Seek

RESEARCH MAGAZINE FOR KANSAS STATE UNIVERSITY

FALL • 2018

Life of the wild

What we can learn from wildlife

The making of a meal

Research that improves America's favorite food

An urban prairie

How university green roofs enrich city life

A drop of water

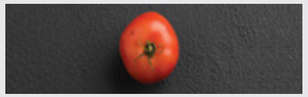
Beads of water form on a plant after an early morning shower in The Gardens at Kansas State University.

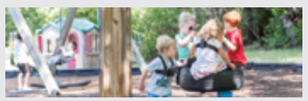
Kansas State University researchers are protecting rural communities from water shortages by taking a fresh approach to training graduate students.

Melanie Derby, assistant professor of mechanical and nuclear engineering and Hal and Mary Siegele professor of engineering, is leading an interdisciplinary team that has been awarded a five-year, $2.9 million National Science Foundation Research Traineeship Program, or NSF NRT, grant. The funding will help the team train graduate students to address complex water-related challenges by working across disciplines. It is the first NRT project awarded in the state of Kansas.

See Contents

Features





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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

You've heard the proverb: It takes a village to raise a child. The same is true of economic development: It requires dedicated leaders, planners, citizens, workers and businesses. Some might call it a village.

We have an outstanding village here in Manhattan, as indicated by consistently high quality of life ratings. Our town-gown relations rankings from The Princeton Review are also high: We ranked No. 1 in 2018 and No. 3 in 2019. Collaborations that build on research strengths, such as expertise that delivers food to your table, on page 20, and fights infectious diseases that affect both animals and people, on page 28, are a start. Although I love to sing the praises of Kansas State University research, I know it takes more than robust research to build long-term economic success.

Our North Campus Corridor project, which is a finalist for a University Economic Development Association 2018 Award of Excellence in the Place category, is an excellent example of how K-State and the surrounding community work together. When the National Bio and Agro-defense Facility came to town, both K-State and Manhattan recognized the opportunity it presented. The village came together to develop a long-term vision and the infrastructure necessary to support future growth. Plans are coming to fruition now, and industry partners are taking notice and bringing more jobs to our region. Read more about the North Campus Corridor on page 8.

Other research centered in our neighborhood explores Kansas wildlife, on page 14, as well as child development. See page 32 to read how a child's play changes over time, how infants recognize familiar caregivers and more. Another project highlighted on page 10 investigates how native plants grow in the harsh environment of a green roof. Finally, don't miss reading about our First Scholars program on page 39 to learn how the university is contributing to national research that helps first-generation college students complete their degrees.

University Distinguished Professor James Sherow's work on the Chisholm Trail is featured on page 37, and Professor Harold Trick's eight patents, with another pending, on biotechnologies that help us produce better crops are on page 36. The people who traveled the Chisholm Trail forged a path to success by driving cattle from Texas to Abilene, Kansas, to avoid an economic disaster that could be caused by an infectious disease carried by ticks. Our area's roots to infectious diseases run deep! Those same people couldn't have imagined the innovations ahead in breeding disease-resistant wheat, or the research that would someday keep their animals healthier. And they certainly couldn't have foreseen a national lab that would be dedicated to protecting their livelihoods.

They would be amazed at our village.

Peter K. Dorhout, Vice President for Research

A four-wheeled rover, called CaveR, explores and collects data inside a lava cave similar to the ones at Lava Beds National Monument in Northern California.

Is there life on Mars? The clues may be in earthly lava caves

When lava flows down the slope of a volcano, it can leave behind an extreme environment ideal for unusual microbial life. It also can leave behind potential clues to answering the life on Mars question.

Saugata Datta, Kansas State University geology professor, is one of the primary investigators of a NASA study that uses a robotic vehicle to explore and collect data inside lava caves at Lava Beds National Monument in Northern California. Lava cave interiors are home to bacterial films and coral-like mineral structures called mineral biomarkers that could help identify similar features that would provide evidence for extraterrestrial life on Mars or another planet.

A multi-institutional team of scientists and engineers is using $3.9 million from NASA's Planetary Science and Technology for Analog Research program to support a three-year project in the lava caves. Researchers are using a four-wheeled rover, called CaveR, to explore the earthly lava caves and produce a detailed map of the inside of the caves. The rover collects images to give the scientists information about the chemical makeup of the features on the cave walls.

For the project, Datta's research focuses on the water, rock and soil chemistry in the caves and what it looks like from the rover's perspective when these three elements interact with each other to create the living or once-living material, called biomass.

Finding the sweet spot to preserving bacon

Kansas State University researchers are sweet on a recent study in which they found that naturally smoked sugar helps to extend the shelf life of frozen bacon.

They tested bacon that had been frozen for up to 120 days to find out whether adding an antioxidant in the form of smoked sugar could slow down the rate of oxidation, a natural process that leads to discoloring and an off flavor to the meat.

The answer is clearly yes.

K-State researchers injected smoked sugar during the meat's curing process, packaged and froze the meat for a period of up to 120 days, and then used trained taste panels to verify the quality of the meat.

"It does not seem, unless we use a vacuum package, that we can get flavor shelf life much longer than 40 days on frozen bacon," said Terry Houser, associate professor of animal sciences and industry and K-State Research and Extension meat specialist. "When we added an antioxidant to these bacon formulations, it really extended our shelf life over the frozen storage period."

Houser said smoked sugar adds another flavor profile that he thinks consumers also will like. He noted that many compounds can be used as antioxidants, but this study was specific to smoked sugar.

Healthy horses: Veterinary Health Center begins offering equine stem cell therapy

The Veterinary Health Center at Kansas State University is now offering regenerative medicine therapy, including platelet-rich plasma and animal stem cell therapies, for equine patients.

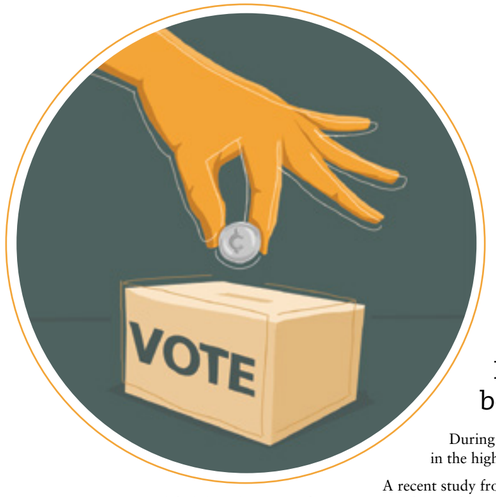
The animal stem cell therapy could benefit horses with osteoarthritis, tendon injuries and ligament tears.

Just like in humans, animal stem cells are the precursors of normal tissue cells. They are found throughout the animal's body and often are enriched in the bone marrow and fat.

Studies have shown that animal stem cell therapy is safe and has the potential to effectively treat multiple acute and chronic inflammatory diseases. Platelet-rich plasma uses the effects of concentrated growth factors, released from the platelets, to enhance the healing process.

The Veterinary Health Center is working with Enso Discoveries, a regenerative medicine company based in Manhattan, Kansas. Chanran Ganta, a stem cell researcher and veterinary pathologist at the Kansas State Veterinary Diagnostic Laboratory, collaborated with Enso Discoveries.

Stem cells collected from patients at the Veterinary Health Center can be processed at Enso Discoveries' Manhattan laboratory and used in a patient within the same day.



Political matchmaking: How campaigns find the best donors

During an election year, political candidates are involved in the high-cost endeavor of finding new donors.

A recent study from two Kansas State University College of Business Administration researchers aims to understand how political campaigns pursue donations.

It all comes down to data, say researchers Doug Walker and Edward Nowlin, both associate professors of marketing. Political campaigns allocate financial resources to collect and analyze data to get to know prospective donors and to solicit the best matches. A campaign can better target donors by collecting more data, but the campaign is limited by what it can afford.

Walker and Nowlin recently published "Data-Driven Precision and Selectiveness in Political Campaign Fundraising" in the Journal of Political Marketing.

In their study, the researchers found that when a campaign expected a large donation size, it should spend more on donor data to increase precision and be less selective on who is targeted. In addition, increases in solicitation costs suggested campaigns should be more selective in targeting potential donors.

Walker and Nowlin's analysis is consistent with federal campaign reports from the 2016 presidential election. During that election, the Clinton campaign received larger donations on average and, as predicted, spent more money on data, while the Trump campaign had more smaller donations and spent less.

"The donation size and the cost of solicitation drives how campaigns should go about targeting," Walker said. "Both groups did that based on the money available to the campaigns. They both did what they had to do under the conditions they experienced."

Cracking the wheat code

Kansas State University scientists have created a genetic road map for wheat, which is a breakthrough that will bring stronger wheat varieties to farmers.

University scientists, in collaboration with the International Wheat Genome Sequencing Consortium, recently published a detailed description of the complete genome of bread wheat, the world's most widely cultivated crop, in the journal Science. The cover article is titled "Shifting the limits in wheat research and breeding using a fully annotated reference genome."

This work paves the way for the production of wheat varieties better adapted to climate challenges, with higher yields, enhanced nutritional quality and improved sustainability.

The research article was authored by more than 200 scientists from 73 research institutions in 20 countries and presents the reference genome of the bread wheat variety Chinese Spring. The DNA sequence ordered along the 21 wheat chromosomes is the highest-quality genome sequence produced to date for wheat. It is the result of 13 years of collaborative international research and the support of the National Science Foundation, the U.S. Department of Agriculture National Institute of Food and Agriculture, Kansas farmers and many others.

"It is a dream come true for Kansas wheat farmers, who were the first to invest in the wheat genome sequencing project and were pivotal in rallying U.S. wheat farmers in support of the wheat genome sequencing project," said Bikram Gill, university distinguished professor emeritus of plant pathology who organized the first workshop on wheat genome sequencing in 2003.

With the genome sequence now completed, breeders have new tools to address global challenges. They will be able to more rapidly identify genes and regulatory elements underlying complex agronomic traits such as yield, grain quality, resistance to fungal diseases and tolerance to physical stress. They also can produce hardier wheat varieties.

Wheat center receives economic engagement award

Kansas State University has recognized the Wheat Genetics Resource Center Industry/University Cooperative Research Center with an Excellence in Innovation and Economic Engagement Award.

The award recognizes exemplary economic engagement in talent, innovation and place. The honor was modeled on the Association for Public and Land-Grant Universities Innovation and Economic Prosperity University designation, which K-State achieved in July 2017.

Peter Dorhout, vice president for research, said the award was designed to enhance recognition for economic engagement activities.

"The Wheat Genetics Resource Center brings industry and university researchers and resources together to mobilize genetic diversity, enhance wheat yields and meet growing global food demand," Dorhout said.

Notable center achievements have included releasing germplasm that is resistant to wheat streak mosaic virus, which caused $76.8 million in direct losses to Kansas wheat farmers in 2017 alone; a patentable technology to bring genetics from ancient ancestors into modern wheat; and nearly $10 million in research funding, including proprietary and infrastructure projects. See page 22 for more on wheat research at Kansas State University.

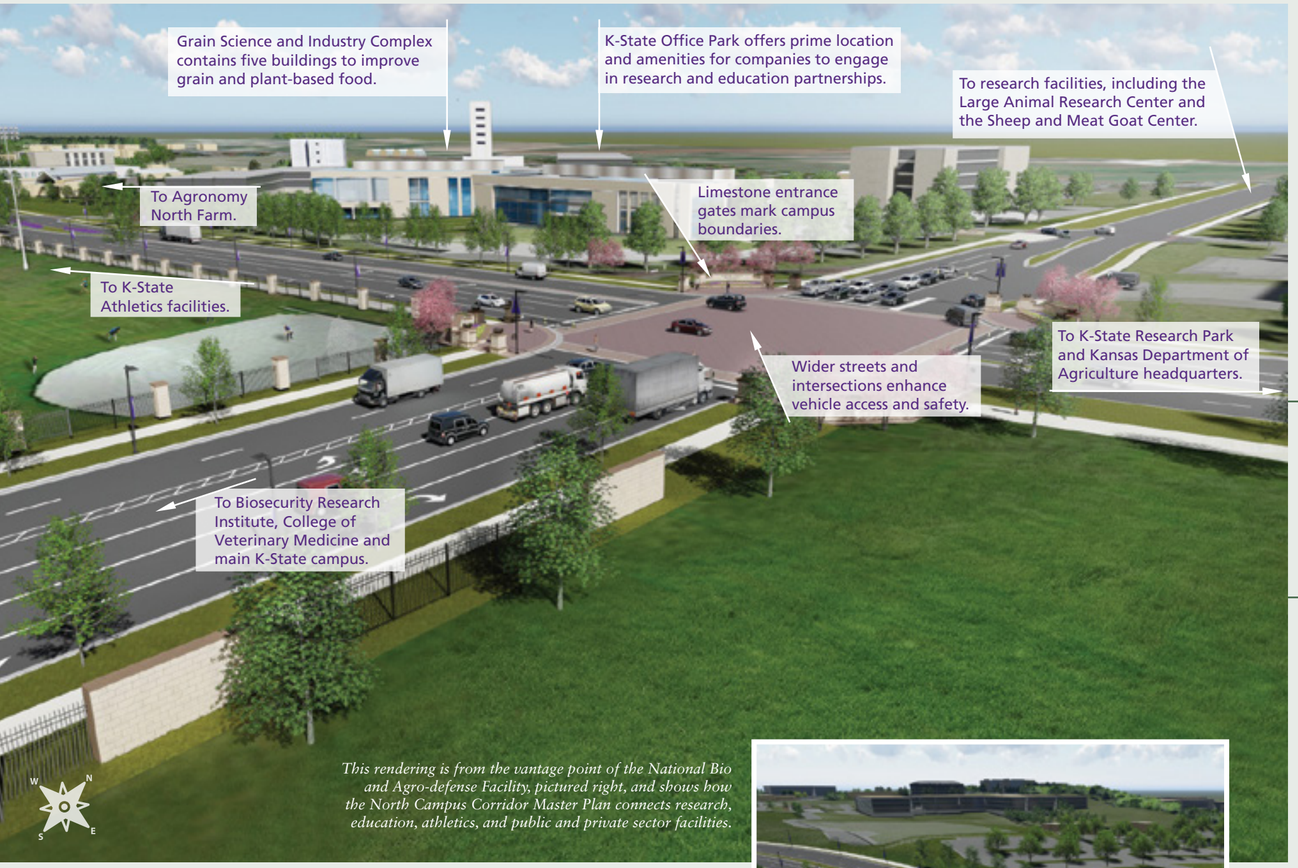
Will Zorrilla, the center's managing director, accepted the award at the May 16 Research Showcase at the K-State Olathe campus.

See Engagement

Welcome to the neighborhood

North Campus Corridor will provide gathering place for university, public sector and private sector

By Sarah Caldwell Hancock



This rendering is from the vantage point of the National Bio and Agro-defense Facility, pictured right, and shows how the North Campus Corridor Master Plan connects research, education, athletics, and public and private sector facilities.

When the federal government selected a site near the north end of Kansas State University's Manhattan campus as the future home of its foremost animal disease research facility, a partnership of university, civic and business interests came together to plan, develop and improve the area around the major laboratory.

Today, with construction of the $1.25-billion National Bio and Agro-defense Facility, or NBAF, underway, the university, the Kansas State University Institute for Commercialization, the Kansas State University Foundation, the city of Manhattan, Riley County, the Manhattan Area Chamber of Commerce and K-State Athletics have put their plan into action. The collaborative team is developing an area where the public and private sectors can co-locate with the university, support the K-State research and education mission, build on the university's expertise in global food systems and biodefense, and create value for all.

> "This plan is an economic development road map that will guide the success and competitiveness of K-State, our community and the region for decades to come." — Richard B. Myers, president of K-State

The North Campus Corridor Master Plan comprises 13 phases to improve access, safety, infrastructure and aesthetics. Phases one through four are underway now; the first visible results will be wider streets, improved intersections, trail and sidewalk access, and continuation of the historical limestone wall and entrance gates. The rest of the phases will be complete by the time NBAF becomes operational in 2023.

"This plan is an economic development road map that will guide the success and competitiveness of K-State, our community and the region for decades to come," said Richard B. Myers, president of K-State.

Sue Peterson, the university's chief governmental relations officer, and Kent Glasscock, president of the K-State Institute for Commercialization, are quick to highlight the excellent relationship between K-State and the community. Town-gown relations here have garnered recognition from The Princeton Review: K-State and Manhattan ranked No. 1 for 2018 and No. 3 for 2019.

The North Campus Corridor project itself has received national recognition and was a finalist in the 2018 Awards of Excellence from the University Economic Development Association.

The project is drawing $10 million from the City University Project Fund, which demonstrates commitment from both parties.

"It all goes back to a $1.25-billion investment and asking how we can capitalize on it," Peterson said. "An economic development study drove our willingness to invest. The state and the city will get a high return on investment."

Jason Hilgers, deputy city manager for the city of Manhattan, said good relationships are key to the success of the plan. Manhattan Mayor Linda Morse said the potential to foster long-term economic growth is enormous.

"In such globally competitive times, building the infrastructure needed to foster and sustain economic development has never been more essential," Morse said. "NBAF, along with the expansion of the Kansas State University research footprint, will serve as vital catalysts for bioscience, agriculture and technology firms to locate and thrive within this corridor and in the broader Flint Hills region."

Two crucial elements in the North Campus Corridor plan are the K-State Office Park, developed by the KSU Foundation, and long-term plans for improvements to K-State Athletics facilities.

The office park offers a prime location for companies to engage in research and education partnerships with K-State or NBAF and to hire K-State students and graduates. Current tenants include a Garmin International Inc. software engineering facility, U.S. Engineering, construction company McCownGordon and the Veterinary and Biomedical Research Center, which helps products earn federal regulatory approvals.

"We are fortunate to have partners throughout the Manhattan community who have vision and are willing to create a streetscape that supports the collaborative ecosystem we're developing at the K-State Office Park and throughout the corridor," said Greg Lohrentz, senior vice president of operations and finance for the KSU Foundation. "Our partner-tenant companies not only strengthen K-State, but also the community and region. It's important for these companies to locate in a place where they can attract talent and innovate in their respective industries while enjoying world-class amenities."

Integrating K-State Athletics also brings energy to the corridor. Jeremy Niederwerder, senior associate athletics director for facilities and capital projects, said combining athletics and North Campus Corridor projects will improve both the day-to-day character of the area and the fan experience.

"Improvement of traffic for both vehicles and pedestrians will enhance patron safety while increasing the ease by which our fans can attend events," Niederwerder said.

The new North Campus Corridor will honor its historical and contemporary role as an agricultural research area. It already includes renowned research organizations and facilities, such as the university's Biosecurity Research Institute, the Grain Science and Industry Complex and the K-State Research Park, which is home to the headquarters for the Kansas Department of Agriculture.

The collaborative university, civic and business team aims for the thriving North Campus Corridor to continue attracting companies and people to the Manhattan area.

"We want to create an environment that's appealing and give it a sense of place," Hilgers said. k

Seek more

Learn more about the North Campus Corridor project.
k-state.edu/seek

An urban prairie

How university green roofs enrich city life and improve ecosystems

By Pat Melgares

Plants and other vegetation enliven the Ted and Jill Spaid Terrace, located on the north roof of the university's Regnier Hall.

At first glance, the rows of grasses and wildflowers on the roof of Kansas State University's Regnier Hall are a pretty sight and a peaceful respite for visitors.

But Lee Skabelund in the College of Architecture, Planning & Design sees much more.

To Skabelund, the grasses and wildflowers represent the diversity of the Kansas Flint Hills. They are pieces of the prairie brought to an urban rooftop. They are ways to improve local ecosystems. And, along with other types of living infrastructure, they represent a pathway to enriching life in cities across the world.

Known as green roofs, the concept of planting flowers or even food crops on the rooftops of buildings dates back centuries — the hanging gardens of Babylon, thought to be constructed around 600 B.C., is one of the Seven Wonders of the World. Yet, only in recent years has green roof construction become trendy. Designers are building gardens to reduce storm water runoff, to cool buildings and to reduce noise, among other benefits.

"Green roofs have been explored now from a research point of view for about 15 to 20 years," said Skabelund, associate professor of landscape architecture and regional and community planning. "In the last 5 to 10 years, it has really blossomed in terms of all kinds of research around the world. Much of the research is being done outside of the U.S., but there are so many people interested in it now."

Researchers plant hardy varieties, called sedums, to help establish vegetation on green roofs, such as this sedum on Regnier Hall's roof.

K-State has four active green roof research projects: a lower and upper roof of Seaton Hall's west wing; a roof on Regnier Hall; and two large roofs covering nearly 43,000 square feet — about 1 acre — at Memorial Stadium.

"Memorial Stadium is intended to be a reflection of the surrounding area," said Pam Blackmore, master's student in landscape architecture who leads a portion of the research on the stadium's roofs. "We are trying to bring some of the biodiversity of the Flint Hills to the edge of campus."

The stadium recently was remodeled to house the Berney Family Welcome Center, the Purple Masque Theatre and other university offices. The current green space was designed to limit the number of people on the two roofs, which decades ago was seating for fans at football games. Each of the roofs has more than 20 species of native grasses and wildflowers.

"Most of the plants are local natives," Blackmore said.

She noted that the green roof design incorporates several purple flowering plants as well as other colors. Native grasses, such as big bluestem and Indian grass, are also in the mix and can grow more than 6 feet tall.

In other words, it's as if the nearby Konza Prairie Biological Station, a research centerpiece of the Kansas Flint Hills, has been nurtured on the main K-State campus.

Not a simple task

But what seems to be a simple process of growing wildflowers is really not so simple at all.

Take the Memorial Stadium project, for instance, where the roofs were insulated first and then a system of webbed plastic cells, called geoweb, was set in place to keep several tons of sandy soil from falling down the steeply sloped surfaces. The geoweb is held in place by stainless steel cables attached to eye bolts at the top of the green roofs.

Because of an error during design, the initial west side construction failed nearly three years ago when the geoweb could not hold the sandy soil in place and it all slithered down to the bottom of the 22-degree sloped roof.

> **"We are trying to bring some of the biodiversity of the Flint Hills to the edge of campus." — Pam Blackmore, master's student**

A recent water leak on the east side of the stadium was another learning experience.

"As with all roofs, it can take a while for roofing professionals to determine where the leak is coming from," Skabelund said. "A green roof makes finding the leak a little more complex because you may need to take some green roof materials off to find the leak."

Research on Regnier Hall's experimental roof focuses on plants' survival and growth, including their height and coverage.

The lush vegetation that covers the east roof of the university's Memorial Stadium represents the biodiversity of the Kansas Flint Hills.

K-State's other green roof projects may not be at such a large scale, but they can be just as complex. Visitors to the green roofs can see soil and plants, but what they cannot see are as many as eight layers of material beneath the surface, including the engineering substrate or soil, filter fabric, a drainage layer, root barrier, waterproofing membrane and roof insulation.

"Green roofs are harsh environments for plants because the substrates or soil depths are very thin, so plants may not have a lot of room for their roots to spread out and establish," said Priyasha Shrestha, master's student in landscape architecture. "The plants have to be very hardy, very drought-tolerant and maybe will only do well when there is ample rainfall on a green roof."

Therein lies the challenge for researchers: design green roofs that can survive in challenging climates while providing a beautiful setting for visitors.

Critical for the Flint Hills region

Shrestha, who studied architecture in her native Nepal, is monitoring the health and growth of plants atop the Regnier Hall roof. The plants are grown in two substrates that are 4, 6 or 8 inches deep.

"We are looking at the plant's survival and looking at growth in terms of height and coverage," Shrestha said. "I'm also looking at physiological health in terms of stomatal resistance, which relates to how water vapor and carbon dioxide move to or from the stomata, or pores, on the leaves of plants."

Shrestha's work is important because, as Skabelund notes, the first step in managing a green roof is getting plants established. A number of sedums — hardy plants normally not native to the area — can establish quickly, while native plants typically take more time and care to survive on a green roof.

"We think you need two years to really get the roots established," Skabelund said.

He noted other studies in which native plants died after being watered for only a couple of months or a single growing season.

Blackmore said that more than 1 million gallons of water were used to maintain the Memorial Stadium rooftops in 2017. Part of her challenge going forward is to determine how to be more strategic regarding when and where to apply water.

"There are some areas that are getting too much water and other areas that don't have as much water," she said. "Distribution uniformity is key for irrigation design, and it gets challenging to achieve when you are dealing with the sloped surface and tall vegetation of Memorial Stadium."

Another student, Allyssa Decker, doctoral student in environmental design and planning, is gathering data from soil and temperature sensors. She is combining it with weather station data to determine the relationship to plant survival and growth.

Her work will help improve irrigation and management practices to make green roofs more sustainable and to minimize nonessential costs, she said.

The following projects also use the green roofs.

- *David Haukos, associate professor of biology, is working with Blackmore to study the community of butterflies on the Memorial Stadium rooftops.*
- *Trisha Moore, assistant professor of biological and agricultural engineering, and Gerard Kluitenberg, professor of agronomy, are helping Skabelund and Decker assess soil moisture data.*
- *Dale Bremer, professor of horticulture, is using drones to monitor drought and other stresses in grass. He is collaborating with Ajay Sharda, assistant professor of biological and agricultural engineering; Harman Singh, master's student in biological and agricultural engineering; and Deon van der Merwe, adjunct faculty member in diagnostic medicine and pathobiology.*

"Our work requires what we call 'ground truthing,'" Bremer said. "We can see patterns from aerial images and may have ideas as to what is happening to the vegetation. But ultimately we need boots on the ground to evaluate the areas where we suspect plants may be suffering stress of some kind to determine exactly what is going on."

Mary Beth Kirkham, university distinguished professor of agronomy, is guiding research on plant health and soil moisture on the Regnier Hall roof and helping Shrestha measure stomatal resistance. She said the work at K-State is extremely important for this part of the country.

"Much of the research on green roofs has been done in the eastern part of the United States, a temperate zone where rainfall is plentiful," she said. "Little research has been done in semi-arid areas like Kansas."

"Professor Skabelund and his students are leading the way in understanding how plants can grow on roofs in dry regions," Kirkham added. "They are studying different kinds of plants, including prairie plants found at Konza Prairie. Prairie plants are adapted to dry conditions, so some are good candidates for species to grow on green roofs."

Research on the K-State green roofs was supported by the Mary K. Jarvis Distinguished Faculty Chair, which Skabelund held from 2015 through the summer of 2018.

Seek more

Learn more about K-State's green roof projects and view a photo gallery.
k-state.edu/seek

life of the wild

Why scientists study ecosystems and the wildlife within them

The swift fox is native to Kansas and is an indicator species of an intact ecosystem. Researchers are studying the swift fox to understand the health of the shortgrass prairie.

Life of the wild

Why scientists study ecosystems and the wildlife within them

By Jennifer Tidball

Take a step outside and enter the laboratories of several Kansas State University researchers.

Scientist Ty Werdel's laboratory is the shortgrass prairie, where he is capturing images of the swift fox to understand the health of the Kansas landscape.

Wildlife specialists David Haukos and Drew Ricketts work in the High Plains as they track two deer species to see where they're moving, how long they live and how these factors affect populations.

Biologist Alice Boyle spends her time with birds in two outdoor locations: the Kansas Flint Hills and the rainforests of Central America. She studies how weather patterns affect bird movement.

These researchers know there is a lot we can learn from the wild. That's why they are searching the prairie, scanning the skies and traveling across forests and plains to track down wildlife. Their questions are as numerous as the species they study. They want to know: How are animals changing? Where are they moving? What can they tell us about the ecosystems where they live? Why is that important?

To find the answers, follow these scientists into the wild.

Swift as a swift fox

One of the biggest indicators of a healthy ecosystem is no bigger than a household cat.

Meet the swift fox — if you can catch a glimpse. The swift fox is an iconic, and adorable, shortgrass prairie species that is native to Kansas. The foxes are small; they weigh around 5 pounds and are only about a foot tall.

"Swift fox are indicator species of intact ecosystems," said Ty Werdel, doctoral student in horticulture and natural resources. "If we find swift foxes and we keep that habitat intact, it benefits all other species that share that habitat."

Swift foxes share habitats with animals such as grassland birds, prairie dogs and ground squirrels. Swift foxes need to live in shortgrass to be able to see predators, such as coyotes. But swift fox populations have declined in recent years as shortgrass prairies have dwindled.

"The shortgrass prairie is changing because of farmland, ranchland and highways," Werdel said. "We want to see if this decrease in shortgrass prairie is affecting swift fox distribution. We want to determine the status of this iconic prairie species in Kansas."

To understand swift fox populations, Werdel and a research team spent the summer breeding months tracking swift fox in 31 Kansas counties. They used cameras to capture images that show the presence of swift foxes.

Werdel is working under the direction of Adam Ahlers, assistant professor of wildlife and outdoor enterprise management. Their team of technicians includes Chelsea Werdel, junior in entrepreneurship; Asa Lee, senior in wildlife and outdoor enterprise management; and Colleen Piper from the University of Georgia. The project is supported with a three-year grant from the Kansas Department of Wildlife, Parks and Tourism.

The researchers have worked with private landowners to place game cameras on 360 sites in western Kansas stretching from the Nebraska to Oklahoma borders. They place the cameras on metal stakes near skunk bait, which they use to attract animals. The motion-activated cameras capture images — ideally images of swift foxes — whenever they detect movement.

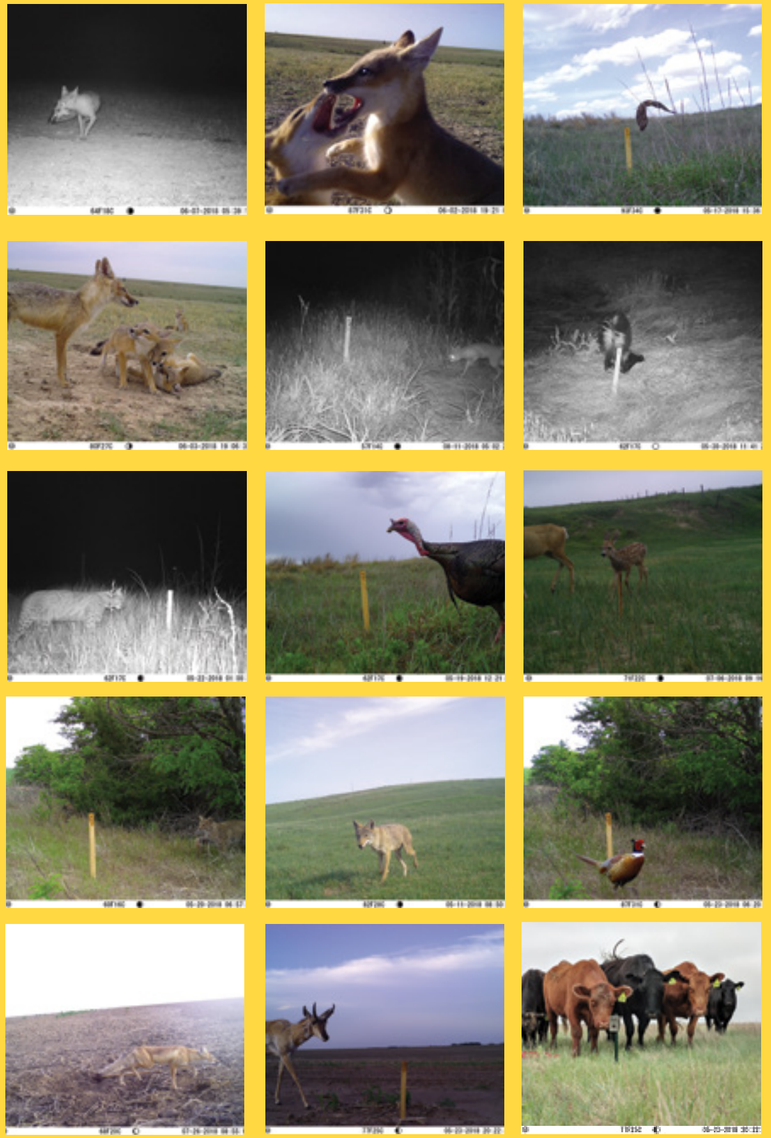
The researchers have captured a variety of swift fox photos: a blurry fox running by in the middle of the night with a mouse in its mouth; a fox den with a mother and her babies; two fox pups playfully roughhousing.

The team is using the images to create a map that shows where swift foxes can be found throughout western Kansas. Werdel is investigating how landscapes, habitat, vegetation, precipitation and climate affect where the foxes are located.

Perhaps what is just as interesting and humorous are the photos that the team has captured of other animals: a herd of cattle gathering curiously around the camera; a bobcat sneaking nearby; a flying hawk diving toward prey.

Although their primary goal is to track the presence of swift foxes, the researchers are learning about the variety of wildlife across the western portion of the state as they work to understand the health of the Kansas prairie.

"It is important to understand how species distributions are being impacted by landscape change," Ahlers said. "This is especially true for animals like swift foxes that are habitat specialists occurring in areas where shortgrass prairies are becoming increasingly rare."



By using game cameras, university wildlife researchers have captured images of a variety of western Kansas wildlife, including swift foxes, hawks, coyotes, skunks, bobcats, turkeys, deer, quail and cattle.

Ty Werdel, doctoral student in horticulture and natural resources, collects data from one of the game cameras he has placed on 360 sites in western Kansas.

Deer far and near

Another group of K-State researchers is conducting the largest deer study ever performed in Kansas.

Their goal: Track two native Kansas deer species — the white-tailed deer and the mule deer — to understand how the deer are moving throughout the state. The information is important for farming, disease control and hunting.

"We're trying to answer bigger picture questions about deer in Kansas and the Great Plains, too," said Drew Ricketts, project co-leader and assistant professor of wildlife and outdoor enterprise management. "We are collecting data from the adults and fawns of both species and that will help manage habitats for the different species."

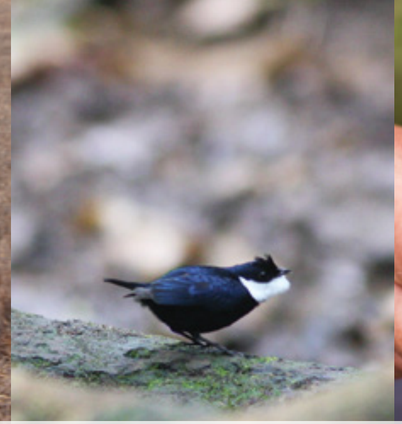
For the past 50 years, the presence of the two deer species has changed rapidly in Kansas. Mule deer populations have declined and moved farther west, whereas white-tailed deer populations have increased throughout the state, but especially in the west.

Those deer population changes are concerning for multiple reasons, Ricketts said. More deer mean more crop depredation; increases in vehicle-deer collisions; and the further spread of diseases carried by deer, such as chronic wasting disease.

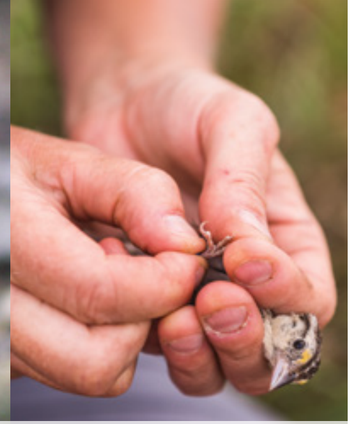
"We're trying to understand if there are any interactions between the two deer species or if it's mostly changes in landscape or habitat that are causing these trends," said David Haukos, project co-leader and associate professor of biology.

A research team takes deer measurements, including weight, blood, hoof size and leg length, before releasing the deer back on the Kansas prairie.

A white-tailed deer doe runs while wearing a GPS satellite collar that shows where the deer travels. (Photo credit: Kansas Department of Wildlife, Parks and Tourism)



A white-ruffed manakin performs a mating display in Costa Rica.



A researcher takes measurements from a grasshopper sparrow in the Kansas Flint Hills.

The study involves more than 100,000 acres of private land in 10 counties in northwestern Kansas. It is a three-year project with funding from the Kansas Department of Wildlife, Parks and Tourism; the Kansas Cooperative Fish and Wildlife Research Unit; the Mule Deer Foundation; and smaller conservation groups.

For the grant's first year, the researchers partnered with a helicopter company to find, capture and tag more than 130 does, bucks and fawns during the spring 2018 breeding season. The researchers took deer measurements, including blood, hoof size, weight and leg length, as well as habitat measurements, including nearby vegetation and grass height. They also marked each deer with a GPS satellite collar, which creates a record of where the deer has traveled and shows if the animal spends more time in grassland or forested areas.

Early data analysis has revealed a surprising result: More does are giving birth to fawns in open areas, such as wheat fields, with little cover. Typically, does give birth in wooded areas with tree and shrub cover for protection. The researchers are not sure why the change is happening, but they want to find out more by continuing to track deer and analyze data.

"These deer are important to the economy of the state and to the agricultural areas in western Kansas," Haukos said. "This is just a start in terms of understanding deer ecology management and conservation in Kansas."

The project involves a large team of graduate students: Maureen Kinlan, master's student in biology; Mitchell Kern, master's student in horticulture and natural resources; and Talesha Karish, doctoral student in biology. It involves four technicians and numerous veterinarians and landowners.

From the mountains to the prairies

Alice Boyle, assistant professor of biology, studies wildlife around the world, from the mountains of Central America to the hills of the Konza Prairie Biological Station.

Boyle researches avian ecology, and her work is helping scientists understand how climate and weather changes affect bird movement in these two ecosystems.

"Both research projects are converging because in both the tropical and the grassland systems, I am becoming more and more convinced that rainfall matters more to birds than anybody has really ever thought before," said Boyle, whose background is in tropical biology.

In the tropics, Boyle studies the white-ruffed manakins in the mountains of Costa Rica. The bird is known for elaborate mating displays where males dance and perform acrobatics for females. Boyle and Elsie Shogren, doctoral student in biology, are using a two-year National Science Foundation Early-Concept Grant for Exploratory Research, or EAGER, to study how rainfall influences the mating behavior and evolution of this species.

"A big interest of mind is the importance of climate, and specifically rainfall, in shaping what these birds are doing, where they are going and what kinds of decisions they are making," Boyle said.

Boyle and Shogren also collaborate with an interdisciplinary team of more than 50 researchers from the U.S., Canada, Brazil, Venezuela, Colombia and Bolivia as part of a National Science Foundation Research Coordination Network to perform comparative studies of manakin evolution. Each of the network laboratories focuses on different questions and everyone combines those insights with new manakin genomic data to understand how sexual selection works from the level of the gene to the level of big biogeographic patterns. Boyle's laboratory is the only network laboratory that studies white-ruffed manakins.

Boyle also is researching birds closer to home. A three-year National Science Foundation grant is helping her study how environmental causes, such as weather, affect the populations of various prairie bird species.

She is studying several common tallgrass prairie bird species found in Kansas: grasshopper sparrows, dickcissels and eastern meadowlarks. Her six-person team of graduate and undergraduate students spends the summer breeding season combing through the Konza Prairie — an 8,600-acre tallgrass prairie ecological research site jointly owned by the university and The Nature Conservancy.

The team finds, captures and marks birds to track where they go every year and how often they return to the same territory. The researchers find nests and monitor their success to understand what makes a good habitat in wet and dry years and how nest success affects birds' movement patterns. They gathered data on more than 167 nest sites in summer 2018.

The research team includes Sarah Winnicki, master's student in biology, and a group of biology undergraduate students, including Dylan Smith, senior; Blair Pfeifer, senior; Mary Kate Wilcox, sophomore; Joanna Gresham, junior; and Katelyn Thompson, 2018 graduate. See page 38 for more on Konza Prairie research from Boyle's team.

For Boyle, the research on the Kansas tallgrass prairie is a way to help an ecosystem that is quickly disappearing.

"It is so amazing to be surrounded by this beautiful prairie landscape," Boyle said. "Because K-State is one of the only universities located in the last big tract of tallgrass prairie, I think if we don't do this research, it might never happen at all. I see it as an opportunity, and on some level, my obligation to help these threatened birds and contribute to understanding the ecology of this special place." k

Seek more

View a gallery of wildlife photos.
k-state.edu/seek

Alice Boyle, assistant professor of biology, prepares to release a grasshopper sparrow at the Konza Prairie Biological Station. Boyle researches avian ecology.

A closer look

See the species that Kansas State University researchers study.

Swift fox

Scientific name: *Vulpes velox.*
Habitat: Shortgrass prairies.
Did you know? The swift fox is swift and can run more than 30 miles per hour.

White-tailed deer

Scientific name: *Odocoileus virginianus.*
Habitat: Forests, croplands and grasslands.
Did you know? The white-tailed deer has a reddish summer coat that turns gray in the winter. Its tail is white underneath.

Mule deer

Scientific name: *Odocoileus hemionus.*
Habitat: Open grasslands and croplands between dusk and dawn; shrubby areas or tree cover during the day.
Did you know? The mule deer is much larger than the white-tailed deer and got its name because its large ears resemble a mule's ears.

White-ruffed manakin

Scientific name: *Corapipo altera.*
Habitat: Rainforests.
Did you know? The male white-ruffed manakin has white feathers on its throat and performs incredible "dances." Females pick the best dancer as a mate.

Grasshopper sparrow

Scientific name: *Ammodramus savannarum.*
Habitat: Grasslands and prairies.
Did you know? It is named for its insectlike buzzy song, which is among the highest-pitched bird songs in the world.

THE MAKING OF A MEAL

Take a bite out of research that improves America's favorite meal

By Stephanie Jacques

The perfect savory, salty and sweet traditional American meal of a hamburger, fries and ice cream starts far before the raw ingredients arrive in the kitchen.

Kansas State University researchers know the secret ingredients: the bun's ability to withstand juiciness, the patty's safe delivery of rich nutrients and the vegetable toppings' important nutritional qualities. Scientists are keeping all of this in mind as they serve up improvements to the global food systems supply chain.

THE BUN

Making a perfect hamburger bun starts with breeding the ideal wheat plant and extends to every step along the wheat supply chain — from wheat farmers to millers and bakers.

Every year, Allan Fritz, professor of agronomy and a wheat breeder, works to develop and evaluate numerous wheat varieties for their profitability, yield and quality. After pairing parental varieties in the greenhouse, Fritz ends up with about 3,000 to 5,000 new wheat lines within the first five years of an 11-year process. He tests those varieties for the next several years in about 20,000 plots statewide.

"Most of the 5,000 different lines are destined for the trash can, but we should still be able to find one or two really good ones out of that," Fritz said.

With constant environmental changes, Fritz has to consider multiple factors, such as a plant's ability to withstand diseases, drought and heat.

"Every year is so different in Kansas," Fritz said. "We have to identify varieties that can grow in a wide range of environments — not just from location to location, but year to year. That's a challenge."

While Fritz is trying to develop the ideal wheat variety, Romulo Lollato, assistant professor of agronomy, is working with farmers to understand how management of nitrogen and sulfur in the wheat field can produce profitable, high-protein wheat.

"Nitrogen contributes to wheat's protein, which gives the bread better stability, more dough strength and more volume," Lollato said. "Sulfur, if deficient, can limit yields and the volume of the bread."

Nitrogen fertilizer is one of the most expensive aspects of wheat production. Farmers don't want to use any more than needed, but if they don't deliver wheat with a certain amount of protein, they may see price reductions at the grain elevator, Lollato said.

"We want the wheat to have about 12 percent protein to maintain the baking quality," Lollato said. "If protein is much below 11.5 percent, then the farmer did not have enough nitrogen to maximize yield."

Both Lollato and Fritz have worked with Becky Miller-Regan, assistant professor of bakery science and former director of the university's Wheat Quality Laboratory, to examine wheat varieties for their bread-making quality.

Miller-Regan uses a K-State-developed dough mixing test called the mixograph, which determines the strength of the flour and how much mixing time is needed. The lab also relies on baking tests to better understand the end product's quality.

"If you are going to see if a wheat variety is good for making bread, then the best test is to actually make bread with it," Miller-Regan said. "We bake bread and judge the bread based on its size, crumb structure and elastic balance. For example, a hamburger bun needs to have enough strength to hold its shape but flow out a little bit to fill the shape of the pan."

According to Miller-Regan, bread's end quality is determined 30 percent by the variety of wheat and 70 percent by environmental factors such as fertilizer, rain and temperature. This makes evaluating the data from Fritz and Lollato extremely important in determining if a variety of wheat will be better suited for a scone, pizza crust or a hamburger bun.

THE PATTY

A juicy hamburger patty is the product of one of the world's best conversion systems. Grasslands have great ecological and economical importance, and while they are a vast resource that is largely indigestible to humans, they can be converted to high-quality nutrients such as zinc, iron and protein for people.

KC Olson, professor of animal sciences and industry, is ensuring cattle's nutrient conversion of grassland by controlling the growth of sericea lespedeza, an invasive plant species. Sericea has a bitter taste to cattle, and it robs them of natural dietary proteins the animal needs to maintain health, Olson said.

"Cattle, the predominate herbivore in Kansas grasslands, pretty much leave sericea alone because it has tannins that are astringent like lemons or radishes," Olson said. "Tannins, once they're in the rumen, bind dietary proteins and render them unavailable for fermentative digestion."

About 80 percent of cattle's lifetime calories comes from forages like those in Kansas grasslands, Olson said. Unfortunately, the progressive invasiveness of sericea displaces nutritious, native plant life for cattle and decreases economic returns for ranchers.

Olson's research has shown that changing the timing of grassland burning, traditionally done in the spring, can help control the spread of sericea by introducing fire in the summer right before it goes to seed. After spring burns, Olson saw sericea grow from less than 2 percent of a field's plant population to 11 percent, whereas summer burns helped sericea remain at less than 2 percent. This research gives beef producers a better understanding of how to control a potentially damaging plant.

In addition to managing grasslands, ranchers have been breeding cattle with desired traits for centuries to improve their herds. Megan Rolf, assistant professor of animal sciences and industry, helps ranchers look beyond physical appearances.

"Beef producers have had the ability to use genetic selection tools for several decades in the form of expected progeny differences, or EPDs," Rolf said. "They now have the ability to use genomic testing as part of those tools to select for traits that are economically and environmentally important."

Rolf is using RNA, DNA's messenger in biological roles, in kidney tissue to understand why some animals need less water than others. Her research can help ranchers look at the genetic information of a cow and a bull and decide if their offspring could be more environmentally friendly.

"We want to quantify how much variation there is in both feed and water intake so we can select for more efficient animals, while simultaneously not giving up productivity in other traits that are important for producers and consumers," Rolf said. "It will help us use land and water resources effectively, which will decrease the footprint of beef production."

K-State researchers also are looking out for the beef consumer. Randy Phebus, professor of animal sciences and industry and interim director of the university's Food Science Institute, is part of a $25 million multi-institutional U.S. Department of Agriculture grant to address beef safety.

"We are looking at the prevalence of public health pathogens, particularly Shiga toxigenic *Escherichia coli*, or STEC, in cattle on the farm and how they find their way into fresh raw beef," Phebus said. "This group of pathogens produces a toxin that can cause a devastating illness in people."

According to Phebus, a few hundred STEC cousins can be present naturally in cattle's intestinal tracts without harm to them. Beef processing can spread contaminants into meat products, and when consumed by humans, the pathogen releases a deadly toxin in the gut.

Phebus helps meat and poultry companies validate their safety processes to control pathogens like STEC and salmonella. See page 31 for more about food safety research from Phebus.

"At the university's Biosecurity Research Institute, we test multiple antimicrobial applications and processes at a commercial scale using high levels of real pathogens to reduce public health risks in the food chain," Phebus said

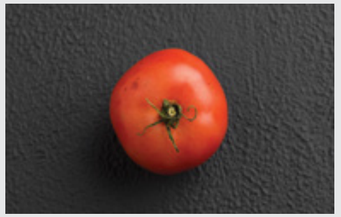
Although food safety is of the upmost importance, a hamburger patty would not be near as popular if it was not satisfying. Travis O'Quinn, assistant professor of animal sciences and industry, is making sure a good old fashioned hamburger still tastes delicious as people become more health conscience.

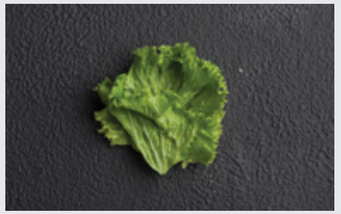
According to O'Quinn, a burger's juiciness is tied to its fat content, which is perceived to improve taste. O'Quinn did a blind survey where participants tasted various blends of lean versus fat in hamburger, such as 70 percent lean/30 percent fat, 80 percent lean/20 percent fat and 90 percent lean/10 percent fat. Participants rated each patty on tenderness, juiciness and flavor. In a second test, each patty was labeled by the quality of the cuts of meat ground into the hamburger: ground round, ground chuck or ground sirloin.

"What was really fascinating is all of the differences once we told consumers what it was," O'Quinn said. "We got a huge change in their rating from the blind to the informed testing, especially with the labels of sirloin and 90/10 fat content."

O'Quinn said that the 90/10 ground sirloin wasn't one of the high-performing patties in the blind tasting, but its rating improved 14 percent in the labeled testing.

"This was the first study that really demonstrated that consumer perception has as big of an impact as what is in the meat," O'Quinn said. "All that branding makes a difference."





THE TOPPINGS

Kelly Gude, doctoral student in horticulture at the K-State Research and Extension Center in Olathe, is shining a light on yield and nutritional quality of tomatoes and leaf lettuce grown in high tunnels. According to Gude, high tunnels — structures similar to greenhouses that allow farmers to manipulate light over produce — have improved crop productivity with fruiting vegetables and leafy crops, but they may come at a cost.

"There are sporadic reports of inconsistent and negative impacts on nutritional quality of produce grown in high tunnels compared to an open field," Gude said. "In particular, ultraviolet light can affect antioxidant capacity and other phytochemical production of the plant."

Gude is testing basic slicing tomatoes, "BHN-589," and two lettuce varieties, "Red Fire" and "Two Star." She is measuring nutrients such as beta-carotene, lycopene and lutein, which are precursors to vitamin A and are cancer-fighting antioxidants also important for human eye health.

Gude is evaluating how different high tunnel coverings filter light and temperature and how they affect crop yield, storage life and nutritional quality of tomatoes and lettuce. The research could help producers maintain good yields and vegetable nutrition.

Page 25 top right photo: Researchers grow green "Two Star" lettuce and dark red "Red Fire" lettuce.

Page 25 bottom left photo: Researchers measure lettuce core length from the base to the tip of the longest leaf to determine lettuce growth variation in different growing conditions.

THE SIDE

Sweet potato fries are growing in popularity, but producing the seed that can support the nutritious orange spud proves to be more difficult in the Midwest. Zachary Hoppenstedt, master's student in horticulture at the K-State Research and Extension Center in Olathe, is digging around ways to get slips — stem cuttings used for sweet potato reproduction — to local producers.

"In the U.S., commercial sweet potato production and propagation is largely concentrated in southern and coastal states and a Midwest supply of organic sweet potato slips can be limited," Hoppenstedt said.

As the demand for locally sourced produce increases, Hoppenstedt is improving wholesale production methods for organic sweet potato slips in the region. His trial evaluates the use of greenhouse-like high tunnels as ways to give producers in colder climates greater flexibility for planting and harvest.

"Increasing the capacity for local growers to produce their own planting material is one way to support sustainable community and economic development," Hoppenstedt said.

THE DESSERT

The secret behind ice cream as delicious as the ice cream made at K-State's Call Hall Dairy Bar comes down to chemistry. According to Karen Schmidt, professor of animal sciences and industry, a good ice cream, at its basic level, has a blend of ice crystals, air bubbles, protein, fat and sugar. All of those properties combine to give ice cream a fluffy texture.

"Heating the cream, milk and sugar helps the proteins bind water, which adds a foaming texture that prevents it from freezing solid like hamburger," Schmidt said. "Also, the faster you freeze the mix, the smaller the ice crystals will be, which results in a smoother and creamier ice cream."

Schmidt is studying heat treatments to kill microorganisms in nonfat dry milk, which increases foaming and gelling textures in commercial foods, ranging from ice cream to hamburger buns, for greater firmness and cohesion.

Textures aside, a great ice cream also needs to tantalize the taste buds. The most notable ice cream flavor made at K-State's Call Hall Dairy Bar is Purple Pride, which is made with blueberries. The fruit is just one of the many kinds of produce that could benefit from bio-based food packaging research at K-State.

Valentina Trinetta and Umut Yucel, both assistant professors of animal sciences and industry in the university's Food Science Institute, are developing a special food packaging film that would guard against foodborne pathogens and microorganisms to extend the shelf life of berries.

"We have put together an active packaging system for food that has active ingredients that are released over time," Trinetta said. "The packaging makes the food safer and last longer because it has active antimicrobial properties encased in nano-emulsions that act against foodborne pathogens."

The researchers tested the film on strawberries and observed a 20 to 30 percent reduction in microbes, a two-day longer shelf life and improved color retention. A patent is approved for the packaging and consumers should see longer shelf lives for berries in the near future.

BREADWINNERS

There's no question: Kansas State University researchers are putting the bread in America's breadbasket. Kansas ranks No. 1 in the country for wheat production, according to the U.S. Department of Agriculture. In the past 10 years, the university has garnered more than $55 million in research funds that directly relate to wheat research and improve the wheat supply chain.

Across the wheat state and around the world, K-State researchers are involved in nearly every step from seed to slice.

1. THE SEED

The wheat supply chain starts with the right seed of the right wheat variety. Using information from the recently sequenced wheat genome, K-State researchers are developing wheat varieties that are better adapted for the environment and production system.

2. THE FIELD

Farmers choose the right wheat variety for their farm, but enviromental conditions in Kansas vary greatly from year to year. Research at K-State is helping farmers plan for changing environmental conditions, such as higher nighttime temperatures that can reduce yield and quality.

3. THE ELEVATOR

After farmers harvest the wheat, they sell the whole grain to grain elevators. The K-State Bulk Solids Innovation Center studies how new wheat varieties move differently in grain elevators and develops ways to efficiently and safely move the whole grains.

4. THE MILL

Milling companies purchase the whole wheat grain from the elevators and grind it into flour. K-State's Hal Ross Flour Mill is a pilot-scale flour mill where researchers and industry can test and process milled wheat with full-scale equipment.

5. THE SLICE

Bakeries and food suppliers buy the flour and sell the end product, whether it's a tasty hamburger bun or a loaf of bread. K-State cereal chemists work to make these products more attractive to consumers, such as improving the texture of whole-wheat bread.

HEALTHY ANIMALS, HEALTHY HUMANS

This photo shows mosquito larvae at the mosquito insectary in the university's Biosecurity Research Institute. Mosquitoes are one way that zoonotic diseases can transmit from animals to humans.

Zoonotic disease research targets maladies that infect both animals and people

By Sarah Caldwell Hancock

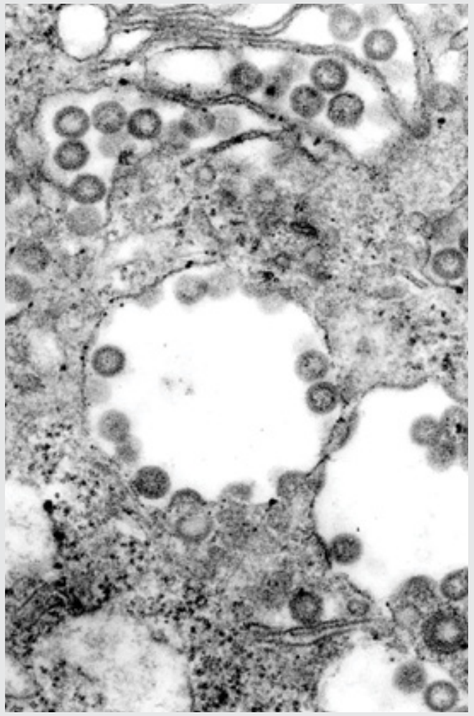
Diseases that spread from animals to people sicken tens of thousands of Americans each year. Some of these diseases are familiar, such as the flu, and others are largely unknown in the U.S., such as Rift Valley fever. Some are transmitted by direct contact with animals, but others are passed along by mosquitoes or ticks.

All of them are described by the same adjective: zoonotic.

Protecting humans from zoonotic diseases requires understanding the complex interactions between animal and human health. One concern is that diseases could spread around the world if the wrong person or animal travels at the wrong time.

Kansas State University researchers are fighting many of the nation's and the world's most devastating zoonotic diseases.

"K-State research is crucial to national security and public health," said Peter Dorhout, K-State vice president for research. "We study several diseases that are priorities for the National Bio and Agro-defense Facility, and as we do this work, we are training the workforce needed to provide future biodefense."



Rift Valley fever virus can cause fatal illness in humans, who contract the disease by handling infected animals or animal products. (Photo credit: CDC/F. A. Murphy; J. Dalrymple)

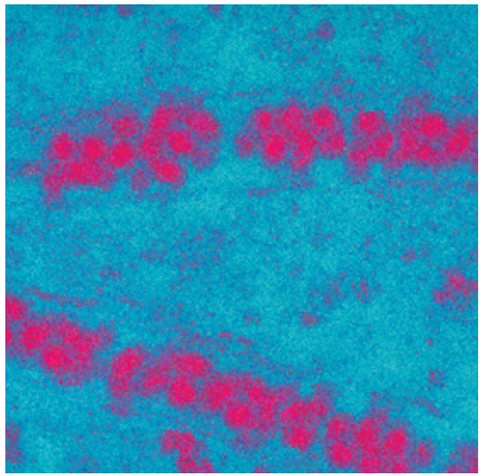
Rift Valley fever

Rift Valley fever virus, transmitted by mosquitoes, causes abortions in cattle, sheep and goats and can kill young animals. The virus also causes severe fever in infected animals and can cause fatal illness in humans, who contract the disease by handling infected animals or animal products.

Although Rift Valley fever has not reached the U.S., it has devastated other areas of the world. According to the World Health Organization, an outbreak earlier this year killed more than 950 animals in Kenya, Uganda and Rwanda from June 22 through July 2. Human deaths reached the double digits. In 2006, the virus killed 150 people in Kenya.

Ongoing U.S. Department of Homeland Security-sponsored research and training at the K-State Biosecurity Research Institute is helping develop and improve vaccines. A team from the K-State Center of Excellence for Emerging and Zoonotic Animal Diseases, or CEEZAD, collaborated with U.S. Department of Agriculture Agricultural Research Service scientists to develop and patent a safe subunit vaccine. The vaccine uses only a specific protein from the virus rather than the whole particle, and the team has licensed it to a private company. The group also confirmed that the common native white-tailed deer is susceptible to infection by the Rift Valley fever virus. See page 17 for more research on white-tailed deer.

"Our work is an example of how collaborative and translational research can result in a tool to control this devastating disease if it ever comes to our shores," said Jürgen Richt, director of CEEZAD and Regents distinguished professor of veterinary medicine.



Japanese encephalitis virus thrives in pigs and wading birds and is transmitted to humans by infected mosquitoes. (Photo credit: Sanofi Pasteur/Alain Grillet)

Japanese encephalitis

Japanese encephalitis virus is a relative of West Nile virus and is the leading cause of vaccine-preventable brain inflammation in Asia and the western Pacific, according to the Centers for Disease Control and Prevention. The virus thrives in pigs and wading birds and is transmitted to humans by infected mosquitoes. Although most infected people do not develop symptoms, a small percentage experiences sudden onset of headache, high fever and other dangerous symptoms. Around 1 in 4 cases is fatal and a total of about 13,000 to 20,000 people die each year.

College of Veterinary Medicine researchers Dana Vanlandingham, associate professor of diagnostic medicine and pathobiology, and So Lee Park, third-year veterinary medicine student and concurrent doctoral student in pathobiology, recently co-authored a study demonstrating that North American domestic pigs could be susceptible to Japanese encephalitis virus. That means if the virus is introduced in the U.S., it could take hold and ultimately infect both pigs and humans. This research was supported by the U.S. Department of Agriculture Agricultural Research Service and its scientists in Manhattan.

Studying foreign animal diseases and understanding their transmission cycles is an important step toward preparedness, Vanlandingham said. The U.S. learned this lesson the hard way with West Nile virus. Since 1999, West Nile virus has infected five million people and killed several thousand people.

"This sort of information would have been useful for past introductions such as West Nile virus, which is similar to Japanese encephalitis virus," Vanlandingham said. "Had we studied West Nile virus prior to its arrival in the U.S., we may have been better able to minimize the spread when it came into New York in 1999."

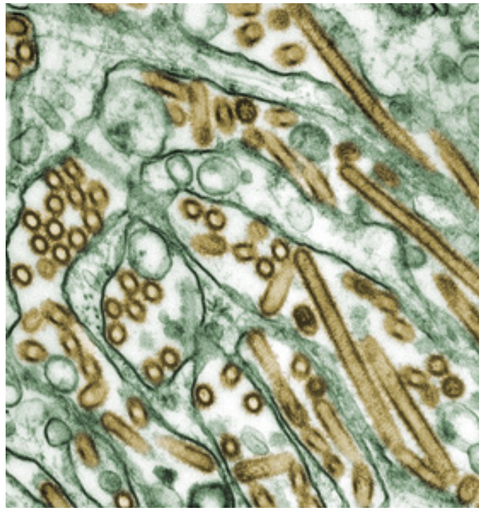
Influenza

Coughing co-workers mumble about having "the flu," but they may not know that their illness may have originated in animals. After the flu, or influenza, makes the initial jump from animals to humans, humans spread it quickly through coughs and sneezes.

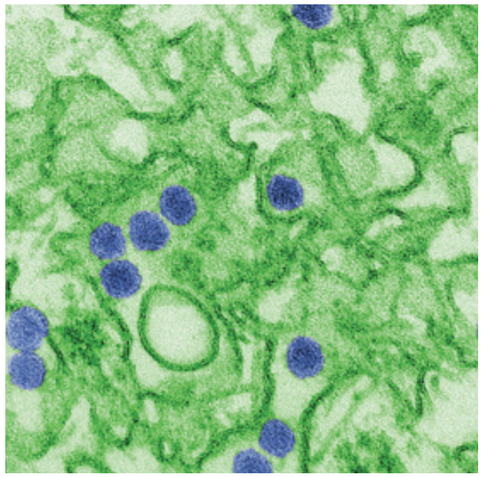
Wenjun Ma, associate professor of diagnostic medicine and pathobiology in the College of Veterinary Medicine, studies different strains of influenza, including highly pathogenic avian influenza and other strains that can afflict poultry as well as swine influenza and bat influenza. A previous collaboration with Jürgen Richt, Regents distinguished professor of veterinary medicine, and Mount Sinai Health System researchers developed a vaccine that easily could be delivered to entire poultry flocks to protect them from multiple avian influenza strains.

The overall goals of Ma's research are to understand why influenza can cross species barriers and how the viruses are transmitted. Bat influenza A-like viruses are one of Ma's targets. These recently discovered viruses cause concern because humans and other species have no immunity against them.

"If a novel virus is able to infect humans and transmit human to human, it can cause a pandemic with higher fatality," Ma said. "Almost nothing is known about these viruses. That's why our research is so important."



Influenza virus strains can originate in avian, swine or bat populations and spread to humans. (Photo credit: CDC/Cynthia Goldsmith; Jacqueline Katz; Sherif R. Zaki)



Zika virus was first identified in monkeys and is spread among humans by certain mosquito species. (Photo credit: CDC/Cynthia Goldsmith)

Zika

Zika virus was all over the news just two summers ago, but scientists remain uncertain about why infections have declined sharply. This virus is spread by certain mosquito species and causes potentially fatal birth defects in babies whose mothers were infected during pregnancy. Last year, 437 people in the U.S. were infected with Zika while traveling abroad, according to the Centers for Disease Control and Prevention.

A resurgence is possible, and K-State researchers are helping the world prepare.

Stephen Higgs, director of K-State's Biosecurity Research Institute, and Dana Vanlandingham, associate professor of diagnostic medicine and pathobiology in the College of Veterinary Medicine, co-edited a book released earlier this year, "Chikungunya and Zika Viruses: Global Emerging Health Threats." The book provides both historical and current information on these important viruses.

"Zika is an example of how quickly something can emerge," Higgs said. "It was an obscure virus that came from Africa and spread rapidly and widely to more than one million people in a short time. We were completely unprepared for it."

Higgs said K-State and Uniformed Services University researchers collaborated with the National Institutes of Health to evaluate new vaccines against Zika.

The team, along with Yan-Jan S. Huang, K-State research assistant professor of arbovirology in the College of Veterinary Medicine, also co-authored a paper that discovered a unique antibody effect between Zika and dengue viruses. So-called cross-reactivity may mean that as vaccines for Zika and dengue are developed and approved, people need to receive them at the same time to avoid the antibodies from one virus enhancing the other, researchers said.

Shiga toxin-producing *E. coli*

Contaminated food is a major source of zoonotic disease spread. Most consumers have heard of *Escherichia coli*, or *E. coli*, and know that it's something to be avoided, but only a few strains sicken people. The types that produce Shiga toxin, known as STEC, can cause illness with symptoms that include stomach cramps, diarrhea, vomiting and fever. Some infections can be life-threatening. STEC strains cause an estimated 265,000 illnesses in the U.S. each year according to the Centers for Disease Control and Prevention, with 36 percent of illnesses attributed to the worst STEC strain type: O157.

Randy Phebus, professor of animal sciences and industry in the College of Agriculture and interim director of the Food Science Institute, said the more than 200 types of STEC are widely distributed in the environment that people share with animals; more than 100 have been linked to human disease.

Validating the effectiveness of commercial antimicrobial technologies to control STEC contamination during meat processing is his area of expertise and the focus of a $25 million U.S. Department of Agriculture grant. Phebus serves on the grant's management team with collaborators from 15 other institutions. The team recently completed a study on veal processing. Raw veal poses a substantially higher STEC risk than beef, according to the USDA, and Phebus and colleagues have now validated multiple methods of reducing veal risks and beef risks in consumer products.

Phebus' team collaborates with several processing companies to demonstrate that lab-generated antimicrobial technologies translate into effective real-world tools. See page 23 for more on Phebus' research.

"Working with industry has made this work really powerful," Phebus said. "We enhance public health by giving the food industry proven antimicrobial intervention technologies to control STEC and other pathogens on their raw and processed products." *k*

Shiga toxin-producing E. coli *can infect humans when they eat contaminated food, such as contaminated beef or veal. (Photo credit: CDC/Janice Haney Carr)*

Child's play

A stone house is home to innovative child development research

By Mary Lou Peter

The joyful sound of children playing fills the air as preschoolers make up games and decide who will be the leader on a warm spring morning. The scene could be any child care center or preschool across the country, but this one is different. A closer look reveals that many of the children are wearing tiny GoPro cameras that are recording their interactions with each other and with adults.

Children wear GoPro cameras while they play on the playground at the university's Hoeflin Stone House Early Childhood Education Center.

The camera recordings are part of the latest child development research project at Kansas State University's Hoeflin Stone House Early Childhood Education Center. Researchers can observe the children without disrupting their play.

Certified early childhood teachers at Stone House teach and care for children while their parents work or attend classes. The playgrounds and classrooms are also a lab of sorts, where child development researchers observe children's interactions with each other as well as their teachers and assistants. Stone House is a home for high-quality early education for children and families to be sure, but it is also a research site and a place where teachers and college students come to learn.

Stone House — an iconic limestone building on the Manhattan campus — was built in 1866 as a private home and was purchased by the university in 1925. It was named Hoeflin Stone House in 1977 to honor Ruth Hoeflin, dean of the College of Human Ecology from 1975 to 1983. Additions and renovations followed, and now the updated building has six classrooms as well as meeting and office space, plus three playgrounds and a classroom for K-State students majoring in early childhood education.

About 65 children attend Stone House at any given time and range in age from 6 weeks old to 5 years old.

"We strongly believe in play-based activity, but there's a need for research of that activity to understand its role in cognitive development," said Deborah Norris, associate professor of early childhood education and lifespan human development.

Norris and colleague Jennifer Francois, assistant professor of early childhood education, are leading research projects to delve deeper into early childhood behavior, language development and temperament in young children.

To take a closer look, Norris and Francois are leading a team that formed the Research and Inquiry Network at Stone House, also called RAIN@SH, in 2017 to facilitate research that examines connections between children's development and learning and their early childhood experiences.

'A fly on the wall'

The team is particularly interested in the interplay among characteristics of adults, children and the environment they're in on children's development and learning, Norris said.

Two primary lines of research within RAIN@SH are "The Power of Play" and "Infants, Toddlers, Twos Language, Literacy and Learning Environments."

For a recent six-month Stone House study, and with the consent of parents and the children themselves, preschoolers donned GoPro cameras that recorded 130 videos — hours and hours of children playing or, in some cases, staying on the sidelines. K-State students who work at Stone House then spent many more hours watching the videos to look for and code certain behaviors, such as peer interactions in pretend play. The children are not identified by name; instead, the research team is looking at how and if children's social and cognitive play, plus their physical activity, changes over time.

The researchers also are studying how the availability and complexity of play spaces and materials influence children's social and cognitive play as well as their physical activity.

Once recorded, quantified and analyzed, the video results will be conveyed to early childhood educators. Their insights will benefit children, teachers and parents, as well as students who are training to become teachers, Norris said. Child-directed play on playgrounds creates the foundation for language development, initiation, emotional control and complex problem-solving. Research has demonstrated long-term benefits to establishing these skills through play in a child's early years.

"One thing that surprised us is the richness of what we have in these observations and what we can learn from them," Francois said.

For a study on preschool leaders and followers, Makayla Norwood, senior in family studies and human services, said that as she watched the videos she observed some children always playing alone. The team is getting ready to examine differences in these leaders, followers and loners.

"There's a need for supervision, but there is much more child-directed problem-solving when the play is happening without adult intervention," Francois said. She added that in some cases, the children make up their own rules. "By using the GoPro cameras, you get a little bit of a sense of being a fly on the wall, which allows us to extend previous research examining children's child-directed play."

Top photo: Hoeflin Stone House Early Childhood Education Center is a child care center and a place where researchers study child development and learning.

Right photo: Preschoolers at play is the focus of recent studies at Hoeflin Stone House Early Childhood Education Center.

Another new K-State study is investigating how young children's executive function skills — such as working memory, cognitive flexibility and self-regulation — change over time. In this study, children complete tasks on a touch-screen monitor, and their performance on these tasks over time provides an understanding of how their executive function skills change.

As part of the infant-toddler line of research, Francois has started using eye tracking to investigate how familiar caregivers influence young infants' language skills. Data are collected beginning when the infants are 3 months old for one month. The researchers specifically want to understand how young infants come to recognize familiar caregivers. What makes a familiar caregiver familiar? How does infant attention to facial characteristics of familiar caregivers change over time? And how does infant attention to the facial characteristics of familiar caregivers differ from attention to unfamiliar people?

The researchers also are studying how the availability and complexity of play spaces and materials influence children's social and cognitive play as well as their physical activity.

Opportunities for students

Norris and Francois noted that undergraduate and graduate students working at Stone House come from an array of backgrounds, including psychology, kinesiology, human development and communication sciences and disorders. Some students work directly with the children in classrooms, some help analyze data, and others conduct their own research projects under the guidance of faculty advisers.

"It's been really nice having the diversity of students and collaborators," Norris said. "We're all interested in growing knowledge."

Several graduate student-led projects are underway. Soomin Kim, doctoral student in human ecology, is researching how dramatic play influences preschoolers' language and literacy skills, while Chelsie Yokum, master's degree student in family studies and human services, is studying how teachers perceive preschoolers' risky play.

Developing Scholars Program student Gabriela De La Cruz, sophomore in biology and biochemistry, is exploring gender differences in preschoolers' playground play, and Brooke Wark, senior in communication sciences and disorders, is conducting a McNair Scholars Program project on prosocial behaviors during outdoor play.

The Developing Scholars Program and the McNair Scholars Program are designed to interest underrepresented and first-generation students in research and graduate school.

"The early childhood field is desperate for graduate students who've been in classrooms and have education, but who also have hands-on experience in this kind of research," Norris said. "Research opportunities with RAIN@SH are an exciting opportunity to further students' development while contributing to the early childhood field."

Seek more

Learn more about the Hoeflin Stone House Early Childhood Education Center.
k-state.edu/seek

See *Patent Focus*

The trick to patent success

Plant pathologist's patent portfolio benefits farmers, researchers

By Pat Melgares

A Kansas State University researcher has received two big thumbs up from the U.S. Patent and Trademark Office for his collaborative wheat work.

Under the leadership of Harold Trick, professor of plant pathology, the university is involved with two wheat-related patents: an approved patent to stop wheat viruses from reproducing and a pending patent to improve the crop's resistance to heat.

"Both of these projects do have a valid product in the end," Trick said. "That's a positive thing."

Trick, who has worked at K-State since 1998, has received eight patents for his work, which places him in the top seven of all-time inventors at the university. If approved, the heat stress project would mark his ninth patent.

Trick received his eighth patent in March 2018 for work to silence — or shut down — a gene that many viruses use to reproduce in wheat. Trick and K-State scientists, in conjunction with U.S. Department of Agriculture Agricultural Research Service, used biotechnology tools to provide protection against wheat streak mosaic virus, Triticum mosaic virus and possibly even the barley yellow dwarf virus.

Trick's pending patent is for work that improves wheat's ability to grow in hot temperatures. The researchers looked specifically at how heat affects wheat during the grain filling stage and studied an enzyme called starch soluble synthase.

"What that gene does is convert sugars to starch in the endosperm of the seed," Trick said. "Unfortunately, this wheat gene doesn't like the heat. Typically in Kansas, this grain fill period usually occurs between the end of May or early June, and it can be extremely hot during those times. That's a potential for loss of yield."

The researchers looked for a starch synthase gene in other crops grown in hot conditions and found that a rice gene provided a 30 to 35 percent increase in wheat grain size when wheat was grown at 86 degrees Fahrenheit.

Harold Trick investigates test tubes of wheat samples.

"That's exciting," Trick said. "And it has tremendous potential in the field. It's not a cure-all for entire heat stress, but it's one component."

Transgenic wheat plants are not approved for U.S. production, but the university's work helps scientists quickly test how effectively genes can produce desirable traits in wheat.

"We can use biotechnology to validate other avenues of research," Trick said. "For example, if K-State collaborators find a gene that is potentially valuable, we can use biotechnology to confirm its function by either turning off its expression or over-expressing the gene."

Trick said this validation could be done in a matter of months, rather than a decade or more through traditional breeding techniques.

"We've also noticed that there's no penalty in other agronomic traits when we use these genes, whether we are using the rice gene for heat tolerance or for shutting off the endogenous wheat gene for the virus work," Trick said.

The work was funded by Kansas wheat farmers through the Kansas Wheat Commission. John Fellers, a K-State adjunct professor of plant pathology and USDA Agricultural Research Service scientist, and Jessica Rupp, assistant professor of plant pathology, were instrumental in the virus project. Allan Fritz, wheat breeder and professor of agronomy, is helping with the heat studies. See page 27 to read more about K-State wheat research.

See *UDP Focus*

On the trail

Professor's passion for history leads him down the Chisholm Trail

By Taylor Provine

To James Sherow, historians are like detectives.

"We have a mystery — what happened — and we go out looking for the clues, and then we put the clues together to form a story of what happened," said Sherow, Kansas State University distinguished professor of history.

For Sherow, now in his 26th year at the university, one of the mysteries that he wanted to solve was why one man gambled on the Chisholm Trail and Texas cattle drives more than 150 years ago. His new book, "The Chisholm Trail: Joseph McCoy's Great Gamble," tells the story of McCoy, an entrepreneur who organized the town of Abilene, Kansas, as a cattle outlet for markets in New York and other urban areas across the globe. The book documents the hardships McCoy encountered along the way.

Sherow's "detective" work included research on the ecological and environmental aspects of trail driving.

"There's a lot to it," he said. "Everything from climate, grasses, water systems, transportation used to deliver cattle to markets and Texas cattle fever — a disease spread by ticks — had an influence and shaped the economy and ecology of the trail."

During Sherow's 15-year journey on his own trail toward the book, he researched records of temperatures, cloud conditions, wind directions and speeds, rainfalls, storms and sunspot activity to document how weather patterns had a positive or negative effect on the trail.

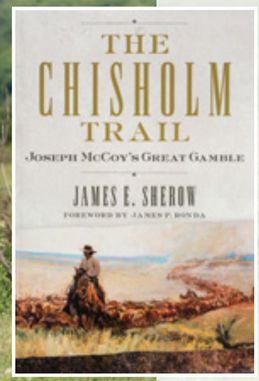
Sherow found that these ecological factors ultimately affected the outcome of the cattle trade. One example he details in the book is how rainfall frequency affected the nutritional value of the grasslands, which then affected cattle's condition at markets. Another example he explains is the winters of 1871 and 1872, which were especially tough on the trail. Temperatures seldom made it above freezing and thousands of cattle died.

"Studying the weather records really gave me a feeling for the reality of the trail and told me exactly how tough it was," Sherow said.

Sherow's accomplished career in history also has led him down several other paths.

A fourth-generation Kansan, he is passionate about public history and historic preservation in the state and in Manhattan. He was selected for the governor-appointed Kansas Historic Sites Board of Review and served on the Manhattan City Commission for six years. He served as mayor from 2011-2012. Sherow also is the author of five other books, several book chapters and scholarly articles, and he is managing editor of Kansas History: A Journal of the Central Plains.

"For me, being a historian gives insights on what it means to be human and tells us how we got to this point in time," Sherow said. "History is ecological and ecology is historical."



James Sherow, university distinguished professor of history, explores the connections between entrepreneur Joseph McCoy and the Chisholm Trail in his latest book.

See *Graduate Scholar*

Taking research to the nest level

Prairie songbird biologist engages public in her work on nestlings

By Beth Bohn

Sarah Winnicki, master's student in ornithology, conducts songbird-tracking research on the Konza Prairie.

Finding and tracking the growth and development of songbird nestlings is how Sarah Winnicki feathers her research nest, and getting to tweet about her work makes this prairie songbird biologist as happy as a lark, or at least a grasshopper sparrow.

Winnicki is a master's student in ornithology at Kansas State University where she is a member of the lab of Alice Boyle, assistant professor of bird ecology. See page 19 for more on Boyle's work.

The team is studying grassland birds at the Konza Prairie Biological Station, a tallgrass prairie reserve jointly operated by the university and The Nature Conservancy. The team searches for nestlings and then tracks them using transmitters and tags to monitor their growth and the predators the young birds face. Winnicki is using the work for her master's thesis on cowbird parasitism and how it affects the growth and development of nestlings of three grassland species: grasshopper sparrow, dickcissel and eastern meadowlark. The cowbird is a bird that lays its eggs in other birds' nests.

Winnicki has been a birder since her childhood in Ohio where she was involved with the Ohio Young Birders Club. She pairs her love of bird-watching with conservation and science communication efforts through her website, Twitter account and YouTube channel.

"I love my science, so sharing it seems very natural," Winnicki said. "I had always shared photos of the birds I saw as I was out birding, so when I started working with birds professionally, transitioning to using social media to share my science was seamless."

Winnicki calls her "adorable nestlings" the perfect excuse for sharing photos and videos of them, such as how nestlings eagerly leave their nests; how she and her fellow team members discover new nestlings; and even how nestlings sometimes escape, and sometimes do not escape, predators such as snakes.

"Social media like Twitter allow me to connect not only with other scientists interested in my work, but also with anyone interested in birds in general," Winnicki said. "Because of my communication through social media, I have been able to connect with nonscientists, with professional scientists in other fields and with collaborators, all while having a ton of fun."

Winnick credits two university-related programs with helping her enhance her science communication efforts. In 2016, she was accepted to the Sunset Zoo's Science Communication Fellowship program for graduate students and postdoctoral researchers. The fellowship is part of the Manhattan zoo's Behind the Science program that is funded by the National Science Foundation and an Institute of Museum and Library Services grant. Winnicki also takes part in the Kansas Science Communication Initiative, which helps K-State faculty, students and staff engage the public in science and research.

"The training with the zoo's fellowship program provided very insightful feedback about my science communication skills and techniques, such as pointing out when I was using jargon or when I was being too technical and how to connect my research to people," Winnicki said. "The experience has been helpful not only for my public science communication but also for my teaching and for my professional science communication as well."

Involvement in the Kansas Science Communication Initiative has helped Winnicki find a larger audience and hone her message for a broader group.

Winnicki was drawn to K-State while an undergraduate at Denison University in Ohio. The school did not offer an ornithology program, so she applied to Research Experience for Undergraduates, or REU, programs offering a bird research project. She was accepted to K-State's program with Boyle's lab in 2014 and 2015. She then joined Boyle's lab as a master's student.

After completing her master's degree in 2019, Winnicki plans to seek her doctorate. Her goal is to land a faculty position teaching ornithology and animal behavior and to continue her research on songbird nestlings.

Seek more

Sarah Winnicki is passionate about sharing her prairie songbird research. Watch videos, look at photos and learn more about her work.

- Website: *sarahwinnicki.com*
- Twitter: *@skwinnicki*
- YouTube channel: *bit.ly/2PRRRfc*

Learn more about the Kansas Science Communication Initiative and the Sunset Zoo's Science Communication Fellowship program.

k-state.edu/seek

Members of the First Scholars program at Kansas State University

See *Undergraduate Scholars*

Ready, set, graduate

Program prepares first-generation students for graduation and beyond

By Taylor Provine

Jessie Carr and Karina Moncayo-Michel are both first-generation students — the first in their families to pursue or receive bachelor's degrees.

Carr, junior in human development and family science, and Moncayo-Michel, May 2018 graduate in communication sciences and disorders, have both benefitted from the First Scholars program at Kansas State University. The university is part of a national research-based project to increase graduation rates among first-generation students.

"I am beyond grateful for the First Scholars program," Carr said. "I've gotten a lot of resources and advantages that I would not have had without it."

In 2014, the university was selected to host First Scholars, a program of The Suder Foundation that supports first-generation students through graduation by focusing on holistic development. The program offers academic, social and personal development along with financial support at five other participating public universities.

Twenty students started in the first K-State cohort, and an additional cohort has been added each year. The scholars receive a $5,000 scholarship each year for a total of $20,000.

But First Scholars is more than a scholarship program because it offers student support based on research to address the unique challenges first-generation students face, said Rebeca Paz, assistant director of the K-State Office of First-Generation Students. Each program year focuses on a different area, such as helping scholars connect to campus, optimizing the college experience, expanding career and community opportunities, and transitioning to the future.

By partnering with The Suder Foundation, K-State is collecting data, researching student success characteristics and supporting students during college. What K-State coordinators learn could help first-generation students nationwide.

"Through our work with K-State, we want to show that if we applied evidence-based practices consistently, First Scholars can work at any four-year, public state university," said Diane Schorr, executive director of The Suder Foundation.

The startup funds for the program covered four years, and K-State has added a university-funded cohort for the 2018-2109 academic year. With additional funding from The Suder Foundation, K-State established the Office of First-Generation Students to provide leadership and strategic coordination.

When the student scholars are seniors, they can give back to the community through a Legacy Project in which they create something meaningful to them.

Moncayo-Michel wanted to help potential future students see a college campus. For her project, she coordinated K-State campus visits for students from her hometown of Liberal — a predominately Hispanic/Latino community in southwest Kansas — and other schools in the area.

"One of my favorite things to do is talk to future students," Moncayo-Michel said. "My goal was to let them know there are a lot of resources on campus to help them."

Marks of success

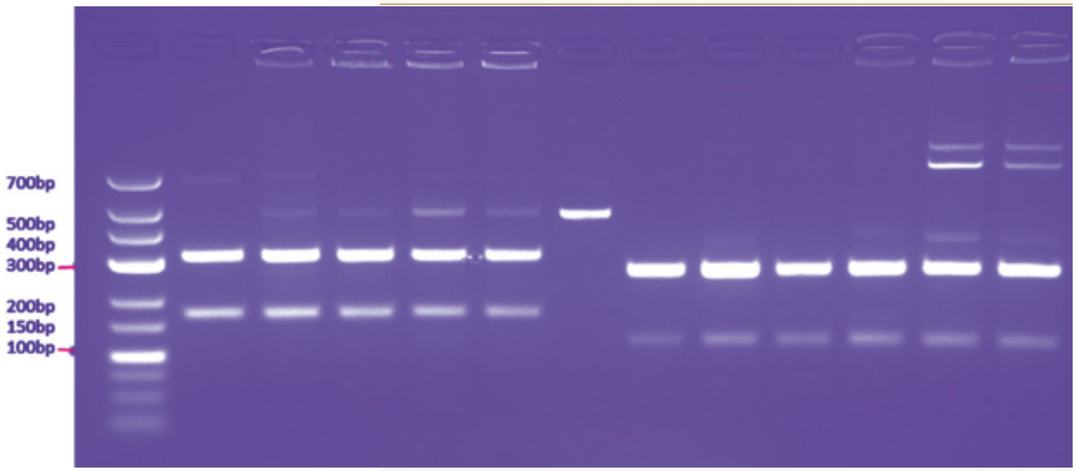
K-State's inaugural First Scholars cohort just completed the fourth year with remarkable statistics.

- 76 percent of the students are on course to graduate between three and a half to five years.
- 3.26 cumulative GPA.
- 3 magna cum laude graduates.
- 69 percent of the graduates have joined or plan to join the workforce.
- 31 percent of the graduates will attend graduate school.

Seek more

Learn more about the First Scholars program and how to support it.

k-state.edu/seek



Top photo: The white bands in this image show DNA fragments that have been obtained from different wheat plants. By analyzing the size of these fragments researchers detect plants carrying CRISPR-Cas9-edited genes.

Bottom photo: Eduard Akhunov, professor of plant pathology, uses CRISPR technology in his wheat genetics laboratory.

CRISPR

/krɪspər/

Eduard Akhunov, professor of plant pathology, explains, in under 100 words, what CRISPR technology is and how it can revolutionize the global food system to feed the world's growing population.

CRISPR is part of the bacterial immune system and is designed to search and destroy invading viruses using a CRISPR-associated DNA-cutting enzyme called Cas9. Cas9 uses the short pieces of RNA as guides to detect invader's DNA and cut it. Scientists use this technique to precisely "edit" genes in any organism, including major agricultural crops. CRISPR-Cas9 is faster and more effective than traditional breeding methods and holds great promise to solve many problems in agriculture. Breeders have started using CRISPR-Cas9 to create crops that are higher yielding, more resistant to diseases and extreme climates, and more nutritious and tastier.

Tasty teaching

The dairy bar at Kansas State University, pictured here in 1941 in Waters Hall, is a beloved tradition of students and alumni. The dairy bar opened in 1923 and was in the west wing of Waters Hall until it moved to its current Call Hall location in 1964. The sales counter serves as a retail outlet for products from the College of Agriculture's animal sciences and industry department. The product line has expanded from milk and "bricks" of ice cream to also include eggs, cheese, meat, wheat products and more than 30 flavors of ice cream. See pages 20-27 to learn how K-State continues to make food better and safer.

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

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UNIVERSITY

102 Anderson Hall
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A magnetic landscape

Kansas State University researchers used magnetic resonance spectroscopy to capture this picture of purple and yellow waves that reveal a peptide's biophysical properties as it defeats a brain tumor called a glioblastoma. The image, "Magnetic Landscape," comes from the lab of Stefan Bossmann, professor of chemistry. His research team is developing peptides to treat and detect cancers. The image was part of the 2018 Science to Art exhibition at the Kemper Museum of Contemporary Art in Kansas City. Jing Yu, 2018 doctoral graduate, performed the original nuclear magnetic resonance research.