Expression of University Strengths

February 2018
MEMORANDUM FROM PRESIDENT RICHARD B. MYERS

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3. National Plant Diagnostic Network, NPDN
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5. Food Animal Residue Avoidance and Depletion Program, FARAD
6. The Center for Food Safety in Child Nutrition Programs
7. National Animal Health Laboratory Network, NAHLN
8. NSF National Ecological Observatory Network, NEON
9. NSF Long-Term Ecological Research Program, LTER, at Konza Prairie
10. USDA-ARS Center for Grain and Animal Health Research, CGAHR
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   - CGAHR — Wheat Quality and Competitiveness
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   - CGAHR — Hessian Fly Research
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### NATIONAL INITIATIVES

1. College of Veterinary Medicine/Association of American Veterinary Medical Colleges
DATE: February 7, 2018
TO: Members and Staff of the Kansas Congressional Delegation
FROM: Richard B. Myers, President Kansas State University
RE: Kansas State University Expression of University Strengths Document

On behalf of Kansas State University, I would like to thank each of you for your work for the citizens of Kansas. Your guidance and support has assisted the university in launching and enhancing programs and research efforts. We particularly appreciate the support you have shown the University in the past.

This document is presented to you as Expressions of University Strengths. The university faculty and staff believe these initiatives represent the strengths of the university and match federal initiatives and programs. In addition, these initiatives are in step with K-State 2025, the university’s strategic plan with the goal to be recognized nationally as a Top 50 public research university by 2025.

If you have questions about any of these requests, please contact Sue Peterson, chief government relations officer, at 785-532-6221 or skp@k-state.edu. She will provide you with whatever information you may require. You may access this document electronically on the K-State Government Relations website at k-state.edu/govrelations/federal.

Richard B. Myers
AGRICULTURE
The Food and Agriculture Systems Teaching, Extension and Research Facility, FASTER

Background
The Kansas State University College of Agriculture has very few modern laboratories, greenhouses and other research or teaching intensive facilities. The last building constructed for plant-related research was Throckmorton Hall, completed in two phases: 1981 and 1994. Other buildings housing animal, meat, food, grain and entomology studies range from 61 to 104 years old. As the state's largest industry, agriculture is critical to Kansas' future, and K-State is essential to the future growth of this industry.

With the world increasing in population to 9.7 billion by 2050, Kansas is positioned to benefit from the resulting increased worldwide food demand. However, we must develop higher-yielding crops, more intensive cropping systems, enhanced beef and dairy genetics and production, and improved processing and distribution systems that minimize food loss while maintaining the natural resource base for future production.

Description
Researchers and educators at K-State are internationally recognized in food and agriculture. The U.S. Agency for International Development selected, or USAID, K-State to host four innovation labs, which focus on applied wheat genomics, sorghum and millet improvement, sustainable intensification, and on the reduction of postharvest loss. The National Science Foundation also funded its first ever Industry/University Center for Wheat Genetics at K-State.

Recently, the National Academies of Sciences' National Research Council published the rankings of doctoral programs in the United States. Many of K-State's College of Agriculture programs were in the Top 10: plant pathology, No. 1; agricultural economics, No. 4; entomology, No. 8; food science, No. 9; and plant sciences, No. 10. The Department of Animal Sciences and Industry was No. 5 in terms of research productivity.

In FY 2016, Kansas State University's Agricultural Experiment Station expended $104 million in research, which was 53.9 percent of the total university research expenditures of $193 million.

Relevance
During the past 10 years, the number of students in the college has increased by more than 1,000. In addition, almost 100 percent of College of Agriculture graduates find excellent jobs, most of them in Kansas: approximately 65 percent. The U.S. Department of Agriculture expects the demand for future agricultural graduates will continue to grow.

For K-State to reach its 2025 goal of becoming one of the nation's Top 50 public research universities, the College of Agriculture and K-State Research and Extension must continue to increase research, teaching and outreach activities.

To capitalize upon our existing strengths in food and agricultural research, we propose a new Food and Agriculture Systems Teaching, Extension and Research, or FASTER, Facility. The new building will also address the needs for growth required by the College of Agriculture and K-State to meet goals in their respective 2025 strategic plans.

A space-needs analysis for the college identified a serious need for an additional 231,572 square feet of usable research laboratory space. The new FASTER Facility will only partially meet this need.

The FASTER Facility would add approximately 125,000 net square feet of state-of-the-art research laboratory space and some, as yet to be determined, space for teaching, extension and distance education.

The project would also add additional square feet of modern greenhouse space to supplement the existing and aging greenhouse facilities.

The new building will include an appropriate number of offices and conference rooms, as well as adequate space for our partners from the USDA Agricultural Research Service and USDA Animal and Plant Health Inspection Service. This will continue our great research collaboration and synergy.

Research space would be allocated to work on the grand challenges facing Kansas agriculture, the nation and the global food system: wheat, sorghum, livestock, food safety, water, etc. With enhanced facilities at K-State, Kansas will continue to produce more crops and livestock for consumers here and abroad, and Kansas agriculture will continue to lead the state's economy.

As the university prepares to partner with the future National Bio and Agro-defense Facility, or NBAF, activities underway in the College of Agriculture/K-State Research and Extension will be crucial to the success of the partnership. New facilities will allow K-State to adequately prepare students for possible careers either within NBAF or with companies working with NBAF on many cutting-edge technologies.

Agency Contact Information
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Background

Established in 2013, the Wheat Genetics Resource Center Industry/University Cooperative Research Center — WGRC I/UCRC — at Kansas State University joins public and private partners to mobilize genetic diversity to enhance wheat yield and meet food security needs. Researchers at the WGRC I/UCRC deliver novel genes, derived from wild wheats, to public and private breeding programs. These genes combat challenges facing wheat farmers, such as hot and dry climate conditions, pests and disease, to ensure a stable and profitable wheat supply that keeps up with global demand. The WGRC I/UCRC will also target genes related to consumer-demanded nutritional, flavor and textural profiles. Beyond scientific deliverables, the WGRC I/UCRC provides a transdisciplinary, applied and fundamental research environment to train the future leaders of crop improvement research.

Description

Kansas State University requests $750,000 per year, for five years, to be matched by industry investors and the National Science Foundation. The funding will go toward the core research program of the WGRC I/UCRC:

• Managing wheat germplasm
• Mining the wheat gene pool
• Wheat phenotyping for drought
• Wheat genetic stocks and introgression platform, and
• Graduate student training.

This core research program enhances the value of the WGRC wild wheat collection to the user community, leading to rapid development of new, high-yielding wheat varieties and value-added food products.

Relevance

• Temperature increases are projected to decrease wheat yields by 20-30 percent.
• Demand for wheat is expected to increase by 60 percent over the coming decades.
• The current trend of wheat yield cannot meet the projected global demand in 2050.

The WGRC I/UCRC provides novel genes to breeders to develop wheat varieties for farmers that can resist pressures such as disease, water, nutrient and energy scarcity, and climate change.

The core research program of the WGRC I/UCRC has three main missions to address challenges facing the global wheat supply:

1) Collect, conserve and utilize germplasm in crop improvement; included in the current stock:

2) Create and promote the free exchange of materials, technology and new knowledge in genetics and biotechnology: in the first three years of operations, center researchers have produced 25 publications and 14 presentations.

3) Train undergraduate, graduate and postgraduate students and visiting scientists: WGRC has mentored 13 master’s students, 25 doctoral students and 20 postdoctoral fellows, in addition to hosting more than 60 visiting scientists from all over the globe.

Agency Contact Information

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Members and Partners
Background

The Collaborative Sorghum Investment Program, or CSIP, is a farmer-university partnership designed to leverage partner resources and build high-performing research teams with field-level deliverables. The program grounds research capacity to farmer-driven results with the following objectives:

- **Yield** — Increase the U.S. national yield average from 62 to 100 bushels per acre by 2025.
- **Demand** — Build an annual, consumptive 1.25-billion-bushel demand market.
- **Value** — Decrease the market trade discount of corn relative to sorghum from 4.6 to 2 percent.

Description

In the U.S., sorghum is grown on approximately 6 million to 8 million acres annually. The High Plains represents the prime sorghum production region with Kansas leading production. In the 2016 crop year, sorghum was grown on 6.7 million acres, producing 475 million bushels valued at $1.35 billion, according to the U.S. Department of Agriculture NASS. Sorghum’s diversity positions the crop as a solution for tomorrow’s agricultural challenges. While underexploited, inherent natural diversity provides resources to enhance sorghum for resiliency in marginal environments and weather risk to high-value, unique grain quality-based end markets.

Despite sorghum’s importance for farmers in drought prone and marginal growing climates and the many new opportunities for sorghum utilization in the bioenergy, bioproducts and food industries, relatively few private resources are being invested in research on genetic improvement, production or innovative uses of the various types of sorghum. The trend toward less research and technology transfer efforts on sorghum threatens the cropping system diversity and economic stability of sorghum producers and fails to capitalize on the unique opportunities afforded by this crop. Sorghum is more resilient to drought and high-temperature stress compared to other crops and is a vital cropping tool to sustain natural resources like the Ogallala Aquifer.

Kansas State University initiated the Center for Sorghum Improvement in 2001. The recent farmer investment and partnership at K-State leverages the center as a collaborative entity across the sorghum research community. The Collaborative Sorghum Investment Program is continuing existing research and education programs, particularly in genetic improvement, production efficiency and sorghum utilization.

Priority Research Areas

To advance sorghum, core gaps in research need to be a key priority for the Collaborative Sorghum Investment Program. These key priorities are:

- **Sugarcane Aphid** — While a new pest to the crop, sugarcane aphid has had swift and devastating industry impact. A national, collaborative research effort is needed to quickly address the challenge from both a short-term agronomic management approach and new tolerant seed traits in the long term.

- **Water** — Sorghum is a key crop in water limited environments. Further research will identify best management practices for sorghum's performance in varying growing climates. With dedicated resources designer sorghums can be developed to invigorate dryland system resiliency and optimize limited irrigated system with high-yield and value-attribute traits. The right investments can poise sorghum as a core tool to advance water inefficiencies and optimize water utilization in agriculture.

- **Genetic Tools and Technologies** — With a focused research thrust, scientists can translate sorghum’s untapped natural genetic diversity to highly valuable commercial opportunities and agronomic advancements. Comparative genetics could provide potential broader outcomes in the closely related maize industry. Sorghum stands ready to capitalize on genetic gain through the integration of genomic-enabled cropping tools.

- **Agriculture Ecosystem Diversity** — Combating the challenges caused by monoculture systems creates critical need for relevant, diverse cropping tools. Crops that have a prospective 90-million-acre market opportunity are the center foci for crop improvement and novel cropping advancement investment. Leveraging cropping advancement technologies from other crops has the potential to leapfrog sorghum genetic advancement and invigorate the cropping system.

Kansas State University’s **long-term research goal** is to advance sorghum demand, yield and value by delivering relevant sorghum research results that strategically advance sorghum for farmers, facilitate novel scientific contributions and deploy greater long-term research capacity through student training.

Agency Contact Information

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Background/Description
The goal of this program is to develop strategies to identify and mitigate foodborne pathogens and antimicrobial resistance in beef production systems. Specifically, studies will focus on the ecology of Shiga toxin-producing *Escherichia coli*, or STEC, both O157 and non-O157 serotypes, *Salmonella*, *Campylobacter* and antimicrobial resistance elements in beef cattle and on the development and testing of on-farm mitigation strategies, with the ultimate goal of enhancing food safety and public health. Because of the economic importance of beef production and beef processing in Kansas, as well as Kansas State University’s leadership in beef cattle research, it is logical for researchers to focus on foodborne pathogens and preharvest beef safety. The research outcomes will have major positive impacts on public health, animal wellbeing and the economic prosperity of the state of Kansas and U.S.

Relevance National/Regional
The food supply in the United States is one of the safest in the world; however, foodborne illnesses do occur and frequently are associated with foods of animal origin. The College of Veterinary Medicine at K-State has an interdisciplinary research team to address scientific issues related to the four vital areas in preharvest food safety in beef cattle: STEC, O157:H7 and non-O157; *Salmonella; Campylobacter*, and antimicrobial resistance of food borne and normal gut bacteria. The team has microbiology, molecular biology, epidemiology and production systems expertise, along with collaborations with researchers from other departments at K-State and input from key industry stakeholders, is generating valid and industry-relevant outcomes. The long-term research goals are to understand the ecology of foodborne pathogens in cattle and their environment and develop effective and practical strategies for comprehensive reduction or elimination of foodborne pathogens at the farm level.

**STEC:** Healthy cattle are the major reservoir of STEC, with the organisms residing primarily in the hindgut. These bacteria are shed in the feces, which then serve as a source of contamination of beef, produce and recreational and drinking water. Research efforts in the past have focused primarily on STEC O157:H7. Recently, there is increased recognition that six other STEC serogroups — O26, O45, O103, O111, O121 and O145 — are also major public health concerns. According to the CDC, the non-O157 STEC serogroups account for twice as many illnesses as STEC O157. However, not much is known about the ecology of the non-O157 STEC in cattle and their environment, partly because methodologies to isolate and detect non-O157 STEC have not been developed. Data on prevalence and factors affecting fecal shedding of these serogroups in the cattle population are needed before strategies for their control can be developed.

**Salmonella:** The presence of *Salmonella* in beef cattle production systems can cause serious adverse effects in cattle as well as humans. In cattle, *Salmonella* can affect morbidity, mortality, production efficiency and the economic well-being of cattle producers. *Salmonella* is a common cause of gastroenteritis in humans, with outbreaks and infections often linked to consumption of contaminated beef, water or other foods. The emergence and dissemination of multidrug resistant *Salmonella* are also major concerns for public health. The research goals are to understand the ecology and epidemiology of *Salmonella* in cattle.

**Campylobacter:** The species of *Campylobacter* cause enteritis and, in some instances, abortion in cattle. However, the importance of *Campylobacter* is as a foodborne pathogen that can cause sporadic cases and outbreaks of human *Campylobacter* infections. In the past, human infections have chiefly been attributed to poultry sources. Recently, cattle have been recognized as an important source of food contamination. The research goals are to understand the ecology and epidemiology of *Campylobacter*.

**Antimicrobial Resistance:** The use of antimicrobials in animal agriculture is considered a major contributor to the emergence and spread of antimicrobial resistance in the environment. The concern over antimicrobial resistance has important consequences for public health and food-animal industries, including restricted access to global markets. The goal is to monitor prevalence, amplification and dissemination of antimicrobial resistance genes and bacteria that carry resistance genes in beef cattle.

The four issues outlined above demonstrate the need to understand the ecology and epidemiology of foodborne pathogens for effective preharvest intervention strategies so that cattle with fewer pathogens and lower antimicrobial resistance elements are presented for slaughter. Control strategies aimed at reducing the prevalence and concentration of these bacteria and their resistance elements in cattle feces, thus reducing the overall number of bacteria entering both food and environmental pathways, may be the most effective approach for reducing the overall risk of human infection and maximizing public health outcomes.

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Background

Today, 1 in 8 people worldwide are hungry, according to the United Nations Food and Agriculture Organization. Food security is the availability of food to a person in a safe and socially acceptable way. People need access to safe food that is unadulterated and free of bacteria and foreign substances.

The world population is expected to surpass 9.7 billion by the year 2050, so the problem with worldwide food security is only going to get bigger, unless people come together to work on solutions.

Description

Kansas State University supports complex relationships throughout the value chain of global food systems. Consumers are increasingly aware of the food supply chain, including aspects of food safety, food ingredients and food production. It is important that the university collaborate to take a “field to fork” approach to food safety and food security, as well as improved nutrition and health.

The focus is on food crops — wheat, sorghum and millet — and food animals — cattle, swine, goats and sheep — at the production, processing, distribution and protection levels.

K-State is developing and commercializing new technologies and practices; attracting a talented workforce; providing leadership in food safety, security and production; and building on relationships in the public and private sectors.

The keys to building long-term prosperity for the citizens of Kansas through the global food systems initiative lie at the intersection of innovation, education and industry.

To maintain K-State’s global leadership position on a permanent basis, the university will need to address several critical needs:

• Retaining and attracting top faculty.
• Creating public infrastructure to expand the global food systems research corridor.
• Building facilities that allow corporate-university partnerships to scale.

The visionary goals presented in K-State’s 2025 strategic plan will be advanced through the global food systems initiative.

Relevance

K-State is among the top land-grant universities receiving U.S. Department of Agriculture National Institute for Food and Agriculture, or NIFA, competitive grants.

Building on K-State’s land-grant heritage, the global food systems initiative leverages public and private sector funding to create a global center focused on four objectives:

1. Conducting research to enhance food production, food safety, human and animal health, and food security.
2. Attracting and developing the future food systems workforce.
3. Discovering and commercializing innovative technologies to enhance productivity and profitability.
4. Providing counsel and thought leadership to industry on a complex range of global food issues.

This initiative brings investments and jobs to Kansas; increases collaboration among suburban, urban and rural constituencies; and provides regional leaders with the confidence and solutions they need to meet the economic, social and regulatory challenges facing 21st century global food needs.

To modernize the research facilities at K-State and to train the new generation of faculty and students, K-State will need to work with the federal and state governments, plus our industry partners, to raise the significant funds needed to build new classrooms and research space, plus remodel older research space to educate the future workforce.

Also, faculty at K-State must aggressively seek external grant funding — whether at USDA-NIFA, National Institutes of Health or the National Science Foundation — for agricultural and food-related research if we are to be successful tackling worldwide food security issues.

By leveraging its history as a land-grant institution, Kansas State University can use this unprecedented opportunity to create long-term prosperity for the citizens of the state of Kansas. The leadership is in place, the time is now and Kansas State University is ready to be the undisputed global leader in global food systems.

Agency Contact Information

Director, USDA NIFA
Washington, D.C.
Developing and Sharing Technologies to Conserve the Ogallala Aquifer

Background

Groundwater from the Ogallala Aquifer is used extensively to produce food and drive the economy of western Kansas. This region leads Kansas in crop production and comprises the core of the U.S. beef cattle feeding industry. The top eight Kansas agricultural counties are located over the Ogallala Aquifer and represent one-third of Kansas’ total value of agricultural production. However, water is increasingly in short supply in the Ogallala region of western Kansas. Kansas State University research in 2013 estimated that, in the Kansas portion of the aquifer, 30 percent of the water was already depleted; by 2060, 70 percent would be depleted; and, by 2100, almost all would be completely depleted. It is common today to have well yields of one-fourth to one-third of historic well yields. In Kansas Groundwater Management District No. 1 in west central Kansas, useful lifetime of the aquifer is estimated at 10 to 30 years.

The rapid depletion of the Ogallala Aquifer has been recognized by both state and local governmental organizations, groundwater management districts and local citizens. In Kansas, significant regulatory and legislative changes have occurred in recent years in an attempt to extend the life of the Ogallala Aquifer. For example, Kansas enacted legislation that allows local groups of farmers to voluntarily develop their own “local enhanced management areas, or LEMAs. The first LEMA developed in northwest Kansas requires all irrigators to reduce their water withdrawals by 25 percent over a five-year period. Kansas has also enacted a five-year flex program where irrigators can enroll and then are able to use their water over a five-year period, which allows more flexibility and the possibility to reduce their overall water use. In 2014 and 2015, Kansas developed a 50-year vision for water. This plan identified research and management needs, as well as suggested needed updates in legislation.

Description

The 50-year vision for water in Kansas calls for a significant investment in research and technology development efforts led by K-State, combined with rapid technology transfer to the agricultural industry. As demand for water resources continues, improved water management practices for crop and livestock production will be critical for sustaining economic viability and population base of the region. The latest tools and technologies must be developed and adopted by water users.

The 50-year vision document identified four major areas that K-State is essential: 1) identifying and developing new drought resistant crops and varieties/germplasm; 2) new irrigation technologies; 3) extension programs to enhance adoption of new technologies; and 4) new education curriculum and delivery to university students and the general public on water issues.

As a land-grant university, K-State has water-related expertise in the following areas:

Research: Plant genetics and crop varietal development, crop and animal production, irrigation and water management technologies, and economics.

Education: Curriculum in engineering, water management, plant genetics, economics and computational models to train the next generation of water scientists and managers.

Extension and Outreach: Engagement with agencies and stakeholder organizations to identify alternative methods and policies for managing groundwater and agricultural management challenges and assisting farmers and other water managers in implementing new practices.

Relevance

The K-State team:

1) Informs citizens, planning agencies, and policymakers and helps them understand technical aspects of water resource management and the production, economic, and social impacts of policy strategies.

2) Develops more drought-tolerant crop varieties, efficient irrigation technologies, and water and nutrient management. Research and extension efforts guide producers in efficient irrigation strategies for various types of irrigation systems, as well as transition toward limited irrigation and dryland practices. Work is being conducted on Water Technology Farms, which are real working farms, with assistance from private industry.

3) Evaluates alternative food and feed grains, oil seeds, and energy crops for drought- and heat-tolerance, adaptation to no-tillage or strip-tillage production systems, and utility as feed for livestock or feedstock for liquid fuel production.

4) Utilizes the latest technologies and computational forecasting tools to quantify and understand interactions and feedbacks between available water resources and societal needs and values.

Kansas seeks long-term solutions to manage a depleting Ogallala Aquifer and to develop agricultural systems, engineering and policy solutions that will sustain the aquifer for current and future generations.

Agency Contact Information

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Background
For American military personnel who have served in war, federal programs have long been in place to address physical injuries from bullets and bombs and psychological injuries of wartime trauma. In relatively recent times, however, veterans returning from war have faced difficulties neither anticipated nor addressed by federal programs. These include chronic health problems resulting from exposure to environmental hazards — e.g., chemical defoliants in Vietnam and a complex mix of neurotoxins in the Persian Gulf War — and traumatic brain injury, or TBI, encountered during deployment, as well as long-term health impacts — e.g., PTSD. Increasingly, for today’s professional military — both active and reserve components — the aftermath of wartime service has consequences not only for veterans’ well-being, but for their families and communities.

Description
Kansas State University is home to a unique cadre of scientists from diverse disciplines with an impressive track record in research, outreach, academic and clinical service programs addressing the health, well-being and sustainment of military and veteran populations. Some examples:

• Programs and community support networks for military-connected children and youth, with local 4-H Clubs, schools and OMK youth/family camps.

• Research and training programs on violence prevention in military families, quality child care and childhood social emotional health.

• Clinical programs for military personnel, veterans and families.

• Research on the long-term effects of deployment and war trauma on marriages, child and youth development, employment and financial planning.

• Cooperative Extension services to families of military personnel.

• Online graduate programs for professionals who serve military families.

• Research on the effects of high-intensity functional exercise training on the body composition, fitness and health of active duty military personnel as well as on barriers to physical activity participation for disabled veterans.

• Implementation of a new Military and Veteran Engaged Research Innovation Center at K-State, the MAVERICK Center, to provide a multi-functional, cost effective collaborative space for military and veterans programs that advance the vision of K-State 2025.

In addition to contributions made by researchers from colleges across the university, the Institute is the “tip of the spear” for K-State’s alliances with area military installations, the Kansas National Guard, Army Reserve, U.S. Department of Veteran’s Affairs, the Department of Defense, and other state and national organizations.

Relevance
Our current partnerships with the U.S. departments of Agriculture and Defense have been primarily focused on outreach rather than on research funding for the study of military families. These outreach initiatives support significant programming underway at K-State and across Kansas. Proposals to other federal agencies, such as the Department of Health and Human Services, will expand the reach of the College of Human Ecology and its units. Expanding partnerships to support additional investment in relevant research would enable K-State, the College of Human Ecology and the Institute for the Health and Security of Military Families to capitalize on the expertise available here.

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Background
Kansas State University has a long and rich tradition of leadership in animal production, health, and well-being. In its 155-year history as a land-grant institution and over 100 years of graduating veterinarians, there has never been a greater opportunity for K-State to positively impact animal and human health and the agriculture industry.

As part of the construction of the National Bio- and Agro-defense Facility, or NBAF, adjacent to the K-State College of Veterinary Medicine, the Comparative Medicine Group large animal facilities have been relocated and named the Large Animal Research Center, LARC, which comprises 22,000 net square feet (green highlighted area).

This critical investment is part of the Kansas City Animal Health Corridor, which stretches from Manhattan, Kansas, to Columbia, Missouri. The corridor has earned this name because its animal health companies account for nearly 32 percent of total sales in the $19 billion global animal health market and produce over 50 percent of the world’s animal vaccines. As a part of the corridor, an expanded LARC facility will foster partnerships we already have with industries.

Description
Building on our academic strengths, the cluster of animal health and nutrition companies that comprise the Kansas City Animal Health Corridor, the recently relocated U.S. Department of Agriculture Arthropod-Borne Animal Disease Research Unit, or ABADRU, and the building of NBAF adjacent to the university’s veterinary college and Biosecurity Research Institute, K-State is poised to lead animal health and zoonotic disease research. To accomplish this, we must update and expand the LARC by 34,000 square feet.

Relevance
An expansion of existing facilities could:
- Create more research capacity and enhance the ability to develop cutting edge research.
- Enable us to meet the needs of NBAF animal staging.
- Expand our ability to test new vaccines and delivery methods.
- Enable us to create and test new diagnostic systems for zoonotic diseases.
- Create an ability to attract and retain quality faculty members, researchers, and technicians.
- Expand our ability to train the critical workforce for the animal health industry.
- Increase government and corporate collaborative opportunities.

The expansion primarily involves enlarging the Animal Bio-Safety Level 2, or ABSL-2, research space (indicated by the red, orange and yellow spaces above). These resources will allow our elite team of researchers to perform more cutting-edge research. Ultimately, this will contribute to the university’s goal of becoming one of the Top 50 public research institutions by 2025.

Research conducted by K-State veterinary and agricultural faculty benefits the university as a whole, and livestock producers of the state and nation. With the expansion of the LARC facility, K-State can become a stronger collaborative partner with NBAF, helping to protect the American food supply and agriculture economy.

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Agriculture Research Service
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Background

Food security. We have created a need for resilient food systems capable of adapting to changes because of a growing population, global politics, climate change, dwindling natural resources, market changes and poor diet preferences among consumers.

Workforce development. Local food sales totaled at least $12 billion in 2014, up from $5 billion in 2008. Experts anticipate at least $20 billion by 2020. More than 22 major cities, from Baltimore to Seattle, have created leadership roles for change makers focused on food. The demand for food-systems experts to address obesity and food access, particularly in urban communities.

New Legislation. The Urban Agriculture Act of 2016 creates new economic opportunities, giving families greater access to healthy food and creating a healthier environment in cities and towns across our nation. The legislation addresses the unique needs of urban farmers by investing new resources and increasing flexibility through existing U.S. Department of Agriculture programs.

Description

Although agriculture increasingly operates globally, it is also becoming more local. As urban centers grow, the demand for locally grown produce is driving the redevelopment of fruit and vegetable production in urban and peri-urban areas. This trend is particularly relevant for produce growers as fruits and vegetables have a relatively short storage/shipping life and have extremely high nutrient content that can benefit food security in urban communities. Clearly, there is an increasing need for researchers and professionals who are knowledgeable about urban agriculture and the associated local food systems given the expanding consumer demand for local food has expanded, and the demographics of horticultural food crop producers has changed. Careers are developing in this new area, known by several names such as urban agriculture, urban horticulture, and urban food systems. Now more than ever, a group of leaders is needed in the agricultural community to help successfully facilitate a revolution in the way consumers think about food.

The Department of Horticulture and Natural Resources, in the College of Agriculture at Kansas State University, identified food crops and global food systems as a target focus area of expertise as part of its 2025 Strategic Plan. The urban food systems graduate program was launched in 2011 and 2013 in Manhattan and Olathe, respectively. Three horticulture faculty oversee this program that currently has 14 Master of Science students. During the first five years of this program, four students have graduated from the program and are now working in urban agriculture. The department received more than $5 million in grants and contracts with projects encompassing horticulture, food science, food safety, sensory analysis and adult education. In June 2016, the department delivered a highly successful international symposium on urban food systems with more than 150 attendees from across the country and world. Faculty from more than 15 different disciplines across K-State’s Colleges of Agriculture, Human Ecology, Engineering, Education, and Arts and Sciences collaborate on this program.

Given the success of the Urban Food System Symposium and the number of faculty and staff across the university who are working in this area, K-State has the expertise and leadership to be a regional, national, and global change leader in urban food systems. To achieve this goal, the department will formalize this initiative through the institute.

Relevance

With operational and infrastructure investment, the Urban Food Systems Institute will secure and maintain the global leadership position on a permanent basis.

The institute’s objectives reflect the land-grant mission:

1. Train the next generation of leaders and extension educators to facilitate successful and resilient urban food systems.
2. Develop and disseminate urban agriculture extension programs and services that support urban agriculture.
3. Expand farm-to-fork research in technologies such protected production systems, including greenhouses, warehouses and vertical and rooftop farming; high-intensity production; appropriate postharvest handling; and sustainable and regenerative farming practices.

Sen. Debbie Stabenow of Michigan said the Urban Agriculture Act of 2016 is “… helping urban farmers get started or expand their business, so they can sell more products and supply more healthy food for their neighbors.” Graduates of the Urban Food Systems program are able to do exactly that, and the development of the Urban Food Systems Institute will provide a venue for collaborative work among graduate students, researchers, practitioners, and industry partners.

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Background

“Lipid” refers to a large and varied group of compounds that are not soluble in water. Lipids are found in every living organism and every part of every organism, including humans, crop plants and food animals.

Established in 2003, the Lipidomics Research Center, or LRC, at Kansas State University is one of the world’s longest-serving facilities dedicated to cutting-edge “lipidomics.” Lipidomics refers to the identification and quantification of lipids using mass spectrometry. LRC scientists have established mass spectrometry-based methods for well over a thousand lipids. Scientists from over 600 labs have come to LRC or sent samples for analysis, resulting in hundreds of scientific publications.

LRC has successfully secured funding for mass spectrometers in two National Science Foundation Kansas EPSCoR and three NSF major research instrumentation competitions.

One of the historic bottlenecks in lipid research is measuring the thousands of types of lipids in each organism. LRC analyzes lipids from all organisms, but is particularly known in the scientific community for its identification and quantification of both known and novel plant lipids. Lipids are important in crop plants for two reasons. First, seed oils, which are major food and energy products, are composed of lipids. Second, lipids are critical in regulating the resilience of crop plants to the challenges of their environment because of their roles in membranes and as molecular signals. Thus, analyses performed at LRC are critical in studies of lipids in crops aimed at improving oil quantity and quality and improving metabolism of lipids to enhance growth and stress resilience of crop plants.

Description

With the current abundance of genomic information on crop plants, the time is right to combine large-scale data on plant lipids with genetic data to make the discoveries needed to design crops that produce high yields of seed oils of specific composition and that can withstand stressful environments.

The LRC is poised to lead the plant science community in a major initiative to collect large-scale lipidomic data on crop plants and to utilize the data to enhance crop improvement programs. Experiments conducted at LRC imply that combining lipidomic data with other plant genomic data will produce insights into plant metabolism that will facilitate crop improvement. LRC scientists work closely with plant biochemists and agronomists at K-State and across the Midwest. For example, collaborators at K-State are utilizing lipidomics to design camelina that produces improved biofuels and oils useful in the chemical industry. Other K-State groups are aiming to understand how lipid differences can improve sorghum and wheat tolerance to heat, cold and drought.

Relevance

The rate of increase in worldwide agricultural production is slowing and is lagging the increase in world population. With limited future ability to bring more land into production, increases in yield are needed. These increases must be made as climate variability is increasing. To develop crops with increased yield and more resilience, new knowledge and strategies are needed. LRC and colleagues can accelerate our understanding of how lipids interact with plant genes and the environment to regulate and enhance crop growth and food production.

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Agro-combs: Tools from Physics to Solve Agronomy Challenges

Background
The most critical agricultural challenge is to double crop production by 2050 to meet the food demand of a growing world population. This must be done in a sustainable way by reducing the environmental footprint of crop and livestock production. To solve this challenge, plant, soil and environmental scientists need accurate data at relevant time and spatial scales to improve the efficiency of agroecosystems. These data include concentration of multiple agriculturally significant gases. Multi-gas detection is indispensable for several agricultural applications, such as crop breeding, measuring trace gas emissions from agricultural systems and crop nutrient management. Unfortunately, current technologies are a limitation for sensing agriculturally significant gases. A revolutionary laser spectroscopic method called dual comb laser spectroscopy, or DCS, offers self-calibrating, rapid field-scale monitoring of multiple gases simultaneously by a single instrument.

Description
Kansas State University is developing, under an National Science Foundation Major Research Instrumentation, or MRI, Award, a novel sensor of agriculturally significant gases based on the Nobel Prize-winning technology of optical frequency combs. DCS is poised to transform crop production gas sensing with never-before realized spectroscopic capabilities, and will serve as a next-generation gas-detection platform. K-State, home to experts and facilities in both optical frequency combs and agricultural gas sensing, offers an excellent environment for the development of this key technological advance. An interdisciplinary team of world-class physicists and agronomists is developing a mid-infrared DCS system for the detection of agriculturally significant gases. This is a novel application of frequency combs that we call agro-combs.

Resulting experiments will lead to increased crop yield in the face of growing demands on natural resources. The instrument will allow simultaneous absorption measurements of multiple gas species with high sensitivity over a 10 m path.

Current agricultural gas detection systems are based on tunable laser absorption spectroscopy, or TLAS, and Fourier transform infrared spectroscopy, or FTIR, and have limitations that create a “bottleneck” for the development of high-throughput phenotyping, or HTP, platforms. TLAS has limited spectral coverage and thus can detect only a limited number of gases with a single instrument. FTIR can detect multiple gases but employs a mechanical delay line, limiting scan rates and stability for field deployment.

A few examples of research areas that could benefit from the agro-comb’s capabilities:

- studies of native tallgrass prairie systems
- wheat breeding program
- animal production efficiency
- soil nitrogen gaseous losses
- ammonia production
- natural gas leak detection

Relevance
The instrument will be used for the broadband detection of many agriculturally significant gases.

Additional investment would dramatically expand this work by allowing multiple prototypes to be built, specially tailored to each application. Furthermore, large-scale funding would allow the integration of multiple laboratories and field sites, expanding the type of experiments that could be conducted with agro-combs in outdoor environments with multiple crops and plots.

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Biosecurity: Preparing the U.S. for Emerging Biological Threats Through Workforce Development

Background
The United States remains relatively unprepared to protect its citizens and agricultural industry from known biological agents that may be introduced into the U.S. with relative ease via various means and routes. The deadly consequences of West Nile virus, Zika, chikungunya, porcine epidemic diarrhea virus and Ebola reinforce the need for a strategic plan to identify and control similar threats before they are introduced. Management in crisis is difficult, inefficient and often costly, thereby creating the need for sustained training and workforce development to rapidly identify or use surveillance, respond to, and control an agent as soon as possible after introduction to enable recovery.

Description
The Biosecurity Research Institute, also known as BRI at Kansas State University’s Pat Roberts Hall is a unique facility eager to train multidisciplinary professionals involved in responding to high-consequence biological pathogens that may threaten our nation’s livestock, crops and people. Training materials will be tailored to meet the needs of personnel ranging from technical staff, first responders, law enforcement (including Customs and Border Protection agents), physicians, veterinarians, epidemiologists, and researchers in academic and private industry environments.

In the late 1990s, K-State made a programmatic commitment to the area of security and agricultural food safety. As a land-grant institution, K-State made food animal health and welfare and protecting the global food system a priority. The state of Kansas made a strong investment in K-State’s research priorities by funding the construction of the BRI. The Department of Homeland Security has acknowledged K-State’s leadership within this area with ongoing construction of the National Bio and Agro-defense Facility, or NBAF, adjacent to the BRI.

The BRI is one of fewer than six high containment facilities in the United States that can conduct research on livestock experimentally infected with a broad range of highly pathogenic organisms. The BRI is the designated facility at K-State for work on organisms classified by the U.S government as select agents, or SAs. One of the defining factors for SA designation is that these agents have the potential for weaponization. As such they are of high priority and require highly specialized facilities and highly trained and approved personnel to ensure constant accountability, safety and security.

Risk analysis is a key factor in the decision for which pathogens currently provide the greatest risk of introduction into the U.S. The U.S. Department of Agriculture APHIS recently released its “Emerging Animal Disease Preparedness and Response Plan,” which is utilized to help identify emerging pathogens of concern. K-State has the capabilities to identify pathways of introduction and the risk associated with those pathways and can focus training efforts towards those areas of greatest risk. Based on the data, estimates of commercial impact on our agricultural industry could be made.

Over 10,000 square feet is dedicated to education, including an integrated classroom and laboratory space, to make students’ learning expeditious and efficient. A tiered classroom seating 25 people is adjoined to a fully-equipped biocontainment laboratory. The laboratory provides hands-on training activities in a pathogen-free training area. Students gain foundational skills in a realistic work environment without the risk of biosafety concerns or biocontainment breaches. The BRI also includes world-class high-definition video capture and streaming technology allowing the training suite and research areas to serve as filming studios for distance-education courses that are taught online.

Relevance
The mission of the BRI is “Leading through research and education to protect agriculture and the public from biological threats.” This mission is epitomized by the BRI’s unique integration of interdisciplinary work on pathogens that contaminate food and infect livestock, people, and plants. Recent management of a DHS-funded Fellowship Program in TransBoundary Animal Diseases based at the BRI provides expertise with DHS workforce development plans for staffing NBAF.

Improving the nation’s long-term capacity to anticipate and respond to biosecurity threats through sustained workforce expansion and the development of teaching materials that could be made broadly available represent essential first steps toward preparing the U.S. for emerging biological threats.

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Biosecurity, Biosafety and Biocontainment Research, Training and Education

Background
In the late 1990s, Kansas State University made a programmatic commitment to the area of food safety and security. The state of Kansas made a strong investment in K-State’s research priorities by funding the construction of the Biosecurity Research Institute, or BRI. Further, the Department of Homeland Security has acknowledged K-State’s leadership within this area and is currently constructing the National Bio and Agro-defense Facility, or NBAF, adjacent to the BRI.

Description
The BRI is well poised to train students, government personnel and technicians in biosafety and systems approaches to working in high-containment facilities. Resources include not only beautiful physical spaces designed for learning but also experienced faculty and staff members who are experts in developing and delivering training. The BRI stands ready to train the future workforce of NBAF and researchers of high-consequence pathogens.

The BRI is unique in its capacity to perform multidisciplinary research on multiple pathogens and host species within a single facility. The ability to work with livestock/food animals — cattle, sheep, goats, pigs, chickens — enables studies aimed at developing and testing diagnostics and vaccines related to high-consequence pathogens. Of the 113,000 square feet total space, 31,000 is dedicated to research. The 14 biosafety level 3, or BSL-3, enhanced laboratories include dedicated BSL-3 agriculture rooms that are approved for research on livestock species, and BSL-3 rooms for studies on food safety and security, and on exotic plant pathogens.

Over 10,000 square feet is dedicated to education, including an integrated classroom and laboratory space, to make students’ learning expeditious and efficient. A tiered classroom seating 25 people is adjoined to a fully-equipped biocontainment laboratory. A wall-size glass window allows students to observe and learn procedures as they will be performed in an actual laboratory setting. The laboratory is then used to provide hands-on training activities in a pathogen-free training area. Students gain foundational skills in a realistic work environment without the risk of biosafety concerns or biocontainment breaches. The BRI also includes world-class high-definition video capture and streaming technology allowing the training suite and research areas to broadcast live video or serve as filming studios. Students can view laboratory techniques and monitor disease progression in challenged animals without the need to enter high-risk research spaces.

Individuals seeking careers in biosafety and biocontainment, as well as professionals seeking careers in high-consequence infectious disease research, will benefit from the research-based training in biocontainment practices and procedures.

Federal initiatives such as the National Institute of Health’s National Biosafety and Biocontainment Training Program offers just one example of groups with which we develop synergistic, collaborative graduate education programs.

Relevance
Utilizing Kansas State University’s world-class resources to educate tomorrow’s biosafety and biocontainment professionals provides our students with a competitive edge as they apply for technical or faculty positions. The BRI is prepared to provide necessary training and experience for the future workforce at NBAF and biotech companies in the expanding animal health corridor.

With thousands of BSL-2 and BSL-3 laboratories in the United States, a graduate-level research and educational program for biosafety and biocontainment professionals provides valuable hands-on skills to ensure safe and secure operations.

Research and training agreements with the U.S. Department of Agriculture, the Department of Homeland Security, Australia’s Commonwealth Scientific and Industrial Research Organization, and Kenya’s International Livestock Research Institute provide unique opportunities for students, staff, and faculty to gain experience for NBAF and related projects that complement existing programs.

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Background
In the late 1990s, Kansas State University made a programmatic commitment to the area of food safety and security. As a land-grant institution with a major focus on food animal husbandry, K-State made food animal health and welfare and protecting the global food system a priority. The state of Kansas made a strong investment in K-State’s research priorities by funding the construction of the Biosecurity Research Institute, known as the BRI. The Department of Homeland Security has acknowledged K-State’s leadership within this area with construction underway of the National Bio and Agro-defense Facility, or NBAF, adjacent to the BRI. As part of DHS workforce development plans for staffing NBAF, a DHS-funded fellowship program is based at the BRI. In 2010, the U.S. Department of Agriculture relocated the Arthropod-Borne Animal Diseases Research Unit, or ABADRU, to Manhattan, Kansas, as its facility did not have secure biosafety level-3, or BSL-3 capabilities but its research priorities include BSL-3 agents, such as Rift Valley fever virus, or RVFV. ABADRU scientists conduct their research and its staff now receive training at the BRI. Being an academic, rather than federal facility, the BRI has supported a USDA-funded training program for non-U.S. citizens. These scientists are critical to establish a global network of experts; however, federal regulations often prevent engagement at government-run facilities.

Description
The BRI, at Pat Roberts Hall, is a state-of-the-art enhanced BSL-3 and BSL-3Ag research facility. This facility is comprised of an ACL/BSL-3 insectary suite, with three BSL-3E rooms available for arthropod transmission studies; a mosquito rearing room; 14 BSL-3/3Ag research laboratories, including five rooms to enable research on livestock; an ABSL-3 vivarium small animal area; a pathogen storage room, rated BSL-3E; and education, training and administrative spaces.

Research on pathogens at the BRI necessitates that personnel be highly trained and approved for such work. To address this requirement, a dedicated 10,000-square-foot educational wing provides hands-on training activities in a pathogen-free integrated laboratory training suite. This allows students to gain foundational skills in a realistic work environment without the risk of biosafety concerns or biocontainment breaches.

The BRI is one of fewer than six high containment facilities in the United States that can conduct research on livestock experimentally infected with a broad range of highly pathogenic organisms. The BRI is the designated facility at Kansas State University for work on organisms classified by the U.S. government as select agents, or SAs. One of the defining factors for SA designation is that these agents have the potential for weaponization. As such they are of high priority, but require highly specialized facilities and highly trained and approved personnel to ensure constant accountability, safety and security. The primary purpose of the research is to improve understanding and to develop diagnostics and vaccines that can better prepare the U.S. to detect and respond to foreign pathogens that threaten agriculture and public health. Collaborative research on RVFV with USDA scientists has involved the first livestock studies to be conducted in the U.S. since the 1980s.

Relevance
The mission of the BRI, “Leading through research and education to protect agriculture and the public from biological threats,” is epitomized by its unique integration of interdisciplinary work on pathogens that infect livestock, people and plants or contaminate food. Given its close proximity to NBAF, capabilities and staff, the BRI has established itself as a well-respected and much needed resource to provide the essential training and research capabilities needed by state and federal agencies to develop the next generation of highly qualified researchers.

With interdisciplinary biosecurity research programs, agrosecurity initiatives and the development of collaborative research with USDA and DHS, the BRI is the platform for transitioning work currently conducted at the Plum Island Animal Diseases Center to NBAF.

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Background
The Department of Homeland Security, or DHS, in 2004 called for the establishment of a new National Bio and Agro-defense Facility, or NBAF, to be “a state-of-the-art biocontainment facility for the study of foreign animal, emerging, and zoonotic — transmitted from animals to humans — diseases that threaten the U.S. animal agriculture and public health.” This $1.25 billion facility, being constructed in Manhattan, Kansas, is to be commissioned in 2021.

Because of antiquated facilities, the current foreign animal disease — or FAD — research program at the Plum Island Animal Disease Center is limited in scope. In addition, coordination among the multiple agencies that work with Plum Island and with NBAF will need to be expanded and enhanced significantly.

A unique partnership between Kansas State University and Mississippi State University, or MSU, can serve as a catalyst to develop state-of-the-art methods to advance research on FADs, thus enabling the new NBAF facility to be fully operational in 2022. This partnership provides the combined strengths of infectious disease and emerging disease research in a BSL-3Ag facility at K-State, along with the high-performance computing capacity at MSU’s Institute for Genomics, Biocomputing and Biotechnology, or IGBB. Both institutions have significant depth in all veterinary areas necessary to support FAD and zoonotic disease research.

The primary research and diagnostic missions at PIADC are carried out by the U.S. Department of Agriculture’s Agricultural Research Service — or ARS — and Animal and Plant Health Inspection Service, known as APHIS; the same will be true at NBAF. However, the breadth of ARS research and development activities will be much greater at NBAF than at PIADC. Technology and computing needs for APHIS will be greater as well.

Description
NBAF will have an immediate and long-term critical need for a workforce capable of conducting BSL-3 and BSL-4 animal research. Expertise in the areas of virology, bacteriology, epidemiology, systems biology, immunology, diagnostic medicine, and pathology are but a few of the areas in which both the K-State and MSU colleges of Veterinary Medicine, or CVMs, can educate a workforce to meet the NBAF mission.

MSU CVM has a veterinary technology program that can meet the immediate mid-level training need for NBAF workforce. K-State has a unique facility, the Biosecurity Research Institute, or BRI, to provide practical training for the workforce and to establish a transitional pathway for the future NBAF facility. K-State and MSU CVMs also have collaborations with PIADC and other modern high containment laboratories across the globe. In addition, they have well-established relationships with the World Organization for Animal Health and the Food and Agriculture Organization, as well as robust capacity development projects in foreign countries.

These connections, relationships and collaborations will allow for a well-rounded education and will provide the next generation of NBAF scientists with practical lab and field experience in targeted diseases to be studied at NBAF.

Relevance
Workforce needs for USDA ARS in NBAF will be much broader and complex than at PIADC. K-State and MSU can assist in developing the necessary skilled workforce for NBAF.

Agency
U.S. Department of Agriculture
1) Agricultural Research Service
2) Animal and Plant Health Inspection Service
Food Security: Plant Pathogen Research

Background
Wheat blast is a potential threat to wheat production worldwide. With implications for food security in developing nations and economic stability in developed nations, rapid response capabilities and effective mitigation measures are needed. This threatening plant pathogen is causing serious reductions in wheat production in South America. Even greater concern arose during the 2015-2016 crop season when wheat blast was observed in Bangladesh, the first time it was found outside of South America. The risk of the disease spreading to the United States has suddenly become very real.

Description
Wheat blast is caused by the plant pathogenic fungus, *Magnaporthe oryzae*. Yield loss to this disease can be greater than 75 percent in severely affected fields. It is spread naturally from plant to plant within a field and from field to field within a region through the forces of wind and rain. *M. oryzae* can also be spread as a result of human activities, including the movement of farm machinery, grain or seeds infected/infested with the wheat blast pathogen. Wheat blast could be introduced into the U.S. as a result of increased trade and travel between the U.S. and Brazil.

Wheat blast could also emerge in the U.S. as a result of the evolution and establishment of new strains of *M. oryzae* from indigenous populations on wild and cultivated grass species, e.g., ryegrass. Wheat blast pathogens may have already emerged in the U.S. on other hosts but environmental factors have not yet favored outbreaks/epidemics.

Research with live pathogen cultures and with infected plant tissues are conducted within biosafety level 3, or BSL-3 biocontainment laboratories at the U.S. Department of Agriculture’s ARS laboratories at Fort Detrick, Maryland, and at the Biosecurity Research Institute or BRI. The BRI, at Pat Roberts Hall, is equipped and capable of meeting the challenge of expanding education, training and research in plant pathogen diseases. This state-of-the-art facility is comprised of 14 BSL-3/3Ag research laboratories, an ACL/BSL-3 insectary suite, a mosquito rearing room, an ABSL-3 vivarium small animal area, a pathogen storage room rated a BSL-3E, as well as education, training and administrative spaces. Laboratory space of 31,000 square feet within the BRI supports diverse and multidisciplinary research and training opportunities, with the capability for research on plant pathogens and foreign animal diseases. Within the BRI, two core facilities in molecular virology and applied immunology support education and research. Basic and applied research, such as pathogen detection, diagnostics and vaccine development, is ongoing on numerous pathogens.

Training of the next generation of plant pathogen researchers is critical to worldwide food security. The BRI training laboratory provides hands-on activities in a pathogen-free training area. Students gain foundational skills in a realistic work environment without the risk of biosafety concerns or biocontainment breaches. The BRI also includes world-class high-definition video capture and streaming technology allowing the training suite and research areas to broadcast live video or serve as filming studios. Using this technology, annual, weeklong Plant Biosecurity short courses have been conducted at the BRI and recorded to enable educational outreach.

Relevance
A comprehensive wheat blast preparedness plan that includes effective surveillance, accurate diagnostics, a reliable forecasting system, resistant wheat cultivars, and an effective fungicide management strategy is under development. Ongoing research at the BRI will expand knowledge about wheat blast and provide support to the nation should an outbreak occur in the United States.

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Arthropods as Vectors of Human and Agricultural Disease

Background
Arthropods comprise the largest and most diverse group of animals, occupying a vast array of biological roles and ecological niches. A number pose very significant threats to human, animal and plant health by carrying and spreading infectious diseases between individuals and often between species. Examples of arthropod vectors of disease are mosquitoes, ticks, fleas, biting flies, house flies and midges. Insects such as psyllids, thrips and leafhoppers can play an important role in plant disease spread.

Kansas State University faculty members in biochemistry and molecular biophysics, biology, diagnostic medicine and pathobiology, entomology and plant pathology, partnered with scientists from the USDA-ARS Center for Grain and Animal Health Research, comprise a strong, interdisciplinary group of researchers studying insect molecular sciences using biochemical, computational, genomic, immunological, molecular, physiological and population-level approaches.

K-State insect molecular sciences researchers have organized and conducted international research collaborations including genome sequencing and annotation of model organisms Tribolium castaneum — red flour beetle — and Manduca sexta — tobacco hornworm. They have led the i5K Initiative that aims to sequence 5,000 arthropod genomes to understand basic mechanisms of insect metabolism and to identify novel approaches to combat diseases spread by insects and other arthropods.

These scientists also lead or are part of teams studying genomes and exomes of Mayetiola destructor — the Hessian fly, a significant pest of cereal crops — and psyllid insects that transmit the bacterium that causes the devastating citrus greening disease. Further, they have pioneered development of biochemical and molecular tools to facilitate research and manipulation of insect genes.

K-State arthropod research also is developing new approaches to controlling insect pests, such as a patented and licensed approach to mosquito control using a double-stranded RNA molecule delivered by nanoparticles that can silence an essential gene. Other promising research areas include vector-pathogen interactions, vector-host interactions, vaccine and drug development, and vector population genetics.

K-State arthropod research is supported by multiple on-campus resources. These include the Biosecurity Research Institute, a BSL-3/BSL-3Ag facility with insect-rearing capability; the Bioinformatics Center; the Center of Excellence for Emerging Zoonotic Animal Diseases; the Center of Excellence for Vector-Borne Disease; two confocal microscopy facilities, one in the Division of Biology and one in the College of Veterinary Medicine; the Integrated Genomics Facility; the K-State Lipidomics Research Center; and the Museum of Entomological and Prairie Arthropod Research.

Relevance
Globalization and human mobility have intensified the risks of arthropod-borne diseases striking the U.S. The most current example of this is the Zika virus, but other recent examples include citrus greening disease — Huanglongbing — that is creating a crisis in the U.S. citrus industry; and West Nile virus, which continues to cause significant disease and mortality each year. In addition, many serious risks lurk just beyond or infringe upon our borders — Rift Valley virus, chikungunya, dengue, African swine fever virus, to name just a few — and vigilance and preparation are critical to address these threats. Further, global conflicts have greatly raised the threat of acts of bioterrorism introducing devastating arthropod-borne plant, animal and human diseases. K-State is uniquely well-positioned to address these threats proactively, and to respond to existing concerns because of our critical mass of expertise and our breadth of experience and tools.

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Background
Few events disrupt society and cause economic loss as severely as an out-of-control infectious disease. Terrorist activities or natural causes can produce an epidemic that may result in human deaths, disposal of herds, and destruction of crops. Fundamental to EPICENTER’s mission is the conviction that epidemic dynamics and intervention strategies must be derived while accounting for underlying complex networks that describe multiple and dynamic interconnections among involved systems.

Description
EPICENTER, a laboratory in Kansas State University’s College of Engineering, provides resources to build, analyze and simulate data-driven computational models for biomedical and biological systems represented as complex networks. Research at EPICENTER challenges scientific boundaries by addressing the impact of heterogeneity, interdependence and stratification of networks in spreading processes. These three characteristics abound in natural and manmade infrastructures and networks, but fundamental questions remain unanswered regarding interconnected and stratified/multilayer networks.

EPICENTER has successfully conducted several research projects since its inception in 2007. Current projects include the following:

- **Predictive models of infectious diseases.** This project aims to develop innovative, multiscale computational models and tools to describe potential transmission cycles of zoonotic pathogens that could be introduced into the United States. Data generated by these models will be used to produce an operationally relevant predictive model that estimates the timing and spatial extent of emerging disease, and the transmission risk to humans. Studied diseases include Ebola, Rift Valley fever, and Japanese encephalitis.

- **Spreading processes over multilayer and interconnected networks.** The research goal of this project is to establish mathematical tools and techniques to understand the role of multilayer and interconnected topologies in spreading processes. For example, a multilayer network is a physical contact network in which a disease can propagate among individuals and an online information-dissemination network in which information can propagate among those same individuals. In zoonotic diseases, interconnected networks include the network of animals and the network of humans in which a virus can transfer from one population — or network — to another.

- **Integrated models of disease spread, supply chain logistics, and communication networks.** The objective of this project is to develop integrated models that capture interdependencies among disease dynamics, supply chain logistics and communication networks. For example, the spread of disease is influenced by the movement of animals, plants and food products through the supply chain. Effective management of this movement and deployment of countermeasures, such as vaccines, require effective risk and crisis communication plans that engage multiple stakeholders. Stakeholders also constitute a network through which information is transmitted. The integrated modeling approach is expected to yield new insight to prevent, mitigate, and respond to infectious disease outbreaks.

Relevance
The National Agricultural Biosecurity Center, or NABC; Institute for Computational Comparative Medicine, or ICCM; Center of Excellence for Emerging and Zoonotic Animal Diseases, or CEEZAD, through the Department of Homeland Security; the planned National Bio and Agro-defense Facility, a DHS facility; and EPICENTER are all located in Manhattan, Kansas, thus making Kansas the national leader in developing countermeasures to naturally occurring and intentionally introduced plant, animal, human and zoonotic diseases.

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Background
The health and productivity of the U.S. agriculture and food system is vital to the national economy and security. Any disruption of this critical infrastructure, such as from emerging, transboundary, and/or zoonotic disease incursions or changes in endemic disease status, would have devastating impacts on both animal and public health. To prepare for and respond to these risks, the detection, distribution, and determinants of disease — i.e., epidemiology — must be understood by all stakeholders across the spectrum of the agriculture enterprise. Maintaining the health status of animal and human populations requires knowledge of detection, distribution and determinants before informed decisions can be made with confidence. As such, federal and state health official, both human and animal health; veterinary practitioners; livestock producers; and allied industry leaders require high-quality information, data analyses and advice on population health risks.

Description
The ability to address these needs and protect and improve animal and public health requires the expertise and integration of epidemiology, surveillance, economics, veterinary medicine and other disciplines, with understanding and application at local, state, regional and national levels. With its Center for Outcomes Research and Epidemiology, or CORE, in conjunction with other centers and institutes, networks of collaborating experts within and outside Kansas State University, and close partnerships with the agriculture industry and state/federal government, the K-State College of Veterinary Medicine brings the necessary expertise under one umbrella. In fact, it may be argued that K-State is a leading university for epidemiological research, service and training in the U.S., as no other institution has its number or breadth of experts within this field. K-State interdisciplinary teams provide: 1) outcomes research and evidence-based advice to stakeholders, such as through intervention effectiveness studies, disease modeling, risk assessment and preharvest strategies to promote food safety and security and address antimicrobial resistance; 2) enhanced surveillance by developing novel and practical methods, technology and tools, and incentivizing their use, to enhance on-farm data collection and early disease detection, with supporting data integration, analysis and dissemination of information tailored to the end-user to support decision-making; 3) diagnostic approaches, including cutting-edge technologies to detect the unknown and rapidly identify the known pathogens, and sharing of critical disease emergence information to network laboratories and state/national agencies; 4) innovative thinking and horizon scanning to support policy and program development, and prepare for effects of land use or climate change, emerging technology, trade dynamics, and other factors on the future of livestock production, public health and global food security, as well as resulting implications for disease prevention and control; and 5) outreach and training to prepare first responders and animal health officials on disease preparedness and response, while also building these capacities to recruit and develop the next-generation veterinary workforce.

K-State’s CORE is a unique interdisciplinary research and training center that excels in population-based and quantitative approaches to enhance animal health for the benefit of animals and society. The current engagement and recognized leadership in significant health and economic issues at the national and global levels are relevant to societal concerns and changing needs.

Relevance
Kansas is at the center of U.S. livestock production and animal health commerce. With the Kansas City Animal Health Corridor located between Manhattan, Kansas, and Columbia, Missouri, and the Department of Homeland Security building its $1.25 billion National Bio and Agro-defense Facility, or NBAF in Manhattan near the K-State College of Veterinary Medicine, the veterinary college is strategically placed at the U.S. epicenter of regional, national and global animal health. Its leadership and expertise will be relied upon to work with veterinarians, their human health counterparts, industry and state/federal government to address challenges and find solutions. These sectors rely on transparent, credible data and information, and support its translation and application into practice for informed decision-making at local, regional and national levels. The K-State College of Veterinary Medicine, through the CORE, has a premier, unique interdisciplinary team to tackle these issues and serve as both a liaison and trusted source to support stakeholders in these decisions, help protect and promote our livestock industries, and ensure the prosperity of national and global population health and food security.

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COMMERCE,
JUSTICE, STATE
**Background**

In today’s increasingly networked, distributed and asynchronous world, cybersecurity involves hardware, software, networks, data, people and integration with the physical world. Society’s overwhelming reliance on this complex cyberspace has, however, exposed its fragility and vulnerabilities: corporations, agencies, national infrastructure and individuals have been victims of cyberattacks. The competitive structure of our national economy is in danger because hackers can infiltrate an organization’s networks and wreak havoc by manipulating, stealing or corrupting data. With recent cyberattacks, and a societal shift towards storing data and information online, a robust and secure cyberplatform is becoming increasingly important for the United States. Both the current and the previous administrations have taken steps to modernize and consolidate the nation’s cyberinfrastructure. Most recently, President Trump underscored the need for cyber development by signing the “Strengthening U.S. Cybersecurity and Critical Infrastructure” executive order in May 2017. It calls for an immediate review of federal agencies’ security framework; an increase in skilled cybersecurity talent; and an adoption of the National Institute of Standards and Technology cybersecurity risk framework by all federal agencies.

**Description**

This initiative will consist of cybersecurity training for IT security professionals. Three classes will be created that are targeted to beginning, intermediate and advanced security professionals. The normal procedure will be for security professionals to enroll in and complete each course in sequence and to use this knowledge to harden organizational networks against attacks and better protect their organization from cybercrime, data destruction and other malicious acts.

In addition, extra topical workshops will be designed and scheduled to attract security professionals seeking to improve their knowledge of specific and known threats to IT systems. These workshops are essentially ad hoc measures aimed at learning how to deal with specific threats as they become known. The workshops will be advertised on a frequent and periodic basis and scheduled to accommodate practitioners who are actively engaged in systems and network security.

The principal outcomes of the project will be enhancing cybersecurity curricula with a focus on evaluating and analyzing cyberattacks and countermeasures at the postattack stage. Through this project, students and professionals will be prepared with the knowledge necessary to better undertake specific roles in future cybersecurity.

**Relevance**

The National Science Foundation has several funding programs for various aspects of computer and network security. The Secure and Trustworthy Cyberspace, or SaTC, program involves several NSF divisions: Computer and Information Science and Engineering, or CISE, Mathematical and Physical Sciences, or MPS, and Education and Human Resources, or HER, to achieve a multidisciplinary approach to design, build and operate, and protect existing infrastructure, and to motivate and educate individuals in cybersecurity.

The National Security Agency has teamed with NSF to introduce middle and high school students to the basics of cybersecurity to help them form communities of young cybersecurity experts. The goal of this program, call GenCyber, is to help students fully understand what a career in this field looks like and to cultivate them for entry into it as they enter the workforce.

NSF has long supported cybersecurity research to help protect and harden the nation’s IT infrastructure.

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Agro-combs: Tools from Physics to Solve Agronomy Challenges

Background
The most critical agricultural challenge is to double crop production by 2050 to meet the food demand of a growing world population. This must be done in a sustainable way by reducing the environmental footprint of crop and livestock production. To solve this challenge, plant, soil and environmental scientists need accurate data at relevant time and spatial scales to improve the efficiency of agroecosystems. These data include concentration of multiple agriculturally significant gases. Multi-gas detection is indispensable for several agricultural applications, such as crop breeding, measuring trace gas emissions from agricultural systems and crop nutrient management. Unfortunately, current technologies are a limitation for sensing agriculturally significant gases. A revolutionary laser spectroscopic method called dual comb laser spectroscopy, or DCS, offers self-calibrating, rapid field-scale monitoring of multiple gases simultaneously by a single instrument.

Description
Kansas State University is developing, under a National Science Foundation Major Research Instrumentation, or MRI, Award, a novel sensor of agriculturally significant gases based on the Nobel Prize-winning technology of optical frequency combs. DCS is poised to transform crop production gas sensing with never-before-realized spectroscopic capabilities, and will serve as a next-generation gas-detection platform. K-State, home to experts and facilities in both optical frequency combs and agricultural gas sensing, offers an excellent environment for the development of this key technological advance. An interdisciplinary team of world-class physicists and agronomists is developing a mid-infrared DCS system for the detection of agriculturally significant gases. This is a novel application of frequency combs that we call agro-combs.

Resulting experiments will lead to increased crop yield in the face of growing demands on natural resources. The instrument will allow simultaneous absorption measurements of multiple gas species with high sensitivity over a 10 m path. Current agricultural gas detection systems are based on tunable laser absorption spectroscopy, or TLAS, and Fourier transform infrared spectroscopy, or FTIR, and have limitations that create a “bottleneck” for the development of high-throughput phenotyping, or HTP, platforms. TLAS has limited spectral coverage and thus can detect only a limited number of gases with a single instrument. FTIR can detect multiple gases but employs a mechanical delay line, limiting scan rates and stability for field deployment.

A few examples of research areas that could benefit from the agro-comb’s capabilities:
- studies of native tallgrass prairie systems
- wheat breeding program
- animal production efficiency
- soil nitrogen gaseous losses
- ammonia production
- natural gas leak detection

Relevance
The instrument will be used for the broadband detection of many agriculturally significant gases. Additional investment would dramatically expand this work by allowing multiple prototypes to be built, specially tailored to each application. Furthermore, large-scale funding would allow the integration of multiple laboratories and field sites, expanding the type of experiments that could be conducted with agro-combs in outdoor environments with multiple crops and plots.

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Data Analytics Institute: Large-Scale Data Inference and Computation

Background
Vast amounts of data currently inundate researchers across many fields and disciplines. A consistent, universitywide, large-scale resource is needed to provide high-performance, efficient, flexible data access and computation at Kansas State University. This resource would allow K-State to participate in future research opportunities while satisfying compliance and data governance requirements from federal funding agencies. Although large datastores are essential for educational and economic development, near-term shortfalls are projected of nearly 200,000 data scientists trained to advantageously utilize big data and convert it to $300B in economic growth.

Information is currently generated as massive, high-dimensional data sets with complex correlation structures and/or nontraditional formats. These data sets arrive with unprecedented speed. Cutting-edge research in the social sciences, life sciences, physical sciences and education generates petabytes of data that are transformatively collected, transmitted, stored, processed and analyzed, revolutionizing how scientists, engineers, business people, and educators approach complex problems. High-dimensional data are generated in diverse fields, including agriculture, astronomy, climate science, ecology, energy, genetic analysis, geospatial sciences, and plant and animal health. These data are often generated in real time and require rapid analysis.

Other web-based sources for current massive data sets provide new realms of data to explore, such as online searches, social networking activities and financial transactions, with potential for improved business decisions and informed policymaking.

Description
This initiative proposes development of an interdisciplinary Data Analytics Institute on the K-State Manhattan campus, staffed primarily by data scientists from the departments of mathematics and statistics in the College of Arts and Sciences, and faculty associated with K-State’s Institute for Computational Research in Engineering and Sciences, or ICRES, in the College of Engineering. Local high-performance computing, or HPC, resources at ICRES uniquely provide a platform to train students and staff in cyber-infrastructure. ICRES staff and students deploy entire clusters and learn state-of-the-art high-performance computing and storage by contributing to ongoing research projects. K-State HPC-trained alumni now work at Google, Lawrence Livermore National Laboratory, Cerner, Garmin and many other leading technology companies.

ICRES faculty, in collaboration with campus researchers, provide requisite skills for design of big data studies; adaptation of algorithms for parallel computing; collection, storage and retrieval of big data, and modeling and analysis of such data; and interpretation of results. New tools for big data analytics will be developed and disseminated to the broader community. A fundamental goal of the institute is the development of innovative curricula for undergraduate and graduate students to engage in large-scale data-driven science and engineering. The institute could specifically contribute collective expertise to precision agriculture, bioinformatics and security; enhance secondary education; and provide significant advancement for federal and state initiatives on STEM workforce development.

Relevance
Establishment of a Data Analytics Institute aligns closely with K-State 2025 goals related to research, and graduate and undergraduate education, including research experiences for undergraduates. The institute will focus on university strengths and critical needs, particularly in biosciences and animal health at K-State. Creating the institute with cluster hires and/or joint appointments will strengthen and expand research funding opportunities throughout the university. In addition, the institute will facilitate corporate partnerships with industry in the Kansas City animal health corridor. The K-State Olathe campus offers a convenient venue for engagement between professional development and/or business related to big data.

K-State’s ICRES has consistently developed and influenced cyber-infrastructure for research and education. With existing collaborations between leading national and international research organizations — e.g., XSEDE — and the anticipated arrival of the National Bio- and Agro-defense Facility, ICRES has the potential to form alliances with and attract a multitude of cyber-enabled and bioinformatics companies to Manhattan. This project will be a catalyst for these endeavors, provide a vital research test bed, and establish a regional center to train the future cyber-enabled workforce.

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Science Communication Initiative

Background
In early June 2016, an editorial on InsideHigherEd.com called on universities to improve communication about the science and research being done on their campuses (Hulcr, 2016). The article offered an opinion on the importance of such communication and suggested tangible ways of approaching the task. The author noted, “there are enormous benefits to be reaped, financial as well as political, if higher education manages to enter mass media.” Higher education has used mass media for a long time, but scientists are often not prepared to provide the right information for nonexpert audiences or to engage with media directly. One path to improve communication between scientists and citizens is for universities to provide better training and collaboration opportunities for both scientists and communicators.

Description
The Science Communication Initiative, or SCI, seeks to engage communities in understanding, enthusiastically promoting and actively participating in science and research. SCI aims to act as a clearinghouse for science and research communication activities on campus and connect campus entities with community partners. Many campus units and local organizations are already engaged in science and research communication activities, so our aim is to organize collaborative efforts and give all interested parties access to the same resources.

SCI formed in spring 2017 out of effort to coordinate science communication events and training sessions across campus and regional communities. In early summer 2017, the Science Communication Fellows program, a joint effort between Kansas State University and community partner Sunset Zoo, was noticed by Maddie Sofia, producer for National Public Radio science correspondent Joe Palca. SCI recognized an opportunity to invite high-profile speakers to campus and structure activities around their visit, organizing the first Science Communication Week in November 2017. The Flint Hills Discovery Center also partnered with SCI, and many campus units — including the Office of the President, the Office of the Senior Vice President and Provost, the Office of the Vice President for Research, and the Graduate School — helped defray costs for the week’s events.

The week was highly successful and included events designed for the general public and for K-State students and faculty. More than 1,000 people attended public lectures, a research colloquium, an open house at a local USDA-ARS facility, Science Café and Science on Tap events, a scholarship expo at K-State Libraries, a graduate student poster competition, an improv workshop for graduate students and a special session for communications staff.

Future plans include an emphasis on offering continued training for graduate students, particularly in science, technology, engineering and mathematics — STEM — disciplines that typically do not offer communication training; connecting researchers with resources necessary to develop broader impacts plans and communications campaigns as part of grant proposals; reaching out to more partner organizations around the state; and providing more venues in which scientists can directly engage with public audiences.

Relevance
Researchers at K-State and elsewhere recognize a great need for communicating about their discoveries to audiences on a much larger scale than has been done in the past. In some cases, this will satisfy requirements from granting agencies, but other benefits include aiding legislators in understanding the economic value of K-State research efforts; advancements that develop new materials and health and technology advances benefiting the entire population; increasing public understanding of research and scientific issues leading to a more educated workforce; and inspiring tomorrow’s researchers.

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Immersive 3D/4D Visualization for Education and Research

Background
Immersive environments and visualization technologies have catalyzed a revolution in education, storytelling and research. Rich interactive simulations have proven effective at improving the educational experience in fields such as engineering, architecture, health care and military operations. Similarly, these simulations are used in groundbreaking basic research in STEM fields. We have extensive knowledge and expertise in developing these kinds of technologies to support STEM training and research. We have state-of-the-art technology and manufacturing laboratories that are used to enhance university education through the creation of immersive digital environments and analog replicas. Examples of key contributions to education and research:

- 3-D visualizations and 3-D prints for architectural and medical purposes
- 20’x 8’ Panoramic Immersive Screen for virtual representations and experiences in research
- 3-D/4-D virtual reality games using state-of-the-art computer hardware and software for education
- Pedagogical expertise in problem-based learning

In interdisciplinary expertise of faculty in the College of Architecture, Planning & Design can be leveraged to contribute toward new educational opportunities, such as serious gaming, as well as novel research opportunities in information visualization and geovisualization.

Description
Educational Opportunities: Integration of serious gaming — where learning is the primary goal — may assist in building a diverse workforce and increasing opportunities for innovation while encouraging critical decision-making strategies. Simulations incorporated in the serious games can provide project-based experiential learning that better prepares graduates entering the workforce and help the public learn today’s critical social and environmental issues.

Military Training Opportunities: Using immersive technologies and environment offer a novel way to support the training of troops in navigation and situational awareness. We are using these technologies to better understand how spatial memory is retained and how we might better use this knowledge to support the wayfinding and navigational skills for our military personnel.

Research Opportunities: Information visualization and geovisualization are technological methods used in research throughout the sciences and humanities. Our area of expertise is in creating high-fidelity virtual simulations of real and imaginary places across multiple spatial and temporal scales. This expertise provides an opportunity to conduct research in environmental perception and spatial cognition, as well as engaging in the visualization of future alternatives for scientific and engineering assessment.

The adaptation of visualization technology to support these efforts, combined with the re-creation of these forms, holds promise for improving education and scientific outreach.

Relevance
Incorporation of problem-based learning enhanced by visualization technology and serious gaming may increase the efficacy of STEM education and military training. Likewise, the ability to create a virtual environment with high realism enables us to better understand how landscape and built-environment landmarks influence spatial memory. Finally, these same technologies can be used to support research in STEM fields by exploring realistic environments and conditions, and how interventions are magnified.

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The Wheat Genetics Resource Center Industry/University Cooperative Research Center, WGRCI/UCRC

Background
Established in 2013, the Wheat Genetics Resource Center Industry/University Cooperative Research Center — WGRCI/UCRC — at Kansas State University joins public and private partners to mobilize genetic diversity to enhance wheat yield and meet food security needs. Researchers at the WGRCI/UCRC deliver novel genes, derived from wild wheats, to public and private breeding programs. These genes combat challenges facing wheat farmers, such as hot and dry climate conditions, pests and disease, to ensure a stable and profitable wheat supply that keeps up with global demand. The WGRCI/UCRC will also target genes related to consumer-demanded nutritional, flavor and textural profiles. Beyond scientific deliverables, the WGRCI/UCRC provides a transdisciplinary, applied and fundamental research environment to train the future leaders of crop improvement research.

Description
Kansas State University requests $750,000 per year, for five years, to be matched by industry investors and the National Science Foundation. The funding will go toward the core research program of the WGRCI/UCRC:
• Managing wheat germplasm
• Mining the wheat gene pool
• Wheat phenotyping for drought
• Wheat genetic stocks and introgression platform, and
• Graduate student training.
This core research program enhances the value of the WGRCI wild wheat collection to the user community, leading to rapid development of new, high-yielding wheat varieties and value-added food products.

Relevance
• Temperature increases are projected to decrease wheat yields by 20-30 percent.
• Demand for wheat is expected to increase by 60 percent over the coming decades.
• The current trend of wheat yield cannot meet the projected global demand in 2050.

The WGRCI/UCRC provides novel genes to breeders to develop wheat varieties for farmers that can resist pressures such as disease, water, nutrient and energy scarcity, and climate change.

The core research program of the WGRCI/UCRC has three main missions to address challenges facing the global wheat supply:

1) Collect, conserve and utilize germplasm in crop improvement; included in the current stock:
- 4,000 WILD WHEATS
- 3,500 UNIQUE GENETIC STOCKS
- 8,500 MAPPING POPULATIONS

2) Create and promote the free exchange of materials, technology and new knowledge in genetics and biotechnology: in the first three years of operations, center researchers have produced 25 publications and 14 presentations.

3) Train undergraduate, graduate and postgraduate students and visiting scientists: WGRCI has mentored 13 master’s students, 25 doctoral students and 20 postdoctoral fellows, in addition to hosting more than 60 visiting scientists from all over the globe.

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Members and Partners
Background
Our highly networked world, where software pervades all aspects, is dominated by cyberphysical systems, or CPS. The dividing line between electronic security, physical security and safety has blurred to the point of near invisibility. Cyberattacks are a major threat to society; they can inflict physical damage to trillions of dollars in infrastructure and threaten the well-being — and lives — of millions. The correct and secure operation of software is required to protect this critical infrastructure. Recent reports to the National Academy of Sciences urge the adoption of software with “correctness certificates.” The Department of Defense, or DOD, has developed a “System Assurance Strategy” that stresses security throughout a system’s lifecycle and requires DOD programs to account for vulnerabilities. The Food and Drug Administration has developed guidance for the security of medical systems and device software. The Institute of Electrical and Electronics Engineers released the report “Building Code for Medical Device Software Security” in response to mounting pressure to secure the medical infrastructure. Kansas State University researchers have been key participants in many of these efforts, with a distinguished history of developing technologies for construction of safe and secure systems.

Description
The Center for Information and Systems Assurance, or CISA, is a leader in cybersecurity research, teaching and outreach. In 2010, CISA was designated as a National Center of Academic Excellence for Research in Cybersecurity by the National Security Agency and Department of Homeland Security. For more than 15 years, CISA researchers have collaborated with partners such as Rockwell Collins, Boeing, HP, Microsoft, Honeywell, Galois, Adventium and Idaho National Lab to design secure, mission-critical software systems. New collaborations in safety, security and education research are being explored.

CISA has also contributed to securing the national infrastructure. DOD contractors integrate custom and off-the-shelf components from hundreds of suppliers to build complex distributed systems. Because current design, acquisition and vulnerability assessment techniques are insufficient for this complexity, security flaws and cost overruns are common. CISA researchers have developed tools to design and assemble such software systems quickly and at low cost. CISA researchers have also developed tools that protect medical communication, reduce programming errors and simplify integration of security into next-generation CPS. CISA members also have multiple prestigious awards, including five National Science Foundation CAREER awards, and more than $1.25 million in DOD funding to study the safety and security of dynamically composable CPS.

Additional funding will significantly enhance CISA capabilities to solve the challenges of next-generation CPS. These challenges include faster, less costly design of “zero-failure” mission critical systems, tools to protect the nation’s critical infrastructure, and partnerships with corporate and local, state and national agencies to educate the general population on ways to overcome cybersecurity challenges.

CISA is uniquely poised to tackle these issues. CISA will develop usable security solutions that seamlessly integrate with current verification and validation activities, and produce secure systems by increasing uptake and reducing development costs. Enabling techniques include reasoning based on formal languages and type theory, code generation, and developer tools evaluated for usability. A shortage of cybersecurity engineers has been regularly cited as a potential threat to national security. CISA will continue to develop tools for security education at the Manhattan, Kansas State Polytechnic and Olathe campuses, and determine how to most effectively present security education material.

Relevance
CISA has a reputation of building secure software protocols and systems. Given existing collaborations with cybersecurity industry leaders and the anticipated arrival of the National Bio and Agro-defense Facility, CISA will promote collaboration with cybersecurity and biosecurity companies, and help establish a regional center to train the future cybersecurity workforce. CISA has also established CANSec, a semiannual workshop to present ongoing research and promote collaboration.

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Background
The Earth’s Critical Zone is the thin outer veneer of our planet, from the top of the tree canopy to the bottom of our aquifers — the region of Earth that supports almost all life. Population growth — and the associated demands for food, fuel and clean water — combined with climate and environmental change place the critical zone under ever increasing pressures. Understanding, predicting and managing land use intensification while mitigating and adapting to rapid climate change, biodiversity decline and sustained provision of key ecosystem services are now some of the most pressing societal challenges of the 21st century. The Critical Zone Observatory, or CZO, Network aims to investigate these processes and pressures through monitoring and observation. Ten U.S. critical zone observatories contribute to a global initiative that includes more than 60 research sites on six continents.

Kansas State University aims to join this network by building on the Konza Prairie Long-Term Ecological Research (LTER) program, a comprehensive ecological research, education and outreach initiative centered on one of the most productive ecosystems in North America: the tallgrass prairie.

Description
Previous ecological and hydrological research conducted at the Konza LTER have established this site as an ideal location for investigating environmental pressures and processes affecting prairie, karst and former prairie landscapes across North America. It also bears particular relevance to the region overlying the Ogallala aquifer. The Konza location presents an ideal complement to the existing CZO network, as it is uniquely equipped to address key questions into critical zone functioning which existing CZOs cannot assess.

A region with areas largely unmodified by human activities. Graslands, rangelands, steppe, tundra, savanna and shrub-grasslands cover 40 percent of the Earth’s land surface. North American tallgrass prairie covered ~67 million ha in the U.S. before the 1800s. Today, less than 5 percent of these grasslands remain and they are concentrated in the Flint Hills of Kansas and Oklahoma. Konza, therefore, represents a reference ecosystem against which intensively managed former prairies can be evaluated.

A region of ecologic transition and climate gradients. From east to west, tallgrass gives way to mixed grass to shortgrass. The region also lies at the confluence of areas which are predicted to undergo contrasting change in climate — drier to the southwest, wetter to the northeast. Rising temperatures will lead to increased demand for water and energy, which constrains development, stresses natural resources, increases competition for water and requires new management practices, and will also affect the ecologic balance.

A region with significant water challenges. Groundwater serves as the main source of water to irrigate western Kansas and support its residents. Water balance across the region is delicate and aquifer depletion is predicted at current extraction rates. To date, 30 percent of the groundwater has been pumped and a further 39 percent is projected to be depleted over the next 50 years. Recharge supplies only 15 percent of the current pumping and would take an average of 500 to 1,300 years to completely refill the aquifer. There is a pressing need to quantify the processes controlling recharge under climatic, geologic and vadose factors in this region so that effective management strategies can be developed.

A CZO in the Konza region would add to the range of lithologic gradients investigated by the CZO network; bring an unglaciated peri-karst weathering history into consideration and allow the evolving hydrology of this pedagogically and geologically dynamic environment to be elucidated. Critically, it would provide the opportunity to examine the consequences of global climate change in an area that could be one of the most dynamic and sensitive regions in the U.S. Steps have been taken to establish new infrastructure at Konza, including vadose zone monitoring arrays, which will bring the site in line with the recommended common measurement approach proposed by the CZO network.

Relevance
This initiative will provide a nexus for collaborative research between K-State departments and colleges, including the Division of Biology; agronomy, geography and geology departments; and the colleges of Agriculture, Arts and Sciences, and Engineering. Furthermore, it will facilitate new opportunities to collaborate with other research institutes within the CZO network.

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1 konza.ksu.edu/knz/pages/home/home.aspx
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Technology Retooling for Workforce Placement Program

Background
The Technology Retooling for Workforce Placement Program has a goal of updating members of the workforce with technology skills in high demand and short supply. Specifically, the program will provide support for university students, community members, military veterans and businesses wishing to upgrade workforce skill sets to make themselves relevant to future, high-demand employment areas. This program especially will target unemployed individuals and those from underrepresented minority areas wishing to retool with the latest technologies by providing resources and easily accessible knowledge. The program will offer training in a variety of technology-oriented venues using a series of workshops of varying duration. Following workshop completion, participants will have the opportunity to take valuable certification exams offered by organizations such as Microsoft, SAP, SAS, IBM, Oracle, CISCO, CompTIA and others. Support materials will remain available in the form of an online learning repository that will be accessible to program participants. The workshops will be taught by university faculty, industry experts and experienced information technology specialists. The knowledge repository will be maintained by university faculty members. The end goal of the program is to update workforce skill sets, particularly in rural areas and within underrepresented demographics, with an emphasis on anticipated technology needs. The outcomes will result in a stronger economy with high-paying jobs in a variety of areas, including those in online, virtual environments. Having a technology-enabled work force will make Kansas a more attractive option to businesses wishing to relocate to this part of the country.

Description
Computer systems analysis is a hybrid of information technology and business practice. The Management Information Systems, or MIS, group, in existence for over 25 years at Kansas State University, specializes in training within this skill area. A successful computer systems analyst leverages his or her knowledge of information technology and business practices to design better software, applications, databases and work processes. She or he understands business and will utilize the best technologies to help achieve organizational goals in cost effective ways. Computer systems analysts prepare cost and benefit analysis for technology upgrades and then oversee upgrades, configurations and installations of new systems. They also may test systems, train users and monitor efficiency. Computer systems analysts require a wide variety of skills, technical knowledge and business acumen. This program will be positioned to address needs in this particular area.

Among the unique elements of the program will be its mix of high quality training it brings to targeted groups. The Kansas State University MIS group has unique relationships with a number of technology firms and can offer certification training by highly qualified faculty and support by successful alumni. The College of Business Administration at Kansas State University offers the ideal venue for development and maintenance of the online course material learning repository with online-development support staff and faculty experts in residence.

Relevance
The causes of unemployment in Kansas are not necessarily the lack of jobs, but rather the mismatch of skill sets within areas seeking new workers. Oil, agriculture and other traditional areas of employment in Kansas are trending downward, highlighting a major shift in national workforce needs. According to U.S. News and World Report, technology jobs are set to become more important with the creation of many high-paying positions and low unemployment rates. Among technology jobs, computer systems analysts are projected to be in high demand with an expected growth rate of 21 percent in the coming decade — and this is just one of many related fields with similar expectations.

The central tenet of the Technology Retooling for Workforce Placement program would be to facilitate the development of skill sets relevant to the needs of a growing and economically viable Kansas. The program would begin with a short research phase to identify the skill sets in most demand. The second phase would be to develop and implement the training.

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**Background**

Daily societal activities increasingly depend on interdependent critical infrastructures such as power grids, telecommunication networks, transportation networks, food networks and water distribution networks. In contrast to isolated systems, interdependent networked systems demonstrate emergent behaviors caused by unpredictable, rare nonlinear interactions between numerous social, physical and cyber components. Because infrastructure systems are large, they are often decentrally controlled through cyber systems. Although decentralization and self-organization theoretically reduce failure risk, interdependencies can lead to disruptive and massive cascading failures.

Interdependent and multilayer networks characterize critical social and engineered infrastructures, but a thorough understanding of their behaviors through fundamental results is still lacking. For example, the smart grid concept includes application of advanced computer, communications and power technologies to obtain a highly automated, responsive and resilient, transmission and distribution infrastructure. At the distribution level, the smart grid integrates distributed, renewable generation sources with energy storage and provides demand response management to customers through dynamic pricing. At the transmission level, communication architecture creates an intelligent infrastructure that can detect and mitigate faults faster than those faults can propagate, thus providing utility operators with improved efficiency and reliability. Although ongoing efforts to design a next-generation communication network within the smart grid framework are in progress, lack of flexibility and programmability of network equipment has impeded experimentation of new schemes. Consequently, power operators are reluctant to adopt untested solutions.

**Description**

This project has two primary goals. The first is to study interdependencies between critical infrastructure networks and provide fundamental insights on the impact of these interdependencies related to reliability of the coupled system, all to increase reliability by developing analytical tools to measure and adapt system interdependencies. The goal is to address key issues in order to allow rigorous experimentation and analysis of networking solutions in the real-world environment. For example, large-scale experiments that incorporate resources from the Smart Grid Lab at Kansas State University, K-State networking resources, and the Global Environment for Network Innovations, or GENI, test bed will be performed. To date, a hybrid simulator has been created that integrates continuous-time behaviors of the power system with discrete-event behaviors of the communication network. This platform has demonstrated performance impacts of the communication network and the power system when the physical infrastructure is designed to maximize robustness. Furthermore, this platform demonstrated that an OpenFlow communication network could perform equally well with or better than its multiprotocol label switching, or MPLS, counterpart. Finally, a smart grid prototype was deployed on the nationwide GENI network test bed to demonstrate OpenFlow’s ability to provide services comparable to MPLS.

**Relevance**

Numerous critical infrastructures in Kansas and the United States rely on secure networking and communications. In Kansas, power and networking companies have demonstrated endorsement by sponsoring K-State’s Electrical Power Affiliate’s Program, known as EPAP. This research has also received national contributions from Raytheon BBN Technologies, KanREN, Internet2, the National Science Foundation and National LambdaRail.

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EPICENTER: Laboratory for a Network Science Approach to Predict and Control the Spread of Infectious Diseases

Background

Few events disrupt society and cause economic loss as severely as an out-of-control infectious disease. Terrorist activities or natural causes can produce an epidemic that may result in human deaths, disposal of herds and destruction of crops. Fundamental to EPICENTER’s mission is the conviction that epidemic dynamics and intervention strategies must be derived, while accounting for underlying complex networks that describe multiple and dynamic interconnections among involved systems.

Description

EPICENTER, a laboratory in Kansas State University’s College of Engineering, provides resources to build, analyze and simulate data-driven computational models for biomedical and biological systems represented as complex networks. Research at EPICENTER challenges scientific boundaries by addressing the impact of heterogeneity, interdependence and stratification of networks in spreading processes. These three characteristics abound in natural and manmade infrastructures and networks, but fundamental questions remain unanswered regarding interconnected and stratified/multilayer networks.

EPICENTER has successfully conducted several research projects since its inception in 2007. Current projects include the following:

- **Predictive models of infectious diseases.** This project aims to develop innovative, multiscale computational models and tools to describe potential transmission cycles of zoonotic pathogens that could be introduced into the United States. Data generated by these models will be used to produce an operationally relevant predictive model that estimates the timing and spatial extent of emerging disease and the transmission risk to humans. Studied diseases include Ebola, Rift Valley fever, and Japanese encephalitis.

- **Spreading processes over multilayer and interconnected networks.** The research goal of this project is to establish mathematical tools and techniques to understand the role of multilayer and interconnected topologies in spreading processes. For example, a multilayer network is a physical contact network in which a disease can propagate among individuals and an online information-dissemination network in which information can propagate among those same individuals. In zoonotic diseases, interconnected networks include the network of animals and the network of humans in which a virus can transfer from one population — or network — to another.

- **Integrated models of disease spread, supply chain logistics and communication networks.** The objective of this project is to develop integrated models that capture interdependencies among disease dynamics, supply chain logistics and communication networks. For example, the spread of disease is influenced by the movement of animals, plants and food products through the supply chain. Effective management of this movement and deployment of countermeasures, such as vaccines, require effective risk and crisis communication plans that engage multiple stakeholders. Stakeholders also constitute a network through which information is transmitted. The integrated modeling approach is expected to yield new insight to prevent, mitigate and respond to infectious disease outbreaks.

Relevance

The National Agricultural Biosecurity Center, or NABC; Institute for Computational Comparative Medicine, or ICCM; Center of Excellence for Emerging and Zoonotic Animal Diseases, or CEEZAD, through the Department of Homeland Security; the planned National Bio and Agro-defense Facility, a DHS facility; and EPICENTER are all located in Manhattan, Kansas, thus making Kansas the national leader in developing countermeasures to naturally occurring and intentionally introduced plant, animal, human and zoonotic diseases.

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Background

“Lipid” refers to a large and varied group of compounds that are not soluble in water. Lipids are found in every living organism and every part of every organism, including humans, crop plants and food animals.

Established in 2003, the Lipidomics Research Center, or LRC, at Kansas State University is one of the world’s longest-serving facilities dedicated to cutting-edge “lipidomics.” Lipidomics refers to the identification and quantification of lipids using mass spectrometry. LRC scientists have established mass spectrometry-based methods for well over a thousand lipids. Scientists from over 600 labs have come to LRC or sent samples for analysis, resulting in hundreds of scientific publications. LRC has successfully secured funding for mass spectrometers in two National Science Foundation Kansas EPSCoR and three NSF major research instrumentation competitions.

One of the historic bottlenecks in lipid research is measuring the thousands of types of lipids in each organism. LRC analyzes lipids from all organisms, but is particularly known in the scientific community for its identification and quantification of both known and novel plant lipids. Lipids are important in crop plants for two reasons. First, seed oils, which are major food and energy products, are composed of lipids. Second, lipids are critical in regulating the resilience of crop plants to the challenges of their environment because of their roles in membranes and as molecular signals. Thus, analyses performed at LRC are critical in studies of lipids in crops aimed at (i) improving oil quantity and quality and (ii) improving metabolism of lipids to enhance growth and stress resilience of crop plants.

Description

With the current abundance of genomic information on crop plants, the time is right to combine large-scale data on plant lipids with genetic data to make the discoveries needed to design crops that produce high yields of seed oils of specific composition and that can withstand stressful environments.

The LRC is poised to lead the plant science community in a major initiative to collect large-scale lipidomic data on crop plants and to utilize the data to enhance crop improvement programs. Experiments conducted at LRC imply that combining lipidomic data with other plant genomic data will produce insights into plant metabolism that will facilitate crop improvement. LRC scientists work closely with plant biochemists and agronomists at K-State and across the Midwest. For example, collaborators at K-State are utilizing lipidomics to design camelina that produces improved biofuels and oils useful in the chemical industry. Other K-State groups are aiming to understand how lipid differences can improve sorghum and wheat tolerance to heat, cold and drought.

Relevance

The rate of increase in worldwide agricultural production is slowing and is lagging the increase in world population. With limited future ability to bring more land into production, increases in yield are needed. These increases must be made as climate variability is increasing. To develop crops with increased yield and more resilience, new knowledge and strategies are needed. LRC and colleagues can accelerate our understanding of how lipids interact with plant genes and the environment to regulate and enhance crop growth and food production.

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Building Innovation-based Partnerships

Background
The Advanced Manufacturing Institute, or AMI, at Kansas State University provides a broad range of integrated business and engineering development services to both industry and university partners to accelerate the innovation process of new products and manufacturing processing technologies. Established as a Kansas Center of Excellence in 1985, AMI serves to advance technologies, people and companies through collaborative engineering and business partnerships in the following ways:

• From 1995 to present, AMI has completed more than 2,800 product design, design/build custom automation, product testing and new venture development projects with more than 600 businesses and organizations throughout the U.S.

• AMI actively supports faculty applied research and development efforts on diverse technologies such as aircraft cabin air filtration, noncontact concrete railroad tie inspection, wind turbine testing and big data recommender systems.

• Since 1995, AMI has continuously operated an engineering/business student internship program that has served to accelerate the hands-on learning of over 600 undergraduate and graduate students.

• Since 2004, AMI has served as a funded University Center for the U.S. Department of Commerce Economic Development Administration, or EDA. In this capacity, AMI focuses on accelerating innovations through building innovation networks and collaborations with individual companies, communities and regions.

• In 2016, AMI was awarded the Kansas State University Excellence in Engagement Award for its performance on a large-scale, innovation-based, regional development project, co-funded by the EDA, USDA-Rural Development and the Kansas Department of Commerce.

Description
AMI can significantly expand and/or amplify the innovation capacity of university faculty/student research teams. Many university innovators lack all of the necessary technical expertise, resources and industry connections to successfully bring their innovations to market in a timely and effective manner. A new early-stage, hands-on, proof-of-concept partnership is required to close this innovation gap. A university-based innovation team can be comprised of industrially experienced, hands-on technical and business professionals who work in partnership with university research teams. This partnership could rapidly construct university/industry open innovation networks to accelerate research projects, directly engage technology brokers and suppliers, scout prospective industry partners, and directly contribute industrially experienced technical and business expertise to harden early-stage university innovations.

Equipping AMI to serve as an early-stage proof-of-concept partner will help the university:

• Enable faculty/student research teams to capture more sponsored research funding through demonstration their teams are equipped for early market validation in the discovery process, and to carry their innovations further in the subsequent technology transfer/commercialization processes.

• Employ a systematic development process that enables faculty/students to focus on learning and discovery and AMI to focus on hardening, refining, and transitioning innovations to industry partners.

• Equip AMI to host an open and accessible university makerspace to increase student experiential mentoring via industry-experienced design and development professionals.

• Position the university to have greater engagement and economic impact with the companies, communities and regions served.

Relevance
As a state, Kansas needs to increase its economic vitality through greater innovation-based economic development engagement. Existing companies need to grow, jobs and personal income need to increase, and communities and regions need new companies and sources of innovation to prosper. The state’s companies, communities and regions could all greatly benefit from more direct engagement with an accelerated university innovation ecosystem.

Being able to accelerate the university transformation process of converting scientific discoveries into marketable products and services is not only vital to health of the university innovation ecosystem, but it is increasingly critical to sustaining financial support from federal/state agencies and industry sponsors. In addition, engaging students actively in this innovation acceleration process better equips today’s university research teams and tomorrow’s future graduates to have a greater near-term impact on society and the state and nation’s economies.

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Background
Arthropods comprise the largest and most diverse group of animals, occupying a vast array of biological roles and ecological niches. A number pose very significant threats to human, animal and plant health by carrying and spreading infectious diseases between individuals and often between species. Examples of arthropod vectors of disease are mosquitoes, ticks, fleas, biting flies, house flies and midges. Insects such as psyllids, thrips and leafhoppers can play an important role in plant disease spread.

Kansas State University faculty members in biochemistry and molecular biophysics, biology, diagnostic medicine and pathobiology, entomology and plant pathology, partnered with scientists from the USDA-ARS Center for Grain and Animal Health Research, comprise a strong, interdisciplinary group of researchers studying insect molecular sciences using biochemical, computational, genomic, immunological, molecular, physiological and population-level approaches.

K-State insect molecular sciences researchers have organized and conducted international research collaborations including genome sequencing and annotation of model organisms Tribolium castaneum — red flour beetle — and Manduca sexta — tobacco hornworm. They have led the i5K Initiative that aims to sequence 5,000 arthropod genomes to understand basic mechanisms of insect metabolism and to identify novel approaches to combat diseases spread by insects and other arthropods.

These scientists also lead or are part of teams studying genomes and exomes of Mayetiola destructor — the Hessian fly, a significant pest of cereal crops — and psyllid insects that transmit the bacterium that causes the devastating citrus greening disease. Further, they have pioneered development of biochemical and molecular tools to facilitate research and manipulation of insect genes.

K-State arthropod research also is developing new approaches to controlling insect pests, such as a patented and licensed approach to mosquito control using a double-stranded RNA molecule delivered by nanoparticles that can silence an essential gene. Other promising research areas include vector-pathogen interactions, vector-host interactions, vaccine and drug development, and vector population genetics.

K-State arthropod research is supported by multiple on-campus resources. These include the Biosecurity Research Institute, a BSL-3/BSL-3Ag facility with insect-rearing capability; the Bioinformatics Center; the Center of Excellence for Emerging Zoonotic Animal Diseases; the Center of Excellence for Vector-Borne Disease; two confocal microscopy facilities, one in the Division of Biology and one in the College of Veterinary Medicine; the Integrated Genomics Facility; the K-State Lipidomics Research Center; and the Museum of Entomological and Prairie Arthropod Research.

Relevance
Globalization and human mobility have intensified the risks of arthropod-borne diseases striking the U.S. The most current example of this is the Zika virus, but other recent examples include citrus greening disease — Huanglongbing — that is creating a crisis in the U.S. citrus industry; and West Nile virus, which continues to cause significant disease and mortality each year. In addition, many serious risks lurk just beyond or infringe upon our borders — Rift Valley virus, chikungunya, dengue, African swine fever virus, to name just a few — and vigilance and preparation are critical to address these threats. Further, global conflicts have greatly raised the threat of acts of bioterrorism introducing devastating arthropod-borne plant, animal and human diseases. K-State is uniquely well-positioned to address these threats proactively, and to respond to existing concerns because of our critical mass of expertise and our breadth of experience and tools.

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21st Century Technology for Legacy Engines

**Background**

Legacy engine is a term applied to industrial engines designed and manufactured before low emission levels were required and before advanced control systems were employed. Typically, they are 20 to 50 years old. Most large legacy engines are mechanically sound and capable of operating reliably for many more decades. Many can perform at present-day standards if retrofitted with advanced technology. The challenge comes in designing technology appropriate for a given engine.

**Description**

Large reciprocating engines provide motive power throughout the U.S. industry. These engines are ruggedly built and typically are capable of continuously generating several thousand horsepower each. They run at relatively low speeds and can continue to operate efficiently more or less indefinitely, if properly maintained. These engines must meet myriad air quality regulations. These regulations vary widely with locality and application, and literally hundreds of different requirements can potentially apply to a given engine.

Use of these engines is widespread but, by far, the single largest use is in compression stations for the natural gas pipeline system. The U.S. has more than 17 million installed horsepower-for-gas pipeline compression stations. Exact figures for the amount supplied by legacy engines are difficult to obtain, but saying 50 percent of installed power is from legacy engines is reasonable.

These engines are sufficiently large, and local requirements are sufficiently unique that each engine must be treated as more or less one of a kind. Upgrading each engine is a unique process, often with trial and error approaches. Our proposed research program is quite simple in concept: developing analytical tool packages that can be used to accurately predict the impact of available technologies on a given legacy engine and its emissions. The automotive engine industry has shown this level of analysis is feasible, but it is a much different proposition to apply it to hundreds of different engines, rather than design of a new engine that will be reproduced a million times. We plan to seek funding to form a National Science Foundation Industry/University Cooperative Research Center, and simultaneously seek major funding through the Department of Energy's Natural Gas Infrastructure R&D Program initiative.

**Relevance**

The pipeline system map demonstrates the nationwide impact of this research. The ability to continue to use legacy engines is important for maintaining low-cost and reliable delivery of natural gas throughout the country. Through incorporation of advanced technology, these engines can continue to provide this service, meet current and future emission requirements, and be part of the solution to improve the environment by delivering an environmentally friendly fuel throughout the country.

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DEFENSE
Background

National security concerns arise when terrorist and rogue states pursue nuclear weapon development. The U.S. departments of Defense, Energy and Homeland Security must identify security barriers and develop new technologies to detect and mitigate these threats. National strategic research must include improved nuclear detectors and sensor systems for safeguard programs. Establishment of a center dedicated to development of radiation sensors and radiation measurement techniques is a direct response to national security needs.

In addition to faculty who are leaders in several areas relevant to nuclear detection, Kansas State University has nuclear capabilities unique to the Midwestern region of the United States. The Semiconductor Materials and Radiological Technologies, or SMART, Laboratory at K-State, one of the largest and most diverse university-based radiation-detector development laboratories in the United States, is dedicated to research and development of new, innovative radiation-detector technologies. Over the past 14 years, the SMART Lab has benefited from numerous government and corporate sponsors, including the DOD, DOE, National Science Foundation, Nuclear Engineering Educational Research program and the DOE NNSA office, totaling more than $23 million in extramural research support. A recently installed class-100 clean room is dedicated to fabrication of innovative radiation detectors.

The radiation-detector development group at K-State is involved in groundbreaking projects that emphasize development, design and fabrication of innovative nuclear-radiation detector materials and devices for applications such as nuclear materials monitoring, radiation imaging, radiation dosimetry and remote radiation sensing. The SMART Lab has extensive materials purification and crystal-growth facilities, semiconductor detector processing fabrication equipment, electronics design and testing equipment, and radioactive calibration sources and detection calibration facilities, allowing the lab to be a fully operable facility for radiation-detector design and development. SMART Lab detectors have been featured in local and national news, and 16 U.S. patents have been awarded to SMART Lab researchers for novel detector designs, in addition to four Research & Development 100 awards for innovative detector designs. The K-State nuclear program has conducted seminal civil defense research and maintains a world-class reputation in radiation shielding research. DOE, DHS and DOD laboratories are currently testing detectors from the SMART Lab. K-State operates the only university research nuclear reactor in an 11-contiguous-state region within the Great Plains. The K-State nuclear reactor is used extensively to test and characterize detector technologies developed in the SMART Lab. Additional support is provided by the K-State Electronics Design Laboratory, or EDL, staffed with professional electronics engineers with combined experience exceeding 80 years. Proximity to the Fort Riley Army post offers potential dual-use development and testing in a secure environment.

Description

The mechanical and nuclear engineering and chemical engineering departments at K-State are renowned for innovative radiation-detector research. In addition to the K-State TRIGA Mark II nuclear reactor and the EDL, K-State seeks to combine and exploit these resources to establish a National Center for Strategic Applications of Nuclear Sensors, or SANS. This interdisciplinary center will have four primary missions: (1) explore new radiation-detector materials, (2) design and fabricate novel radiation detectors with unprecedented performance, (3) develop integrated detector systems and arrays vital to national security, and (4) train the next generation of leaders in detector technology needed to replace the first generation of nuclear-trained scientists and engineers whose ranks are rapidly dwindling due to retirements.

Relevance

A combination of faculty, expertise and facilities will make the SANS center foremost in nationwide university- and government-based radiation-detector research, complete with materials research, neutron and gamma ray detector development, electronics design, wireless detection technologies, and radiation monitoring and imaging devices. Establishment of the SANS center is a direct response to national security needs for development of new radiation detectors to mitigate nuclear materials. Detector development is highly relevant to a variety of radiation-detection applications such as stockpile stewardship, homeland security, astrophysics and space satellites, medical imaging, oil-well logging, active personnel dosimetry, high-resolution gamma ray spectroscopy and alternative methods for neutron detection.

Agency Contact Information

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Scene Perception & Event Comprehension Theory, SPECT

Background
In our everyday lives, we encounter an endless stream of visual events that we effortlessly understand and later remember. These range from mundane events such as someone buying a hotdog from a street vendor, to criminal events, such as an armed robbery, or suspicious events, such as leaving a backpack on a sidewalk. However, we cannot process all the available information we see because of our limited cognitive resources. Instead, we only perceive and remember those people, places, things and events that we pay attention to, and how we understand them determines how we later remember them. This has tremendous importance for intelligence and security operations. For example, when a surveillance operator watches a bank of closed-circuit TV security monitors, what determines what he/she pays attention to or ignores? Furthermore, how does she understand that someone's actions are a security risk? And what will she later remember to write in a report?

These questions have become more important as security camera footage has been increasingly used to track and apprehend criminals — e.g., the Boston Marathon bombers or New York's Chelsea bomber. If we could use artificial intelligence, or AI to automate what a surveillance operator does, we could do it more efficiently at a much larger scale. But to make such an automated AI system, we must first understand how people perceive, understand, and remember what they see. How the human brain accomplishes these feats is only now beginning to be understood. Likewise, different AI programs have recently been developed to recognize people, objects, or events, at human levels of accuracy, but have not integrated these capabilities. Separately, psychologists have spent decades studying how people perceive scenes, understand complex events, and later remember what they saw as three separate research topics. But, progress in each of these areas has been hampered by the lack of a theoretical approach that spans all three processing stages and the lack of necessary interdisciplinary collaboration using such an integrative approach. We have developed the first such integrative theoretical framework, and will use it to leverage recent rapid developments in both cognitive neuroscience and artificial neural networks to bridge these gaps.

Description
Our project is unique in the breadth of our approach, spanning from the first perceptual processes that occur during single-eye fixations to later recall of events from long-term memory, based on our theoretical framework, the Scene Perception & Event Comprehension Theory, or SPECT. We will bring together a team of cutting edge, internationally renowned experts across multiple disciplines from Kansas State University, SUNY Stony Brook, NIU and NYU in psychological science, neuroscience and computer science. We will triangulate the behavioral, neural and computational processes involved in event processing to develop a computational model of SPECT. Our research methods will have human participants watch closed-circuit TV videos while we track their eye movements and measure their brain activity, and later test their memory for the events in the videos. We will also create computational models to account for the relationships between viewers’ eye movements and their brain activity, and between their brain activity and their memory for the video contents. These computational models will provide a cognitive architecture for future applications in security and intelligence.

Relevance
Our project produces numerous impacts on security and intelligence capabilities. We will create a computational architecture for computer applications that can take a previously unseen video and automatically predict which video segments human viewers will later remember. To do this, the software will determine when a new event begins — e.g., a robbery — and when it ends, then store a description of the event — an event model — in memory, then repeat the process for the next event — e.g. a getaway. The event model descriptions will include rich information about the events — people, places, things, people's actions, and their inferred goals that predict their later actions. These event model descriptions will be stored in a deep neural network, similar to human long-term memory. The computational architecture will make a key contribution to taking closed-circuit TV video footage, deriving understanding from it, and producing annotated descriptions of the footage in a retrievable format that makes sense to human analysts. This will have vitally important implications for security and intelligence.

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Building and Maintaining Healthy Relationships

Background
Healthy relationships are the foundation of stable and resilient families. Children and adults with stable and satisfying family relationships experience greater emotional stability and health than do individuals who live with family tension and negative interactions. In Kansas, divorce increases the likelihood that families with children will be poor by 46 percent (State of the Family: Kansas Child and Family Wellbeing Indicators). The following are some of the indicators of whole family, couples and individual family member stress and relationship strain including:

- The rate of children in need of care (i.e., protection services) is 8.4 (per 1,000 children in population) as compared to 5.2 for the nation (Casey Family Programs, 2012).
- In 2013, 23,508 domestic violence incidents were reported to law enforcement agencies in Kansas.
- In 2014, compared to the nation’s 11 percent average, 19 percent of adults in Kansas reported having three or more adverse experiences in their childhood (Kansas Behavior Risk Factor Surveillance Survey).

Many Kansas families experience repeated transitions, prolonged stress, unstable situations and poverty, which negatively impact relationships. Every person deserves the opportunity to have healthy relationships and to live free from the experience of interpersonal violence, toxic stress and social immobility. Researchers, teachers and outreach professionals in Kansas State University’s School of Family Studies and Human Services, or FSHS, in the College of Human Ecology, are dedicated to contributing to the development and enhancement of resilience and healthy relationships to improve the lives of individuals and families.

Description
To address these issues, the following applied research, clinical services and programming are underway or offered across units in the School of FSHS:

1. Supporting healthy relationships across life-course transitions, cultures, family development and in long-term relationships,
2. Examining the impact mental health, namely depression, has on intimate relationships,
3. Supporting healthy partner and/or or parenting relationships,
4. Developing and testing a violence risk assessment tool to guide prevention and treatment of partner violence efforts in military families,
5. Assessing the impact romantic relationships and parenting behaviors have on child outcomes,
6. implementing and evaluating a relationship education program for at-risk youth,
7. Studying communication technologies on relationships between former partners and between parents and children following divorce,
8. Supporting and encouraging parent-child communication about health and well-being,
9. Developing research-based community programs that focus on strengthening family relationships in the context of individual family units and the communities where they reside.

The collaborations of the College of Human Ecology faculty have led to grants and contracts to support research on building healthy relationships, preventing partner violence, and supporting family resilience.

Relevance
Healthy relationships enhance all aspects of life. Children who grow up in homes with parents in healthy relationships do better in all aspects of life. Adults who are in healthy, committed relationships have better physical health, fewer emotional problems and are more financially successful.

Faculty in K-State’s School of FSHS are conducting applied studies that help people build and maintain healthy relationships. They are receiving private, state and federal funding for their research and have received national and international recognition for their efforts.

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Background
Immersive environments and visualization technologies have catalyzed a revolution in education, storytelling and research. Rich interactive simulations have proven effective at improving the educational experience in fields such as engineering, architecture, health care and military operations. Similarly, these simulations are used in groundbreaking basic research in STEM fields. We have extensive knowledge and expertise in developing these kinds of technologies to support STEM training and research. We have state-of-the-art technology and manufacturing laboratories that are used to enhance university education through the creation of immersive digital environments and analog replicas. Examples of key contributions to education and research:
• 3-D visualizations and 3-D prints for architectural and medical purposes
• 20’x 8’ Panoramic Immersive Screen for virtual representations and experiences in research
• 3-D/4-D virtual reality games using state-of-the-art computer hardware and software for education
• Pedagogical expertise in problem-based learning
In interdisciplinary expertise of faculty in the College of Architecture, Planning & Design can be leveraged to contribute toward new educational opportunities, such as serious gaming, as well as novel research opportunities in information visualization and geovisualization.

Description
Educational Opportunities: Integration of serious gaming — where learning is the primary goal — may assist in building a diverse workforce and increasing opportunities for innovation while encouraging critical decision-making strategies. Simulations incorporated in the serious games can provide project-based experiential learning that better prepares graduates entering the workforce and help the public learn today’s critical social and environmental issues.

Military Training Opportunities: Using immersive technologies and environment offer a novel way to support the training of troops in navigation and situational awareness. We are using these technologies to better understand how spatial memory is retained and how we might better use this knowledge to support the wayfinding and navigational skills for our military personnel.

Research Opportunities: Information visualization and geovisualization are technological methods used in research throughout the sciences and humanities. Our area of expertise is in creating high-fidelity virtual simulations of real and imaginary places across multiple spatial and temporal scales. This expertise provides an opportunity to conduct research in environmental perception and spatial cognition, as well as engaging in the visualization of future alternatives for scientific and engineering assessment.

The adaptation of visualization technology to support these efforts, combined with the re-creation of these forms, holds promise for improving education and scientific outreach.

Relevance
Incorporation of problem-based learning enhanced by visualization technology and serious gaming may increase the efficacy of STEM education and military training. Likewise, the ability to create a virtual environment with high realism enables us to better understand how landscape and built-environment landmarks influence spatial memory. Finally, these same technologies can be used to support research in STEM fields by exploring realistic environments and conditions, and how interventions are magnified.

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High-Consequence Pathogens, including Potential Bioweapons, Countermeasure Development

Background
Mosquito and tick-transmitted diseases such as Zika, chikungunya, West Nile and Lyme disease are receiving a great deal of attention. The vectors that spread these diseases can rapidly infect entire regions of our nation. To control the spread of disease, it is important to monitor and take appropriate measures to control or eliminate the hazards.

Description
The Biosecurity Research Institute, or BRI, at Kansas State University’s Pat Roberts Hall is one of fewer than six high containment facilities in the United States that can conduct research on livestock experimentally infected with a broad range of highly pathogenic organisms. The BRI is the designated facility at Kansas State University for work on organisms classified by the U.S. government as select agents, or SAs. SAs have the potential for weaponization and, as such, they are of high priority and require very specialized facilities and trained and approved personnel to ensure constant accountability, safety and security. The primary purpose of the research is to improve understanding and to develop diagnostics and vaccines that can better prepare the U.S. to detect and respond to foreign pathogens that threaten agriculture and public health.

This state-of-the-art facility contains an ACL/BSL-3 insectary suite available for arthropod transmission studies; a mosquito rearing room; 14 BSL-3/3Ag research laboratories, including five rooms to enable research on livestock; an ABSL-3 vivarium small animal area; and a pathogen storage room that is aBSL-3E.

The BRI is the first nonfederal facility approved to work with African swine fever, or ASF, and classical swine fever, or CSF, viruses, two highly contagious pathogens associated with high mortality in pigs. Recent acquisitions of ASFV and CSFV have enabled research that has led to testing of promising new vaccines for CSF and innovative molecular genetic studies to improve our understanding of ASF in swine. Research on Rift Valley fever virus has involved the first livestock studies to be conducted in the U.S. since the 1980s. Other SA work has been on highly pathogenic avian influenza, anthrax, glanders, plague and brucellosis.

Non-SAs studied at the BRI include Japanese encephalitis, or JEV, yellow fever and Zika virus, all of which are zoonotic pathogens carried by mosquitoes that can infect humans with high morbidity and potentially high mortality. Recent mosquito experiments with JEV, a priority pathogen for study at the National Bio and Agro-defense Facility, NBAF, are the first such studies to be conducted in the U.S. since the 1940s. Our experiments with JEV demonstrated susceptibility of North American mosquitoes that could be effective vectors in the event this virus is introduced into the United States. Research with Zika virus, which has infected over 4,000 people in the U.S., investigated mosquito transmission and also supported collaborative studies to evaluate new vaccines for Zika.

With interdisciplinary biosecurity research programs, agrosecurity initiatives and the development of collaborative research, the BRI is the platform for transitioning work currently conducted at the Plum Island Animal Diseases Center to the NBAF, which is being constructed adjacent to the BRI.

Relevance
The mission of the BRI, “Leading through research and education to protect agriculture and the public from biological threats,” is epitomized by its integration of interdisciplinary work on pathogens that contaminate food or infect livestock, people, and plants.

It is vitally important to develop new programs that will provide comprehensive training in both basic and applied aspects of vector biology/medical entomology, arbovirology and the epidemiology of arthropod-borne diseases. Graduate students and postdoctoral fellows to be trained will create a competent cadre of interdisciplinary professionals who will work together to anticipate and respond to arthropod-borne disease outbreaks.

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Background
Our highly networked world, where software pervades all aspects, is dominated by cyberphysical systems, or CPS. The dividing line between electronic security, physical security and safety has blurred to the point of near invisibility. Cyberattacks are a major threat to society; they can inflict physical damage to trillions of dollars in infrastructure and threaten the well-being — and lives — of millions. The correct and secure operation of software is required to protect this critical infrastructure. Recent reports to the National Academy of Sciences urge the adoption of software with “correctness certificates.” The Department of Defense, or DOD, has developed a “System Assurance Strategy” that stresses security throughout a system’s lifecycle and requires DOD programs to account for vulnerabilities. The Food and Drug Administration has developed guidance for the security of medical systems and device software. The Institute of Electrical and Electronics Engineers released the report “Building Code for Medical Device Software Security” in response to mounting pressure to secure the medical infrastructure. Kansas State University researchers have been key participants in many of these efforts, with a distinguished history of developing technologies for construction of safe and secure systems.

Description
The Center for Information and Systems Assurance, or CISA, is a leader in cybersecurity research, teaching and outreach. In 2010, CISA was designated as a National Center of Academic Excellence for Research in Cybersecurity by the National Security Agency and Department of Homeland Security. For more than 15 years, CISA researchers have collaborated with partners such as Rockwell Collins, Boeing, HP, Microsoft, Honeywell, Galois, Adventium and Idaho National Lab to design secure, mission-critical software systems. New collaborations in safety, security and education research are being explored.

CISA has also contributed to securing the national infrastructure. DOD contractors integrate custom and off-the-shelf components from hundreds of suppliers to build complex distributed systems. Because current design, acquisition and vulnerability assessment techniques are insufficient for this complexity, security flaws and cost overruns are common. CISA researchers have developed tools to design and assemble such software systems quickly and at low cost. CISA researchers have also developed tools that protect medical communication, reduce programming errors and simplify integration of security into next-generation CPS. CISA members also have multiple prestigious awards, including five National Science Foundation CAREER awards, and more than $1.25 million in DOD funding to study the safety and security of dynamically composable CPS.

Additional funding will significantly enhance CISA capabilities to solve the challenges of next-generation CPS. These challenges include faster, less costly design of “zero-failure” mission critical systems, tools to protect the nation’s critical infrastructure, and partnerships with corporate and local, state and national agencies to educate the general population on ways to overcome cybersecurity challenges.

CISA is uniquely poised to tackle these issues. CISA will develop usable security solutions that seamlessly integrate with current verification and validation activities, and produce secure systems by increasing uptake and reducing development costs. Enabling techniques include reasoning based on formal languages and type theory, code generation, and developer tools evaluated for usability. A shortage of cybersecurity engineers has been regularly cited as a potential threat to national security. CISA will continue to develop tools for security education at the Manhattan, Kansas State Polytechnic and Olathe campuses, and determine how to most effectively present security education material.

Relevance
CISA has a reputation of building secure software protocols and systems. Given existing collaborations with cybersecurity industry leaders and the anticipated arrival of the National Bio and Agro-defense Facility, CISA will promote collaboration with cybersecurity and biosecurity companies, and help establish a regional center to train the future cybersecurity workforce. CISA has also established CANSec, a semiannual workshop to present ongoing research and promote collaboration.

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ENERGY AND WATER
Background/Description

The proposed Center for Attosecond Nanophotonics, or CAN, will develop from a synergistic overlap between two strong subfields in the Physics department, namely atomic-molecular-optical — AMO — physics and nanomaterials. This highly innovative center offers promise for new discoveries by combining advanced photonics, nanoscience and soft matter systems. It is a collaboration unlike any other in the world.

The J. R. MacDonald Laboratory, or JRML, in the Kansas State University Department of Physics is a large AMO physics laboratory, supported by the U.S. Department of Energy and its predecessors since 1969. JRML was the first U.S. laboratory to produce single attosecond (billionth of a billionth of a second; comparable to the extremely short time taken by electrons to move within an atom) light pulses. Currently, the JRML group is known for its leadership in ultrafast laser science and is well positioned to be the nucleus for a leading attosecond nanophotonics center in the U.S. The AMO physics program has been highly ranked nationally for many years.

The nanomaterials group at K-State has excellent synthetic and materials characterization capabilities. Scientists in this group have extensive experience in the synthesis of nanoparticles and their assembly, nanowires and graphene. The major theme of this research is to create a new class of nanoparticle solids in which the nanoparticles act as the “atoms” of the material and thereby mimic atomic and molecular materials found in nature.

It is thus timely to extend the application of ultrafast and intense optical pulses to the new arena of nanoscale matter in the Center for Attosecond Nanophotonics. The proposed center will use light sources with unprecedented properties, applying them to nanoscale matter that research has shown to be a treasure box of new phenomena. This novel combination is certain to yield exceptional new physics given the extremes of intensity, time and length scales.

The K-State physics department has a strong culture of solving practical problems and producing products. The department has recently received a major private gift for the purposes of creating innovation and entrepreneurship, and promoting opportunities for interdisciplinary research. Some recent intellectual property disclosures from our department include detonation graphene nanosheets, fiber lasers, and electrochemical nanowires. Explorations are currently underway for applications in sub-cellular force sensors, laser-based chemical detection and remote sensing, and optical telecommunications.

We are confident that CAN’s novel science will lead to next-generation opto-electronic technologies that could enable high speed computing using light interfaced with electronics. Two leading companies in high-power ultrashort lasers such as KMLabs in Boulder, Colorado, and Thales, in Paris, France, have already shown interest in collaboration with the scientists in the center. We envision the establishment of spinoff companies based on new laser and imaging technology as a result of these collaborations.

At present, the physics department is limited by space and cannot accommodate the necessary physical environment for attosecond studies of nanoscale particles and structures, which require temperature stability, a vibration-free environment, etc. While we are successful in acquiring multimillion-dollar laser equipment through resources available from federal funding agencies, infrastructure for CAN, this new center requires other federal funding resources.

Relevance

The proposed development of a federally funded world-class research center, CAN, will cultivate a research and teaching environment that accommodates the synergy of our niche research areas. CAN’s fundamental research output can be translated into a powerful engine of innovation and entrepreneurship. Students involved with CAN will be encouraged to have an entrepreneurship focus, and in collaborations with the K-State College of Business Administration and the Institute for Commercialization, will be introduced to various aspects of intellectual property, technology transfer and the process of innovation. Trained this way, these student innovators, who are by definition the foremost authorities on their discoveries, will facilitate and shorten the time needed for research outcomes to be transferred into a marketable product.

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Background

Increased global demand for energy and dwindling fossil fuel reserves are causing concern regarding global warming, climate change and sustainability. This has resulted in worldwide interest in clean energy technologies such as wind and solar energy, and electric vehicles. Total worldwide wind power capacity has increased from 74 gigawatts, or GW, in 2006 to 487 GW in 2016; the United States’ share of wind power capacity surpassed 80 GW in 2016. Similarly, solar energy capacity in the United States increased from less than 1 MW in 2000 to more than 40 GW in 2016; 14.8 GW of this capacity was installed in 2016. Regarding consumption of electricity, more than 100,000 electric vehicles have been sold in the United States since 2013. Despite many benefits of clean energy, integration of these systems into the power grid can lead to a new set of technical challenges such as power plant scheduling to accommodate fluctuating wind and solar power, mitigating power quality issues due to increased usage of power electronics converters, reducing maintenance costs while providing high reliability and availability of wind turbines, and integrating high levels of rooftop solar photovoltaic, or PV, generation and electric vehicles.

Government and industry have funded several research projects at Kansas State University, making the university a leader in power engineering research and education in Kansas. The proposed research aims to leverage prior research and strength in power systems and cyber-physical systems to seek innovative solutions for an increasing penetration of clean technologies into the power grid.

Description

Objectives of the proposed multidisciplinary research include removing barriers and developing human capital through education to advance sustainable energy pathways associated with electricity generation and its use in transportation, while utilizing synergy between clean electricity generation and consumption. Faculty, students, industrial companies and government agencies will collaborate for successful commercialization.

The research will investigate enhancement of wind- turbine efficiency and durability, energy forecasting, integrated planning, reconfigurable grid-interactive converters, and integration of advanced cyber and communication technologies for optimized operation of the cyber-physical system with a high penetration of renewable resources. Increased efficiency and long-term reliability are crucial in order for wind turbines to compete directly with natural gas.

Accurate forecasting will allow improved characterization of the stochastic nature of renewable resources, leading to more efficient planning and operation of the electric power grid. The investigation will allow opportunities to build models and tools that will facilitate more effective utilization of existing renewable resources, and integration of a significantly larger amount of additional renewable generation into the power grid.

The research will include solid-state converters, considered enabling technology, to realize a wide range of critical technologies such as grid-tied wind and solar energy systems, and electric hybrid vehicles. These converters can significantly enhance flexibility and controllability of the power grid, consequently transferring the existing energy infrastructure to the next generation with a massive deployment of clean technologies.

Research related to power-distribution networks will focus on large-scale integration of solar rooftop generation and electric vehicles with on-site storage. Life-cycle analysis will consider air quality and climate change impacts using the triple bottom line of social, environmental, and economic concerns. Public education will increase understanding of the benefits of electric cars, and wind and solar energy. The requested amount for the project is $4 million, to be used by K-State for research, education and outreach. Some of the funding will be used for installation of solar PV generation, which will be fully instrumented and connected to the Smart Grid Laboratory at K-State, for real-time data collection and analysis.

Relevance

To reduce dependence on foreign oil and to reduce carbon emissions and promote economic prosperity, clean energy technologies must be a top priority of the U.S. government. Clean energy not only combats climate change, but creates new opportunities for jobs and business. The proposed research is focused on maintaining the world leadership of the United States in research and education related to clean energy generation, and utilizing and advancing the K-State 2025 plan to be a Top 50 public research university.

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Aluminum Nitride for High-Power Electronics and Ultraviolet Light-Emitting Diodes

Background
Aluminum nitride is an undeveloped semiconductor that offers promising new solid-state device capabilities and high energy-saving efficiencies compared to silicon, the most common well-known semiconductor. Aluminum nitride’s physical, optical, and electrical properties are superior to silicon for high-power electronic devices and ultraviolet, or UV, light-emitting diodes, or LEDs, two technologies poised to develop into multibillion-dollar per-year industries within five to seven years. Kansas State University and the startup company Nitride Solutions Inc., leaders in producing high-quality aluminum-nitride single crystals and thin films, propose to team together to move beyond materials synthesis to device fabrication and development of systems incorporating these devices.

Description
Funds are sought to support research to solve lingering technical challenges related to material synthesis, device fabrication, device characterization and electronic system design that incorporates aluminum nitride devices. Funds are also sought to provide education and training necessary to produce qualified researchers to accelerate the growth of this new industry. Funds will support K-State faculty and students, in partnership with Nitride Solutions, to develop advanced manufacturing technologies for aluminum nitride-based solid-state devices. Funding is requested to help establish a Kansas-based advanced solid-state device industry that will create jobs and bring Kansas technological recognition.

These funds will support research to create high-purity, low-defect density materials; develop practical device fabrication processes; and design electrical circuits to support new devices. Funds will also support education to produce engineering students with specialized talents, technical skills and entrepreneurial spirits needed for this burgeoning industry to thrive.

Relevance
Although silicon has the properties needed for low-power electronic devices for computers, mobile phones and photovoltaics, its properties are not well-suited for high-power switches and transistors as used in electrical conditioning in power supplies, motor controllers and power distribution systems. Because aluminum nitride can withstand higher voltages, currents and temperatures than silicon or silicon carbide, which is the current choice for power electronics, its devices can switch more than 10 times the power, while being more than six times smaller than comparable silicon devices. In addition, aluminum-nitride devices can operate 200 degrees hotter while providing all advantages at increased energy efficiencies.

Aluminum nitride is the only semiconductor material suitable for making deep UV LEDs. UV LED light sources are essential for biological contamination detection and for killing pathogens in air and water. Aluminum nitride-based UV light sources also directly impact a broad array of defense technologies. Biological detection; identification; diagnosis; therapy and elimination; hostile fire identification, or HFI systems; superior light detection and ranging, or LIDAR; 3-D imaging through smoke; short-range free-space communication; and target recognition are critical military applications enabled by aluminum nitride-based UV light sources. As in all defense-related material platforms, this technology will filter down to commercial and private use for anticollision systems in cars, faster wireless communication, and a multitude of future products.

Since 1997, K-State has been a research leader in the synthesis of nitride semiconductors. In fact, former K-State students founded Nitride Solutions to capitalize on this technology. Proposed funding would support the next step in the manufacturing chain by developing technology to create electronic devices and UV LEDs from aluminum nitride. Ultimately, aluminum nitride electronic devices will be deployed in electric vehicles, wind turbines, elevators, computer power supplies, solid-state UV light sources for non-chemical disinfection of water and food, and environmental monitoring.

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Innovation in High Performance Building Envelopes
Collaborative Research Program

Background
Buildings consume a staggering amount of energy in the U.S.: nearly 40 percent of all energy consumed — more energy than that used by either transportation or industry (Source: EIA). Building energy costs also have a significant economic impact for businesses, whose utilities can be around 20 percent of operating expenses, and for households, whose utilities can be around 10 percent of expenditures. Thus, designing future buildings to conserve energy is crucial to the sustainability of our society, economy and environment.

The International Energy Administration estimates that 40 percent of future energy reductions can be made by improving the performance of building envelopes: the walls, windows, roofs and foundations of buildings (Source: Technology Roadmap: Energy Efficient Building Envelopes, 2013). High performance building envelopes reduce heating, cooling and lighting energy in buildings by reducing unwanted energy flow through the building skin, while making daylight available to offset electrical lighting use.

Due to the inherent complexity of buildings, innovation in building envelopes isn’t simply discovered in laboratories, but instead comes from the application of science and technology to problems identified in the real world.

Description
During the last five years at Kansas State University, a collaborative research program in the area of high performance building envelopes has brought together experts in building science with professional architects, engineers and manufacturers to explore real-world performance challenges in building envelopes.

Research teams, composed of graduate students, use the College of Architecture, Planning & Design's state-of-the-art facilities and laboratory resources to build and test prototype building envelopes while applying advanced computer analysis tools to study the energy and economic impacts of designs. Collateral benefits of the program include the transfer of research methods and tools with collaborating professionals and industry partners, while expanding the skill sets of graduate students in professional degree programs.

As it enters its sixth year of activity, the program seeks to identify the following expansion resources:

- Partners to serve as potential clients for activities such as energy consulting and design assistance.
- Manufacturers interested in collaborating with the program to expand or realize R&D.
- Partnerships or funding that can expand the program’s outreach and service.

Relevance
Building better performing buildings and upgrading existing buildings is critical to sustaining future prosperity and growth in our communities and cities. Knowledge of building envelopes is an important asset for future professionals, and the dialogue around emerging design and analysis methods offers an incentive for professionals and manufacturers to work together to ensure improved building performance. Lastly, this project intends to support the state economy by benefiting its collaborating Kansas professionals and manufacturers.

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Background

“Lipid” refers to a large and varied group of compounds that are not soluble in water. Lipids are found in every living organism and every part of every organism, including humans, crop plants and food animals.

Established in 2003, the Lipidomics Research Center, or LRC, at Kansas State University is one of the world’s longest-serving facilities dedicated to cutting-edge “lipidomics.” Lipidomics refers to the identification and quantification of lipids using mass spectrometry. LRC scientists have established mass spectrometry-based methods for well over a thousand lipids. Scientists from over 600 labs have come to LRC or sent samples for analysis, resulting in hundreds of scientific publications. LRC has successfully secured funding for mass spectrometers in two National Science Foundation Kansas EPSCoR and three NSF major research instrumentation competitions.

One of the historic bottlenecks in lipid research is measuring the thousands of types of lipids in each organism. LRC analyzes lipids from all organisms, but is particularly known in the scientific community for its identification and quantification of both known and novel plant lipids. Lipids are important in crop plants for two reasons. First, seed oils, which are major food and energy products, are composed of lipids. Second, lipids are critical in regulating the resilience of crop plants to the challenges of their environment because of their roles in membranes and as molecular signals. Thus, analyses performed at LRC are critical in studies of lipids in crops aimed at (i) improving oil quantity and quality and (ii) improving metabolism of lipids to enhance growth and stress resilience of crop plants.

Description

With the current abundance of genomic information on crop plants, the time is right to combine large-scale data on plant lipids with genetic data to make the discoveries needed to design crops that produce high yields of seed oils of specific composition and that can withstand stressful environments.

The LRC is poised to lead the plant science community in a major initiative to collect large-scale lipidomic data on crop plants and to utilize the data to enhance crop improvement programs. Experiments conducted at LRC imply that combining lipidomic data with other plant genomic data will produce insights into plant metabolism that will facilitate crop improvement. LRC scientists work closely with plant biochemists and agronomists at K-State and across the Midwest. For example, collaborators at K-State are utilizing lipidomics to design camelina that produces improved biofuels and oils useful in the chemical industry. Other K-State groups are aiming to understand how lipid differences can improve sorghum and wheat tolerance to heat, cold and drought.

Relevance

The rate of increase in worldwide agricultural production is slowing and is lagging the increase in world population. With limited future ability to bring more land into production, increases in yield are needed. These increases must be made as climate variability is increasing. To develop crops with increased yield and more resilience, new knowledge and strategies are needed. LRC and colleagues can accelerate our understanding of how lipids interact with plant genes and the environment to regulate and enhance crop growth and food production.

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**21st Century Technology for Legacy Engines**

**Background**

Legacy engine is a term applied to industrial engines designed and manufactured before low emission levels were required and before advanced control systems were employed. Typically, they are 20 to 50 years old. Most large legacy engines are mechanically sound and capable of operating reliably for many more decades. Many can perform at present-day standards if retrofitted with advanced technology. The challenge comes in designing technology appropriate for a given engine.

**Description**

Large reciprocating engines provide motive power throughout the U.S. industry. These engines are ruggedly built and typically are capable of continuously generating several thousand horsepower each. They run at relatively low speeds and can continue to operate efficiently more or less indefinitely, if properly maintained. These engines must meet myriad air quality regulations. These regulations vary widely with locality and application, and literally hundreds of different requirements can potentially apply to a given engine.

Use of these engines is widespread but, by far, the single largest use is in compression stations for the natural gas pipeline system. The U.S. has more than 17 million installed horsepower-for-gas pipeline compression stations. Exact figures for the amount supplied by legacy engines are difficult to obtain, but saying 50 percent of installed power is from legacy engines is reasonable.

These engines are sufficiently large, and local requirements are sufficiently unique that each engine must be treated as more or less one of a kind. Upgrading each engine is a unique process, often with trial and error approaches. Our proposed research program is quite simple in concept: developing analytical tool packages that can be used to accurately predict the impact of available technologies on a given legacy engine and its emissions. The automotive engine industry has shown this level of analysis is feasible, but it is a much different proposition to apply it to hundreds of different engines, rather than design of a new engine that will be reproduced a million times. We plan to seek funding to form a National Science Foundation Industry/University Cooperative Research Center, and simultaneously seek major funding through the Department of Energy’s Natural Gas Infrastructure R&D Program initiative.

**Relevance**

The pipeline system map demonstrates the nationwide impact of this research. The ability to continue to use legacy engines is important for maintaining low-cost and reliable delivery of natural gas throughout the country. Through incorporation of advanced technology, these engines can continue to provide this service, meet current and future emission requirements, and be part of the solution to improve the environment by delivering an environmentally friendly fuel throughout the country.

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Background

Daily societal activities increasingly depend on interdependent critical infrastructures such as power grids, telecommunication networks, transportation networks, food networks and water distribution networks. In contrast to isolated systems, interdependent networked systems demonstrate emergent behaviors caused by unpredictable, rare nonlinear interactions between numerous social, physical and cyber components. Because infrastructure systems are large, they are often decentrally controlled through cyber systems. Although decentralization and self-organization theoretically reduce failure risk, interdependencies can lead to disruptive and massive cascading failures.

Interdependent and multilayer networks characterize critical social and engineered infrastructures, but a thorough understanding of their behaviors through fundamental results is still lacking. For example, the smart grid concept includes application of advanced computer, communications and power technologies to obtain a highly automated, responsive and resilient transmission and distribution infrastructure. At the distribution level, the smart grid integrates distributed, renewable generation sources with energy storage and provides demand response management to customers through dynamic pricing. At the transmission level, communication architecture creates an intelligent infrastructure that can detect and mitigate faults faster than those faults can propagate, thus providing utility operators with improved efficiency and reliability. Although ongoing efforts to design a next-generation communication network within the smart grid framework are in progress, lack of flexibility and programmability of network equipment has impeded experimentation of new schemes. Consequently, power operators are reluctant to adopt untested solutions.

Description

This project has two primary goals and include studying interdependencies between critical infrastructure networks and providing fundamental insights on the impact of these interdependencies related to reliability of the coupled system, all in order to increase reliability by developing analytical tools to measure and adapt system interdependencies. The goal is to address key issues in order to allow rigorous experimentation and analysis of networking solutions in the real-world environment. For example, large-scale experiments that incorporate resources from the Smart Grid Lab at Kansas State University, K-State networking resources and the Global Environment for Network Innovations, or GENI, test bed will be performed. To date, a hybrid simulator has been created that integrates continuous-time behaviors of the power system with discrete-event behaviors of the communication network. This platform has demonstrated performance impacts of the communication network and the power system when the physical infrastructure is designed to maximize robustness.

Furthermore, this platform demonstrated that an OpenFlow communication network could perform equally well with or better than its multiprotocol label switching, or MPLS, counterpart. Finally, a smart grid prototype was deployed on the nationwide GENI network test bed to demonstrate OpenFlow’s ability to provide services comparable to MPLS.

Relevance

Numerous critical infrastructures in Kansas and the United States rely on secure networking and communications. In Kansas, power and networking companies have demonstrated endorsement by sponsoring K-State’s Electrical Power Affiliate’s Program, or EPAP. This research has also received national contributions from Raytheon BBN Technologies, KanREN, Internet2, the National Science Foundation and National LambdaRail.

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Background

Intelligence fusion centers were created nationwide after 9/11 to promote the sharing of classified information between federal government agencies and state and local governments. They exist in 49 states today — with some states having multiple centers — and they are intended to enhance homeland security. However, fusion centers differ significantly in how they operate. One reason for the functional differences is that every fusion center must comply with the laws in its particular state, and applicable statutes vary greatly from state to state.

Formation of the Kansas Intelligence Fusion Center, or KIFC, began more than a decade ago as a partnership between the adjutant general and attorney general in Kansas. The founding premise was to provide Kansas policymakers and operational leaders with up-to-date global intelligence, which would allow them to make better informed strategic and tactical decisions. That is still the KIFC’s focus today.

Other fusion centers across the nation tend to be law enforcement-centric, focused on criminal investigative work. The KIFC aims at being preventative in nature. In military parlance, it’s the difference between working prior to an attack, with the Kansas model versus the after-an-attack model of other fusion centers. The former can obviously aid with the latter when necessary, but the prior-to-an-attack operational vision from day one sets the KIFC apart.

The KIFC is also unique in having a biothreat team that includes public and private-sector subject matter experts to help analyze global and domestic threats. These outside specialists hold security clearances, which lets them work with KIFC analysts to dissect, interpret and exploit classified data collected around the world. The additional expertise allows the KIFC to do a superior job protecting Kansas, but it also allows the external professionals to do a better job protecting their company, university, hospital, state agency, etc., from biological threats.

Description

Multiple KIFC biothreat team members are scientists at Kansas State University, including experts on food, crop, livestock and zoonotic disease biothreats. A Sensitive Compartmented Information Facility, or SCIF, already exists at K-State in the Biosecurity Research Institute, also known as the BRI, a biocontainment laboratory where research is conducted on high-consequence pathogen threats to food crops, food animals, the food supply and people.

The BRI is immediately adjacent to the $1.25 billion Department of Homeland Security National Bio and Agro-defense Facility, or NBAF, currently under construction. NBAF is projected to be fully operational in 2022-23 and it will be the nation’s primary foreign animal disease research facility, with the ability to work on zoonotic livestock diseases for which there are no treatments — biocontainment at the BSL-4 level, requiring “space suit” personal protective equipment.

Establishing an Agrodefense Intelligence Center, or AIC, in the BRI SCIF would allow the K-State subject matter experts to provide their insights and knowledge much more frequently — potentially daily if/when the need arises. This would significantly enhance both state and federal bio/agrodefense in a homeland security sector that is underserved today. Being in the BRI, global intelligence could transition to laboratory biothreat assessments quickly when newly emerging pathogens are discovered — another upside for establishing the biothreat annex.

Relevance

Setting up the AIC biothreat annex in the BRI with full-time analyst staff will allow K-State biothreat subject matter experts with security clearances to provide their input and assessments rapidly, as requested/needed. Containment of disease outbreak is critical to mitigating and managing the negative outcomes of such events — regardless of whether food crops, food animals, or people are involved — so the importance of proximity to speed of response cannot be overstated.

At the federal level, the intelligence community, led by DHS and the FBI, participate in several joint fusion centers. This carries down to 76 regional, state and local fusion centers that bring together not only the governmental and law enforcement representatives but also private sector and academia. As with disaster management, the point of the spear for Homeland Security is the maintaining of fully functional fusion centers staffed with fully trained and cleared experts. Closer integration between K-State and DHS to improve access, timing and quality can occur by utilization of K-State’s cleared facility and expertise.

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Background
Foodborne pathogens remain a constant threat to consumers and are responsible for an estimated 48 million illnesses every year. Symptoms can range from mild and transient to fatal, with an estimated 3,000 deaths in the U.S. per year. Natural gut flora present in healthy animals can be a significant cause of human illness because of contamination during slaughter and processing. Products prepared by combining harvests from multiple animals are especially vulnerable since large batches may be contaminated from just a single source. Sources of contamination from imported products can be especially difficult to identify. In addition to health impacts, economic consequences can be substantial with potential closure of processing facilities and product recalls.

Description
The Biosecurity Research Institute, or BRI, at Kansas State University’s Pat Roberts Hall has a highly unique capability for research on raw and further processed food, primarily meat products, in secure high containment. A dedicated food security and food processing area of over 2,500 square feet includes an industry-standard slaughter floor and is fully equipped with standard meat processing equipment. A unique, purpose-built carcass-scale electrostatic spray chamber designed for controlled product inoculation and efficient application of food-grade antimicrobials is also located in the area. To provide additional containment, some large equipment can be housed in transparent plastic biobubbles that not only control dissemination of aerosols, but also enable rapid decontamination procedures. These facility features and validated operational protocols enable research on highly infectious and potentially lethal pathogens that can be precisely introduced into the food production process at multiple points. This can include the preharvest infection of livestock with subsequent slaughter and processing, to contamination of postharvest products, such as ground meat products. Most processing equipment is movable enabling significant containment space to be used for large equipment needed to research other food commodities — e.g., produce and grain-based foods. Analysis of samples collected during processing is performed in dedicated laboratory space within the food wing. Contaminated carcasses and other animal waste are ultimately disposed of using a 5,000-pound capacity alkaline hydrolysis tissue digester, autoclaves and effluent disposal systems.

Ongoing U.S. Department of Agriculture-funded research includes large-scale studies on highly pathogenic Shiga toxin-expressing *Escherichia coli*. Previous projects have included Department of Defense-funded research to develop detection and identification technologies for organisms such as *Bacillus anthracis*, or anthrax, and *Yersinia pestis*, plague, that could be deliberately introduced into the food system, posing great risks to the public and our military.

The BRI is one of fewer than six high containment facilities in the United States that can conduct research on livestock experimentally infected with a broad range of highly pathogenic organisms. Uniquely, however, the BRI supports the systematic evaluation of pathogen responses in various food products: from live animal or food crop, through processing, to final consumer-ready products within one biocontainment facility. The BRI is the designated facility at K-State for work on organisms classified by the U.S Government as select agents, or SAs. One of the defining factors for SA designation is that these agents have the potential for weaponization. As such, they are of high priority and require highly specialized facilities and highly trained and approved personnel to ensure constant accountability, safety and security.

Relevance
The mission of the BRI is “Leading through research and education to protect agriculture and the public from biological threats.” This mission is epitomized by the BRI’s unique integration of interdisciplinary work on pathogens that contaminate food and infect livestock, people, and plants.

The primary purpose of research in the food wing is to improve the understanding of risks associated with the food system, and to develop diagnostics and manufacturing processes that can better detect, quantify and neutralize pathogenic food contaminants that threaten agriculture and public health.

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Deputy Commissioner for Operations and Chief Operating Officer
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High-Consequence Pathogens, including Potential Bioweapons, Countermeasure Development

Background
Mosquito and tick-transmitted diseases such as Zika, chikungunya, West Nile and Lyme disease are receiving a great deal of attention. The vectors that spread these diseases can rapidly infect entire regions of our nation. To control the spread of disease, it is important to monitor and take appropriate measures to control or eliminate the hazards.

Description
The Biosecurity Research Institute, or BRI, at Kansas State University’s Pat Roberts Hall is one of fewer than six high containment facilities in the United States that can conduct research on livestock experimentally infected with a broad range of highly pathogenic organisms. The BRI is the designated facility at Kansas State University for work on organisms classified by the U.S. government as select agents, or SAs. SAs have the potential for weaponization and, as such, they are of high priority and require very specialized facilities and trained and approved personnel to ensure constant accountability, safety and security. The primary purpose of the research is to improve understanding and to develop diagnostics and vaccines that can better prepare the U.S. to detect and respond to foreign pathogens that threaten agriculture and public health.

This state-of-the-art facility contains an ACL/BSL-3 insectary suite available for arthropod transmission studies; a mosquito rearing room; 14 BSL-3/3Ag research laboratories, including five rooms to enable research on livestock; an ABSL-3 vivarium small animal area; and a pathogen storage room that is ABSL-3E.

The BRI is the first nonfederal facility approved to work with African swine fever, or ASF, and classical swine fever, or CSF, viruses, two highly contagious pathogens associated with high mortality in pigs. Recent acquisitions of ASFV and CSFV have enabled research that has led to testing of promising new vaccines for CSF and innovative molecular genetic studies to improve our understanding of ASF in swine. Research on Rift Valley fever virus has involved the first livestock studies to be conducted in the U.S. since the 1980s. Other SA work has been on highly pathogenic avian influenza, anthrax, glanders, plague and brucellosis.

Non-SAs studied at the BRI include Japanese encephalitis, or JEV, yellow fever and Zika virus, all of which are zoonotic pathogens carried by mosquitoes that can infect humans with high morbidity and potentially high mortality. Recent mosquito experiments with JEV, a priority pathogen for study at the National Bio and Agro-defense Facility, NBAF, are the first such studies to be conducted in the U.S. since the 1940s. Our experiments with JEV demonstrated susceptibility of North American mosquitoes that could be effective vectors in the event this virus is introduced into the United States. Research with Zika virus, which has infected over 4,000 people in the U.S., investigated mosquito transmission and also supported collaborative studies to evaluate new vaccines for Zika.

With interdisciplinary biosecurity research programs, agrosecurity initiatives and the development of collaborative research, the BRI is the platform for transitioning work currently conducted at the Plum Island Animal Diseases Center to the NBAF, which is being constructed adjacent to the BRI.

Relevance
The mission of the BRI, “Leading through research and education to protect agriculture and the public from biological threats,” is epitomized by its integration of interdisciplinary work on pathogens that contaminate food or infect livestock, people, and plants.

It is vitally important to develop new programs that will provide comprehensive training in both basic and applied aspects of vector biology/medical entomology, arbovirology and the epidemiology of arthropod-borne diseases. Graduate students and postdoctoral fellows to be trained will create a competent cadre of interdisciplinary professionals who will work together to anticipate and respond to arthropod-borne disease outbreaks.

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Background
Few events disrupt society and cause economic loss as severely as an out-of-control infectious disease. Terrorist activities or natural causes can produce an epidemic that may result in human deaths, disposal of herds, and destruction of crops. Fundamental to EPICENTER’s mission is the conviction that epidemic dynamics and intervention strategies must be derived while accounting for underlying complex networks that describe multiple and dynamic interconnections among involved systems.

Description
EPICENTER, a laboratory in Kansas State University’s College of Engineering, provides resources to build, analyze and simulate data-driven computational models for biomedical and biological systems represented as complex networks. Research at EPICENTER challenges scientific boundaries by addressing the impact of heterogeneity, interdependence and stratification of networks in spreading processes. These three characteristics abound in natural and manmade infrastructures and networks, but fundamental questions remain unanswered regarding interconnected and stratified/multilayer networks. EPICENTER has successfully conducted several research projects since its inception in 2007. Current projects include the following:

• **Predictive models of infectious diseases.** This project aims to develop innovative, multiscale computational models and tools to describe potential transmission cycles of zoonotic pathogens that could be introduced into the United States. Data generated by these models will be used to produce an operationally relevant predictive model that estimates the timing and spatial extent of emerging disease, and the transmission risk to humans. Studied diseases include Ebola, Rift Valley fever, and Japanese encephalitis.

• **Spreading processes over multilayer and interconnected networks.** The research goal of this project is to establish mathematical tools and techniques to understand the role of multilayer and interconnected topologies in spreading processes. For example, a multilayer network is a physical contact network in which a disease can propagate among individuals and an online information-dissemination network in which information can propagate among those same individuals. In zoonotic diseases, interconnected networks include the network of animals and the network of humans in which a virus can transfer from one population — or network — to another.

• **Integrated models of disease spread, supply chain logistics, and communication networks.** The objective of this project is to develop integrated models that capture interdependencies among disease dynamics, supply chain logistics and communication networks. For example, the spread of disease is influenced by the movement of animals, plants and food products through the supply chain. Effective management of this movement and deployment of countermeasures, such as vaccines, require effective risk and crisis communication plans that engage multiple stakeholders. Stakeholders also constitute a network through which information is transmitted. The integrated modeling approach is expected to yield new insight to prevent, mitigate, and respond to infectious disease outbreaks.

Relevance
The National Agricultural Biosecurity Center, or NABC; Institute for Computational Comparative Medicine, or ICCM; Center of Excellence for Emerging and Zoonotic Animal Diseases, or CEEZAD, through the Department of Homeland Security; the planned National Bio and Agro-defense Facility, a DHS facility; and EPICENTER are all located in Manhattan, Kansas, thus making Kansas the national leader in developing countermeasures to naturally occurring and intentionally introduced plant, animal, human and zoonotic diseases.

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**National Science Foundation**
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Background
In an era dominated by higher standards and greater accountability for America's schools, the Kansas State University response is to prepare great leaders at all levels who know how to implement change. The College of Education, or COE, at K-State is utilizing partnerships for educational leadership development that will have wide and lasting impact in Kansas and across the nation. The programs and the activities in the college are led by its Department of Educational Leadership, which includes preparation of K-12 school leaders as well as faculty who specialize in adult education. This group uses a partnership model for collaborating with schools and other educational organizations to provide leadership training that touches the lives of thousands of learners and hundreds of schools.

We believe that partnering for a new generation of leaders produces better results by focusing on the different leadership needs associated with different community and school contexts. This foundational premise accounts for the success of current programs and informs the design of future programs.

Description
The COE is creating models and implementing educational and professional development activities to increase the number and quality of educational leaders in Kansas schools at all levels. This includes the following organizations and collaborations:

- Educational Leadership Academies in Dodge City, Garden City, Junction City, Manhattan, Salina, Topeka and other large school districts working with economically and socially diverse populations have provided graduate education and leadership development opportunities for school principals across the state. K-State's academies have operated since 1987 and have drawn national praise, having prepared more than 500 school leaders at principal and superintendent levels. Our most recent academy serves the indigenous populations of the Osage Nation in Oklahoma.

- The Kansas Educational Leadership Institute, or KELI, emerged from collaborative planning by five major Kansas professional entities interested in developing and supporting leadership for Kansas schools and districts in the 21st century. Partners in this effort are the Kansas Association of School Boards, Kansas State Department of Education, Kansas School Superintendents Association, Kansas State University and the United School Administrators of Kansas. KELI supports first-year Kansas superintendents and recently expanded to include school principals and special education directors. These licensed leaders participate in seminars, a mentoring program, and leadership coaching and academic work. The KELI mission and model are unique in the U.S.

- COE has a long history of collaboration providing educational leadership opportunities at Fort Leavenworth with the Command and General Staff College, or CGSC. The Adult Education Program has awarded nearly 1,000 graduate degrees in a cohort master's program to officers at the CGSC during its nearly three-decade history. The program has also awarded 12 doctorates to faculty and faculty developers at CGSC.

- K-State faculty, graduate students and school partners are collaborating on research that demonstrates the efficacy of our leadership models and programs. More funding is being sought to provide support for the extensive and rigorous research and evaluation that is needed to promote this K-State model into a nationally recognized and adopted exemplary practice.

- The education leadership graduate program is actively seeking funds to enhance professional development of school leaders in such topical areas as computer science.

Relevance
Preparing successful educational leadership is the primary mission of the COE's educational leadership program and relates to the college's 2025 plan: Theme III, to provide quality graduate education that prepares students for leadership, and Theme IV, to increase service to communities through systematic engagement. These activities also relate to K-State 2025's themes III and IV.

Agency Contact Information
U.S. Department of Education: Fund for the Improvement of Postsecondary Education in the Office of Postsecondary Education, Lynn Mahaffie, Assistant Secretary, 202-453-6914; the Office of Career, Technical and Adult Education, Kim R. Ford, Assistant Secretary, 202-245-6063; and the Office of Elementary and Secondary Education, Jason Botel, Assistant Secretary, 202-401-0113. The National Science Foundation, Directorate of Education and Human Services, William (Jim) Lewis, Assistant Director, 703-292-8600, wjlewis@nsf.gov
Institute for the Health and Security of Military Families

Background
For American military personnel who have served in war, federal programs have long been in place to address physical injuries from bullets and bombs and psychological injuries of wartime trauma. In relatively recent times, however, veterans returning from war have faced difficulties neither anticipated nor addressed by federal programs. These include chronic health problems resulting from exposure to environmental hazards — e.g., chemical defoliants in Vietnam and a complex mix of neurotoxins in the Persian Gulf War — and traumatic brain injury, or TBI, encountered during deployment, as well as long-term health impacts — e.g., PTSD. Increasingly, for today’s professional military — both active and reserve components — the aftermath of wartime service has consequences not only for veterans’ well-being, but for their families and communities.

Description
Kansas State University is home to a unique cadre of scientists from diverse disciplines with an impressive track record in research, outreach, academic and clinical service programs addressing the health, well-being and sustainment of military and veteran populations. Some examples:

- Programs and community support networks for military-connected children and youth, with local 4-H Clubs, schools and OMK youth/family camps.
- Research and training programs on violence prevention in military families, quality child care and childhood social emotional health.
- Clinical programs for military personnel, veterans and families.
- Research on the long-term effects of deployment and war trauma on marriages, child and youth development, employment and financial planning.
- Cooperative Extension services to families of military personnel.
- Online graduate programs for professionals who serve military families.
- Research on the effects of high-intensity functional exercise training on the body composition, fitness and health of active duty military personnel as well as on barriers to physical activity participation for disabled veterans.
- Implementation of a new Military and Veteran Engaged Research Innovation Center at K-State, the MAVERICK Center, to provide a multi-functional, cost effective collaborative space for military and veterans programs that advance the vision of K-State 2025.

In addition to contributions made by researchers from colleges across the university, the Institute is the “tip of the spear” for K-State’s alliances with area military installations, the Kansas National Guard, Army Reserve, U.S. Department of Veteran’s Affairs, the Department of Defense, and other state and national organizations.

Relevance
Our current partnerships with the U.S. departments of Agriculture and Defense have been primarily focused on outreach rather than on research funding for the study of military families. These outreach initiatives support significant programming underway at K-State and across Kansas. Proposals to other federal agencies, such as the Department of Health and Human Services, will expand the reach of the College of Human Ecology and its units. Expanding partnerships to support additional investment in relevant research would enable K-State, the College of Human Ecology and the Institute for the Health and Security of Military Families to capitalize on the expertise available here.

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Background
Antimicrobial, or antibiotic, resistance has come to the forefront as a major health challenge for the 21st century in both human and veterinary medicine. A 2013 report by the Centers for Disease Control highlighted major challenges in human medicine, including some that overlap with veterinary medicine. This overlap raises questions as to the possible relationship between veterinary use of antimicrobials, especially in food animals, and resistance trends in human medicine.

It is also essential to recognize that antimicrobial resistance is a very real problem in veterinary pathogens. There is an urgent need for clinically relevant outreach to practicing veterinarians.

Description
The antimicrobial resistance team at Kansas State University includes microbiologists, epidemiologists, pathologists, basic researchers, diagnosticians, four board certified veterinary clinical pharmacologists, and clinicians who all have an interest in preserving the activity of antimicrobials in both veterinary and human medicine. The surveillance capability of the diagnostic laboratory is a core component of driving research, education and outreach related to these goals.

This team recognizes that the definition of antimicrobial stewardship includes two key concepts: preventing the need for antimicrobials and using them appropriately when the need arises.

Relevance
Animal protein production in the United States is dependent on protecting the health and welfare of animals through preventive and therapeutic practices. Examples of team interactions on multiple levels illustrate the broad reach of personnel at K-State.

Optimizing Antimicrobial Efficacy: Significant gaps exist in understanding how best to construct an antimicrobial regimen, including selection of the optimal duration of exposure. K-State has significant resources in modeling capacity for pharmacokinetics and pharmacodynamics, as well as the ability to use in-vitro and in-vivo techniques to generate data for the models.

Primary Veterinary Pathogen Research: A team project was initiated after observing that approximately 70 percent of the main bovine respiratory disease pathogen isolates at the Kansas State Veterinary Diagnostic Laboratory are resistant to most of our treatment options. This project was an evaluation of the movement of antimicrobial resistance genetic elements in pathogens related to respiratory disease in cattle. Research spanned from in-field cattle evaluation and sample collection to detailed analysis of full-sequence genome data from isolated pathogens in collaboration with the U.S. Department of Agriculture. At the same time, another part of the team was evaluating technology that would enable intervention in the disease process as early as possible, therefore increasing the chance of a quick cure.

Foodborne pathogen research: Multiple team members are engaged in research that relates antimicrobial use, environmental factors and disease incidence to the transfer of antimicrobial-resistant foodborne pathogens through the environment or food chain. *Escherichia coli*, *Salmonella* and *Campylobacter* are frequent research targets.

Veterinary Practitioner Outreach: Calls are increasing for information to guide veterinary practitioners in advancing antimicrobial stewardship. The faculty on this team have an outstanding record of interaction with practicing veterinarians through individual consultation, publications and continuing education.

Retail and Restaurant Policies: Antimicrobial use criteria put forth by commercial entities can have a dramatic effect on treatment options in food animals. K-State team members are routinely interacting with management to bring the scientific aspects of animal production, microbiology and pharmacology to the table. These team members also have significant interaction with legislative and regulatory personnel searching for data to drive decisions.

Synergy: Kansas State University has increased the commitment to this undertaking by establishing two new positions in the College of Veterinary Medicine that are directed toward research and outreach in the areas of drug use in food animals, with an emphasis on the need to advance antimicrobial stewardship.

Routine contact between team members spanning from the laboratory bench, to production facilities and finally to key decision-makers creates an atmosphere of discovery that follows through to interactions across the entire animal protein chain.

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Changes that occur in the brain as a function of growth, aging or experience are referred to collectively as plasticity. Plasticity is essential for adaptive behaviors, and is critical for healthy functioning. CNAP researchers investigate plasticity in humans and animal models using basic and translational research techniques. The overarching goal of this recently-funded center is to understand the mechanisms of cognitive and neural plasticity with the ultimate goal of promoting healthy functioning.

Research projects will occur along three themes:

- **Aging and neurodegeneration** research will connect with multidisciplinary centers on aging at K-State and Wichita State. The average age of the U.S. population has been increasing significantly, and persons over 65 now represent about 15 percent of the population, with projections of about 22 percent by 2040. Understanding factors that promote healthy aging — both in terms of cognitive performance and delaying disease onset — can have a major financial impact in addition to the overall impact on the well-being of the U.S. population. Our projects related to aging are designed to understand mechanisms that impact on important everyday functioning, which is critical for maintaining an independent lifestyle.

- **Neurobiology of reward and decision** will examine neuronal plasticity of reward valuation, with links to decision-making and alcohol abuse. Given the numerous disorders associated with deficient reward valuation and decision-making processes, including ADHD, drug abuse, gambling and obesity, there are rich opportunities for CNAP to make a significant impact on the field in these areas. Our projects in this area will examine factors that influence the development of alcohol abuse in adolescence/early adulthood and the neural circuits of flexible decision-making.

- **Translational/comparative neuroimaging** is an area of recent growth and additional planned growth at K-State. With the establishment of a new small-animal imaging core in the Department of Chemistry, coupled with plans to grow human neuroscience in the Department of Psychological Sciences, and the collaborative use of human neuroimaging facilities at University of Kansas Medical School, we are in a position to support both animal model and human neuroimaging techniques. These techniques can be implemented to answer questions relating to aging and neurodegeneration as well as work in the neurobiology of reward and decision, significantly advancing our understanding of neuronal plasticity mechanisms within these areas. Neuroimaging is an essential technique for understanding neuronal plasticity, and we aim to develop a strong focus on this area over the course of the next five years.

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Diversity and Inclusion in Educational Settings

Background
The College of Education, or COE, at Kansas State University recognizes its important and continuing work of preparing its students for an increasingly diverse and changing world. Significant work is being done in the college that positions it as a national and international leader in addressing culturally responsive teaching and learning through its programs and research. The COE’s longstanding commitment to diversity can be seen throughout the collective work of its departments, center, and programs since the early 1990s. Guiding these initiatives is the COE mission of “Preparing educators to be knowledgeable, ethical, caring decision-makers in a diverse and changing world.”

Description
The COE is creating educational programming and conducting social science research related to pedagogical practices that are culturally relevant and are informed by the context of the learner and the educator through a number of programs, projects and research endeavors:

- The Center for Intercultural and Multilingual Advocacy, known as CIMA, implements programs and conducts research that has national and international significance. CIMA originated the BESITOS program model that has supported 95 bilingual/bicultural students to graduation and placement in English as a second language education. Of these, 35 have gone on to graduate school with 21 to date completing and serving in Kansas. CIMA has supported over 500 migrant students in obtaining GEDs, and has served over 98 migrant students in postsecondary education. Several CIMA programs have won national and international awards. In addition, CIMA researchers have produced highly ranked books and peer-reviewed publications.

- The COE is a partner in the Kansas Louis Stokes Alliances for Minority Participation, or LS-AMP, funded by the National Science Foundation. This award funds four colleges at K-State that partner with community colleges in Kansas designated as Hispanic serving institutions, or HSI. This pipeline project promotes the recruitment, retention and graduation of underrepresented minorities in STEM. COE faculty provide expertise and professional development for their partners related to culturally responsive practices in recruitment, retention, and teaching. We are also engaged in research related to these best practices.

- Commitment to and inclusion of culturally responsive teaching and learning is demonstrated by research conducted by faculty in all departments in COE.

Some examples:

Relevance
Our current and planned work in this area aligns with all themes of COE’s 2025 plan as well as to the COE mission. These activities also relate to K-State 2025 themes I, II and III.

Agency Contact Information
U.S. Department of Education: Office of Elementary and Secondary Education, Jason Botel, Assistant Secretary, 202-401-0113; Office of English Language Acquisition (OELA), Jose A. Viana, Assistant Deputy Secretary, 202-453-6562.
Building and Maintaining Healthy Relationships

Background

Healthy relationships are the foundation of stable and resilient families. Children and adults with stable and satisfying family relationships experience greater emotional stability and health than do individuals who live with family tension and negative interactions. In Kansas, divorce increases the likelihood that families with children will be poor by 46 percent (State of the Family: Kansas Child and Family Wellbeing Indicators). The following are some of the indicators of whole family, couples and individual family member stress and relationship strain including:

- The rate of children in need of care (i.e., protection services) is 8.4 (per 1,000 children in population) as compared to 5.2 for the nation (Casey Family Programs, 2012).
- In 2013, 23,508 domestic violence incidents were reported to law enforcement agencies in Kansas.
- In 2014, compared to the nation’s 11 percent average, 19 percent of adults in Kansas reported having three or more adverse experiences in their childhood (Kansas Behavior Risk Factor Surveillance Survey).

Many Kansas families experience repeated transitions, prolonged stress, unstable situations and poverty, which negatively impact relationships. Every person deserves the opportunity to have healthy relationships and to live free from the experience of interpersonal violence, toxic stress and social immobility. Researchers, teachers and outreach professionals in Kansas State University’s School of Family Studies and Human Services, or FSHS, in the College of Human Ecology, are dedicated to contributing to the development and enhancement of resilience and healthy relationships to improve the lives of individuals and families.

Description

To address these issues, the following applied research, clinical services and programming are underway or offered across units in the School of FSHS:

1. Supporting healthy relationships across life-course transitions, cultures, family development and in long-term relationships,
2. Examining the impact mental health, namely depression, has on intimate relationships,
3. Supporting healthy partner and/or or parenting relationships,
4. Developing and testing a violence risk assessment tool to guide prevention and treatment of partner violence efforts in military families,
5. Assessing the impact romantic relationships and parenting behaviors have on child outcomes,
6. implementing and evaluating a relationship education program for at-risk youth,
7. Studying communication technologies on relationships between former partners and between parents and children following divorce,
8. Supporting and encouraging parent-child communication about health and well-being,
9. Developing research-based community programs that focus on strengthening family relationships in the context of individual family units and the communities where they reside.

The collaborations of the College of Human Ecology faculty have led to grants and contracts to support research on building healthy relationships, preventing partner violence, and supporting family resilience.

Relevance

Healthy relationships enhance all aspects of life. Children who grow up in homes with parents in healthy relationships do better in all aspects of life. Adults who are in healthy, committed relationships have better physical health, fewer emotional problems and are more financially successful. Faculty in K-State’s School of FSHS are conducting applied studies that help people build and maintain healthy relationships. They are receiving private, state and federal funding for their research and have received national and international recognition for their efforts.

Agency Contact Information

Administration for Children and Family
U.S. Department of Health and Human Services
Military and Veterans Programs
National Institute of Food and Agriculture U.S. Department of Agriculture
Family Advocacy Program Manager
Secretary of Defense for Military Community and Family Policy
Background
In 2012 the National Research Council, or NRC, released a report, “Discipline-Based Education Research: Understanding and Improving Learning in Undergraduate Science and Engineering.” A major goal of this report is to invite postsecondary institutions to increase interest and research activity in discipline-based education research and improve its quality and usefulness across all natural science disciplines, as well as guide instruction and assessment across natural science courses to improve student learning. In this report and elsewhere, discipline based education research, or DBER, is defined as research on the teaching and learning of science, technology, engineering and mathematics, or STEM, topics, which frequently is conducted by faculty who have appointments in the STEM departments. The NRC DBER report and other related reports place added emphasis on the status of discipline-based educational research and implementation of that research within university STEM departments.

STEM education is considered a priority by state and federal governments, and agencies such as the National Science Foundation and the Department of Education.

At K-State, we are uniquely positioned to become a leader in DBER and in research-based STEM instruction because of our following resources:

- Significant efforts in discipline-based educational research in STEM disciplines such as physics, math, engineering and computer science.
- The Center for Science Education.
- Involving a broad range of disciplines.
- The Teaching and Learning Center.
- Noyce Projects for helping science discipline majors become secondary school teachers.
- The university’s first-year experience programs.
- Core faculty who are involved in existing STEM education research and implementation.
- Significant overlap among the goals of the Ce-RISE and strategic plans of several colleges.

Description
K-State has recently established a center for DBER with faculty at the leading edge of this important field. With key resources, this center will form the core of a world-leading DBER initiative to understand and improve the many teaching and learning issues that affect students, nationally and internationally, in STEM courses during their academic careers. Furthermore, the DBER initiative will enable research elucidating students’ transition between school and university and between university and workforce. The research from this initiative will in turn lead to development and implementation in a broad range of STEM-related educational experiences not just at K-State but at educational institutions at all levels and throughout the world. As part of the effort, we anticipate coordination across disciplines in ways that will help students see connections and transfer learning from one discipline to another. Thus, K-State will extend its reputation in research-based physics education to other STEM areas, becoming an internationally-known center for high quality, research-based STEM education.

The faculty members involved in the center are from the colleges of Agriculture, Arts and Sciences, Education and Engineering. The goals for the center are to provide a home for conducting cross-disciplinary education research in the STEM disciplines, and conducting and publishing research on teaching and learning within and across disciplines as well as career and academic transitions.

Relevance
Today’s STEM students will need many different skills as they move through their careers. Universities today cannot anticipate all of the specific skills that students will need over their lifetimes. However, universities must provide the foundation upon which students can build as they need to respond to the changing situations. Thus, universities must respond to students’ future needs by providing education that cross disciplines and that builds on the changes now being made in precollege STEM education.

For example, at the precollege level, the Common Core Standards have increased mathematics standards significantly. The intended result is to make high school graduates ready to begin at a higher level when they start university, thereby easing the transition from secondary school to university.

At K-State, particularly in physics, we have made significant contributions to understanding and to improving teaching and learning. We can now contribute to research on teaching and learning as students move from one discipline to another, from school to university, and from university to the workforce, areas where research is lacking. We have assembled a research team that includes a variety of disciplines and research perspectives to conduct such research, including faculty from all STEM-related disciplines and well as the College of Education.

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Food Security: Foodborne Pathogens in Preharvest and Postharvest Livestock Research

Background
Foodborne pathogens remain a constant threat to consumers and are responsible for an estimated 48 million illnesses every year. Symptoms can range from mild and transient to fatal, with an estimated 3,000 deaths in the U.S. per year. Natural gut flora present in healthy animals can be a significant cause of human illness because of contamination during slaughter and processing. Products prepared by combining harvests from multiple animals are especially vulnerable since large batches may be contaminated from just a single source. Sources of contamination from imported products can be especially difficult to identify. In addition to health impacts, economic consequences can be substantial with potential closure of processing facilities and product recalls.

Description
The Biosecurity Research Institute, known as the BRI, at Kansas State University’s Pat Roberts Hall has a highly unique capability for research on raw and further processed food, primarily meat products, in secure high containment. A dedicated food security and food processing area of over 2,500 square feet includes an industry-standard slaughter floor and is fully equipped with standard meat processing equipment. A unique, purpose-built carcass-scale electrostatic spray chamber designed for controlled product inoculation and efficient application of food-grade antimicrobials is also located in the area. To provide additional containment, some large equipment can be housed in transparent plastic biobubbles that not only control dissemination of aerosols, but also enable rapid decontamination procedures. These facility features and validated operational protocols enable research on highly infectious and potentially lethal pathogens that can be precisely introduced into the food production process at multiple points. This can include the pre-harvest infection of livestock with subsequent slaughter and processing, to contamination of postharvest products, such as ground meat products. Most processing equipment is movable, enabling significant containment space to be used for large equipment needed to research other food commodities — e.g., produce and grain-based foods. Analysis of samples collected during processing is performed in dedicated laboratory space within the food wing. Contaminated carcasses and other animal waste are ultimately disposed of using a 5,000-pound capacity alkaline hydrolysis tissue digester, autoclaves and effluent disposal systems.

Ongoing U.S. Department of Agriculture-funded research includes large-scale studies on highly pathogenic Shiga toxin-expressing *Escherichia coli*. Previous projects have included Department of Defense-funded research to develop detection and identification technologies for organisms such as *Bacillus anthracis*, or anthrax, and *Yersinia pestis*, or plague, that could be deliberately introduced into the food system, posing great risks to the public and our military.

The BRI is one of fewer than six high containment facilities in the United States that can conduct research on livestock experimentally infected with a broad range of highly pathogenic organisms. Uniquely, however, the BRI supports the systematic evaluation of pathogen responses in various food products from live animal or food crop, through processing, to final consumer-ready products within one biocontainment facility. The BRI is the designated facility at Kansas State University for work on organisms classified by the U.S government as select agents, or SAs. One of the defining factors for SA designation is that the agent has the potential for weaponization. As such, SAs are of high priority and require highly specialized facilities and highly trained and approved personnel to ensure constant accountability, safety and security.

Relevance
The BRI mission is “Leading through research and education to protect agriculture and the public from biological threats.” This mission is epitomized by the BRI’s unique integration of interdisciplinary work on pathogens that contaminate food and infect livestock, people, and plants.

The primary purpose of research in the food wing is to improve the understanding of risks associated with the food system and to develop diagnostics and manufacturing processes that can better detect, quantify and neutralize pathogenic food contaminants that threaten agriculture and public health.

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Deputy Commissioner for Operations and Chief Operating Officer
Food and Drug Administration
Department of Health and Human Services
TRANSPORTATION
Background
Kansas State University Polytechnic is uniquely positioned to leverage technological advancements in unmanned autonomous aerial vehicles, demand for value-added advanced systems/processes for commerce and government, and educational opportunities for high-demand qualified and certified technicians. This intersection of technology, Polytechnic’s experience, and rapidly expanding market demand provide an extraordinary opportunity to be a national and global leader.

With a rich history in aviation, applied research and education, Kansas State Polytechnic has a unique opportunity to become a community of learning and partner of choice for global companies. An innovative statewide economic growth strategy will build upon an existing set of capabilities, assets and organizations to create a collaborative ecosystem around manned and unmanned aeronautics that cannot be found anywhere else in the world.

Description
The focus on manned and unmanned aeronautics includes training UAV system operators and managers and future aviation industry leaders. The strategies and initiatives envisioned by Kansas State University are focused not only on local impacts, but on economic prosperity and competitiveness across the state.

K-State is poised to lead a statewide effort to advance economic development in aviation through research, innovation and training. Linking research and training efforts from around the state into a globally competitive coalition will enable Kansas to become the world leader for solutions to challenging problems in applied aviation.

Relevance
Kansas State Polytechnic will pull relevant organizations and departments in the state together to develop a targeted and intentional vision/plan to court this industry. This is the cornerstone of a larger statewide strategy to retain global aerospace manufacturing and training dominance. To further this plan, we are seeking assistance with these major sub-initiatives:

1. Test Site — K-State has been designated as an affiliate member of the Pan-Pacific UAS Test Range Complex, or PPUTRC, headed by the University of Alaska, Fairbanks and administered through the FAA. UAS flight test operations under K-State’s direction will require an initial investment of $1 million and an annual sustainment budget of $500,000.

2. ASSURE, or Alliance for System Safety in UAS through Research Excellence, collaboration — K-State continues to be a major contributor to the UAS ASSURE Center of Excellence, or COE, administered by the FAA. However, a stronger FAA research prioritization on Kansas members’ core strengths of UAS airworthiness and standards development is needed. The ASSURE and Test Site initiative have significant potential to leverage each other’s success moving forward.
   a. Near opportunities are available for a dialogue with personnel from Sen. Cochran’s office to determine how best to champion ASSURE in the future. These conversations may help Kansas to have a stronger voice in the future of this COE.

3. Aircraft Certification — A need is emerging to train world engineers in the practice of aircraft certification, the single most significant key to a safe national airspace system. When Kansas State Polytechnic’s certification program was presented to FAA mid-management personnel, they suggested that it become the national standard. Assistance is needed to convince senior FAA leadership to prioritize certification training standardization, policies and standards.

4. KS UAS Airspace Integration Partnership Program — Currently, Kansas is seeking to be designated as a partner state to develop low-altitude UAS airspace integration policies. Advocacy for the Kansas effort would certainly enhance the chance of success.

5. Bi-state UAS Cluster Initiative — Kansas State Polytechnic is involved in the UAS Cluster Initiative that is working towards economic development in UAS technology in Kansas and Oklahoma. Funding advocacy for the Small Business Association Grant, which supports the program, is key to its successful future, uascluster.com/.

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Center for Rail Infrastructure Durability and Sustainability

Background

Railways are the backbone of the United States’ economic system because they allow swift, economical and fuel-efficient movement of agricultural products, coal and finished goods. However, maintaining freight movement requires efficient train networking and reliable track systems. Kansas State University currently utilizes multidisciplinary expertise in railway track systems for $4.1 million in research contracts with the Federal Railroad Administration to investigate methods of improving safety and durability of concrete railroad ties. Additionally, K-State researchers are assisting the Kansas Department of Transportation to evaluate track infrastructure for heavier car loads and to evaluate track ballast nondestructively. K-State departments involved in this research include civil engineering, mechanical and nuclear engineering, and industrial and manufacturing systems engineering.

Description

The overarching objective of this multidisciplinary research is to enhance current understanding of how various materials and fabrication processes interact and consequently affect railway durability and sustainability. K-State has pioneered development of a laser-speckle imaging, or LSI, device that can be used in rugged environments such as railroad tie production facilities. This patented device has led to development of a system that images concrete railroad ties to determine if they are properly assembled at the manufacturing plant to prevent cracking and failure in track.

K-State researchers are also developing methods to determine how raw materials and manufacturing processes affect durability of the railroad ties in states such as Kansas, where many freezing and thawing cycles occur each year. Therefore, K-State recently installed a specially designed, 120-cubic-foot environmental chamber dedicated to testing full-size railroad ties under water-saturated freezing and thawing cycles. This chamber is the only test apparatus of its kind in the U.S. capable of testing full-scale railroad ties.

Use of LSI techniques and full-scale freeze-thaw testing of concrete railroad ties have positioned K-State at the forefront of railroad track systems' durability research. Therefore, K-State proposes to establish a Center for Rail Infrastructure Durability and Sustainability, to be known as CRIDS. The proposed center will be used to further develop and deploy existing K-State-developed technologies to improve durability and sustainability of the U.S. rail infrastructure. Funding for the Rail Infrastructure Durability and Sustainability Center will have the following objectives:

- **New Railway Infrastructure Environmental Test Chamber.** Long-term durability of railroad ties under repeated loading from heavy-freight and high-speed railway lines should be tested under extreme weather conditions, including hot and cold temperatures, wet and dry conditions, and varying subgrade materials and temperatures. Funds will be used to design and build the first high-tech, varying-climate, full-scale test chamber for railroad track systems in the U.S.

- **Durability of Railroad Ties under Various Load and Support Conditions.** Railroad ties made with newly developed materials could provide longer life, thereby increasing sustainability of the railroad infrastructure. Existing full-scale testing capabilities at K-State will be enhanced to include the ability to evaluate the performance of railroad ties under varying load and support conditions, such as found on heavy-freight and high-speed railways with different supporting ballast conditions.

- **Deployment of Existing Laser-Speckle Technology.** K-State researchers will demonstrate application of the newly developed LSI technology at concrete railroad tie manufacturing plants in the U.S., and assist with implementation of the technology in these plants for improved quality assurance. This technology will allow optimal components — concrete mixtures and prestressing reinforcement — to be selected for maximum durability.

Relevance

Sharp increases in rail traffic in the last 10 years have caused railways to become increasingly critical to the U.S. economy. Improved materials and test methods for railroad tie systems, and development of reliable test procedures for new ties and components, will help prevent derailments and increase the lifespan of current railways.

Agency Contact Information

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Background
Across the nation and at all levels of government, there has been a resurgence of interest in public transportation. This interest stems from transit’s ability to meet a number of pressing social concerns. Economic development specialists see transit as offering a key amenity to attract young knowledge-workers, lure growing businesses, ensure community resilience to fluctuations in fuel prices, reduce congestion, allow older adults to age in place, and preserve property values. Environmental advocates see transit as a means to reduce air pollution, slow greenhouse gas emissions, revitalize existing urban areas, foster alternative travel behavior — such as walking, biking, and shared-use modes — and mitigate the need for costly investments in additional roadway infrastructure. Equity advocates see transit as an essential service to foster food, health care and employment access for lower-income populations as well as a critical component to meeting federal civil rights and environmental justice objectives. All of these groups are united in their concern that transit is actually achieving these goals.

One of the best means to assess and monitor transit performance is by analyzing the results of on-board surveys. Most public operators conduct such surveys already and recent civil rights guidance from the Federal Transit Administration ensures that all will need to do so in the near future. Unfortunately, despite the substantial sums of public monies required to conduct these surveys, the resulting data are surprisingly difficult to attain. No single public repository for this information exists, with the result that even within a single transit agency, data are often lost over time. Furthermore, the lack of data availability hinders the work of outside researchers, auditors and public advocates to examine the success of the transit systems. Those systems themselves are unable to easily examine the survey instruments and data from their peers to inform their own surveying efforts or compare their results.

In short, the major public investment in transit survey data creation is not being optimized. A demonstrated need exists for an institute dedicated to collecting, archiving, researching and disseminating this information.

Description
The National Transit Survey Institute, or NTSI, combines a secure data repository, research center and outreach program to advance transit use and transportation justice. NTSI is in the process of developing the nation’s only secure and searchable archive for transit survey data. This resource provides, for the first time, a platform for the systematic, academic inquiry of ridership across the transit services in the United States. NTSI researchers use this resource to develop innovative approaches for exploring transit survey data. Current research evaluates transit equity, particularly in light of the federal civil rights guidance, as well as the role of transit in fostering community resilience, especially regarding older adults, people with disabilities, low-income families and rural households.

NTSI researchers also assess and refine transit surveying techniques, which are undergoing a rapid transformation with the availability of handheld, GPS-enabled data-entry technologies. NTSI partners with public agencies and consultants to implement and test these new approaches to surveying. This activity provides an important engagement and service learning opportunity for Kansas State University faculty and students. Furthermore, this outreach is critical to NTSI’s mission of advancing the quality of transit data to advance the effectiveness of transit.

Relevance
Public agencies in the United States spend millions of dollars annually to collect transit survey data. Currently, the benefits of that investment are quite limited. The NTSI is working to greatly expand the public return on those investments. The NTSI makes those data available and provides a research environment to make those data relevant. This environment incorporates undergraduate and graduate students in engaged scholarly work with high value both for academia and for practice. These efforts are an integral part of the K-State 2025 plans of the Department of Landscape Architecture and Regional & Community Planning, the College of Architecture, Planning & Design, and Kansas State University.

Agency Contact Information
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AGENCY INITIATIVES
Development and Management of Canola in the Great Plains Region

Background
The Supplemental and Alternative Crops Competitive — SACC — Grants Program is funded through the USDA-NIFA. Kansas State University is part of the SACC Grant Program that supports integrated research and extension projects to increase canola production and satisfy consumer demand that far exceeds U.S. domestic supply.

The project “Development and Management of Canola in the Great Plains Region” provides solutions to Global Food Systems, one of five Grand Challenges identified by the Kansas State University Agricultural Experiment Station and Cooperative Extension Service that are vital to feeding a growing world population.

Producers in the Great Plains region need profitable and reliable winter broadleaf crops that can be grown in rotation with wheat. Canola is an alternative crop that can be used to enhance winter wheat quality and yield. K-State research has shown increases between 18 and 51 percent in wheat yield the first year following winter canola. Other benefits to growing canola include the use of minimum and/or no tillage, decreased soil erosion, improved water infiltration of soils, and enhanced cropping system diversity. Winter canola acres have increased because of improved cultivars, observed rotational benefits to wheat, growing demand for canola oil, and increased research and extension activities.

Description
The long-term goal of this multistate, interdisciplinary, and integrated research and extension project is to facilitate the adoption of winter canola into cropping systems of the southern Great Plains (SGP). To stimulate acreage and production increases, the project focuses on the following objectives that align closely with the priority areas of the SACC.

1. Develop and evaluate high-yielding and regionally adapted winter canola cultivars. Priority traits include: winter survival, tolerance to sulfonylurea herbicide carryover, tolerance to post-emergence applications of glyphosate herbicide, yield, oil quality and quantity, hybrid parent lines, and blackleg, or Leptosphaeria maculans, disease resistance.

2. Improve canola cropping systems by addressing agronomic management issues identified through stakeholder input. Management studies include: crop establishment, seeding rate and row spacing, irrigation management, crop rotation, harvest management, herbicide carryover, fungicide and growth regulator use, on-farm testing, and crop modeling in DSSAT.

3. Deliver cultivar and agronomic management technologies to new and experienced canola growers through appropriate extension programs. Methods of delivery may include, but are not limited to, field days, risk management schools, extension and journal publications, professional society meetings, agronomy updates, radio and television interviews, web-based applications, peer-to-peer interactions, and social media updates.

Relevance
A high-value market exists for the heart-healthy oil and high-protein meal derived from canola seed. The U.S. imports more than 80 percent of the canola oil used domestically. Production in the major spring canola growing areas has nearly peaked because of competition from other crops; therefore, more winter canola must be grown to meet growing U.S. demand. Winter canola planted acres have increased substantially in the SGP. Recently, total planted acres in the region have exceeded 250,000. Federal crop insurance is available, and a regional seed crushing facility provides an end market. New adapted cultivars are needed to increase production to meet this strong demand.

K-State’s canola breeding and research program focuses on developing cultivars adapted specifically to the SGP. It is the only public canola breeding program in the region. Nine adapted cultivars have been released by the breeding program since 2010, including Torrington, the most winter hardy cultivar available for commercial production. The program released four adapted, glyphosate-tolerant cultivars in 2013 and 2014 that are licensed to private seed companies for sales across the SGP.

Most states do not have statewide winter canola cultivar testing programs. Thus, regional variety testing and agronomic performance trials are an important component of this project. The National Winter Canola Variety Trial, or NWCVT, is also coordinated by Kansas State and this trial is planted at 39 locations in 19 states. NWCVT data facilitates the release of new cultivars in areas where they can be profitably marketed. Coordination of the NWCVT demonstrates a strong ability to manage a collaborative program with national impact.

Agency Contact Information
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Background
Funding in the USDA-ARS budget for FY 2018 is requested for the Ogallala Aquifer Program. This program conducts research and outreach activities to protect the Ogallala Aquifer and retain the economic integrity of the Southern Great Plains region, including the Texas High Plains and portions of Oklahoma, New Mexico, Kansas and Colorado, all states that are dependent on the survival of the Ogallala Aquifer.

The Ogallala Aquifer in western Kansas and the Texas High Plains is declining at an unacceptable rate with average depletion rates of 1 to 3 feet per year. Agricultural irrigation use accounts for nearly 90 percent of the groundwater withdrawals in the region. Water availability, cost and policy, together with technology development and adoption rates, will shape the rural landscape in the coming decades. To ensure the sustainability of rural communities in this region, continued investments are needed in irrigation management and agronomic research concerning water use efficiency, improved hydrologic assessments of water availability and sustainability, socioeconomic considerations, and wise public policy regarding water rights and public outreach engaging all stakeholders.

Description
The Ogallala Aquifer has provided water for the regional development of a highly significant agricultural economy. Ninety percent of groundwater withdrawals are used for irrigation. This region produces about 4 percent of the nation’s corn, 25 percent of the hard red winter wheat, 23 percent of the grain sorghum, 28 percent of the cotton, and 42 percent of the fed beef. Local grain production is used primarily as feed grains for intensive beef, dairy, and swine production. The Ogallala Aquifer is a finite resource with aquifer recharge being much less than withdrawals. The aquifer impacts the Kansas State University Agricultural Experiment Station and Cooperative Extension Service and the other lead universities on this project. Together, our research into the complex nature of water availability, uses, technological improvements and pricing will drive the discussions and decisions relative to water policy.

Relevance
This initiative will:
• Develop, evaluate and disseminate information and technologies for water users that will result in balancing economic, environmental, and social concerns.
• Provide scientifically sound data and knowledge to planners and policymakers, which will enable them to develop effective water management policies that will result in balancing utilization and protection of the Ogallala Aquifer.

Objectives:
• Investigate and improve water management within existing cropping systems.
• Develop and evaluate integrated crop and livestock systems that reduce dependence on underground water resources.
• Assess groundwater resources in the Ogallala Aquifer and their relationships with climate.
• Enhance the knowledge base of producers, water professionals, and policymakers.
• Evaluate the implications of alternate water policy options.

Funding for FY 2018 will allow the partners to continue developing innovative conservation measures for the Ogallala Aquifer resource through a multistate university and federal program. The group will develop, evaluate and transfer technologies that will allow efficient water utilization while conserving and protecting the Ogallala Water Aquifer. The consortium also will develop and establish the program as the resource for data and knowledge in the development of fair and effective water policy.

Partners
USDA-Agricultural Research Service (lead agency)
Texas AgriLife Research
Texas AgriLife Extension Service
Kansas State University
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Background

The National Plant Diagnostic Network, or NPDN, is a critical component of our national plant health infrastructure and has become a model for university-government-industry partnerships. Funded through the USDA-NIFA Food and Agricultural Defense Initiative, or FADI, NPDN addresses national agricultural biosecurity imperatives through enhanced detection and diagnostic capability for new diseases and pests. The agricultural and natural plant systems that we rely upon for food, feed, fuel, timber and fiber are under increasing pressures from a long list of biological invasions associated with the massive imports of plants and plant products into the U.S. These biological invasions threaten both domestic production systems and our agricultural export industries. NPDN operates in all 50 states and US territories through five regional centers, and reports detections to the NPDN National Data Repository. The U.S. is dependent upon exports to stimulate an economic recovery. Plants and plant products contribute one-half to two-thirds of U.S. agricultural exports worth over $60 billion annually. The European Union, Australia and Canada are all creating plant diagnostic networks based on the NPDN model.

In 2015, the NPDN was a crucial partner with USDA-APHIS Plant Protection and Quarantine, or PPQ, in delimiting a new disease of corn, bacterial stripe.

Description

The appropriation for the FADI funding line was cut by 40 percent in FY 2011 and has remained at essentially that level since. The result has been a weakened NPDN and other FADI programs. Congress has provided enhanced funding for the animal diagnostic network through the APHIS budget, but the other networks have been left with the challenges of the previous cuts. We are hopeful that the funding for FADI will see no further cuts and that NPDN and EDEN might see the increases needed to address the critical protection of our food enterprises and assist people faced with disasters.

Drastically reduced training and education programs impair early detection of new and emerging pathogens and pests. Aging diagnostic technologies compromise the ability to employ the most sensitive and reliable detection and diagnostic protocols in NPDN laboratories. The USDA is investing tens of millions/year to enhance plant biosecurity infrastructure in other nations — our competitors — while funding for NPDN remains at about $3 million annually. The volume of plants and plant product imports is so large that we only inspect 1-2 percent; border inspection and interception alone will not protect U.S. agriculture. As a result, there are an increasing number of pest introductions. Without effective plant biosecurity infrastructure for early detection and accurate diagnostics to inform rapid and appropriate response, both agricultural production and exports are at risk.

There are over 40 million people on food assistance in the U.S. Increased food costs resulting from import/export disruptions will increase the number of people requiring food assistance in the U.S. This will lower the standard of living in the U.S. and impair our ability to address the global food security challenge.

Relevance

NPDN is listed as critical infrastructure by USDA and by the Department of Homeland Security. To protect U.S. agriculture from the threats of bioterrorism and from unintentional introductions, this infrastructure must be strengthened. International phytosanitary protocols, and ultimately policies, are transitioning to advanced molecular-based detection and diagnostic technologies. Protocols based on these more accurate and sensitive technologies will require that plant diagnostic labs that support trade are equipped with these technologies and staffed by trained diagnosticians. NPDN is an important partner with APHIS-PPQ in safeguarding U.S. agriculture. Underfunding NPDN jeopardizes the effectiveness of that partnership.

The Plant Diagnostic Information System, or PDIS, a lab management software system developed at Kansas State University, is in use in 30 states. K-State provides leadership for the national exercise scenario program to facilitate preparedness of local, state and federal personnel in outbreak management and hosts a network of states called the Great Plains Diagnostic Network, or GPDN. Due to funding cuts, the national exercise preparedness program is at risk. All GPDN states have participated in K-State organized training workshops on advanced diagnostic techniques, first detector training, and secure communications. Those essential programs have been dramatically reduced and are becoming outdated and difficult to maintain.

K-State and GPDN continue to provide leadership in setting a vision for the network. That leadership is recognized as evidenced by many invitations to speak at national and international meetings, including keynote presentations and plenary lectures at international meetings. Although significant advances were made in enhanced diagnostic capability, we remain deficient in our national detection capability.

Agency Contact Information

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Background
Feed the Future is the U.S. government’s global hunger and food security initiative with 24 Innovation Labs. The labs follow the success of the Collaborative Research Support Program that was authorized under the “Title XII-Famine Prevention and Freedom From Hunger” of the Foreign Assistance Act of 1961. Four of the 24 labs are located at Kansas State University.

Description
Establishment of the innovation labs creates new partnerships between the U.S. and developing-nation universities globally. The labs focus on building human and institutional capacity while advancing scientific frontiers that are beneficial domestically as well as internationally. The reasons for this approach are:

- No country can grow without educated leaders, scientists, entrepreneurs, doctors, teachers, nurses, engineers and other high-skilled drivers of economic growth. Lack of well-educated citizenry is a major impediment to international development; it undermines U.S. development assistance efforts and makes private sector engagement costly and difficult.
- A World Bank study shows higher education investments returns are substantial. Contrary to prevailing thought, the poorer the country the greater the return on investment to higher education. In fact, the poorest world region, sub-Saharan Africa, shows the highest rates of return from investments in higher education at 21.9 percent, which is nearly double that for primary and secondary education in the region.
- The innovation labs are a two-for-one investment, solving critical agricultural problems that impact food security and poverty via research conducted collaboratively between U.S. and developing country students and scientists, while building capacity for countries to solve their own problems in the future.
- More than 65 U.S. universities throughout the nation are engaged in the labs. Global engagement increases the reach of U.S. research institutions, creates linkages that facilitate U.S. economic ties with developing countries and fosters economic growth in developing countries that benefits their economy and ours.

Sustaining Progress
The Global Food Security Act of 2016, or PL 114-195, was signed into law and covers a two-year period; it will likely come up for renewal in 2018.

The legislation codifies the U.S. government’s commitment to the productivity, incomes and livelihoods of small scale producers — particularly women — by working across agricultural value chains and expanding farmers’ access to local and international markets. It strengthens the initiative’s existing accountability mechanisms and establishes parameters for robust congressional oversight, monitoring and evaluation.

Relevance
A revised Feed the Future research strategy was rolled out by USAID in 2017. K-State leads four USAID Feed the Future Innovation Labs. The Global Food Security Act of 2016 makes explicit recognition of the innovation labs in the strategy. Renewal of the Global Food Security Act will permit continuation and is consistent with the new USAID research strategy.

The current Innovation Labs address the following topics:
1) Applied Wheat Genomics
2) Reduction of Post-Harvest Loss
3) Collaborative Research on Sorghum and Millet
4) Sustainable Intensification.

K-State is the only university in the U.S. to have successfully competed for four of the new innovation labs. It also will continue its work with other existing and new USAID Feed the Future Innovation Labs, as it continues its leadership in global food systems.

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Food Animal Residue Avoidance and Depletion Program, FARAD

Background / Description
The Food Animal Residue Avoidance and Depletion, or FARAD, program is an integrated extension and applied research program that maintains the Food Animal Residue Avoidance Databank, which is designed to eliminate adverse drug and chemical residues from appearing in the edible tissues of food-producing animals. FARAD helps keep food animals healthy and safe for human consumption through outreach activities that include a telephone hotline, 1-888-USFARAD; website for request by veterinarians for direct residue avoidance assistance, FARAD.org; and mobile applications for field use. FARAD is a veterinary tool designed to keep adverse levels of drugs and chemicals from contaminating milk, meat and eggs destined for human consumption. No other federal or private entity duplicates work carried out by FARAD. FARAD straddles the missions of USDA — agriculture research and extension — and FDA — food safety. FARAD is an integrated extension and applied research program that provides required, scientifically valid information on how to avoid drug, environmental and pesticide contaminant residues in milk, meat and eggs, thus helping to avert food safety crises. FARAD provides the scientific basis for determining the appropriate withdrawal period when drugs are used in an extra label manner, a scenario often employed when veterinarians are trying to reduce antimicrobial resistance in animals they treat. The research component of this program involves development of mathematical models that predict withdrawal times and then can be used real time by veterinarians in field situations. FARAD publishes handbooks and journal digests of these data to increase availability to practitioners, as well as contributing technical manuscripts to the peer-reviewed scientific literature of this field. FARAD is also used when food-producing animals are mistakenly exposed to environmental contaminants — e.g., pesticides, biotoxins, melamine, etc. — or, for example, to nuclear fallout two years ago from the Fukushima reactor disaster in Japan. FARAD provides veterinarians with a legal mechanism for determining withdrawal intervals for extra label drug use or contaminant exposures. Because it is often not economically viable for pharmaceutical companies to pursue a drug label claim for minor species, FARAD is the only source for food safety and drug withdrawal information for veterinarians treating these particular species: sheep, goats, reindeer, elk, ducks, pheasant, quail, rabbits, fish shrimp and honeybees. Veterinarians often must use drugs approved for both animals and humans to address animal health and welfare and to enhance public safety. PL 103-396, Animal Medicinal Drug Use Clarification Act, or AMDUCA, authorized in 1994, permits veterinarians to prescribe drugs in an extra-label manner to treat conditions for which there are no effective approved drugs. AMDUCA requires a scientifically derived withdrawal period for drugs used in an extra-label manner. FARAD is the only approved source for such information and in fact enables much needed drug usage in food animal practice. FARAD serves as the veterinarian’s clearinghouse for residue data.

Relevance
The FARAD program was developed in 1981 by pharmacologists and toxicologists at four land-grant universities. Dr. Jim Riviere, emeritus faculty member of the College of Veterinary Medicine at Kansas State University, is the national coordinator for this program with collaborators at the University of California-Davis, University of Florida and North Carolina State University. FARAD continues to serve as the primary resource for veterinarians to maintain a drug and chemical residue free food supply. In 2016, FARAD experienced a 20.9 percent increase in residue avoidance cases. Calls are very diverse and range from “ordinary requests” for drug withdrawal recommendations — related to extra label drug use often to reduce potential for antimicrobial resistance or after accidental drug overdoses — to “extraordinary requests,” which include pesticide and contaminant exposures — e.g., oil products spilled from freight trains — as well as disasters such as hurricanes. The global veterinary drug residue avoidance database effort continues to be pursued, a development that would greatly impact the food safety community, and provide direct support for Kansas beef exporters.

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Background
The United States Department of Agriculture’s Food and Nutrition Services, or FNS, provides healthy meals to more than 31 million children each day in over 100,000 schools through the School Lunch Program, and about 3.2 million children and 112,000 adults are served daily through the Child and Adult Care Food Program. The safety of these meals is of great importance and there is strong federal legislation to support food safety.

USDA FNS established The Center of Excellence for Food Safety Research in Child Nutrition Programs at Kansas State University in 2011. Kansas State University was selected to administer the inaugural Center through a competitive process. In 2017, K-State was again selected to administer the Center for Food Safety in Child Nutrition Programs after a competitive selection.

Description
The center provides science-based evidence to improve the safety of foods provided through the FNS nutrition assistance programs, particularly those served in schools and childcare settings. The center conducts research that has an immediate impact on the safety of food served in child nutrition programs. The goals of the center are to provide a multidisciplinary approach to basic and applied food safety research needs related to child nutrition programs, conduct applied studies to resolve food safety issues in schools and other child nutrition programs, and convey those findings in a way that facilitates the transfer of knowledge to school food service directors and program operators, scientists, policymakers, educators and practitioners.

Faculty from the Department of Hospitality Management and the Department of Food, Nutrition, Dietetics and Health in the College of Human Ecology provide leadership for the center. The center has received a total of $5.8 million for the eight years that it has been funded. Continuation of the center will depend on FNS priorities and funding availability.

Relevance
Kansas State University offers food safety expertise along the entire continuum of the food chain that is unparalleled in any university nationally. Current research initiatives of the center include:

- Microbial growth: Use microbiological testing and pathogen modeling to determine microbial growth in food commonly served in child nutrition programs.
- Employee behavior assessment: Determine school nutrition employees’ behavioral intentions to follow food safety practices and develop interventions to improve employee practices and the safety of food served.
- Summer food service programs: Identify proper and improper food safety practices in summer food service programs to identify targeted areas of improvement for educational interventions.
- Child care: Identify food safety regulations and operational characteristics of child care center and in-home operations participating in the Child and Adult Care Food Program and determine food safety education and training needs.
- Food allergy management: Determine best practices and challenges for managing food allergies in schools, including the nature of food allergy reactions.

This applied research is used by FNS to inform public policy. The Institute of Child Nutrition uses the results as the basis for educational programs and materials for child nutrition programs across the United States. This collaborative relationship ensures that the research is translated into meaningful resources that have a direct, positive impact on practice.

The center also developed an intensive immersion program about the food science principles that underscore food safety. The course, delivered to management staff in school nutrition programs and state agencies, helps participants learn to establish and foster a food safety culture and expands their understanding of food science as it applies to their programs. Participants are challenged to return to their home state and educate other child nutrition managers and directors utilizing the tools and knowledge they have gained from the course. Since 2013 approximately 300 people from 49 states have completed the program. Alumni have indicated that they have used the knowledge gained to reach an additional 20,000 individuals engaged in child nutrition programs.

The work of the center is enhanced through partnerships with the many programs and institutes at K-State, including the Biosecurity Research Institute, Food Science Institute and K-State Olathe, and with the Kansas Department of Education’s Division of Child Nutrition and Wellness.

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National Animal Health Laboratory Network, NAHLN

Background
Homeland Security Presidential Directive-9, or HSPD-9, Defense of U.S. Agriculture and Food, states that America’s agricultural and food sector is vital to our economy and is one of the key underpinnings of national security and thus it must be protected from disruption by natural, accidental or deliberate events. HSPD-9 also directed a number of federal agencies to work together to provide a unified strategy to protect our agriculture sector and to improve coordination with and among the states. More specifically, the directive states that these agencies should “…develop nationwide laboratory networks for food, veterinary, plant health and water quality that integrate existing federal and state laboratory resources, are interconnected, and utilize standardized diagnostic protocols and procedures.” The passage of the Securing our Agriculture and Food Act in June 2017 supports HSPD-9 to ensure coordination to protect agriculture.

Historically, the USDA’s Animal and Plant Health Inspection Service, or APHIS, has served as the vanguard to protect America’s preharvest resources. The National Animal Health Laboratory Network, or NAHLN, represents a cooperative effort between two USDA agencies: APHIS and the National Institute of Food and Agriculture, or NIFA, and the American Association of Veterinary Laboratory Diagnosticians, or AAVLD. The NAHLN is a multifaceted network comprised of sets of laboratories that focus on different high-consequence diseases — primarily foreign animal diseases) — using common testing methods and software platforms to process diagnostic requests and share information.

The National Agricultural Biosecurity Center, or NABC, at Kansas State University was established to help protect the U.S. agricultural infrastructure and economy from endemic and emerging biological threats. Beginning in 2006, NABC entered into a strategic relationship with the NAHLN for the development of training exercises and operations software that provided a common and secure frame of reference for NAHLN laboratories in disease outbreak response.

Description
NAHLN provides an automated high-throughput diagnostic protocol to facilitate rapid and accurate examination of samples from diseases of importance to food animal security.

K-State has participated with NAHLN in significant ways, including both the Kansas State Veterinary Diagnostic Laboratory, or KSVDL, and the NABC. These include the development, enhancement and delivery of targeted technical training support programs, with 1) exercises and reviews of best practices from NAHLN labs; 2) expanded animal health diagnostic screening capabilities regionally; 3) participated in proficiency testing personnel and conducting surveillance testing for CSF, ASF, FMD, APMV-1, HPAI, SIV, CWD, Scrapie, VHS, PRV, ISV and emerging diseases; 4) increased testing capacity of the KSVDL by conducting research on new methodologies; 5) development of training strategy framework for NAHLN laboratories by assessing lessons learned; and 6) in the occurrence of an outbreak, perform post-surveillance testing to ensure disease freedom in affected areas.

Relevance
At the federal level, USDA’s National Veterinary Services Laboratories, NVSL, serve as the national veterinary diagnostic reference and confirmatory laboratory.

The state/university laboratories, such as KSVDL in the NAHLN perform routine diagnostic testing for endemic animal diseases as well as targeted surveillance and response testing for foreign animal diseases and other high-consequence diseases. State/university laboratories also participate in the development of new assay methodologies and are on the frontline of detecting emerging diseases important in animal and/or human health, or zoonoses. KSVDL has been a second-tier NAHLN lab since the network was established in 2002.

Networking these resources provides an extensive infrastructure of facilities, equipment, and personnel that are geographically accessible no matter where disease strikes. The laboratories have the capability to conduct nationwide surveillance testing for the early detection of an animal disease outbreak. The ability to test large numbers of samples rapidly during an outbreak and then to demonstrate freedom from disease after eradication is critical and requires enhanced capacity nationwide. This can only be accomplished with a strong and responsive NAHLN.

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National Program Leader for Veterinary Science Animal Section
Background
The National Ecological Observatory Network, known as NEON, is a continental-scale ecological observation facility sponsored by the National Science Foundation to gather and synthesize data on the nation’s natural resources and biodiversity. When completed, it will consist of state-of-the-art environmental sensors, standardized research equipment and sampling protocols at sites across the U.S. — including Alaska, Hawaii and Puerto Rico — strategically selected to represent different ecosystem types, land uses and climates.

NEON will combine site-based measurements with airborne remote sensing and other continental-scale data sets — e.g., satellite data — to document the health of the nation’s ecosystems and to assess changes in those ecosystems through time. Sensor networks, instrumentation, experimental infrastructure, natural history archives and remote sensing will be coupled and linked with computational, analytical and modeling capabilities to create an integrated NEON infrastructure. In this way, NEON will transform biological research by enabling studies on major environmental challenges at regional to continental scales.

Relevance
NEON sites are distributed across 20 large regions — eco-climatic domains — with each region having a “core” terrestrial and aquatic site and two additional sites that represent contrasting environmental conditions or different land uses. For the Prairie Peninsula region, the core terrestrial and aquatic sites are located at Kansas State University’s Konza Prairie Biological Station, and an additional relocatable site is located at the University of Kansas field station. The two Kansas sites are the only NEON sites in the multistate Prairie Peninsula region.

NEON moved through the concept, approval and design stage from 2006 through 2012. Congress has approved NEON funding, and NEON sites are currently being developed and instrumented. At the Kansas sites, construction of instrument towers was completed in 2015. NSF expects that all NEON sites will be fully operational by 2017, and that the core sites will collect data for at least 30 years.

Continued funding for NEON will bring new state-of-the-art equipment to biological field stations in Kansas and provide unique research capabilities for researchers and students at K-State and elsewhere. For example, in 2016 NEON supported aircraft with state-of-the-art sensor technology to collect remotely sensed data for Kansas field sites. The co-location of NEON infrastructure and the Konza LTER program also provides unique research and training opportunities for students and scientists at institutions throughout Kansas and beyond. This will facilitate additional research funding built around NEON and LTER capabilities and data availability, and will help in attracting the nation’s top ecological scientists and students to Kansas.

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NSF Long-Term Ecological Research Program, LTER, at Konza Prairie

Background
The Long Term Ecological Research, or LTER, program was created by the National Science Foundation in 1980 to support a network of research sites to address critical ecological questions that cannot be answered with more typical short-term observations or experiments. Funding is provided by NSF in the form of renewable six-year grants, which are peer-reviewed and renewed based on the quality of science, research productivity and contributions to network and synthesis activities. NSF conducts rigorous reviews of LTER sites at the midpoint of each grant cycle, as well as a comprehensive review of the entire LTER Network every 10 years.

Relevance
Kansas State University’s Konza Prairie Biological Station is the core research site for the Konza Prairie LTER, or KNZ, program. Konza Prairie, an 8,600-acre native tallgrass prairie research station, is jointly owned by K-State and The Nature Conservancy, and managed by K-State’s Division of Biology. Konza Prairie was one of the six initial LTER sites funded in 1980, and LTER funding for the site was renewed in 2014 for the next six years at a level of $6.76 million, bringing total LTER funding for the program to more than $29 million. In addition, the core LTER program provides a research platform that facilitates successful competition for additional federal funding from a variety of agencies.

NSF funding for the Konza Prairie LTER site supports an interdisciplinary research program with a long-term goal of building a comprehensive understanding of ecological processes in tallgrass prairie and other grasslands, while contributing to broad synthetic and conceptual advances in ecology. The Konza LTER program also provides education and training, from K-12 to postgraduate; public outreach; and knowledge to inform grassland management and conservation. Our site-based research focuses on the tallgrass prairies of Kansas, but cross-site and comparative studies with other grasslands extend the relevance of this research globally.

Konza Prairie LTER research is organized around four major themes — land-use change, climatic variability, altered biogeochemical cycles and restoration ecology — and builds on a 30-year foundation of long-term experiments and measurements in terrestrial and aquatic grassland ecosystems.

Konza Prairie Biological Station has approximately 120 active registered research projects by K-State scientists in five colleges and 14 departments as well as more than 60 visiting scientists and students from other research institutions across the U.S. and world. Research conducted at Konza Prairie has resulted in more than 1,700 publications, including more than 275 student theses and dissertations.

Konza Prairie LTER funding also supports on-site K-12 activities, undergraduate and graduate education and training, community outreach and engagement with grassland managers and conservationists. Collectively, LTER research and associated cross-site and comparative studies are contributing to improved management, conservation and restoration of grasslands globally.

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Description
The Agricultural Research Service's Center for Grain and Animal Health Research, or CGAHR, is the only U.S. Department of Agriculture research laboratory in Kansas. Based in Manhattan, research conducted at CGAHR falls under five national programs. The center is ideally located in the heart of the Great Plains, the nation's breadbasket and livestock center, and now an emerging center for the production of biofuels and other bio-based products.

The mission of CGAHR is to conduct innovative research and develop new technologies to solve problems in arthropod-transmitted animal diseases, and in the production, storage and utilization of grain to ensure a safe, abundant and high-quality food supply.

CGAHR has four research units with unique missions and interacts with key customers and stakeholders. CGAHR scientists are recognized worldwide for innovative research and technology development.

1) The Arthropod-Borne Animal Diseases Research Unit studies animal diseases spread by arthropods and develops diagnostic tools, vaccines, and other technologies to protect animal health.

2) The Hard Winter Wheat Genetics Research Unit finds and provides new genetic material to address hard winter wheat problems, including insect pests, diseases, and abiotic stresses.

3) The Grain Quality and Structure Research Unit investigates relationships between physical and chemical attributes and end-use quality for various wheat and sorghum products, and it develops rapid and precise predictive tests.

4) The Stored Product Insect and Engineering Research Unit develops new knowledge and methods for controlling insect pests in grain and food products, and it develops technology to measure and preserve grain quality.

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Description
The Arthropod-Borne Animal Disease Research Unit (ABADRU) conducts research on animal diseases including Rift Valley fever, Vesicular Stomatitis, and Bluetongue that threaten U.S. livestock. Collaborative research including Kansas State University scientists in the colleges of Agriculture and Veterinary Medicine, has recently been initiated on several swine diseases including African swine fever and Japanese encephalitis that pose a serious risk to producers and the entire industry and cause outbreaks, trade would be affected. If these diseases are introduced into the U.S. This initiative will strengthen ongoing research to develop diagnostic and control measures for these diseases. In addition, several critical research gaps will be addressed, including determining the potential North American arthropod vectors and the host-vector-virus relationships involved in arbovirus transmission to swine, and understanding the epidemiology and progression of both diseases. It is critical to strengthen the vector biology component of this research.

The requested funds ($2 million permanent increase to base funds) will be used to hire two scientists for the ABADRU, along with support staff to conduct this research.

Relevance
- The U.S. produces 31 million tons of pork annually, valued at more than $14 billion. Exotic diseases of swine threaten domestic production as well as an important export market. These funds are needed to increase research efforts on African swine fever and other exotic swine diseases.
- With these funds ABADRU and its K-State partners will:
  - Evaluate the competence of potential native arthropod vectors to transmit disease to domestic and feral swine, and determine their possible role should the disease be introduced to the US.
  - Determine the important geographic, climatological, and ecological factors that could influence the establishment and spread of this disease.
  - Develop and evaluate disease diagnostic, surveillance and control measures to protect U.S. swine from this disease.

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CGAHR — Wheat Quality and Competitiveness

Description
The Hard Winter Wheat Quality Laboratory (HWWQL), part of the Grain Quality and Structure Research Unit, serves the largest growing region of the four USDA-ARS wheat quality laboratories and provides leadership, expertise and service to the U.S. industry for improving quality and marketability of hard winter wheat (HWW).

The engineering component within the Stored Product Insect and Engineering Research Unit (SPIERU) develops new technology for measuring, selecting, and predicting wheat quality. These programs have suffered from long-term decline in funding, staffing, and antiquated equipment.

Immediate action must be taken to provide adequate funding and resources, or research critical to the economic health of the U.S. wheat industry will be curtailed.

The requested funds will be used to increase program funds to both HWWQL and engineering component of SPIERU ($650,000 permanent increase to base funds for each program).

Relevance
• The Hard Winter Wheat Quality Laboratory was established by Congress in 1937 to determine the end-use quality of experimental wheat lines. The HWWQL evaluates 100% of the hard winter wheat commercially released in the U.S. that is used in a $70 billion bakery and snack food industry. A similar volume of HWW is exported.
• The HWWQL and engineering need program funds to support the development of:
  • Rapid assessment of wheat quality to more accurately predict protein, starch, processing and end-product quality.
  • Rapid, accurate and nondestructive evaluation on a single kernel basis, of color, hardness, protein and starch quality.
  • Novel end-use qualities and trait combinations using molecular and conventional biochemical approaches.


To successfully compete in the world wheat market, U.S. wheat must have superior end-use qualities and offer exceptional value to millers and bakers. This initiative would support the HWWQL and its national mandate to conduct research and provide support for the entire wheat industry, including breeders, growers, millers, bakers, and exporters.

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In Kansas and neighboring states, heat stress cuts average wheat yields in half and significantly reduces grain quality. Heat stress also dramatically reduces water use efficiency, especially in irrigated wheat. In rainfed systems, drought stress is typically the most important yield constraint. If predictions of climate change and aquifer depletion are realized, the challenges from heat and drought will increase. New research investment is urgently needed to accelerate efforts to improve wheat resilience to heat and drought stress.

It will require aggressive, comprehensive program is required that uses both conventional and biotechnological approaches for germplasm enhancement and fundamental studies on stress tolerance. The program will leverage existing USDA-ARS and K-State personnel who have expertise in wheat genetics, high throughput genotyping, whole plant stress physiology, and field plot-level physiology. This expertise must be complemented by additional personnel with expertise in the cellular-level physiology, biochemistry, and molecular biology of stress tolerance.

Research objectives include: 1) develop improved laboratory and field-screening techniques for heat and drought tolerance; 2) identify wheat lines or wheat wild relatives with stress tolerance and introgress into elite germplasm lines; 3) map and characterize genes involved in conventional tolerance to heat and drought; 4) characterize biochemical mechanisms and regulatory pathways that control heat and drought stress susceptibility or tolerance; 5) identify novel molecular targets and innovative strategies for enhancing stress tolerance; and 6) develop transgenic wheat plants to test new hypotheses and strategies for increasing abiotic stress tolerance.

To achieve these objectives, the following new USDA-ARS positions are needed:

1) Research plant physiologist/biochemist
2) Biological science technician

The requested addition to permanent base funds for salaries, materials, supplies, and equipment, as well as overhead, is $700,000.

• Tolerance to heat stress is the single most important genetic improvement needed for wheat worldwide.
• Tolerance to drought stress is the second most potentially useful trait in the Great Plains.
• Expected outputs include: 1) high throughput stress tolerance screening methods; 2) biomarkers or reporter genes for measuring stress responses; 3) new elite germplasm lines with enhanced conventional stress tolerance; 4) locations, effects, and DNA markers for genes that are involved in conventional stress tolerance; 5) identification of physiological or biochemical constraints and yield-limiting factors under heat or drought stress; 6) understanding the composition and dynamics of stress-responsive gene regulatory networks; 7) new models, strategies, and testable hypotheses for abiotic stress tolerance; and 8) invention of novel stress-resilient transgenic wheat lines.

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CGAHR — Hessian Fly Research

Description
The Hard Winter Wheat Genetics Research Unit in close cooperation with Kansas State University, conducts research to control the Hessian fly. This pest attacks wheat across the U.S. and is especially prevalent in the Southern Great Plains. It is typically found in 70% of wheat fields in Kansas, Oklahoma, and north Texas. Most older, resistant varieties have been defeated by new biotypes of the Hessian fly.

New genetic sources of resistance and rapid, effective screening methods are needed to achieve more durable resistance. Greater understanding of the mechanistic basis of insect virulence and host resistance is also needed. New sources of resistance and knowledge of this pest are critical to protecting U.S. wheat producers.

The requested funds ($250,000 permanent increase to base funds) will be used to expedite research on this high priority constraint.

Justification:
• Hessian fly is becoming a more important problem. Its resurgence can be attributed to increasing adoption of reduced tillage management practices, increased insect virulence, and warmer fall and winter weather. In the Southern Great Plains only 2 of 22 resistance genes are continuing to provide resistance to the Hessian fly. New resistance genes are urgently needed. The Hessian fly project at Manhattan currently provides resistant germplasm sources and screening for resistance services to all public and private wheat breeding programs in the hard winter wheat region.
  • Increased capacity to screen germplasm and develop resistant wheat varieties are needed to support regional breeding efforts.
  • The search for more durable resistance requires investment in basic research to determine molecular mechanisms for insect virulence and host plant resistance.
  • The Hessian fly project is underfunded in relation to the mission that it fulfills.

The National Wheat Improvement Committee, National Association of Wheat Growers, and U.S. Wheat Associates strongly recommend additional funding for this initiative to improve Hessian fly resistance in wheat.

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Animal Disease Response Training for Emergency Responders

Background
Kansas State University’s National Agricultural Biosecurity Center’s, or NABC, Animal Disease Response Training — ADRT — course curriculum is for awareness level training of agricultural emergency first responders. The curriculum has been approved for inclusion in the Federal Emergency Management Agency’s National Preparedness Directorate, National Training and Education Division, or NTED, course catalog. This catalog provides high-quality training to equip first responders to prevent, protect against, respond to and recover from both manmade and natural catastrophic events.

ADRT provides information needed to minimize the effects of a disease outbreak on a community, state and the nation. This training focuses on the best practices and safety issues associated with an agriculture emergency in the areas of quarantine, biosecurity, euthanasia and disposal; use of personal protective equipment; and cleaning and disinfection. This education platform also assists in increasing coordination of responders across jurisdictions, lines of authority and disciplines by examining the integration of response efforts.

Description
ADRT training and education is designed for responder groups that include, but are not limited to, the following:

- Emergency Management Agencies, or EMA
  - Emergency Medical Services, or EMS
- Veterinarians
- Agriculture Emergency Responders
- Fire Fighters
- Law Enforcement
- Public Health
- Public Works/Utilities
- Environmental Agencies
- Elected/Civilian Officials
- Producers/Associations
- Industry
- Academia
- Military

The term “first responder” refers to those individuals who, in the early stages of an incident, are responsible for the protection and preservation of life, property, evidence and the environment; this includes emergency response providers as defined in section 2 of the Homeland Security Act of 2002, 6 U.S.C. 101, as well as emergency management, public health, clinical care, public works, law enforcement and other skilled support personnel — such as equipment operators — who provide immediate support services during prevention, response and recovery operations.

ADRT helps many responder groups, including emergency medical services, veterinarians, firefighters, law enforcement, producers, environmental agencies, and public health and elected officials. Acceptance in the FEMA NTED catalog means that the course meets nationally recognized standards and uses adult learning principles, including problem-based learning. All courses undergo rigorous validation and continuous assessment processes and are tested through state and local exercises that help enhance disaster plans and training course development.

Relevance
Recent incidences of porcine epidemic diarrhea virus, or PEDV, and high pathogenic Avian influenza, or HPAI, outbreaks in the U.S. have brought more attention to agricultural emergency preparedness and the necessity of coordinating responders. ADRT brings the whole community together. The response is not solely one specialty — it requires multiple resources in a highly coordinated response. For imposing quarantine, law enforcement is needed. For disposal or burial, the Environmental Protection Agency may be needed. Targeting local responders rather than only national and state authorities is also key. The need for local responders to be educated is an area of emphasis with national and state authorities. Planners and responders will be much more effective already having at least an awareness level of knowledge concerning why and how things need to be done.

Minimizing the impact from these kinds of emergencies requires complex coordination between many individuals, organizations and government agencies. It is essential that any type of responder understand and communicate the basic concepts necessary for an effective response effort.

Opportunities to reduce additional threat gaps exist with development of advanced ADRT courses to include public information officer awareness, executive-level training and disaster preparedness for veterinarians and veterinary technicians.

ADRT builds on prior NABC research coordination projects and translates knowledge products from K-State into training that helps protect our global food systems and meet the requirements of Public Law 115-43, the Security our Agriculture and Food Act.

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NATIONAL INITIATIVES
Background
Veterinary medicine is an integral and indispensable component of our public health system as well as our agriculture and agricultural biosecurity systems. In addition to their obvious role in maintaining animal health, veterinarians also protect human health by preventing and controlling infectious diseases, ensuring the safety and security of our food supply, promoting healthy environments, and providing health care for animals. Because of the threat that infectious diseases pose to both human and animal health, there is an immediate and urgent need to build national capacity in training of veterinarians with expertise in food animal medicine, public health and agricultural biosecurity. Rural veterinarians, engaged in food animal practice, are our nation’s first line of defense in recognizing a foreign animal disease. It has become increasingly important for schools and colleges of veterinary medicine to provide high quality training programs in agricultural biosecurity within the instructional program for veterinary medical students, as well as at a higher level for graduate veterinarians who seek advanced training in agricultural biosecurity. Such additional instructional programs are difficult to implement within the severe constraints of veterinary medical schools and colleges, placing a premium on programs that can assist the educational institutions in meeting a greatly expanded national need.

The U.S. has only 30 veterinary medical colleges, and they do not have enough capacity to meet all of these needs. All of these schools are at the maximum number of students they can accept because of space limitations for teaching, diagnostics and research. Laboratories, teaching hospitals, veterinary research facilities and animal diagnostic areas are built specifically for use with animals, including laboratory animals, livestock species and wildlife. This is space built with unique safety, restraint and handling requirements that are not commonly found on American campuses.

In addition to the projected need based on current assumptions about veterinary medicine, even more veterinarians will be needed because of other factors such as greater encroachment on animal habitat, resulting in increased human interaction with wild and exotic animals; changing climates and ecosystems, deforestation, dam building and irrigation, leading to greater numbers of arthropod vectors of disease and greater contact between these vectors and humans; more and faster global travel and displaced human and animal populations, leading to rapid and wide dispersal of infectious diseases; and changing human behavior, such as consuming exotic foods and keeping exotic pets, which increases the risk of exposure to newly emerging infectious diseases.

To be successful, programs that seek to recruit and retain veterinarians in careers in food animal practice, public health and agricultural biosecurity must compete effectively with programs recruiting veterinarians to many other career options. A new graduate from an accredited U.S. veterinary medical school or college typically enters the profession with more than $160,000 of educational debt. Consequently, graduates very logically examine the salary expectations, both at entry and over the long term, of a potential career choice, recognizing their need to repay their student loans even as they seek to establish a family and maintain a reasonable lifestyle. With such financial pressures and analyses, a career in food animal practice and agricultural biosecurity often pales in comparison to the salary potential of other, more lucrative career options. Consequently, measures to relieve a significant portion of debt, contingent upon entering and remaining in a career in food animal practice and agricultural biosecurity, are very important for the recruitment and retention of veterinarians to this area of national need.

The support of effective strategies to recruit and retain an adequate number of veterinarians in food animal practice and to facilitate their training in agricultural biosecurity are key elements in maintaining the security of our food supply and of our agricultural economy.

Measures to facilitate the recruitment and retention of veterinarians in food animal practice while simultaneously expanding the training of veterinarians in agricultural biosecurity are keys to maintaining the security of animal agriculture, our agricultural economy and our food supply.

Description
The Agriculture Act of 2014 — PL 113-79 — contained provisions important to veterinary medicine. Section 7104 established a competitive veterinary services grant program to develop, implement and sustain veterinary services. Authorized at $10 million annually, this section would amend the National Agricultural Research, Extension and Teaching Policy Act of 1977 to direct thesecretary of agriculture, USDA, to carry out a program with qualified entities to develop, implement and sustain veterinary services in the states. The program received initial funding in FY 2016 for $2.5 million. This program would allow recipients to: a) establish or expand veterinary practices or establish mobile veterinary facilities, b) recruit veterinarians, technicians and students, c) attend training programs in food safety or food animal medicine, d) establish or expand accredited education, internship, residency and fellowship programs, e) assess veterinarian shortage situations, and f) support continuing education and extension, including tele-veterinary medicine and other distance-based education.

The Veterinary Medicine Loan Repayment Program, or VMLRP, Enhancement Act would amend the Internal Revenue Code to make VMLRP awards exempt from gross income and employment taxes. Awards are currently taxed at 39 percent, although those taxes are paid by USDA directly to the treasury on behalf of the award recipient. Tax exemption for VMLRP awards would result in one additional veterinarian for every
Support is requested for: 1) Provisions of the Agriculture Act of 2014 — PL 113-79 — important to the veterinary profession, namely the Animal Health and Disease Research/1433 Formula Funds; Centers of Excellence, Food Animal Residue Avoidance Databank, or FARAD, and the Competitive, Special and Facilities Research Grant Act, as well as the new funding for the Veterinary Services Grant Program, or VSGP, to develop, implement and sustain veterinary services 2) tax exemption for awards made under the VMLRP, and 3) passage of appropriations legislation that maintains or increases funding for the VMLRP, Animal Health and Disease Research/1433 Formula Funds, Agriculture and Food Research Initiative, FARAD, the VSGP, the National Animal Health Laboratory Network, or as well as for the National Institutes of Health.

Aspirations for the appropriations for FY 2018 should be to maintain or increase current funding levels for such critical programs as the Animal Health and Disease Research/1433 Formula Funds, Veterinary Medicine Loan Repayment Program, Agriculture and Food Research Initiative, the Agriculture Research Service, or ARS, and the National Institutes of Health.

Relevance
Agriculture, and specifically animal agriculture, is vital to the Kansas economy. Training, recruiting, and retaining enough veterinarians to meet the needs of agriculture and of agricultural biosecurity are important concerns of agriculture and related organizations. They are also natural issues of concern to the College of Veterinary Medicine at Kansas State University, one of only 30 such schools in the United States. As one of only 27 states with a veterinary medicine college, Kansas would clearly benefit by increased federal investment in the training of veterinarians in agricultural biosecurity and food animal practice, as well as in their subsequent recruitment and retention.

The proposed federal investment would augment, not replace or diminish, the importance of funding from the state of Kansas. It will, however, multiply the impact of state funds and enhance the ability of Kansas State University and the College of Veterinary Medicine to meet the needs of the state and nation. Leaders from the Kansas congressional delegation have lent their support to these important legislative efforts.

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