Seek

RESEARCH MAGAZINE FOR KANSAS STATE UNIVERSITY

SPRING • 2017

The Silicon Valley of biodefense

K-State at forefront of biodefense

Home of the range

Preserving the tallgrass prairie

The buzz behind the bite

Scientists fight infectious disease challenge: the mosquito

This Powercat — made of 3-D printed graphene aerogel — is so lightweight that it can rest on the petals of a flower without bending them. The 3-D printed graphene aerogel weighs 0.5 milligrams per cubic centimeter, which makes it the lightest material created in the U.S.

Dong Lin, Kansas State University assistant professor of industrial and manufacturing systems engineering, co-developed the 3-D printed graphene aerogel with researchers at the State University of New York at Buffalo. The material has important qualities — such as low density and good conductivity — and Lin continues studying the 3-D printed graphene aerogel to understand how it can improve energy harvesting or even create flexible batteries.

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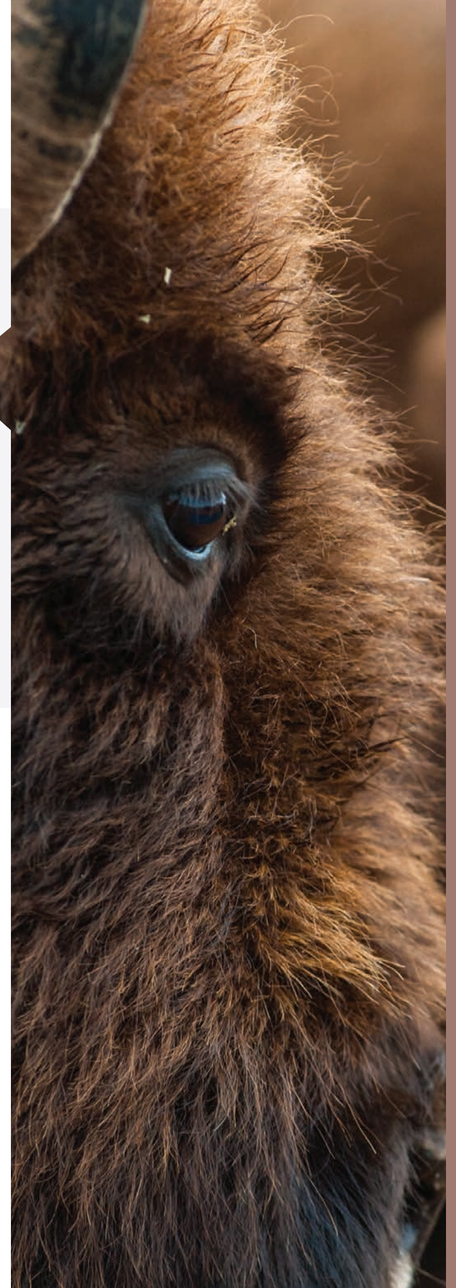

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KANSAS STATE UNIVERSITY

What did you think about when the bison on the cover of this magazine caught your eye? Heritage? The majesty of nature? How about singing around a campfire under a star-filled prairie sky on a cool spring evening — yes, I'm an Eagle Scout.

I thought of all of those things, but I also thought of security.

As you'll read in these pages, the Blue Ribbon Study Panel on Biodefense visited Kansas State University earlier this year for a series of discussions about agrodefense. We were proud to host the group, and we're eager to showcase the work that demonstrates why K-State is worthy of the nickname panel member and former majority leader of the U.S. Sen. Tom Daschle offered during his introduction: the "Silicon Valley for biodefense." The *b* denotes stories about K-State's biodefense research in this issue.

Despite their small size, mosquitoes are a prominent enemy of health security, and our experts are finding new ways to fight the diseases they spread, including Zika, Japanese encephalitis, dengue, and more. Our teams are developing vaccines, working to understand the genetic sources of mosquitoes' immunity and how viruses travel from their guts into their bodies for transmission, and investigating new control mechanisms.

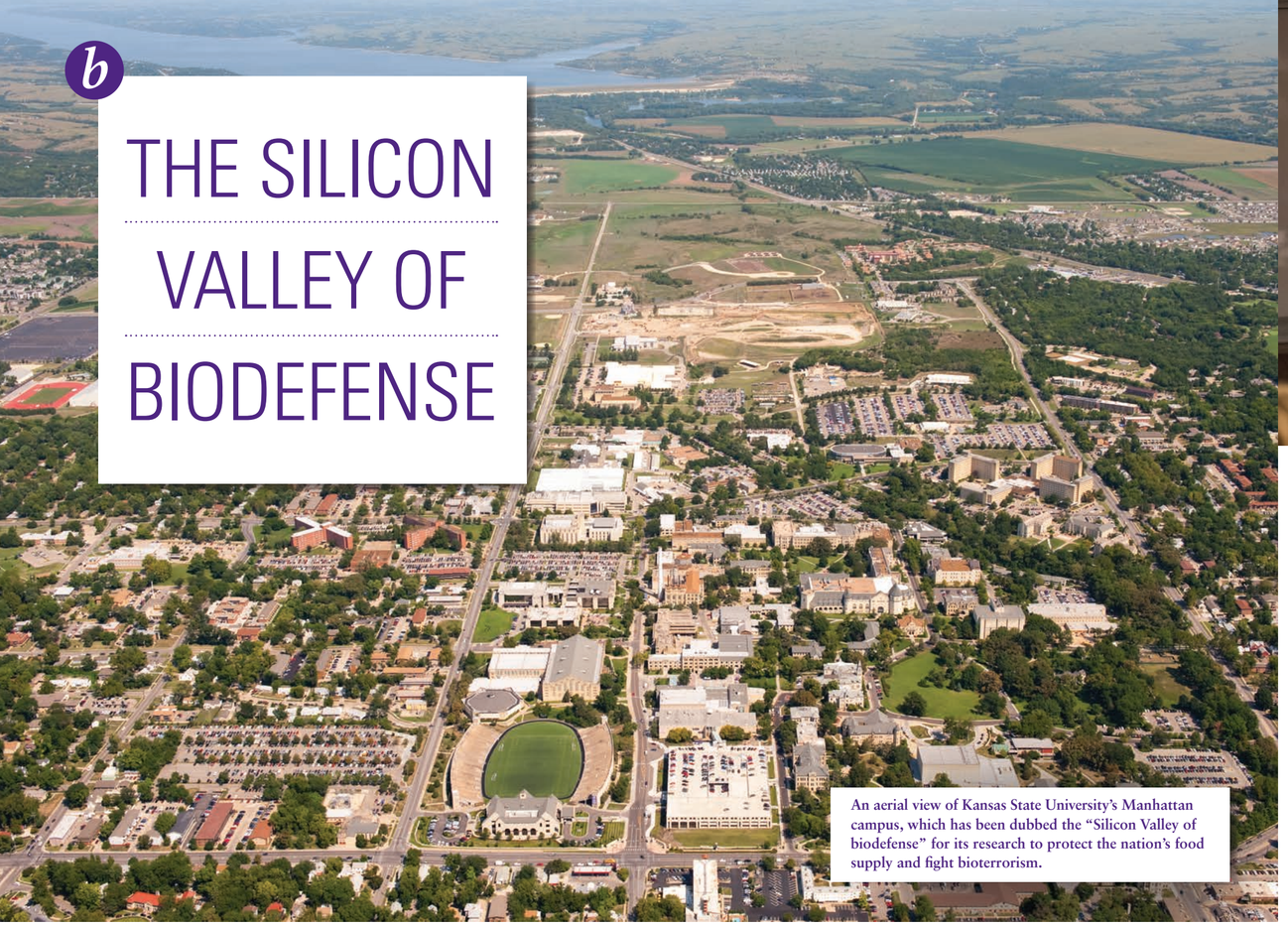
Antimicrobial resistance is also a growing and deadly problem. K-State research is fighting this threat to both animal agriculture systems and human health through the efforts of experts who are testing the antimicrobial properties of common minerals in animal feed, finding the genetic basis of resistance, and ensuring that veterinarians and producers understand the best management practices that can protect the industry from disease outbreaks.

Such efforts in the area of biodefense are crucial to national security. But defending security requires that we take unflinching looks at both our past and our future. Take note of a K-State author's study of American poetry during World War I as we commemorate the centennial of U.S. entry into that grim chapter of world history along with projects in our Chapman Center for Rural Studies that engage our students in discovering their histories. Feel the energy of translating ideas into business with the Center for the Advancement of Entrepreneurship, and read how one of our university distinguished professors is helping ensure a stable food supply to feed the world's growing population through the Feed the Future Innovation Lab for Collaborative Research on Sustainable Intensification. Clearly we are learning what the past has to teach us while also creating future economic success.

That brings me back to our bison companion, who resides at the Konza Prairie Biological Station, a joint effort between K-State and The Nature Conservancy. At Konza, researchers are working to conserve one of the most diminished ecosystems in North America. Prairies respond slowly, so the research is long term, but that doesn't mean it isn't cutting edge; efforts to study the effects of burning on prairie grasses and the grazers who eat them, how both burning and grazing change the prairie, and how we can restore lost grassland resources are important to both ecology and the economic underpinnings of our food supply. Kansas State University is proud to be defending this Home of the Range.

Peter K. Dorhout, Vice President for Research

THE SILICON VALLEY OF BIODEFENSE



An aerial view of Kansas State University's Manhattan campus, which has been dubbed the "Silicon Valley of biodefense" for its research to protect the nation's food supply and fight bioterrorism.

A NATIONAL LEADER: K-STATE CEMENTS STATUS AT THE FOREFRONT OF BIODEFENSE

By Jennifer Tidball and Beth Bohn

WHAT SILICON VALLEY IS TO TECHNOLOGY, KANSAS STATE UNIVERSITY IS TO BIODEFENSE.

That's how a member of the Blue Ribbon Study Panel on Biodefense has described the university and its national leadership in animal health, biosciences and food safety research. The panel visited K-State's Manhattan campus in late January 2017 for a series of discussions titled "Agrodefense: Challenges and Solutions." Panel members and staff learned about better ways — many taking place at K-State — to protect the country's food supply and fight bioterrorism.

Kansas State University President Richard Myers speaks to the Blue Ribbon Study Panel on Biodefense in late January 2017. With Myers, from left, are Asha George, co-director; Tom Daschle, former Senator majority leader and panel member; Kenneth Wainstein, former homeland security adviser to President George W. Bush and panel member; and Ellen Carlin, co-director.

"K-State has really become the Silicon Valley for biodefense," said Tom Daschle, former majority leader of the U.S. Senate and panel member. "Its Biosecurity Research Institute, links to the Kansas Intelligence Fusion Center and the National Bio and Agro-defense Facility are all illustrative of the extraordinary effort that is now underway in Manhattan. It's an amazing demonstration of innovation, of collaboration and of engagement."

The panel — chaired by former Sen. Joe Lieberman and former Secretary of Homeland Security Tom Ridge — recommends changes to U.S. national policy and law to strengthen biodefense. The panel intends to produce a report to share with the country's new administration, Congress and the public by the end of the year.

"One of the centerpieces of our report is the recommendation to try and coordinate information-sharing efforts among the different and often disparate parts of state and local governments that address biothreats," said the Honorable Kenneth Wainstein, panel member and former homeland security adviser to President George W. Bush. "Nowhere is that as important, and the need as marked, as in the agriculture area."

During the panel's time at K-State, university researchers discussed their work on emerging diseases — Zika virus, West Nile virus, avian influenza and porcine epidemic diarrhea virus, known as PEDv — as well as efforts to fight biological terrorism, such as the anthrax events of 2001, which affected Daschle. They also discussed pursuing biodefense through partnerships with government, industry and other universities.

"We want to be a good partner in the effort to protect our nation's food supply, both plant and animal," said Kansas State University President Richard Myers, former chairman of the Joint Chiefs of Staff during the aftermath of the Sept. 11 attacks. "We have expertise and facilities here that enable us to do this."

WHAT PEOPLE ARE SAYING ABOUT K-STATE AND BIODEFENSE

"Collaboration requires a convener. Collaboration requires leadership. I believe that K-State is in a very good position to be that convener, to be that leader and to create opportunities for better dialogue and engagement with others as we consider the national challenges we face. That's going to take a real effort and I think K-State is well-positioned to do just that."

— Tom Daschle, former majority leader of the U.S. Senate

"As agriculture is elevated in terms of recognition and importance, it will be important for K-State to play a key role in giving us the kind of direction and public policy approach that is necessary to get the job done right."

— Tom Daschle, former majority leader of the U.S. Senate

"Kansas is agriculture; agriculture is Kansas. Kansans have proven themselves in leading and preventing potential outbreaks."

— Physician and U.S. Rep. Roger Marshall of Kansas

"Zoonotic diseases are going to require physicians, veterinarians and researchers to work together. I see that my role is to push these people together. I see incredible opportunity with NBAF to work with those people and further the collaboration."

— Physician and U.S. Rep. Roger Marshall of Kansas

"Preventing an attack is going to be knowledge-based. We need to know everything possible about the pathogens and the potential perpetrators. Know the agent. Know the agencies that are involved. The type of research, education and training conducted at the Biosecurity Research Institute is critical to gain that sort of knowledge."

— Stephen Higgs, Kansas State University associate vice president for research and director of the Biosecurity Research Institute

"We cannot simply discuss One Health anymore, but we must embrace it. We need surveillance systems that can share information from the animal sector to the human health sector. We need surveillance systems that are not agent or disease based, but are more broadly syndromic based so that we have early detection for these emerging diseases."

— Tammy Beckham, dean of Kansas State University's College of Veterinary Medicine

Biosecurity Research Institute

National Bio and Agro-defense Facility

ON THE FRONT LINE OF BIODEFENSE

Kansas State University has a long history in biodefense — a history that accelerated in 1999 with the publication of "Homeland Defense Food Safety, Security, and Emergency Preparedness Program." The 100-page document — informally called "The Big Purple Book" — outlined the university's research programs in three major infectious disease components: plant pathology, animal health and food processing.

As the "Silicon Valley for biodefense," the university maintains numerous facilities, research collaborations and academic programs devoted to agrodefense and biodefense. Here are just a few:

• The Biosecurity Research Institute, or BRI, at Pat Roberts Hall is a biosafety level-3 facility that addresses threats to plant, animal, and human health and food contamination through infectious disease and pathogen research. The institute is jump-starting research on National Bio and Agro-defense facility diseases, including Japanese encephalitis virus, Rift Valley fever, classical swine fever and African swine fever.

• The College of Veterinary Medicine has research strengths in animal health infectious diseases, comparative biomedical science and food safety and security.

• The College of Agriculture conducts research in agricultural and horticultural crops, livestock, natural resources and the environment.

• The National Agricultural Biosecurity Center, or NABC, unites biosecurity researchers with federal, state and local agencies to provide a response to emerging agricultural threats.

• The U.S. Department of Homeland Security's Center of Excellence for Emerging and Zoonotic Animal Diseases, or CEEZAD, develops countermeasures for emerging high-priority animal diseases that can spread to humans. It's based in the College of Veterinary Medicine.

• The Food Animal Residue Avoidance Databank, or FARAD, hosted by the College of Veterinary Medicine, is a risk-management program that provides science-based expertise to help mitigate unsafe chemical residues, such as from drugs, pesticides and biotoxins, that might be found in products derived from food animals.

• The K-State Plant Disease Diagnostic Lab, part of the Great Plains Diagnostic Network, provides information on disease identification and management, and processes more than 1,000 samples from Kansas each year. The samples help K-State keep a pulse on what plant diseases are active around the state.

• The U.S. Department of Homeland Security's National Bio and Agro-defense Facility, or NBAF, will be a biosafety level-4 laboratory and the country's foremost animal disease research facility. It is under construction adjacent to the Manhattan campus and will replace the aging Plum Island Animal Disease Center in New York.

• The Kansas Department of Agriculture, the first state department of agriculture in the nation, is devoted to the total support of agriculture in Kansas. Among the department's priority objectives is developing strategic partnerships with K-State, as well as and other potential partners, to better serve Kansans and the agriculture industry. Access to the university's main campus was one of the reasons the agency relocated its main offices to Manhattan.

• The U.S. Department of Agriculture's Center for Grain and Animal Health Research is home to several research units in Manhattan: the Arthropod-Borne Animal Diseases Research Unit, the Grain Quality and Structure Research Unit and the Hard Winter Wheat and Genetics Research Unit.

IN THE LAB

Kansas State University is home to a wide variety of biodefense-related research funded by government agencies and industry. Here's a look at some of these projects:

• At the Biosecurity Research Institute, researchers have studied mosquitoes to understand how they become infected with Zika virus. University scientists were part of a multi-institutional team that recently developed a possible new Zika virus vaccine. They also are investigating an emerging type of Japanese encephalitis virus and conducting the first U.S. studies since the 1940s. Find out more about this work on pages 18-23.

• Researchers are taking mobile applications to the field to improve food security and economic welfare through a $1.5 million project funded by the National Science Foundation Basic Research to Enable Agriculture Development, or BREAD, Program. The team is creating mobile phone and tablet applications that enable breeders and scientists around the world to develop better plant varieties.

•The Center of Excellence for Emerging Zoonotic and Animal Diseases, or CEEZAD, is using a $2.3 million federal grant from the Defense Threat Reduction Agency in the U.S. Department of Defense, through a collaboration with the commercial firm NewLink Genetics, to study a newly developed livestock vaccine that could protect humans from the Ebola Zaire virus. A $100,000 matching contribution from the state of Kansas' National Bio and Agro-defense Facility, or NBAF, Transition Funds brings the total project funding to $2.4 million.

• The Center of Excellence for Vector Borne-Diseases received $200,000 from the state of Kansas through its NBAF Transition Funds to study the tick-transmitted pathogen Ehrlichia ruminantium. It causes heartwater, which is deadly to cattle, sheep and goats. The researchers are working on a vaccine against the disease.

• Wheat blast fungal disease research, led by Barbara Valent, university distinguished professor of plant pathology, and Jim Stack, professor of plant pathology, continues at K-State's Biosecurity Research Institute. The 2016 discovery of wheat blast in Bangladesh, the first time the fungus has occurred outside of South America, emphasizes this pathogen's threat to crop production.

• Weiping Zhang, professor of microbiology, is working on vaccines for E. coli diarrhea using a five-year, $2.1 million grant from the National Institutes of Health.

• The National Agricultural Biosecurity Center is developing a database to help agricultural emergency management coordinators combat animal disease outbreaks and other emergencies. The database is called ICAAR, which stands for Identifying Corrective Actions from Agricultural Response. The project is supported by the U.S. Department of Homeland Security's Office of Health Affairs Food, Agriculture and Veterinary Defense Branch through the Food Protection and Defense Institute at the University of Minnesota.

• Five grants from the Swine Health Information Center are helping the College of Veterinary Medicine and the Kansas State Veterinary Diagnostic Laboratory develop reliable swine pathogen diagnostic tests.

•T.G. Nagaraja, university distinguished professor of diagnostic medicine and pathobiology, and Raghavendra Amachawadi, assistant professor of clinical sciences, are studying if copper and zinc, two common minerals, as animal feed additives can provide disease protection to animals. Learn more about this work and other ways K-State is combating antimicrobial resistance on pages 24-27.

• Barbara Drolet, who is with the U.S. Department of Agriculture's Arthropod-Borne Animal Diseases Research Unit and K-State as an adjunct faculty member in diagnostic medicine and pathobiology, is leading research on the disease threat of exotic Bluetongue virus serotype 8 from Northern Europe to sheep breeds of North America.

• Jürgen Richt and his CEEZAD team are developing a vaccine for African swine fever virus in collaboration with researchers at Iowa State University and Centro de Biología Molecular Severo Ochoa in Madrid, Spain. Richt is a regents distinguished professor of veterinary medicine and a Kansas Bioscience Authority eminent scholar.

• Jishu Shi, professor of anatomy and physiology, is developing a novel vaccine, KNB-E2, that differentiates pigs infected with classical swine fever virus from those that are vaccinated with KNB-E2.

• Scott McVey, an adjunct faculty member in diagnostic medicine and pathobiology, and the USDA's Arthropod-Borne Animal Diseases Research Unit are studying mosquito-transmitted flaviviruses that threaten both human and livestock populations in North America.

• Steven Eckels, professor of mechanical engineering, and Chris Sorensen, Cortelyou-Rust distinguished professor of physics, are improving the science and engineering systems for biosecurity buildings like K-State's Biosecurity Research Institute. The team has been studying the science of detecting micron-sized holes in the HEPA filtration systems and has been documenting the accuracy of state-of-the-art autoscan systems for the National Bio and Agro-defense Facility. k

Home *of the* Range

Home *of the* range

Konza Prairie Biological Station works to conserve one of the most diminished ecosystems in North America

By Stephanie Jacques

AMERICAN BISON GRAZE ON GRASS THAT CAN grow taller than most people, rainbows of wildflowers dance in the breeze on the limestone-studded terrain, and new life rejuvenates the charcoaled hills in spring. This mosaic landscape is the Kansas Flint Hills, home to the nation's most diminished ecosystem.

The tallgrass prairie today is about 4 to 5 percent of its original glory. Most of its former range — from Canada to Texas and from Kansas east to Indiana — is now cropland, urban development or woodland. The largest remaining expanse of native prairie is in the Flint Hills of Kansas and Oklahoma because the rocky land made it difficult for settlers to plow.

"We all like to eat, and we eat a lot of food, so those former grasslands are important for our cropland," said John Briggs, director of Konza Prairie Biological Station, an 8,600-acre native tallgrass prairie research station on the northern edge of the remaining tract of Kansas prairie. "On the other hand, the intact tallgrass prairie here is some of the most productive grassland in the world and supports the multibillion-dollar cattle industry in Kansas."

Researchers at Konza Prairie, jointly owned by Kansas State University and The Nature Conservancy, have been

fostering long-term ecological research, education and prairie conservation for more than 45 years. Konza's decades of data give ecologists and land managers an understanding of multiple influences on the rich ecosystem and provide an indication of how the prairie ecosystem works in a controlled environment with minimal human influence.

"Konza is an important reference site and is very unique in that the long-term research gives us the opportunity to see changes over many years," said Brian Obermeyer, Kansas landscape programs manager for The Nature Conservancy. "A lot of things you can't tease out in a two- or three-year study. It takes a long time to really understand how the prairie ticks and it may take decades to get conclusive data."

Konza Prairie's ecological research is as diverse and extensive as the prairie itself, with more than 150 active research programs collaborating and coinciding on the landscape. Managed by Kansas State University's Division of Biology, the site has produced historical data on climate and rainfall patterns; cattle and bison effects on prairie diversity; the value of prairie fires to control threatening tree invasions; plant, insect, bird and mammal populations; nitrogen cycling; soil carbon; and the quality and quantity of tallgrass-filtered water.

"Konza's research and the advancement of ecological theory can help people understand why we need grasslands, the danger of losing them and techniques to conserve and even restore them," said Briggs, who also is a professor of biology.

Blazing and grazing a path

Konza Prairie — where dry grass is intentionally set on fire — is home to a herd of 250 to 300 American bison and 215 cow/calf pairs of cattle. Konza data demonstrate that both fire and grazing are important

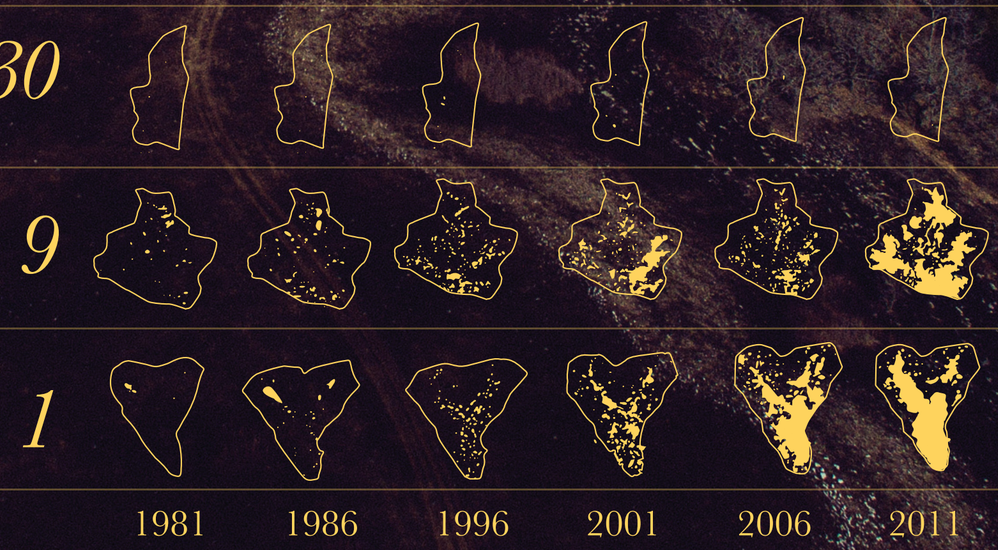
Using a ring fire technique to circle an area, the burn crew starts with a slow fire into the wind, called a back burn. Then they light flank fires around the area and save lighting a head fire for last. Driven by the wind, the head fire quickly burns across the prairie until it meets the already blackened areas and burns out.

Counting shrubs for 30 years in annually burned, four-year burned and 20-year burned watersheds

Researchers at Konza have hard numbers that show that the tallgrass prairie has a tipping point in the absence of fire.

Konza Prairie's research units — called watersheds because their boundaries are set by how the rainfall and water flows down them — are burned at different frequencies. In the annually burned watersheds, the amount of shrubs and trees is minimal — plants are counted every five years — but in the absence of fire, shrubs expand into the prairie landscape and trees may have a better opportunity to become established.

The three watersheds below — an annually burned watershed on top, a watershed burned once every four years in the middle and a watershed burned once every 20 years at the bottom — show the increase in woody plant life in yellow across 30 years of counting plants.



Updated from Briggs et al. 2005. *Bioscience*

to tallgrass prairie management and influence prairie ecology. Konza is divided into more than 50 research units called watersheds, each with a different experimental approach.

Each watershed has an assigned burning season — winter, fall, summer or the traditional spring burning — and a fire frequency in one-year, two-year, four-year or 20-year burning regimens in grazed and ungrazed prairie watersheds.

"The key to effectively managing the prairie is the interaction of fire and grazing — not just one versus the other," said Tony Joern, university distinguished professor of biology who studies grassland ecology and the interaction of insect and plant communities.

Some of Konza's watersheds host bison as a historical reference for how native grazers influence prairie ecology. Other watersheds host cattle, the most common grazer of today's prairie. Ungrazed watersheds provide comparisons to both grazers and mimic conditions at many prairie preserves in the region.

"If land managers put any kind of grazer — cattle, bison or even mowing — in an annual burned site, it increases plant diversity because cattle and bison eat the dominant grasses, which allows the subdominant plants called forbs, or flowering plants, to increase," Briggs said.

If not controlled by grazing, the towering tallgrass — like big bluestem, the iconic grass of the tallgrass prairie that can reach heights of 6 to 8 feet with a root system nearly twice that size — can overshadow the flowering plants and reduce plant diversity.

"Fire and grazing work together to open up the canopy and expose short wildflowers to key resources, which increases plant diversity," Joern said. "The more plant species you have on a prairie, then the more animal diversity there will be, including more pollinators. Ecological diversity starts with plants, which affect diversity at all levels."

A nearly 20-year collection of grasshoppers on ungrazed prairie compared with a 10-year collection of grasshoppers on grazed prairie indicated that moderately grazed watersheds have 32 percent more arthropods, with some areas reaching as much as 50 percent more insects. According to Joern, the increase in insects will increase the animals that prey on them.

"If you leave the prairie unburned for more than eight to 10 years, you start getting a decrease in plant diversity — especially in prairie plants — as few dominant woody plants, such as cedars, dogwoods and sumac, will take over," Briggs said.

Beyond favoring the tallgrasses, fire also controls the invasion and expansion of trees and shrubs, called woody encroachment, Briggs said. On Konza, there is a visual contrast between annual burned watersheds and 20-year burned watersheds, which have more trees and shrubs but less grasses and forbs.

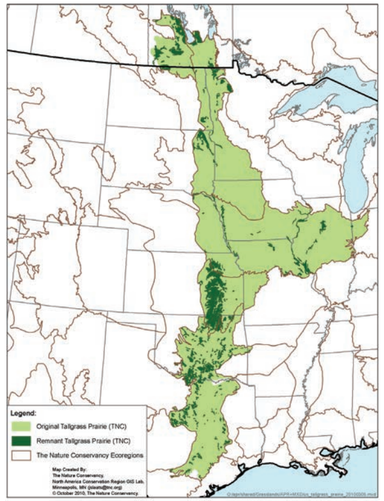
"If you leave the prairie unburned for more than eight to 10 years, you start getting a decrease in plant diversity — especially in prairie plants — as a few dominant woody plants, such as cedars, dogwoods and sumac, will take over," Briggs said.

The encroachment of woody vegetation caused by a lack of fire threatens the remaining areas of tallgrass prairie ecosystem. According to Briggs, increased tree cover not only changes the appearance of traditional prairie but also devastates wildlife habitat for grassland animals like greater prairie chickens.

"The grassland is a nursery," Briggs said. "That's where the young birds are born and are raised. If they have restricted grassland sites, you are not going to get the birds reproducing at the rates they used to and this is a cause for concern."

Researchers further defined the relationship between fire and grazers for prairie health by using tracking collars on the bison. The records indicate that the bison follow fire to the watersheds with the newest and most nutritious grass.

"Bison and cattle are attracted to areas that have been recently burned,"



Courtesy of The Nature Conservancy, the light green represents estimates of the historic spread of native tallgrass prairie before the conversion to cropland, urban development and woodland. The dark green is what is left today.

The flowering Western ironweed is common on Konza Prairie, especially in grazed watersheds, and blooms in mid- to late summer when many other plants have dried up from the heat.

Left: With the wind blowing away and water nearby, the burn crew can control a slow wide strip of prairie fire along mowed fireguards to serve as a stopping point for the head fire and prevent the fire from spreading to other areas.

Below: The wild Konza bison eat about 25 percent of the above-ground plant productivity of warm season grasses, like big bluestem, across 2,375 acres. Bison crop the grass so close to the ground that it creates a short grazing lawn that is hard to burn, so the bison remain safe as prairie fire burns taller grass around them.

Joern said. "If you have an area that has had very little grazing and then you burn it, the grazers basically spend the summer there. The areas that they grazed the summer before are left mostly untouched and build up fuel for the next burn."

Joern said that the fire-grazing interaction moves around in time and space on the prairie to create a cycle. The consequences of that cycle are effectively measured only over many years.

"Konza shows that long-term research is essential," Joern said. "Historically, researchers thought burning every four years would keep woody vegetation under control. Based on the accumulation of data of Konza's watersheds, we are seeing that's probably no longer the case. We're thinking burning at least every three years is the most effective to managing that cycle."

According to John Blair, director of Konza Prairie's Long-Term Ecological Research program, which is funded by the National Science Foundation, long-term studies are needed to understand the prairie's responses to reduced fire frequencies.

"Sometimes the prairie responds abruptly to environmental changes, indicating that the prairie may have thresholds of stability where it is resilient to change until it is pushed beyond a tipping point," Blair said. "That appears to be the case when we look at the prairie's responses to reduced fire frequencies."

Blair said that the changes to the prairie from a lack of fire are slow at first, but once woody plants have established, the conversion from a grass-dominated prairie to a shrubland or woodland can occur quickly. The change is rapid because the trees and shrubs reduce grass. Less grass reduces the fuel that makes the rejuvenating prairie fire possible. This makes it very difficult to restore the grassland to its original state. The researchers have seen this in a few heavily wooded watersheds that used to be burned every 20 years and have recently been changed to annual burned watersheds.

"It can take decades to see these types of threshold changes," Blair said. "The real value of our long-term studies is being able to run experiments long enough to separate short-term responses from longer-term responses that may only start to reveal themselves after a decade or more of running the experiment."

Profit and prairie health

Konza Prairie's patch burn study is a long-term study to determine how burning a third of the prairie every year will affect the ecological performance and cattle performance, such as weight gain and fertility. Two patch burn watersheds were established, each divided into three sections, with one section burned each year. Cattle have free roam of the entire space.

According to Kansas Department of Agriculture economists, animal agriculture is responsible for $21.9 billion in direct revenue, which supports 67,832 jobs in Kansas. Flint Hills-grazed cattle, a part of that revenue, depend on regularly burned tallgrass prairie, according to KC Olson, professor of animal sciences and industry who is collaborating with Joern for the study.

"Fire is absolutely essential to rangeland health, over the long and the short term," Olson said. "It's a major determinate in livestock performance. If we exclude fire over the long term, we get an undesirable composition change, which influences livestock performance in a negative way."

Olson said that an average of about 30 pounds of gain or growth per animal is missed if cattle graze on prairie that hasn't been burned that year. Less growth means cattle production decreases, an economic hit to ranchers. In contrast, research from Konza's annually burned watersheds suggests that burning every year can decrease plant diversity. Therefore, the patch burn study gives sections of prairie a chance to rest from fire while also allowing cattle access to a newly burned section.

"In the patch burn systems, the predictability of cattle movement is incredible," Olson said. "In a normal moisture year, cattle spend about 75 to 85 percent of their time on the patch that has been burned that particular year."

The amount of time cattle spend on the burned section is why Olson's yearly cattle productivity measurements, since 2010, have not shown performance differences between cattle in the patch burned areas versus the annually burned controls. Olson has noticed one difference between the two areas.

"In 2011, 2012 and 2013, when drought conditions were pretty severe and we destocked our annually burned pastures, we didn't have to do anything in the patch burn pastures," Olson said. "There was a significant amount of residual forage in the unburned areas that was sort of drought insurance that we did not have in the annual burn pastures."

Coinciding with the cattle performance research on the patch burn watersheds, Walter Dodds, university distinguished professor of biology, is collecting water samples from Kings Creek, Konza's water source, which is a U.S. Geological Survey benchmark site because about two-thirds of its headwaters are confined to Konza's unpolluted conditions. He is using Konza's more than 25 years of water quality and discharge data to compare the effects of the cattle and bison as well as how water quality on Konza compares to the rest of the tallgrass prairie.

"We are seeing more of an effect on water quality with the cattle than the bison, mostly with increased levels of ammonia," Dodds said. "But one of the things that we've found is that current cattle grazing practices across the Flint Hills have conserved this endangered ecosystem and preserved good water quality relative to areas with cropland."

Prairie beauty only soil deep

The vast majority of Konza Prairie serves as a reference site for other tallgrass prairie areas because it has never been plowed. But researchers have found a use for the few areas along Konza's entrance and headquarters that have been plowed: They offer an opportunity for researchers to attempt to re-create prairie.

"Farmers are able to convert the nutrients that have been stored in grassland soil over hundreds of thousands of years to crops that feed us," Briggs said. "It's good soil for growth, but as the need to feed more people increases and grasslands are consumed by nonnative plants, it's getting to be more and more of a conservation challenge to maintain the tallgrass prairie."

Briggs said that the U.S. Department of Agriculture's Conservation Reserve Program, which provides financial incentives for farmers to convert less productive cropland back to prairie for 10-15 years, has helped conservation efforts, but the ecosystem may not return to its

The longer the prairie goes without fire, the more green woody plants there will be, which under the correct circumstances can create more smoke.

belowground unplowed condition for 100 years.

"To the casual observer, a restored prairie looks pretty but if you really dive into the details, the diversity is missing, especially in the soil," Briggs said. "You get a lot of really tall grasses that dominate the prairie like a 300-hundred-pound gorilla to keep everything out of the field. There are a lot of plants missing, especially the flowering and non-grasses — the ones that provide all of the coloring in the springtime."

Konza researchers are involved in multiple projects that evaluate the ecological and human factors that affect prairie restoration success, such as manipulating soil resources by adding rocks under the soil to mimic the hilly terrain of the Flint Hills or adding sawdust and table sugar as sources of carbon to increase soil microbe populations and reduce nitrogen availability.

A few of the projects measure changes in restored prairies over time as part of Konza's Long Term Ecological Research program, one of the NSF's original six funded long-term programs in the nation.

According to Blair, a common problem in prairie restoration is that even if a variety of plants is planted initially, diversity decreases over time. Blair and his colleagues started the first prairie restoration study, called the environmental heterogeneity hypothesis project, on Konza in 1998. It is based on a theory that increasing heterogeneity of soil resources will help increase plant diversity in restored prairie.

"It builds on the data collected from Konza that suggests that soil nitrogen availability and soil depth, or water availability, are some of the key factors that influence diversity in native grasslands," Blair said. "We want to know if we can use this information to steer recovery of prairie."

Another project is an ongoing sequential restoration experiment. Over 20 years, researchers will restore 65 square feet of cropland every two years with the same species of seed mixture and timing and planting techniques to see how the prairie restoration is affected by variations in climate and precipitation.

"We have some sections that started in a really good spring and all the plants germinated and took off, and others that we started in really weedy conditions, and others that started in drought conditions," Blair said. "We want to understand, over time, if the deterministic management factors take over."

In chronosequence and restoration benchmark studies, researchers are using the soil from intact prairie as a reference for cropland off Konza that was converted in the early 1980s. This helps researchers like Blair understand how time affects the prairie restoration.

"The data collected from native prairie across the Konza landscape provides basic benchmarks that other prairie restoration projects in the Flint Hills can aim for to reach the prairie's full potential," Blair said.

The restoration projects are just a few of Konza's programs and projects that are designed to help further ecological theory and improve grassland management in the tallgrass prairie ecosystem and around the globe. Briggs said educating the next generation is important to obtaining that goal.

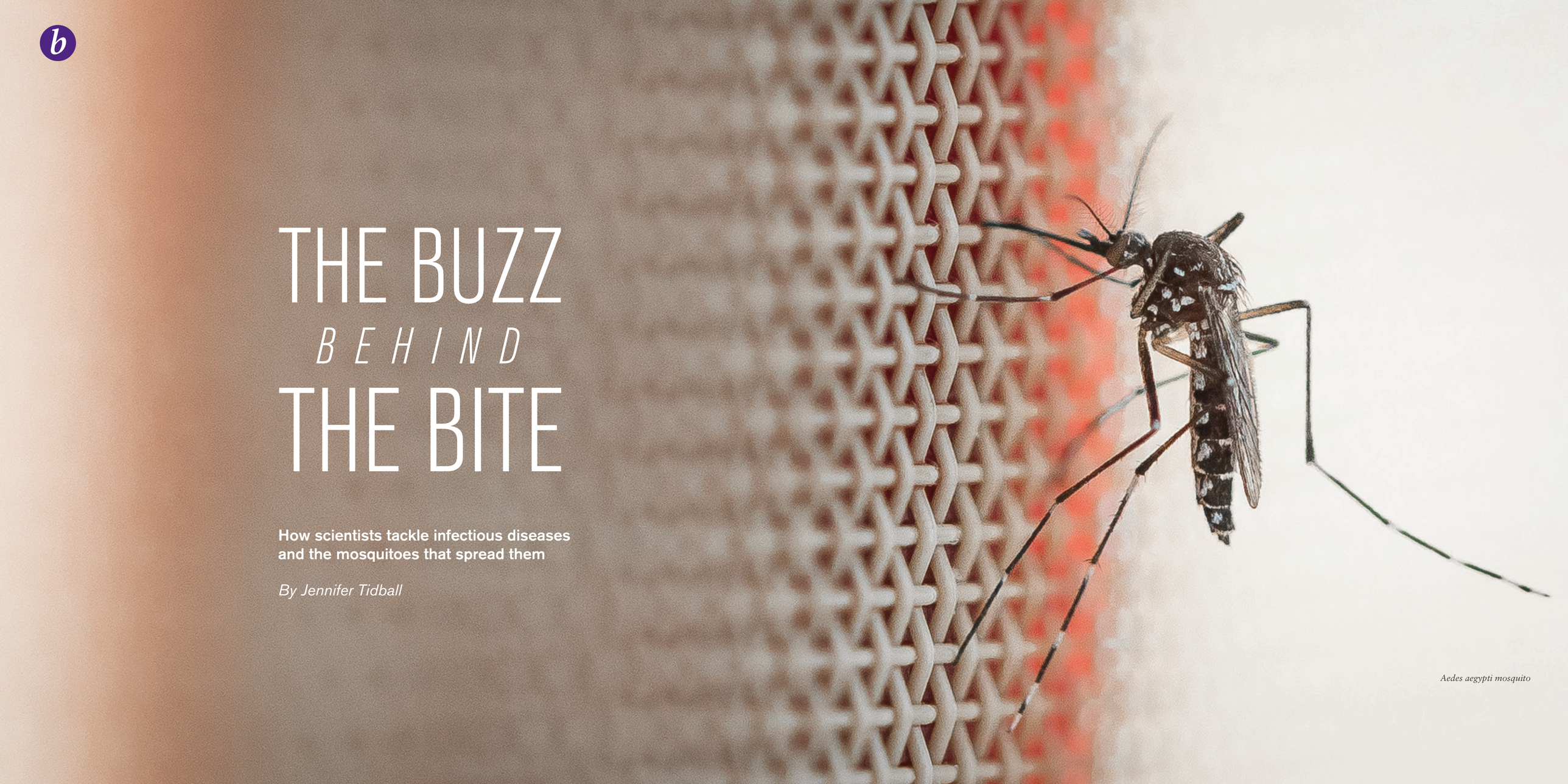
"Education is a major component of Konza's mission, particularly since we are a research university," Briggs said. "Training and hands-on experiences for undergraduates and graduate students are essential for the future. We have taken on the additional task of education from K-12 to the general public, and we hope that all of these aspects lead to appreciation and understanding of tallgrass prairie to assure that this endangered ecosystem is protected."

The 1,000-1,800 pound American bison is extremely temperamental and resilient. A bison's large muscled head and thick coat give it an extra layer of warmth in the bitter winter wind of the Kansas Flint Hills. When it snows, they use their head to plow the snow to get to the grass underneath.

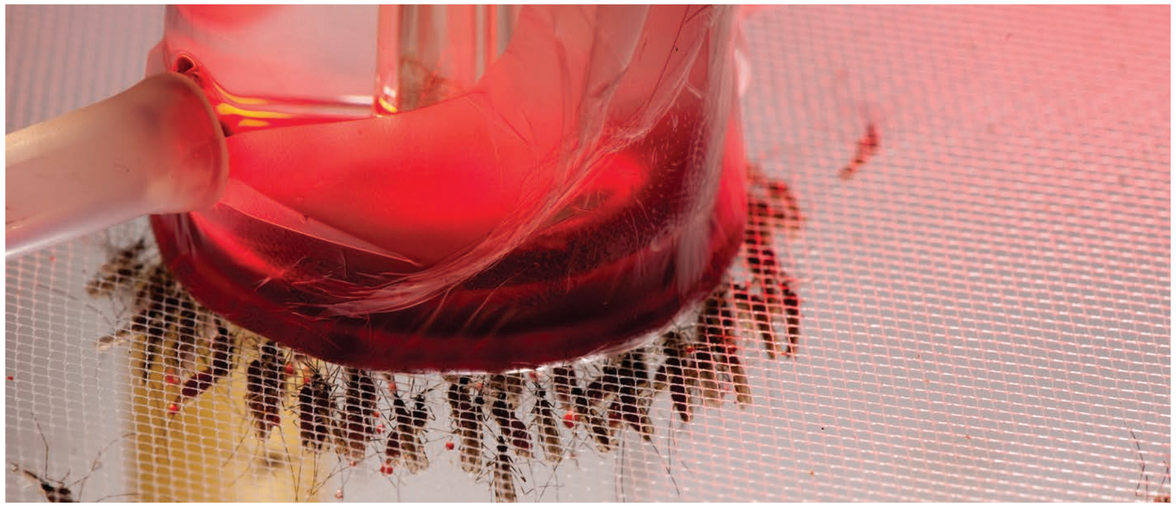
THE BUZZ *BEHIND* THE BITE

How scientists tackle infectious diseases and the mosquitoes that spread them

By Jennifer Tidball



Aedes aegypti mosquito



THE NUMBERS ARE ENOUGH TO MAKE YOU FEEL ITCHY.

Since 2015, more than 43,000 cases of Zika virus have been reported in U.S. states and territories.

Malaria caused an estimated 212 million clinical cases and 429,000 deaths worldwide in 2015.

West Nile virus has infected an estimated 2.5 million people in North America and caused more than 44,000 U.S. cases since it emerged in 1999.

There's no question: Mosquitoes may be small insects, but their presence affects the health of billions of people across the world.

"Seventy percent of emerging diseases are zoonotic, and many of them are mosquito-borne," said Stephen Higgs, director of Kansas State University's Biosecurity Research Institute. "Mosquito-transmitted viruses are expanding. The viruses that Kansas State University is working on are things that could be next."

What's next? The possible list includes names like Japanese encephalitis virus, yellow fever virus or dengue viruses.

No matter the virus and no matter the disease, scientists agree: Advanced research is the solution. From studies of viruses, mosquito biology and insect control, Kansas State University researchers are tackling the unknowns of infectious diseases and the mosquitoes that spread them. They hope to make it easier to manage — and possibly someday eradicate — health threats such as malaria or Zika virus.

"Studying these viruses before they get to the United States gives us the knowledge we need to prepare," said Dana Vanlandingham, assistant professor of virology. "It's important to estimate what we think might be coming in, because if it does, we need a plan immediately. Debate and slowness let the diseases establish. Once some of these diseases are here, they're here."

VIRULENCE OF VIRUSES

Researcher Scott Huang knows firsthand the effects of infectious diseases. Huang is from Taiwan, where Japanese encephalitis virus and dengue viruses are endemic pathogens.

"Once these viruses are introduced, there is no way to get rid of them because they can be persistent in mosquitoes or susceptible hosts," said Huang, a university research assistant professor of diagnostic medicine and pathobiology. "These viruses can infect humans and animals without showing symptoms, which makes them some of the hardest targets to control."

That's part of what motivates Huang to study mosquito-transmitted viruses at the university's Biosecurity Research Institute, a biosafety level-3 facility where scientists can safely study animal and human infectious diseases. Higgs, Vanlandingham and Huang collaboratively are studying Zika virus, Japanese encephalitis virus, yellow fever virus and Cache Valley virus with researchers from institutions in the U.S. and the U.K.

The university scientists were part of a multi-institutional team that recently developed a possible new Zika virus vaccine and published the results in Nature. The immunogenic vaccine potentially could protect against the virus with one dose and could become a tool to prevent future outbreaks, Higgs said.

The Biosecurity Research Institute team played an important role during the Zika virus public health emergency in 2016. The institute has facilities needed to study mosquitoes and understand how they become infected with Zika virus.

Through a research project with Ross University, along with funding from the National Institutes of Health, the scientists are providing skills and expertise for further studies with Zika virus and chikungunya virus.

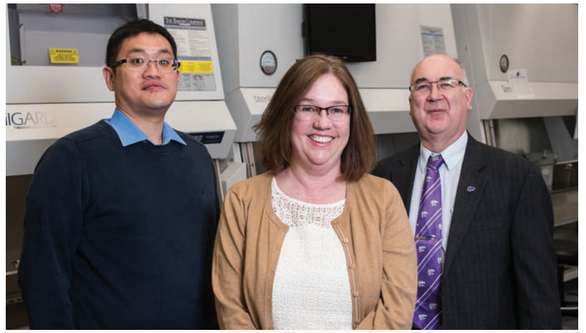
But the university work extends to other emerging viruses as well.

Higgs, Vanlandingham and Huang are performing several studies — funded by the National Bio and Agro-defense Facility Transition Fund and the Swine Health Information Center — on an emerging type of Japanese encephalitis virus. Their studies are the first U.S. studies of Japanese encephalitis since the 1940s and the researchers also are doing the first studies with the Cache Valley virus that is present in North America.

Japanese encephalitis virus is found primarily in pigs and birds in Asia, but it can transmit to humans and cause severe inflammation, or encephalitis, of the brain.

The Japanese encephalitis virus research at the Biosecurity Research Institute is especially important: A new, emerging type killed 14 people in China in 2014. Other older strains of Japanese encephalitis virus constantly are circulating in Asia and infect an estimated 67,900 people per year. Although many people in Asia are vaccinated, the vaccine is not very effective because it is made for the older strains, researchers said.

"As the virus continues to circulate, the threat still remains," Higgs said. "The new strain is just as bad as the old strain. If a strain is going to be introduced to the U.S., it's going to be this new strain and the U.S. is not prepared for a potential outbreak."



Scott Huang, Dana Vanlandingham and Stephen Higgs study mosquito-transmitted viruses.

Through U.S. Department of Agriculture funding and collaboration with the Arthropod-Borne Animal Diseases Research Unit in Manhattan, the researchers are determining if North American mosquitoes could transmit Japanese encephalitis virus and how the U.S. could prevent an outbreak.

The team has published results in Vector-Borne and Zoonotic Diseases and PLOS Neglected Tropical Diseases. The Japanese encephalitis virus work is a transition project that will jump-start research at the National Bio and Agro-defense Facility, or NBAF, the U.S. Department of Homeland Security's foremost animal disease research facility that is being built adjacent to the university's Manhattan campus.

Higgs, Vanlandingham and Huang's research on Cache Valley virus aims to increase limited knowledge of the virus's transmission cycles. The virus is an important agriculture pathogen that primarily affects sheep and is widespread in North America.

With no approved vaccine or treatment, Cache Valley virus's biggest human public health concern is its potential to cause neurotropic diseases, which can lead to permanent nerve damage, Huang said. The Biosecurity Research Institute work aims to identify potential carriers that could transmit Cache Valley virus. The USDA-sponsored project is a collaborative effort with U.K. researchers.

BACK TO THE BIOLOGICAL BASICS

One way to fight mosquito-borne diseases like malaria, yellow fever or dengue fever is to make the insect its own worst enemy. University biologist Kristin Michel has a specific target in mind: the mosquito immune system.

Michel, associate professor of biology, and Bart Bryant, research assistant professor of biology, are studying Anopheles gambiae, the mosquito species that is the main transmitter of malaria in sub-Saharan Africa. Their goal is to identify ways to eliminate pathogens and parasites in the mosquito before it can transmit them to humans.

Michel and Bryant approach their work like a puzzle: Figure out what molecules are in the immune system, how they function and what immune responses they control. Then determine how these pieces fit together to contribute to the mosquitoes' immunity as a whole and how they relate to the pathogen.

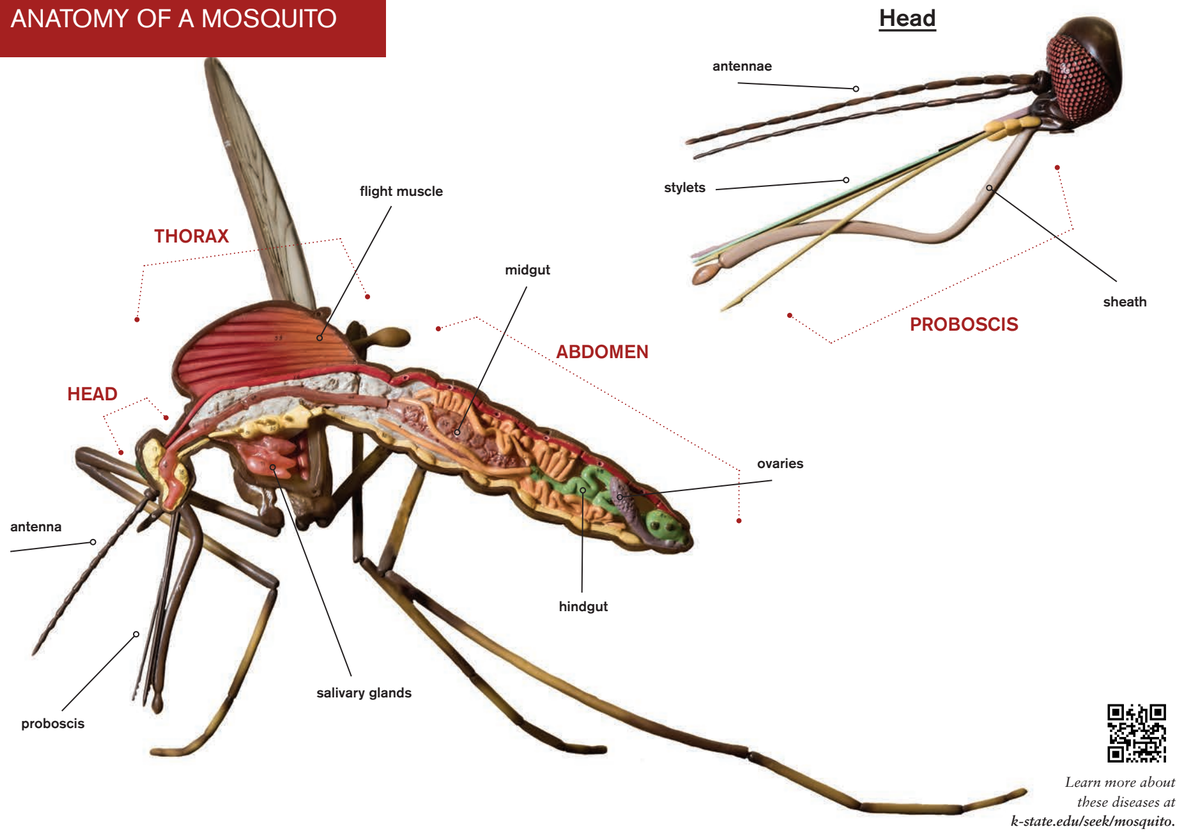
Their NIH- and USDA-funded research has determined the key role of proteases and their inhibitors in controlling humoral immunity as well as the role of hemocytes in cellular immunity.

Michel's team recently showed that in the first 24 hours after a mosquito eats, the hemocytes — or blood cells — increase in a mosquito's immune system as it prepares to fight any pathogens from the blood.

"Imagine if every single time you eat a meal, all your white blood cells double," Michel said. "It would have to be a massive infection or inflammation response, and mosquitoes do that every time they take a blood meal."

Bryant now is using NIH funding to develop a gene therapy-type approach to turn off specific genes in specific tissues in Anopheles gambiae.

ANATOMY OF A MOSQUITO



Learn more about these diseases at ***k-state.edu/seek/mosquito.***

A CLOSER LOOK AT MOSQUITO-BORNE DISEASES

JAPANESE ENCEPHALITIS VIRUS

Japanese encephalitis virus is Asia's leading cause of pediatric viral encephalitis, or severe inflammation of the brain. While most human cases are mild, about 1 in 4 unvaccinated human cases are fatal.

ZIKA VIRUS

Zika virus detections have occurred since the 1940s, but an epidemic spread through the Americas in 2015-2016. Many humans infected only have mild symptoms, but the virus is linked to birth defects, including microcephaly.

CHIKUNGUNYA VIRUS

Chikungunya fever first appeared in the 1950s, but the first transmission in the Americas occurred in 2013 on Caribbean islands. Chikungunya virus is not often fatal, but can cause fever, muscle pain, headaches and severe joint pain in humans.

WEST NILE VIRUS

West Nile virus came to North America in 1999 and has become endemic in the U.S. and Canada. Only 1 in 5 people infected develop symptoms. Severe cases can lead to encephalitis or meningitis, while rare cases cause a fatal neurologic illness.

CACHE VALLEY VIRUS

Cache Valley virus comes from the northern agricultural valley in Utah with the same name. While it primarily affects sheep and rarely infects humans, severe cases can cause brain inflammation or organ failure.

MALARIA

Malaria is a severe and potentially fatal disease found in warmer regions. It can cause high fevers, chills and flu-like symptoms. Young children and pregnant women are most vulnerable.

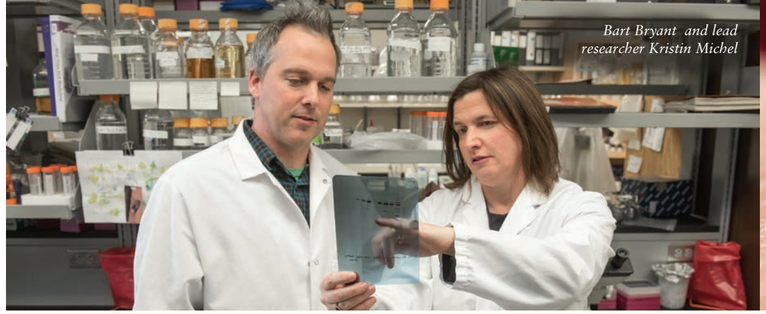
DENGUE FEVER VIRUSES

Dengue fever is the main cause of illness and death in tropical and subtropical regions. It can cause high fevers, joint pain and mild bleeding. Dengue hemorrhagic fever is a severe form that can be fatal if untreated.

YELLOW FEVER VIRUS

Yellow fever can produce devastating outbreaks in tropical regions. Most infected people have only mild illness, but severe cases can cause liver disease and bleeding. Fatalities occur in 20 to 50 percent of severe cases.

Sources: Centers for Disease Control and Prevention, World Health Organization



Bart Bryant and lead researcher Kristin Michel

Anopheles gambiae mosquito

"We want to better understand what a gene is doing and what its role is in one tissue versus another," Bryant said. "We're trying to come up with a unique way to better regulate the expression of a gene."

A better genetic understanding could help stop the spread of malaria, yellow fever and dengue fever. Scientists could maximize mosquito control strategies while minimizing side effects for the insect.

"Malaria is a global problem," Michel said. "People agree that the existing control methods will not lead to elimination of malaria. We need to accelerate our efforts and for that, we need to continue to do research. Our team wants to contribute — even if it's a tiny bit — to that mission."

GOING WITH THE GUT

Only a few dozen of the more than 3,000 species of mosquitoes in the world can transmit viruses. To understand why, two biology professors — Rollie Clem and Lorena Passarelli — are investigating the insects' intestines.

It turns out that the gut and the surrounding structure — called the basal lamina — are a mosquito's key defense against viruses. Through NIH funding, Clem and Passarelli have studied the basal lamina and its network of proteins to understand how it can act as a barrier against viruses and how that barrier is disrupted during a blood meal.

When a mosquito bites a host, any viruses in the blood travel through the mosquito digestive system to the gut. Sometimes viruses are able to escape the gut, infect the salivary glands and shed in the saliva when the mosquito bites another host. Yet other times, viruses are not able to leave the gut and the mosquito does not spread the virus. The biologists want to know how the virus can escape the gut and travel into the main body.

"We previously identified enzymes that were necessary for midgut escape in an insect virus," Passarelli said. "We are now investigating whether mosquito-vectored viruses use the same enzymes to facilitate midgut escape."

Specifically, the researchers are studying Sindbis virus, a mosquito-transmitted virus that can cause mild symptoms in humans, such as fever or a rash. The biologists use an arthropod containment level-2 facility to safely study Aedes aegypti mosquitoes.

By looking at enzymes involved in allowing midgut escape by Sindbis virus, the researchers could apply any gained knowledge to other Aedes aegypti-transmitted diseases, including Zika virus, dengue fever and yellow fever.

"Many of these diseases are in other countries, but certainly are threatening to come into the U.S.," Clem said. "With changing climates, these mosquitoes are expanding their range farther and farther north. There is a lot of public awareness about the importance of these diseases and our research could help the millions of people affected by these viruses every year."

INVESTIGATING INSECT CONTROL

Of course, a key way to keep mosquito-borne diseases under control is to control the insects that spread them.

That's where Kun Yan Zhu, professor of entomology, fits in. His work starts with chitin, a major chemical component of a mosquito's exoskeleton shield. When insects are not able to produce chitin, they can't survive. But when insects produce a reduced amount of chitin, they may become more susceptible to insecticides.

"The exoskeleton is the first defense line for mosquitoes and other insects," Zhu said. "Chitin biosynthesis is an important target for insect control. We are trying to understand chitin biosynthetic pathways and develop new techniques to prevent chitin production using chemical and genetic approaches."

Zhu and his team recently patented a form of nanoparticle insect control that uses a genetic chain reaction to prevent mosquitoes and insects from producing chitin.

"Insect control that targets chitin biosynthesis is safer and less likely to affect humans because we do not produce chitin," Zhu said.

Zhu's research also is attacking another major problem in mosquito control: insect resistance to insecticides. Over time, mosquitoes can become resistant to insecticides, which have to be replaced with newer versions.

Using USDA and other funding, his team is investigating a family of enzymes that helps mosquitoes detoxify chemicals. The scientists are trying to find possible connections between the insecticide structure and the detoxification enzymes in Aedes aegypti mosquitoes to better understand how the mosquitoes become insecticide-resistant.

"By understanding detoxification mechanisms, we will be able to selectively use insecticides that may be able to control resistant insects, including mosquitoes," Zhu said. "This is an important strategy to control some of the most devastating disease-spreading insects in the world."

INSIDE A SWARM

What is it like to be in the middle of a swarm of mosquitoes? Check out an interactive 360-degree video and photo that show a closer look at research at the Biosecurity Research Institute.

Video:

bit.ly/2mpINTe

Photo:

bit.ly/2mnrTTE

RESISTANCE

Scientists race to stay ahead of disease-causing microbes

By Pat Melgares

NEARLY 90 YEARS AGO, SCOTTISH SCIENTIST ALEXANDER FLEMING DISCOVERED penicillin, heralding the dawn of antibiotics to fight infections and protect humans from emerging diseases.

History indicates that the use of penicillin likely saved the lives of many wounded soldiers during World War II, in addition to countless others suffering from previously untreatable ailments.

But disease-causing microbes have survived since the beginning of time largely because of their ability to adapt. In fact, it wasn't long after Fleming discovered penicillin that he realized that microbes had already become resistant to the medicine.

In a world of bacteria, fungi, viruses and parasites, science can never rest.

Kansas State University researchers involved with antimicrobial resistance, or AMR, are ramping up efforts to tackle the growing and deadly problem.

"In the mid-1980s, we were so bold as to say the era of infectious disease is behind us, that we've conquered infectious disease," said Mike Apley, the Frick professor of production medicine and clinical pharmacology in K-State's College of Veterinary Medicine.

"Bacteria aren't smart, but there are billions and billions of them and they have mutations — and some of those mutations select for resistance to antibiotics," he said.

MICROBES 'ADAPT AND SURVIVE'

That's the essence of antimicrobial resistance, which threatens human and animal health as the wave of resistant bacteria grows while the world's production of new antibiotics and the effectiveness of existing antibiotics diminish. An antibiotic will kill most microbes for which it's designed, but the surviving microbes develop resistance, ultimately making the antibiotic ineffective to future strains of the illness.

"AMR is a natural phenomenon," said Brian Lubbers, director of the Clinical Microbiological Laboratory in the Kansas State University Veterinary Diagnostic Laboratory. "Bacteria are responding to a pressure from the environment — antibiotics. The bacteria try to adapt and survive just like any species."

"The concern for the future is if we get an infection in the hospital, we may not be able to deal with it," said Apley, who was appointed in 2015 to the Presidential Advisory Council on Combating Antibiotic Resistant Bacteria. "That would be catastrophic in a lot of different ways."

According to a 2013 report from the U.S. Centers for Disease Control, a little more than 2 million human illnesses are caused annually by bacteria and fungi that are resistant to some classes of antibiotics. The CDC reports that 23,000 of these illnesses result in death.

Antimicrobial Resistance (AMR) occurs when a microorganism becomes resistant to an antimicrobial drug that was originally effective for treatments of infections.

1 Microorganisms (including bacteria, fungi, viruses and parasites) attack a cell, whether it be in humans or animals, causing sickness.

2 An antibacterial drug, or antibiotic, can kill most microorganisms that cause the sickness, but some microorganisms are resistant to the drug.

3 The surviving microorganisms are able to multiply, rendering the original antibacterial drug ineffective. A new antibacterial drug must be used or developed to fight the new strain.

The CDC also reports that illnesses and deaths attributed to antimicrobial resistance cost Americans $20 billion in additional health care spending and $35 billion in lost human productivity.

PROTECTING ANIMAL AGRICULTURE

A.J. Tarpoff, a beef extension veterinarian and assistant professor in K-State's animal sciences and industry department, said concerns regarding antimicrobial resistance have led some to point a finger at animal agriculture, where antibiotics are a reliable way to prevent and treat diseases in food animals.

Tarpoff notes, however, that the agriculture industry has long been a good steward of antibiotics, and that some of the criticism may be due to a growing disconnect from farm life.

"With most of our population so far removed from the farm, many people have lost the understanding of how we care for animals, how we raise them, how we feed them, what diseases affect them and how we treat them and control diseases," he said. "The average consumer who walks into a grocery store doesn't understand how we raise these animals."

Even so, K-State scientists like T.G. Nagaraja and Raghavendra Amachawadi are discovering new ways to reduce the use of antibiotics and still give animals protection from common diseases.

They've worked on research that tests the efficacy of two common minerals — copper and zinc — as additives in animal feed.

"Copper is not an antibiotic, but it does inhibit bacterial growth," said Amachawadi, a microbiologist and assistant professor of clinical sciences at the College of Veterinary Medicine. "Plus, copper is economical and a natural alternative to antibiotics."

The researchers identified a novel copper resistance gene, tcrB, in Enterococcus, bacteria common in hospital-acquired infections. Amachawadi said their study showed a connection between copper and two classes of antibiotics commonly used in animal agriculture: tetracyclines and macrolides.

"We have also shown a positive dose response to zinc supplementation to MRSA, or methicillin-resistant Staphylococcus aureus, a common skin bacteria in humans more simply known as staph," Amachawadi said. "The use of antibiotic alternatives are becoming popular, especially as antibiotics are phased out for growth promotion and production efficiency."

Nagaraja, university distinguished professor of diagnostic medicine and pathobiology at the College of Veterinary Medicine, noted that the researchers also found that bacteria eventually were developing resistance to copper and zinc.

"That is a significant finding," Nagaraja said, "because no one expected that there could be a relationship between resistance to copper and zinc and antibiotic resistance."

The findings led the two scientists to further pursue studies on other nonantibiotic alternatives, such as probiotics — naturally extracted, beneficial bacteria found in milk, cheese, yogurt and other foods — and vaccines.

"When you give antibiotics in feed and water, it goes to the gut, which has a lot of bacteria that are then exposed to a high concentration of antibiotics, so they are more likely to develop resistance," Nagaraja said. "If you inject the same drug, it's mostly under the skin, which means the gut bacteria are not exposed as much."

Other recent projects further illustrate K-State's efforts in deterring antimicrobial resistance.

In early 2016, K-State scientists were the first to note that feed ingredients could serve as a vector for disease. They have since conducted trials on feed additives that could reduce or eliminate the risk of contaminated feed infecting animals, including the use of medium chain fatty acids and other enriched products.

Another breakthrough occurred in late 2015 when Raymond "Bob" Rowland, a professor of diagnostic medicine and pathobiology, announced that he and colleagues at the University of Missouri had developed pigs that were resistant to the industry's most deadly disease, porcine reproductive and respiratory syndrome, or PRRS.

The project took more than 10 years to develop as the scientists worked to breed pigs that lacked a vital protein that had previously made them susceptible to the disease.

One way Kansas State University is tackling antimicrobial resistance is through the development of pigs resistant to porcine reproductive and respiratory syndrome, or PRRS, a deadly swine disease. PRRS-resistant pigs were developed by a K-State scientist and colleagues at another university.

K-State researchers are studying feed additives that could reduce or eliminate the risk of contaminated feed infecting animals.

"At the very least, the development of PRRS-resistant pigs is a new tool for improving pig well-being and reducing economic losses," Rowland said. "At the most, it could be the beginning of a revolution that will eradicate many of the most important livestock diseases that affect global animal and human health communities."

VETERINARIANS HELP PRODUCERS

In fall 2016, the U.S. Food and Drug Administration awarded $1.5 million to Apley and his colleagues to monitor antibiotic use in beef cattle feedlots and dairies. Data will be collected from 30 feedlots and 32 dairies in California, Kansas, Texas, Colorado, Nebraska, Iowa, Pennsylvania and Minnesota.

"We are fortunate to have the collaborative assistance of both the beef and dairy industries, and the U.S. Department of Agriculture's Center for Epidemiology and Animal Health," Lubbers said. "With their help, we aim to create usable systems that can be adopted by agriculture to understand and continuously improve our antibiotic use practices."

On Jan. 1, 2017, new FDA regulations expanded the veterinary feed directive, which requires producers to receive written guidance from a veterinarian to use medically important antibiotics in animal feed.

"Most producers out there already have this relationship with the veterinarian, called a veterinary client patient relationship," Tarpoff said. "What the veterinary feed directive does is reaffirms the relationship with their vet. They always go to their veterinarian for recommendations or questions pertaining to animal health. Now it takes it a step further to make the relationship stronger."

Joel DeRouchey, an extension livestock specialist at K-State, said the university regularly communicates with producers in Kansas about the veterinary feed directive and research findings. He is involved with a project that established a website, KSUantibiotics.org, to provide information, fact sheets and more to help livestock producers, veterinarians, consumers and others.

"The information is unbiased and comes from many agencies," DeRouchey said. "We are providing new information all the time so that everyone in the industry can know what is being communicated to livestock producers about using antibiotics in a correct manner."

MANAGEMENT AND LIVESTOCK HEALTH

Aside from making sure the agriculture industry is using antibiotics appropriately, Tarpoff said veterinarians and extension specialists constantly review best management practices for keeping animals healthy.

"Through biosecurity, we can prevent introduction of disease so that we should never have to treat them," he said. "We are looking for ways that we can change management strategies to decrease stress on animals, where their immune system stays stronger for longer so that they never succumb to a disease."

Management also includes keeping pens clean, improving conditions during transportation, properly timed vaccines that don't include antibiotics, and even immune-modulators that boost the animals' immune systems.

"The issues have been brought to light and now we have an action plan of how we're going to combat some of these issues," Tarpoff said. "It's not just one thing — it's not just the veterinary feed directive, it's not just the regulation — but we have innovation and education.

"Between that and the push from industry and consumers, we're going to win. It will be a win for the industry. It will be a win for everyone."

2017 RESEARCH SHOWCASE

Showcasing K-State in KC

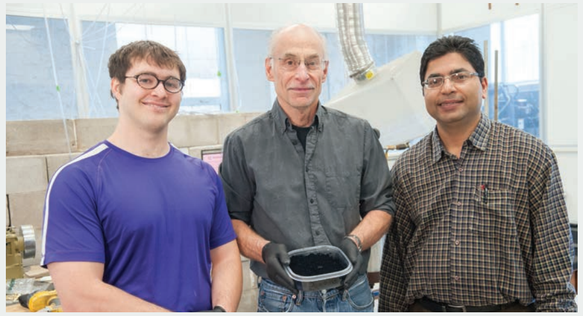
On May 17, Kansas State University is opening its doors to businesses in the Kansas City metro area.

The 2017 Research Showcase at the K-State Olathe campus highlights the wide breadth of research expertise, resources and capabilities at the university that are available to public and private corporate partners.

To be featured at the showcase:

- Global food systems, particularly in agriculture and food science.
- Animal and human health and nutrition.
- Engineering and technology, ranging from construction and architecture to software.
- Workforce development and diversity.
- Life sciences and analytics, such as sensory analysis and consumer preferences and behavior.

Greater Kansas City is home to more than 240 life sciences companies with more than 30,000 employees. The region also is part of the Animal Health Corridor — a nexus for animal health research and development with more than 300 animal health companies located from Manhattan, Kansas, to Columbia, Missouri.



Patented success: Easier way to make graphene

Forget catalysts and expensive machinery — a Kansas State University team of physicists has discovered a way to mass-produce graphene with three ingredients: hydrocarbon gas, oxygen and a spark plug.

Their method is simple: Fill a chamber with acetylene or ethylene gas and oxygen. Use a vehicle spark plug to create a contained detonation. Collect the graphene that forms afterward.

Chris Sorensen, Cortelyou-Rust university distinguished professor of physics, is the lead inventor of the recently issued patent, "Process for high-yield production of graphene via detonation of carbon-containing material." Other Kansas State University researchers involved include Arjun Nepal, postdoctoral researcher and instructor of physics, and Gajendra Prasad Singh, former visiting scientist.

"We have discovered a viable process to make graphene," Sorensen said. "Our process has many positive properties, from the economic feasibility, the possibility for large-scale production and the lack of nasty chemicals. What might be the best property of all is that the energy required to make a gram of graphene through our process is much less than other processes because all it takes is a single spark."

Graphene is a single atom-thick sheet of hexagonally coordinated carbon atoms, which makes it the world's thinnest material.

'Shrew'-d finding on climate change

The shrew and its parasites — even 40-year-old preserved ones — are the new indicators of environmental change, according to a Kansas State University researcher.

Andrew Hope, assistant professor of biology, and his colleagues across the U.S. have published "Shrews and Their Parasites: Small Species Indicate Big Changes" in the National Oceanic and Atmospheric Administration's 2016 Arctic Report Card. The study indicates an expansion in the range of the forest-dwelling masked shrew in Alaska, while the range of its tundra neighbor to the north, the barren ground shrew, constricts and fragments whenever the climate warms.

According to Hope, the pointy-nosed, often overlooked small insectivores are good indicators of environmental changes because they are found around the world and share space with large animals. Shrew population shifts can reflect changes in species that are more familiar to people but harder to work with, like caribou and moose, he said. The invasion of the masked shrew into the barren ground shrew's territory also brings with it parasites and pathogens that can be transmitted among different shrews and possibly to other animals.

"Each shrew carries within it or on it whole communities of other species," Hope said. "Most people don't know what a shrew is but they are an important part of community dynamics around the world. We can use small mammals, like shrews, as a tool to understand the processes of change. Taking it a step further, we learn how parasites and pathogens spread through the environment."

The researchers are using field collections of shrews archived in museums to understand how the populations of shrews and their parasites change in response to changes in the environment. From these collections, the researchers can tell that this is not the first time the climate has warmed and the barren ground shrew's range has constricted — but the current rate of that change is unprecedented.

"The tundra community has survived previous warm periods, and then expanded back out again when it got cold," Hope said. "We are at a point now where it is as warm as it ever was in the history of these species and we're moving into a phase that's unknown."

Worst cooks in America? Researcher finds celebrity chefs may be in running

Celebrity chefs are cooking up poor food safety habits, according to a Kansas State University study.

K-State food safety experts Edgar Chambers IV and Curtis Maughan, along with Tennessee State University's Sandria Godwin, published "Food safety behaviors observed in celebrity chefs across a variety of programs" in the Journal of Public Health. The researchers viewed 100 cooking shows with 24 popular celebrity chefs and found several unclean food preparation behaviors.

"Twenty-three percent of chefs licked their fingers; that's terrible," said Chambers, university distinguished professor and director of the Sensory Analysis Center at Kansas State University. "Twenty percent touched their hair or dirty clothing or things and then touched food again."

The chefs' most common food safety hazards included lack of hand-washing, not changing the cutting boards between raw meat and vegetables that wouldn't be cooked, and not using a meat thermometer to check meat doneness.

"Washing your hands is not a one-time thing," Chambers said. "We saw some chefs wash their hands in the beginning before preparing food, but they didn't wash their hands during food preparation when they should have."

Chambers said this is not modeling good behavior for viewers. Celebrity chefs' purpose is to entertain and educate about food preparation techniques and helpful kitchen hints, which should include proper food safety practices, he said.

According to the study, about 1 in 6 Americans are exposed to foodborne illnesses each year, which can economically and socially affect consumers.

Placidus Amama

Melanie Derby

Emily McLaurin

Up-and-coming researchers

Three Kansas State University faculty members are being recognized by the National Science Foundation for their career potential. Placidus Amama, assistant professor of chemical engineering; Melanie Derby, assistant professor of mechanical engineering; and Emily McLaurin, assistant professor of chemistry, are recent Faculty Early Career Development, or CAREER, Program recipients.

Amama was awarded a $520,000 CAREER grant for his project, "Rational Design of Efficient Carbon Nanotube-Supported Titanium Dioxide Photocatalysts for Air Purification." This study focuses on the coupling of carbon nanotubes and titanium dioxide, with the goal of enabling production of low-cost and large-area coatings of this material for efficient outdoor pollution control. The technology is expected to provide significant improvement in urban air quality and combat ozone at the source, Amama said.

Derby received a $500,000 CAREER award for her project, "Altering Transient Soil Evaporation Mechanisms through Hydrophobicity." This project investigates mixing water-repellent particles with soil to reduce evaporation rates. Initial experiments will first study evaporation from small soil pores and progressively move to large soil samples in controlled laboratory tests. According to Derby, reducing irrigation by only 0.5 inches on the irrigated farmland in Kansas would conserve 20 billion gallons of water annually.

McLaurin received a CAREER award of more than $700,000 for her project, "Microwave-Assisted Ionic Liquid Etching of Colloidal III-V Semiconductor Nanocrystals." The project is developing a more efficient and safer way of etching semiconductor nanocrystals, which could lead to more energy-efficient lighting and greener technology. McLaurin uses microwaves in the etching process with the goal of more efficiently producing safer, superior semiconductor nanocrystals known as quantum dots.

"Horses and Wagons" by John Steuart Curry

A new look at the work of John Steuart Curry

The early career of one of the nation's most noted Regionalist artists is the focus of an original exhibition at Kansas State University's Marianna Kistler Beach Museum of Art.

"John Steuart Curry: Mapping the Early Career" runs through May 13 in the museum's Donna Lindsay Vanier Gallery. Along with exploring the little-known early life of Curry, the exhibition features some never-before-viewed objects from K-State's more than 900-piece Curry collection. The centerpiece of the exhibition is the major Curry mural "Wall Map of Europe," on loan from the Burr Living Trust of Lewisberry, Pennsylvania.

During the late 1920s, Curry gained national attention for his portrayals of Kansas. At the height of his career, during the 1930s, he would become associated with prominent Regionalists Thomas Hart Benton of Missouri and Grant Wood of Iowa. Among Curry's best-known works are the murals he created in 1937 at the Kansas State Capitol in Topeka.

Much less is known about Curry's early years as an artist, according to Elizabeth Seaton, Beach Museum of Art curator.

"This exhibition explores Curry as a student and early professional through more than 30 drawings, paintings and magazine illustrations," said Seaton, who organized the exhibition with members of a spring 2016 seminar comprised of students from Kansas State University and the University of Missouri, Kansas City.

"A look at Curry's career beginnings provides insight into his success. What becomes clear is the importance of his upbringing on a farm in Kansas and his strong need to visualize this," Seaton said.

Most of the Beach Museum of Art's collection of Curry's works came as a bequest in 2002 from Kathleen Curry, the artist's widow.

Kevin Dorn

Caroline Ylioja

Federal fellowships boost global food systems research

Two agriculture researchers at Kansas State University have received federal fellowships totaling $246,660 to study issues that affect local and worldwide food systems.

Kevin Dorn, associate scientist in plant pathology, was awarded a two-year $151,660 postdoctoral fellowship to uncover key genes that underlie the difference between annual and perennial plants — a finding that could lead to the development of new perennial grain crops while improving the environment. Caroline Ylioja, doctoral student in animal science, was awarded a two-year $95,000 predoctoral fellowship to study strategies that could improve the health of replacement dairy animals and their lifetime milk production.

The Agriculture and Food Research Initiative fellowships were awarded through the Food, Agriculture, Natural Resources and Human Sciences Education and Literacy Initiative of the U.S. Department of Agriculture-National Institute of Food and Agriculture.

Dorn's project looks to shed light on the mechanisms underlying some crops' perennial growth cycles and inform long-standing efforts to perennialize major annual crops like wheat. He also will help in the development of new perennial crops like intermediate wheatgrass. This project builds upon Dorn's ongoing research of intermediate wheatgrass genomics, which he and his adviser, Jesse Poland, assistant professor of plant pathology, are exploring in collaboration with The Land Institute and several other academic partners.

Ylioja's project concerns colostrum, which is the first milk a cow produces for its calf after giving birth. Typically, the quality of colostrum is measured by its antibody levels, but Ylioja proposes additional strategies, such as assessing the presence of molecules that carry messages between cells, organs and tissue to boost immunity.

We've got your goat cheese better defined

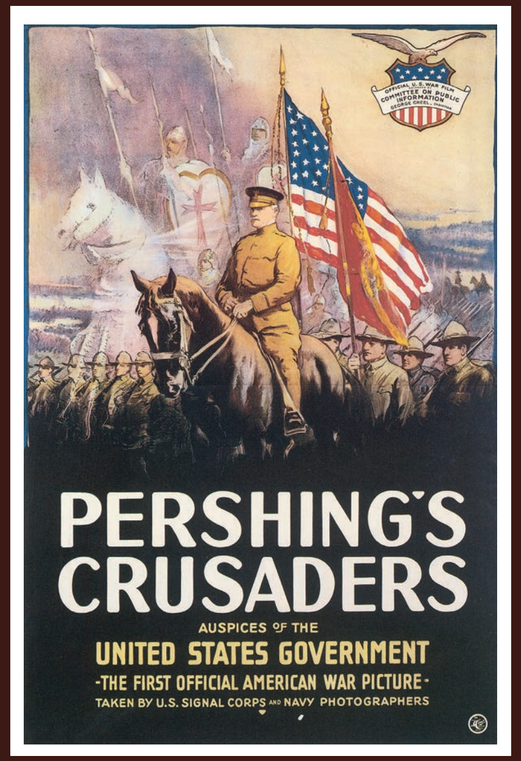
Nutty? Salty? Soapy? Goaty? Those are some of the descriptions Kansas State University and K-State Olathe researchers list in a new flavor lexicon that characterizes goat cheeses made in the U.S.

Martin Talavera, assistant professor of sensory analysis and consumer behavior at K-State Olathe, and Delores Chambers, professor of food, nutrition, dietetics and health and co-director of Kansas State University's Center for Sensory Analysis and Consumer Behavior, catalog the comprehensive list of descriptors and the science behind them in the study, "Flavor lexicon and characteristics of artisan goat cheese from the United States." It was recently published in the Journal of Sensory Studies.

The lexicon describes the specific flavor characteristics of American-produced cheeses made from goat milk. While lexicons exist for cheddar, Swiss and other types of cheeses, cheese made from goat milk previously had no such guide.

Flavor lexicons serve as important production tools for numerous aspects of cheesemaking — particularly adapting cheeses to meet consumer interests, Talavera said. For example, previous research shows that American consumers currently prefer more mild, less "goaty" flavors of cheeses that are made with goat milk. With a standardized flavor lexicon, cheesemakers could reduce the less desirable flavors in cheeses and other products made with goat milk and instead scale up the individual flavors and flavor combinations that match consumer demand.

Researchers conducted the study using 47 artisan cheeses made from goat milk. Cheese samples were collected from California, Texas, Kansas, Georgia, Maryland, Wisconsin, Colorado and Connecticut. Samples included goat cheeses of the cheddar-style — those with waxy, nutty and sweet flavors; feta-style — those with saltier flavor profiles; chèvre-style — those with milder flavors; and mold-ripened — cheeses that were more pungent and sharp. Cheese samples were evaluated at the university's Center for Sensory Analysis and Consumer Behavior by a trained sensory panel.



The Dark Side of Progress

English professor Tim Dayton studies, creates archive of American World War I-era poetry

By Sarah Caldwell Hancock

April 6, 2017, marks the centennial of U.S. entry into World War I, a grim chapter of world history. America lost more than, 116,000 soldiers during the war. The loss of life in Europe was even more staggering: Germany and Russia alone lost 3.4 million soldiers. Military and civilian deaths during the war totaled 16.5 million, and 20 million more were wounded. If the total number of American casualties was relatively small, the rate was severe: The vast majority was suffered in just six months.

The scale of loss had pronounced and lingering effects. Tim Dayton, professor of English at Kansas State University, says understanding WWI is central to understanding 20th century culture. Dayton's study of literature and poetry from the period, "American Poetry and the First World War," chronicles a pronounced cultural shift. The book is forthcoming in winter 2017-2018 from Cambridge University Press.

Prior to WWI, poetry tended to be closed-form, following set patterns or structures in terms of rhyme scheme, number of lines or meter, Dayton said. Poetry also was romantic, idealizing its topics, including war. The modern warfare and mass casualties of WWI called into question the idea of noble sacrifice on the battlefield.

"The war amplifies the idea that things don't make sense," Dayton said. "The enormous increase in productive capacity in industrial societies correlates with enormous destructive capacity. Things that make life better also can make life worse."

The dark side of progress led to a struggle in the depiction of war in the literature of the 1920s. "The grounds of judgment change in large part because of reaction to the war," Dayton said.

America's reaction differed from Europe's. Whereas British wartime figures such as Wilfred Owen protested the war through the classics — Owen's best-known poem "Dulce et Decorum Est" exposes "the old lie" that it is "sweet and fitting to die for one's country" — American literature assumed what Dayton calls a deflationary style. Dayton argues this reaction arose from the high-minded reasons Woodrow Wilson and other Americans offered in support of entering the war.

"The U.S. couldn't claim it was defending itself in the war. The justification was more rhetorical, and more on a moral basis — the Russians could say, 'You must defend the motherland from the Germans;' the Germans could say, 'You must defend the fatherland from the Russians,' and so on. Wilson's justifications for the war were lofty — war to end war, war to make the world safe for democracy — and his prose style was very windy," Dayton said.

According to Dayton, Ernest Hemingway's prose style is one example of an attempt to deflate Wilson's rhetorical speech. Dashiell Hammett provides another example in his prose fiction: He adopted a clipped, direct style devoid of rhetorical flourish.

Dayton discovered his affection for the literature of the post-WWI period while researching his dissertation, which wasn't about the war, and then while teaching undergraduate literature courses at K-State. The Library of Congress online catalog and a bibliography from a dissertation written in the 1960s led him to many forgotten poems. One of his favorite discoveries is "Father Hiram on the World's War," a long poem entirely in Midwestern dialect. No one had previously written about the poem. Several such instances later, Dayton now has a bibliography of 400 volumes of American poetry — many more than the 120 he started with in his original Library of Congress search results.

Dayton's bibliography forms the basis of another project, a digital archive to allow anyone to access annotated versions of the poems. Although the poetry was usually not written in an elevated style, it can be fairly obscure to modern readers because of historical references, place names and other details, so annotations are helpful. He plans to add biographical and critical introductions for the authors, many of whom published nothing apart from a single volume of war poems.

Dayton is working to obtain funding for the archive, which will be useful for the general public as well as for literature and WWI scholars. He and several graduate students have made good progress; half a dozen volumes are ready for display as soon as a content management system is in place.

The work is valuable for students. "It's a really nice opportunity to teach grad students and some talented undergrads how to do primary research and annotation," he said.

Hands-on history

By Taylor Manges

The discoveries by undergraduate students at Kansas State University's Chapman Center for Rural Studies keep coming.

"Our students learn that if they unlock one door, there are a million doors behind that door," said Bonnie Lynn-Sherow, associate professor of history and executive director of the center.

Launched with a gift in 2006 from Mark Chapman, a 1965 K-State history and political science alumnus, the Chapman Center's initial focus was on preserving the memory of Chapman's hometown, Broughton, Kansas. It now is a busy multidisciplinary center that supports undergraduate students' research endeavors, especially in the social sciences and humanities — disciplines that Lynn-Sherow said have fewer opportunities for hands-on experiences.

"Undergraduates have clearly expressed their desire for skills-based experiences," Lynn-Sherow said. "This opportunity is extremely exciting for a lot of students, and we've had hundreds of students from all majors and departments involved at the center."

Center faculty also select four student interns each semester based on their class work, most often a published history of a small town. The interns receive scholarships, travel funds and their own workspaces. They also are mentored one-on-one by faculty on original research projects, as well as contribute to larger projects, such as the recent "Going Home: Hidden Histories of the Flint Hills" exhibit at Manhattan's Flint Hills Discovery Center.

Brandon Williams, sophomore in history, is a current Chapman scholarship intern.

"Through the Chapman Center I found what it was I was supposed to be doing, what I am passionate about," Williams said. "I would not have had the opportunity to do research had it not been for the center."

Williams' project for the spring 2017 semester is a photo essay of Orion, Kansas, a town that no longer exists. He is working with an elderly former Orion resident and will scan her six generations of family photographs taken in and around the town.

Williams was selected to present his fall 2016 project, "Cameras in the Streets: The Use and Evolution of Photography in Turn-of-the-Century Kansas," at the 2017 Kansas Undergraduate Research Day at the Capitol in Topeka. Lynn-Sherow said Williams is the fourth Chapman Center student selected to present research at the event since 2010.

M.J. Morgan, longtime research director at the center and instructor of history, is responsible for the day-to-day work of the interns. The goal of the interns' research projects — and the courses Lynn-Sherow and Morgan teach — is to incorporate service learning into the curriculum and help students network both on and off campus.

"A lot of small historical societies do not have the technology to scan their collections, organize their collections or conserve their photographs. These are things that we train our students to do so we can do it for these communities," Lynn-Sherow said. "It becomes a great collaboration because the students can then use the content of these collections for their research projects, which in many cases is not available anywhere else."

The hours of work interviewing and digging in files for months at a time serve a twofold purpose for Williams.

"My research is something that I take upon myself to finish and is for more than just me," he said. "I know my research might be beneficial to other people."

According to Lynn-Sherow, students at the center gain a deeper appreciation for history and the humanities.

"They never see the world again in the same way," Lynn-Sherow said. "As Dr. Morgan puts it, 'Where other people see a derelict collection of buildings, a student from the center will look at that place and see Main Street. They can tell you where the blacksmith shop was, or where the grocery store was, or where you are going to find the cemetery.'"

Many of center's alumni are now working in or running historical societies and cultural institutions, have started consultancy firms or produce and edit historical films. Based on their work at the center, several have received scholarships for graduate school to study public history. *k*

See an online archive of students' research projects at k-state.edu/history/chapman.

Images courtesy of Tom Parish and the Chapman Center for Rural Studies.

See *Research Scholar*

‘Chocolate pie guy’ shows how exercise affects the way our bodies process high-fat meals

By Tiffany Roney

Nutrition researcher Sam Emerson is gaining a slice of research fame by asking people to eat pie.

Emerson, a doctoral student in food, nutrition, dietetics and health at Kansas State University, and his team had volunteers eat chocolate pie to document effects on glucose, lipids and triglycerides for three groups of people: active adults, ages 18-35; active adults, ages 60-plus; and inactive adults, ages 60-plus.

The researchers found the largest disparities between active and inactive persons, including a 76-year-old runner and an inactive man 10 years younger. The team measured triglycerides, a type of fat in the blood that, at higher levels, can increase the risk of heart disease and signal a metabolic disorder. The inactive man’s triglycerides increased more than three times over pre-pie levels, whereas the active man’s triglycerides hardly changed. Emerson said these findings show the benefits of a lifetime of physical activity.

“The thread connecting all my studies is the examination of how nutrition and exercise relate to human health in true-to-life situations,” Emerson said. “Nourishment and movement have a powerful effect on quality of life.”

This spring, Emerson will present the results of the pie study at the K-State Graduate Research, Arts and Discovery Forum and the American College of Sports Medicine’s annual meeting. In addition, he will share findings from another study he conducted at the American Society for Nutrition’s annual meeting.

Emerson is the primary author of five papers and co-author of eight papers published in the Journal of the International Society of Sports Nutrition, the British Journal of Nutrition and other publications.

Emerson earned his bachelor’s in nutritional sciences at Oklahoma State University and his master’s in kinesiology at K-State, where he was named a distinguished master’s student and received the American Kinesiology Association Master’s Student National Scholar Award and the American College of Sports Medicine’s Master’s Student Research Award.

He chose to stay at K-State for his doctoral studies because he wanted to work with Sara Rosenkranz, assistant professor of food, nutrition, dietetics and health.

“Working under Dr. Rosenkranz has helped me see the type of professor I would like to be so that I can guide students and give them opportunities to participate in exciting research,” Emerson said. “K-State has allowed me to discover and develop my passion for research while developing my teaching skills as a graduate teaching assistant.” k

See *UDP Focus*

Prasad’s work all about feeding the future

By Beth Bohn

P.V. Vara Prasad believes research goes beyond finding solutions to problems; it’s also about preparing the next generation of scholars and practitioners.

The Kansas State University distinguished professor of agronomy and new fellow of the American Association for the Advancement of Science enjoys teaching and research equally.

“I believe they are complementary,” Prasad said. “Conducting good research requires that you keep up with new science and recent literature. This allows you to teach students with good material and explain the science behind the principles. Interactive teaching also allows students to ask some novel and critical questions, which can help you to design your research and develop hypotheses to find answers and viable solutions.”

Research and teaching are the backbone of Prasad’s latest challenge as principal investigator and director of the university’s Feed the Future Innovation Lab for Collaborative Research on Sustainable Intensification. The lab, funded by a $50 million grant through the U.S. Agency for International Development’s Feed the Future program, seeks ways to increase food production with limited resources and reduced stress on the environment. The lab is fully established and working on projects in its focus countries of Bangladesh, Ethiopia, Burkina Faso, Senegal, Tanzania and Cambodia.

“I am proud that we are working with smallholder farmers to improve their livelihoods,” Prasad said. “We use the model of collaborate, learn and adapt. Our lab brings together about 100 scientists from 40 different organizations in 10 countries to work together and create an environment and a culture that facilitate innovative research and education. We are building the capacity of the next generation of scholars and practitioners by training, and we are providing knowledge to students, teachers, scientists, farmers and policymakers.”

The lab’s strong focus on sustainability is key to the future of farming in the countries it serves, Prasad said.

“We want to ensure that we safeguard our environment and natural resources so that the next generation can survive and strive,” Prasad said. “The biggest challenge is how do we translate this knowledge generated from research to practices that will improve productivity from existing land and will minimize impact on environment and on food and nutritional security.”

Prasad’s research looks at understanding responses of food grain crops to climate change and developing crop, water and soil management strategies for efficiency and improved crop yields.

Since joining K-State in 2005, Prasad has received $62 million in grant funding to support research, education and extension activities from local, national and international agencies. He has published more than 150 peer-reviewed journal articles and book chapters, and his research has been cited more than 5,500 times. He also has mentored and trained more than 100 research scholars and graduate students. k

Center for the Advancement of Entrepreneurship helps turn ideas into business

By Tiffany Roney

New businesses are popping up across Kansas with the help of Kansas State University's Center for the Advancement of Entrepreneurship.

The center, housed in the College of Business Administration, provides entrepreneurship education and opportunities to prospective entrepreneurs across campus and the state. Annually, it provides:

- More than 800 hours of research support for businesses started by Kansans.
- 280 hours of mentoring by entrepreneurial alumni for students.
- Thousands of dollars in cash and in-kind prizes for Kansas entrepreneurs.

Since 2008, the center has involved more than 2,200 students in K-State Launch, an annual program that has awarded $180,000 to help start 48 new companies, many of which have stayed in Kansas.

The center's successes translate into real benefits for rural Kansas, where communities need new people, ideas and income to flourish, according to the director Chad Jackson.

"We're continually looking for ways to engage rural communities by guiding students with business ideas to start new businesses and connect with growing ventures in rural areas," Jackson said. "We are finding ways to bridge the gap because it's important to support rural communities in our state."

The center's statewide outreach programs include the Kansas Entrepreneurship Challenge and the Launch a Business competition.

The Kansas Entrepreneurship Challenge is for future entrepreneurs from Kansas high schools and Kansas Board of Regents institutions. Their business ideas are evaluated by a panel of judges. In 2016, more than $10,000 in cash prizes was awarded to six winning teams.

Launch a Business accepts the top applicants for a five-week intensive program in which entrepreneurs engage with students, faculty and alumni to refine and improve their ideas. Participants present their pitches at a public launch party at the end of the program. In 2015, 14 high-potential startups in Kansas competed for thousands of dollars in cash prizes.

Jackson said the center hosts these events because it takes K-State's land-grant mission seriously.

"We're here to support entrepreneurs, whether we're teaching students who want to start businesses, pairing students with community mentors or using K-State's resources to encourage new entrepreneurs in Kansas," Jackson said. "It's all about leveraging K-State capital — intellectual, financial and relational — to benefit Kansas' economy and citizens."

The Center of It All

By Julee Cobb

In the emerging industry of unmanned aircraft systems, or UAS, Andi Meyer is determined to make the Kansas State University Polytechnic Campus a go-to hub for the technology's advancement.

When the UAS program was established in 2007 on the Polytechnic Campus in Salina, Meyer was studying mechanical engineering at Wichita State University. But living and learning in a city dubbed the "Air Capital of the World" made aerospace impossible to avoid, and it was aviation-centered experiences that brought Meyer where she is today as research program manager of the Applied Aviation Research Center at Kansas State Polytechnic.

> **"While we can't be masters of all, we can cultivate an environment, through a network of experts, that produces solutions to a broad array of complex challenges facing the UAS industry," Meyer said.**

Meyer worked part time at Spirit AeroSystems while earning her bachelor's degree. The Wichita-based aviation manufacturer chose her to compete in an international airplane design challenge. Meyer sought advice for the contest from an expert at the National Institute for Aviation Research and was offered a job on the spot. She worked on translational research at the institute, merging aerospace technologies with biomedical engineering. At one point, her assistance was needed on a collaboration between the facility and Kansas State Polytechnic's UAS program. Less than a year later, Meyer was a full-time Wildcat.

Meyer's responsibilities are many, but creating a hub for UAS exploration — design, integration, flight testing and data analysis — is her No. 1 goal. She believes the center can be a principal provider of new ideas and solutions for the unmanned frontier because of the program's talent, experts on the Manhattan campus and K-State's connections with other universities and companies.

"I want Kansas State Polytechnic's UAS research program to be known for pre-eminent problem solving," Meyer said. "Commercial applications are still in the early stages, and the regulatory pathway is murky. Applications of this technology are yet to be discovered and tested. If we can bring together the skills and proficiencies of our staff with the bright minds of various departments in Manhattan and industry stakeholders, this program can be the center of it all."

Meyer's plan is working. The UAS research program has been awarded four projects from the Federal Aviation Administration in the last two years.

Industry collaboration also is thriving. The program teamed up with Precision-Hawk, a drone data and safety company headquartered in Raleigh, North Carolina, to calculate an achievable level of safety for drone pilot response time and choice of action when confronted by a manned intruder. The program also is working with Westar Energy to demonstrate how unmanned aircraft can propel the electric utility industry forward through inspection and maintenance methodologies.

Meyer says the UAS research program is typically involved in multiple large projects at a time while balancing numerous small ones, such as collaborating with the entomology department on the Manhattan campus to provide data collection flights over fields throughout the growing season. This wide variety of projects is all according to plan.

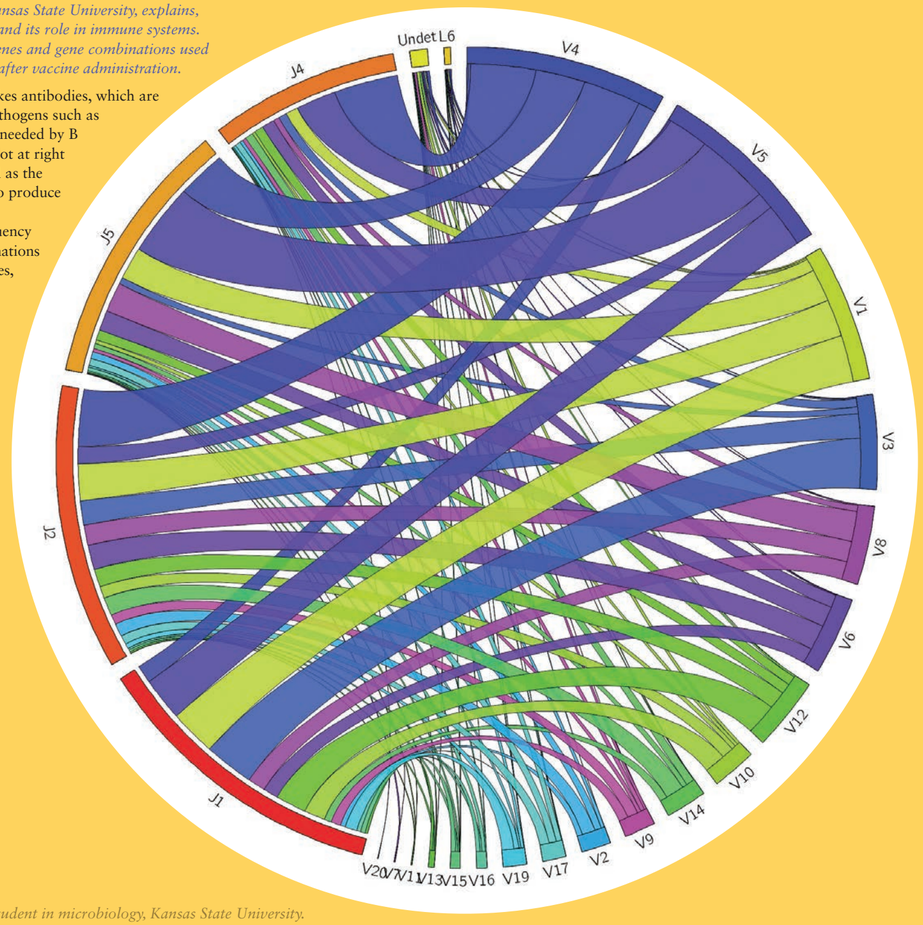
"While we can't be masters of all, we can cultivate an environment, through a network of experts, that produces solutions to a broad array of complex challenges facing the UAS industry," Meyer said.

B cell

bē 'sel

Stephen K. Chapes, professor of biology and interim director of the Johnson Cancer Research Center at Kansas State University, explains, in around 100 words, what a B cell is and its role in immune systems. Chapes' lab wants to know how the genes and gene combinations used by a B cell to make antibodies change after vaccine administration.

A type of white blood cell, a B cell makes antibodies, which are used by the immune system to fight pathogens such as bacteria and viruses. Several genes are needed by B cells to make antibodies. The Circos plot at right shows how often a gene is used as well as the combination of genes used by B cells to produce antibodies. The arc size on the circle's circumference correlates with the frequency of the gene's use, while the gene combinations are shown by lines drawn between genes, with size representing frequency of the combination. These combinations determine to what pathogens an antibody will bind.



Circos plot by Tricia Rettig, doctoral student in microbiology, Kansas State University.

Range rovers

Much of the 8,600-acre Konza Prairie Biological Station was at one time part of the Dewey Ranch, a working cattle operation. These photos, courtesy of the Konza Environmental Education Program, show what life was like on the range in the late 1930s to 1950. Top left: In this photo from 1938, steers brought up from the Paloma Ranch in Eagle Pass, Texas, graze on the rich and nutritious tallgrass prairie before being sold. Bottom left: This photo taken in 1950 is of Orville Burtis Sr., manager of the Dewey Ranch, in a Jeep feed wagon. The photo was taken in what now is the present-day headquarters area of Konza. Right: Not much is known about this photo other than it was taken in 1947, probably along the Konza's main road.

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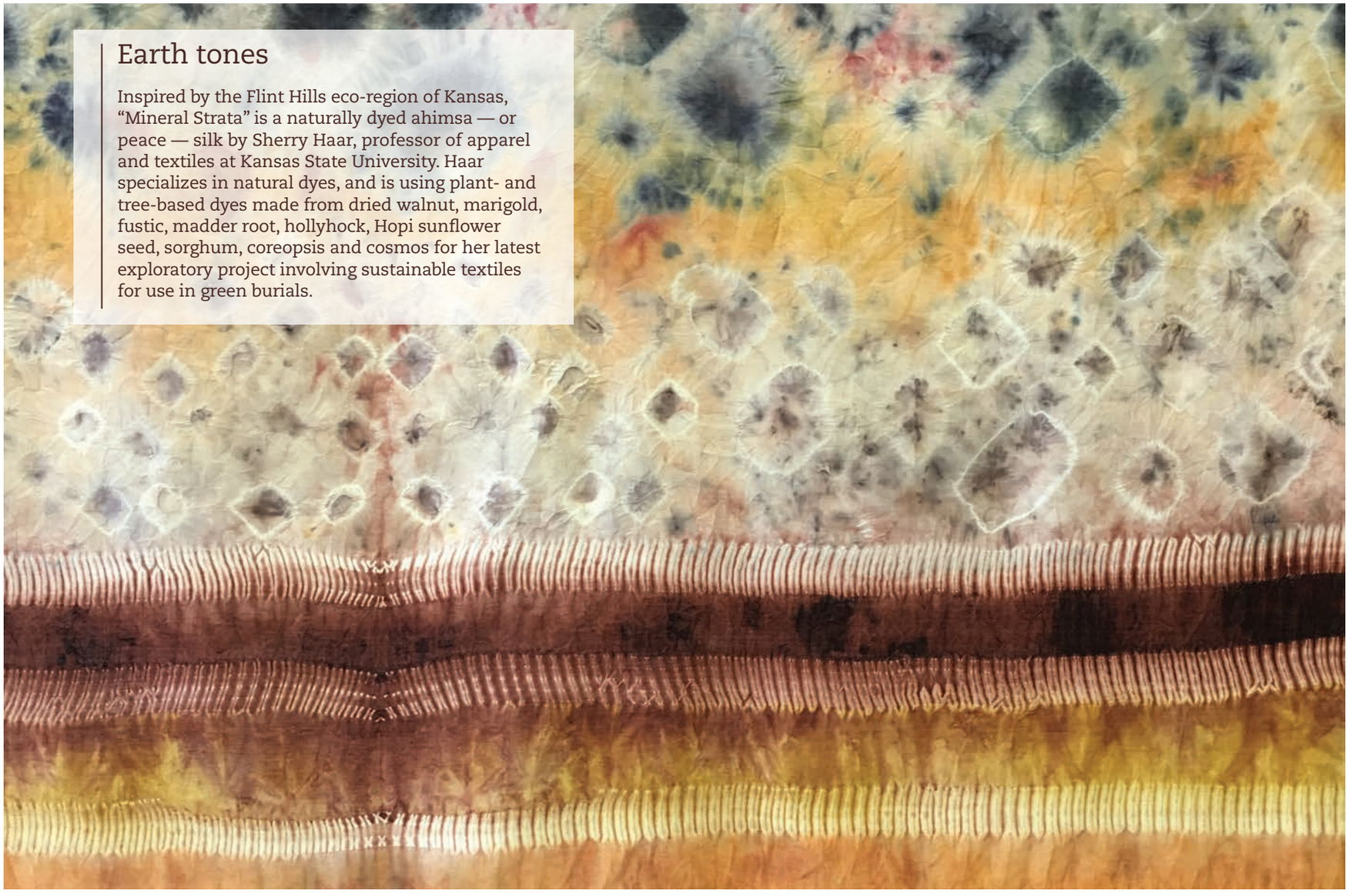

Earth tones

Inspired by the Flint Hills eco-region of Kansas, “Mineral Strata” is a naturally dyed ahimsa — or peace — silk by Sherry Haar, professor of apparel and textiles at Kansas State University. Haar specializes in natural dyes, and is using plant- and tree-based dyes made from dried walnut, marigold, fustic, madder root, hollyhock, Hopi sunflower seed, sorghum, coreopsis and cosmos for her latest exploratory project involving sustainable textiles for use in green burials.