Seek

RESEARCH MAGAZINE FOR KANSAS STATE UNIVERSITY

FALL • 2017

Feeding a hungry world

Feed the Future labs fuel innovation

The curiosity of collections

Treasure troves for science, art and research

Communicating science

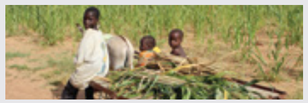
Taking research from the beaker to the tractor and beyond

Amber waves

Bread wheat thrives before harvest in a Kansas field. Kansas State University crop breeders have produced several new varieties of wheat and other crops in the last two years. Learn more about them on pages 36-37.

See Contents

Features



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KANSAS STATE UNIVERSITY

A national conversation about the value of higher education and research has intensified in the last few months. This issue of Seek clearly demonstrates the value that Kansas State University research adds to the state of Kansas, our region and the nation. K-Staters aren't the only ones who notice, either: This summer, the Association of Public and Land-grant Universities named K-State an Innovation and Economic Prosperity University. The designation honors 60 public institutions in the U.S. for their economic engagement.

The self-assessment process that we completed to apply for the Innovation and Economic Prosperity designation highlighted several strengths along with growth areas we will continue to target. Our internal and external stakeholders identified strengths in talent, place and innovation, and you'll find those strengths reflected in the pages of this magazine.

Talent is clearly on display in "Communicating science for everyday use," Page 16, which highlights the efforts of a few K-State Research and Extension personnel who excel at transferring research-based knowledge to small business owners, agricultural producers and citizens with food safety questions. These researchers help different audiences cut through the noise to find out how to improve their lives and businesses, and they use a range of platforms — from social media to face-to-face meetings — to deliver their messages.

K-State talent — and innovation — also attracted four of the nation's 25 U.S. Agency for International Development Feed the Future innovation labs. These labs are helping the world address the need to feed nearly 10 billion people by 2050 with the investment of more than $100 million in federal funding to support projects in many countries. All of this research benefits U.S. and Kansas agriculture. Read about it in "Feeding a hungry world" on Page 10.

Place is vital to the research and creative activities of K-State, too, as evidenced by the piece on our institution's collections, Page 20. Great Plains plants and insects, historical textiles and cookbooks, Kansas and regional artwork, and fungi — yes, fungi — are examples of the collections K-State curators maintain to facilitate better understanding of our natural and social environments and their history. Artist Erin Wiersma also helps us understand place in new ways with her work that uses the freshly charred grass of the Konza Prairie Biological Station as charcoal to create large-scale drawings that capture the scope and patterns of the prairie, Page 34. Such art-science interfaces provide vital social, cultural and community development resources to the state.

Innovation is never in short supply here. Unmanned aircraft systems, Page 30, and new crop varieties that generate millions of dollars in revenue for Kansas agriculture, Page 36, are two examples of K-State innovation. These stories show that our innovators are both high-flying and well grounded. I know more accomplishments are to come.

One of the best examples of K-State's economic engagement, Project 17, is profiled in this issue on Page 38. Project 17 brings together all of our resources in talent, place and innovation in an effort to provide tools and resources to improve economic vitality and quality of life for those who live in 17 counties in southeast Kansas. K-State is harnessing talent, place and innovation to fight poverty, invest in infrastructure, and build personal and business capacities with the goal of improving people's lives in Kansas.

That's just a glimpse of the full value that Kansas State University adds.

Peter K. Dorhout, Vice President for Research

K-State: Where economic engagement excels

For its strong commitment to economic engagement, Kansas State University has been named an Innovation and Prosperity University by the Association of Public and Land-grant Universities.

The designation means K-State joins 60 other public institutions across the country that are improving lives well beyond the confines of their campuses.

"Our land-grant heritage, established over 150 years ago, entrusted K-State with a leading role in economic engagement," said Peter Dorhout, vice president for research. "We appreciate APLU recognizing the impact K-State has on our state and region. We also look forward to building on this recent self-assessment process by implementing a growth plan to bolster our status as an economic driver."

According to Dorhout, the rigorous process for the coveted Innovation and Prosperity designation helped the university take valuable steps toward achieving the goal of becoming a Top 50 public research university. The university conducted a self-assessment and obtained feedback from internal and external stakeholders to identify accomplishments and strengths as well as possible growth areas. The process also included cataloging more than 300 centers, institutes and programs that affect economic engagement.

The economic impact of Kansas State University touches all 105 counties in Kansas. In Riley, Geary and Pottawatomie counties — the three closest to the main campus — that impact is nearly $900 million annually — and growing as the region grows.

Many of the programs you will read about in this issue of Seek played a role in the university earning the Innovation and Prosperity designation:

- **Our four Feed the Future labs, featured on pages 10-15, are an investment of more than $100 million from the U.S. Agency for International Development in K-State research to feed a hungry world and improve production agriculture.**
- **New K-State-developed varieties of some of the state's main crops, including wheat, sorghum and canola, are a multimillion dollar industry for Kansas. Learn more about our most recent varieties on pages 36-37.**
- **Project 17, featured on pages 38-39, shows how K-State leadership, engagement, research, technology and more is sparking an economic revitalization in southeast Kansas.**

Biologists find male, female live-bearing fish evolve differently

A Kansas State University study has found that male and female live-bearing fish evolve differently, which is important for understanding big-picture evolutionary patterns.

Researchers Michael Tobler, associate professor of biology, and Zach Culumber, former university postdoctoral research associate and current postdoctoral researcher at Florida State University, spent two and a half years studying more than 100 species of Poeciliidae, or live-bearing, fish. Live-bearers — which include species such as mollies, platies, guppies, swordtails and mosquitofish — retain eggs during pregnancy and give birth to live young, similar to mammals like humans.

Tobler and Culumber found that female evolution is influenced more strongly by natural selection and the environment, while male evolution is influenced more strongly by sexual selection, which involves characteristics that females find desirable or that make them superior competitors for females.

"In the big picture, this means that males and females are different and that matters not only within species but also in terms of shaping broad-scale evolutionary outcomes. Acknowledging that the sexes are different really affects how we make inferences about how evolutionary change has actually unfolded," said Tobler.

The findings were published in the Nature Ecology and Evolution journal article, "Sex-specific evolution during the diversification of live-bearing fishes."

See *Shorts*

A discovery for the record books

The world's lightest 3-D printed structure is so lightweight that it can be held by a cotton ball or the petals of a flower.

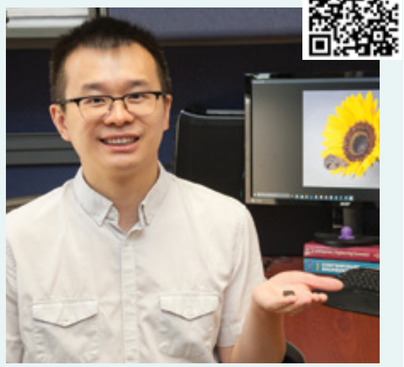
The record-breaking material is 3-D printed graphene aerogel developed by Dong Lin, Kansas State University assistant professor of industrial and manufacturing systems engineering; Chi Zhou, assistant professor of industrial and systems engineering at University at Buffalo; and Qiangqiang Zhang, an associate professor at Lanzhou University in China.

GUINNESS WORLD RECORDS™ has named the graphene aerogel as "the least dense 3-D printed structure." The 3-D printed graphene aerogel weighs 0.5 milligrams per cubic centimeter. The researchers developed the material in February 2016 and have received the official recognition from GUINNESS WORLD RECORDS, including a feature in the GUINNESS WORLD RECORDS 2018 Edition.

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

"Graphene is a revolutionary material and it makes sense that its aerogel form would be just as important," Lin said. "Our 3-D printed graphene aerogel has important properties that give the material many applications for better electronics, batteries or semiconductors."

Watch the world's lightest 3-D printed structure:
youtube.com/watch?v=RQhAwvg7TGg



Center for Sensory Analysis helping consumers 'Fight Bac'

Kansas State University research is reaching kitchens and grocery stores across the country, thanks to a national campaign that promotes food safety and safe poultry handling.

The Partnership for Food Safety Education is using research from K-State's Center for Sensory Analysis and Consumer Behavior for its nationwide campaign, Don't Wing It: Practice Safe Poultry Handling. The campaign is being featured by Wal-Mart, Publix and other supermarkets across the country.

University researchers conducted years of food safety studies and developed safety tips that are the basis of the campaign. These food safety tips and information will appear in grocery store signs, circular ads, poultry bags, cooler shelf tags, propane tanks and other locations throughout stores.

This network planted in safety

A diagnostic network established in part to address the United States' vulnerabilities to a terrorist attack on agricultural crops quietly keeps building the country's safety net.

Jim Stack, Kansas State University professor of plant pathology and incoming executive director of the National Plant Diagnostic Network, said that the national system has collected more than 1.3 million diagnostic records of plant diseases and insect pests in the past decade.

Stack is also director of the Great Plains Diagnostic Network, which is housed at K-State and is one of five such regional labs in the U.S. Those labs monitor plant diseases and pests and quickly report areas of new introductions.

"There's no end to this," Stack said. "If you look at our trends in trade and travel, that's not going to change. We've gone far enough down the globalization road that we're not retreating, not in my lifetime and probably not in the next generation's lifetime either."

Learn more about the work of the Great Plains Diagnostic Network and the national network at gpdn.org.

'X'cellent power: Physicists create 'molecular black hole' using ultra-intense X-ray pulses

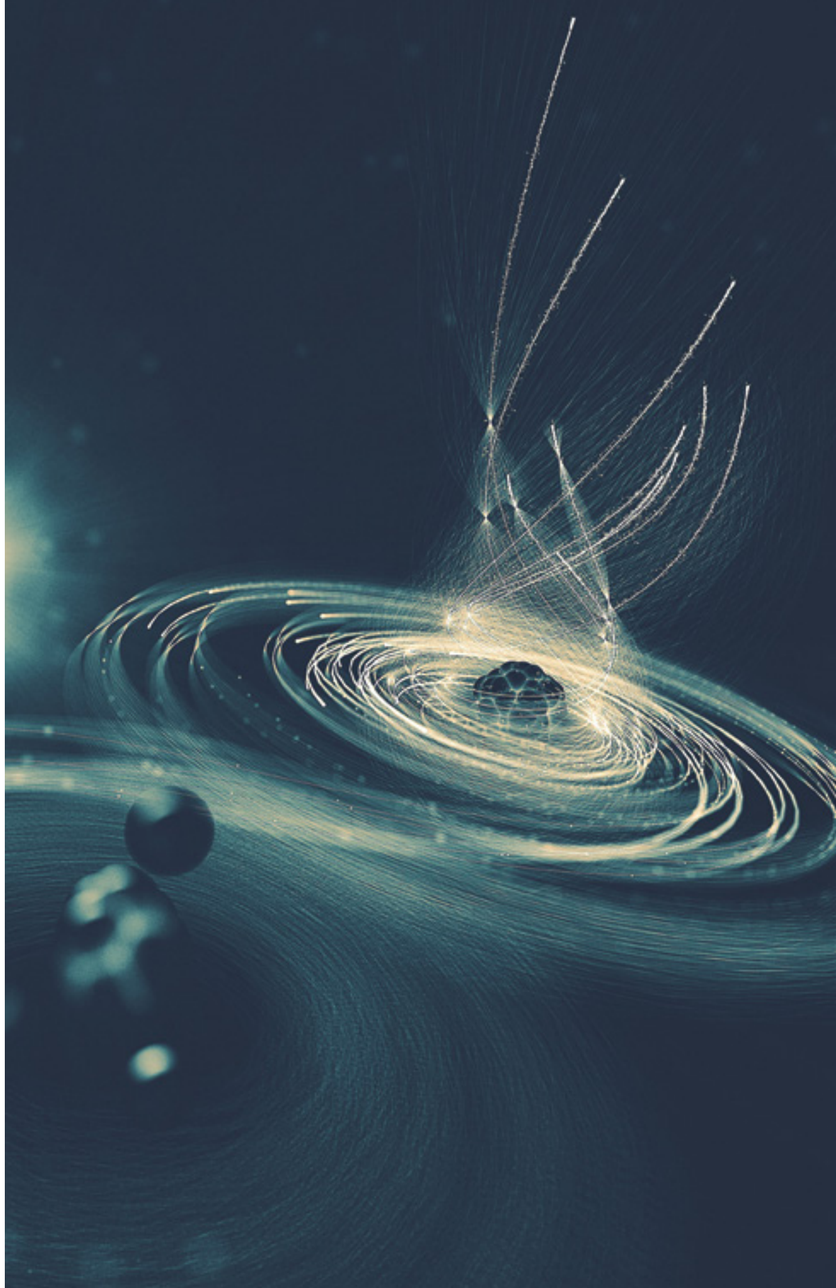
Kansas State University physicists Artem Rudenko and Daniel Rolles are the first researchers to successfully use short pulses of ultra-intense high-energy X-rays to produce a detailed picture of how X-ray radiation interacts with molecules. They are calling it a "molecular black hole."

Using the Linac Coherent Light Source, a 100 quadrillion kilowatt laser, at SLAC National Accelerator Laboratory at Stanford University, they discovered when a laser hits a molecule, the heavier atom absorbs the X-ray several hundred times faster than the other atoms. Most of its electrons are stripped away, creating a large positive charge on that atom, which creates the short-lived black hole. Unlike the real black hole, the molecular version lets the electrons out again.

Understanding the ultrafast dynamic process is important for many applications of intense X-ray lasers, including X-ray imaging of biomolecules, and understanding the damage caused by the intense laser.

In addition to helping scientists image and understand biological systems, the research also sheds new light on the charge and energy flow in a highly energized molecule. The research of these fundamental processes could be important for solar energy conversion and radiation-driven chemistry.

Rudenko and Rolles collaborated with other researchers across the globe on this study.



Artistic rendering of the process courtesy of DESY/ Science Communication Lab.

Spice up your life — and your meats

A recent Kansas State University study reveals that using spices and marinades prevents or drastically reduces formation of carcinogenic compounds when grilling.

J. Scott Smith, professor of animal sciences and industry, found that black pepper nearly eliminates the formation of heterocyclic amines, or HCAs, which can form on the surface of meat when it is cooked. HCAs are recognized as carcinogens by the International Agency for Research on Cancer, which is the cancer agency of the World Health Organization, and the National Toxicology Program, which is part of the U.S. Department of Health and Human Services. Almost any meat, including beef, pork, chicken and most types of fish, can form the carcinogenic compounds.

Smith's research primarily focused on adding antioxidant-rich spice blends that block the chemical formation of HCAs. When applied to the surface of meat — or mixed into the meat, as in the case of ground beef — some of the spices Smith has studied drastically reduce the incidence of HCAs. Most of the highly effective spices are from the mint family, which includes rosemary, thyme, oregano, basil, sage and marjoram, and the myrtle family, which includes cloves and allspice.

"Blending pepper with antioxidant-rich spices works so well in ground beef patties and on steaks that the spice formulation eliminates nearly 100 percent of HCAs," Smith said.

In addition, Smith also found that marinades work well at limiting HCAs without sacrificing the meat flavor.

Raising a stink: Corpse flower experience feast for the eyes, but a sock to the nose

Kansas State University's horticultural and natural resources department put on an unexpected, multisensory show in June when its *Amorphophallus titanium*, or "corpse flower," bloomed for the first time since its 2001 cultivation.

The *titan arum* is the largest, non-branching flowering plant native to Sumatra and Indonesia. Its flowering cycling is irregular and unpredictable, but when it does bloom, its flowers can reach astonishing heights. At its peak, K-State's *titan arum* was about 51 inches high.

Along with the impressive size, these flowers also have a distinct odor: one of rotting flesh. Hence, the nickname of corpse flower is also used.

"If you've ever driven by a dead animal on the side of the road in the middle of summer, that's been lying there for a day or two, that's what this pretty much might smell like to most folks," said Chad Miller, an assistant professor of landscape horticulture at K-State. The scent given off by the corpse flower, along with the heat it generates, is meant to draw the flies that serve as pollinators.

Miller collected pollen from the plant to store and share with other universities and botanical gardens in the future.

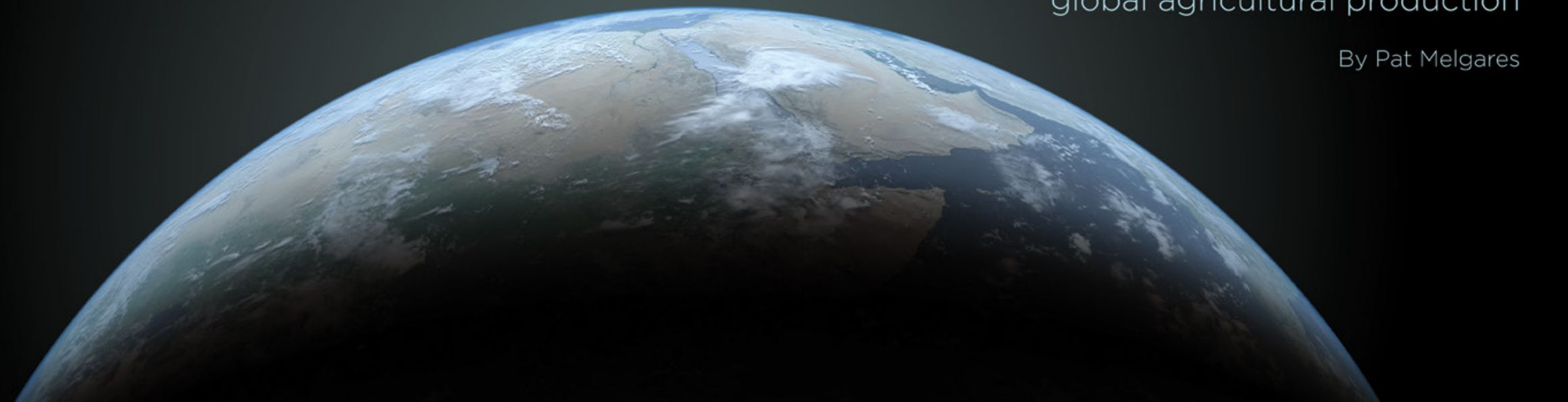
Watch the corpse flower open in this time-lapse video:
youtube.com/watch?v=g9fUrrTu3wM&feature=youtu.be

Learn more about the *titan arum*:
facebook.com/kstate.hfrr/posts/10155523761949885

Feeding a Hungry World

How Kansas State University is improving global agricultural production

By Pat Melgares



The world's population is expected to grow from 7.5 billion people today to nearly 10 billion by the year 2050. Experts predict that the world's farmers will have to produce as much food in the next 35 years as they have in the entire history of the world to feed everyone.

Kansas State University, a leader in global food systems research, is rising to the challenge through the Feed the Future program, the government's global hunger and food security initiative that is funded through the U.S. Agency for International Development. The program seeks innovations that will help feed a hungry world.

Of the 25 Feed the Future innovation labs, four are at K-State. Since 2013, K-State has received base funding and associated awards of more than $100 million to support projects in 15 countries, including high-tech efforts that use drones and satellites to scour landscapes from high above the Earth to gather plant data — including height, size of grain and more — to support development of new varieties and better nutrition.

Getting an accurate picture

Near the far northern tip of India, a steady buzz makes its way up and down rows of lush wheat fields.

Armed with sophisticated, multispectral cameras no larger than your back pocket, an unmanned aerial vehicle — a drone — zips through the field collecting images that will give researchers and wheat breeders important information on how to improve crops.

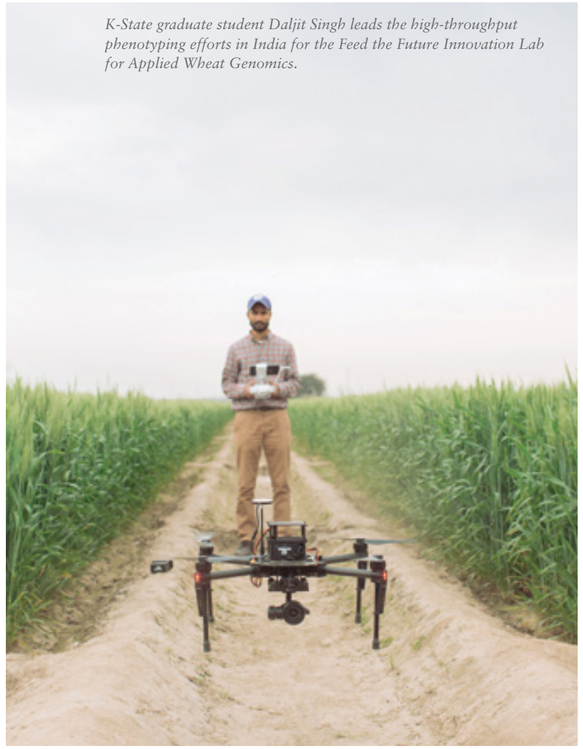
This is not your grandfather's agriculture. It's 21st-century innovation, something that K-State's Jesse Poland knows well.

As director of the university's Feed the Future Innovation Lab for Applied Wheat Genomics, Poland is helping lead projects in India, Pakistan, Bangladesh, Mexico and the U.S., bolstered by a $976,000 grant he received last year from the U.S. Department of Agriculture and the National Institute of Food and Agriculture.

"We've done some work with push carts and ground vehicles, but right now we are primarily focused on the unmanned aerial vehicles, using different types of cameras and then photogrammetry approaches to extract plant information from those flights," said Poland, assistant professor of plant pathology.

Researchers with the Feed the Future Sustainable Intensification Innovation Lab tour maize and pigeon pea intercropping field trials in Babati, Tanzania.

K-State graduate student Daljit Singh leads the high-throughput phenotyping efforts in India for the Feed the Future Innovation Lab for Applied Wheat Genomics.



"It's 'big data' science where we have massive data sets, and we evaluate tens of thousands of candidate breeding lines and varieties," he said. "We study how all those genetic differences combine together to make a better-yielding, more heat-tolerant, more disease-resistant wheat variety."

The result of this work is more — and better — food because the images can provide important information about a plant's growth, susceptibility to disease and more that help researchers improve the plant's resilience over time.

The global community has made great strides in improving food security over the past few decades, said Jagger Harvey, director of K-State's Feed the Future Innovation Lab for the Reduction of Post-Harvest Food Loss.

"A lot more people have been lifted out of poverty globally — about a billion people," Harvey said. "More recently, the global agricultural and international development community has been focused on quality and safety of the food. We're getting a lot more information about things that, despite having sufficient food, could really be impacting people, stunting children's development, and overall keeping people and communities and nations from realizing their full, vibrant potential."

Doing more with less

At K-State's Feed the Future Innovation Lab for Sustainable Intensification, director Vara Prasad is working with researchers at the University of California-Davis and Stanford University who are using remote sensing and geospatial tools through Google Earth to map the landscape in the specific countries where the lab has projects.

The term "sustainable intensification" is becoming fairly common in the agricultural industry. It refers to growing more food on the same land base while also protecting the air, land and water that feeds that land.

"To efficiently use water and nutrients, we need to look at site-specific management, and that means understanding the landscape and then selecting the crops that are good for your landscape," said Prasad, a university distinguished professor of agronomy.

David Lobell, a professor of earth system science at Stanford, is leading a project funded by Prasad's lab to map maize fields and yields in Tanzania. His work is part of the Geospatial and Farming Systems Research Consortium at UC-Davis that will feed information from outer space to help scientists on the ground improve food production.

"U.S. agriculture will benefit from the same technologies we are testing in Tanzania, particularly the ability to combine multiple sensors to rapidly map crop performance at a very high resolution," Lobell said.

Good for the world, good for Kansas

K-State's Tim Dalton, director of the Feed the Future Innovation Lab for Collaborative Research on Sorghum and Millet, says bringing value back to the United States and many other areas of the world is the basis for international research.

In the early 1980s, the sugarcane aphid was causing problems in southern Africa. U.S. researchers worked to develop germplasm resistant to the aphid, which then was the key solution 10 years later when the greenbug aphid attacked sorghum in the Texas High Plains and parts of Oklahoma.

"The thing that makes it really interesting is that we estimate a benefit of about $750 million in 2015 dollars to U.S. producers because of this one research finding," said Dalton, a professor of agricultural economics. "It's very easy to show both internationally and domestically that there have been more benefits than costs. When I did some calculations last year, there was slightly over $1 billion invested in federal support programs for international research. So that one benefit to producers covers about three-quarters of the cost."

More recent calculations by Dalton show a global net benefit of $4.6 billion over 42 innovations generated by the labs and their precursor, giving a benefit to cost ratio of 4.5 to 1.

Harvey's postharvest loss lab has also seen evidence of a high potential return on investment. He is leading a project to study toxins that are produced by fungi, known as mycotoxins, which frequently develop in such crops as corn and peanuts. One in particular, aflatoxin, is estimated to contaminate as much as a quarter of the global food supply, putting 4.5 billion people at risk, he said.

A recent study from Michigan State University indicated that U.S. corn production losses due to aflatoxin can reach $1.6 billion in bad years;

K-State Professor Jesse Poland, right, and members of the research team at the Borlaug Institute for South Asia discuss high-throughput phenotyping methodologies on-site in Ludhiana, India.

K-State's Jesse Poland, left, and Daljit Singh, right, tour trial plots at Punjab Agricultural University.

in normal years — years when the environment is not so conducive to growth of mold, according to Harvey — corn losses due to aflatoxin are about $52 million.

"It varies a lot from year to year," Harvey said. "In some places like Kansas, we can have some problems with it, and in a bad year, it will be worse than others. But in some of the countries we're working in, it tends to be a problem every year. In surveys of toxin exposure in some of these countries, we're finding that a lot of people are being exposed to it."

Harvey said aflatoxin is a potent carcinogen and can cause death after short-term, high-concentration exposure.

"We're taking a systematic approach in our program," Harvey said. "In every country we work in, we have national leaders in research and in government who we're often engaging as the implementers of the project. We've established labs to improve the capacity for these national leaders to address this problem locally. The long-term goal across USAID programs is to empower local systems so that such programs are no longer needed.

"Until we can equip these countries to monitor and then have a safe way to dispose or use it as feed or decontaminate it, it's going to continue to be a problem."

Diversification a must

Prasad's lab is working with partners who have established weather stations in several countries, giving scientists the ability to match growing patterns with weather data. They are using drones to identify stress tolerance in crops and irrigation patterns in large fields. They are also studying the best ways to mix crops and livestock on the same land.

"We are trying to help farmers diversify so that they not only minimize the risk of farming, but also have a diversity of foods in their diet," Prasad said. "Diet diversity is the key to nutrition. If you're only producing cereals in your subsistence farming, then you're eating only rice, or only wheat or only maize.

"There needs to be more focus on nutrition, rather than just getting the calories. You can get the calories easily from any of the cereal base. For good nutrition, you really need diversification — you need the protein, you need the fat, you need the micronutrients."

In July 2017, the World Food Program reported that 20 million people in four African countries would suffer from starvation within a few months. The United Nations called the situation the worst humanitarian crisis of our time.

But in a world where technology can help produce more food for more people, and put more money in local economies, U.S. researchers and the work they do can provide some relief.

"As a very blessed country with a lot of resources, there comes the equal responsibility to take that to the benefit of the rest of the world," K-State's Poland said. "A number of countries, especially ones that have been defined in the Feed the Future initiatives, are really in a state of current or imminent food insecurity. That represents hundreds and hundreds of millions of people in these target regions who are at or maybe just a step above subsistence-level farming and household nutrition.

"An obvious benefit of doing this work is to take agricultural innovations that can help these countries and these people to develop into more productive economies and increase their food security and their standard of living."

The sun sets over a wheat field in Ludhiana, India, where researchers from the Feed the Future Innovation Lab for Applied Wheat Genomics are conducting a field trial.

Easy to prepare sorghum- and millet-based products provide important nutrition to consumers while creating new income and market opportunities for entrepreneurs.

K-State Professor Jesse Poland, graduate student Daljit Singh and Indian researcher Uttam Kumar test the Phenocart 2.0 at the Borlaug Institute for South Asia in Ludhiana, India.

A Senegalese woman prepares millet couscous in her home. Millet is a staple crop to millions of people across West Africa and beyond.

By creating microenvironments that encourage better germination and plant establishment, seedballs present exciting new possibilities for millet farmers in West Africa who struggle to establish a successful stand in the harsh Sahelian climate.

U.S. researchers are conducting studies to compare hermetically and traditionally stored chickpeas in Ethiopia. On the left are chickpeas that have been hermetically stored; on the right, traditionally stored chickpeas heavily infested by insect pests.

FEED THE FUTURE INNOVATION LABS AT K-STATE

The U.S. Agency for International Development established the Feed the Future Innovation Labs program to harness the capacity of U.S. land-grant institutions, other universities and the private sector to improve global food security.

Feed the Future, along with the new U.S. Government Global Food Security Strategy, seeks to promote inclusive growth of agricultural economies, increase resilience against shocks and improve health and nutrition in Feed the Future countries. K-State officials say the university's four innovation labs are contributing to these goals in major ways.

Here is an overview of the four labs currently housed at K-State.

Sorghum and Millet

k-state.edu/smil

- Funded in 2013 for $13.7 million base; $10 million in associated awards.
- Focuses on improving the productivity, disease resistance, agronomy and economic value of sorghum and millet.
- Focus countries are Burkina-Faso, Ethiopia, Mali, Niger and Senegal.
- Will be seeking a second five-year funding cycle in July 2018.

Applied Wheat Genomics

k-state.edu/wheat-innovation-lab

- Funded in 2013 for $5 million.
- Focuses on developing heat-tolerant, high-yielding and farmer-accepted wheat varieties for South Asia.
- Focus countries are Bangladesh, India and Pakistan.

Sustainable Intensification

k-state.edu/siil

- Funded in 2014 for $32 million; $18 million in associate awards.
- Focuses on developing practices for producing more food and nutrition on the same land base while protecting natural resources.
- Focus countries are Bangladesh, Burkina-Faso, Cambodia, Ethiopia, Senegal and Tanzania.

Post-Harvest Loss

k-state.edu/phl

- Funded in 2014 for $8.5 million; $15 million in associate awards.
- Focuses on improving global food security by reducing postharvest losses in long-term storage crops, such as grains, oilseeds, legumes, root crops and seeds.
- Focus countries are Bangladesh, Ethiopia, Ghana and Guatemala.
- Has received an additional $3 million for projects in Nepal, Honduras and Afghanistan.

COMMUNICATING SCIENCE FOR EVERYDAY USE

Lauri Baker

Karen Blakeslee

Brian McCornack

Terry Griffin

Romulo Lollato

21st-century communication takes 19th-century research mission from beaker to tractor and beyond

By Jason Hackett

In a state where nearly half of the economy is driven by agriculture — and at a land-grant institution first named the Kansas State Agricultural College — people in purple maintain a strong link to the land.

Kansas State University was created to make the lives of all Kansans better through education, scientific research and purposeful sharing of knowledge, especially agricultural knowledge, through the extension system (see "Education for all," Page 18).

For decades, farmers and ranchers learned best practices and better ways to raise their crops and livestock through printed publications and in-person gatherings called field days. Both methods were spearheaded by scientific experts from the university and delivered by extension agents. They were — and are — efficient and successful means of sharing knowledge.

In the internet age, however, what used to be a small number of straightforward sharing methods has become myriad choices for researchers, extension specialists and agents. They now use Twitter, Facebook, blogs, institutional sites, unique web platforms and more.

Whatever their individual choices, person-to-person contact remains at the center of their communication. The difference is in the delivery.

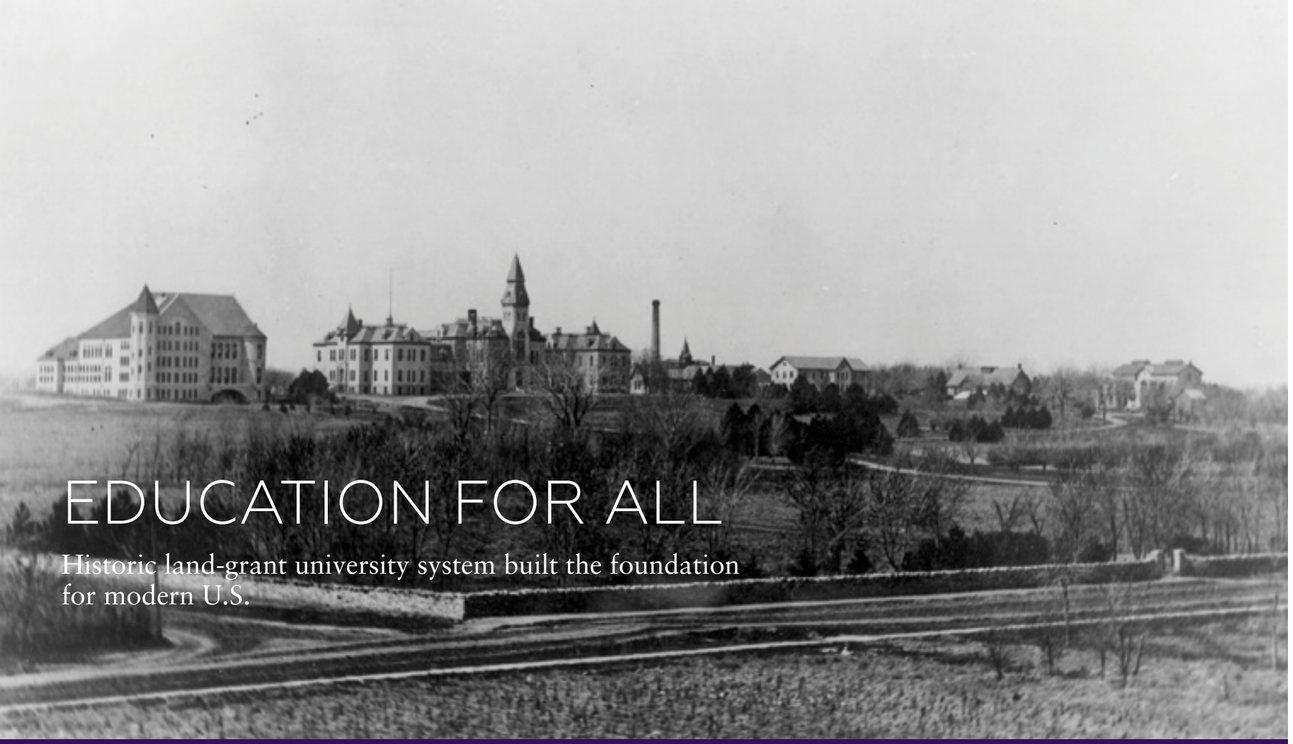
"My most frequent audiences are producers and crop consultants, but we also reach the general public when interviews are broadcast on national television," said Romulo Lollato, wheat specialist and assistant professor of wheat and forages production at K-State. "Building direct connections with our stakeholders is very important, as they need to trust the information we are providing. Working one-on-one is sometimes necessary to build direct trust relationships."

Through his @KSUwheat account, Lollato shares information that matches the wheat production calendar along with novel research findings as soon as they become available.

The world of ag production is in transition mode, he said. Plenty of farmers and ranchers still rely on conventional extension venues, but "the newer generations need to be reached on social media, as they are using these venues daily and often do not reach out to an extension office," he said.

"In modern society, an extension specialist needs to hold an active social media account."

Even as the "how" evolves, the "why" remains constant: From an extension standpoint, sharing information to help people do their work is the most obvious reason for communicating in several ways.



EDUCATION FOR ALL

Historic land-grant university system built the foundation for modern U.S.

When it comes to timeless legislation, the Morrill Act of 1862, the Hatch Act of 1887 and the Smith-Lever Act of 1914 are as wisely crafted as the U.S. Constitution. The original framers could have scarcely dreamed how these laws would be applied more than a century after the newest one was written.

In all cases, the marching orders were clear: Make knowledge directly available to everyone.

The concept behind a land-grant college was simple: Through the Morrill Act, the federal government would provide support through public lands to have at least one institution in each state teach agricultural and mechanical arts — making such an education available to virtually anyone, as opposed to only those well-heeled enough to afford higher education.

The Hatch Act took that concept a step further in formalizing ag research at experiment stations throughout each state. The Smith-Lever Act created Cooperative Extension: "instruction and practical demonstration of agriculture and home economics to persons not attending or resident in said colleges in the several communities."

Together, the acts' three main results — education, research and extension — are a braided rope that hoisted the United States to superpower status. Once it could systematically feed itself, innovate scientifically and benefit from exporting food, goods and knowledge, the U.S.:

- Took a primary position in World War I food production and conservation.
- Created farm cooperatives and seed-and-loan programs to survive the Great Depression and Dust Bowl era.
  - » Stretched resources and built self-sufficiency through home-economics programs.
  - » Led the world in the ag-technology and farm-management revolutions of the mid-20th century.
  - » Provided a nutritional safety net for low-income families in inner cities.
  - » Weathered another farm crisis in the 1980s.
  - » Raised its level of preparation to deal with 21st-century agro-terrorism.

Kansas State Agricultural College, the forerunner to today's university, was the first institution established because of the Morrill Act and became the first to accept the provisions of the Hatch Act thanks to the Kansas Legislature's next-day action after President Grover Cleveland signed the act into law.

What followed began modestly, with only 12 scientists working for the college. Now — 130 years later — a network of Kansas State University researchers reaches every corner of the state, defining and refining best practices for livestock, growing test plots, breeding new seed varieties to ensure crops grow well in the many different climatological regions of Kansas, and learning how to manage water resources, soil and threats from insects, disease and severe weather.

TWITTER INTEGRATION

Sitting at a conference in Illinois and tweeting photos from another conference in North Dakota to share critical information with Kansas farmers qualifies as just another day for Terry Griffin, assistant professor of cropping systems economics at K-State.

For Griffin, @SpacePlowboy, Twitter provides a seamless way to interact with farmers and research colleagues throughout each day.

You're judged by the company you keep, Griffin said, and on Twitter, his peers are experts in precision ag. When he contributes to conversations or simply shares high-quality information from others, the community sees the benefit of Griffin's expertise as well as those he respects, adding credibility and value to the entire community.

Griffin said farmers often ask him, "who do we listen to?" when trying to cut through all the noise and thousands of voices in social media. They can be online any time of day or night, and "if they're in a tractor and they have a good cell connection, they want to know instantly what commodity prices are or if there's a disease outbreak," he said.

Even before Griffin was on Twitter, he was active in what could now be called "old-fashioned" social media. "Some of my best programs came out of my having a light bulb go above my head because of me reading what farmers were talking about on discussion forums," he said. "And Twitter's the same way. Even if we don't tweet, we in extension need to know what people are talking about — and not the yahoos, but the actual clientele we have."

THE INFORMATION BATTLE

Food safety expert Karen Blakeslee, @KSREfoodie, views social media as a constant battle: the good information versus the bad information.

Amateur bloggers and celebrities are a toxic combination that is responsible for a lot of the bad.

Blakeslee, an extension associate who coordinates the Rapid Response Center to answer food safety questions and provides oversight for the Master Food Volunteer program, maintains a robust online presence with a website, e-newsletter and an active social media profile.

She confesses frustration that self-proclaimed experts attract large audiences with passionate — and thus resonant — presentations of falsehoods and pseudoscience. "People, if they trust something, almost implicitly believe it whether it's true or not," she said.

"I wish I had time to counteract some of these statements," Blakeslee said. "I guess I'm not sure how far I should go … What would be the best way to respond to some of these things that are out there? In the food world, it's just something so big … I can't solve everything."

Nevertheless, she persists, publishing science-based content online multiple times a week — even when it feels like she's shouting into the wind. Blakeslee finds the most persuasive platform is still in-person interaction such as the food preservation classes she teaches throughout the year in various locations across Kansas.

"I'm quite blunt and basically say, 'I'm trying to help you not kill yourself,'" she said. "Last year, for the first time in one of my classes, a lady came up to me toward the end and said, 'It really is about science isn't it?'"

Advocacy leads to persuasion, but it requires patience, Blakeslee said, "because you first have to get that basic fundamental understanding that, yes, there are people doing the science here, and you need to trust the scientists as opposed to 'that's what the bloggers and celebrities said.'"

LONG-HAUL TRUST

Earning and building trust through technology is equally crucial for Lauri Baker, co-founder of K-State's Center for Rural Enterprise Engagement. She presents new media marketing boot camps around the state to provide hands-on, high-tech training for owners of small and independent businesses.

She also researches effective ways of communicating science — especially complex and controversial topics — to people who do not have a background in ag science and who face a barrage of constant information — some trustworthy, some not as much.

Baker says if scientists want their work to be accepted by broad audiences, then emotional engagement is needed before facts and research are presented.

"Connecting with the real people involved in an issue, I think, has a way to make it past all the other gibberish," she said. "And then, if you have that transparency underneath it and the foundation of facts and science, you can be proud of what you're showing."

Brian McCornack, K-State associate professor of entomology, and a whole team of researchers and technologists are proud of and passionate about what they're building. Like so many others, he believes personal contact with stakeholders is bolstered by social media activity.

"The whole idea of being able to customize their experience through building relationships and choosing when and where to share data — if you look at extension in the same way — we can actually be a lot more effective in delivering our content."

That's why McCornack, @bmccornack, is part of a team working to build a multistate, multispecialty web platform called myfields.info. On it, extension specialists and farmers in multiple states voluntarily share data, allowing all users to benefit by finding out pest migration patterns, learning conditions of specific crops and getting real-time updates on key agronomic issues.

McCornack said his team is taking its time building the platform to ensure it helps its intended audience. "We've done several side sessions at crop schools asking what tools we need," he said. "We want growers to know it's theirs."

For McCornack, it's all about extending the first word in his area of expertise: integrated pest management.

When working with farmers, "you start looking at all the complexity of the questions that you're really asking and how much of an expert you need to be to those areas," he said. "Simply relying on static publications that are floating in multiple places on the web becomes a really inefficient way of delivering information to our stakeholders. And that's not just me talking. We've surveyed enough growers and consultants in side sessions to know that 90 percent of the people that we surveyed would be using extension resources more if we made them more accessible." *k*

THE CURIOSITY OF COLLECTIONS

A behind-the-scenes look at what's in the drawers, cabinets and refrigerators of K-State collections and why it's important

By Jennifer Tidball

Collective treasures abound across Kansas State University's Manhattan campus.

On the north side of campus, a refrigerated storage room contains wheat seed that helped grow ingredients for your morning toast.

Drawers in Waters Hall are filled with colorful butterflies, long-legged beetles and tiny wasps that provide more than 100 years of entomology data.

Throckmorton Hall has rooms of refrigerators and freezers filled with fungi, some of which came from World War II cotton tents and may be key for biofuel development.

Rows of wardrobes in Justin Hall contain regal textiles from China's Ming dynasty and thrifty clothing made from cotton feed sacks during the Great Depression and World War II.

These are the collections at Kansas State University. From science and natural history to the arts, these collections contain valuable treasures that are used for research, development, exhibits and scholarly activity.

And their scope is staggering.

The Cookery Collection with K-State Libraries special collections maintains more than 38,000 cookbooks and volumes in multiple languages from 1487 to the present. The Herbarium preserves more than 180,000 plants from the Great Plains and around the world. The Beach Museum of Art has more than 900 pieces from famed artist John Steuart Curry.

But behind the numbers is a passion for sharing these collections and the treasures they contain. Turn the pages to learn more about seven of the university's collections.

Items on Page 20 include from top left: Late Antique/Early Byzantine linen fragment; glass tubes of agar media without Trichoderma, left, and with Trichoderma, right; and wild wheat seeds. From center: longhorn beetle in the family Cerambycidae and vegetative shoot of Phlox hirsuta. From bottom left: juvenile cookbook and page proof illustrations for "My Friend Flicka" by John Steuart Curry.

K-State Museum of Entomological and Prairie Arthropod Research

Description: A natural history collection of insects and other arthropods from the Plains and prairie states as well as around the world

Website: biodis.k-state.edu

Specialties: *Hymenoptera* (ants, bees, wasps); *Lepidoptera* (butterflies and moths); leafhoppers; flies

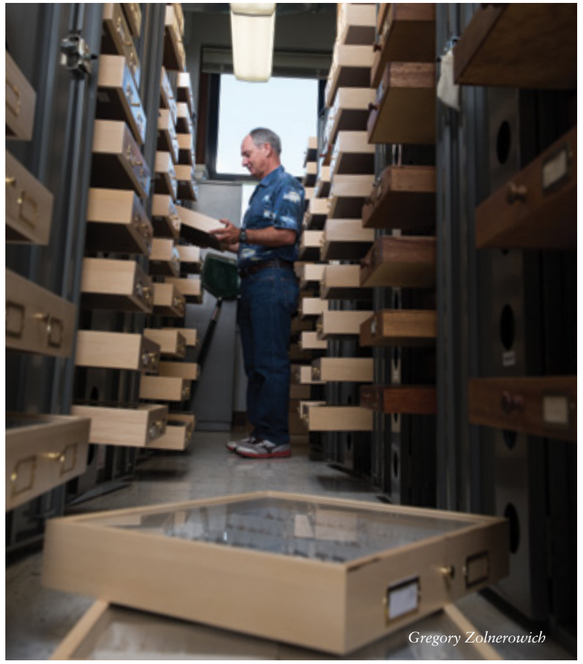
Year founded: 1879

Size: More than 360,000 specimens

Curator: Gregory Zolnerowich, professor of entomology

The entomology collection includes a variety of specimens.

The zebra swallowtail, Eurytides marcellus, *can be found throughout the eastern U.S.*



Gregory Zolnerowich

From the bright blue butterflies of Papua New Guinea to tiny ticks and the brown-patterned moths found on the Konza Prairie Biological Station near Manhattan, the university's entomology collection shows the diversity of insects and the ways they evolve — vital information for tracking insect-borne diseases, too.

"The value of this collection is it gives a picture of what insect is in a particular place at a particular time," said Gregory Zolnerowich, curator of the K-State Museum of Entomological and Prairie Arthropod Research. "If you put these pictures together, you can understand the past and make predictions for the future."

For Zolnerowich, it is especially important to maintain the collection's digital database and make it accessible to scientists and students for research and education.

Zolnerowich is collaborating with 28 other institutions through a National Science Foundation-funded project called the Lepidoptera of North America Network, or LepNet. The project is linking collections of North American Lepidoptera — butterflies and moths — to create a common digital database of information and images for researchers nationwide.

Several K-State College of Veterinary Medicine researchers recently used the collection's historical data to model suitable habitat and potential range expansion of the lone star tick. The findings are important for tick control because the species can carry human and animal diseases.

The collection's Plains and prairie emphasis helps K-State Research and Extension county agents diagnose pests or emerging species. Organizations such as the Kansas Department of Agriculture, Kansas Forest Service and the U.S. Department of Agriculture also turn to the collection for its valuable research specimens and data.

"Think of a collection as a library," Zolnerowich said. "Just as you can't have every book in the library, you can't collect every specimen you need for a project. Instead, scientists can use our collection to complete their research. We're a scientific resource that serves the systematics community."

Historic Costume and Textile Museum

Description: A notable collection of traditional and artistic artifacts, including clothing, textiles, accessories and quilts

Website: he.k-state.edu/hctm

Specialties: Nelly Don dresses, American quilts, military uniforms, Byzantine-era textiles, and Chinese and other ethnic textiles

Year founded: 1873

Size: More than 17,000 holdings

Curator: Marla Day, senior curator

This 1930s floral dress is made entirely of patterned cotton feed sacks used to sell flour.

South Korean artist Ki-Yong Kang designed this silk scarf.

Historical messages are present among the clothing racks in the Historic Costume and Textile Museum.

Handmade children's shoes show the love and attention devoted to dressing even the smallest family members. Ming dynasty textiles from the 1500s portray the respect for royalty through detailed stitchwork. Military uniforms display the awards and pins of brave soldiers.

"This is more than a collection of clothing; it's a collection of history," said Marla Day, museum curator. "By studying what people wear, we learn more about their lifestyles and values. Each item is a snapshot of a certain period of time."

From life on the farm to couture fashion, the museum documents what people wore and why it was important. The museum includes clothing, textiles and accessories from the fourth century to present day.

Collection highlights include dresses from Kansas-born fashion designer Nell Donnelly Reed, or Nelly Don; Chinese textiles from the Ming dynasty; American quilts; salon shoes; military uniforms; Byzantine-era textiles; ethnic textiles; and Midwestern clothing and textiles.

The museum collaborates with local and regional museums, and collection objects have been used by Columbus College of Art & Design in Columbus, Ohio; the American Jazz Museum in Kansas City, Missouri; and the Lakeside Arts Park at the Dole in Crystal Lake, Illinois. A current exhibit at the university's Marianna Kistler Beach Museum of Art explores how Americans used feed sacks to make clothing and other items during the 1930s.

While exhibits educate visitors, scholars and students also use the collection to study historic textiles and costume and fashion trends.

"Dress is important," Day said. "What you're wearing sends a message to others. This collection helps us understand those messages of other times and places."

Marla Day

Kansas State University Herbarium

This Maximilian sunflower, Helianthus maximiliani, *was collected in Kansas in 2007.*

Description: One of the oldest, largest and most diverse collections of preserved plants in the Great Plains region

Website: k-state.edu/herbarium

Specialties: Great Plains plants; weeds and introduced species

Year founded: 1877

Size: More than 180,000 specimens

Curator: Carolyn Ferguson, professor of biology

This bindweed is one of the Herbarium's early historical specimens and was collected in 1851 in Texas.

On the top floor of Bushnell Hall, the Herbarium's rows of cabinets are filled with preserved plants dating from the late 1800s to the present. Samples such as colorful sunflowers are arranged for study and stored on special paper. Other specimens show the intricate white flowers and leafy green stems of different phlox species.

Some cabinet shelves contain the first-known collections from Kansas of certain plant species, from mosses to prairie grasses and colorful wildflowers.

"Our emphasis is the Great Plains, but we have specimens from around the world for researchers to study," said Carolyn Ferguson, curator of the Herbarium. "When we document plant diversity, it spawns research, curiosity and investigation. If we don't explore this diversity, we run the risk of losing it."

The collection supports a variety of research on plant diversity, including taxonomic research that describes and classifies plants as well as floristic research that documents what plants occur in a particular region.

Ferguson and her research group use the collection to study morphological and genetic diversity in phlox and other groups. The Herbarium's curating team is collaborating with the nearby Konza Prairie Biological Station, home to one of the world's few remaining tallgrass prairies, to improve documentation of plants that grow there.

The Herbarium helps K-State Research and Extension county agents identify plants, particularly new introductions and potential weeds. National Science Foundation funding has helped add specimens to the Herbarium and supported a digital database to make the collection even more accessible.

"Researchers from around the world use the Herbarium," Ferguson said. "The collection is a foundational research resource and is widely known and used in the plant community."

Carolyn Ferguson

These small bags contain ampoules of living freeze-dried fungal spores preserved from the 1940s through the 2000s.

Fungal Genetics Stock Center

Description: A resource that preserves strains of fungi important in genetics research

Website: fgsc.net

Specialties: Fungal strains such as *Neurospora, Aspergillus, Magnaporthe, Cryptococcus* and *Candida*

Year founded: 1960; moved to Kansas State University in 2014

Size: More than 25,000 different strains of fungus that are stored in more than 150,000 individual specimens

Curator: Kevin McCluskey, research professor of plant pathology

Neurospora crassa *strain 102 carries a single mutation that gives it this frosty appearance.*

The key to improved medicine, better biofuel or tastier food may be something microscopic: fungus.

The Fungal Genetics Stock Center is a collection of fungi that have been studied genetically, from the model organism *Neurospora* to the valuable *Trichoderma* that came from World War II cotton tents and may help develop better biofuel.

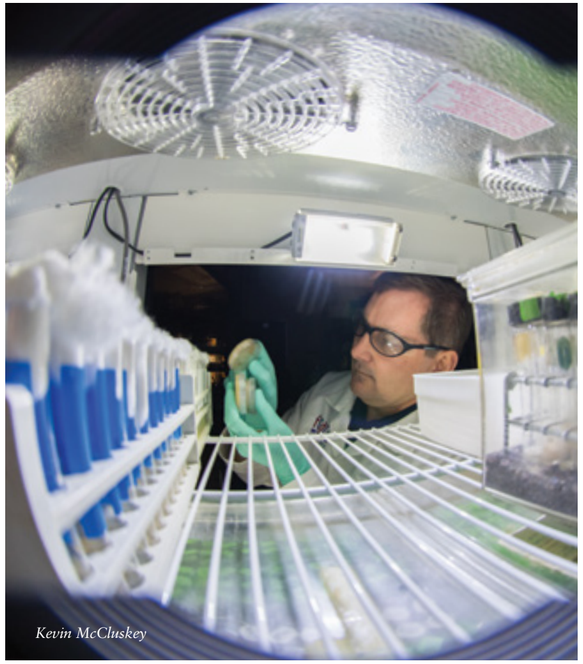
"Fungi are essential to make everyday life interesting and diverse," said Kevin McCluskey, curator. "We create, maintain and provide thousands of fungal samples to researchers across the world. This collection holds the potential for new discoveries."

By studying fungi and their genetics, researchers can advance agriculture or improve human health. Although some fungi can be plant or animal pathogens, most are harmless. Many fungi are used in the production of chemicals and drugs or can be used to produce enzymes for food and fiber processing.

The center preserves thousands of different fungi, including 23,000 *Neurospora* strains and 2,000 *Aspergillus* strains. Each strain in the collection has a different genetic makeup, and every strain is stored in two different formats in refrigerators and freezers.

The center provides fungal samples to more than 5,000 researcher clients and has been largely supported by the National Science Foundation and the National Institutes of Health. It is currently collaborating with the U.S. Department of Energy's Joint BioEnergy Institute to study *Neurospora* and how it can be used for bioenergy and biofuel. McCluskey also is the principal investigator on an NSF grant to lead the U.S. Culture Collection Network.

"We make each research dollar go further," McCluskey said. "Without collections like the Fungal Genetics Stock Center, researchers would have to start at square one. Our collection enables scientists to try research that they normally wouldn't try because it would be much too expensive."



Kevin McCluskey

Wheat Genetics Resource Center

Description: A wheat gene bank and world leader in wheat genetic research and development

Website: k-state.edu/wgrc

Specialties: Wild wheat, hybrid wheat, mapping populations of wheat

Year founded: 1979

Size: 16,450 wheat genetic stocks

Curators: Bikram Gill, university distinguished professor of plant pathology, and John Raupp, senior scientist

The seeds of many bread wheats, such as this Kansas State University-developed wheat variety Zenda, contain genes mined from wild wheats maintained in the Wheat Genetics Resource Center's gene bank.

A shock of bread wheat

The next time you enjoy a loaf of bread or a bowl of cereal, you can thank the Wheat Genetics Resource Center.

That's because the wheat in these foods has genetic connections with the center's wheat stock.

"Our collection is a gold mine for all the crop traits that can improve the wheat varieties used to make bread," said Bikram Gill, center director. "There is no collection quite like ours, which contains wild species and genetic stocks used for research and crop improvement. The key to improving wheat yields is genetic diversity."

The center — housed in the Kansas Wheat Innovation Center on the north end of the Manhattan campus — develops and maintains thousands of wheat genetic stocks. This includes 3,900 wild wheat strains, 3,650 genetic stocks and 8,900 mapping populations. The center shares the stocks with scientists developing wheat varieties with disease resistance, insect resistance, high protein and other traits. The stocks have been used in breeding programs in 39 states in the U.S. and 45 countries.

The collection has attracted nearly $30 million in funding since its inception, thanks to collaborations with the U.S. Department of Agriculture, the National Science Foundation and companies such as Bayer CropScience, Syngenta and DuPont Pioneer. The center works closely with Jesse Poland, director of the university's Feed the Future Innovation Lab for Applied Wheat Genomics.

Wheat center researchers played a key role in mapping the wheat genome and provided all the wheat stocks used for the project. The researchers continue studying goat grass — one of the center's most important wild wheat species — to find genes that can resist pests, cold and heat.

"This is an active and growing collection, and it's going to become even more important over time as we look to feeding a growing population," said John Raupp, curator of the center. "It's a work in progress."

John Raupp and Bikram Gill

Marianna Kistler Beach Museum of Art

Description: The John Steuart Curry collection is the largest collection of his art in the Midwest. The Gordon Parks collection includes photographs donated to the university by Parks.

Website: beach.k-state.edu/explore/collection

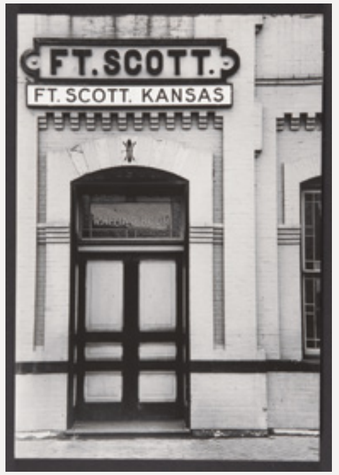
Specialties: The museum focuses on Kansas and regional art.

Year founded: The university acquired its first Curry painting in 1935. Gordon Parks donated his works to the university in 1973.

Size: More than 900 pieces in the Curry collection; 128 photos in the Parks collection

Curators: Elizabeth Seaton, curator; Sarah Price, registrar/collections manager; and Aileen June Wang, curator

John Steuart Curry painted "Our Good Earth … Keep It Ours" in 1942 for a war bonds poster during World War II.



Gordon Parks took this photo, "Frisco Railway Station," in 1949 when he returned to Fort Scott, Kansas.

Elizabeth Seaton, Aileen June Wang and Sarah Price

At the Beach Museum of Art, collections of two Kansas-born artists — John Steuart Curry and Gordon Parks — celebrate art for everyone.

Through his Kansas portrayals, Curry became one of America's most prominent Regionalist painters during the 1920s and 1930s. In 1935, K-State was one of the first institutions in Kansas to acquire one of Curry's paintings. The university's Curry collection became one of the nation's largest with a 2002 gift of sketches and paintings from the estate of his second wife, Kathleen Curry. It serves as a significant study collection for students and researchers.

Part of the Curry collection was featured in a 2015 Beach Museum exhibition, "Art for Every Home: Associated American Artists," that later traveled to New York University's Grey Art Gallery and Syracuse University Art Galleries.

"Place was extremely important to Curry, and Kansas became important because of his rural upbringing," Elizabeth Seaton, curator, said. "His background and his ambition to make art accessible to as many Americans as possible make him a fitting artist to have represented at a regional art museum at a land-grant institution."

Parks' roots in segregated Fort Scott, Kansas, played an important role in shaping his career. He became the first African-American staff photographer and writer at Life magazine in 1948 and used his art to spark social justice awareness. He donated 128 photographs to the university in 1973.

"What is unique about this collection is that it contains photographs personally selected by Gordon Parks," said Aileen June Wang, co-curator of the Parks collection. "We have a snapshot of his thinking at that time in the early 1970s."

The original Parks collection became an exhibition that traveled to U.S. cities and Kansas communities. The museum recently partnered with the Gordon Parks Foundation to reprint the collection and is planning a future exhibition.

"It was important to Gordon Parks to make these photographs available to communities in Kansas that may not have had access to art," said Sarah Price, co-curator of the Parks collection. "We want to continue to make these photographs available because that was important to him and it is important to the museum."

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

A variety of items from the Cookery Collection and the Consumer Movement Archives

Description: The Cookery Collection is the most comprehensive collection of cookbooks and related volumes in the U.S. The Consumer Movement Archives extensively documents the U.S. consumer movement.

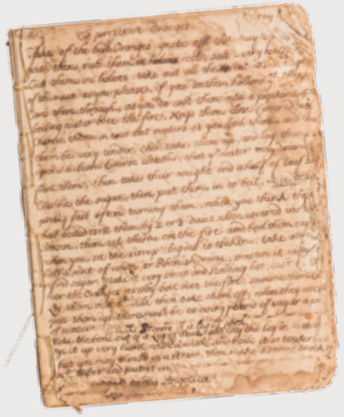
Website: lib.k-state.edu/special-collections

Specialties: The Cookery Collection specializes in international cuisine, juvenile cookery and celebrity cookbooks. The Consumer Movement Archives concentrates on consumer history, protection, rights, health and safety.

Year founded: Cookery Collection in 1943; Consumer Movement Archives in 1987

Size: More than 38,000 volumes in the Cookery Collection; more than 30 discrete collections in the Consumer Movement Archives

Curators: Keli Rylance, department head; Roger Adams, rare books librarian; and Jane Schillie, special collections librarian



This English manuscript cookbook from the mid-1600s contains culinary recipes and household remedies, including instructions for preserving oranges.

At Hale Library's special collections, researchers can understand plague water's medicinal properties in the 1600s or ancient cooking practices as they were known in the 1400s. Visitors can consult correspondence from U.S. Sen. Edward M. Kennedy or delve into lemon law protections.

"Our collections represent K-State history and its strengths as a land-grant university," said Keli Rylance, department head. "We have more than 1 million historical items that help scholars across disciplines conduct original research and we are expanding our digital presence."

Two of these special collections — the Cookery Collection and the Consumer Movement Archives — show what we can learn from the past and present.

The Cookery Collection contains thousands of cookbooks, printed materials and manuscripts in multiple languages from 1487 to the present. Historians, dieticians and culinary experts use it to study food in popular culture, over centuries and across continents. The archaeological museum of Pas-de-Calais in northern France recently used digitized materials in an exhibit on salt, and Kansas State University English professors have studied women's writing through the collection's manuscript cookbooks.

"The study of home economics and human ecology has played a role at K-State since the university's beginning," said Roger Adams, Cookery Collection curator. "The Cookery Collection is a constantly growing collection through donations and purchases."

The Consumer Movement Archives includes letters, television footage and photographs related to consumer rights and safety. The collection maintains records for the Consumer Federation of America, the National Consumer Law Center and the American Council on Consumer Interest. The Richard L. D. Morse papers are the collection's flagship. Morse, former chair of the university's department of family economics, defined the phrases Annual Percentage Rate, or APR, and Periodic Percentage Rate, or PPR.

"These materials are crucial to understanding the history of consumer education and its evolution to what we know today," said Jane Schillie, Consumer Movement Archives curator. "Our documentation of the consumer movement provides resources for a more informed population."

Jane Schillie, Roger Adams and Keli Rylance

The Consumer Movement Archives safeguards the history of consumer advocacy through a wide array of personal and organizational records.

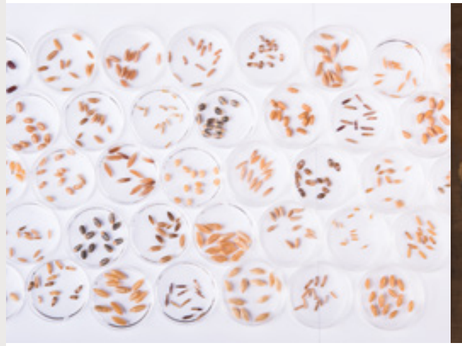
This 1962 Gordon Parks photo, "Ethel Sharrieff," portrays the daughter of Nation of Islam leader Elijah Muhammad. Parks donated this photo and 127 others to the university in 1973.

The Historic Costume and Textile Museum maintains a collection of western wear, including this circa 1945 men's western shirt made by California Ranchwear.

One of the specialties of the K-State Museum of Entomological and Prairie Arthropod Research is Lepidoptera, *which are butterflies and moths. The butterflies, moths and damselflies in this photo are native to Kansas.*

Neurospora crassa *strain 1384 was discovered in 1967 and is one of 23,000* Neurospora *strains preserved at the Fungal Genetics Stock Center.*

This 1930s British army notebook is part of the Cookery Collection and was used to record various household recipes.



These wheat seeds are a sampling of some of the 4,000 ancient and wild wheats housed in the gene bank at the Wheat Genetics Resource Center.

The Historic Costume and Textile Museum includes this Ming dynasty (1368-1644) roundel, which was worn by Chinese aristocracy and indicated their individual rank or status at court.

This specimen of silver maple, Acer saccharinum, *was collected in 1936 by former Herbarium curator Frank C. Gates. Such specimens were the foundation of Gates' many important publications on Kansas plants.*

Vantage point:

Sky's the limit for aerial-obtained data

By Stephanie Jacques

Looking at problems from a different angle can provide the perspective needed to find solutions. Kansas State University researchers are employing this strategy by using unmanned aircraft systems, or small UAS, to gather important data needed to address some of the world's most pressing problems, including UAS safety, nuisance species and air composition.

K-State researchers also are at looking at how to improve data fusion: the integration of aerial data — including satellites and UAS — to make information more useful.

"UAS enables us to approach data collection in new ways," said Andrea Meyer, research program manager at the Applied Aviation Research Center at Kansas State University Polytechnic in Salina, where data fusion is a key research area. "With advances in coding and software, the aerial data from UAS — usually in high resolution — can be combined with more traditional sources, such as satellite imagery, to help make data more influential and practical. Automating that process is key to managing data more effectively and efficiently."

A ray of light

The federal government is among the entities looking for more efficient and reliable methods to collect and analyze data relating to climate.

Through a National Science Foundation grant, Matthew Berg, K-State associate professor of physics, is working on a method to image aerosol particles using UAS. By mounting a miniature mobile laser lab on an unmanned aerial vehicle, Berg may be able to collect holographic images of free-floating aerosol particles in the atmosphere. This may help climate scientists better understand the composition of the atmosphere and if atmospheric particles have the potential to reflect or absorb heat.

"Identifying free-floating particles from light-scattering methods was largely guesswork before, unless you had a sphere," Berg said. "Now, we get objective size and shape measurements with a quick, contact-free light-scattering method that we can put on an instrument and fly around in the air."

Berg has already tested the process in the lab using intersecting green and red lasers. The lasers flash for 30 nanoseconds at a time, illuminating the light scattering from the particle and producing a hologram that can be captured by a camera. Not only will this process help identify what is in the air as it is flying through the air, but with further development, it could have the potential to detect airborne biological weapons.

Clearing the airway

UAS operation safety is of growing importance. On average, the Federal Aviation Administration receives around 1,000 non-hobby unmanned aircraft systems registrations every week. Based on registration trends, the FAA estimates that 420,000 small commercial UAS will be sharing the national airspace by 2021, up from 42,000 in 2016. Along with this increase is further development of UAS technology for commercial purposes, such as quicker delivery of packages or lifesaving search and rescue.

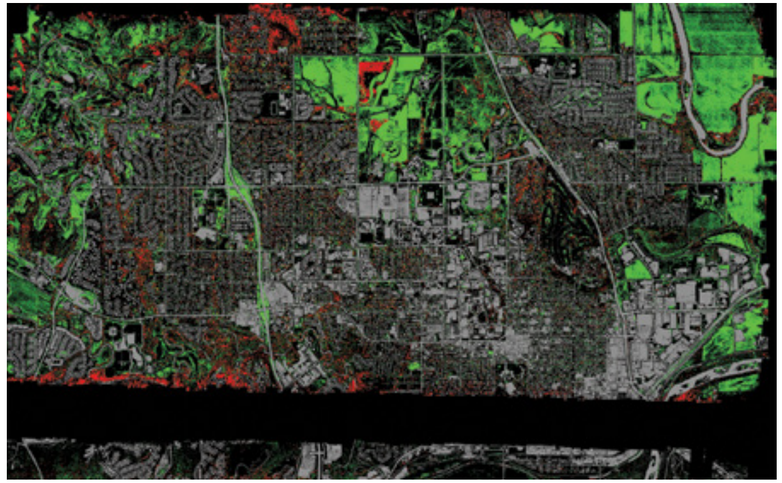
Even with the FAA's first set of rules specifically for UAS flight in national airspace — Code of Federal Regulations Part 107 — UAS flight is still more restricted than manned aircraft, Meyer said. The Applied Aviation Research Center is leading the way on safety with two projects as part of the FAA's Alliance for System Safety of UAS through Research

Excellence, or ASSURE, to create industry standards for how all aspects of the unmanned aircraft system work together before flight and for continued flight as the industry progresses.

"Many of today's manned aviation regulations were created because of catastrophic accidents," said Trevor Witt, UAS pilot and data analyst for the center. "The FAA is trying to be proactive and maintain safety with UAS regulations but in a way that it still benefits the economy."

Both safety projects at the center use the current regulations for manned aircraft as a baseline but adjust for the unique aspects of the entire system: the vehicle, the control station, the data link, the software and even a human operator.

Creating an industry standard for how all these aspects work together is important for continued safety as the industry progresses, Meyer said. The partnership with the FAA also has given the center opportunities to pitch safety plans for some of the regulations, like flying at night, so researchers can collect different types of data for research projects.



Trained software classifies an aerial image of Manhattan, Kansas, to distinguish the presence of invasive bush honeysuckle in red and irrigated grass or farmland in green so land managers can pinpoint locations for eradication efforts of the "forest bully."

A honeysuckle in haystack

In fall 2016, Witt worked with Ryan Armbrust, forest health and conservation forester at the Kansas Forest Service, an independent agency within K-State Research and Extension, to come up with software protocol to identify an invasive and aggressive plant species. Native to Asia, bush honeysuckle suppresses root regeneration in nearby plants and produces berries that are like junk food for birds. The plant is widespread in Kansas.

"The goal with this project was to use known locations of bush honeysuckle to 'train' software so that it could find other concentrations of bush honeysuckle," Witt said.

After Armbrust confirmed a few ground locations, the team modified a digital camera to block red light and capture near-infrared light, which is invisible to human eyes. They attached the camera to a manned aircraft and flew over Hutchinson, Lawrence, Manhattan, Topeka and Wichita in search of the plant's unique light reflection signature.

"Bush honeysuckle will stay green through early December," Armbrust said. "That's a competitive advantage because it can shade out a lot of its competition, but it also means we can use its strength against it."

Since the researchers were evaluating entire cities at a time and FAA regulations prevent flying unmanned vehicles over people, Witt flew a Cessna 172 for the beta testing of the software. The camera, which took photos at 12 centimeters per pixel, can also be attached to an unmanned aircraft for smaller sections of land such as a park. The software automatically maps the location of the invasive species so people can spray or remove the plant.

"Having this kind of information may provide an opportunity for some partners to more effectively and strategically manage this invasive plant, and for them, this could be a big advantage over the old anecdotal efforts to understand where the plant is and where treatment should be concentrated," Armbrust said.

Bush honeysuckle, once intentionally planted, has beautiful red berries and stays green into December. Looks can be deceiving. The berries are a bird's junk food and the fibrous root system that was supposed to help with soil erosion releases a substance toxic to other forest plants.

Knowledge is power

As the only U.S. partner in a three-year project with the Plant Biosecurity Cooperative Research Centre in Australia, Brian McCornack, K-State associate professor of entomology, is working with his Australian counterparts to develop an interactive knowledge tree that will help end users decide if current UAS platforms and sensor technologies are worth the investment for managing invasive species.

As a case study for the knowledge tree, McCornack is using UAS to identify sugarcane aphid infestations in grain sorghum — a high-energy grain known for its remarkable drought tolerance and variety of uses in human and animal nutrition. Kansas has historically led the nation in grain sorghum production acres, but according to McCornack, the sugarcane aphid has caused drastic production declines.

> "UAS provides immediate value to help crop scouts identify problem areas in a sorghum field by providing a new perspective, or vantage point, instead of just what is viewable from eye level as they walk through the field"

"There are estimates of 30-40 percent reduction in sorghum acres planted in Kansas since the addition of sugarcane aphid to the landscape, which affects the farmer's bottom line," McCornack said. "This is why early detection and effective pest surveillance programs are vital to Kansas agriculture."

The small but mighty sugarcane aphid, capable of devastating a field, is one of the influencing factors that may lead farmers to implement UAS into their technology toolbox for feeding the world.

McCornack said the invasive insect can cause a 70-80 percent yield reduction in sorghum if it is not caught in time, and costs $15-$20 an acre to treat and manage plus time scouting fields for the pest. The use of small UAS shows promise in helping target early infestations by covering a larger amount of ground in a short period of time.

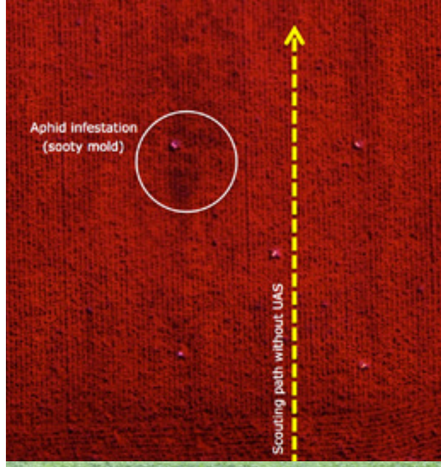
Sugarcane aphids may be small — about 1.5 millimeters — but they come in masses to suck sap out of sorghum plants. They secrete honeydew droplets on the plant's leaves, causing a black, sooty mold to grow on them. This condition can be easily seen in images from UAS flown just above the canopy. With Witt's assistance, McCornack can get an aerial perspective of the pest, which could potentially change how a crop field is sampled for infestations and disease.

"UAS provides immediate value to help crop scouts identify problem areas in a sorghum field by providing a new perspective, or vantage point, instead of just what is viewable from eye level as they walk through the field," Witt said. "They can possibly catch a problem before it gets too big."

This case study is just one example that McCornack is using to build the knowledge tree. Since the technology is constantly advancing, the knowledge tree will help the agriculture industry decide if the technology has enough immediate benefit or if plant biosecurity programs should continue to wait until UAS has the proper sensor technologies, more tools or more automation.

"We want others to learn about the process that we went through using the diverse case studies we have explored, from fields to forested areas to vineyards," McCornack said. "UAS technologies have quickly evolved in ways we didn't anticipate. We feel our interactive knowledge tree will help frame some of the key questions people need to ask before they invest in the technology."

UAS may not be able to provide automatic prescriptions or solutions to today's agricultural production problems yet, but researchers, farmers and consultants are finding innovative ways to make the technology's extra perspective useful and informative, McCornack said. *k*



Photos top to bottom

Knowing what to look for is half the battle for crop scouts; knowing where to look is the other. The yellow line is a crop scout's path, which didn't result in accurate detection of sugarcane aphid infestations. A UAS-mounted near-infrared camera can get a different perspective of the infestations and sooty mold seen in the dark grey to black patches.

Trevor Witt works with one of Brian McCornack's colleagues from the Queensland University of Technology in Australia to obtain the aerial images that can detect the aphid infestations.

Unhealthy, aphid- and sooty mold-infested grain sorghum, left, and healthy pest-free grain sorghum, right, can be detected by a normalized difference vegetation index, middle. The index helps human eyes see how much plants are photosynthesizing.

Drawing —in Place

Art professor Erin Wiersma uses char from tallgrass burns and an intensely physical process to capture the prairie

By Sarah Caldwell Hancock

photos by David Mayes

See *Faculty Focus*

Gaze at Flint Hills tallgrass prairie, and you may see scenic hills stretching under an open sky, a home to richly diverse wildlife, or an ancient sea floor. Erin Wiersma, associate professor of art at Kansas State University, sees a new way to draw and understand her adopted home.

The color of the hills changes with the seasons. In spring, the area is smudged with black ash left behind by burning, a management practice that maintains the endangered landscape's health. Moments to weeks after the burn, Wiersma methodically rubs or drags large paper over the freshly charred grass of the Konza Prairie Biological Station (see photo top left), effectively using the burned grass as charcoal to create large-scale drawings. Her process captures marks that show the growth patterns spanning the area's terraced topography along the ledges and shelves of flint shale.

Wiersma excels at making sense from chaos, whether it's natural or man-made. As she creates the Konza drawings, Wiersma experiences the wind, temperature, humidity and other natural conditions that create and inform this precious landscape. These works are related to the large-scale performative drawings and paintings she has been creating for more than 10 years. Wiersma consistently relies on a linear, drawn language, aiming to evoke heightened awareness of the bodily form through the gestural mapping of her body's movement. Another ongoing series of work contains paintings in which lines proliferate and travel in many directions. Pockets of stillness emerge from the kinetic labyrinth. If you look closely, you might think of neural networks, or circuits — or even a tangle of grass (see photos left and top center).

The East Coast native says the Konza project is helping her immerse herself in the prairie of her new home, engaging in dialog with the space and systems that shape this land.

"The expansive environment of the prairie is new to me; through the process of making these drawings, I continue to learn about this preserved, endangered land," Wiersma said.

Working at Konza Prairie, which is jointly owned by Kansas State University and The Nature Conservancy, has deepened Wiersma's understanding of the grassland's history and the urgency for continued ecological research. Her artistic process has been intensely physical because of her chosen method as well as the scale of the work, which conveys a sense of place and the experience of prairie burning to viewers.

"In my creative practice, I constantly strive to cultivate a heightened level of mindfulness — an awareness which I believe is desperately needed in all lives. Being present for the burn and witnessing regrowth becomes a personal, intentional act of awareness," Wiersma said.

When she takes the pieces back to a studio, memory of the physical process comes into play (see photo top right).

"Our visual memories can't retain the whole prairie," she said. "By tracing into these mappings made by the char material, I draw from the memory I have of experiencing the environment itself."

Understanding the ecology of the prairie is the aim of the long-term research at the Konza Prairie. John Briggs, director of the station, said about 94 percent of original tallgrass prairie has been lost or modified by urban and agricultural development. The burning and grazing programs at Konza Prairie were implemented in the late 1970s. Areas are burned at different intervals, with and without grazers, and the process is critical for maintaining the diversity of the grassland ecosystem.

Briggs said Wiersma's art could help viewers understand the value of the prairie.

"We are here to promote ecological research, education and prairie conservation," he said. "Erin's work offers another way for people to understand this amazing place."

Wiersma has exhibited throughout the U.S., including recent solo exhibitions at A.I.R. Gallery in Brooklyn, New York; Mallin Gallery at Kansas City Artist Coalition in Kansas City, Missouri; Soho20 Gallery in New York City; Sarah A. Coyne Gallery at Syracuse University in Syracuse, New York; and Rebecca Randall Bryan Art Gallery at Coastal Carolina University in Conway, South Carolina. Her work has been featured in OnVerge — CUE Foundation, Art21Online Magazine and Two Coats of Paint. Wiersma's work is available at Robischon Gallery in Denver.

Growing a multimillion dollar industry for the state of Kansas

By Tiffany Roney

The years of 2016 and 2017 will go down as bin-busters for Kansas State University plant breeders.

K-State normally produces one wheat variety every one or two years, but in 2016 and so far in 2017, K-State breeders have produced six new varieties of wheat. The breeders also were productive with canola, soybeans and grass, putting out two canola varieties, one soybean variety and the first turfgrass variety in several years.

According to K-State plant breeders and licensing experts, these 10 new varieties will generate millions of dollars for the state, the university and Kansas farmers.

For example, in the last five years, Everest, a top-performing wheat variety developed at K-State, yielded 1-2 bushels per acre more than other wheat varieties, said Daryl Strouts, CEO and president of the Kansas Wheat Alliance. Across the approximately 1 million acres where Everest was grown, experts estimate that Everest brought in an additional $10 million per year, which translates to roughly $70 million more revenue for the Kansas agricultural industry since the variety was released in 2009.

K-State plant breeders are also saving Kansas farmers from catastrophic losses. Five of the six new wheat varieties are resistant to stripe rust, which destroyed 9.1 percent of the Kansas wheat crop in 2016 — equating to a loss of about $134 million, according to K-State's Allan Fritz, professor of agronomy, and Erick DeWolf, professor of plant pathology. Early estimates for the 2017 harvest are that the disease caused an 8 percent loss, said K-State's Romulo Lollato, assistant professor of agronomy and wheat and forage extension specialist.

"When people plant K-State seed, we want them to know they are planting the best," said Chris Brandt, president and CEO of the Kansas State University Research Foundation.

New K-State plant varieties

WHEAT

Lead breeders: Allan Fritz, professor of agronomy; and Guorong Zhang, associate professor of agronomy at the K-State Agricultural Research Center in Hays.

- Joe — More than your average Joe, this variety has an excellent yield record, good drought tolerance, and a good disease package with resistance to stripe rust, leaf rust and wheat streak mosaic virus. The variety is named after T. Joe Martin, a retired wheat breeder at the K-State Research and Extension Agricultural Research Center in Hays.
- Kanmark — With very good drought tolerance, this variety offers excellent straw strength, good winter hardiness and consistently high yields. It also could make a good component in blends, and it has especially good yields under irrigation.
- Larry — This variety is taller than Everest and has better overall quality than Everest, according to the Kansas Wheat Alliance. Named after Larry Patton, a longtime technician in K-State's wheat breeding program, Larry wheat has good acid soil tolerance, high yield potential, moderate drought tolerance and acceptable quality for milling and baking.
- Tatanka — Like the buffalo that this wheat variety is named after, Tatanka wheat is drought-tolerant and can thrive in the dry areas of western Kansas. Tatanka is moderately resistant to acid soils and is highly resistant to soil-borne mosaic virus. It also shows good resistance to stripe and stem rust, and intermediate resistance to leaf rust.
- Zenda — As a successor sired from the high-performing Everest, Zenda is a variety that carries high hopes from agronomists. Like Everest, Zenda has good acid soil tolerance, a strong yield record statewide and excellent potential for growing after corn. It outperforms Everest in baking quality. "Wherever you hear the name 'Everest' today, you'll likely be hearing the name 'Zenda' within a few years," Brandt said.
- Hot Rod — Offering excellent straw strength and yields, Hot Rod is highly resistant to lodging, or the bending of stems near the ground. Lodging renders crops difficult to harvest, so strong stems are a desirable trait. Hot Rod works well with stripper headers and combines during harvest. After harvest, the standing stubble traps snow, benefiting the following crops.

SOYBEAN

Lead breeder: William Schapaugh Jr., professor of agronomy

- K11-2363/KS4117NS — This soybean variety is adapted to a wide range of soil types and climates, and it provides a very good yield — 3-6 bushels per acre more than K-State's 2013 soybean variety, KS4313N. The new variety has excellent resistance to lodging, moderate resistance to soybean sudden death syndrome, and good resistance to the nematode pest.

WINTER CANOLA

Lead breeder: Michael Stamm, associate agronomist

- DKW45-25 — Crop rotation is important to keep land healthy and continue producing high yields. DKW45-25 is great for crop rotation because, unlike typical canola varieties, it can grow in fields where sulfonylurea herbicide products were applied to previous crops. Also, it maintains great yields in rotation with winter wheat, and it is tolerant to glyphosate, a broad-spectrum herbicide.
- Griffin — This variety carries on the legacy of its namesake, a Reno county canola producer who used canola as forage for his grazing program. Griffin is a good candidate for dual-purpose use — grazing and grain production — because of its high-protein, highly digestible forage, ability to recover after grazing by livestock and winter hardiness.

TURFGRASS

Lead breeder at K-State: Jack Fry, professor of horticulture and natural resources

- KSUZ 0802 — Of all K-State's new crop varieties, this cold-hardy zoysia grass variety could have the farthest geographical reach. In the next few years, it may be found on golf courses and home lawns from southwest Kansas to the Mid-Atlantic region of the East Coast and locations farther south. It offers a fine leaf texture and good density. K-State and Texas A&M University jointly released the turfgrass. Sod Solutions Inc., a national marketing company, recently signed a licensing agreement for the variety. k

More information on K-State's latest varieties, including climate zones, pest susceptibilities, resistance to viruses and diseases, and other data, is available at agronomy.k-state.edu/extension/crop-production.

Project 17 revitalizing southeast Kansas

By Beth Bohn

Pervasive poverty. High unemployment. Lack of skilled workers. A deficit of civic leadership. The state's poorest public health indicators.

With these challenges and more facing a 17-county region in southeast Kansas, state lawmakers and community leaders and members have turned to Kansas State University for solutions. The result is an award-winning economic development effort.

Project 17 is an innovation-based economic development initiative spearheaded by K-State's Advanced Manufacturing Institute. The project seeks to improve the economic vitality and quality of life of those who live, work and play in Allen, Anderson, Bourbon, Chautauqua, Cherokee, Coffey, Crawford, Elk, Franklin, Greenwood, Labette, Linn, Miami, Montgomery, Neosho, Wilson and Woodson counties in Kansas.

"Project 17 is engaged in developing and deploying network-based strategies; economic development based on current assets and clusters; and tools and resources to improve rural communities, businesses and citizens' lives," said Heather Morgan, the executive director who came aboard in May 2013 to get the project up and running.

"To date, we've engaged more than 2,500 people in projects that address economic development, health, leadership and workforce development issues. These four areas are the pillars of Project 17," Morgan said. "We've encouraged investment in broadband internet infrastructure, pulled people together to change the narrative of the region from poverty to innovation, launched multiple anti-poverty programs, created and retained hundreds of jobs, and provided tools and resources to help many businesses grow."

Along with leadership, K-State's contributions to Project 17 include assessing area resources through asset mapping, cluster analysis and network analysis; technology development; connections to other parts of the state; access to national best practices; K-State student engagement in the region; and much more. Students and faculty from six K-State colleges and the Staley School of Leadership Studies have been involved with Project 17 through various activities and hands-on help. For example, grant funding is supporting the work of K-State agricultural marketing and agricultural communications students who are working directly with businesses in the region on new websites, e-commerce, logos and social media strategies to help them grow.

The project also has partnerships with two federal and four state agencies, three other Kansas universities, six Kansas community colleges, the Casey Family Foundation and more than 100 partner organizations.

Primary funding for Project 17 has come through the U.S. departments of Agriculture and Commerce and the Kansas Department of Commerce.

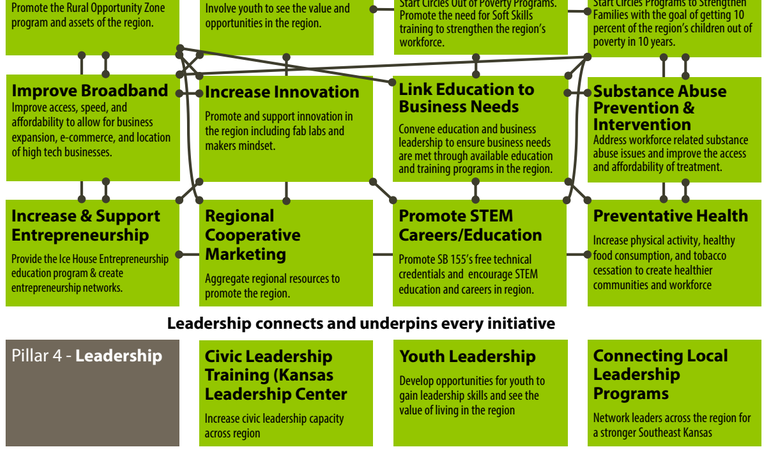
Some of Project 17's successes:

- The Advanced Manufacturing Institute helped lead efforts to secure multiple grants for Project 17, including a three-year Rural Jobs and Innovation Accelerator Challenge Grant from the U.S. Commerce and Agriculture departments, with matching funds from the Kansas Department of Commerce; a federal grant for developing a networked manufacturing reshoring strategy for the region; and funding for anti-poverty programs to assist rural businesses with websites and e-commerce and to help agricultural producers aggregate and sell their products.
- A grant from a national foundation helped launch an anti-poverty program in three Project 17 communities. The small investment allowed anti-poverty programs to expand to four additional communities; two more communities are exploring starting programs. Using K-State resources, the programs are helping people find and keep jobs, improve family relationships and finances, and learn healthy habits and life skills.
- In partnership with the Kansas Leadership Center, more than 1,000 citizens have been trained on adaptive leadership strategies to improve civic leadership.
- The Kansas Fiber Network, a Kansas company that has worked closely with Project 17, is making a multimillion dollar regional investment in broadband trunk lines in the region.
- K-State, along with Project 17, is earning recognition for its engagement work. K-State was recently designated an Innovation and Economic Prosperity University by the Association of Public and Land-Grant Universities. The designation recognizes universities that are leaders in spurring and promoting regional economic development. Work from Project 17 was highlighted in the university's application for the designation. Project 17 also received K-State's Excellence in Engagement Award in 2016.

Various activities and the places of Project 17. Photos courtesy of Jeff Tuttle/The Journal, Kansas Leadership Center.

Kansas State University Project 17

A Change Platform for Large-Scale Regional Economic Development & Community Engagement



Project 17 addresses systemic issues in four interrelated pillars and their respective task teams to create a platform of change using grassroots activity and engaged university support

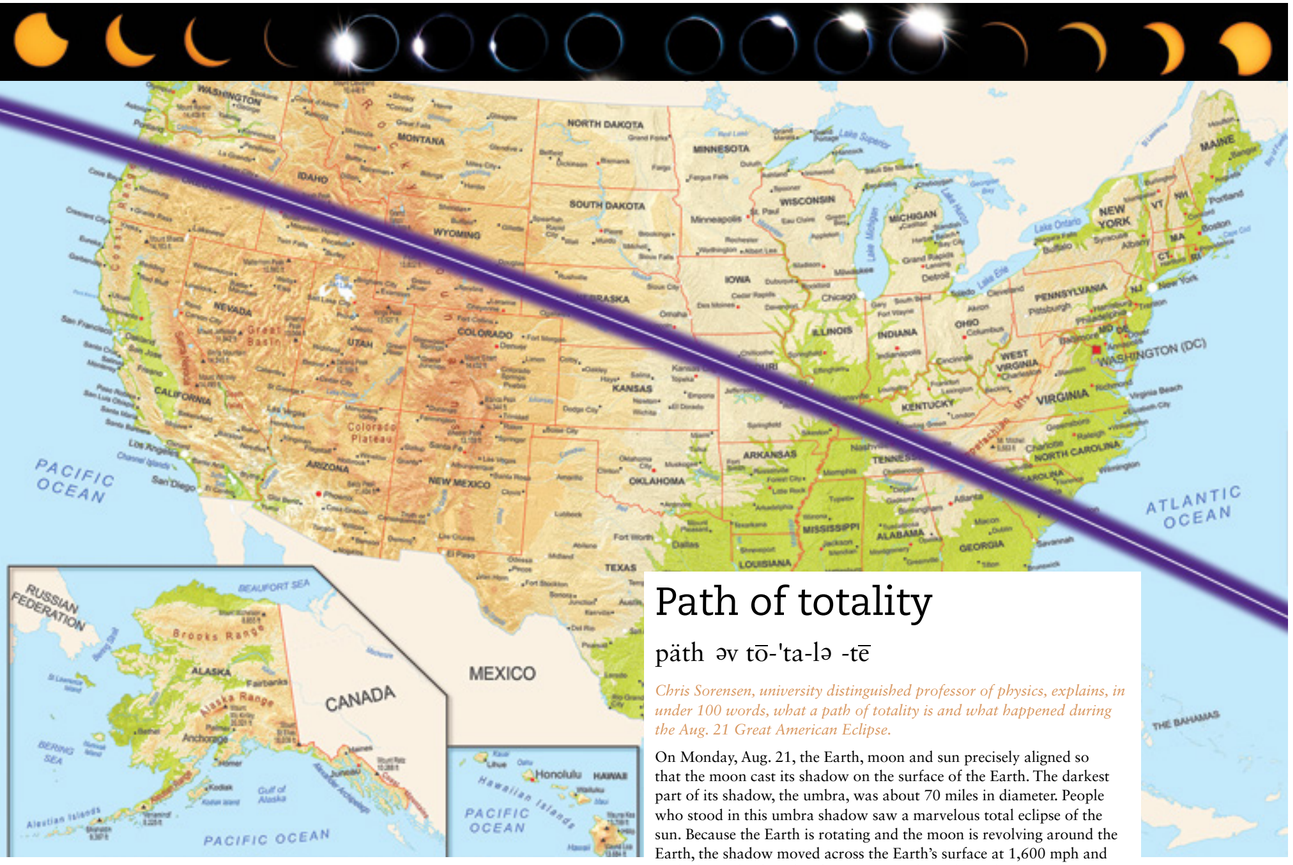
Engaged more than **2,500** Kansans.

Trained more than **1,000** leaders.

Leveraged more than **$15** million in private investment.

Assisted more than **200** businesses.

Created and retained hundreds of jobs — with more in the pipeline — for an expected total of more than **1,000** jobs created or retained in the region.



Path of totality

päth əv tō-'ta-lə -tē

Chris Sorensen, university distinguished professor of physics, explains, in under 100 words, what a path of totality is and what happened during the Aug. 21 Great American Eclipse.

On Monday, Aug. 21, the Earth, moon and sun precisely aligned so that the moon cast its shadow on the surface of the Earth. The darkest part of its shadow, the umbra, was about 70 miles in diameter. People who stood in this umbra shadow saw a marvelous total eclipse of the sun. Because the Earth is rotating and the moon is revolving around the Earth, the shadow moved across the Earth's surface at 1,600 mph and scribed a path of totality from Oregon, through northeast Kansas, to South Carolina.

youtu.be/ZtJMmJQ7sUs

Though viewing conditions were forecast to be less than ideal in northeast Kansas, a group of Kansas State University faculty, staff, students and the surrounding community braved the elements and journeyed to Highland, Kansas, on a trip sponsored by K-State and the Flint Hills Discovery Center. Watch their journey to view totality in this video, "Seekers of the Eclipse."

A collection's roots

Research at Kansas State University's Herbarium harkens back to the early days of the university. This 1892 photograph shows Mary "Minnie" Reed, one of the first women scientists to graduate from Kansas State Agricultural College in 1886. Reed returned to earn her master's degree in botany in 1893 and became the author of the first published flora of Kansas mosses. During her research, she collected and classified 165 species of Kansas mosses, which formed the basis for part of the Herbarium's historical collections of Kansas flora. Today, researchers at the Herbarium benefit from her important work and students — both undergraduate and graduate students — continue to stay involved with the Herbarium. Find out more about the Herbarium and other K-State collections on pages 20-29.

Photo courtesy of Kansas State University Herbarium

KANSAS STATE
UNIVERSITY

102 Anderson Hall
Manhattan, KS 66506

In a different light

As part of a collaborative project with the Kansas Forest Service, Kansas State University's Applied Aviation Research Center captured aerial photos of Manhattan, Kansas — including the university's athletics complex — with a near-infrared camera in search of an invasive plant, bush honeysuckle. Vegetation has a lot of near-infrared reflection, which is seen in shades of red, but fields made of synthetic turf remain green since they have little near-infrared reflection. Read more about how K-State is advancing aerial data collection and putting it to good use on pages 30-33.