

# See *k*

RESEARCH MAGAZINE FOR KANSAS STATE UNIVERSITY

*SPRING • 2019*

## A solid defense

Research tackles military challenges from every angle

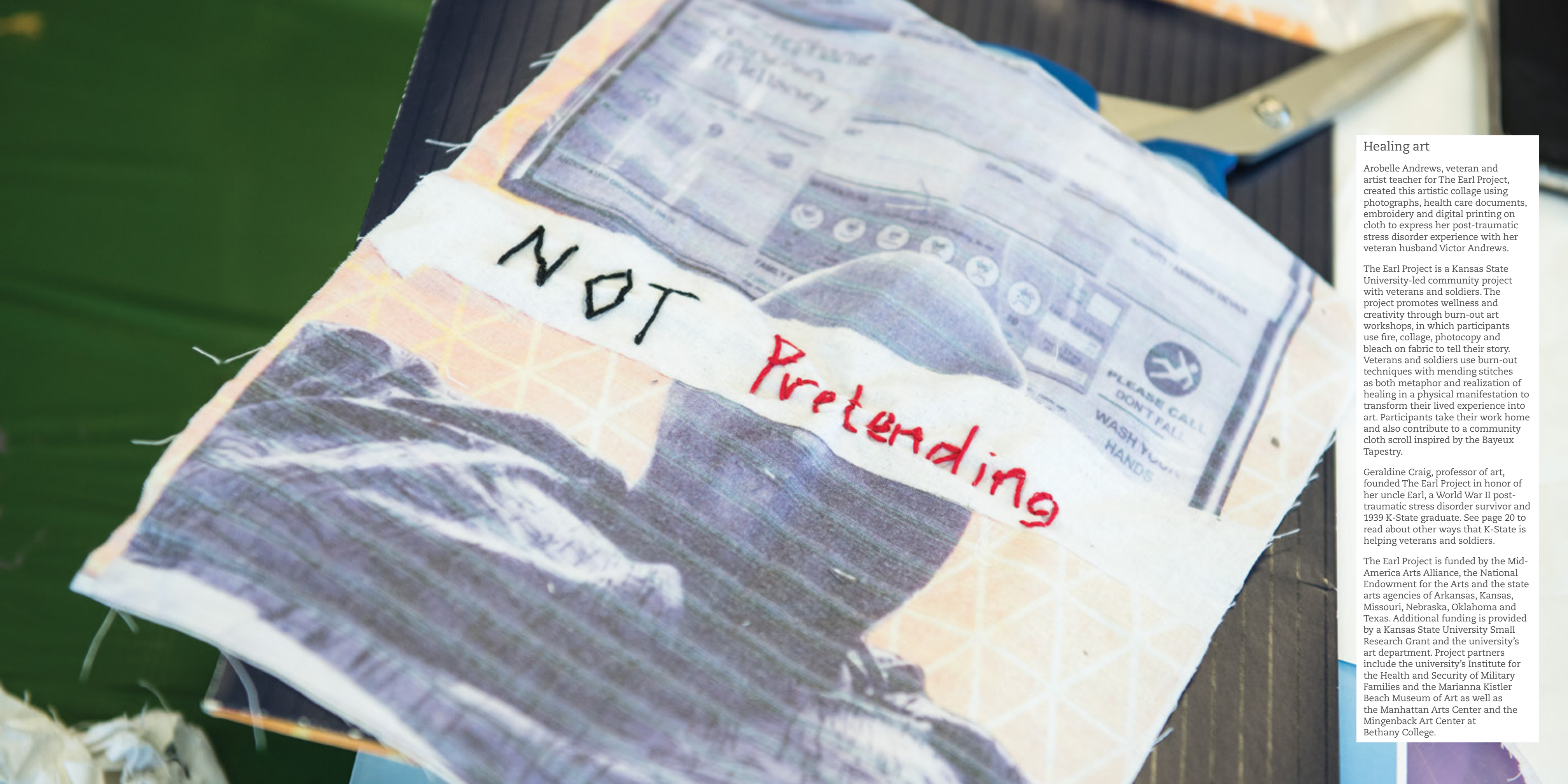
## CRISPR connections

Genetic technology that improves our world

## Keeping Kansas beef on track

CattleTrace project safeguards state's industry





## Healing art

Arobelle Andrews, veteran and artist teacher for The Earl Project, created this artistic collage using photographs, health care documents, embroidery and digital printing on cloth to express her post-traumatic stress disorder experience with her veteran husband Victor Andrews.

The Earl Project is a Kansas State University-led community project with veterans and soldiers. The project promotes wellness and creativity through burn-out art workshops, in which participants use fire, collage, photocopy and bleach on fabric to tell their story. Veterans and soldiers use burn-out techniques with mending stitches as both metaphor and realization of healing in a physical manifestation to transform their lived experience into art. Participants take their work home and also contribute to a community cloth scroll inspired by the Bayeux Tapestry.

Geraldine Craig, professor of art, founded The Earl Project in honor of her uncle Earl, a World War II post-traumatic stress disorder survivor and 1939 K-State graduate. See page 20 to read about other ways that K-State is helping veterans and soldiers.

The Earl Project is funded by the Mid-America Arts Alliance, the National Endowment for the Arts and the state arts agencies of Arkansas, Kansas, Missouri, Nebraska, Oklahoma and Texas. Additional funding is provided by a Kansas State University Small Research Grant and the university's art department. Project partners include the university's Institute for the Health and Security of Military Families and the Marianna Kistler Beach Museum of Art as well as the Manhattan Arts Center and the Mingenback Art Center at Bethany College.



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**About Seek**  
*Seek is Kansas State University’s flagship research magazine and invites readers to “See” “K”-State’s research, scholarly and creative activities, and discoveries. Seek is produced by the Office of the Vice President for Research and the Division of Communications and Marketing.*

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**KANSAS STATE**  
UNIVERSITY



As individuals and as a society, we strive for many types of security: financial security, food security, national security and health security are just a few. This issue of Seek illustrates how research at Kansas State University addresses security in all of these areas — and pushes the boundaries of what we will be able to achieve in the future.

Our feature story on page 20 highlights how funding from the U.S. Department of Defense is helping K-State researchers in biology, computer science and political science attack military challenges, from treating post-trauma inflammation or developing cyber-resilient embedded systems to understanding the causes of skin cancer and the effects of troop deployments on attitudes toward the U.S. We are proud of our contributions to protecting national security and the health of our military personnel.

Financial security and health security are foremost concerns for most of us. On page 16, read how K-State research helps us understand how finances affect relationships — and vice versa — at both our kitchen tables and international trade negotiation conference tables. On page 34, read how our Center on Aging PEAK program is helping Kansas families care for their loved ones in assisted living and nursing homes.

Biodefense, global food systems and food security are highly entwined, and they are special areas of expertise at K-State. The story on page 28 focuses on the CattleTrace project, which aims to protect the \$17 billion cattle industry in Kansas by developing a system that would help track suspected animal diseases and, should the unimaginable occur, reduce response time to an outbreak. This project is likely to become a model for the rest of the country as it brings all segments of the industry together to solve a problem, to ensure data accuracy and privacy, and ultimately to help market U.S. beef overseas. Read how K-State wheat breeders, biochemists and animal disease experts are applying cutting-edge gene-editing technology to their work on page 10. They are speeding up important processes and giving us glimpses of a more secure future. Our features on a distinguished professor of soil science on page 36 and recipients of National Bio and Agro-defense Facility Scientist Training Program fellowships on page 38 provide further evidence of K-State’s vital role in protecting food security and human health through our tripartite mission of teaching, research and service to the state and our nation.

Research at K-State harkens back to our land-grant roots, and our first problem-solving and training in “agriculture and the mechanic arts.” Our talented faculty, students and staff are always looking for new ways to secure our future, and as they advance our tools and techniques, we advance the efforts to build a safer, more secure future for our families. After reading this latest issue of Seek, I hope you will be sleeping more soundly at night.

Peter K. Dorhout, Vice President for Research



# Decoding ancient DNA

A Kansas State University researcher is helping to unlock the mystery behind the migration of prehistoric humans from Asia to the Americas.

Marta Alfonso-Durruty, associate professor of anthropology, is part of an international collaborative research project that is sequencing ancient genetic markers to understand how North America and South America — from Alaska to Chile — were populated. She is also a co-author of the group’s paper, “Early human dispersals within the Americas,” published in the journal *Science*.

For 10 years, Alfonso-Durruty has researched prehistoric remains in the area of Patagonia, Chile. For the latest study, researchers used DNA from ancient dental samples to determine genetic traits. With the resulting gene sequencing, Alfonso-Durruty collaborated with researchers conducting similar projects in other locations to map population patterns from Alaska to Patagonia.

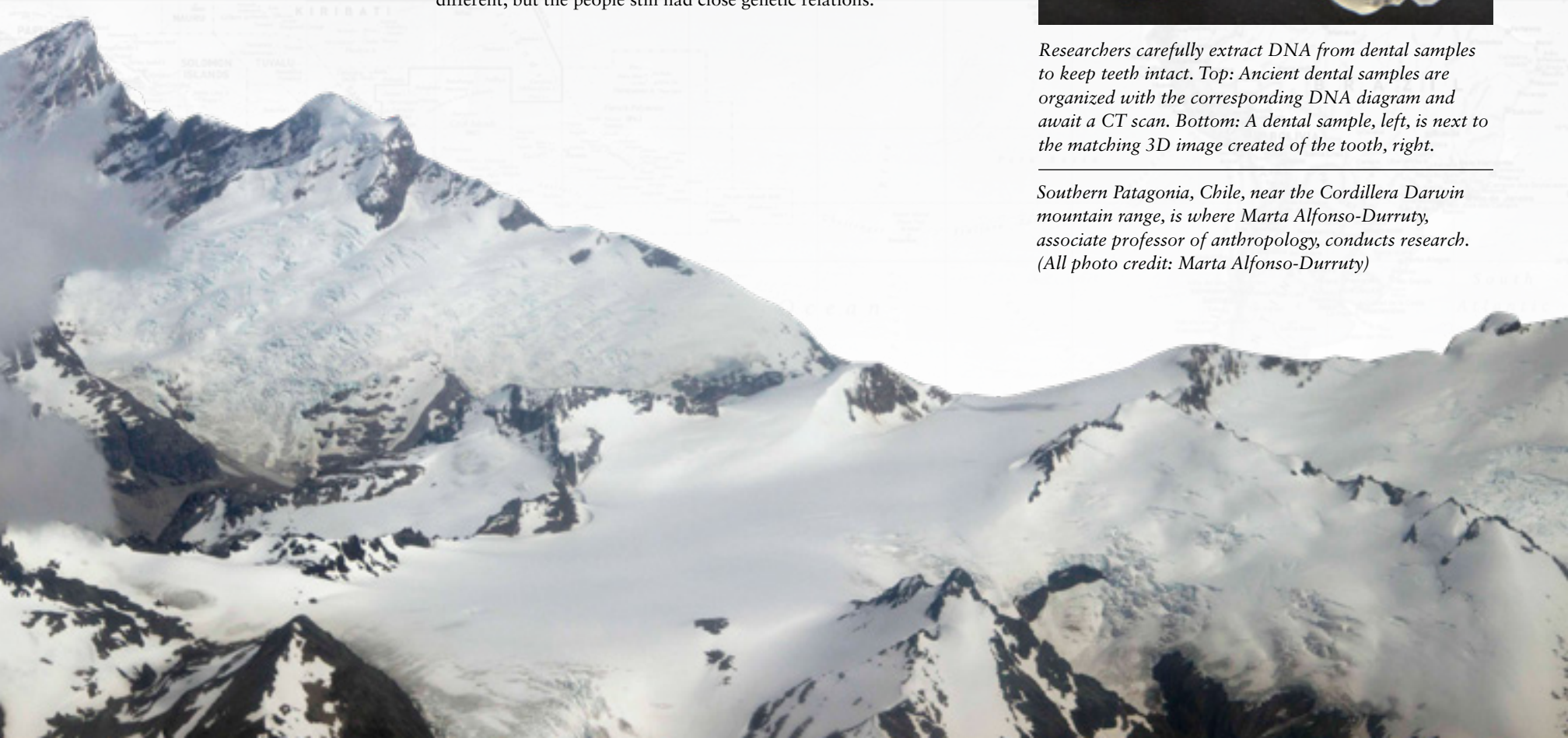
“This work helps us understand the population dynamics that account for the original peopling of the Americas,” Alfonso-Durruty said. “It is also revealing there might have been even older populations that entered the Americas before the dates that we have from 12,000 years ago.”

According to Alfonso-Durruty, the combined research also has concluded that the populations were moving across the continents very quickly and that they were very diverse in how they used the natural environment. For example, the tools used by each group might have been very different, but the people still had close genetic relations.



Researchers carefully extract DNA from dental samples to keep teeth intact. Top: Ancient dental samples are organized with the corresponding DNA diagram and await a CT scan. Bottom: A dental sample, left, is next to the matching 3D image created of the tooth, right.

Southern Patagonia, Chile, near the Cordillera Darwin mountain range, is where Marta Alfonso-Durruty, associate professor of anthropology, conducts research. (All photo credit: Marta Alfonso-Durruty)



The protein Headcase, or Hdc, functions together with the protein Unkempt, or Unk, to regulate tissue growth in fruit flies.

# Study identifies proteins that could suppress tumor growth in humans

The concept sounds simple but understanding the process has been elusive: Cut off the nutrient supply to suppress the growth of tumors.

Researchers with Kansas State University’s College of Veterinary Medicine are unveiling promising results for this concept by studying the behaviors of specific proteins in fruit flies. The proteins have known counterparts in humans.

Jianzhong Yu, assistant professor of anatomy and physiology, is collaborating with a team that recently identified Headcase, or Hdc, and Unkempt, or Unk. Both are two nutrient-restriction-specific tumor suppressor proteins that restrict cell-cycle progression and tissue growth in response to nutrient stress in *Drosophila* or fruit flies.

“Given the role of the human counterparts of these proteins, our results suggest that Hdc and Unk may function as tumor suppressors in mammals,” Yu said. “Although the human ortholog of Unk has not been studied in the context of cell proliferation, we showed that both Hdc and Unk are able to inhibit tissue growth in vivo in the *Drosophila* model. It is worthwhile in the future to investigate the growth control function of these two proteins, especially in regard to the formation of cancer tumors.”



Scott Tanona, associate professor of philosophy, is part of a team studying responsible research conduct.

# The ethics of science

Kansas State University collaborators are working across disciplines to explore responsible conduct in research and the goals and values of science that influence practice.

Jon Herington, assistant professor of philosophy; Scott Tanona, associate professor of philosophy; and James Lavery, assistant professor of physics, have received funding from the National Science Foundation to study what scientists think the goals of science should be and how responsible research obeys personal, rule-based, ethical limits.

The team wants to create a new area of study that can address the understanding of what is considered science and the responsibility in conducting ethical research.

“There has been a lot of research done recently on how we motivate scientists to engage in responsible conduct,” Herington said. “Our project takes a different approach that says what drives people to engage in responsible conduct in research is not whether they know what the rules are, but what their views are about the goals of science as a whole and whether they think it’s their job to help ensure those goals get met. For training in science to be effective at encouraging responsible research, it needs to engage with these views.”





## Unearthing new information on Alaska's Wrangell volcanic belt

*A series of approximately 7- to 8-million-year-old lava flows from the Green Hills in the central Wrangell volcanic arc. The terrain, including the small receding glacier in background, is representative of the Wrangell Mountains.*



*Matthew Brueseke, associate professor of geology, collects river cobbles for age-dating and geochemical analyses from the Kuskulana River in Alaska's Wrangell Mountains.*

A new study by a team of geologists that includes Kansas State University's Matthew Brueseke, associate professor of geology, has found that the Wrangell volcanic belt in Alaska's Wrangell-St. Elias National Park and Preserve is older than previously recognized and has determined why its volcanic field has been persistently active since it formed.

The study produced new geochemical and geochronological data that covers the entirety of the volcanic arc's formation. Coupled with data from prior studies, the team determined the age of the volcanic belt.

"The new data helped demonstrate that the Wrangell volcanic belt magmatism initiated at least approximately 30 million years ago, which is several million years earlier than previously recognized," Brueseke said.

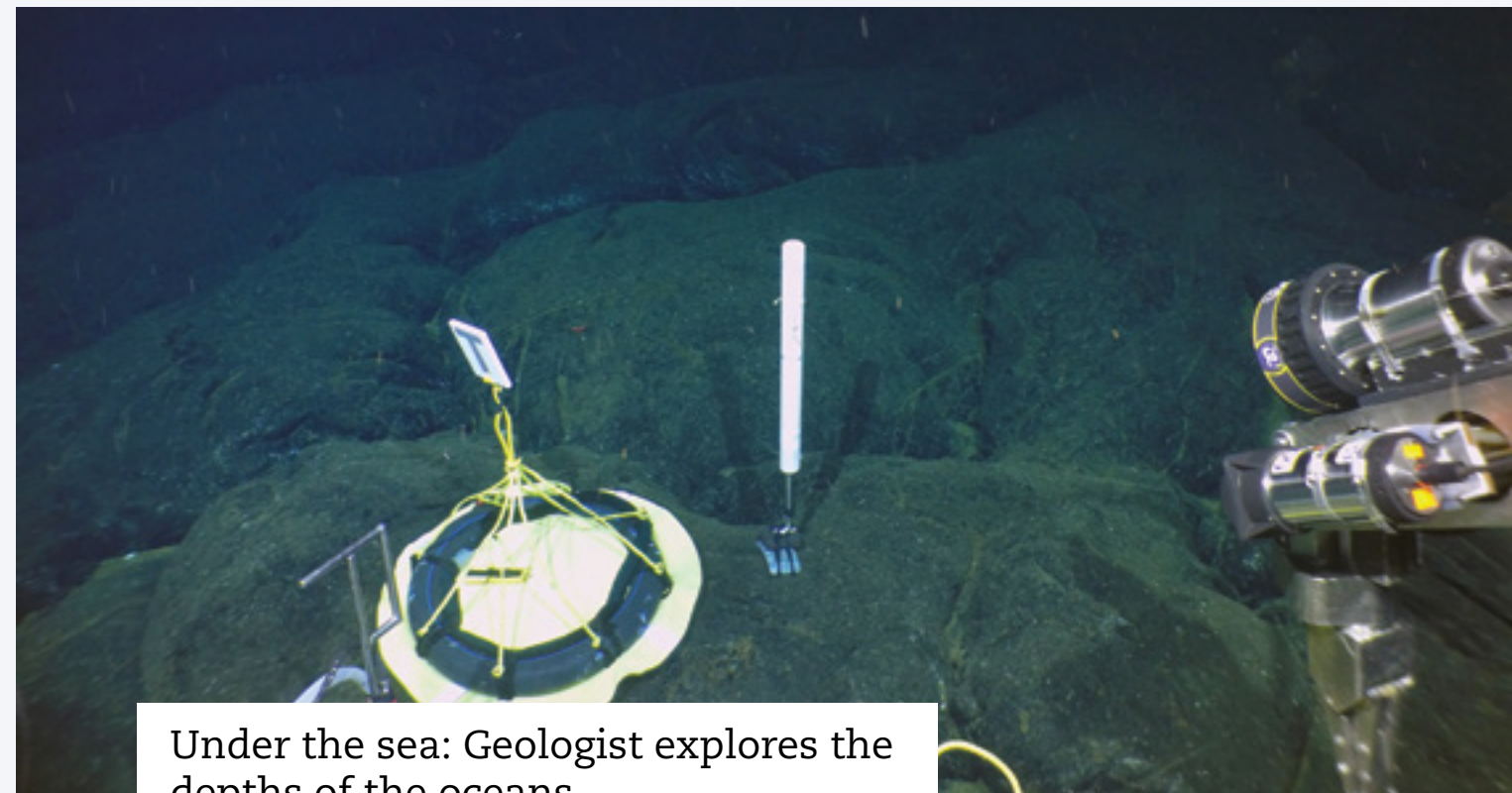
The group also determined that location and geometry have a lot to do with the continuous activity and size of the volcanoes. This creates an environment that allows for increased volumes of magma, which can then move up through the crust along the faults and possibly erupt.

The Wrangell volcanic belt is home to some of the largest — by height and volume — volcanoes on Earth, including at least two that are historically active and considered hazardous by the U.S. Geological Survey.

### ➤ Seek more

View additional photos and videos from geologists Matthew Brueseke and Aida Farough.

[k-state.edu/seek](https://k-state.edu/seek)



## Under the sea: Geologist explores the depths of the oceans

Kansas may be landlocked, but that has not stopped a Kansas State University geologist from going 1.5 miles underwater to explore the deepest parts of the Pacific Ocean.

Aida Farough, a teaching assistant professor of geology, has been spending weeks at sea while she studies the ocean floor, underwater volcanoes and hydrothermal vents at mid-ocean ridges. But Farough's underwater explorations are doing more than helping scientists understand the minerals and microbial life on the ocean floor. Her research can provide key insights to the origin of life on Earth as well as the existence of life and hydrothermal vents on other planets.

"Just because we don't have an ocean in our backyard in Kansas, we shouldn't ignore the oceans and the opportunities of marine exploration," Farough said. "We know less about the oceans than we know about some of the planets in our solar system. In fact, we have better maps of Mars than parts of the oceans within the U.S. territory."

That's why Farough is involved in several large international research projects that are aiming to learn more about the geologic processes on the ocean floor.

During one National Science Foundation-funded research cruise with the University-National Oceanographic Laboratory System, Farough dove to the bottom of the Pacific Ocean — a depth of 2,500 meters, or about 1.5 miles — in Human Occupied Vehicle Alvin. Farough also recently spent two months with International Ocean Discovery Program scientists on the U.S. research drilling vessel called the JOIDES Resolution to study the mineral resources near Brothers volcano, which is the most hydrothermally active volcano in the Kermadec Arc in the Pacific Ocean northeast of New Zealand.

*A circular thermal blanket and a current meter take measurements of the heat flow from the seafloor at the East Pacific Rise. Aida Farough, teaching assistant professor of geology, deployed this thermal blanket.*



*Aida Farough, teaching assistant professor of geology, stands on board the U.S. research drilling vessel called the JOIDES Resolution.*





## Just chill: Research keeps school lunches safe

The school field trip is a springtime ritual: Buses burst with exuberant children who are happy to learn outside classroom walls. But packed lunches coupled with warm temperatures could allow dangerous bacteria to flourish and sicken the travelers.

Researchers from the Kansas State University Center for Food Safety in Child Nutrition Programs in the College of Human Ecology and the Food Science Institute in the animal sciences and industry department have published a study confirming that limiting the time lunches are stored in coolers to less than four hours may reduce the risk of salmonella and listeria monocytogenes growth in a typical school lunch of deli sandwiches, apple slices and baby carrots.

Randy Phebus, professor of animal sciences and industry and interim director of the Food Science Institute, said food safety often is at the back of everyone’s mind when field trip excitement hits.

“Spring or summertime heat can cause a school bus waiting in a hot parking lot to reach temperatures that could compromise food stored for a later lunch,” Phebus said. “We wanted to know what level of risk this scenario actually poses to schoolchildren.”



*Ram Raghavan, spatial epidemiologist, collects long-horned ticks near southeast Queensland in Australia.*

## Predicting the spread of invasive ticks

A tick species known as the long-horned tick could establish itself in North America if the ticks are transported accidentally, according to a study published in Nature’s *Scientific Reports* by Ram Raghavan, assistant professor in Kansas State University’s College of Veterinary Medicine, and his international team of collaborators.

“The long-horned tick is also known as the east Asian tick, in Australia as the bush tick and in New Zealand as the cattle tick,” said Raghavan, a spatial epidemiologist. “This species of tick is native to Japan, China, Primorsky Krai region of eastern Russia and Korea; and it is well-established as an invasive species in Australia, New Zealand and on several Pacific Islands.”

In some of these countries, Australia and New Zealand in particular, Raghavan said this tick is implicated in the transmission of theileriosis to cattle — costing several millions of dollars each year — and in other places the tick is known to transmit severe fever thrombocytopenia virus to humans.

Raghavan has conducted extensive field surveys in Queensland, Australia, and collaborated with Steve Barker of the University of Queensland to understand the natural habitat characteristics of these ticks and their wildlife hosts.

## Researchers Down Under

Kansas State University is a worldwide leader in research collaborations with Australia. The university was the first U.S. educational institution to partner with the Australian-American Fulbright Commission, which manages an international exchange program between the U.S. and Australia. Through the program, Australian Fulbright Scholars come to K-State for up to six months to collaborate with university researchers.

The K-State-Fulbright partnership has existed for five years and the university has hosted 10 scholars, including the only Fulbright Distinguished Chairs in the U.S. The university recently renewed the program for five more years.

The university also leverages the Australian Fulbright program through the Oz to Oz program, a seminar series

in which every senior Australian Fulbright Scholar is invited to visit K-State and interact with faculty, staff and students. The university has hosted 12 visits for the 2018-2019 academic year.

“No other university in the country is doing anything like the Oz to Oz program with Fulbrighters from any other country in the world,” said John Leslie, university distinguished professor of plant pathology who helped start the Australian Fulbright program at K-State. “This program focuses on research and helping our faculty members build and expand international networks and collaborations.”

Learn more about the latest Fulbright Scholars from Australia.



*Jeremy Davey, professor, University of the Sunshine Coast*  
**Area of study:** Sociology

**K-State collaborator:** Lisa Melander, associate professor of sociology

Davey is investigating impaired driving and studying the enforcement of drunk driving laws and drugged driving laws, particularly in the context of the legalization of marijuana in parts of the U.S. He is especially interested in Kansas because of its proximity to Colorado, which has legalized marijuana. Kansas is a Top 10 state in the U.S. for road crashes per vehicle miles traveled, Davey said. He is comparing laws in Kansas and the U.S. with Australian laws, which involve random drug tests.



*Brett Summerell, director, The Royal Botanic Garden Sydney*  
**Area of study:** Plant pathology

**K-State collaborator:** John Leslie, university distinguished professor of plant pathology

Summerell is collaborating with Leslie on a revision of their book, “The Fusarium Laboratory Manual.” Their research focuses on a new species of Fusarium, a mold that causes diseases in most agriculturally important crop plants. Fusarium also can infect livestock and immuno-compromised people as well as produce toxins that affect health and limit trade. Summerell has collaborated with the university’s plant pathology department since the 1990s. He is a K-State adjunct professor of plant pathology and serves every year as an instructor in the Fusarium Laboratory Workshop.



*Geoff Cockfield, professor, University of Southern Queensland*  
**Area of study:** Agricultural economics

**K-State collaborator:** Allen Featherstone, professor and head of the agricultural economics department

Cockfield has conducted a comparative study of Australian and U.S. agricultural policy. Australia’s agricultural sector is mostly deregulated, which provides little support to farmers and exposes farms to immediate market forces. Cockfield has been learning more about U.S. policy and working with K-State experts in crop insurance, market programs, water management and farm bill policy.





HOW SCIENTISTS USE GENETIC TECHNOLOGY TO  
IMPROVE OUR WORLD

*By JENNIFER TIDBALL*

# CRISPR connections



The solution to some of the world’s most devastating animal and plant diseases often can be found in a single gene on a DNA strand.

Finding these solutions used to take scientists years or even decades. The work is even more difficult with incredibly complex genomes like wheat, which includes 16 billion base pairs in its DNA code. To compare, the size of the human genome is only 3 billion DNA pairs.

But thanks to a revolutionary new gene-editing technology called CRISPR-Cas9, researchers have an easier and more efficient way to work with complex genomes.

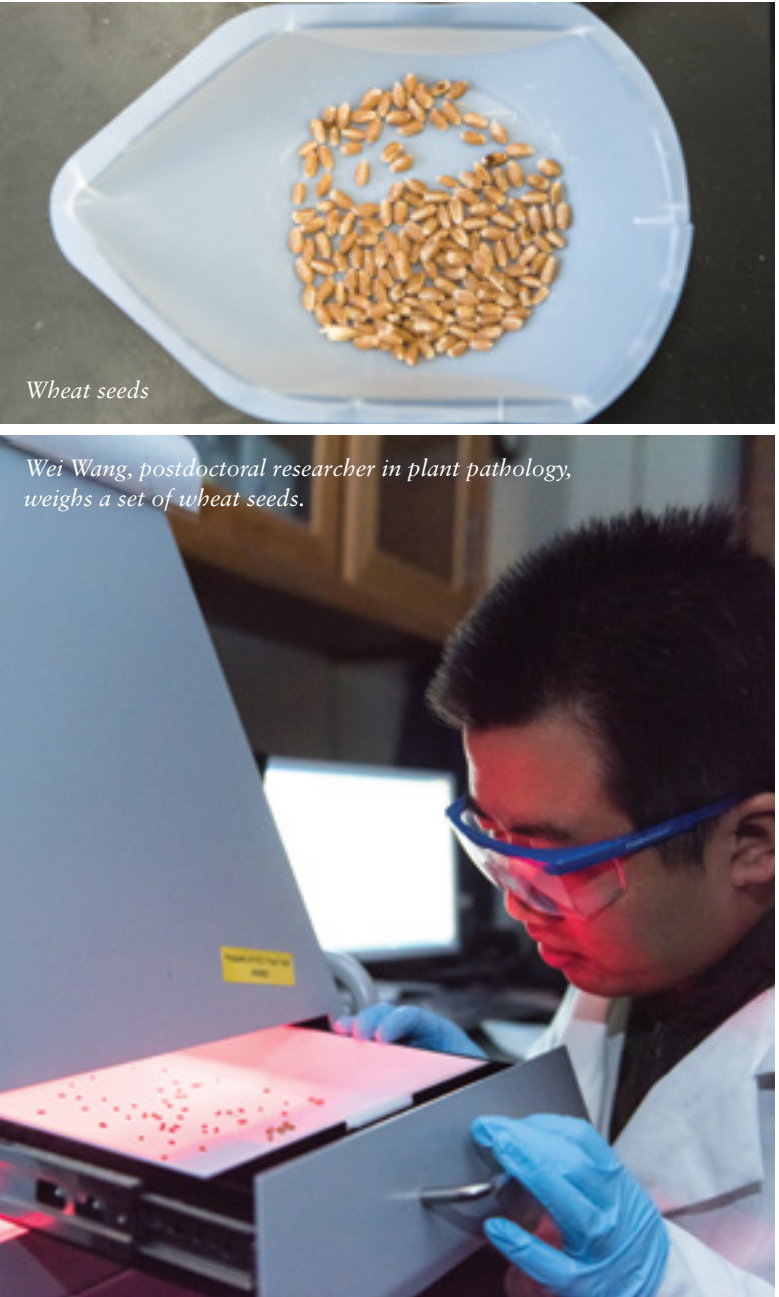
Kansas State University researchers know the value of CRISPR, and they’re developing ethical and responsible ways to use this technology to improve our world, from developing new wheat varieties to fighting animal diseases.



Megan Goeckel, junior in microbiology, and Nathan Henderson, senior in biochemistry, look at yeast samples in the laboratory of Gregory Finnigan, assistant professor of biochemistry.



Eduard Akhunov, professor of plant pathology, works on research that uses CRISPR technology to develop wheat varieties.



Wheat seeds

Wei Wang, postdoctoral researcher in plant pathology, weighs a set of wheat seeds.

“This new technology uses the natural processes in cells to edit or hybridize a gene to select for a specific trait in the cell as it reproduces,” said Peter Dorhout, K-State’s vice president for research who has presented to congressional staff and other national organizations on the importance of CRISPR technology.

CRISPR — pronounced “crisper” — stands for Clustered Regularly Interspaced Short Palindromic Repeats. CRISPR-Cas9 is a simple, but powerful, genome-editing technology that targets and cuts DNA with an enzyme called CAS9. A genome comprises the complete set of DNA genes bundled together as the chromosomes in cells.

Since it was introduced in 2012, CRISPR technology has revolutionized the scientific world. Using CRISPR, researchers like plant pathologist Eduard Akhunov can start developing wheat breeds that have higher yield or are more drought tolerant. Biochemist Gregory Finnigan can study model species like yeast. Virologist Raymond “Bob” Rowland can combat devastating swine diseases.

The process starts with a genetic blueprint: DNA. The CRISPR-Cas9 enzyme works like molecular scissors that make cuts at specific places in DNA. Then scientists can either let the cells fix the DNA through an error-prone repair process that knocks out specific genes or scientists can supply cells with a short template of new DNA to repair the cut and simultaneously introduce a precise change to the gene.

It may seem synthetic, but a species’ DNA constantly changes because of the ongoing natural mutation process.

“All breeding, whether in crops or animals, depends on these naturally introduced mutations,” Akhunov said. “CRISPR-Cas9 can do the same thing as the natural mutation process, but it is doing it at a very fast pace and only in a specific gene in the genome.”

“Hybridizing plants, for example, has existed for millennia to utilize a plant’s own reproductive systems to create a new plant with hopefully the best traits of the parents,” Dorhout said. “However, this

process can take many years and many trials to breed the best traits possible. CRISPR technology enables scientists to do this much more efficiently and effectively.”

CRISPR is a part of the immune system that protects bacteria from viruses. In fact, CRISPR was used to develop virus-resistant bacterial cultures for dairy production, which means if you ate a yogurt parfait for breakfast, you likely ate bacteria carrying CRISPR.

Researchers can use CRISPR-Cas9 technology to further explore many plant and animal genomes. The sequencing of so many genomes in the past few decades is exciting, Finnigan said, but the capabilities of CRISPR technology are even more exciting because they give scientists like him a new tool kit.

“With this new technology, we can ask questions that are bigger, more complicated and closer to a disease,” Finnigan said. “Instead of studying one or two genes, we can study hundreds of genes. Now we can do really exciting science.”

EDITING GENES

As a genetic code, DNA defines all desirable traits in wheat, including higher yield, disease resistance, drought tolerance and end-use quality.

In the College of Agriculture, Eduard Akhunov, professor of plant pathology, and Wei Wang, postdoctoral researcher in plant pathology, are using CRISPR technology to develop wheat varieties with improved traits. The Kansas Wheat Commission is supporting their efforts.

“We are looking at traits that can benefit the Kansas farmer and wheat production in Kansas,” Akhunov said. “Then, we are trying to edit genes affecting these traits and transferring them into Kansas wheat varieties.”

Thanks to the recently sequenced wheat genome, Akhunov’s team can use computational tools to find specific pieces of the wheat genome that they would like to fix. Because CRISPR is so precise, the scientists can use it to fix a few DNA base pairs to improve the wheat.

“Instead of studying one or two genes, we can study hundreds of genes. Now we can do really exciting science.”  
— Gregory Finnigan, biochemist



The team already has seen success: They have used CRISPR to replace a few DNA base pairs and create wheat lines with increased grain weight and improved protein content.

To create a new wheat variety using traditional breeding methods can take at least five to seven years because scientists must crossbreed different varieties, or sometimes even distantly related species, to introduce desirable traits. Using CRISPR technology, Akhunov and his team can introduce novel traits into wheat varieties in about two years by editing specific genes that control these traits.

CRISPR technology especially can be useful in cases when new devastating wheat diseases emerge quickly and rapid development of resistant varieties is critical for maintaining crop production.

“Currently, for example, we are looking for genes that can make wheat resistant to multiple fungal pathogens,” Akhunov said.

Genetic and molecular biology studies in cereal crops — such as rice, barley and corn — have identified a number of genes that control major traits across species.

“CRISPR-based gene editing has emerged as a powerful technology that can take full advantage of the available genomic information and help to rapidly transfer traits from other crops into wheat cultivars,” Akhunov said.

Akhunov and his team are applying CRISPR technology to improve a wide range of traits that includes yield, resistance to pathogens, end-use quality and nutritional quality.

## DRIVING GENES

If CRISPR is the “car” of genetic technology, then a biochemistry team is studying the car’s engine and GPS unit.

In other words, Gregory Finnigan, assistant professor of biochemistry and molecular biophysics in the College of Arts and Sciences, is improving a piece of CRISPR technology: gene drives.

“We’re looking at the design, the architecture, how the gene drive works and how it can work better,” Finnigan said. “We want to make sure the gene drive ‘drives’ with an off switch.”

Through gene drives, genetic changes made by CRISPR can pass to offspring and future generations and can be used to direct the traits of biological populations. Finnigan and his team of graduate and undergraduate students are studying gene drives through the model system of yeast. Specifically, they are studying baker’s

yeast, which is used to make bread and ferment wine.

“Our interest is studying the CRISPR technique itself, and we’re looking at including additional control to this unique system,” Finnigan said. “There’s a way to do this so that everybody wins. You can combat diseases, but you can also still preserve and protect the natural environment.”

Finnigan’s laboratory is one of a handful of laboratories worldwide that specializes in gene drive technology. By working in a single-celled organism like yeast, Finnigan can study gene drives quickly and efficiently. His work has wide applications and can benefit agriculture, humans, ecology and research itself.

For instance, Finnigan’s team has developed a gene drive with a genetic “switch” to turn off Cas9 when it is no longer needed. The team’s goal is to develop such safety mechanisms so that gene drives can be used ethically in the future.

“We want to study how to more effectively control gene drives and build safer systems,” Finnigan said.

## BREEDING GENES

CRISPR technology is helping veterinarians and researchers fight animal diseases with a new tool: genetics.

“Whether you are talking about vaccines, diagnostics or breeding animals that are more resistant to diseases, it’s all about genetics,” said Raymond “Bob” Rowland, professor of diagnostic medicine and pathobiology in the College of Veterinary Medicine, who studies swine diseases. “CRISPR technology is changing things.”

CRISPR can cut down research time from years to months, which is important in a world where swine diseases can develop and devastate quickly. Rowland has several collaborative projects that use CRISPR to address some of the headline-making swine diseases, such as African swine fever and porcine epidemic diarrhea virus, or PEDv.

Rowland also has used CRISPR to address the most devastating disease in the swine industry: PRRS, or porcine reproductive and respiratory syndrome. The disease costs the U.S. pork industry more than \$600 million in losses every year, according to researchers.

Through a collaboration with Randall Prather, a professor at the University of Missouri, Rowland and a team have developed PRRS-resistant pigs. Using CRISPR-Cas9 technology, the researchers have found that pigs without the CD163 protein show no signs or evidence of being infected with the PRRS virus. CD163 is the receptor for the virus.

“CRISPR-based gene editing has emerged as a powerful technology that can take full advantage of the available genomic information and help to rapidly transfer traits from other crops into wheat cultivars.”

— Eduard Akhunov, plant pathologist

Rowland also has found that mothers without the CD163 protein are resistant to the PRRS virus and give birth to healthy, normal piglets. The research can save swine producers millions of dollars because pigs are protected from the PRRS virus during the critical reproductive process, Rowland said. The pigs without the CD163 protein are undergoing further evaluation before they become available to producers.

Rowland has added swine coronaviruses to his area of study and CRISPR is helping him develop ways to make swine resistant to multiple pathogens and viruses at once.

Additionally, pigs are a good model species for studying disease in humans and other animals. The ways that Rowland and his collaborators treat diseases in pigs also could help cure diseases in humans, such as multiple sclerosis or diabetes.

“Our job as academics is to use the latest technology so that the world becomes different and better because of something we have done,” Rowland said. [k](#)

### ➤ Seek more

Learn more about CRISPR through extra images and graphics.

[k-state.edu/seek](https://k-state.edu/seek)

## A CRISPR TECHNIQUE

Scientists use CRISPR-Cas9 technology to work with genomes, from developing new wheat varieties to fighting animal diseases. Here is a step-by-step guide that explains how CRISPR works.







FEDERAL RESERVE NOTE

# MONEY MATTERS

MAKING SENSE OF CENTS

BY MARY LOU PETER

“Happily ever after” sounds good for personal relationships, business partnerships and international trade agreements alike, but differing viewpoints and a lack of communication about money can sour the best of connections in all of these realms. Kansas State University researchers are taking a closer look at financial choices and their implications, from the personal to the global.

THIS NOTE IS LEGAL TENDER  
FOR ALL DEBTS, PUBLIC AND PRIVATE

TWENTY



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WASHINGTON, D.C.





# LOVE AND MONEY

Who hasn’t had a tense money conversation with a spouse or partner? “Did you really need another pair of shoes?” “How much should we save for retirement?” “And tell me again why we can’t buy that boat?”

Researcher Sonya Britt-Lutter combines her interest and background in marriage and family therapy and financial planning as she studies topics such as predicting financial conflict in couple relationships. The work is helpful to couples directly, but also to financial planners who work with couples.

“Financial problems are consistently reported as a top stressor for Americans, and disagreement over money matters is a frequently cited source of conflict for couples,” said Britt-Lutter, associate professor and interim director of K-State’s Institute for Personal Financial Planning.

In a recent study, she and colleagues have found that some of the top predictors of financial conflict for husbands and wives include believing the other spends too much money; having financial worries; reporting income differences; and having three or more children. The study is based on data gathered from couples who average 45 to 46 years old and have been married an average of 18 years.

The evidence suggests that money arguments are less related to the amount of family income and more related to decisions on allocating that income.

Britt-Lutter and the researchers also include tips to guide financial planners as they work with couples struggling with money conflicts. The team provides resources, including the Financial Anxiety Scale, which is a series of questions that helps planners assess clients’ financial stress.

In another study, Britt-Lutter and colleagues explore how living together outside of marriage influences net worth and the accumulation of financial and nonfinancial assets during young adulthood. They have found that young adults who live together but do not marry may be less financially prepared for retirement in later years than married couples.

The study results show that married young couples have the highest net worth. First-time co-habitators are the next wealthiest group, and young adults who have lived with more than one partner, but not married, have an average of \$33,809 less in wealth. According to the researchers, nonmarried partners tend to accumulate more possessions instead of investing in financial assets.

Britt-Lutter also has worked with Camila Haselwood, doctoral student in personal financial planning, and Emily Koochel, doctoral student in human ecology, to develop a guide to help couples through money-related conversations. The “Love and Money” curriculum is a partnership with brightpeak financial and allows couples to explore each person’s individual thoughts about money. The curriculum shows promise as a tool for marriage and financial counselors because it provides tangible ideas on starting important conversations about what money means in the relationship.



Sonya Britt-Lutter

# UNDERSTANDING FINANCIAL DECISIONS

In her work as a family resource management specialist with K-State Research and Extension, Elizabeth Kiss conducts research and takes money-related knowledge to Kansans. She does this through publications, presentations and the local work of K-State Research and Extension agents across the state.

Kiss, also an associate professor of family studies and human services, recently has collaborated with specialists at other universities to study how young adults make financial decisions on four topics: financial goals, homeownership, retirement planning and student loans. Many study participants’ families experienced the housing market collapse and mortgage credit crunch during the Great Recession of 2007-2009.

The team has found that student loan debt is a primary factor weighing on financial decisions. The researchers also have discovered that many participants are sequencing financial priorities, rather than funding them simultaneously. As a result, they are delaying homeownership and retirement savings.

“Phrases like ‘once I have ...,’ ‘after I ...’ and ‘as soon as ...’ were commonly provided in responses,” Kiss said. “This indicated a hesitancy to fund certain financial goals until achieving others.”

The study results can sharpen financial planners’ educational approaches, as well as empathy and awareness of how and why young adults make certain choices, Kiss said. The study is part of a multistate project supported by the U.S. Department of Agriculture National Institute of Food and Agriculture.

Another study by Kiss and colleagues addresses young adults’ lack of understanding of health insurance and looks at ways, such as delivering information through social media, to bridge the knowledge gap.

Previous studies have shown that nearly 50 percent of consumers lack confidence in selecting a health insurance plan and many do not understand basic terms such as premium, deductible, copayment or provider network, Kiss said.



Elizabeth Kiss



Her study is part of the national Cooperative Extension System’s goal to be a leader in health research and education, much like how extension has worked to improve agriculture for more than 100 years. Health insurance literacy is one priority in that effort.

The study includes an online survey of millennials to gain an understanding of that age group’s health insurance-related issues and preferred social media platforms and text messaging formats.

Although four out of five respondents indicate they have health insurance, 23 percent do not know their insurance plan, 12 percent indicate a Marketplace health plan, 27 percent are covered by a Health Maintenance Organization and 29 percent are covered by a Preferred Provider Organization. The social media platform checked most frequently by respondents is Facebook, followed by Snapchat, Instagram and Twitter. Many also receive text messages, most from their closest friends but also from other sources.

Based on those insights, Kiss and her colleagues have developed a mobile messaging pilot project to increase millennials’ health insurance literacy with quick and easy-to-understand “content bites” delivered through social media and text messages. The final study, expected in mid-2019, will shed light on some of the best ways to convey educational messages to a generation more comfortable with communicating through technology.

# A GLOBAL VIEW

Peri da Silva, professor of economics, works with economists around the world by looking at money from the global perspective, specifically focusing on trade agreements.

Da Silva was born in Brazil and became interested in international economics during college there. His interest was piqued by Brazil’s protectionist trade policies, which led to higher prices for cars and other consumer goods for Brazilians compared to other countries.

“The opportunities for corruption of public officials in a system where politicians can apply trade barriers without respecting international rules involving trade agreements has always been visible, although not easily proven in a court of law,” said da Silva, who has taken an in-depth look at such trade agreements as the North American Free Trade Agreement, or NAFTA, and other international pacts.

Recent work by da Silva and his colleagues, published in the Journal of Political Economy, focuses on the degree of cooperation among World Trade Organization, or WTO, members. WTO-sponsored agreements are designed to promote cooperation among members in order to thwart countries’ abilities to apply tariffs and exploit their market power in international markets.

In the study, the economists measure what would happen if countries abandoned their WTO commitments and applied noncooperative tariffs as would happen in a global trade war. Their estimates indicate that the average world exporter would face an increase in tariffs of 32 percentage points, whereas U.S. exporters would face an average increase of 27 percentage points.

“These outcomes suggest that a full-blown trade war would have no winner,” da Silva said.

He noted that some of the world’s most vulnerable populations may be harmed most. The researchers’ work has been the basis for articles in The Washington Post and The Economist, among others.

The annual value of U.S. imports and exports adds to about 29 percent of the U.S. national income, da Silva said, and the value of trade even can exceed total income. For example, in Switzerland the annual value of imports and exports is 115 percent. That happens because there is double-counting in international trade when countries also trade intermediate products.

“These facts illustrate the importance of international trade,” da Silva said. “International agreements represent a rules-based system where countries can voluntarily engage in international trade without fearing sudden changes in barriers and rules.”

Without trade agreements, a government can take measures to benefit a group of business owners and workers by imposing a higher tariff on imported goods, da Silva said. The tariff negatively affects foreign businesses and workers because it transfers the domestic policy cost to them. This action is usually not allowed by trade agreements.

An alternative, he said, would be for a government to raise taxes and distribute the proceeds to domestic groups it wishes to provide a benefit. International agreements do not prevent this action as long as foreigners are not forced to pay for the benefit. [\*\*k\*\*](#)



Peri da Silva





# A SOLID ★ DEFENSE

RESEARCH TACKLES MILITARY CHALLENGES FROM EVERY ANGLE

## BY MEGAN SAUNDERS

Kansas State University research can be found in military operations and hospitals, in cybersecurity technology and in communities overseas.

University researchers are playing a key role in securing our nation, particularly through partnerships with the U.S. Department of Defense and related entities. The university has more than 75 DOD-funded grants totaling nearly \$20 million from fiscal years 2015-2019.

Each grant funds research that will affect our nation and its military personnel for years to come. Read on for a sampling that highlights university DOD-funded projects that span disciplines, time and personal connections.





“If a UAV in flight is communicating with a source on the ground, you want to ensure you’re communicating that information to the right source.”  
— Robby, professor of computer science

# THESE WALLS DON’T TALK

Robby and John Hatcliff, computer science  
DARPA grant

Connectivity is crucial to military operations, but with increased connectivity comes potential high-stakes security hazards.

Robby, professor of computer science, and John Hatcliff, university distinguished professor of computer science, are part of an international team that is developing cyber-resilient embedded systems. The team is using a Defense Advanced Research Projects Agency, or DARPA, grant to turn architectural models of these systems into an executable, real-world cybersecurity approach for military-crucial equipment, such as an unmanned aerial vehicle, or UAV.

“If a UAV in flight is communicating with a source on the ground, you want to ensure you’re communicating that information to the right source,” Robby said.

Data61, the digital innovation arm of Australia’s national science agency, is providing a framework for building system architectures with security properties that have been mathematically verified using computer-checked proofs. Meanwhile, researchers like Robby and Hatcliff are translating architectural models into the code level to run on Data61’s framework in the real world.

“In some sense, it’s like building a house where you use architecture to build very strong walls so you can only get from one room to another through a controlled mechanism,” Hatcliff said. “When you’re certain that the transition from a particular door is being closely controlled, you don’t have to worry about someone making a hole in the wall, like a hacker trying to introduce malware.”

Security is never completely guaranteed, especially in a software-oriented world prone to intrusion. That’s why the DARPA team also is focused on cyber resiliency. The researchers are determining highly critical system pieces and isolating them from other, less-crucial segments, which enables the system to still function even when some pieces are compromised.

“Since they’re walled off, if someone breaks into a particular room, the system allows you to isolate and lock that door, preventing others from getting through,” Hatcliff said. “You’re resilient to attacks and able to fight through them. Even though there may be a security breach, you can still make progress toward accomplishing your mission.”

Another issue that frequently exists in military cyber systems is difficulty in creating change. Often, a component is intertwined with the rest of the system, which makes it difficult to make an update without upending the entire system. Robby said by focusing on the system architecture, it becomes possible to change something in a single partition.

“Since you know you’ve been careful about how that system communicates, you have confidence that it’s not going to impact the rest of the system in unanticipated ways,” he said. “It’s a much better approach for updates to system components.”

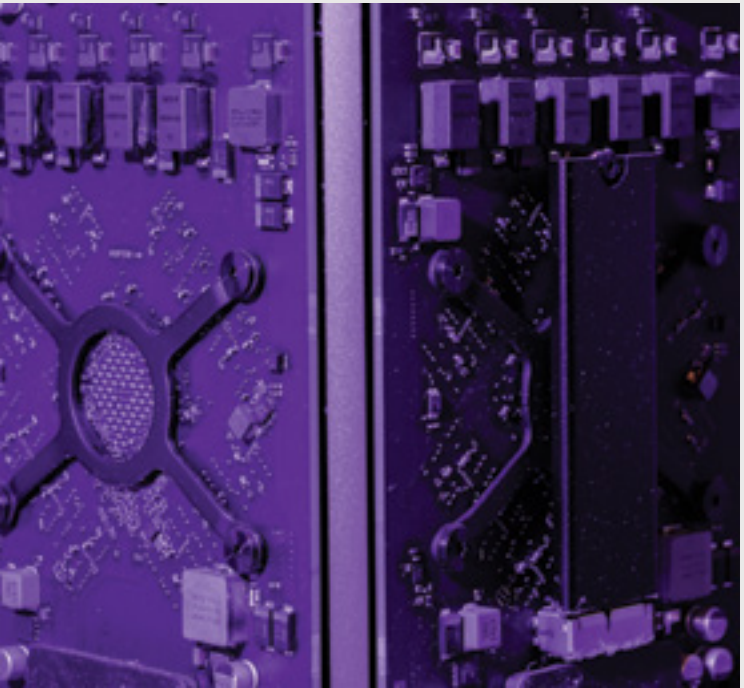
For example, since unmanned aerial vehicles are used in many types of missions, including low-ground work and night missions, it is necessary to constantly reconfigure them for mission objectives. The framework Robby and Hatcliff’s team is developing makes it much easier to know the cyber system will work correctly when needed.

The K-State researchers’ collaborators on the \$800,000 DARPA project include Data61; Adventium Labs in Minneapolis; Collins Aerospace in Cedar Rapids, Iowa; and the University of Kansas.



Above: John Hatcliff, university distinguished professor of computer science, left, and Robby, professor of computer science, are developing cyber-resilient embedded systems.

Below: Computer science researchers are working to make computer equipment cyber resilient using mathematically verified frameworks.







## IMPROVING RELATIONS

### Michael Flynn and Carla Martinez Machain, political science

Minerva Research Initiative grant



*Michael Flynn and Carla Martinez Machain, both associate professors of political science, are studying perceptions of U.S. military around the world.*



U.S. military service members work throughout the world in small numbers and large deployments, on battle frontlines and in humanitarian work. Regardless of assignment, this work is essential, yet two K-State researchers and their team are concerned that little is known about the effects these deployments may have on their environments.

Michael Flynn and Carla Martinez Machain, both associate professors of political science, are using a \$1.2 million U.S. Department of Defense Minerva Research Initiative grant to study the long-term effects of overseas deployments on attitudes toward the U.S. This includes not only general perceptions, but also crime statistics and local economic impact.

“In past decades, we saw a lot of information from more of an editorial, anecdotal standpoint,” Flynn said. “Instead of drawing from these isolated cases, we’re studying perception and how it manifests itself in different, measured ways, including how opinions about the U.S. military extend to the general U.S. population and government.”

The grant has allowed Flynn and Martinez Machain to carry out online surveys as well as visit six countries — Panama, Peru, England, Germany, Japan and South Korea — to interview U.S. and host country military, civilians and government officials. Altogether, their surveys have reached 14 countries in noncombat zones, most with at least 1,000 U.S. military personnel deployed annually. The researchers have made some exceptions for countries such as Poland that have smaller U.S. deployments with political importance.

Although the researchers’ main focus is countries with a long-term U.S. presence — such as Germany, Italy and South Korea — they also have interviewed people in Latin American countries, including Panama and Peru, for their smaller humanitarian civic assistance missions.

“We took a mixed-method approach, utilizing hard data and statistical analysis alongside field work,” Martinez

said. “We surveyed different social classes and interviewed local government officials, U.S. diplomatic and military officials stationed abroad, and journalists to find out how their perceptions are formed.”

The researchers already have gathered large data subsets that give a glimpse inside deep-rooted perceptions of the U.S. They have found that perceptions are influenced by the amount of indirect or direct contact with U.S. troops, how aid is attributed by the U.S., the degree of threat by outside powers, the length of the U.S. deployment and other nuanced opinions.

The researchers plan to repeat the survey twice more in each country to explore evolving patterns. The next project phase will focus on the military’s economic footprint in these countries as well as crime data.

“The military is embedded in a broader social, economic and political system,” Martinez Machain said. “It isn’t until you analyze these issues in a socially scientific way that these answers become clear.”

From a policymaking perspective, Flynn said they want to simply provide lawmakers and military officials with tools to make informed decisions and with sound guidance for leaving a particular impact on a foreign nation.



## A NEW HANDLE ON HEALING

### Sherry Fleming, biology

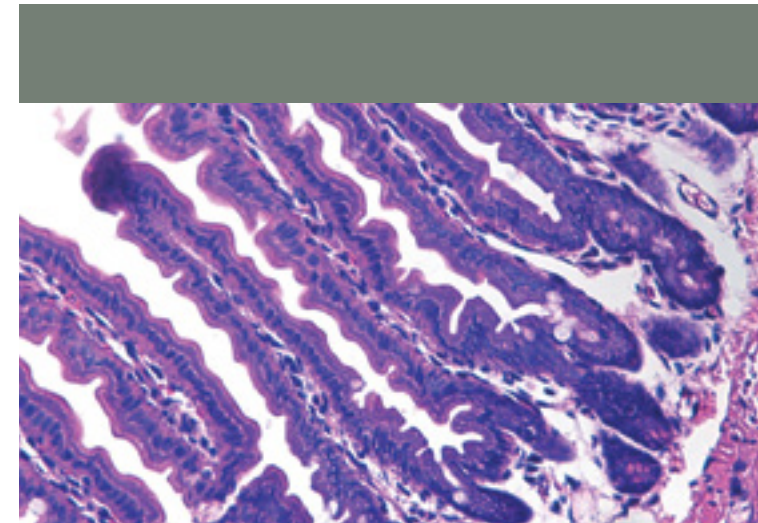
Department of Defense grant

Jerald, an 80-year-old Vietnam War veteran medic, inspired Sherry Fleming’s research years ago while she was completing her postdoctoral work at Walter Reed National Military Medical Center in Maryland.

“He told me about these badly injured soldiers they would treat and get ready to send home,” said Fleming, professor of biology. “Then, several days later, they would crash for seemingly no reason. Today, we know that post-trauma inflammation was most likely responsible. I explained that to Jerald and all he said was, ‘Well, what are you going to do about it?’”

Fleming has since searched for the answer by investigating differences in post-trauma medical treatment for men and women. She recently received a \$650,000 U.S. Department of Defense grant to research how male and female hormones cause different physical reactions to post-traumatic injury treatment. Trauma causes bleeding — damage from the actual wound — as well as trauma-related inflammation from the body’s immune system, Fleming said.

“Your immune system protects you, but it also can overreact and cause additional damage as it is healing you,” she said.



*Left: Sherry Fleming, professor of biology, is investigating differences in post-trauma medical treatment for men and women.*

*Above: This microscopic photo shows a healthy intestine. The purple shows epithelial cells that absorb nutrients and the pink shows connective tissue with blood vessels at the base of the intestine.*



For example, if an individual has a heart attack caused by a clogged artery, cells won’t receive blood flow and will die. But when doctors open the artery and allow blood to flow through, the immune response can cause further damage.

“It’s allowing your heart to recover, but the inflammation can cause even more damage,” Fleming said. “That’s what we want to stop.”

Men and women often have different symptoms when suffering a heart attack, and Fleming is investigating if hormonal differences may be to blame. If so, these hormones also could affect how the body reacts to trauma.

“Preliminary data suggests this may be the case,” Fleming said. “Female soldiers who are hit by an improvised explosive device and receive treatment similar to their male counterparts are dying at a much higher rate than men.”

In fact, one study suggested that the death rate for injured female soldiers was almost twice as high. Fleming’s research is aimed in two potential directions. First, some data suggests the body reacts differently

because of the lack of testosterone, as opposed to the presence of estrogen.

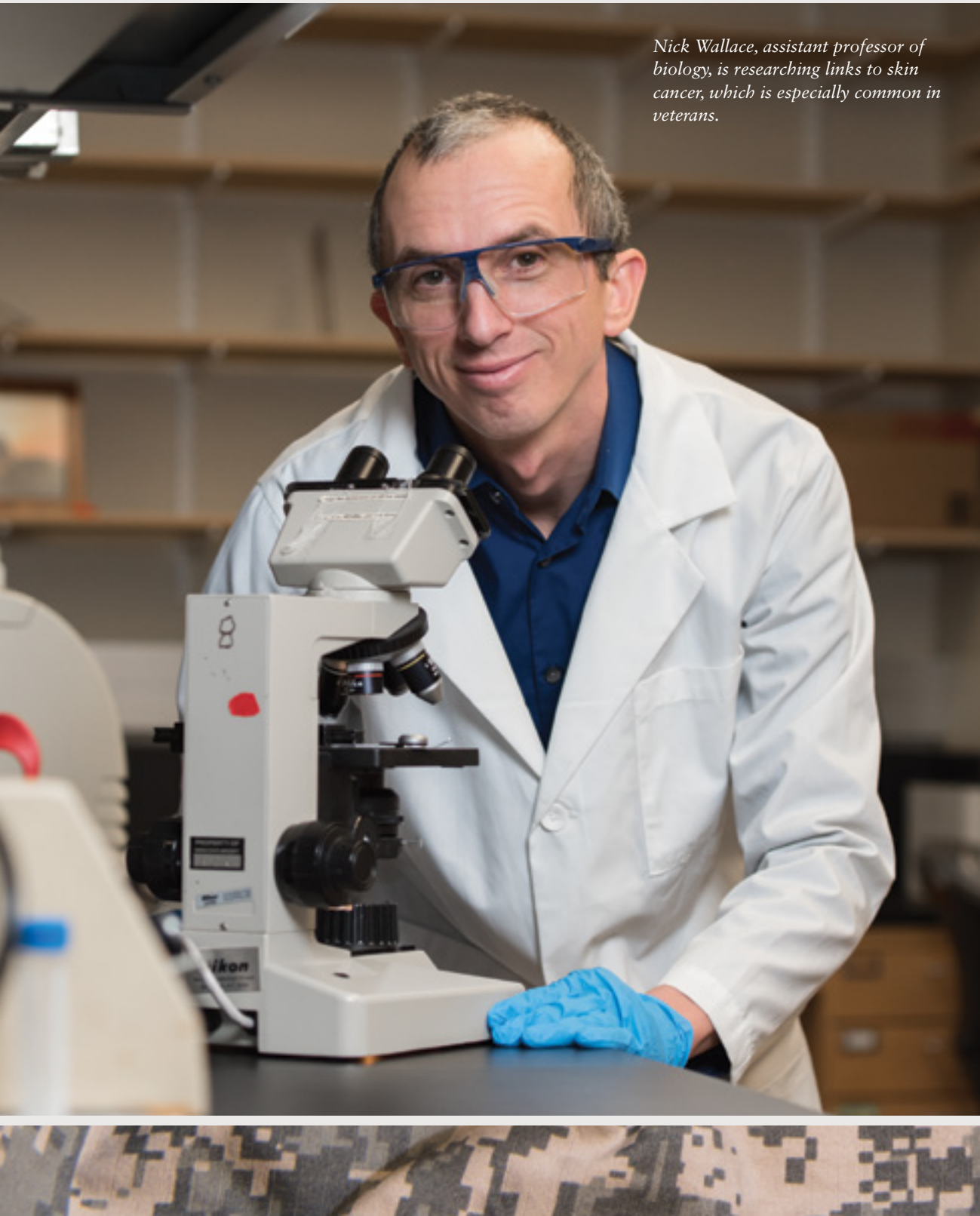
The second approach is related to non-steroidal anti-inflammatory drugs, or NSAIDs, which stop the swelling that starts in one molecule before becoming prostaglandins, which are hormonelike chemical compounds. Preliminary data suggests that men may make larger quantities of prostaglandins than women after a traumatic incident.

“We may simply be making different amounts of soluble molecules,” Fleming said. “If that’s the case, we may already have the drugs necessary for treatment.”

Fleming’s team holds a drug patent that could prevent antibodies in blood from binding and causing further cell damage.

“It’s amazing what sort of trauma we can live through, only to turn around and have your own body cause this extra damage,” Fleming said. “Soldiers are dying because we don’t understand what’s going on. These men and women are important to me, and if I can do something to help them, then that’s important, too.”





*Nick Wallace, assistant professor of biology, is researching links to skin cancer, which is especially common in veterans.*

# THE LIGHT OF DAY

## Nick Wallace, biology Career Development Award

Every year, 3 million cases of skin cancer are diagnosed in the U.S. and \$4.8 billion is spent treating these patients, according to the Skin Cancer Foundation. Skin cancer is especially common among active military members and veterans, often because of the extreme sun exposure in the locations of their deployments.

Nick Wallace, assistant professor of biology, is using a \$510,000 Career Development Award from the U.S. Department of Defense Congressionally Directed Medical Research Programs to research an unexpected link between skin cancer and sun exposure: human papillomavirus, or HPV.

“Nearly 80 percent of people contract some form of HPV in their lifetimes,” Wallace said. “We know sexually transmitted HPV can cause cervical cancer, but the DOD wants to know if skin-to-skin HPV infections combined with sun damage also may cause skin cancer.”

Although the military has made a lot of progress in ultraviolet, or UV, radiation prevention, little is known about whether a viral infection may make sun damage even worse, Wallace said. Researchers recently have discovered strong links between several forms of skin-to-skin HPV, UV damage and skin cancer.

If Wallace can provide solid evidence that these interactions are taking place, it’s a relatively simple fix to adjust the current HPV vaccine to include skin cancer protection. HPV protection also could be included as a sunscreen additive.

“During sun exposure, the HPV binds to a protein that affects the cell’s response,” Wallace said. “If we can block the virus’ interaction with that cellular protein through an additive, we could target soldiers or civilians at a critical moment as they apply sunscreen before direct exposure.”

Wallace’s lab work includes taking normal skin cell samples, adding HPV proteins to a select number and exposing them to UV and other damaging agents.



*These skin cells have been treated with fluorescent markers to determine their response to UV damage. Purple markers identify the tiny fibers that hold cells together, while yellow markers identify DNA. HPV makes it more likely that skin cells have too much DNA and may become cancerous.*

“Community engagement means a lot, particularly when it comes to protecting our nation’s soldiers.”  
– Nick Wallace, assistant professor of biology

“Cells are constantly dividing, and about 10 percent of the time they can make a mistake,” Wallace said. “This can double the amount of DNA, which can be worsened by UV and put cells at risk for developing cancer.”

Wallace is taking pictures of these cells with fluorescent markers to determine their response to UV damage. Looking closely at individual cell proteins, he studies how these infections change skin cells.

Both at home and internationally, Wallace said the response to his team’s work has been incredibly rewarding.

“We don’t want our discoveries to sit on a shelf, but we want to unveil them so people can ask even more questions,” Wallace said. “Community engagement means a lot, particularly when it comes to protecting our nation’s soldiers.” **K**





# Keeping Kansas beef on track

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CattleTrace project aims to safeguard  
state's \$17B industry

*By Pat Melgares*





*A worker at Farmers & Ranchers Livestock sale barn in Salina monitors pens of cattle. The sale barn has installed technology that tracks Kansas cattle through the CattleTrace project.*

On a brisk December day, about 30 head of cattle arrive at Innovative Livestock Services Inc. near Great Bend, Kansas, moving methodically through a semitrailer, down a short ramp and into a feedlot pen.

As they make their way, the bright yellow tags attached to their right ears send signals through ultrahigh frequency chip readers to a computer located nearly 130 miles away in Manhattan, where a Kansas State University team and several Kansas groups are building an important safeguard for the state’s \$17 billion cattle industry.

Their two-year pilot project, called CattleTrace, shows how the state’s beef industry may eventually track suspected animal diseases, and it could be a preview of things to come for the rest of the U.S. The U.S. is one of a few countries that does not have a national animal disease traceability system in place for beef cattle.

“We view CattleTrace as a risk management tool for the industry,” said Brandon Depenbusch, vice president of cattle operations at Innovative Livestock Services Inc. and a K-State graduate. “It’s important for all segments of the industry to have a tool such as CattleTrace to be able to track animals just in case of a disease outbreak.”

## Addressing vulnerability

Industry officials point to the Kansas Livestock Association’s annual convention in late 2017 as a key driver for an animal traceability system in Kansas. At that meeting, the association passed a resolution in support of mandatory traceability for all classes of cattle in Kansas.

Two months later, as a result of its Beef Industry Long Range Plan, the National Cattlemen’s Beef Association released a feasibility study on a national animal identification and traceability system.

“Kansas has made traceability a huge part of what we do for the simple fact of our vulnerability,” said Justin Smith, the Kansas animal health commissioner and state veterinarian with the Kansas Department of Agriculture. “We tend to be an import state, meaning we get a lot of animals into the state of Kansas. Our attitude is that we are vulnerable to animal disease, and probably our risk is somewhat higher than the states that tend to produce the animals and ship them out of their states.”

Cassie Kniebel, the K-State project manager for CattleTrace, noted that traceability is not new in the cattle industry; for example, the U.S. government has

passed legislation that requires disease traceability for breeding animals over the age of 18 months.

“But that doesn’t include feeder cattle, which are those cattle younger than 18 months,” Kniebel said. “If you look at the majority of cattle moving across the country at any given time, it’s those feeder animals.”

In Kansas alone, most of the 6.3 million cattle typically in the state are feeder cattle, including nearly 2.5 million cattle in feedlots, according to the U.S. Department of Agriculture.

“Today, if you suspect a disease in a feeder animal, there have been traceability efforts that have happened over the past few years, and they have taken six months to two years to identify the problem,” Kniebel said.

“That’s not ideal.”

## Crucial response time

Indeed, a disease such as foot-and-mouth disease could spread so quickly through cattle herds that a delay of even a few days would be devastating, both in terms of loss of animals and export markets. Simply put, the



emotional and economic damage wrought by animal disease would mount as each precious hour passed.

Kniebel said the tracing system Kansas is putting in place could allow animal health officials to trace a disease within minutes and narrow down where the suspect animals came from and which animals they may have interacted with or infected. Treatment and quarantine of those animals could begin immediately. Producers whose cattle are not affected could quickly resume normal operations.

“The key buzzword we use is speed of commerce,” Smith said. “We need to be able to gather that information but not impact how business is done.”

Thus, CattleTrace is a hands-free — and nearly maintenance-free — system. In the first eight months of the pilot project, officials have made available 55,000 ear tags equipped with ultrahigh frequency chips. As cattle move from farms to sale barns to feedlots and eventually to packing plants, they pass chip readers that can capture the signal and send it to a database managed by the CattleTrace team at K-State.

“I liken this to the K-TAG system that is common on the Kansas Turnpike,” Depenbusch said. “If you have a K-TAG in your car, you just drive right on through the toll booth and don’t have to stop. If you don’t have a K-TAG, you have to go through an alternate booth; that slows me down and slows the speed of commerce.

“What that allows us to do in the cattle industry is we can run multiple animals down an alleyway, a hundred at a time, and it catches all of those reads as the animals run through.”



*Top left: CattleTrace uses tags that contain ultrahigh frequency chips and are attached to cattle’s ears.*

*Top right: A load of heifers at Clint Sturdy’s ranch near Lyndon, Kansas, waits for CattleTrace ear tags.*

*Below: The new CattleTrace tags are bright yellow and slightly larger than ear tags used in the past.*





Each pass sends a signal that places each animal at a given point in the production cycle. From the database in Manhattan, officials who are granted access can respond within minutes to any report of suspected animal disease.

“Data privacy is top of mind for many producers,” Kniebel said. “So we established CattleTrace Inc. as a private, nonprofit organization. CattleTrace Inc. has agreements in place with K-State for data management purposes, but a board of directors that includes producer representatives was named to determine the process for data access. This is an industry-driven program, and key decisions will be determined by the industry.”

## Working together

A little more than 10 years ago, U.S. producers were involved in efforts to establish the National Animal Identification System. Brad White, a K-State professor of production medicine and director of the Beef Cattle Institute, said that program never got much traction because multiple groups were unable to work together for a system that suited the entire industry.

“Whether you’re a producer, a veterinarian, an animal health official or a government agency, you all have different points of view,” White said. “And if it’s a program driven by any one of those groups, it’s going to struggle because the others don’t have the same motivations.”

Kniebel said CattleTrace is off to a promising start because all segments of the Kansas cattle industry are working together. The pilot project currently includes numerous producers, 14 feedlots, eight sale barns and all three major packers in Kansas. Kansas State University, the Kansas Department of Agriculture, the Kansas Livestock Association and private industry stakeholders are significantly supporting the project.

“I’m a great supporter of it,” said Clint Sturdy, a rancher near Lyndon, Kansas, who recently put CattleTrace ear tags on 85 heifers that he bought in Montana. “I want to participate when I can to help guide the development of the system. The industry needs a disease traceability program, and so I think this is a forefront program that we need to be behind.”

Kniebel said many other producers also are excited about CattleTrace.

“There’s still some folks who are a little hesitant about it and have questions, but we hope to answer some of those questions with this pilot project and provide a forum for them to have input into this system,” she said. “Because we want it to be industry-driven, we need everybody’s feedback whether they’re in support of it or not so that we can address industry concerns.”

## Value-added opportunities

This spring, graduate and undergraduate students in K-State’s agricultural economics department are conducting research to determine what value a system such as CattleTrace provides to the state’s industry. Ted Schroeder, university distinguished professor of agricultural economics, is supervising the students, who are interviewing officials at feedlots and packing plants on the value of information that can be gathered from animal identification.



*Above: Heifers leaving the sale arena at Farmers & Ranchers Livestock in Salina pass through a reader, which sends a signal to a computer database in Manhattan.*

*Below: Ranchers have long used ear tags to identify cattle. CattleTrace ear tags include ultrahigh frequency chips to track cattle movement.*



Schroeder’s colleague, Dustin Pendell, professor of agricultural economics, has been studying animal traceability for more than a dozen years. He said that in addition to quickly identifying disease and slowing its spread, animal traceability provides potential added benefits for the industry.

“If you’re a cow-calf producer, for example, you could use these electronic records in managing your operation,” he said. “If you’re selling your calves to a branded program, you have documentation and records on all the cattle.”

White said the current work to establish chip readers at feedlots, sale barns and packing plants is like building an interstate. As time goes on, companies and others will determine the best ways to build on-ramps — or value-added benefits — to the interstate.

“Once we set up and we have the structure in place to record information, there may be other systems that can use that same structure and gain more value, be they private systems in the industry, or others,” White said. “Building the infrastructure is critical.”

## A national system

Smith noted that the eyes of the USDA are fixed on what Kansas finds out in the two-year CattleTrace trial.

“One of the goals of this project is to make it scalable and give something that maybe other states could look at and tweak it to make it work nationally,” he said.

The project also could scale nationwide as the U.S. looks at ways to create an animal disease traceability system that will help to market U.S. beef overseas.

“Other countries are using the fact that the U.S. doesn’t have a disease traceability system as leverage against us when they’re trying to do business with other countries,” Depenbusch said. “We need to take this disadvantage off the table; we need to make sure we have disease traceability so that can’t be used against us.

“CattleTrace won’t prevent our exports from going away if we have a disease outbreak, but we expect that it will allow us to come back and regain those exports quicker than if we didn’t have it.” [k](https://k-state.edu/seek)

### ➤ Seek more

Watch a video on the CattleTrace project.  
[k-state.edu/seek](https://k-state.edu/seek)

*Cattle wait in the sale arena at Farmers & Ranchers Livestock in Salina. Each animal has an ear tag that indicates where it has come from, what other animals it has mingled with and when it was at different locations. That information is stored privately in a central database in Manhattan.*





## Delivering a PEAK performance

*Center on Aging improves Kansas nursing home care*

*By Beth Bohn*

*The Leonardville Nursing Home in Leonardville, Kansas, has achieved sustained person-centered care home status through the PEAK 2.0 program offered by the Kansas Department of Aging and Disability Services and developed and operated by the Center on Aging at Kansas State University. Above: A Leonardville Nursing Home resident, left, meets with Gayle Doll, center, director of the Center on Aging, and Laci Cornelison, PEAK 2.0 director. Center and far right: Cornelison and Doll spend time with residents of the Leonardville Nursing Home.*

The Center on Aging at Kansas State University is proving that Kansas nursing home and long-term care facilities in PEAK condition are delivering better care to their residents.

PEAK stands for Promoting Excellent Alternatives in Kansas and is the first-ever Medicaid pay-for-performance incentive program for person-centered care. The program launched in 2002 by the Center on Aging under a contract with the Kansas Department for Aging and Disability Services and is now called PEAK 2.0.

“Nursing homes have been notoriously known as places that nobody wants to go,” said Laci Cornelison, director of PEAK 2.0 and a research associate with the Center on Aging. “Part of that is feeling like a person loses all of their autonomy and rights when they become a nursing home resident. The K-State Center on Aging PEAK program is really about helping homes changes their service models so that they can be individualized to each person, and that the homes can provide services around what each resident wants.”

Under PEAK 2.0, K-State is helping homes in Olathe, Topeka and all around Kansas engage in system changes to support person-centered care or demonstrate implementation of person-centered care to receive financial incentives through Medicaid reimbursements from the state of Kansas.

PEAK 2.0 also is the first program able to measure the quality of nursing home care at various levels of person-centered care adoption, said Gayle Doll, director of the Center on Aging. Doll has been involved with PEAK almost from its start.

“Before PEAK 2.0, a single home could be found to be doing a nice job overall, but that really couldn’t be used for comparison purposes,” Doll said. “PEAK 2.0 changed that by creating a structured program, standard definitions of care and a rigorous evaluation process.”

PEAK 2.0 data shows person-centered care is having positive effects on nursing home residents.

“What we’re finding is that satisfaction increases in homes that have fully adopted person-centered care,” Cornelison said. “We’re finding that pressure ulcers are going down, that urinary tract infections are going down and that depression rates go down.”

Results are more variable but show promise for PEAK 2.0 homes and their incidences of incontinence, antipsychotic use and vaccinations for influenza and pneumonia, as well.

“The data reveals that the PEAK 2.0 program creates a significant impact on the health and satisfaction of residents who live in PEAK participant homes,” Doll said. “These results demonstrate that Kansas has implemented one of the most effective and impactful pay-for-performance programs in the U.S.”

The Center on Aging is responsible for oversight, evaluation, assessment and related paperwork of PEAK 2.0. Cornelison, as full-time director, oversees two K-State graduate students who work on the program and five consultants who travel to the nursing homes and help with evaluations. Doll is co-principal investigator on PEAK. Environment and aging expert Migette Kaup, a professor of apparel, textiles, and interior design at K-State, is co-principal investigator.

When nursing homes enroll in the PEAK 2.0 program, they take an assessment to see where they are in terms of providing person-centered care and are given access to a number of resources, including training,

on-site visits, Zoom meetings, web resources and more. The Center on Aging evaluates homes on their progress in PEAK 2.0 using a variety of quality measures. The data also is used to measure nursing homes enrolled in the program against homes that aren’t enrolled.

Cornelison and Doll are optimistic that the clinical proof the Center on Aging has collected will show lawmakers and state government leaders that the program is a success and worth continued funding.

“PEAK is unique to any other state,” Cornelison said. “Our website publishes homes that are engaged in the program and homes that are engaged in those upper levels. It’s important to get this information out to consumers as it can be really valuable in helping them select a nursing home or long-term care facility.”

PEAK 2.0 is just one way the Center on Aging seeks to make life better for the elderly. Doll has earned national attention for her research on sexuality and aging, sexual expression in long-term care settings and the impact of ageism on sexual well-being. Another center project studied an all-day kindergarten classroom at a Kansas nursing home where residents took part in classroom activities. [k](#)

### ➤ Seek more

Watch a video about the PEAK 2.0 program.  
[k-state.edu/seek](https://k-state.edu/seek)





Mary Beth Kirkham, university distinguished professor of agronomy, studies soil, plant and water interactions to answer questions about environmental effects on plant growth.

## Soil superstar

*Professor’s distinguished career keeps growing*

By Taylor Provine

When Mary Beth Kirkham sees a problem, she turns to the soil for the answers.

The Kansas State University distinguished professor of agronomy studies interactions among soil, plants and water, which involves the movement of water from soil to plants out into the atmosphere. Her research has answered questions about how the environment affects plant growth.

Kirkham was the first researcher to study the effects of elevated carbon dioxide levels on crops grown under semiarid conditions, like those in Kansas.

“Carbon dioxide levels are naturally increasing in the environment each year,” she said. “We want to see how this would affect plant growth in the future.”

Kirkham and her students have monitored how much water is being lost from the plants through their stomata, which are the small holes in the leaves.

“One effect elevated carbon dioxide has on plants is it closes the stomata,” Kirkham said. “The more the stomata are closed, there’s less water loss in the plant.”

Their research also shows that soil-water content is

greater under elevated carbon dioxide levels.

“As the carbon dioxide concentration in the atmosphere increases, the water-use efficiency of crops also increases,” she said. “Plants are going to be more drought resistant under elevated levels of carbon dioxide, which is extremely beneficial for semiarid regions.”

Kirkham also studies the uptake of heavy metals by plants grown in highly polluted soil.

In her most recent study, Kirkham and a graduate student took a soil sample from an abandoned mining district in southeast Kansas and applied biosolids, or treated sewage sludge, which is known to improve plant growth.

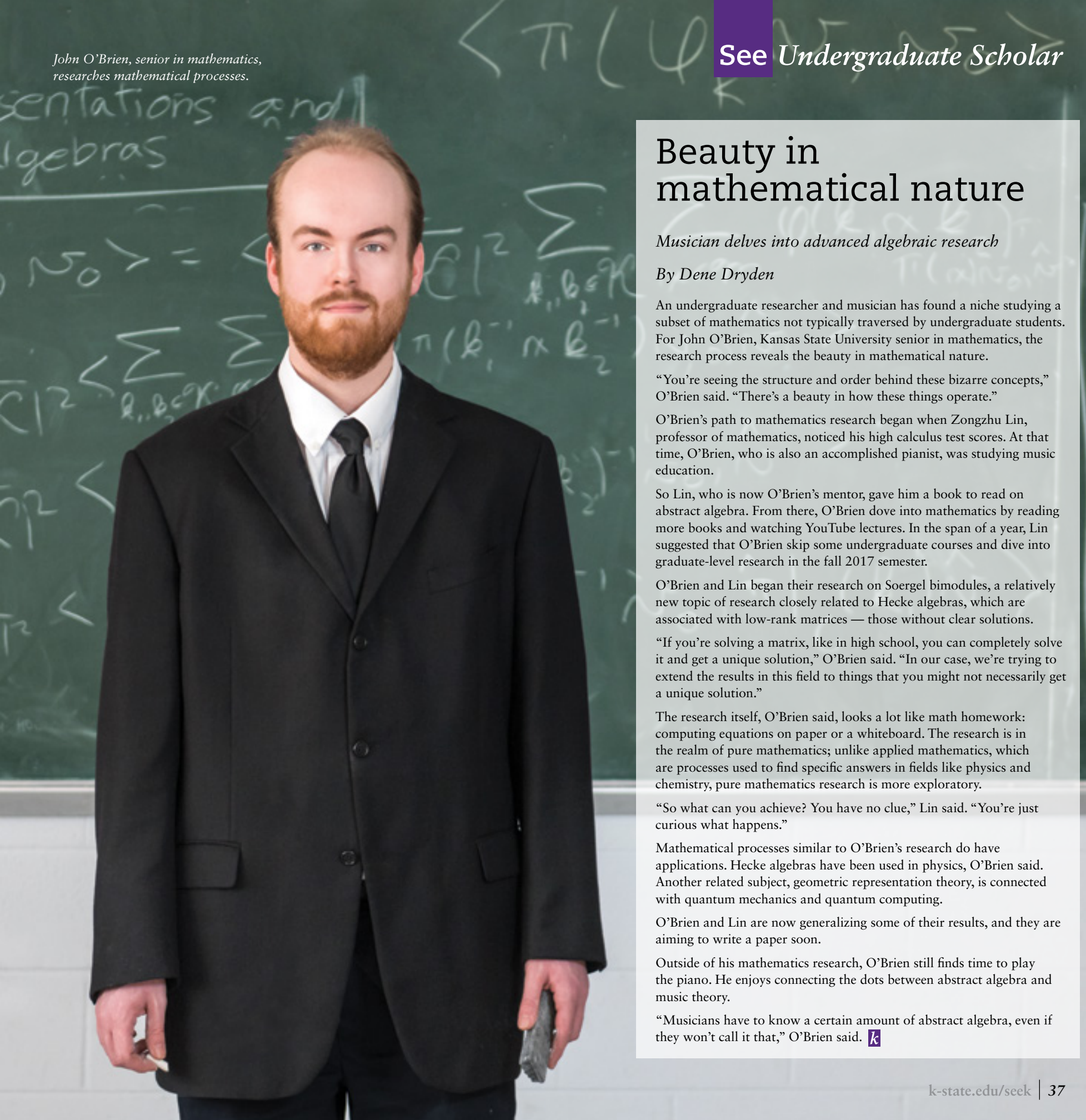
“We found that the phosphorus in the sludge was preventing the uptake of the metals from the soil and the plants grew fine,” Kirkham said. “The plants that grew without the sludge were stunted and showed serious heavy metal damage.”

For degraded land, this could be a solution to remediate it and make it more productive, she said.

Kirkham joined the university in 1980. She has published three textbooks and contributed to more than 300 articles in scientific publications. She is a fellow of the American Society of Agronomy, the Soil Science Society of America, the American Association for the Advancement of Science, the Crop Science Society of America and the Royal Meteorological Society.

She has received several notable awards, including the Carl Sprengel Agronomic Research Award from the American Society of Agronomy, the 2010 Crop Science Research Award and the 2013 Irvin E. Youngberg Award in Applied Sciences, one of the Higuchi-University of Kansas Endowment Research Achievement Awards. **k**

John O’Brien, senior in mathematics, researches mathematical processes.



## Beauty in mathematical nature

*Musician delves into advanced algebraic research*

By Dene Dryden

An undergraduate researcher and musician has found a niche studying a subset of mathematics not typically traversed by undergraduate students. For John O’Brien, Kansas State University senior in mathematics, the research process reveals the beauty in mathematical nature.

“You’re seeing the structure and order behind these bizarre concepts,” O’Brien said. “There’s a beauty in how these things operate.”

O’Brien’s path to mathematics research began when Zongzhu Lin, professor of mathematics, noticed his high calculus test scores. At that time, O’Brien, who is also an accomplished pianist, was studying music education.

So Lin, who is now O’Brien’s mentor, gave him a book to read on abstract algebra. From there, O’Brien dove into mathematics by reading more books and watching YouTube lectures. In the span of a year, Lin suggested that O’Brien skip some undergraduate courses and dive into graduate-level research in the fall 2017 semester.

O’Brien and Lin began their research on Soergel bimodules, a relatively new topic of research closely related to Hecke algebras, which are associated with low-rank matrices — those without clear solutions.

“If you’re solving a matrix, like in high school, you can completely solve it and get a unique solution,” O’Brien said. “In our case, we’re trying to extend the results in this field to things that you might not necessarily get a unique solution.”

The research itself, O’Brien said, looks a lot like math homework: computing equations on paper or a whiteboard. The research is in the realm of pure mathematics; unlike applied mathematics, which are processes used to find specific answers in fields like physics and chemistry, pure mathematics research is more exploratory.

“So what can you achieve? You have no clue,” Lin said. “You’re just curious what happens.”

Mathematical processes similar to O’Brien’s research do have applications. Hecke algebras have been used in physics, O’Brien said. Another related subject, geometric representation theory, is connected with quantum mechanics and quantum computing.

O’Brien and Lin are now generalizing some of their results, and they are aiming to write a paper soon.

Outside of his mathematics research, O’Brien still finds time to play the piano. He enjoys connecting the dots between abstract algebra and music theory.

“Musicians have to know a certain amount of abstract algebra, even if they won’t call it that,” O’Brien said. **k**



## Future defenders

*NBAF Scientist Training Program supports student development and biodefense workforce*

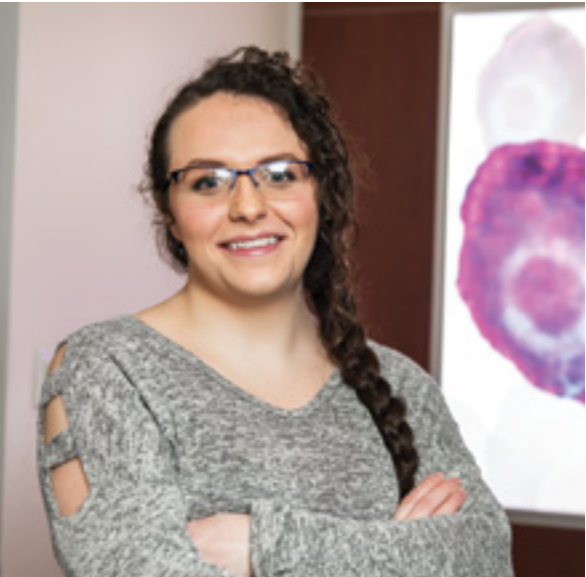
*By Sarah Caldwell Hancock*

As the National Bio and Agro-defense Facility, or NBAF, takes shape adjacent to Kansas State University’s Manhattan campus, several graduate students look forward to launching their own careers there.

The NBAF Scientist Training Program offers support for students pursuing master’s or doctoral degrees in microbiology, virology, molecular biology, diagnostics, veterinary medicine and other fields related to the facility.

The U.S. Department of Agriculture Animal and Plant Health Inspection Service funds the program, which provides the students with full tuition and supplementary support to build the necessary expertise for the Foreign Animal Disease Diagnostic Laboratory at NBAF. NBAF will be operational in 2022, and Plum Island Animal Disease Center operations will transition to NBAF by 2023.

The first K-State cohort of NBAF Scientist Training Program fellows began in summer 2018. All five students are from the College of Veterinary Medicine and already are working on research that safeguards U.S. agriculture.



*Kaithlynn Schuck, master’s student in veterinary biomedical sciences*

**Research focus:** Rift Valley fever virus, which is transmitted by mosquitoes and primarily affects animals such as sheep, cattle, goats and camels, but also can infect humans.

### What excites you about your research?

“It is the potential to be involved in innovations that may open new doors to more options for diagnostic and confirmatory testing for Rift Valley fever virus. It’s exciting to know that your efforts can translate into real-world applications.”

### Why do you want to work at NBAF?

“I want to continue my research and expand my skill set in this new state-of-the-art research facility. I also am excited to be part of this first cohort of fellows so that I am able to help with the transition from Plum Island Animal Disease Center and preserve its legacy and crucial role.”



*Laura Constance, concurrent Doctor of Veterinary Medicine and doctoral student in diagnostic medicine and pathobiology*

**Research focus:** African swine fever, which is a highly contagious and deadly disease of pigs, and the ways it could be introduced in the U.S. through imported feed ingredients.

### What excites you about your research?

“I find my work very gratifying because it will help protect our country against introduction of foreign animal diseases. African swine fever causes severe disease and deaths to pigs in other countries. Preventing entry of this disease in the U.S. is critically important.”

### Why do you want to work at NBAF?

“I want to expand my knowledge of foreign animal diseases and help prevent their introduction into the country. Eradication of many foreign animal diseases is still in progress; I want to be a part of the team that helps with this process. I also am interested in teaching and training future scientists, veterinarians and students about these diseases so they can help prevent disease entry and potentially develop treatments.”



*Chester McDowell, concurrent Doctor of Veterinary Medicine and doctoral student in diagnostic medicine and pathobiology*

**Research focus:** Portable sequencing technologies for the detection, characterization and surveillance of emerging animal diseases and diseases that affect both animals and humans.

### What excites you about your research?

“I am able to utilize novel technology for the rapid detection and surveillance of high-consequence and emerging pathogens that may be missed using conventional technology. It is very exciting to work with cutting-edge equipment that can be used in a field setting rather than only in a laboratory environment.”

### Why do you want to work at NBAF?

“It will allow me to work closely with leading experts in the field of high-consequence animal pathogens in a state-of-the-art setting. NBAF will possess the equipment and personnel necessary for the development and validation of novel diagnostic assays for an array of diseases and will provide a unique opportunity to conduct research that is beneficial to both human and animal health.”



*Victoria Ayers, doctoral student in diagnostic medicine and pathobiology*

**Research focus:** Bunyaviruses, which are spread by mosquitoes and ticks and can cause fever or brain swelling in humans or animals, and vaccine development for ruminant animals, such as cattle, sheep, goats and deer.

### What excites you about your research?

“I’ve always had a passion for animal health, and working in the research field allows me to make a direct or indirect impact on animal and human health.”

### Why do you want to work at NBAF?

“Working at NBAF would allow me to work on new diagnostics tools in high biocontainment to assist in the improvement of animal health and protection.”




*Christian Cook, doctoral student in diagnostic medicine and pathobiology*

**Research focus:** Japanese encephalitis virus, which is transmitted to humans by infected mosquitoes.

### What excites you about your research?

“It will determine the role of swine species in the evolution of Japanese encephalitis virus and determine its contribution to transmission cycles outside endemic regions.”

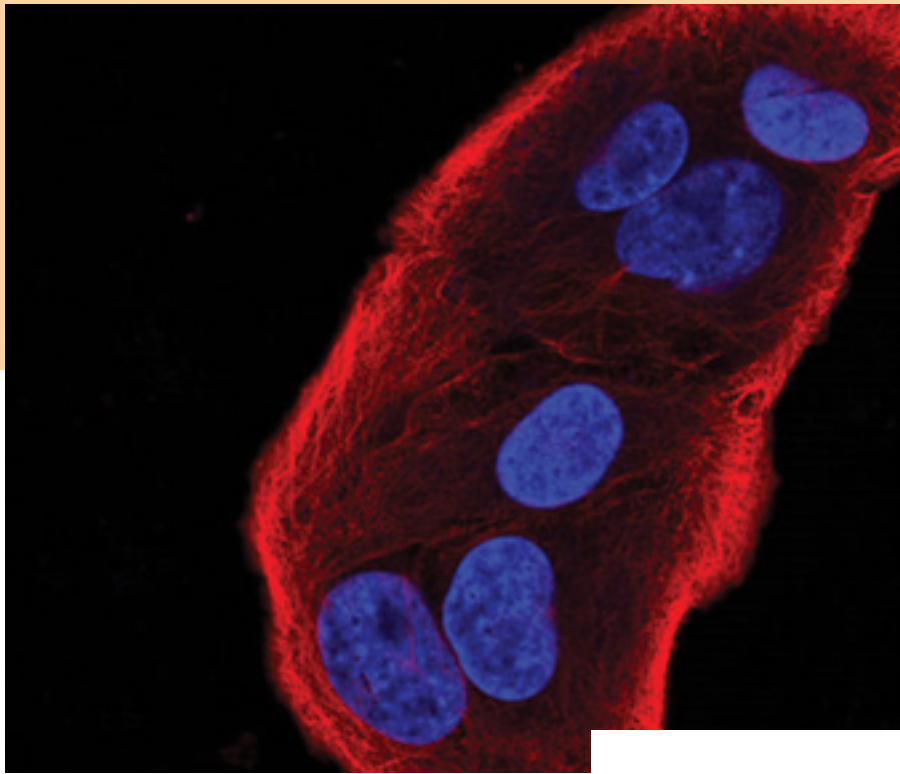
### Why do you want to work at NBAF?

“I want to research and develop diagnostic capabilities for foreign animal and zoonotic diseases. I aim to be involved in research to prepare for and prevent potential threats to agriculture.” 

➤ Seek more

Read more about the fellows.  
[k-state.edu/seek](https://k-state.edu/seek)





*A microscope took this photo of two cells, shown in red, and oncoproteins, shown in blue. The two cells should have only two blue ovals of oncoproteins, but they have three times that amount because they are cancer cells.*

# oncoproteins

äŋ-kō-'prō-tēns

*Nick Wallace, assistant professor of biology, explains, in under 100 words, what oncoproteins are and why they are important in detecting cancer.*

Most meals have some salt in them, but adding too much can ruin any dish. Oncoproteins are similar. Each of your cells makes oncoproteins, but only a small amount. A limited quantity of oncoproteins is helpful, but too much causes cancer. Some viruses like human papillomavirus, or HPV, make oncoproteins when they infect us, which also can cause cancer. Scientists have identified more than 100 types of oncoproteins. This helps doctors find and treat cancers sooner. Recognizing cancers early is a big deal, because the quicker you find a tumor, the easier it is to treat.

*See page 26 to learn more about Wallace’s research on the links between skin cancer and HPV.*



## A core component

The opportunity to explore and investigate always has been a core component of academic life at Kansas State University. The students pictured here in 1891 are from a special chemistry class for advanced students. In the 1890s, K-State chemistry courses included elementary, organic, analytical and agricultural chemistry as well as mineralogy. Today, chemistry-related research occurs in departments and programs across the university, from chemistry and biochemistry to agriculture and veterinary medicine. See page 10 to learn how K-State researchers are using cutting-edge scientific technology.


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



## Influencing tomorrow

As the nation's first operational land-grant university, Kansas State University is dedicated to research that betters our community, state and world.

The Influence Tomorrow initiative explores the university's mission to address challenges in agriculture, biodefense, personal and financial health, business, infrastructure, education, basic science and more.

As an example, K-State helps Kansas consumers select patient-centered care that increases satisfaction and health of residents. See page 34 to learn how K-State is influencing tomorrow through the K-State Center on Aging PEAK 2.0 program. 

### ➤ Seek more

Explore the power of K-State research.

[k-state.edu/seek](https://k-state.edu/seek)

[k-state.edu/influence-tomorrow](https://k-state.edu/influence-tomorrow)

