than 200,000 spiral galaxies suggest that the universe could have a defined structure and that the early universe could have been spinning. Patterns in the distribution of these galaxies suggest that spiral galaxies in different parts of the universe, separated by both space and time, are related through the directions toward which they spin, according to the study.

"Data science in astronomy has not just made astronomy research more cost-effective, but it also allows us to observe the universe in a completely different way," said Shamir, also associate professor of computer science in the Carl R. Ice College of Engineering. "The geometrical pattern exhibited by the distribution of the spiral galaxies is clear, but can only be observed when analyzing a very large number of astronomical objects."

Jürgen A. Richt

Philip Hardwidge

A new infectious disease research center

The National Institutes of Health has awarded a Kansas State University-led team of veterinary researchers with a prestigious five-year, $11.3 million grant under the Centers of Biomedical Research Excellence, or COBRE, program to establish a new Center on Emerging and Zoonotic Infectious Diseases, or CEZID.

The center includes four primary research projects that bridge areas of excellence in the collective infectious diseases programs involving the colleges of Veterinary Medicine and Arts and Sciences.

"The overarching goal of the CEZID is to advance our overall understanding of emerging and zoonotic infectious diseases based on research performed in the state of Kansas," said Jürgen A. Richt, Regents distinguished professor at K-State and a Kansas Bioscience Authority eminent scholar.

Richt is the director of the center and Philip Hardwidge, professor of diagnostic medicine and pathobiology, serves as associate director.

Richt said there are two research core facilities to support the research projects and programs: an Animal Model/Pathology Core and a Molecular and Cellular Biology Core, which offer unique research infrastructure resources at K-State and the state of Kansas. See page 26 to learn more about Richt's infectious disease research.

Career builders

There's no question: Kansas State University early career faculty are award winners.

In fiscal year 2020, K-State had a significant number of early career award winners: four researchers received National Science Foundation CAREER awards and one researcher received a U.S. Department of Energy early career award.

The NSF Faculty Early Career Development, or CAREER, Program is one of the most prestigious NSF awards for supporting early career faculty who effectively integrate research and education in the context of the mission of their departments or organizations. The award comes with a federal grant for research and education activities for five consecutive years.

The DOE Office of Science Early Career Research Program is designed to bolster the nation's scientific workforce by providing support to exceptional researchers during crucial early career years when many do their most formative work. The five-year grants are very competitive and only 76 scientists received the award in 2020.

Learn more about the award-winning early career faculty members at K-State.

See *Shorts*

By the numbers

24

Number of K-State researchers who have received National Science Foundation CAREER awards since fiscal year 2001

3

Number of K-State researchers who have received U.S. Department of Energy Office of Science Early Career Research Program awards since the program was established in 2010

Dong Lin

Assistant professor of industrial and manufacturing systems engineering

Area of study: 3D printing and manufacturing composites

Award: $500,000 NSF CAREER award

Project title: "Bio-inspired manufacturing of high-strength, high-toughness metal-graphene composites"

Project description: Lin, Don and Linda Glaser Keystone research scholar in the Carl R. Ice College of Engineering, is establishing a bio-inspired manufacturing technology. He is engineering high-strength, high-toughness, 3D metal-graphene composites that can be used for automotive applications, aerospace, electronics packaging and thermal management.

"Nature-evolved, damage-tolerant materials such as nacre, bone and wood are both strong and tough because of their hierarchical composite structure," Lin said. "Unlike bone and wood, which have complex microstructures, nacre, more commonly known as mother of pearl, exhibits superior mechanical properties with a simple composite microstructure."

Lydia Zeglin

Associate professor of biology

Area of study: Microbial ecology

Award: $650,000 NSF CAREER award

Project title: "How do microorganisms and grazing mammals interact at local to regional scales to maintain grassland nitrogen cycling processes?"

Project description: Zeglin, a microbial ecologist in the College of Arts and Sciences, is researching interactions between the tallgrass prairie's largest species, which are bison and cattle, and the smallest species, which are soil microbes. The interactions between grazers and soil microbes are important for prairie biodiversity and may affect how soil can remediate nitrogen pollution. Zeglin is testing soil from multiple prairie locations with a citizen scientist approach.

"Our ultimate goal is to understand the nitrogen cycle in all prairie soils better," Zeglin said. "We are working with The Nature Conservancy, ranchers and students to contribute soil samples from bison- and cattle-grazed areas across the Flint Hills to expand the range of understanding."

Ryan Hansen

Assistant professor of chemical engineering

Area of study: Biomaterials

Award: $550,000 award from NSF CAREER and Kansas EPSCoR programs

Project title: "Understanding bacteria encapsulation, proliferation and release in photodegradable hydrogel materials"

Project description: Hansen, Steve Hsu Keystone research scholar and Warren and Gisela Kennedy Keystone research scholar in the Tim Taylor Department of Chemical Engineering in the Carl R. Ice College of Engineering, is investigating the chemical and physical properties of light-reactive hydrogels. The hydrogels will be used for isolation of rare bacteria and on-demand delivery of therapeutic bacteria to targeted disease sites.

"The project is creating new research avenues at K-State in areas of human health and food safety and will produce globally minded students prepared for crosscutting careers in materials science and microbial biotechnology," Hansen said.

Jeff Comer

Associate professor of anatomy and physiology

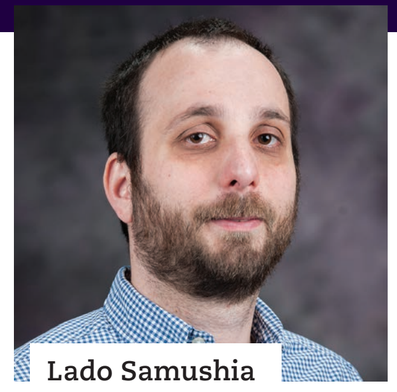
Area of study: Biomolecular binding and nanomedicine

Award: $565,800 NSF CAREER award

Project title: "Programmable assembly of glycine-rich peptides on a graphitic surface"

Project description: Comer is the first researcher in the College of Veterinary Medicine to receive a CAREER award. He works at the intersection of biology, physics and computer science, and designs protein-like molecules that can be programmed to arrange themselves into complex biomedical devices for drug delivery and diagnostic tests. The educational part of the project uses state-of-the-art molecular simulation methods to help students understand how medicines work at the molecular level.

"The miniaturization of devices such as computers and cellphones has been so successful that the size of their parts is now similar to the size of molecules and atoms," Comer said. "The future is building devices atom-for-atom out of individual molecules."



Lado Samushia

Associate professor of physics

Area of study: Cosmology

Award: $750,000 DOE early career award

Project title: "Robust dark energy constraints with dark energy spectroscopic survey"

Project description: Samushia, a cosmologist in the College of Arts and Sciences, is measuring positions and properties of tens of millions of distant galaxies. His statistical analysis of the distribution of those galaxies and the patterns they make can help us to better understand dark energy.

"Dark energy is one of the hottest topics in modern cosmology," Samushia said. "We know that 70% of the universe is made of a mysterious substance that we call dark energy — dark because it does not emit any light — but we don't really have a good idea of what it is."

WELCOME HOME

ARCHITECTURE STUDENTS USE RESEARCH TO DESIGN AFFORDABLE, SUSTAINABLE HOUSING — BY BETH BOHN

Home. Be it big or small, rented or owned, on the range or in the big city, there's no place like it.

Finding an affordable home, though, can be a challenge across the U.S. Experts say affordable housing should cost no more than 30% of one's annual income. But according to 2016 U.S. Census Bureau data, nearly half of Americans earning under $50,000 per year are now overburdened by housing costs and spend more than 30% of their income on housing. And for every home built for under $150,000, more than 18 homes are built for over $300,000.

A graduate architecture studio at Kansas State University wants to change that by designing affordable and energy-efficient homes that improve quality of life. The Net Positive Studio, created and led by Michael Gibson, associate professor of architecture, is a research-based studio for students in their final year of the five-year Master of Architecture program in the College of Architecture, Planning & Design.

"Our mission is to research, develop and demonstrate housing models that can support households and communities," Gibson said. "Through lean construction and thoughtful design, the homes intend to foster the quality of life and well-being of residents by freeing up income, minimizing required maintenance, improving social connections and building restorative connections to the outdoors."

Along with affordability, the studio focuses on designing net-zero energy homes that offset energy use through renewable energy generation, and the students use the latest technology to optimize home construction.

"Homes in the U.S. are responsible for a staggering one-fifth of national energy consumption and use more energy than commercial, institutional and industrial buildings," Gibson said. "Moreover, the cost of housing and utilities increasingly burdens household budgets with an average utility expenditure that can exceed $2,000 annually for heating fuel and electricity."

This model shows a proposed home for the Indian Mound neighborhood in Kansas City, Missouri.

DIFFERENT PLACES, SAME PROBLEM

The studio has put its mission to work with real clients: nonprofit partners who are helping fund homes in the Indian Mound neighborhood in urban Kansas City, the largest city in Missouri with a population just under 500,000, and in rural St. John, a south central Kansas community with a population just under 1,200.

The 15-member 2018-2019 studio was tasked by the Mattie Rhodes Center, a community service organization in Kansas City, to introduce a new model of affordable, sustainable housing for Indian Mound, while the 14-member 2019-2020 studio is working with Stafford County Economic Development to come up with affordable, appealing rental housing in St. John.

Using research as the foundation for their home designs, Gibson said each class analyzed the number and condition of existing homes in each area. They also looked at average housing costs and median incomes. Despite the difference in population between Indian Mound and St. John, the students found the same problem in each place: aging housing stocks. In both locations, more homes are coming down than are going up each year, which makes finding an affordable home more difficult.

According to the students' research, the Indian Mound neighborhood has 3,000-plus homes, but only one new home permit has been issued in the last 22 years.

"Indian Mound is among the historic northeast Kansas City neighborhoods known for diversity and prosperous family life," Gibson said. "But in the last 20 years, these neighborhoods have suffered from neglect and absentee landlords."

In their study of St. John, the students found that of the 552 homes currently in the community, 85% were built between 1920-1969 and only 4% were built between 1980-2019.

"Our goal is to expand the availability of affordable housing in the county and in particular, rental housing," said Carolyn Dunn, executive director of Stafford County Economic Development. "The housing inventory in Stafford County is on average 78 years old, and the last time housing was built specifically as rental housing in St. John was 1982."

> "THIS IS NOT SOMETHING THAT A LOT OF ARCHITECTURE STUDENTS CAN SAY, THAT THEY GOT TO CREATE A HOUSE WITH THEIR OWN TWO HANDS.
>
> *Jameson Jones, member of Net Positive Studio*

MAKING THEIR PLANS

Just as professional architects do, each class met regularly with its client and with community members to help shape their designs and get feedback before finalizing plans.

"What I most enjoyed about the project was getting to work with and present our proposals to the community," said Christian Carter, a member of the Indian Mound studio. "Some of these diverse northeast Kansas City neighborhoods haven't seen much growth since the 1950s and Indian Mound wasn't an exception. It was also really great to hear the stories and how people were hoping to bring change and reinvigorate this neighborhood while keeping the aspect of affordability at the forefront of every decision."

In Indian Mound, the students chose to build a home on a vacant lot owned by the Mattie Rhodes Center. Their goal was to keep it affordable for the buyer most interested in this neighborhood: a family who has one or two children and may be transitioning from rental housing.

Dunn challenged the St. John studio to come up with a rental home for around $100,000 to be built on a vacant lot owned by Stafford County Economic Development. The average median income for St. John/Stafford County is $47,000 a year, which means the cost of new construction can exceed what most people can afford.

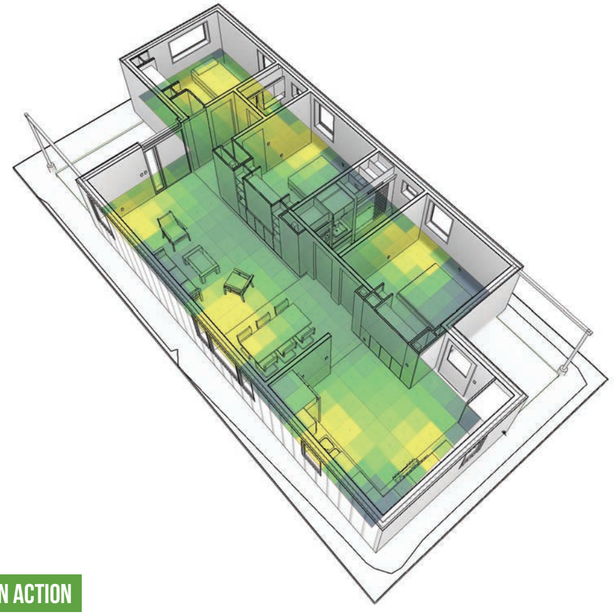
"This is not something that a lot of architecture students can say, that they got to create a house with their own two hands and solve the problems along the way that needed to be solved," said Jameson Jones, a member of the St. John studio.

Above: These renderings show the exterior and interior of a Net Positive Studio home.

Above: Net Positive Studio students discuss and build components for one of the two homes they have designed.

Above: These additional renderings show the interior and exterior of a Net Positive Studio home.

Above: Net Positive Studio students discuss, design and present home plans.



The layout of a Net Positive Studio home shows how the social core takes advantage of space that would be lost to hallways in a typical house, which helps to achieve a compact footprint. Generous windows in the living room offer daylight, natural ventilation, and passive solar heating that will result in the house using approximately 80% of the energy that a comparable new home would use.

DESIGN IN ACTION

The students' final home designs for both locations are energy-efficient, prefabricated homes with three bedrooms and two bathrooms. The Indian Mound home will be 1,033 square feet, while the St. John home will be 1,100 square feet. The foundations for both homes will be insulated so they can better retain heat in the cold months and keep cool when it's warmer outside.

Students shifted the public and private areas in each home to optimize circulation. While the bedrooms are small, the communal areas, including the kitchens and living rooms, are bigger so families have room to spend time together. Mechanical systems in the ceiling run through the middle of the home so they don't take up valuable space.

As Net Positive Studio members, students are engaged in all facets of the home projects, including building the prefabricated components for the homes. They do so in an off-campus university workshop under the supervision of Gibson.

The components for the Indian Mound home were completed in the spring 2019 semester. The home has 26 insulated exterior and interior wall panels. The exterior panel seams will be sealed once assembled to increase energy efficiency. The home will feature high-performance vinyl windows, high-efficiency appliances and a 3.4-kilowatt solar power system in the roof. The interior walls are sanded plywood coated with polyurethane so no drywall or painting is needed.

Net Positive Studio students build components for their homes in an off-campus workshop owned by the university.

The Mattie Rhodes Center is working with CoBuild, a general contractor, and Emerging Builders, a nonprofit providing construction training and educational opportunities for women and minorities, on the Indian Mound home. The center also will find the buyer for the home, which is being financed in part with a U.S. Department of Housing and Urban Development grant through its HOME program. The projected buyer is a household of four making less than 80% of the $82,700 median income for Kansas City.

The St. John home will include many of the same features of the Indian Mound home, but the students will use prefabricated, preinsulated wall panels to save construction time. The solar power system will be comprised of a dozen small-but-efficient solar panels that the students said will pay for themselves in about 10 years. While larger than the Indian Mound home, Gibson said the St. John studio succeeded in designing it with fewer parts.

COVID-19 put the construction of home components on hold, but a small crew of students completed the prefabricated components in the summer. The project is now slated to be finished in fall 2020 with the help of Stafford County Economic Development interns. The organization will retain ownership of the home and property as a rental because of the rental housing shortage in the county, Dunn said.

"It's nice knowing that this is going to be built, that it's going to come to fruition and not just be a project in a portfolio," said Catherine Gutman, a member of the St. John studio. "This is a house that someone will live in."

The St. John home may start a building boom. Dunn said Stafford County Economic Development is receiving $500,000 from the Kansas Housing Resource Corporation through the HOME program to build four additional houses in St. John and nearby Hudson. The houses also will be rental properties.

"We really want to complete the K-State house and prove out the estimated costs," Dunn said. "A big part of what makes the students' design relevant for addressing the rural housing challenge is being able to construct the homes at a price that is substantially lower than conventional housing design."

ON BUDGET

The cost of building the initial homes is being kept low because of the volunteer student and faculty time and some donated materials, including the windows from Interstate Glass Co. in Junction City. Students and faculty in the K-State interior architecture & industrial design and landscape architecture programs assisted by designing the cabinetry and outdoor spaces. Gibson said the intent is for both homes to be duplicated by a general contractor for between $125,000 and $150,000.

"We are working on grant applications that will take this house design and replicate it for what I hope will be a dozen or so rental properties in the next couple of years," Dunn said.

BUILDING SUCCESS

The next assignment for the Net Positive Studio is the 2020 Solar Decathlon, a biennial collegiate competition sponsored by the U.S. Department of Energy. K-State was selected as one of 10 schools to design a super-efficient home that demonstrates next-level technology. A prototype of the home was to be constructed and taken to the National Mall in Washington, D.C., this summer for judging, but the event was canceled because of COVID-19. Gibson said the studio is still competing in the decathlon but under some fluctuating rules and calendar adjustments.

While the national recognition is rewarding, Gibson said having the studio mission realized is the best sign of its success.

"These projects have been a reminder of how important houses and housing are to the people who live in them," Gibson said. "This studio's tireless effort in researching and designing housing is matched by the earnestness and empathy the students show in responding to the real people and problems that are behind the headlines in today's housing crisis. Every time their designs advanced, I felt more strongly that these aren't just construction projects; these homes will give back a tremendous amount to the people who will live in them."

Seek more

View a gallery of photos from the Net Positive Studio. Learn more about the studio and how to become a partner. ***k-state.edu/seek***

This completed tiny home is part of the tiny home community project in Nicodemus, Kansas.

JohnElla Holmes

La Barbara James Wigfall

TINY IS BIG IN NICODEMUS

A research project by Kansas State University College of Architecture, Planning & Design students has provided a tiny solution to a big housing problem in Nicodemus, Kansas.

Residents of Nicodemus, the only continuously settled African American town west of the Mississippi River and a national historic site, have been working to keep their community economically viable since the 1970s.

K-State interior architecture & industrial design and landscape architecture students came up with the solution with their fall 2017 studio project: "The Nicodemus Campus of Small Homes."

Their plans for a tiny community of tiny homes were based on meeting with Nicodemus residents JohnElla Holmes, a K-State faculty member, and Angela Bates, director of the Nicodemus Historical Society, and learning about community needs and goals. The residents loved the students' idea and garnered a $120,000 grant from the Dane G. Hansen Foundation to launch the Nicodemus Tiny Homes Project.

Two homes have been built: one is a residence for a retiree and the second is the Cabin, which provides short-term residential living for groups, artists-in-residence and other visitors. Construction of a third home, for a retiree, was put on hold because of COVID-19. To raise funds to build the next four tiny homes, the town sponsored a tiny home giveaway as part of the virtual 142nd Nicodemus Homecoming Emancipation Celebration and the community's Pioneer Day Festival.

College of Architecture, Planning & Design involvement in Nicodemus has been ongoing for nearly 40 years and has been a focus of La Barbara James Wigfall, associate professor of landscape architecture and regional & community planning, with several award-winning projects.

A DECADE OF RESEARCH

2010
2020

Looking back at 10 years of K-State milestones

By Jennifer Tidball

It's been a busy decade for Kansas State University researchers.

Since 2010, K-State researchers have studied infectious diseases, tackled global food insecurity and created new research centers and laboratories. They have achieved international recognition and have been at the forefront of the latest scientific developments and creative discovery.

These researchers have continued the university's land-grant mission to serve communities at home and across the globe — a key piece of the K-State 2025 visionary goal to be a premier, student-centered, public research university by 2025.

Read more about 10 of the biggest research achievements of the past 10 years.

Biosecurity: The Biosecurity Research Institute, or BRI, opened in 2007, and in 2009, Manhattan was selected as the site for the federal National Bio and Agro-Defense Facility, or NBAF. In the decade that followed, K-State has become the "the Silicon Valley for Biodefense," according to Tom Daschle, former majority leader of the U.S. Senate and member of the Blue Ribbon Study Panel on Biodefense.

Scientists across the university have studied H1N1 virus, Zika virus, African swine fever virus, West Nile virus, avian influenza, wheat blast fungus and many other infectious diseases. Many of these projects will jump-start research at NBAF when it becomes operational in the next decade.

The university has continued to maintain numerous biosecurity-related facilities, research collaborations and academic programs, including the BRI, which is biosafety level-3 facility devoted to comprehensive infectious diseases research and training; the Center of Excellence for Emerging and Zoonotic Animal Diseases, which the U.S. Department of Homeland Security created in 2010 at K-State; the National Agricultural Biosecurity Center; and the K-State Plant Disease Diagnostic Lab, among many other organizations and partnerships. See page 26 to learn how researchers are using many of these K-State facilities to study COVID-19.

K-State Olathe: The K-State Olathe campus opened in 2011 as a Kansas City-area hub for research on human and animal health, food innovation and sensory analysis.

There have been many successes in its first decade. The 1Data collaboration formed in 2017 by K-State and the University of Missouri-Kansas City and includes multiple projects that use big data to improve human and animal lives. Many startup and brand name companies have scaled up operations and developed or refined new products with the Food Innovation Accelerator. Local and Fortune 500 companies use the Sensory and Consumer Research Center to study food and consumer products and improve them. The Postharvest Physiology Lab helps local and national growers improve their produce and is helping Kansas hemp farmers tap an emerging economic market. See page 36 to learn more about industrial hemp research.

K-State Polytechnic: The K-State campus in Salina has evolved in the past decade and built research programs focused on aviation, unmanned aircraft and bulk solids. A 2015 name change to the Kansas State University Polytechnic Campus reflected this evolution.

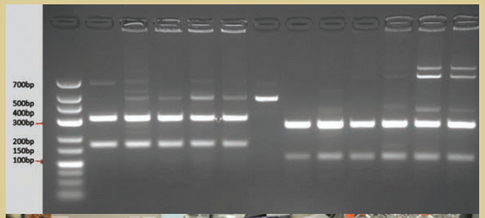
The K-State Polytechnic Applied Aviation Research Center is engaged in research that promotes the commercialization of unmanned aircraft. The center has been involved in validating unmanned aircraft standards for the Federal Aviation Administration, exploring unmanned aircraft as tools for inspecting power lines or wind turbines and using unmanned aircraft to map natural resources. The Bulk Solids Innovation Center focuses on testing, storing and transporting bulk solids, which are loose, dry commodities such as pellets, granules, powder, grain and recycled plastics. The center opened in a new facility in 2015 and is the only one of its kind in North America.

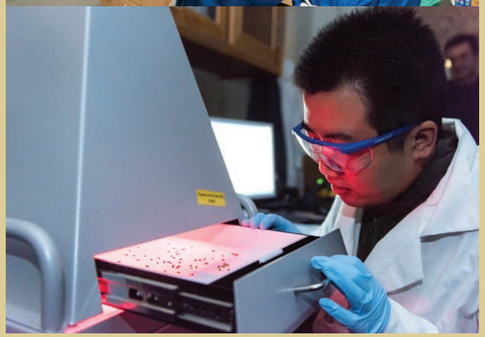
Feed the Future Innovation Labs: Beginning in 2013 and over the course of 14 months, K-State was named the winner of four highly competitive grants totaling more than $100 million from the U.S. Agency for International Development, or USAID. The grants established four Feed the Future Innovation Labs: the Feed the Future Innovation Lab for Collaborative Research on Sorghum and Millet, the Feed the Future Innovation Lab for Applied Wheat Genomics, the Feed the Future Innovation Lab for the Reduction of Post-Harvest Loss and the Feed the Future Innovation Lab for Sustainable Intensification.

The Feed the Future Innovation Labs are global collaborations among universities, industry and nongovernmental organizations. The labs focus on ending world hunger by improving the resiliency and production of food crops as well as preventing crop losses in grain-producing countries. The labs address these challenges through a combination of research, education and outreach in target nations.

The Edge Collaboration District: The northern edge of the Manhattan campus was largely undeveloped land in 2010. In the past 10 years, it has become a hub of industry, research and university collaboration. The area became known as the North Campus Corridor, and in 2020 was renamed the Edge Collaboration District, which is a partnership between K-State and the Kansas State University Foundation.

More than a dozen partners and six academic colleges are represented in the Edge Collaboration District, and more are expected. Some of these partners include the city of Manhattan, the K-State Research Park, the K-State Office Park, the National Bio and Agro-Defense Facility, the Biosecurity Research Institute, the Kansas Department of Agriculture, the College of Veterinary Medicine, the College of Agriculture Grain Science and Industry Complex, the Kansas Wheat Commission and the National Science Foundation I/UCRC Wheat Genetics Resource Center.



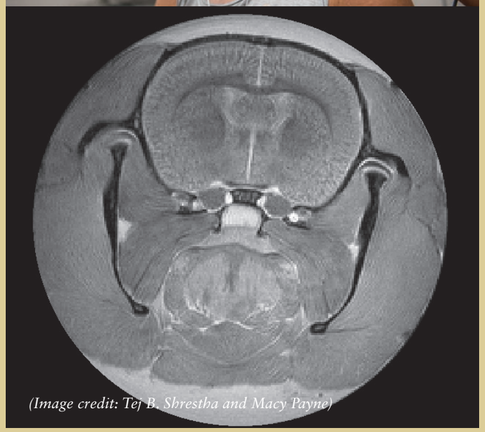


CRISPR technology: CRISPR-Cas9 technology was introduced in 2012 and has since revolutionized the scientific world. The 2020 Nobel Prize in chemistry was awarded to the scientists who developed the gene-editing technology.

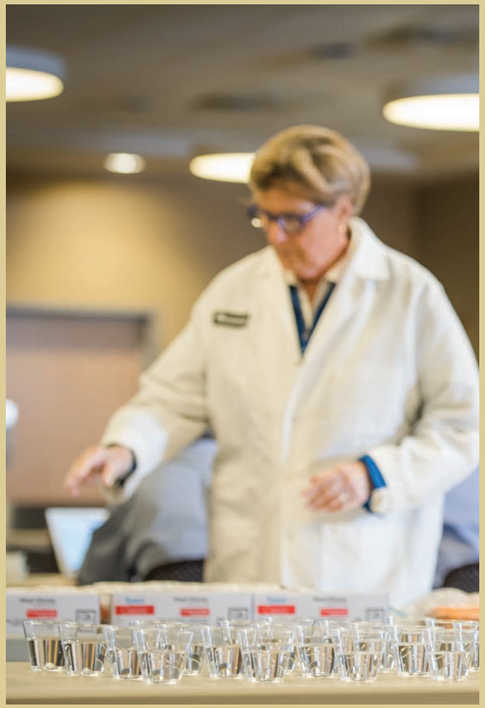
K-State researchers have used CRISPR technology to ethically and responsibly combat some of the world's most devastating animal and plant diseases. College of Agriculture plant pathologists are developing wheat varieties with improved traits, such as having higher yields or being more drought tolerant. A biochemistry and molecular biophysics team in the College of Arts and Sciences is studying gene drives through the model system of yeast. College of Veterinary Medicine researchers have used the technology to fight animal diseases such as African swine fever and porcine reproductive and respiratory syndrome.

Konza Prairie Biological Station: In 2010, the Konza Prairie Biological Station was named one of the Eight Wonders of Kansas Geography by the Kansas Sampler Foundation. In addition to beautiful views of untouched tallgrass prairie, the 8,600-acre Konza Prairie is also the site of long-term ecological research, from burning and grazing techniques to all aspects of the grassland ecosystem: flowers, soil, water and wildlife.

The Konza Prairie has been a National Science Foundation Long-Term Ecological Research site for more than 45 years and it continued to received funding renewals in 2014 and 2020. The Konza Prairie is jointly owned by K-State and The Nature Conservancy and is managed by the Division of Biology in the College of Arts and Sciences.



(Image credit: Tej B. Shrestha and Macy Payne)



CNAP Center: In 2017, the National Institutes of Health awarded a nearly $11 million Centers of Biomedical Research Excellence, or COBRE, grant to establish the K-State Cognitive and Neurobiological Approaches to Plasticity Center, or CNAP. It is the largest grant in the history of the psychological sciences department and marked the second time that K-State has received a COBRE grant.

The statewide center aims to understand the human brain and how it changes. More than 63 collaborators, including University of Kansas and Wichita State University researchers, are involved with CNAP and are conducting cognitive, behavioral and neurobiological research on topics such as self-control, alcohol abuse, aging, hearing, memory loss and learning.

Sensory Analysis Center: The K-State Sensory Analysis Center has investigated sensory analysis and worked with companies across the globe for more than 30 years. In 2015, the center was named the top in the world for sensory analysis research influence by the Journal of Sensory Studies.

The Sensory Analysis Center conducts more than 50 studies every year. At the Manhattan and Olathe campuses, faculty, students and panelists conduct consulting, education and consumer research on a variety of products and topics: food, beverages, cosmetics, fabrics, packaging, paints, personal care products and fragrances, as well methodologies and food safety.

Global Food Systems Initiative: In the past decade, K-State began the Global Food Systems Initiative to focus on what will become a critical challenge in the coming decades: feeding the rapidly growing world's population, which will grow to an estimated 9.6 billion people by 2050.

The K-State research initiative aims to solve global food challenges through innovation, outreach and workforce development. K-State has been preparing for this challenge for decades, and it is a challenge that harkens back to the university's land-grant mission when it was founded many decades ago.

WHAT'S NEXT?

The next decade offers many new research developments and opportunities.

Infectious disease research: The COVID-19 pandemic has made it even more evident that infectious disease research will continue to play a critical role in the coming years. See page 26 to learn more about how K-State is fighting the coronavirus pandemic.

Center on Emerging and Zoonotic Infectious Diseases: In 2020, K-State received its third National Institutes of Health Centers of Biomedical Research Excellence grant. The $11 million in funding established the new Center on Emerging and Zoonotic Infectious Diseases. See page 11 to read more about the new research center.

3D printing: 3D printing has dramatically improved, and artists, researchers and scholars continue to use this technology across the university, from the art department in the College of Arts and Sciences to the Carl R. Ice College of Engineering and the College of Architecture, Planning & Design.

Chapman Center for Rural Studies: The center's focus on strengthening rural Kansas communities will play a key role as rural communities evolve in the next decade.

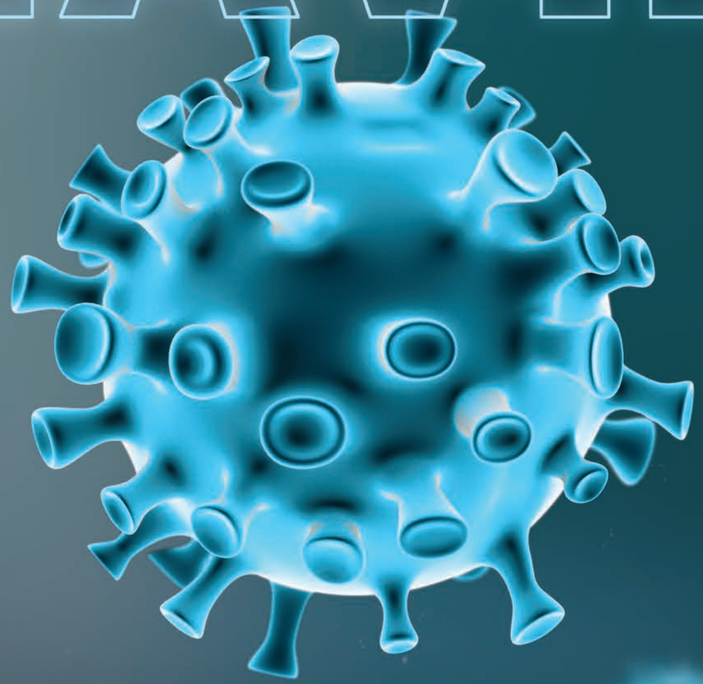
Health sciences: The recently renamed College of Health and Human Sciences is setting the stage for new research, education and outreach that promotes the well-being of individuals, families and communities.

Beach Museum of Art: The collection at the Marianna Kistler Beach Museum of Art has grown to more than 10,000 objects that highlight Kansas and regional art. The museum will celebrate its 25th anniversary in 2021.

Seek more

Read more about the decade of K-State research achievements.
k-state.edu/seek

CORONAVIRUS



A pandemic battle

In the time of COVID-19, K-State scientists take the lead

By Erin Pennington and Jennifer Tidball

By now, we all know the key phrases that describe the COVID-19 pandemic. They are familiar snippets we have heard many times during this period of history. Loss of taste and smell. Cases spreading. Hundreds of thousands of deaths. Staying home. Record unemployment. Economic collapse. No treatment and no vaccine.

At the center of everything is a newly emerged coronavirus called SARS-CoV-2, which causes COVID-19. In its name, CO stands for corona, VI for virus, D for disease and 19 for the year 2019 when it emerged. This highly contagious and difficult-to-treat virus is covered in spikes — similar to the jewels on a crown, or corona — that attach to the cells in our bodies.

There is no denying that the pandemic has affected nearly every aspect of our daily lives. Things look different now. We wear face coverings. We stand 6 feet apart. We practice behaviors to mitigate the spread of the virus.

Kansas State University researchers are helping by battling the pandemic from multiple angles: understanding the virus, exploring vaccines and treatment options, improving COVID-19 tests, 3D-printing test materials and assisting communities.

The solutions during this COVID-19 pandemic come through a multifaceted approach led by the state's land-grant university.

"As the country's first operational land-grant university, K-State has always risen to the occasion to help our state and country through difficult times," said Richard Myers, K-State president. "The current COVID-19 pandemic is no different and our researchers continue to lead the way through important work across disciplines. Together, we will battle this pandemic."

The Biosecurity Research Institute in Pat Roberts Hall is a biosafety level-3 facility where researchers can safely study SARS-CoV-2, which is the coronavirus that causes COVID-19.

Answering the call

While it has been a K-State research asset for more than 10 years, the Biosecurity Research Institute, or BRI, was created for historic moments like the current global pandemic. The BRI, in Pat Roberts Hall, is a biosafety level-3 facility where researchers can safely study infectious diseases that affect plant, animal and human health. Zoonotic viruses, which are viruses such as SARS-CoV-2 that spread between animals and humans, are one of the areas of focus at the BRI.

Since the beginning of the COVID-19 pandemic, scientists and staff at the BRI have ramped up research on SARS-CoV-2 in an "all hands on deck" approach to fighting a virus that affects us all. Under the leadership of Director Stephen Higgs, the BRI quickly began new research programs related to SARS-CoV-2 and built on existing infectious disease research and training programs.

"Time is of the essence when responding to a new biological threat," Higgs said. "I am proud of the work we are doing at K-State to learn as much as we can about SARS-CoV-2 and other dangerous pathogens. This work is possible because of the unique capabilities of the BRI and the dedicated BRI and institutional staff."

The BRI provides the secure environment, training and infrastructure required for research on SARS-CoV-2. It is adjacent to the federal National Bio and Agro-Defense Facility, or NBAF, which is under construction and will be America's foremost animal disease research facility. NBAF is a biosafety level-3 and biosafety level-4 laboratory that will replace the aging Plum Island Animal Disease Research Center in New York.

Research facilities such as the BRI have brought K-State and the state of Kansas into the national and international spotlight for important biosecurity work during the current pandemic.

State leaders recognize the importance of the BRI and the research conducted there. Kansas Gov. Laura Kelly toured the BRI in August to meet with researchers and learn more about their work fighting COVID-19 and other diseases that affect human, animal and plant health.

"The Kansas State University Biosecurity Research Institute has a long history of excellence and innovation researching disease spread like what we are currently facing with COVID-19," Gov. Kelly said after the visit. "My conversations with BRI staff served as a reminder of how many of our best and brightest have answered the call to help end the pandemic."

BRI researchers have answered the call and completed six projects related to COVID-19 since March, in addition to many ongoing coronavirus research projects.

Stephen Higgs, Biosecurity Research Institute director, talks with Kansas Gov. Laura Kelly during her visit to learn more about K-State research that is fighting COVID-19 and other diseases. (Photo credit: Office of Governor Kelly)

Researchers Taeyong Kwon, left, and Jürgen A. Richt have completed several coronavirus projects.

A new zoonotic disease

Some of the BRI research focuses on the zoonotic potential of SARS-CoV-2 to pass between animals and humans.

Researcher Jürgen A. Richt has completed several coronavirus projects at the BRI. Richt is the Regents distinguished professor in the diagnostic medicine and pathobiology department and director of the Center on Emerging and Zoonotic Infectious Diseases, or CEZID, in the College of Veterinary Medicine.

His work focuses on five areas: animal susceptibility and transmission of SARS-CoV-2, virus stability on surfaces, therapeutic treatments, diagnostics and vaccines.

Richt and his colleagues have found evidence that SARS-CoV-2 is more stable under spring and fall conditions than under summer conditions on various surfaces. The work was recently published in a non-peer-reviewed paper on bioRxiv.org.

He has found that pigs do not seem to be susceptible to coronavirus, but little is known if the virus affects cattle, sheep, chickens or wildlife. He is further researching if other livestock may be susceptible to coronavirus.

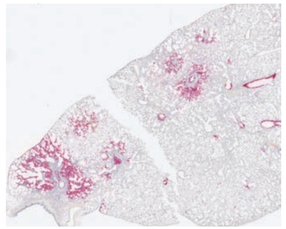
Domestic cats are susceptible to feline coronaviruses and Richt's team is studying if domestic cats can carry and spread SARS-CoV-2. The team has found that cats are a potential host species for SAR-CoV-2, and even asymptomatic cats can transmit the virus to other cats. They have published the non-peer-reviewed study on bioRxiv.org.

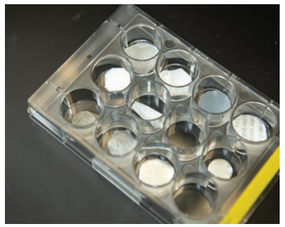
"This study is critical in understanding the role of companion animals in the ecology of SARS-CoV-2," Richt said. "We must continue to study SARS-CoV-2 to better understand potential virus reservoirs such as cats as well as its potential transmission to other animals and humans."

The study is one of several COVID-19-related studies. Separate studies have been published on bioRxiv.org and have looked at the susceptibility of swine cells and domestic pig cells to the SARS-CoV-2 virus.

Richt also serves on an expert panel for the World Health Organization, which has tasked the group with developing COVID-19 preclinical models for the evaluation of vaccines and therapeutics.

One of Richt's collaborative projects involves Sumit Chanda with the Sanford Burnham Prebys Medical Discovery Institute, Nevan Krogan with the University of California San Francisco and Adolfo García-Sastre with the Icahn School of Medicine at Mount Sinai. The project has involved repurposing existing drugs that have been in human clinical trials or approved by the Food and Drug Administration, or FDA, for treating diseases such as cancer, leprosy, Crohn's disease and other illnesses.





Above left: This microscopic image shows a hamster lung that has been infected with SARS-CoV-2 coronavirus. Viral RNA is shown in red.

Above right: This tray of objects is used for a test to study the stability of SARS-CoV-2 on various surfaces, such as plastic, metal, glass and other surfaces.

The researchers used a National Institutes of Health library of 12,000 drugs and tested them for efficacy against COVID-19 in cell cultures to see if they inhibited SARS-CoV-2 replication. They have narrowed the list of drugs down to about two dozen potentially effective drugs. Richt is now testing these potential antiviral drugs in preclinical models.

"We are on the front end of studying whether these drugs, which look very promising in cell culture assays, can be used in COVID-19 patients," Richt said. "We hope that the work we are doing presently will save lives."

Richt's research is supported in part by the National Bio and Agro-Defense Facility Transition Fund provided by the state of Kansas, the U.S. Department of Homeland Security and the National Institutes of Health. See page 11 to learn more about Richt's work with the new Center on Emerging and Zoonotic Infectious Diseases, or CEZID.

Mosquitoes do not transmit SARS-CoV-2 to people, according to a K-State collaborative study.

Mosquitoes and the virus

Stephen Higgs led a collaborative study that is the first to confirm that SARS-CoV-2 cannot be transmitted to people by mosquitoes. The study, published in Nature Scientific Reports, found that the virus cannot replicate in three common mosquito species — *Aedes aegypti, Aedes albopictus* and *Culex quinquefasciatus* — and, therefore, cannot be transmitted to humans by mosquitoes.

"While the World Health Organization has definitively stated that mosquitoes cannot transmit the virus, our study is the first to provide conclusive data supporting the theory," said Higgs, Peine professor of biosecurity and university distinguished professor of diagnostic medicine and pathobiology.

The study involved BRI and College of Veterinary Medicine collaborators in diagnostic medicine and pathobiology, including Yan-Jang Huang, research assistant professor; Dana Vanlandingham, professor; and Ashley Bilyeu, Susan Hettenbach and Haelea Sharp, all research assistants.

The research was in part supported by the National Bio and Agro-Defense Facility Transition Fund provided by the state of Kansas.

Researcher Yunjeong Kim holds up a lab sample with the expression of a therapeutic target, SARS-CoV-2 3C-like protease.

Virologists Kyeong-Ok "KC" Chang, left, and Yunjeong Kim are developing antiviral drugs for human coronaviruses.

Blocking the spike

K-State has signed four COVID-19-related licensing agreements with companies for vaccine candidates and possible antiviral drugs. All the licensing agreements have been coordinated through K-State Innovation Partners.

In one research agreement with clinical-stage biopharmaceutical company Tonix Pharmaceuticals, scientist Waithaka Mwangi is studying a COVID-19 vaccine candidate at the BRI. The research is based on a new vaccine platform that his team developed for bovine parainfluenza 3 virus, known as BPI3V, which is closely related to human parainfluenza 3 virus.

Mwangi, professor of diagnostic medicine and pathobiology in the College of Veterinary Medicine, and his team have focused on the most critical protein of coronaviruses: the spike protein. When a person is exposed to the virus, this protein is involved in the infection of the host cell. The vaccine candidate developed at K-State has been engineered to display the spike protein in a manner that mimics the actual virus.

Instead of being injected, Mwangi's vaccine candidate could be sprayed in the nose to trigger immune protection and block the virus's spike protein from infecting the host cells. The vaccine also would induce T-cell responses capable of killing infected cells.

Antiviral drugs and treatment

One problem during the COVID-19 pandemic is that there are not yet any antiviral drugs for human coronaviruses.

Two virologists in the College of Veterinary Medicine, Yunjeong Kim and Kyeong-Ok "KC" Chang, are trying to solve this problem by discovering a treatment for COVID-19. They have signed two licensing agreements with Cocrystal Pharma Inc., which is a clinical-stage biotechnology company, and another licensing agreement with Anivive Lifesciences, which develops companion animal and human medicines.

"Vaccine developments and treatments are the biggest targets in COVID-19 research," said Chang, professor of diagnostic medicine and pathobiology.

One of the licensing agreements grants Cocrystal the use of two series of protease inhibitors that Kim and Chang developed and patented.

"Protease inhibitors bind and block the function of the virus protease," said Kim, associate professor of diagnostic medicine and pathobiology. "Those virus proteases are essential enzymes for virus replication, so if you bind and block them, then the virus cannot replicate anymore."

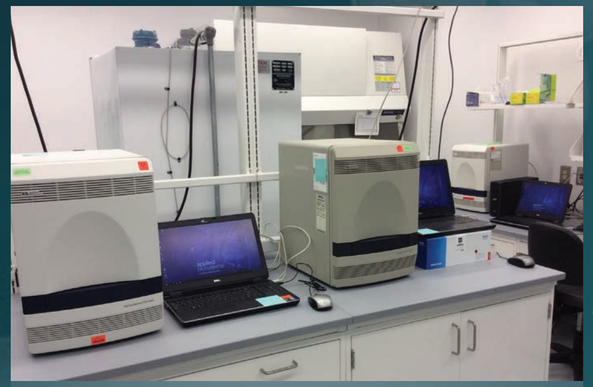
Cocrystal is moving forward with the preclinical research on the patented compounds and will then complete additional steps, such as pharmacokinetics and eventually clinical trials. Kim said the ultimate goal is that one of the compounds will become a drug that can be licensed by the FDA as a possible treatment of the coronavirus infection that causes COVID-19.

Another licensing agreement with Cocrystal includes antiviral compounds with a focus on norovirus and Middle East respiratory syndrome, known as MERS. The company intends to pursue research and development of theses antiviral compounds, including preclinical and clinical development.

Kim and Chang also recently published a study about the licensed potential COVID-19 therapeutic treatment in the prestigious medical journal Science Translational Medicine.

Kim and Chang have spent years developing antiviral compounds to combat devastating viral animal and human diseases, from feline coronaviruses to human coronaviruses, noroviruses and rhinoviruses. They have received National Institutes of Health funding and collaborated with teams led by Bill Groutas at Wichita State University, Stanley Perlman at the University of Iowa and Scott Lovell at the University of Kansas.

"Drs. Chang and Kim have been working on antivirals and inhibitors for SARS and MERS at K-State for a number of years, so discoveries related to corona and noroviruses are really not surprising," said Peter K. Dorhout, K-State vice president for research. "Some of the discoveries they've made about treating fatal feline coronavirus translate nicely into understanding the current SARS-CoV-2 virus, emphasizing the important, critical connection between basic virology research on animal and human diseases."



These machines perform COVID-19 polymerase chain reaction, or PCR, tests.

The Kansas State Veterinary Diagnostic Laboratory is a full-service laboratory that offers a range of diagnostic services for all species. (File photo)

Building better tests

Another issue throughout the pandemic has been testing, including shortages of testing supplies and challenges with testing results. Several K-State and community partnerships are helping on both fronts.

By partnering with the BRI, the Kansas State Veterinary Diagnostic Laboratory, or KSVDL, has performed thousands of COVID-19 tests since the pandemic began and has maintained a quick turnaround time. Researchers are performing overflow tests for the Kansas Department of Health and Environment, or KDHE, and they are processing student and employee tests from Lafene Health Center at K-State. The KSVDL also routinely provides COVID-19 testing for six community partners.

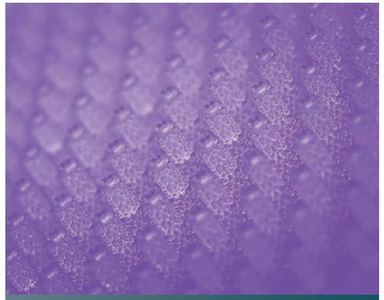
"Because of planning and preparation with the BRI over the last few years concerning foreign animal disease, as part of the National Animal Health Laboratory Network, KSVDL was able to respond quickly to the request to assist with human pandemic testing," said Jamie Henningson, KSVDL director.

KSVDL researchers are developing better COVID-19 tests, too. The KSVDL Molecular Research and Development team has been working on a fast polymerase chain reaction, or PCR, test, which detects the presence of viral genetic material earlier to determine if a person has the virus. The PCR test is a widely used test, but the K-State test uses a single PCR reaction for each sample instead of the three PCR reactions that are normally needed.

"The multiplex assay has been validated with a number of positive and negative samples from human patients," said Jianfa Bai, professor and section head of the Molecular Research and Development team. "An emergency use authorization application has been filed with the FDA for the assay, which will speed up the detection process three times that of the Centers for Disease Control and Prevention protocol."

Engineers Dong Lin, left, and Jungkwun Kim are 3D-printing COVID-19 testing swabs.

Each 3D-printed swab is about 6 inches long. It takes about 25 hours to 3D-print each batch of 400 swabs.



The team has 3D-printed more than 7,000 swabs and continues to print more.

Engineer Jungkwun Kim, left, and Michael Bomberger of Community HealthCare System look closer at several 3D-printed swabs.

A state commendation

A K-State and community partnership has received recognition from the Kansas Department of Health and Environment, or KDHE, for collaborative efforts to make COVID-19 testing supplies available.

K-State has teamed up with Community HealthCare System and the Northeast Kansas Healthcare Coalition to successfully fill the supply chain gap of nasopharyngeal swabs for COVID-19 testing in the region. Researchers in the Carl R. Ice College of Engineering are 3D-printing testing swabs to use at clinics and hospitals in northeast Kansas, including Onaga, St. Marys, Seneca and Holton.

K-State administrators and faculty members involved include Beth Montelone, senior associate vice president for research; Jungkwun Kim, assistant professor and Michelle Munson-Serban Simu Keystone research scholar in the Mike Wiegers Department of Electrical and Computer Engineering; and Dong Lin, assistant professor of industrial and manufacturing systems engineering and Don and Linda Glaser Keystone research scholar.

Both Kim and Lin specialize in research related to 3D printing. Kim specializes in 3D microfabrication and Lin studies 3D printing and manufacturing composites. See page 12 for more about Lin's research.

The group was recognized in a virtual ceremony of commendation with KDHE Secretary Lee Norman, M.D.

"On behalf of KDHE, I want to thank Dr. Montelone and Dr. Kim for their contributions in helping solve a problem that we had during this pandemic of COVID-19: a short supply of a particular item, the nasal swabs," Norman said. "It really is very illustrative that something kind of minor can really stop the presses. The Northeast Kansas Healthcare Coalition, Community Healthcare System and K-State met this need in a very creative way, which provided these much-needed swabs — not just to KDHE, but to hospitals, clinics, etc."

K-State has printed and donated more than 7,000 swabs and continues to print more.

"This is just something K-State has done throughout its history — we are the land-grant university for the state of Kansas and it's in our mission to do research and extension for the greater good," Montelone said.

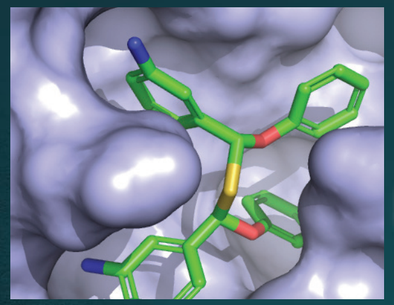
Seek more

Find additional stories, photos and videos that show how K-State researchers are helping to battle the COVID-19 pandemic.

k-state.edu/seek

From all angles

The battle against COVID-19 crosses disciplinary boundaries. Kansas State University researchers are tackling all dimensions of the pandemic.



Leading an open source

K-State is leading a new research consortium that uses artificial intelligence to find promising drugs for COVID-19 treatment.

Ho-Leung Ng, associate professor of biochemistry and molecular biophysics in the College of Arts and Sciences, is the founder of the Open Source COVID-19 research consortium that is using computational chemistry to speed up the process of finding COVID-19 drug treatments.

The consortium is making all findings from its researchers freely available to others worldwide. Along with K-State, main host universities include the Wistar Institute in Philadelphia and the University of Toronto in Canada. Intel is the research sponsor.

Above image: This image shows an artificial intelligence-generated molecule docked to a viral drug target. (Image credit: Ho-Leung Ng)

Protecting processing facilities

A K-State team is studying how to effectively control the spread of SARS-CoV-2, the virus that causes COVID-19, in meat and poultry processing facilities. The researchers are protecting plant workers and their surrounding communities by evaluating potential sources of exposure and identifying, developing and validating cleaning and disinfection strategies.

A $1 million grant from the U.S. Department of Agriculture is funding the project along with $330,000 from the State of Kansas National Bio and Agro-Defense Facility Transition Fund for research at the K-State Biosecurity Research Institute.

The project involves College of Veterinary Medicine, College of Agriculture and Food Science Institute researchers, including A. Sally Davis, assistant professor of experimental pathology and project director; Randy Phebus, co-project director and professor of animal sciences and industry; Jeanette Thurston, director of the Food Science Institute and co-investigator on the project; and many other collaborators.

Above image: K-State researchers involved in a U.S. Department of Agriculture-funded project include, from left: Randy Phebus, A. Sally Davis, Valentina Trinetta, Sara Gragg and Daniel Vega. Not pictured are Jeanette Thurston, Erin Schirtzinger and Yunjeong Kim.

Modeling the virus spread

Researchers in the Carl R. Ice College of Engineering have been modeling the spread of COVID-19 to create short-term forecasts and long-term mitigation strategies.

During the initial spread of the virus in China, Caterina Scoglio, the LeRoy and Aileen Paslay professor in the Mike Wiegers Department of Electrical and Computer Engineering, led a team that accurately predicted and modeled the daily cases reported in Wuhan City. Their simulation results have shown that without continued control measures, the epidemic in the province of Hubei would have become more persistent. They published the research in the journal Infectious Disease Modeling and also have received a National Science Foundation Rapid Response Research grant to continue modeling the spread of COVID-19.

Scoglio and her research team also have developed a computer simulation that revealed beef supply chain vulnerabilities that need safeguarding, which is a realistic concern during the COVID-19 pandemic.

Above image: Caterina Scoglio, professor of electrical and computer engineering, is modeling the spread of COVID-19.

Becoming a cyber land-grant university

As colleges and K-12 schools across the country incorporate remote and hybrid instruction models, several K-State teams are helping navigate the world of online learning.

A multidisciplinary team of researchers in the College of Education has identified the top needs and challenges of K-12 teachers during the COVID-19 pandemic through a study involving 800 teachers in rural, urban and suburban schools in Kansas.

In another project, Thomas Vontz, professor of curriculum and instruction, coordinated the Remote Learning P-12 community, which is a free digital resource for sharing innovative ideas and resources that support student success. The online forum is open to parents, teachers, principals, superintendents and school counselors in Kansas and around the nation and world.

In addition to Keep Teaching and Keep Learning websites available for K-State faculty, students and staff, the K-State Global Campus also has developed the Keep Teaching: Resources for Higher Ed online community. The online space includes faculty, library staff, information technology professionals and administrators who are from universities around the world and are sharing valuable information on teaching and learning remotely.

Helping the agricultural industry

The COVID-19 pandemic has affected nearly all aspects of the agricultural industry, from health and safety in meat processing facilities to food security and economic resources. College of Agriculture researchers have been helping since the beginning of the pandemic.

When flour shortages occurred in the early months of the pandemic, the grain science and industry department and the Hal Ross Flour Mill manufactured flour to provide basic food supplies for local people in need. The group handed out 15,000 pounds of flour in 10-pound bags in a single day to local residents.

The Kansas economy is directly and substantially affected by anything that alters agriculture in the state. Glynn Tonsor, professor of agricultural economics, has been studying livestock prices during the pandemic and providing information and guidance to help the livestock sector.

K-State Research and Extension, or KSRE, also has been helping Kansans across the state with research-based information and programs. The agricultural economics department, in partnership with KSRE, has been maintaining and updating the AgManager website, which includes valuable resources for livestock and agricultural communities. The College of Agriculture and KSRE also produce radio programs and webinars focused on relevant COVID-19 topics.

Monitoring mental health

The K-State Family Center, a therapy training and service center in the College of Health and Human Sciences, has continued offering teletherapy and helping people cope with COVID-19-related mental health concerns, including financial stress, child care and school issues, concerns about health, grief over canceled events and activities, and increased social isolation.

Megan McCoy, professor of practice in personal financial planning, also has been helping couples cope with financial stress and anxiety during the pandemic. She consulted with Morningstar to aid in the development of a new financial therapy digital tool called MoneyTalk.

K-State Research and Extension specialists Bradford Wiles, associate professor of applied human sciences, and Elizabeth Kiss, associate professor of personal financial planning, have published information for parents and communities to help children cope during hard times.

The hemp frontier

Building a statewide network of research pioneers on a new crop

By Jason Hackett

Battling torrents of rain, blasts of wind, unrelenting heat and humidity, pestilence and endless tall tales, Kansas State University researchers forge ahead as pioneers in the uncertain frontier of industrial hemp.

Using their decades of experience breeding and growing specialty crops, K-State Research and Extension horticulture and agronomy experts are turning their attention to hemp, or *Cannabis sativa L.*, which is one of the more versatile and useful plants in the world.

Until recently, hemp was off limits in the U.S. because it looks, smells and sometimes can become its close cousin, marijuana. The difference between hemp and marijuana is how much tetrahydrocannabinol, or THC, is present. That's what causes a "high" and keeps marijuana illegal in most states. But industrial hemp can be grown with low to no THC.

The 2014 U.S. Farm Bill opened the door for state agencies and educational institutions to grow hemp for research and, in 2018, the Kansas Legislature passed the Alternative Crop Research Act. Those two steps, along with establishment of ground rules, officially opened a new frontier in Kansas and empowered the Kansas Department of Agriculture, or KDA, as the state's regulatory agency.

Left photos: Jason Griffin, director of the John C. Pair Horticultural Center, tends to young hemp plants being prepared for the 2020 growing season.

An untamed frontier

Rather than a gold rush, a green rush began as experimental growers and handlers obtained licenses to grow hemp if they presented a formal research plan and followed strict controls. In the first year of licensure, the KDA issued 254 research program licenses.

A primary control for growers was the requirement that if representative sample tests revealed THC concentrations above 0.3%, then the entire crop must be destroyed.

That's a significant risk for Kansas farmers already facing a yearslong economic storm. But some see a risk worth taking because of the interest in hemp products. Industrial hemp can be grown for a variety of options: grain, fiber or both, through dual-purpose production.

"The uses for industrial hemp are almost limited only by the imagination," said Jason Griffin, director of the John C. Pair Horticultural Center, which is a K-State Research and Extension research center near Wichita.

A newer use for hemp is cannabidiol extract, better known as CBD oil. In recent years, CBD has been touted as a miracle drug by some, but with little to no research backing up those claims.

With so much unverified information, whether it's CBD product claims or methods for planting, growing and harvesting, the hemp marketplace looks a little like the Wild West. That's why the K-State research is so important.

"We saw a natural fit for us given our expertise and reputation as a trusted source of properly controlled, unbiased research information," said Ernie Minton, dean of the K-State College of Agriculture and director of K-State Research and Extension. "Given the diverse climate across the state, we recognized we had the ability to take an initial statewide look at key knowledge gaps relative to how the crop should be grown in Kansas. I think it is natural for us to be leading that effort."

Growing hemp inside of high tunnels, which are crop shelters similar to greenhouses, is one of the numerous growing methods that researchers at the John C. Pair Horticultural Center are testing.

The call to adventure

When Minton tapped Griffin as the leader of the K-State Research and Extension hemp team in late 2018, he began an adventure into a world with few experts at all.

Under Griffin's leadership, K-State is part of a multistate hemp project funded by the U.S. Department of Agriculture. The Pair Center is the primary K-State site for experimental growth of hemp. Significant test plots also were grown in 2019 at the K-State Research and Extension Center-Olathe in the Kansas City metro area and at the Northwest Research-Extension Center in Colby, which provided a much different view of the plant in the drier, higher elevations of western Kansas. Attempts to plant test plots outside of Manhattan were rained out twice.

The same fate nearly befell Griffin's research at the Pair Center, but a second planting survived. The hemp grew fast over the summer and provided new information for the growers almost every day. Most of the CBD varieties were grown in high tunnels, which are crop shelters similar to greenhouses, while fiber and grain varieties were grown outside with different variables to track.

"We had a couple of varieties that produced very well," Griffin said. "Kansas producers are very familiar with growing a grain crop, and it looks like we might be able to do this one very well."

While Griffin saw early promise in the southern part of the state, the other plots also saw first-year success. Cary Rivard, director of the Olathe research center, and Lucas Haag, Northwest area agronomist based in Colby, conducted parallel research in their very different climates.

Rivard focused solely on CBD hemp and saw his high tunnel plants yield 3.5 times more than expected. In the drier climate of western Kansas, Haag conducted agronomic growth trials for fiber, grain and dual-purpose hemp rather than CBD varieties. Their early assessments indicate that hemp may have a role as a rotational crop.

Hemp may be an old crop, but it's new to universities and the rigors of repeatable, peer-reviewed, controlled research.

"There's so much information online, but how much of it is misinformation?" Rivard said. "It's not malicious misinformation; it's just not backed up by replication. We're trying to get away from the hearsay and get into evidence."

Haag also cautioned there are plenty of snake oil salespeople blowing into town with only one thing in mind.

"There's so much money pouring in from the outside," he said. "In a lot of cases, these are people who don't have a clue about growing a crop. We're at ground zero in terms of how to grow this crop. It's exciting and challenging."

Left photos: After CBD hemp is harvested, the plants are hung to dry, then the flower portions are mechanically separated so they can be processed to yield CBD oil.

Testing the wild

Samples from the various K-State plots were sent to the K-State Olathe Postharvest Physiology Lab. Eleni Pliakoni, director and associate professor of urban food production and postharvest handling, along with Tricia Jenkins, master's student in urban food production, handled the bulk of the hemp testing.

Pliakoni followed the KDA testing procedures and developed a method to screen for five common cannabinoids. She developed a fee-for-service model that enabled her to work with 27 growers who sent her 63 samples from late August through early November, in addition to the 160 samples from K-State test plots. The KDA lab remains the sole resource for official compliance testing, but the K-State Olathe lab helps growers monitor their crops so they know when to harvest before the plants go "hot" with THC concentrations over the legal level.

In the first year, only 10% of the hemp she tested was above the legal level. Pliakoni noted that test results are strictly confidential between her lab and clients.

Spreading the word

Because hemp is new and fraught with both possibility and peril, it's a topic that has captured the attention of the general public.

During the past year, K-State hemp researchers and the KDA hemp team have shared helpful material and teamed up for dozens of outreach events across the state.

Industrial hemp is a legal crop that looks and smells exactly like marijuana, so law enforcement officers need to know about the legalities of transporting hemp. K-State and KDA staff have conducted law enforcement field days at the Pair Center and presented to nearly 100 law enforcement personnel from across the state as well as Kansas Department of Wildlife, Parks and Tourism staff.

"It's helping them to answer the question, 'What should I be looking for to ensure that someone is conducting activities that they're legally allowed to conduct?'" said Braden Hoch, KDA industrial hemp specialist.

To many law enforcement personnel, the educational sessions are their first opportunity to learn about the crop with details that pertain to their work. The transportation and carrying of hemp is the main point of intersection between farmers and law enforcement, and Kingman County Sheriff Randy Hill said his staff took proactive steps after attending the information sessions.

"The challenge is making sure everybody has the same understanding so we all enforce the law with consistency," Hill said. "Everybody was impressed with the training and speakers. They did a good job of explaining why this is going on and how the law is applied."

Griffin organized K-State's first industrial hemp conference at the K-State Research and Extension — Sedgwick County office in February. He brought in 220 people to hear about the variety trial results, different production systems, disease and insect control, and CBD and THC testing.

"There is a lot of information out there from people who just really want to share their success stories and tell you what has worked for them," Griffin said. "That's great. However, not much of it has been put through the rigors of scientific investigation. If accuracy of information is important to you, that is why you come to K-State."

Eric Atkinson, Dan Donnert and Pat Melgares contributed to this story.

A versatile crop

Industrial hemp end products range from diapers to denim, flooring to fuel, cardboard to cosmetics, paper to protein powder, and handbags to hempcrete, which is a lightweight building product with excellent insulation properties. Here are three ways that Kansas State University research is investigating the versatility of hemp.

Nutrition

One team is studying the potential for industrial hemp grain to be used for human food and food ingredients.

The researchers — Donghai Wang, professor of biological and agricultural engineering and the Robert and Becca Reichenberger and Carl and Mary Ice Cornerstone teaching scholar in the Carl R. Ice College of Engineering, and Weiqun "George" Wang, professor of food, nutrition, dietetics and health in the College of Health and Human Sciences — are characterizing physical properties and the chemical composition of hemp. They also are studying nutritional values of hemp seed oil, including protein and carbohydrates.

Biofuels

Industrial hemp has high biomass yields per hectare and high cellulose content, which makes it an ideal feedstock for biofuels.

Donghai Wang and Weiqun "George" Wang also are applying a zero waste approach to converting hemp biomass, which includes stems and residues, into biofuels and bio-based products.

The research could determine how hemp variety and production location affect the physical properties and chemical composition of hemp seeds.

Cattle feed

College of Veterinary Medicine researchers have partnered with Jason Griffin, director of the John C. Pair Horticultural Center, to conduct pharmacokinetic studies to learn how cannabinoids from industrial hemp are absorbed in cattle. Industrial hemp has potential as an economic feed, which would extend the plant material's usefulness rather than the plant going back to the field or into a landfill.

Michael Kleinhenz, assistant professor of beef production medicine, and Hans Coetzee, department head of anatomy and physiology and interim director of the Nanotechnology Innovation Center of Kansas State and the Institute of Computational Comparative Medicine, finished one trial late in 2019 and have two planned for 2020. They are collecting data to evaluate hemp as a component of cattle feed and the potential ways to mitigate food safety risks.

By the numbers

Kansas Industrial Hemp Research Program

The 2019 growing season included:

254 active licenses

190 growers, including 35 processors and 20 distributors

5,700 acres licensed

2,700 acres planted

1,757 acres harvested

Based on applications, the recently concluded 2020 growing season included:

207 growers, including 23 processors and 20 distributors

Seek more

View additional photos, videos and online content focused on the industrial hemp research program.
k-state.edu/seek

Source: Kansas Department of Agriculture

Fighting the fever

As African swine fever spreads worldwide, scientists protect U.S. industry

By Pat Melgares

The American heartland is just a little less than 11,000 miles from Beijing … a distant world away, it seems. Yet, in Manhattan, Kansas, several Kansas State University scientists focus daily on the Chinese city.

China, which once raised more than half of the world's approximately 1.5 billion pigs, is the center of the current outbreak of African swine fever virus that has affected multiple countries in Africa, Asia and Europe, according to the World Organization for Animal Health.

The disease has never been reported in the U.S., which is the second largest country for pork production and raised approximately 70 million animals in 2019. Humans cannot contract African swine fever and pork from infected animals is safe to eat.

But for pigs, the African swine fever virus is bad news. There are no vaccines to prevent the highly contagious and deadly disease, which causes high fever, loss of appetite and other clinical signs in infected animals. Government officials have enforced strict biosecurity barriers to slow the spread of the virus.

"We compare African swine fever to lava," said Cassie Jones, associate professor of animal sciences and industry in the College of Agriculture and a swine nutritionist with K-State Research and Extension. "There are some pathogens that are more like a volcano, where there is just an explosion of virus. African swine fever is more like the flow of lava, where it is a slow flow of disease, but you can't stop it. It seems like no matter what we do in the countries that have been struggling with it, as soon as a herd gets contaminated or infected, it just continues to slowly spread. It's very difficult to contain."

China's losses since the virus was first detected in August 2018 have topped $50 billion, according to estimates from the Food and Agriculture Organization of the United Nations. High estimates claim that 50% of the pigs in that country have been lost, which is one-fourth of all pigs in the world.

"When you think about the world's largest pork producer losing that many pigs, it significantly changes the global swine industry because China is now going to have to replace the pork that they are no longer able to produce," said Megan Niederwerder, assistant professor of diagnostic medicine and pathobiology in the College of Veterinary Medicine.

In the U.S., the K-State Biosecurity Research Institute, or BRI, is the only university laboratory where researchers can study African swine fever virus, which is a biosafety level-3 pathogen. A significant amount of work with African swine fever also is being done at the Plum Island Animal Disease Center in New York. The center will be replaced by the National Bio and Agro-Defense Facility, which is under construction adjacent to the K-State Manhattan campus.

The K-State research, which includes partnerships with other universities and private industry, involves experts who study the traits of the virus, the host's immune system, potential vaccines, animal husbandry, international trade, movement of materials associated with the virus and more. Research takes place both in countries where African swine fever is present and in the safe research space at the BRI.

"In order to control most viruses, you need a multipronged approach," said Jürgen A. Richt, Regents distinguished professor in the College of Veterinary Medicine. "This is also the basis for all of these foreign or transboundary animal diseases. It doesn't matter whether it's African swine fever, classical swine fever, foot-and-mouth disease, Rift Valley fever or others."

> "African swine fever is more like the flow of lava, where it is a slow flow of disease, but you can't stop it."
>
> *Cassie Jones, associate professor of animal sciences and industry in the College of Agriculture*

Safe and effective

Through industry partnerships, K-State scientists are conducting African swine fever virus vaccine development work. One project involves a sponsored research agreement facilitated by K-State Innovation Partners and MEDIAN Diagnostics Inc., or MDx, a veterinary medicine company based in South Korea.

"The technology we are utilizing is based on a novel adenovirus backbone — developed from human adenovirus serotype 6 — that can amplify a transgene up to 10,000 copies in the infected cell without producing infectious viruses," said Waithaka Mwangi, professor of diagnostic medicine and pathobiology in the College of Veterinary Medicine.

Mwangi said that the single-cycle adenovirus vaccine platform can safely induce more robust and persistent immune responses compared to live, inactivated and subunit vaccines that are traditionally used. This platform was originally developed at the Mayo Clinic.

"We believe this will be a way to deliver a safe and effective vaccine," Mwangi said.

Feed and fever

Niederwerder focuses on ways that foreign animal diseases, such as African swine fever, could be introduced through feed and feed ingredients. Swine feed often consists of many ingredients, such as amino acids, vitamins, vegetable proteins or grains, to give the pig the nutrition it needs.

"One of the first parts of our work was to discover if the virus is stable in feed and feed ingredients that have been subjected to fluctuating humidity and temperature conditions during shipment," Niederwerder said. "The U.S. imports millions of kilograms of feed ingredients from countries that may have circulating foreign animal disease. These ingredients are incorporated into swine diets, provided to pigs for consumption and could potentially serve as a route for the spread of transboundary animal disease."

One major finding indicated that the African swine fever virus can indeed survive the boat ride across an ocean, where it could be introduced into feed provided to animals. The bottom line: This virus is stable enough to survive a simulated transport from Beijing to Des Moines, Iowa.

"That's not a big surprise to us, but what we want to know now is if a virus makes its way into a contaminated ingredient, does that get distributed through an entire batch of feed and through the entire feed manufacturing environment, or does it tend to stay in pockets of contamination?" Jones said. "Knowing that has some really meaningful implications of whether the entire feed supply chain is contaminated, or if we have a risk area, and how careful we need to be about biosecurity and subsequent uses of equipment or trucks."

Researchers also are working on methods to decontaminate and clean infected feed. Niederwerder has conducted a study that indicates that the half-life of African swine fever — or the amount of time it takes for the virus to decay by one-half — is between 9.6 and 14.2 days.

"Defining the timeline for how a virus decays naturally in feed allows us to consider storage periods for feed ingredients after they arrive to the U.S. from high-risk countries," Niederwerder said.

That information also could help researchers establish guidelines for using thermal treatments or antiviral chemical mitigants, she said.

Diagnostics and vaccines

Richt's work includes developing tools to diagnose the disease quickly as well as developing vaccines.

"The earlier you diagnose a foreign animal disease, the earlier you can stop its spread," he said. "If you can detect the disease 24 hours earlier, how many animals can you save? How many millions of dollars can you save?"

For African swine fever, Richt's group has partnered with Silver Lake Research Corp. of Azusa, California, to develop a point-of-care diagnostic test that is the first of its kind in the U.S. The test, called PenCheck, can be used right in the field with a simple drop of blood from a pig.

"It's very simple, very fast and very accurate," Richt said.

The test was developed and tested in the BRI and it is being validated by the Food and Agriculture Organization of the United Nations. Many other tests to increase the speed of diagnosis are underway, but are not yet ready for market, he said.

It will take a while to develop vaccines to provide immunity to pigs, Richt said. The first licensed vaccine for African swine fever may not be available for another three to five years.

"We do not know a lot about the basic functions and replication strategies, or the immunosuppressive functions of this virus," he said. "When we talk about African swine fever, we often compare it to classical swine fever and foot-and-mouth disease. The genome of the African swine fever virus is 15 to 20 times the size of those agents. Also, the African swine fever virus expresses more than 150 viral genes, but we only know about 30 of those in detail, or about 20%. So, right now this virus is very effective in undermining the immune system of pigs."

The K-State researchers agree: Collaboration is key to fighting African swine fever and other devastating diseases worldwide.

"Worldwide, we're already having big conversations in agriculture about how we are going to feed 9.8 billion people by the year 2050," Niederwerder said. "These diseases significantly impact the health of food-producing animals and our ability to provide protein for humans."

See *Engagement*

Em Knobbe, senior in animal sciences and industry, works in the training laboratory at the Biosecurity Research Institute.

Making connections

K-State Innovation Partners contributes to record year of economic engagement

By Erin Pennington

The numbers show it: Kansas State University engagement is reaching new heights.

The Kansas State University Research Foundation and the Institute for Commercialization merged in July 2019 to form K-State Innovation Partners. By collaborating with the university, industry and community, Innovation Partners is making great strides in economic development, technology transfer and community engagement.

The collaborative efforts are succeeding.

In fiscal year 2020, Innovation Partners posted a near-record $3.2 million in licensing revenue and 35 licensing or options agreements. Those agreements include four technologies that are directly involved in the fight against COVID-19. The technologies include both therapeutic and vaccine candidates to fight the disease and are based on many years of research leading up to their commercial deployment, which further demonstrates the relevance of K-State work in world-class facilities such as the Biosecurity Research Institute. See page 31 to learn more about the therapeutic and vaccine candidates.

"Commercializing technology is one step in K-State's process of translating ideas, discoveries and technologies from the lab to the marketplace," said Chris Brandt, chief tech innovation officer with Innovation Partners. "Our recent commercialization successes are reflective of how K-State addresses the challenges facing society while also driving economic growth."

According to AUTM, a nonprofit comprising more than 3,000 members and more than 800 universities around the globe, K-State ranks in the Top 50 for intellectual property disclosures, total licensing revenue and license revenue per active license.

"In this time of economic uncertainty, it is more important than ever to protect innovations and license the technologies to existing companies and startups," said Peter K. Dorhout, vice president for research. "Our emerging technologies can help current companies or be the foundation of new industries in Kansas."

In addition to technology commercialization efforts, Innovation Partners has advanced economic development in the region by assisting with 174 economic partnerships, attracting 24 companies to establish or expand a presence in Kansas, and launching or investing in 18 K-State-related companies.

Economic development efforts have additionally created 600 new jobs in the region with average salaries of more than $56,000 and totaling more than $33 million in annual payroll.

"Innovation Partners continues to promote the successes of K-State faculty, researchers and students to ensure that technologies developed at K-State can get into the hands of the public where they can create jobs and improve lives," said Kent Glasscock, CEO of Innovation Partners.

Fusarium fun-guy

Plant pathologist creates international connections through fungal identification, education

By Stephanie Jacques

Teach a man how to identify fungi and he'll have strains for a lifetime. That's what John Leslie, Kansas State University distinguished professor of plant pathology and director of the Fungal Genetics Stock Center in the College of Agriculture, has been trying to do as he travels the world.

Leslie's research focuses on the genus *Fusarium*, which is a large group of fungi found on most plants. Using genetics, he has identified new species of *Fusarium* and has evaluated variation within natural populations. One of his early career discoveries helped separate corn and grain sorghum *Fusarium* so breeders could find plant varieties that withstand the fungi's damaging effects.

"Breaking *Fusarium* into separate species has made a difference for the sorghum industry to find a line of resistance," Leslie said.

There are now more than 100 species of *Fusarium*. Some of these fungi are harmless; some can destroy crops and result in large economic losses; and some produce mycotoxins, which are natural toxins that can cause a range of chronic illnesses, malnutrition and even death in humans and animals.

"Fusariums are very important plant pathogens and mycotoxin producers," Leslie said. "Not everyone in the group is a bad 'fun-guy,' but we focus on the bad guys because of the damage that they do."

While Leslie's research with *Fusarium* has positively affected the agriculture industry, it is his international collaborative ability that promotes true problem-solving. He's been to South Africa, Afghanistan, Italy, Nepal, Nigeria, Mali, Malaysia, Egypt, Australia, South Korea and many other countries through his work with the Fulbright program and through research projects with the U.S. Agency for International Development, or USAID, and the European Union. He also has led popular fungal identification and remediation workshops.

"We've had more than 700 people from over 71 countries attend our *Fusarium* workshops," Leslie said. "The ones that we do outside the U.S. are really important. There are people at some of those workshops who would never be able to make it to the U.S."

Through the Fulbright program, he also established the K-State Australia initiative and the Oz to Oz program, which was recently recognized by the Institute of International Education for innovative and sustainable partnerships that advance internationalization for K-State.

"The relationships that the university has built through this partnership program allow students and faculty to benefit from enhanced global opportunities and shared research," Leslie said.

In addition, Leslie has served in multiple K-State leadership roles: He was the plant pathology department head from 2006 to 2016 and was the interim director of the USAID Feed the Future Innovation Lab for the Reduction of Post-Harvest Loss. Yet his passion remains for the most important fungi in agriculture.

"I've tried to make *Fusarium* a viable research organism so we can understand what it does and if it's doing things that we don't want, we know how stop it," Leslie said.

See *UDP Focus*

John Leslie, university distinguished professor of plant pathology, researches Fusarium.

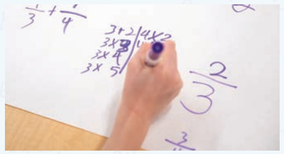
See *Faculty Focus*

A winning equation

Strategy instruction helps students learn math in a fraction of the time

By Patrice Scott

Mickey Losinski



It works.

That was the conclusion Mickey Losinski, professor of special education, counseling and student affairs in the Kansas State University College of Education, reached after studying if self-regulated strategy development, or SRSD, could be a beneficial framework for teaching math to students with disabilities.

Losinski and Robin P. Ennis, associate professor at the University of Alabama at Birmingham, used the SRSD framework to help students with learning, emotional or behavioral disabilities master fractions. SRSD is an evidence-based practice in the area of writing and has been heavily researched in the area of reading, but until this point, had not been used to help struggling students learn math.

Losinski and Ennis wanted to know if carefully crafted lessons with explicit instruction and self-regulation could help students learn fractions. The researchers focused on how to add and subtract fractions with unlike denominators, how to simplify fractions and how to convert fractions to mixed numbers. Ultimately, the researchers created fraction mnemonic devices: FILMS, CUT and EDIT to help students remember the steps to the problems. They also created lesson plans and a theme-based cue card and checklist.

Losinski and Ennis studied the FILMS, CUT and EDIT strategies at two rural elementary schools in Kansas and at one urban elementary school in Alabama.

"By the third day, they knew the process by heart," Losinski said. "The kids asked why they weren't taught it this way from the beginning. They loved it."

The mnemonic devices are only a part of this winning equation; the foundation includes explicit instruction, self-regulation strategies and teaching to fluency.

"During guided and independent practice, we tried very hard to ensure that students did not miss a step or make a mistake as they were working out these problems," Losinski said. "They were constantly working on the math, then going to the sheet and checking a task off until they became fluent. That's the key to all of this."

Letter by letter

Researchers created the FILMS, CUT and EDIT strategies to help students learn fractions.

FILMS stands for:

- **F** *Find the denominator.*
- **I** *Identify the multiples.*
- **L** *Locate the least common multiple.*
- **M** *Multiply to make new fractions.*
- **S** *Solve the problem.*

CUT stands for:

- **C** *Calculate the factors.*
- **U** *Underline the greatest common factor.*
- **T** *Time to divide the numerator and denominator.*

EDIT stands for:

- **E** *Examine whether the numerator is greater than the denominator.*
- **D** *Divide the numerator by the denominator.*
- **I** *Insert the quotient as a whole number.*
- **T** *Turn the remainder into your new numerator.*

In 2019, Losinski was awarded the Council of Children with Behavioral Disorders' Interventionist Award. Losinski joined K-State faculty in 2013 and published more than 50 articles in peer-reviewed journals, co-authored four book chapters and presented at national conferences. He served on the editorial boards of the journals Exceptional Children, Behavioral Disorders, Beyond Behavior, Intervention in School and Clinic, and the Journal of Disability Policy Studies.

Seek more

View the lessons on fractions and watch a video on the math research project.

k-state.edu/seek

In memoriam

Mickey Losinski was a committed educator, a loving husband and father of five. He passed away while this article was in production. He took precious time to share his research because he was proud of the ways that it helped students with special needs. We send our deepest sympathies to his family and are forever grateful for his contributions to his students, his colleagues and his profession.

See *Undergraduate Scholar*

Super saver

Student's research prevents pollution, reduces freshwater use

By Taylor Provine

Isaac Wright, recent graduate in biological systems engineering, has studied methods to save freshwater and reuse wastewater disposal from industrial processes.

You could say Isaac Wright's research is making a splash.

Wright, a spring 2020 graduate in biological systems engineering in the Kansas State University Carl R. Ice College of Engineering, has studied methods to save freshwater and reuse wastewater disposal from industrial processes.

"I study ways to take water that's not good enough for drinking and use it in other ways," he said. "Any water that remains in the cycle is useful."

As an undergraduate, Wright participated in the Pollution Prevention, or P2, Intern Program offered through the K-State Pollution Prevention Institute. Through the 11-week program, interns are trained and placed at a host company with specific pollution prevention projects. The interns perform a case study and calculate project recommendations, environmental outcomes and cost.

Wright interned at Compass Minerals at one of its salt mining plants in central Kansas. The company has a corporate goal to reduce freshwater use across all of its sites nationally and internationally, he said.

One of Wright's projects reviewed two continuous flow drinking fountains that ran 24/7 year-round, he said.

"My research showed installing two traditional hi-low drinking fountains would save 1.7 million potential gallons of water and $4,600 per year, depending on exact water consumption and electricity use," Wright said. "Based on my recommendations, they installed these new water fountains at the site."

He also studied diversion options for the company's wastewater.

"The salt mining process contributes to wastewater because the high saline water can't be used for irrigation, so it is immediately pumped into an underground water deposit," Wright said.

Wright's recommendations included diverting wastewater to an area golf course for use on fairways or using it for wetland creation or restoration. While these options could be implemented in the future, Wright said more research and policy changes are needed.

Wright said freshwater reduction and wastewater reuse research is important because it can address water problems in other areas.

"In central Kansas, water is readily available, but if you go 100 miles west, they are struggling to bring in the water that they need," he said. "You have to start in the areas that don't have the problem and have the best management practices in place so that the problem doesn't continue."

Wright has presented his research at the Governor's Water Conference and the Kansas Environmental Conference, which is the state's premier environmental conference hosted by the Kansas Department of Health and Environment.

"We enjoy working with the K-State Pollution Prevention Institute and appreciate the contributions that the interns have made at our facility over the last several years," said Brent Peterson, Compass Minerals project engineer. "Isaac's work made an immediate positive impact on water use at the plant and further developed our long-term plans for continuously improving the way we manage water."

Seek more

Learn more about the Pollution Prevention Institute.

k-state.edu/seek

Drawing in the negative

Printmaker reclaims empowerment through art

By Stephanie Jacques

Pain, betrayal and visceral emotion cascade from the giant sheets of paper that graduate student Hailey Quick uses to process her feelings about a family trauma. In more ways than one, her powerful images start with the negative.

"My art deals a lot with trauma, the pain behind it and processing those memories," said Quick, master's student in printmaking in the Kansas State University College of Arts and Sciences. "As I create a piece, I reflect on how I was feeling at the time and now."

Quick's Renaissance-like artwork reflects her childhood and love of Louisiana wildlife. She assigns animals to represent different people and incorporates them in dramatic and detailed scenes. She heals by creating large 16-by-20-inch prints of an alligator surrounded by wasps, a great blue heron intertwined with a wood stork, or intermingled herons and snakes inside an alligator's mouth.

"I fell in love with the intensity of the printmaking processes as well as the heavy drawing," Quick said. "Seeing the finished prints fresh off the press is just so special because it takes so much to get it on paper compared to the immediate gratification of just a pencil and paper."

Hailey Quick, master's student in printmaking, holds the print "Venomous Intent," which has earned two first place awards at multiple competitions across the U.S.


1


2


3


4

Printmaking is an extensive process and it takes days for Quick to create a piece. She starts in her studio surrounded by black and white images of her past creations. Using a soft ground technique and lithographic crayon made of grease, she draws on a copper plate in the negative, or the reverse of how she wants the finished piece.

The grease acts as a barrier between the plate and the acid; it slowly breaks apart in an acid bath and etches what is exposed. The thicker Quick applies the grease, the longer it takes to fall off when the copper plate is placed in a corrosive acid bath. The combination of time in the bath and thickness of the grease determines the shade and line thickness in the finished print.

"The acid creates channels in the copper plate," Quick said "The longer the plate is in the acid, the deeper and wider the channel, which will hold more ink. Less time will create a shallower and narrower channel so it will hold less ink."

Quick repeats the process to get the desired channel size. When a plate is finished, Quick applies the ink, which settles in the channels, and she wipes away the excess. She places paper on top and presses the two pieces together.

"Printmaking is where I can present my academic work, which is different than the aesthetic art that most people would see in a store," Quick said. "Instead of a happy bird, I like to draw my birds tearing each other apart. It's more emotional than aesthetic."

In spring 2021, Quick will present her research work as a conference demonstration at the University of Colorado Boulder. The Embracing the Wilds conference is part of the Colorado Month of Printmaking, or Mo'Print.

"Hailey is a very talented and driven artist with important work," said Jason Scuilla, professor of art and Quick's adviser. "She fearlessly confronts her past experiences with beautiful hand-rendered images of struggle and perseverance. Hailey has excelled in her graduate studies and is an inspiration to our undergraduate students in the art department."

According to Quick, her art and the printmaking community have helped her cope with repressed feelings and everyday life. She is not ready to talk publicly about what has happened to her, but hopes her art conveys the emotions.

"It's OK that my audience doesn't know exactly what's going on, but they can still get the feelings that are happening — the raw emotion and my quest to reclaim my sense of empowerment after trauma," Quick said.

The four above photos document Hailey Quick's printmaking process.

1. Create a line drawing, which is a rough draft of an image before she starts the printmaking process.

2. Apply the lithographic crayon to the copper plate.

3. Place the copper plate into an acid bath to start the etching of the plate.

4. Pull the first proof of the plate to see where she needs to deepen the etching.

Chemical and artistic innovation

Hailey Quick's printmaking work contributes to a National Endowment for the Arts research project, led by Jason Scuilla, professor of art, and Stefan Bossmann, former university distinguished professor of chemistry. Printmaking materials and processes can be harmful both to the printmaker and the environment. Scuilla and Bossmann have developed a new printmaking process that is less toxic and uses more sustainable materials.

Their research focuses on developing and refining electrochemical etching processes and green biosolvents to empower artists to create prints in a more effective and safe manner. It changes the way prints are made while maintaining equal or greater quality.

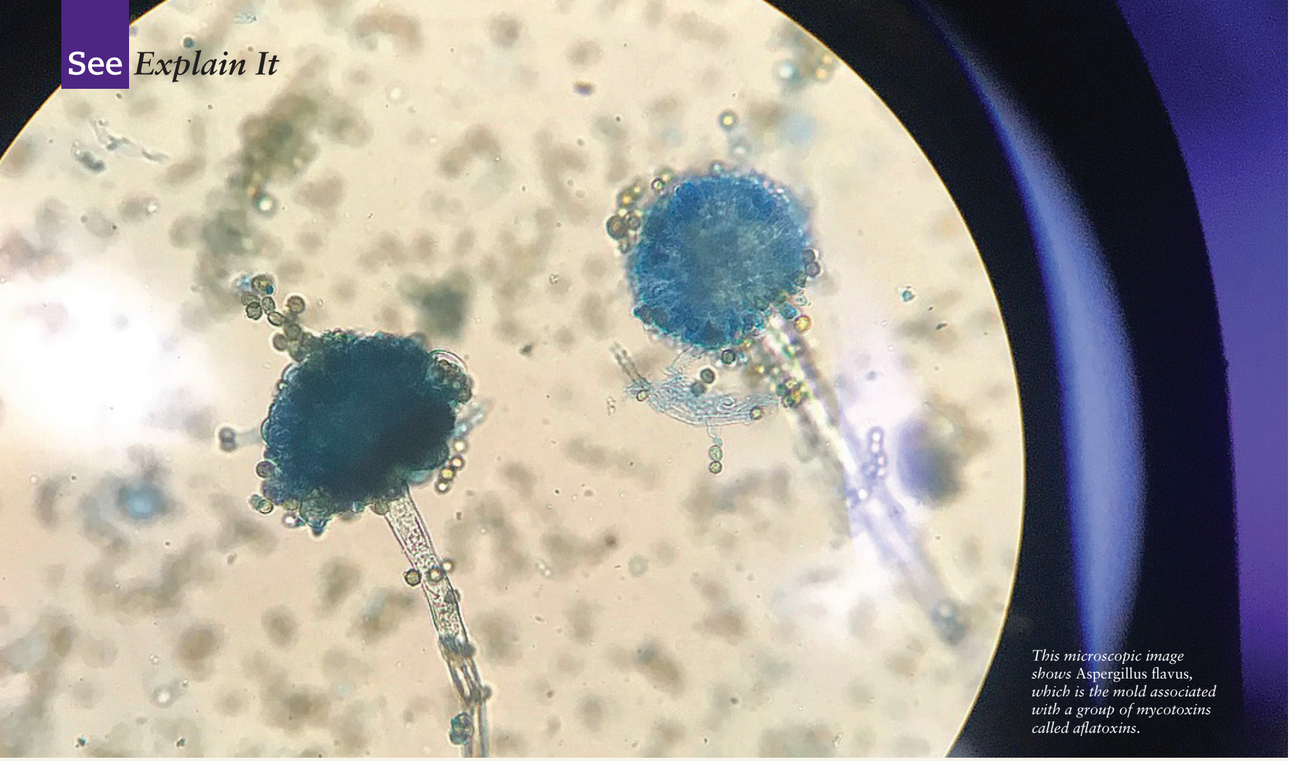
Quick is working on a few pieces using this new method, which will be part of a portfolio to show other printmakers the safer alternative to the traditional acid bath.

Scuilla recently presented and shared the research as part of a new major exhibition, "The Renaissance of Etching," at the Metropolitan Museum of Art, or Met, in New York City.

Seek more

View a gallery of additional prints and artwork from Hailey Quick.

k-state.edu/seek



This microscopic image shows Aspergillus flavus, *which is the mold associated with a group of mycotoxins called aflatoxins.*

mycotoxins

ˌmī-kə-'täk-sənz

Jagger Harvey is the director of the Feed the Future Innovation Lab for the Reduction of Post-Harvest Loss, which is one of four Kansas State University laboratories that are funded by the U.S. Agency for International Development, or USAID. Harvey is also a research associate professor of plant pathology in the College of Agriculture and he explains in fewer than 100 words what mycotoxins are and why they are a big problem for crops.

Mycotoxins are naturally occurring fungal toxins that form on many crops, foods and feeds, including wheat, sorghum and corn. Mycotoxin-producing fungi pervade the soil and environment globally, with over a quarter of the world's food supply contaminated. Exposure can lead to cancer or death and has been associated with stunting children's development; livestock are also affected. Mycotoxins have serious economic impacts, such as potentially costing U.S. corn production billions of dollars in a bad season. Many pre- and post-harvest factors contribute to mycotoxin contamination, including temperature, rainfall and improper drying and storage; research is producing a range of effective interventions.

See pages 7 and 47 to learn more about K-State research related to mycotoxins.

A history of outreach and extension

The 1910 Gas Engine Institute occurred at Kansas State Agricultural College in late December of that year. The event was part of a weeklong state institute for farmers and was organized by what is now known as K-State Research and Extension. E. B. McCormick, dean of mechanic arts, organized the engine institute to provide training on the fabrication, operation and care of oil and gasoline engines. Several manufacturers provided lectures and demonstrations, such as the Rumely tractor demonstration in this photo. In the 1920s, the institutes for farmers were replaced by K-State Research and Extension county agents and county fair organizations. See page 36 to learn how Kansas State University continues to provide valuable training and knowledge for farmers across the state through research of new crops such as industrial hemp.

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

KANSAS STATE UNIVERSITY

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Partnering for innovation

True innovation during a global pandemic takes teamwork. Kansas State University has a long history of diverse collaborations — from fighting infectious diseases to forming the newly merged K-State Innovation Partners. This tradition extends to interdisciplinary work such as designing sustainable homes and studying new crops that support Kansas farmers.

The K-State land-grant mission will continue in the decades to come as a student-centered, public research university that tackles the challenges our world faces.

Tomorrow's solutions come from today's collaborations. Read this issue of Seek to learn more.

Seek more

Learn how K-State research is innovating tomorrow.
k-state.edu/seek
k-state.edu/influence-tomorrow