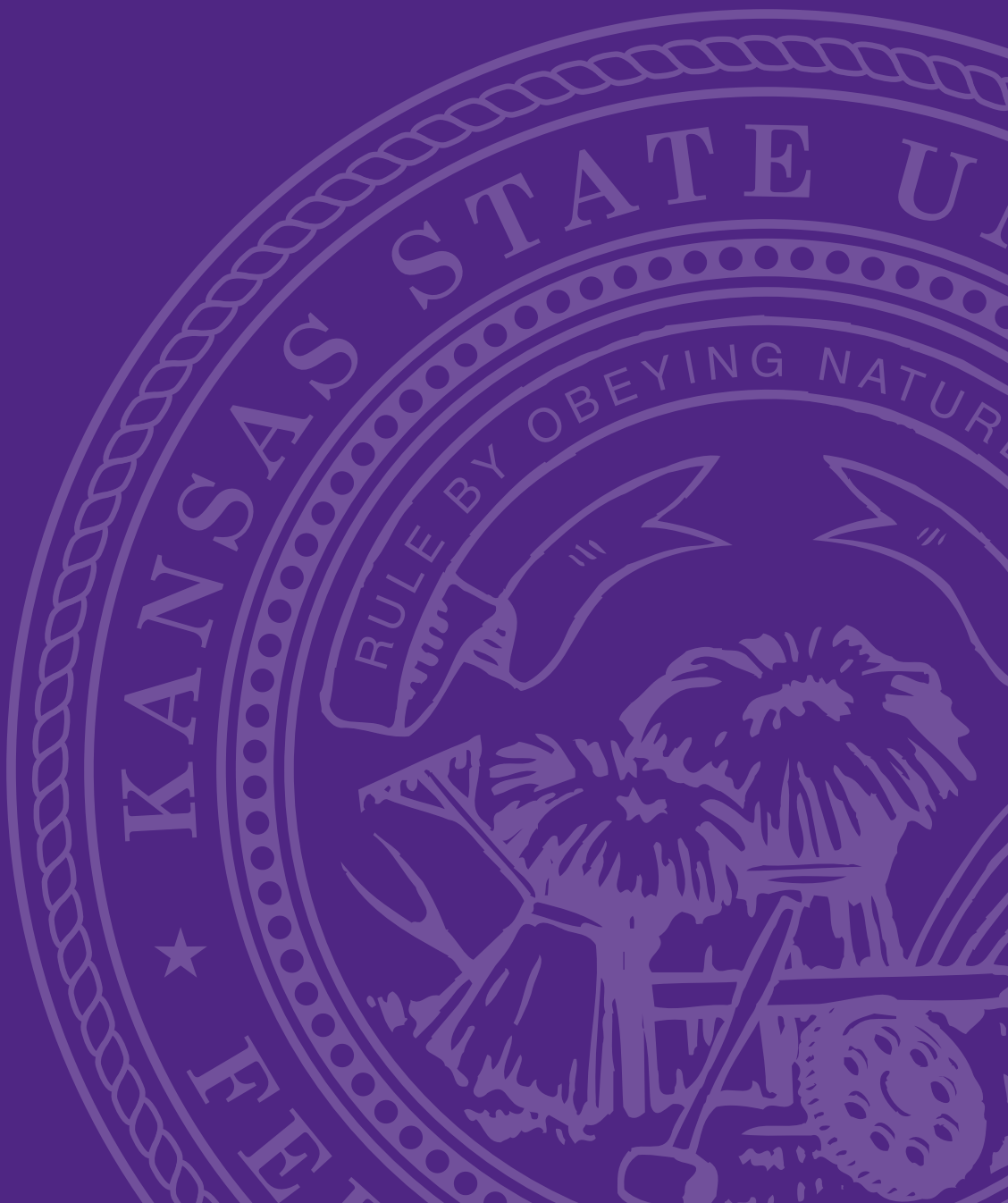
# Expression of University Strengths

February 2017




KANSAS STATE
UNIVERSITY

# Expression of University Strengths

February 2017




KANSAS STATE UNIVERSITY

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KANSAS STATE UNIVERSITY | Office of the President

# Memorandum

DATE: February 8, 2017

TO: Members and Staff of the Kansas Congressional Delegation

FROM: Richard B. Myers, President, Kansas State University

RE: Kansas State University Expression of Strengths Document

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On behalf of Kansas State University, I would like to thank each of you for your work in Washington on behalf of the citizens of Kansas. Your guidance and support has helped the University to launch and enhance programs and research efforts over the years. We particularly appreciate the support you have shown Kansas State University in the past.

This document is presented to you as expressions of university strengths. The university Vice-Presidents, Provost, Deans, and Directors 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 Research University by 2025.

If you have questions about any of these requests, please contact Sue Peterson, Director of Governmental Relations, at 785-532-6221 or skp@k-state.edu. She will provide you with whatever information you may require. A flash drive of the entire document is included for your convenience. You may also access it electronically on the K-State Governmental Relations website at www.k-state.edu/govrelations/federal.

# AGRICULTURE

# FASTER – The Food and Agriculture Systems Teaching, Extension and Research Facility

## 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 world-wide food demand. However, we must develop higher yielding crops, more intensive cropping systems, enhanced beef/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 Kansas State University are internationally recognized in food and agriculture. The U.S. Agency for International Development selected K-State to host four innovation labs, which focus on applied wheat genomics, sorghum and millet improvement, sustainable intensification, and on the reduction of post-harvest loss. The National Science Foundation also funded its first ever Industry/University Center for Wheat Genetics at K-State.

Recently, the National Academies of Science's National Research Council published the rankings of doctoral programs in the United States. Most 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 2014-15, the College of Agriculture and K-State Research and Extension expended $105.2 million in research, which was 55.8% of the total research expenditures ($188.7 million) at the University.

## 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 (~65 percent). USDA expects the demand for future ag 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 (FASTER) Facility. The new building will also address the needs for growth required by the College of Agriculture and Kansas State University 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 (ARS) and USDA Animal and Plant Health Inspection Service (APHIS). 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 (i.e. wheat, sorghum, beef, 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 (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

Director
USDA National Institute for Food and Agriculture

# FASTER – The Food and Agriculture Systems Teaching, Extension and Research Facility

# The Wheat Genetics Resource Center Industry/University Cooperative Research Center (WGRC I/UCRC)

## Background

Established in 2013, the WGRC I/UCRC at Kansas State University joins together 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.

## Members and Partners

## Description

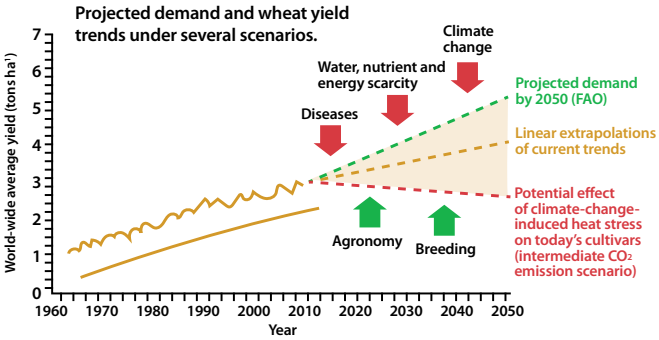
Kansas State University requests funding from USDA NIFA to be matched by industry investors and the National Science Foundation (NSF). The funding will go toward the core research program of the WGRC I/UCRC: Managing Wheat Germplasm, Mining the Wheat Gene Pool, Wheat Phenotyping for Drought, Wheat Genetic 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 increase cannot meet the projected global demand in 2050.




-CGIAR WHEAT, 2014

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:*

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 Ph.D. students, and 20 post-doctoral fellows, in addition to having hosted more than 60 visiting scientists from all over the globe.

## Agency Contact Information

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# Global Food Systems Initiative

## Background

Today, one in eight people worldwide are hungry, according to the United Nations Food and Agriculture Organization (FAO). 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.

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

There are complex relationships throughout the value chain of global food systems that Kansas State University supports. 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.

Kansas State University 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 Kansas State's global leadership position on a permanent basis, the university will need to address a number of critical needs:

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

The visionary goals presented in Kansas State University's 2025 strategic plan will be advanced through the global food systems initiative.

## Relevance

Kansas State University is now #5 in terms of U.S. universities receiving USDA National Institute for Food and Agriculture (NIFA) grants.

Building on Kansas State University'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, Kansas State University 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 and educate the future workforce.

Also, faculty at K-State will have to compete hard for competitive grant funding (whether at USDA NIFA, NIH or NSF) for agricultural and food-related research, if we are to have a chance at reducing 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 National Institute for Food and Agriculture

# Center for Sorghum Improvement
# Collaborative Sorghum Investment Program

## Background

The Collaborative Sorghum Investment Program (CSIP) is a farmer and University partnership. The program was created by an agreement between Kansas State University, the United Sorghum Checkoff Program, Kansas Grain Sorghum Commission and investment from the Kansas Department of Agriculture. The agreement establishes a center program to pursue the following program objectives:

- ***Yield.*** Increase the U.S. national yield average from 61.95 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

The U.S. is a major producer of grain sorghum. Kansas and Texas are the largest producers, contributing to more than 80 percent of U.S. sorghum acreage and production. 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 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 sustaining our natural resources like the Ogallala.

Kansas State University initiated the Center for Sorghum Improvement in 2001. The recent farmer investment and partnership at K-State re-leverages the Center as a collaborative entity across the sorghum research community. The focus of research is on genetic improvement, production systems to enhance water and nutrient use, innovative strategies to provide improved weed control, utilization of sorghum in human food products, animal feed, and as a bioenergy and industrial feedstock, plus marketing.

## Priority Research Areas

Core gaps in research areas that are needed to advance the crop are 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 long-term.
- ***Gene Flow.*** A limitation in sorghum research is gene flow. The concern that enhancement of sorghum can cross over to weed populations continues to hinder sorghum's investment. Focused research limiting gene flow could be the catalyst that unlocks several technologies for sorghum.
- ***Database.*** This database resource would enhance the speed at which the research community could collectively advance the crop and take advantage of new genetic tools and technologies.
- ***Genetic Tools and Technologies.*** To leverage recent investments from the Department of Energy, the sorghum industry needs the development of practical tools and technologies to apply the vast amount of data resources in private and commercial sorghum genetic and breeding programs.
- ***Water.*** Sorghum has been found to be a key crop in water-limited environments. Further research is needed to identify best management practices for sorghum's performance in varying growing climates and also to enhance the crops naturally occurring water sipping traits. The right investments can poise sorghum as a core tool in response to water limitations.

The Collaborative Sorghum Investment Program is continuing existing research and education programs, particularly in genetic improvement, production efficiency and sorghum utilization. Sorghum is one of the most drought- and heat-tolerant crops in the world, offering potential advantages as a food, feed and bioenergy crop to the rural economies of the Great Plains. The wide diversity of sorghum types (sweet, forage, silage, biomass, grain) offer tremendous opportunity, but these resources need to be evaluated to identify the best suited varieties to meet the specific needs of food, feed, biofuel and industrial uses.

To meet the growing demand from private industry and academia, it is important to train graduate students as sorghum scientists. Expanding training and research on genetic improvement, production and utilization will result in technologies and information leading to an increase in sorghum productivity and profitability, and improving the global competitiveness of the U.S. sorghum industry.

## Agency Contact Information

USDA National Institute of Food and Agriculture
Ann Marie Thro, 202-401-6702

# The Center of Excellence for Food Safety Research in Child Nutrition Programs

## Background

The United States Department of Agriculture's Food and Nutrition Services (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.

As part of their response to a direct initiative of the Secretary of Agriculture, Tom Vilsack, 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 as the institution to house the Center through a competitive process.

## 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. Research scientists affiliated with the Center conduct 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 foodservice directors and program operators, scientists, policy makers, 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 funding for a five-year period at $4.0 million. Continuation of the Center will depend on FNS priorities and funding availability. Further, we will be required to compete for the grant after the sixth year of funding.

## Relevance

Kansas State University offers food safety expertise along the entire continuum of the food chain that is unparalleled in any university across the nation. 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 Change: Determine school nutrition employees' behavioral intentions to follow food safety practices and develop interventions to improve employee practices and the safety of food served.
- Sustainability and Reducing Wasted Food: Improve food sustainability and reduce wasted food while maintaining food safety practices.
- 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 and characterize state food safety regulations and operational characteristics of child care operations across the United States.

This applied research is used by FNS to inform public policy, while the Institute of Child Nutrition (funded by FNS and housed at the University of Mississippi) uses much of this research as the basis for developing 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. The program started in 2013 and is offered three times per year. A total of 124 people from 38 states have completed the course. In 2016, an additional 72 participants have been invited and this will include participants from 11 states who have not previously sent participants.

The work of the Center is enhanced through partnerships with the many food safety programs and institutes at Kansas State, including the Biosecurity Research Institute, Food Science Institute, Kansas State University Olathe, and with the Kansas Department of Education's Division of Child Nutrition and Wellness.

## Agency Contact Information

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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 (K-State) faculty members from Biochemistry & Molecular Biophysics, Biology, Diagnostic Medicine/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.

The K-State Arthropod Genomics Center provides a convening function for these researchers and hosts speakers as well as a highly successful annual symposium that consistently attracts internationally known experts. The 2015 symposium was the ninth in the series.

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 5000 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 causing 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, for example, 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 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. We are 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.

## Agency Contact Information

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# Pre-Harvest Food Safety and Security

## Background/Description

The goal of this program is to develop strategies to identify and mitigate food-borne pathogens and antimicrobial resistance in beef production systems. Specifically, studies will focus on the ecology of Shiga toxin-producing *Escherichia coli* (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 food-borne pathogens and preharvest beef safety. The research outcomes will have major positive impacts on public health, animal well-being, and the economic prosperity of the state of Kansas and the U.S.

## Relevance National/Regional

The food supply in the United States is one of the safest in the world; however, food-borne 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 pre-harvest 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 with microbiology, molecular biology, epidemiology and production systems expertise, 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 food-borne pathogens in cattle and their environment and develop effective and practical strategies for comprehensive reduction or elimination of food-borne pathogens at the farm level.

***Shiga toxin-producing E. coli (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, O1O3, 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 multi-drug 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 food-borne 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 strengthen the need to understand the ecology and epidemiology of food-borne pathogens for effective pre-harvest 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.

## Agency Contact Information

USDA National Institute of Food and Agriculture
Division of Food Safety
202-401-1954

# National Bio and Agro-defense Facility: U.S. Department of Agriculture Research

## Background

The U.S. Department of Homeland Security (DHS) is constructing the National Bio and Agro-defense Facility (NBAF) in Manhattan, Kansas. It will replace the Plum Island Animal Disease Center (PIADC) on Plum Island, New York, that was constructed in the 1950s.

Due to antiquated PIADC facilities in need of major repairs, livestock research on Plum Island will be shut down for a significant portion of FY 2017 and perhaps longer. Two foreign animal diseases (FADs) that have been studied on Plum Island and are targeted for NBAF research are African swine fever (ASF) and classical swine fever (CSF). The research was conducted by the U.S. Department of Agriculture's (USDA's) Agricultural Research Service (ARS), but has been funded by DHS the past few years. However, DHS funding of ASF and CSF research at PIADC has ramped down and future work there on either FAD is questionable.

Zoonotic diseases (those that can be transmitted from animals to people) cannot be studied on Plum Island due to the poor infrastructure; it would be unsafe for the scientists, animal handlers and technicians. Zoonotic FADs targeted for NBAF include Rift Valley fever (RVF) and Japanese encephilitis (JE), among others.

## Description

Kansas State University (K-State) is conducting ASF, CSF, RVF and JE research in the Biosecurity Research Insitute (BRI) located immediately adjacent to the NBAF site. USDA scientists at the Center for Grain and Animal Health Research (CGAR) in Manhattan, Kansas, conduct their reseach in the BRI when it requires biosafety level-3 (BSL-3) and/or BSL-3Ag (livestock) biocontainment, and they also collaborate with K-State scientists on some of the FAD projects noted.

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NBAF is not scheduled to be operational for a few more years, but the NBAF workforce cannot be fully trained on Plum Island even if the current infrastructure issues are resolved; plus, more breakdowns could still occur. Moreover, as already noted, zoonotic disease research cannot be done on Plum Island regardless. Thus, growing NBAF-related research activities in the BRI on both zoonotic and non-zoonotic FADs could be beneficial for multiple reasons.

## Relevance

Based on the fact that USDA will conduct the primary research mission in NBAF, moving some PIADC research to USDA's CGAHR might be helpful for a number of reasons:

1) Livestock research at PIADC has been shut down.

2) It's unknown if the repairs currently underway on Plum Island will be sufficient for PIADC to be fully operational until NBAF opens.

3) ASF and CSF research has been done on Plum Island, and research on those two FADs has been ongoing in the BRI since 2015.

4) With NBAF becoming operational in a few years, growing the USDA FAD research program in Manhattan will need to be undertaken soon.

5) USDA cannot undertake NBAF zoonotic FAD livestock research on Plum Island.

6) USDA CGAHR scientists have been collaborating with K-State scientists on zoonotic RVF research in the BRI since 2014.

7) More zoonotic and non-zoonotic FAD research could be undertaken by USDA CGAHR scientists in the BRI.

Additionally, the NBAF research budget must be ramped up prior to NBAF becoming operational and growing the R&D budget at USDA CGAHR could initiate that required process. For decades, PIADC research has focused primarily on one FAD — food and mouth disease (FMD) — while NBAF is expected to conduct research on six to eight FADs concurrently, thereby better protecting the nation.

DHS or USDA should fund this important USDA research at CGAHR in Manhattan, Kansas, so there is no delay in developing much-needed countermeasures to FAD threats to America. By doing so, the USDA FAD research program can grow in preparation for the opening of NBAF.

## Agency Contact Information

U.S. Department of Agriculture
Agricultural Research Service
U.S. Department of Homeland Security
Science and Technology Directorate

# Urban Food Systems Institute

## Background

*Food security*. We have a need for resilient food systems that are capable of adapting to changes due to the growing population, global politics, climate change, dwindling natural resources, market changes and poor diet.

*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. At least 22 cities, from Baltimore to Denver, have created leadership roles for change-makers focused on food. The demand for food systems experts to address obesity and food access, particularly by cities, is growing.

*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 USDA programs.

## Description

As 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 knowledgeable about urban agriculture and the associated local food systems, given the expanding consumer demand for local food, and the changing demographics of horticultural food crop producers. 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 we 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 niche 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 masters students. During the first five years of this program, four students have graduated from the program and are now working in urban agriculture. We have 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, we 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 the Colleges of Agriculture, Human Ecology, Engineering, Education, and Arts and Sciences are collaborators in this program.

Given the success of the Urban Food System Symposium and the number of faculty and staff across the university that are working in this area, we recognize that we have the expertise and leadership to be a change leader in urban agriculture for the region, the country, and the world. To achieve this goal, we 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 help urban farmers.
2. Develop and disseminate urban agriculture extension programs and services with an emphasis on being a change leader for local and urban food systems.
3. Expand farm-to-fork fruit and vegetable research: Protected production systems (warehouses, vertical farming, rooftop farming), increasing production, post-harvest storage, extending shelf-life, sustainable farming practices, cover crops (water and soil conservation), all with small acreage farmers.

Senator Stabenow 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 between graduate students, researchers, practitioners, and industry partners.

## Agency Contact Information

USDA National Institute for Food and Agriculture
Director
202-720-4423

# 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 (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, including:

- Programs and community support networks for military-connected children and youth, with local 4-H Clubs, schools and Operation Military Kids (OMK) youth/family camps.
- Research and training programs on violence prevention in military families, quality childcare and childhood social-emotional health.
- Clinical programs for military personnel, veterans and families.
- Research on the long-term effects of deployment and combat-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.

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 Kansas State University, the College of Human Ecology and the Institute for the Health and Security of Military Families to capitalize on the expertise available here.

## Agency Contact Information

Military and Veterans Programs
Division of Family and Consumer Sciences
National Institute of Food and Agriculture
United States Department of Agriculture

Military, Child and Youth
Division of Youth and 4-H
National Institute of Food and Agriculture
United States Department of Agriculture

# 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). Indicators of whole family, couples and individual family member stress and relationship strain include:

- 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 K-State's School of Family Studies and Human Services (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, applied research, clinical services, and programming are underway across units in the School of FSHS to:

1. Support healthy relationships across life-course transitions, cultures, family development, and in long-term relationships.
2. Assess the impact of witnessing inter-parental violence across generations.
3. Examine the impact that treatment of depression has on intimate relationships.
4. Support healthy partner and/or or parenting relationships.
5. Develop and test a violence risk assessment tool to guide prevention and treatment of partner violence efforts in military families.
6. Assess the impact romantic relationships and parenting behaviors have on child outcomes.
7. Implement and evaluate a relationship education program for pregnant and parenting adolescents.
8. Study communication technologies on relationships between former partners and between parents and children following divorce.
9. Support and encourage parent-child communication about health and well-being.
10. Develop 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 in the College of Human Ecology are conducting applied studies that support 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

# Arthropod-Borne Diseases Research, Education and Training at the Biosecurity Research Institute

## Background

The growing public health problems associated with mosquito and tick-transmitted diseases such as Zika, chikungunya, West Nile and Lyme disease are currently receiving a great deal of attention and causing great fear to individuals and the general public. The vectors, such as mosquitoes and ticks, 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. Lack of funding for training and research in arthropod-borne diseases is creating a void that is making it difficult to respond to the threat of increased vector-borne diseases and address the public's concerns in a timely manner.

## Description

The Biosecurity Research Institute (BRI) at Pat Roberts Hall is equipped and capable of meeting the challenge of expanding education, training and research on arthropod-borne diseases. This state-of-the-art Arthropod Containment Level 3 (ACL-3) Laboratory and supporting mosquito rearing room allows researchers to investigate interactions between infectious disease agents and insect vectors. This specialized space for infected insect maintenance has controlled access, downdraft air curtains and screening. The insectary contains a 4-foot biosafety cabinet and specialized equipment to enable feeding, inoculation and transmission studies.

Laboratory space of 31,000 square feet in the BRI supports diverse and multidisciplinary research and training opportunities, with the capability for research on vector-borne and foreign animal diseases in both large animal and small animal models. Within the BRI, two core facilities in Molecular Virology and Applied Immunology support education and research. The BRI is the first nonfederal facility to be approved for the tick-borne select agent African swine fever virus (ASFV). Recent acquisitions of ASFV and classical swine fever virus (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.

Arthropod-borne viruses that have been studied at the BRI include Zika (ZIKV), bluetongue, chikungunya, Japanese encephalitis (JEV), Rift Valley fever virus (RVFV) and yellow fever. 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. This virus is closely related to West Nile virus that has probably infected more than 2 million people and caused more than 1,900 deaths since 1999. Our experiments with JEV demonstrated susceptibility of North American mosquitoes that could be effective vectors in the event this virus is introduced into the U.S. Research with the ZIKV that has infected more than 4,000 people in the U.S., investigated mosquito transmission, and also supported collaborative studies to evaluate new vaccines for Zika.

Experiments at the BRI with RVFV in livestock is the first such work in the U.S. for more than 20 years. A USDA-funded U.S.-U.K. collaboration is studying genetically engineered vaccines of mosquito-borne RVFV, Cache Valley, Schmallenberg, Akabani and Kairi viruses.

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 (PIADC) to the NBAF which is being constructed adjacent to the BRI.

## Relevance

The threat of arthropod-borne diseases to U.S. citizens and agriculture is constant, especially with so many of these being zoonotic, infecting both wildlife and people. U.S. vulnerability has been demonstrated by the introduction and establishment of West Nile virus, and numerous travel-related cases of chikungunya and Zika viruses. 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.

Providing education and training to graduate students and postdoctoral fellows will help create a competent cadre of interdisciplinary professionals who will work together to anticipate and respond to arthropod-borne disease outbreaks. Working with some viruses can only be performed in high containment and the BRI is equipped and ready to undertake this research.

Public health professionals are an additional sector that will benefit from training at the BRI. By increasing their knowledge of arthropods and the diseases they vector, they are better equipped to work with the public they serve. They are a vital link in working with the public to increase and map surveillance of the insects and ticks, as well as reporting data so that the response to outbreaks can be swift and effective.

## Agency Contact Information

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# Immersive 3-D/4-D 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 ground-breaking 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.

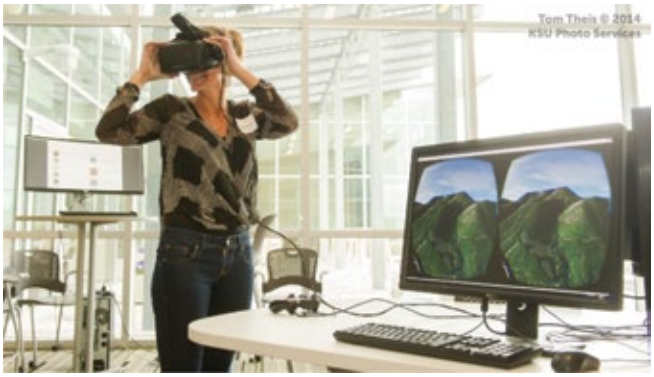
In interdisciplinary expertise of faculty in the College of Architecture, Planning & Design can be leveraged to contribute toward new educational opportunities, such as serious gaming, as well as novel research opportunities in info- and geovisualization.

## 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, leading to better prepared graduates entering the workforce, and the public to learn critical social and environmental issues today.

Military training opportunities: Using immersive technologies and environment offer a novel way to support the training of troops to help 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 recreation 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 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).

## Agency Contact Information

USDA Agriculture and Food Research Initiative
Dr. Robbin Shoemaker
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# Food Security: Plant Pathogen Research, Education and Training at the Biosecurity Research Institute

## Background / Description

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 for the first time outside of South America in Bangladesh. 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 biocontainment laboratories at the USDA ARS laboratories at Fort Detrick, Maryland and at the Biosecurity Research Institute (BRI) at Kansas State University. The BRI in 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 (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 facilities at the BRI include 31,000 square feet dedicated to education. Physical spaces include a 55-seat, tiered lecture hall and an integrated classroom and laboratory. The 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 held 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 U.S.

## Agency Contact Information

USDA
National Institute for Food and Agriculture

# Research, Education and Training to Support State and Federal Agencies (USDA, DHS) at the Biosecurity Research Institute

## Background / Description

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 (BRI). The Department of Homeland Security (DHS) has acknowledged K-State's leadership within this area and construction of the National Bio and Agro-defense Facility (NBAF) is ongoing. 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 their expert group, the Arthropod-Borne Animal Diseases Research Unit (ABADRU) to Manhattan, Kansas. Since their facility does not have secure Biosafety Level 3 (BSL-3) capabilities but their research priorities include BSL-3 agents, such as Rift Valley fever virus (RVFV), ABADRU scientists receive training and conduct their research at the BRI. As an academic, rather than federal facility, the BRI supports 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 located at Pat Roberts Hall is an enhanced BSL-3 and BSL-3Ag research facility. This state-of-the-art facility is comprised of an ACL/BSL-3 insectary suite (3 rooms at BSL-3E) available for arthropod transmission studies, a mosquito rearing room, 14 BSL-3/3Ag research laboratories, including 5 rooms to enable research on livestock, an ABSL-3 vivarium small animal area, a pathogen storage room (BSL-3E), as well as 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 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. Trainees can view laboratory techniques and monitor disease progression in challenged animals without the need to enter high-risk research spaces.

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 (SA). 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 (PIADC) to the National Bio and Agro-Defense Facility (NBAF) which is being constructed adjacent to the BRI.

## Agency Contact Information

USDA Agriculture and Food Research Initiative
Dr. Robbin Shoemaker
202-720-5468, rshoemaker@nifa.usda.gov

# Population Health Risks: Detection, Distribution, Determinants and Decision-Making

## 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. In order to prepare for and respond to these risks, the detection, distribution and determinants of disease must be understood by all stakeholders across the spectrum of the agriculture enterprise. The health status of animal and human populations require knowledge of detection, distribution, and determinants before informed decisions can be made with confidence. As such, federal and state animal/human health officials, veterinary practitioners, livestock producers and allied industry leaders require high quality information, data analyses and advice on population health risks.

## Description

The ability to accomplish this and protect and improve animal health requires the expertise and integration of epidemiology, surveillance, diagnostics, economics and population medicine with understanding and application at local, state, regional and national levels. With its many centers, Institutes, laboratories, network of collaborating experts within other K-State colleges and outside institutions, and close partnerships with the agriculture industries and state/federal government, the College of Veterinary Medicine at Kansas State University brings the above expertise under one umbrella and as such, is the center of the animal health consortium in the U.S. In fact, it may be argued that K-State is a leading university for epidemiological research in the U.S., as no other institution has its number of researchers or breadth of expertise within this field. K-State interdisciplinary research teams provide: 1) **outcomes research and evidence-based advice** to stakeholders, such as through intervention effectiveness studies, disease modeling, risk assessment, and pre-harvest strategies to promote food safety and security and address antimicrobial resistance; 2) **enhanced biosurveillance** by developing novel 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) **diagnostics,** including the development of cutting-edge technologies to discover the unknown, and rapidly detect and identify the known animal pathogens, and sharing of critical disease emergence information to 'network' laboratories and state/national policy-making agencies; 4) **innovative thinking and horizon scanning** to support policy development and prepare for the effects of climate change, land use change, new/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.

This unique research team and their combined expertise are directly aligned to help K-State meet and exceed its 2025 visionary plan due to their current engagement and recognized leadership in significant social, political, health and economic issues at the national and global levels that 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 Animal Health Corridor located between Manhattan, KS and Columbia, MO, and the Department of Homeland Security building its $1.25 billion National Bio and Agro-defense Facility (NBAF) in Manhattan, KS beside the veterinary college, the K-State College of Veterinary Medicine 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 alongside veterinarians and their human health counterparts, industry and state/federal government to address challenges and find solutions. These sectors rely on transparent, credible research and guidelines and support its translation and application into practice for informed decision-making at local, regional and national levels. K-State's College of Veterinary Medicine has the premier, unique research 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.

## Agency Contact Information

USDA NIFA, 202-401-4952

# Transboundary and Emerging Infectious Diseases of Food Animals

## Background

Kansas State University has a long and rich tradition of leadership in animal production, health and well-being. In its 150-year history as a land-grant institution and more than 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 plan to build the National Bio and Agro-defense Facility (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 resides in America's Animal Health Corridor. The area has earned this name because area companies account for nearly 32 percent of total sales in the $19 billion global animal health market and produce more than 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 Animal Health Corridor, the recently relocated USDA Arthropod-Borne Animal Disease Research Unit (ABADRU), and the building of NBAF adjacent to the university's 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 (ABSL-2) research space (red, orange and yellow spaces). 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, as well as 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.

## Agency Contact Information

USDA ARS
Steve Kappes, Associate Administrator for National Programs

United States Department of Agriculture-Agriculture Research Service

# Advancing Research in Animal Health

## Background

Kansas State University has a long and rich tradition of leadership in animal production, health and well-being. In its 150-year history as a land-grant institution and more than 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.

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## Description

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## 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 (ABSL-2) research space (red, orange and yellow spaces). 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, as well as 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.

## Agency Contact Information

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United States Department of Agriculture-Agriculture Research Service

# COMMERCE, JUSTICE, STATE

# Computer Network Security

## 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 cyber-attacks. 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. According to the National Science Foundation, cybersecurity is one of the defining issues of our time. The issue that we need to focus on is whether we can we keep our networks, devices and critical systems open, safe and secure and protect commerce, government and ultimately, our national economy.

## Description

This initiative will consist of generalized 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 cyber-crime, data destruction and other malicious acts.

In addition, 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.

## Relevance

The National Science Foundation (NSF) has several funding programs for various aspects of computer and network security. The Secure and Trustworthy Cyberspace (SaTC) program involves several NSF divisions: Computer and Information Science and Engineering (CISE), Mathematical and Physical Sciences (MPS), and Education and Human Resources (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 in order to help them form communities of young cybersecurity experts. The goal of this program, called GenCyber, is to help students fully understand what a career in this field looks like and to thereby cultivate them for entry into it as they enter the cybersecurity workforce.

NSF has long supported cybersecurity research to help protect and harden the nation's IT infrastructure. As of October 2015, the agency has committed $74.5 million in research grants toward cybersecurity.

## Agency Contact Information

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# Data Analytics Institute: A Center of Excellence for Large-Scale Data Inference and Computation in Business, Engineering, Science and Education

## 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 (K-State). 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 $300 billion 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 at Kansas State University-Manhattan, 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 (ICRES) in the College of Engineering. Local 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 multiple other leading technology companies.

ICRES faculty, in collaboration with campus researchers, provide requisite skills for the design of big data studies; adaptation of algorithms for parallel computing; collection, storage and retrieval of big data, 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 advancements for federal and state initiatives on STEM workforce development.

## Relevance

The 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-Missouri 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 arrival of the National Bio and Agro-defense Facility (NBAF), 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.

## Agency Contact Information

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# Great Plains Center for Urban Watersheds (GPCUW): Joining Sustainable Water Science, Planning, and Management

## Background

Kansas communities are facing water supply shortages, the necessity of replacing aging water infrastructure, and the need for cost-effective, sustainable water conservation measures. Seventy-three percent of Kansas' population (most of which is in eastern Kansas) relies on surface water for all or part of their water needs. Three of the five major river basins that supply water to the cities and towns of eastern Kansas show potential for shortages within the next 10 years (perhaps sooner given current climate change and drought predictions). The remaining basins rely heavily upon reservoir storage which continues to decrease due to accelerated erosion and sedimentation. Thus the need for water conservation is real and pressing.

Most Kansas communities are addressing the replacement of aging, water related infrastructure as a result of design life expiration or due to CSOs (Combined Sewer Outflows), as well as searching for less expensive, longer lasting ways of handling storm water in newly developing areas. Cities, towns, environmental planners and engineers, architects, and landscape architects are in great need of green, sustainable water solutions. Yet, little research has been conducted regarding green infrastructure, natural channel design restoration, or innovative water conservation strategies in the Midwest.

Currently there is little to no extension or outreach to assist communities, agencies or private entities regarding green infrastructure and water conservation. The requisite interdisciplinary expertise and experience are here at Kansas State; the coordination, synergy and conveyance of the Great Plains Center for Urban Watersheds (GPCUW) allows for the application of this expertise.

## Description

GPCUW is a nexus of research, application and outreach focused on sustainable green infrastructure and urban stream restoration in the communities of Kansas, the Midwest and the Great Plains. GPCUW research focuses on sustainable stormwater management, natural stream channel design and restoration, and innovative water conservation techniques in the cities and towns of Kansas. GPCUW communication joins teaching, service learning and outreach with entrepreneurial opportunities between Kansas State University, K-State Olathe, and those involved with sustainable water infrastructure in Kansas communities. GPCUW facilitates the development of new technologies and hybridization of current practices for sustainable water planning and management. GPCUW practices rigorous and sustained monitoring of stormwater management, stream restoration and water conservation measures for this is how we learn, improve, invent and move closer to sustainability.

## Relevance

Innovative, green technologies are being implemented throughout Kansas and the Midwest, yet there is no research hub focused on gauging efficacy or developing the most place-appropriate and sustainable measures. The Great Plains Center for Urban Watersheds — its work of developing new technologies and practices for sustaining the waters of Kansas — is poised to address the needs of the communities of the Great Plains. The sharing of new knowledge through education, extension, service- learning and innovative public-private partnerships is the mission of a land-grant university. The GPCUW is an intergral part of the 2025 plans of the LARCP Dept., the College of Architecture, Planning & Design, and falls within three of the five priority research topical areas of Kansas State University. GPCUW at Kansas State University will focus and facilitate a more resilient and sustainable water future for the communities and people of Kansas, the Midwest and Great Plains.

## Agency Contact Information

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# Developing Critical Zone Research on the Konza Prairie

## Background

The Earth's Critical Zone (CZ) 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 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 over 60 research sites on six continents.

K-State aims to join this network by building on the Konza Prairie Long-Term Ecological Research (LTER) program[1], 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[2]. 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*. Grasslands, rangelands, steppe, tundra, savanna and shrub-grasslands cover 40% of the Earth's land surface. North American tallgrass prairie covered ~67 million ha in the U.S. prior to 1800s. Today, less than 5% of these grasslands remain and these 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 pedologically 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 Biology, Agronomy, Geography, Geology and Engineering. Furthermore, it will facilitate new opportunities to collaborate with other research institutes within the CZO Network.

## Agency Contact Information

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[1] http://www.konza.ksu.edu/knz/pages/home/home.aspx

[2] http://www.konza.ksu.edu/knz/pages/home/home.aspx

# Launch A Business

## Background

A key challenge in the launch of new ventures, including the commercialization of university research, is the underlying assumption of marketability and lack of validation of a customer need. To increase the likelihood of commercial success, aspiring entrepreneurs need to get out of the office/laboratory to search for facts
that validate or invalidate the hypotheses about customers, and ultimately enable pursuit of strategies that will accelerate the development and commercial launch of technologies and new firms.

Kansas State University's leadership is critical in developing the path to future economic vitality for its region. In fact, national associations, such as APLU, are calling on higher education leaders, state government officials, and business and industry representatives to align the work of higher education with the economic and social needs of our states. Supporting and enhancing the entrepreneurial environment to facilitate the launch of new ventures is critical to the economic success of our nation as these young firms are the major contributors of net new jobs.

## Description

K-State Launch a Business, or LAB, is a new venture accelerator program that leverages unique K-State resources and strengths to help grow the state's economy.

The K-State LAB provides a unique experience with access to world-class K-State faculty, students and alumni support for high-potential startup concepts over an intensive five-week period. The program is designed to give first-time founders with early-stage ideas the business basics to turn their concepts into ventures. The LAB program is free of charge for participants. There is no application fee, no cost to participate, and LAB does not retain any equity or ownership stake.

The unique aspects of LAB include:

- Custom startup curriculum for turning concepts into ventures, designed and delivered by top K-State faculty.
- Hands-on market and competitor research conducted by K-State MBA and undergraduate students.
- Access to the world-class K-State alumni network, including one-on-one mentorship and consulting from experienced entrepreneurs.

The 2015 LAB program provided 20 hours of faculty workshops, 800+ hours of student research support, and 280 hours of alumni mentoring and helped to successfully launch 14 new ventures.

LAB requires investment to expand access to the program for additional potential high-growth entrepreneurs including K-State faculty and graduate students who aim to commercialize research.

## Relevance

LAB supports the goals of K-State 2025 through:

- Enhanced graduate student learning opportunities.
- Improved commercialization opportunities of faculty research through customer discovery training.
- Support of university outreach and economic development initiatives through growth of high-growth new ventures.

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# Arthropod-Borne Diseases Research, Education and Training at the Biosecurity Research Institute

## Background

The growing public health problems associated with mosquito and tick-transmitted diseases such as Zika, chikungunya, West Nile and Lyme disease are currently receiving a great deal of attention and causing great fear to individuals and the general public. The vectors, such as mosquitoes and ticks, 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. Lack of funding for training and research in arthropod-borne diseases is creating a void that is making it difficult to respond to the threat of increased vector-borne diseases and address the public's concerns in a timely manner.

## Description

The Biosecurity Research Institute (BRI) at Pat Roberts Hall is equipped and capable of meeting the challenge of expanding education, training and research on arthropod-borne diseases. This state-of-the-art Arthropod Containment Level 3 (ACL-3) Laboratory and supporting mosquito rearing room allows researchers to investigate interactions between infectious disease agents and insect vectors. This specialized space for infected insect maintenance has controlled access, downdraft air curtains and screening. The insectary contains a 4-foot biosafety cabinet and specialized equipment to enable feeding, inoculation and transmission studies.

Laboratory space of 31,000 square feet in the BRI supports diverse and multidisciplinary research and training opportunities, with the capability for research on vector-borne and foreign animal diseases in both large animal and small animal models. Within the BRI, two core facilities in Molecular Virology and Applied Immunology support education and research. The BRI is the first nonfederal facility to be approved for the tick-borne select agent African swine fever virus (ASFV). Recent acquisitions of ASFV and classical swine fever virus (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.

Arthropod-borne viruses that have been studied at the BRI include Zika (ZIKV), bluetongue, chikungunya, Japanese encephalitis (JEV), Rift Valley fever virus (RVFV) and yellow fever. 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. This virus is closely related to West Nile virus that has probably infected more than 2 million people and caused more than 1,900 deaths since 1999. Our experiments with JEV demonstrated susceptibility of North American mosquitoes that could be effective vectors in the event this virus is introduced into the U.S. Research with the ZIKV that has infected more than 4,000 people in the U.S., investigated mosquito transmission, and also supported collaborative studies to evaluate new vaccines for Zika.

Experiments at the BRI with RVFV in livestock is the first such work in the U.S. for more than 20 years. A USDA funded U.S.-U.K. collaboration is studying genetically engineered vaccines of mosquito-borne RVFV, Cache Valley, Schmallenberg, Akabani and Kairi viruses.

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 (PIADC) to the NBAF which is being constructed adjacent to the BRI.

## Relevance

The threat of arthropod-borne diseases to U.S. citizens and agriculture is constant, especially with so many of these being zoonotic, infecting both wildlife and people. U.S. vulnerability has been demonstrated by the introduction and establishment of West Nile virus, and numerous travel-related cases of chikungunya and Zika viruses. 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.

Providing education and training to graduate students and postdoctoral fellows will help create a competent cadre of interdisciplinary professionals who will work together to anticipate and respond to arthropod-borne disease outbreaks. Working with some viruses can only be performed in high containment and the BRI is equipped and ready to undertake this research.

Public health professionals are an additional sector that will benefit from training at the BRI. By increasing their knowledge of arthropods and the diseases they vector, they are better equipped to work with the public they serve. They are a vital link in working with the public to increase and map surveillance of the insects and ticks, as well as reporting data so that the response to outbreaks can be swift and effective.

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# National Strategic Selling Institute: Developing Business-Ready Sales Talent for the 21st Century Workforce

## Background

A recent study by Georgetown University revealed that sales represents one of the top four occupations for 74 percent of all university students, regardless of major.[1] All industries need salespeople and thus any major would benefit from sales coursework. The National Strategic Selling Institute (NSSI), housed within the College of Business Administration at Kansas State University, is designed to develop business-ready sales talent to meet the critical needs of the business community.

## Description

The NSSI develops undergraduate students' skills in professional strategic selling. Our certificate in professional strategic selling, which can be paired with any undergraduate major, is designed to give students an edge over their peers. Our curriculum provides students with a solid understanding of (1) the customer-oriented sales process and the role of sales in business success; (2) the importance of effort and integrity in sales success; and (3) the value of solving customer problems and creating win-win solutions.

The K-State College of Business Administration identified the NSSI and the sales program as one of its keys to pursuing national recognition. The reason is clear: Sales talent is in high demand. The Manpower talent shortage survey (as reported in USA Today) identifies sales representative as the second most difficult job to fill in today's workforce. Today's salesperson requires more technical knowledge and analytical skills to be successful.[2] Demand is outstripping supply; consequently, the number of sales representatives making more than $100,000 has increased 12 percent from 2010 to 2012, moving from 8 percent to 20 percent.[3] This tracks with the excellent starting salaries received by our current NSSI graduates.

Our students enjoy a 100 percent placement rate, but we are at capacity and need to expand our services to meet the labor demands of businesses. Ultimately, our goal is to provide businesses with well-prepared, entry-level sales talent that can hit the ground running and bring in revenue more quickly than their peers, thus contributing significantly to the economic well-being of the organization, the state of Kansas, and the U.S.

## Relevance

The NSSI and the certificate in professional strategic selling accomplish the following:

1. Provide a full range of coursework aimed at developing students selling skills.
2. Provide an avenue for students who are seeking a sales career to more fully prepare for the realities of the sales role.
3. Allow K-State to compete for the growing number of students who desire the opportunity to study professional strategic selling within the context of business.
4. Continue to develop strong connections with businesses locally as well as nationally.
5. Meet the business community's ever-growing demand for well-prepared sales talent.

Companies are hungry for entry-level sales talent, and Kansas State University's NSSI will provide companies with a much needed resource, resulting in excellent careers for our students.

## Agency Contact Information

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[2] Davidson, Paul (2013), "Bosses Lament: Sales Jobs Hard to Fill," USA Today, July 21, Accessed Online October 16, 2016: http://www.usatoday.com/story/money/business/2013/07/21/sales-job-openings/2568003/.

[3] Krogue, Ken (2013), "Inside Sales Jobs and Career Demand up 54%: But Most Leverage Comes with Dialer Software and Lead Research," Forbes, March 29, Accessed Online October 16, 2016: http://www.forbes.com/sites/kenkrogue/2013/03/29/inside-sales-job-and-career-growth-up-54-but-most-leverage-comes-with-dialer-software-and-lead-research/#70409e1560cb.

# The ALPHA LAB: An Innovation Accelerator Core Facility

## Background

Universities and their research communities can radically multiply innovation outcomes by readily convening internal multidisciplinary teams and purpose-driven innovation networks that accelerate open innovation for ideas and acquisition of critical missing expertise, experience, and insights. Adaption of such project management structures and processes allows universities to be premier collaborative research partners to their industry counterparts.

Kansas State University (K-State) seeks to expand its collaboration with academic and industry research partners for product and technology development projects by building on the following unique technology development assets at K-State:

- The Advanced Manufacturing Institute (AMI) has completed more than 2,700 technology development projects with 500+ businesses throughout the United States. AMI employs integrated business and technology development processes that facilitate collaborative industrial projects and partnerships.
- AMI has supported faculty research efforts on diverse projects such as aircraft cabin air filtration, noncontact railroad tie inspection, wind turbine testing, and Big Data recommender systems.
- An Economic Development Administration (EDA) funded innovation accelerator has focused on technology developments in animal health, food processing, and the advanced industries.

When individual innovators are unable to readily overcome complex problems, projects stall and potentially great ideas languish. Inability to proceed on research and development projects can be a consequence of a lack of ideas or know-how/expertise, limited internal capacity or resource capability, insufficient funds, or inadequate connectedness to those with the missing resources. Consequently, most innovative companies regularly convene internal, multidisciplinary teams in order to enrich and accelerate effective innovation. Companies also frequently connect to other companies, universities and individuals through open innovation processes in order to access knowledge, ideas, people, and research capacity.

## Description

The proposed ALPHA LAB is a collaborative core facility that will be staffed and equipped to expand the innovation capacity of faculty/student research teams. Industrially experienced technical professionals will work with research teams to develop and cost-effectively produce proof-of-concept (Alpha) artifacts, prototype devices and processes for targeted research and industrial uses. In addition, ALPHA LAB will build university/industry innovation networks to accelerate research projects, and directly engage technology brokers and suppliers to scout relevant markets and available, competitive sources of technology.

ALPHA LAB will be staffed with professors of practice and dedicated practitioners (project managers and technologists) from a variety of disciplines, who join research teams to enable faculty and senior graduate students to focus on discoveries, and to mentor new graduate students to build and strengthen critical bridging skills such as market and competitive research, recombinant innovation, open innovation and technology sourcing, digital design and fabrication, and project management fundamentals (via an internal Project Management Academy). ALPHA LAB will employ a facilitated deep-dive, multidisciplinary problem-solving process with industrially experienced staff and industry collaborators and suppliers.

Knowledge management and sharing will be central to ALPHA LAB, with development and delivery of internal workshops, and boot camps in project management, digital design and fabrication, and technology entrepreneurship. ALPHA LAB will also serve as host and convener to universitywide communities of practice, such as computational modeling and simulation, and National Instruments users.

ALPHA LAB will require investment to expand faculty and graduate student involvement, hire instructors and practitioner staff, enhance digital design and fabrication capabilities, and expand its industrial reach.

## Relevance

The ALPHA LAB in support of K-State 2025 will

- Increase funding for investigator-based research, research centers and graduate training grants;
- Increase graduate-student involvement in high-level learning and experiential training;
- Support more clusters and centers of collaborative research, scholarly, and creative activities and discovery (RSCAD) focus; and
- Enhance integration between academics and student service learning.

## Agency Contact Information

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202-482-2000

# 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 located in online, virtual environments. Having a technology-enabled workforce 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 (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

In the state of Kansas, the number of unemployed persons has increased over the past year. For instance, information provided by the Bureau of Labor Statistics shows the number of unemployed Kansas citizens was nearly 7 percent higher in September 2016 than it was a year earlier. The causes of unemployment 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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# 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, the disposal of herds, and the 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 man-made infrastructures and networks, but fundamental questions remain unanswered regarding interconnected and stratified/multilayer networks.

## Projects within EPICENTER

EPICENTER has succesfully conducted several research projects since its inception in 2007. Current projects include:

***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 U.S. 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 (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 (NABC), the Institute for Computational Comparative Medicine (ICCM), the Center of Excellence for Emerging and Zoonotic Animal Diseases (DHS CEEZAD), the planned National Bio and Agro-defense Facility (DHS NBAF), and EPICENTER are all in Manhattan, Kansas, thus making Kansas the national leader in developing countermeasures to naturally occurring and intentionally introduced plant, animal, human and zoonotic diseases.

## Agency Contact Information

National Science Foundation
703-292-5111

# Science Communication Initiative

## Background

In early June 2016, an editorial appeared in InsideHigherEd.com calling 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, suggesting some ways of approaching the task. While the author noted, "there are enormous benefits to be reaped, financial as well as political, if higher education manages to enter mass media," he failed to recognize that higher education has long been in mass media. Though scientists at Kansas State University have, for some time, made efforts to communicate about their research to reach citizens, including youth, the real shortcoming is that the two entities (science and mass media) have rarely come together for a shared purpose.

## Description

Because many campus units are already engaged in science and research communication activities, the aim of the initiative is to enhance the communication of science and research information through organized and centralized collaborative efforts, giving all interested parties access to the same resources.

The Science Communication Initiative seeks to establish a center that will act as a clearinghouse for science and research communication activities on campus, offering a home and support for the many science and research communications activities already in place. Additionally, center staff will be charged with cultivating connections on and off campus of potential resources for the various communication efforts. Obviously, Journalism faculty are an important resource, but, faculty from the Theatre and Dance programs might also be recruited to conduct a workshop on improvisational acting or choreography to portray a scientific discovery through dance. Other similar partnerships could also be utilized. Affiliated faculty members would receive an appropriate stipend for their contributions to the center.

The development of a K-State Science Communication Center can assist researchers on several levels. At the beginning of the grant-writing process, communicators can aid in developing a communications campaign to be included into each grant proposal, offering channels to fulfill broader impacts requirements, thus making the proposal more competitive against other institutions. Specialists from various units could support K-State Research and Extension (KSRE) and the Office of the Vice President for Research (OVPR) personnel to be included in science-based grants to which they may not otherwise have access. Funding identified for broader impacts of funded grants that are developed with the assistance of the Science Communication Center can be used to assist these efforts.

The Science Communication Initiative will also greatly benefit graduate student training. Graduate programs in Science, Technology, Engineering and Mathematics (STEM) disciplines typically do not train students with effective communication skills to interact with the nontechnically trained public. As a result, scientists lack the vocabulary, rhetorical strategies, and audience awareness to communicate with public audiences. These skills are necessary to engage the public to understand and support research and to educate school-age youth to foster an interest in scientific research. A recent collaboration with community partner Sunset Zoo, the initiative has allowed us to offer such training and provide venues to disseminate research results to the public. The Science Communication Initiative will allow further development of this and similar community-based collaborations.

## 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. While in some cases this will satisfy requirements from granting agencies, other benefits include aiding legislators in understanding the economic value of K-State research funding 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.

## Agency Contact Information

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# Immersive 3-D/4-D 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 ground-breaking 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.

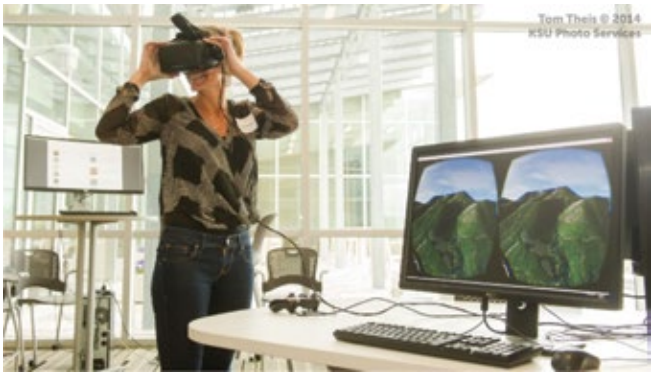
In interdisciplinary expertise of faculty in the College of Architecture, Planning & Design can be leveraged to contribute toward new educational opportunities, such as serious gaming, as well as novel research opportunities in info- and geovisualization.

## 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, leading to better prepared graduates entering the workforce, and the public to learn critical social and environmental issues today.

Military training opportunities: Using immersive technologies and environment offer a novel way to support the training of troops to help 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 recreation 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 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).

## Agency Contact Information

NSF Transforming Undergraduate Education in Science, Technology, Engineering and Mathematics
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NSF Perception, Action & Cognition
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# Developing a Better Understanding of Controls on the Quality of Water Resources

## Background

Water is essential to our ability to sustain growth of human populations, industry, and agriculture in the USA and worldwide. Population growth, human activities, land use change and climate variability all pose challenges to ensuring that water supplies of sufficient quality are available. Understanding the fundamental chemical, biological and hydrological controls on water resources is essential to our ability to meet future water resources challenges.

## Description

A team of students and faculty in the Department of Geology are working to expand knowledge of water quality and ensure that a diverse workforce is available to meet future demands for water scientists and managers.

Research: Studies in which faculty members and students are actively engaged include:

1) *Impacts of human activities on groundwater resources*. Current efforts include research aimed at identifying how agricultural activities impact groundwater quality in the High Plains aquifer system in south-central Kansas.
2) *Investigation of environmental controls on aquifer microbiology*. Aquifer microbes strongly influence the quality of water resources. In turn, aquifer environments represent a fundamental control on the activity of the microbial populations they host.
3) *Controls on the mobility of toxic trace elements*, including arsenic, manganese, tungsten, selenium and lead. These elements are hazardous to human health even at very low concentrations. Factors that control their mobility directly influence their accumulation and dispersion along water flow paths.
4) *Controls on water quality in urban and rural reaches of a freshwater stream over time*. Human activities and natural processes affect the quality of water in our streams. The nature and magnitude of these effects vary seasonally and with the type of setting. Artificial Aquifer Recharge processes are being studied for vadose and saturated zone transportation for efficiency of replenishment of groundwater. Flood monitoring and examining flood mitigation strategies via rainfall-runoff modeling.
5) *Investigating the consequences of CO2 injection into the subsurface and its impact on water resources*. CO2 is being injected into the deep saline aquifer at Wellington Oil Field, KS. Pre- and post-injection monitoring and analysis of water and head gas from the shallow unconfined freshwater aquifers. Variations in dissolved gases, rare earth elements, organic constituents, isotopic fractionations, trace and major elements are being combined to develop a model to predict the consequence of CO2 injection in the years to come and hence protecting shallow drinking water reserves from CO2 mixing.

*Education*: Geoscience courses that train future water scientists include introduction to geochemistry, water resources geochemistry, hydrogeology, geochemical and biogeochemical modeling, geomicrobiology, environmental geology.

*Extension and Outreach*: Geoscience faculty and students promote water science to elementary and middle school students and underrepresented groups through participation in the Kansas Louis Stokes Alliance for Minority Participation (KS LSAMP), the K-State Developing Scholars Program (DSP), and the K-State program Girls Researching Our World (GROW). Additionally, our researchers participate in the K-State Urban Water Institute and Natural Resources Educational Sources as a Secondary Major.

## Relevance

Groundwater resources in western Kansas and much of the U.S. are dwindling and yet expected to be relied on more heavily in the future. These resources are hydrologically linked to surface water bodies. To ensure sufficient supply of quality resources in the future, we need to consider both settings.

Our efforts will better enable us to:

1) Predict and manage consequences of future environmental change, including those caused by human activities, climate change and land-use pattern changes.
2) Limit human impacts to surface water resources in urban and rural areas.
3) Develop strategies to remediate contaminated water supplies.
4) Preserve ecosystem services that help cleanse water supplies naturally.

## Agency Contact Information

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# Networking, Security and Resiliency for Critical Infrastructures

## 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 have 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 into the impact of these interdependencies related to reliability of the coupled system, 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), K-State networking resources and the Global Environment for Network Innovations (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 demonstrates that an OpenFlow communication network could perform equally well to or better than its Multiprotocol Label Switching (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 (EPAP). This research has also received national contributions from Raytheon BBN Technologies, KanREN, Internet2, the National Science Foundation and National LambdaRail.

## Agency Contact Information

National Science Foundation
Computer & Science Information
703-292-8900

National Science Foundation
Computer and Network Systems
703-292-7366

# National Bio and Agro-defense Facility: Research and Development to BASIC Solutions

## Background

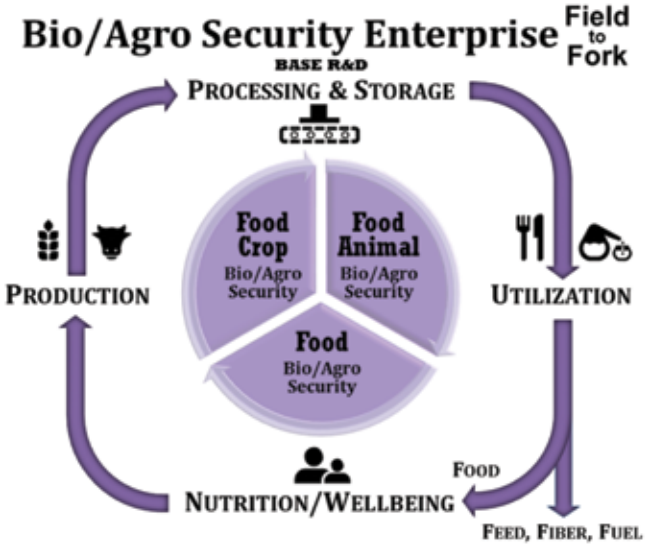
The U.S. Department of Homeland Security (DHS) plans to create a Bio/Agro Security Innovation System (BASIS) around the National Bio and Agro-defense Facility (NBAF) under construction in Manhattan, Kansas. BASIS is intended to be a highly networked technology development ecosystem. It is designed to catalyze bio/agro security innovation via enhanced public and private-sector engagement, the creation of key strategic alliances, and increased investment. The long-standing Bio/Agro Security Enterprise (BASE) at Kansas State University (K-State) provides the research and development BASE upon which to build BASIS.

K-State has focused on safeguarding the agricultural infrastructure and economy of Kansas since 1863, creating today's College of Veterinary Medicine (CVM) and Department of Animal Sciences and Industry in 1905. Hog cholera was devastating the U.S. at the time, and antiserum production for that disease began on the K-State campus in 1908. Hog cholera is now known as classical swine fever (CSF) and is one of the diseases targeted for NBAF.

K-State formalized its bio/agro security efforts in 1999 when the 100-page "Homeland Defense Food Safety, Security and Emergency Preparedness Program" was assembled. That program is designed to protect food crops, food animals, the food supply and people, and it contributed to Manhattan winning NBAF.

## Description

***BASE R&D:*** K-State's research and development efforts to protect U.S. food production are illustrated here:




As noted above, this BASE R&D can underpin the DHS innovation ecosystem, BASIS. Nevertheless, BASE encompasses more of the food production system than NBAF, which fosuses only on food animals.

***BASIC Solutions:*** The Bio/Agro Security Innovation Corridor (BASIC) in Manhattan, Kansas, contains more bio/agro security assets than anywhere in the U.S. — perhaps the world. In addition to the DHS's $1.25 billion NBAF, it includes USDA's Center for Grain and Animal Health Research (CGAHR), the Kansas Department of Agriculture (KDA), and numerous K-State assets: the Biosecurity Research Institute (BRI); CVM; the plant sciences building housing the departments of Plant Pathology and Agronomy; the Grain Sciene and Industry Complex; the research park; and the office park. This delineates the local innovation district. The DHS innovation ecosystem — BASIS — will span a much broader area regionally.


BASIC is anticipated to be the epicenter for delivering new and novel solutions to global biothreats, those known today and others emerging tomorrow. The concentration of both public- and private-sector bio/agro security expertise should expedite the research and development process. That is exactly what innovation districts and ecosystems are expected to do.

The U.S. Department of Commerce should invest in facilitating BASIC private-sector economic growth. That would not only enhance regional economic outcomes, it would help protect America from global biological threats as well.

## Relevance

Accelerating the delivery of new technologies into the marketplace will help protect America's food supply and agricultural infrastructure. Morover, it will help safeguard public health and the U.S. economy. Finally, it will stimulate economic growth locally, regionally and nationally.

## Agency Contact Information

U.S. Department of Commerce

# DEFENSE

# Nuclear Radiation Detector and Systems Development

## Background

National security concerns arise when terrorist and rogue states pursue nuclear weapon development. The U.S. departments of Defense (DoD), Energy (DOE), and Homeland Security (DHS) 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 (K-State) has nuclear capabilities unique to the Midwestern region of the United States. The Semiconductor Materials and Radiological Technologies (SMART) Laboratory at K-State, one of the largest and most diverse university-based, radiation- detector development laboratories in the U.S., 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, NSF, U.S. DOE Nuclear Engineering Educational Research program (NEER), and U.S. 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 (R&D) 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 (EDL), staffed by professional electronics engineers with combined experience exceeding 80 years. Proximity to the Fort Riley military installation offers potential dual-use development and testing in a secure environment.

## Description

The mechanical and nuclear engineering (MNE) and chemical engineering (CE) departments at K-State are renowned for innovative radiation-detector research. In addition to the KSU 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 (SANS). This interdisciplinary center has 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

Defense Threat Reduction Agency
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# Discovery, Development and Curation of Research Datasets for Utilization and Collaborations among Government, Academia and Industry

## Background

The United States has a global footprint of data generation that includes military, academia, industry and others. Large amounts of data are accumulated in various forms and historically have not been able to be widely utilized because of a variety of reasons such as curation, common formatting, lack of cataloging, system compatibility and general lack of access issues, etc. Because much of the data, even though gathered, is generally not available for research, redundant collection efforts of the same data occurs which adds cost and impacts the timeliness of research products. The ongoing availability of appropriate datasets would also increase the opportunities for the conducting and utilization of the resulting research in a timely manner. An enhancement of this initiative would be identifying data gaps and working with interested partners in filling those data gaps.

## Description

The objective of this initiative is to define and establish a process for creating, populating and maintaining researchable databases that can be used by DOD, academia, industry and other interested parties for research purposes. This would include unclassified and classified data. The initial effort would be to gather and process all data materials related to the National Guard Agribusiness Development Teams (ADT) that were formed and deployed to Afghanistan. The processes and database infrastructure developed would be one that could be used in the gathering and establishment of a wide variety of datasets that would be of value to multiple research interests such as DOD, academia and others. The initiative will leverage the Kansas State University (K-State) Biosecurity Research Institute (BRI), Libraries and the National Agricultural Biosecurity Center (NABC) infrastructure and capabilities. The objective is accomplished through the following activities:

- Develop and maintain information technology infrastructure, unclassified and classified, to support multiple databases that could be made available to support research.
- Process development for acquiring the data to establishing the researchable databases.
- Process development for including information stakeholders and potential users for determining how data is stored and made available to support research and discovery.
- Process development for efficiently and properly cataloging data for maximum research benefit with a goal of having as much structured data as possible. The process would take into account the wide variety of data sources that could be included. The data would be in multiple formats including paper, photographs, electronic, etc.
- Identify and obtain other datasets (government, academia, industry, etc.) that could be added to the researchable databases to facilitate research and information products. Tagged, labeled and supervised datasets would be of significant interest to Global Food System focused research.

## Relevance

This program would support United States efforts world-wide and would significantly support military, academia and other interests by preserving and providing datasets that could be used in support of research and information needs. The datasets could also include data that would be of value to industry when researching and gathering information for future business decisions.

## Agency Contact Information

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Project Number: 906

# Immersive 3-D/4-D 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 ground-breaking 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.

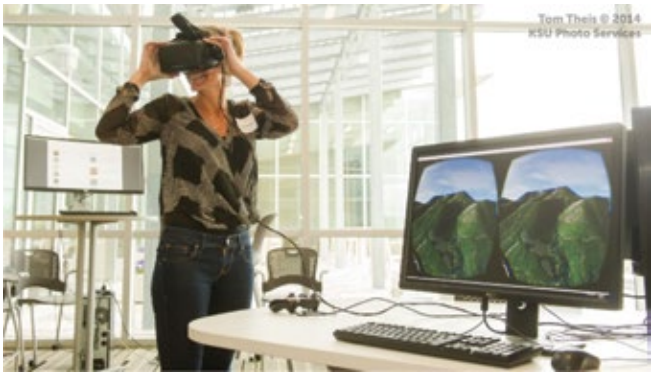
In interdisciplinary expertise of faculty in the College of Architecture, Planning & Design can be leveraged to contribute toward new educational opportunities, such as serious gaming, as well as novel research opportunities in info- and geo-visualization.

## 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, leading to better prepared graduates entering the workforce, and the public to learn critical social and environmental issues today.

Military training opportunities: Using immersive technologies and environment offer a novel way to support the training of troops to help 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 recreation 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 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).

## Agency Contact Information

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# 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). Indicators of whole family, couples and individual family member stress and relationship strain include:

- 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 K-State's School of Family Studies and Human Services (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, applied research, clinical services, and programming are underway across units in the School of FSHS to:

1. Support healthy relationships across life-course transitions, cultures, family development, and in long-term relationships.
2. Assess the impact of witnessing inter-parental violence across generations.
3. Examine the impact treatment of depression has on intimate relationships.
4. Support healthy partner and/or or parenting relationships.
5. Develop and test a violence risk assessment tool to guide prevention and treatment of partner violence efforts in military families.
6. Assess the impact that romantic relationships and parenting behaviors have on child outcomes.
7. Implement and evaluate a relationship education program for pregnant and parenting adolescents.
8. Study communication technologies on relationships between former partners and between parents and children following divorce.
9. Support and encourage parent-child communication about health and well-being.
10. Develop 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 in the College of Human Ecology are conducting applied studies that support 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

Military and Veterans Programs
National Institute of Food and Agriculture United States Department of Agriculture

Family Advocacy Program Manager
Secretary of Defense for Military Community and Family Policy

# ENERGY AND WATER

# Center for Attosecond Nanophotonics (CAN)

## Background/Description

The proposed Center for Attosecond Nanophotonics (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 (JRML) in the Kansas State University Physics department is a large AMO Physics laboratory, supported by the U.S. DOE and its predecessors since 1969. JRML was the first U.S. laboratory to produce single attosecond (billionth of a billionth of a sec; 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 US. 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 (Boulder, CO) and Thales (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 were successful in acquiring multi-million dollar laser equipment through resources available from Federal funding agencies, infrastructure for the new center (CAN) 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 entrepreneurial 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.

## Agency Contact Information

U.S. Department of Energy

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# Large-Scale Integration of Clean Technologies in the Power Grid

## Background

Increased global demand for energy and dwindling fossil fuel reserves are causing concerns regarding global warming, climate change and sustainability, resulting in worldwide interest in clean energy technologies, such as wind and solar energy, and electric vehicles. Total worldwide wind power capacity has increased from 24 gigawatts (GW) in 2001 to 318 GW in 2013; the United States' share of wind power capacity surpassed 65 GW in 2013. Similarly, solar energy capacity in the United States increased from less than 1 MW in 2000 to approximately 18 GW in 2014. 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 (PV) generation and electric vehicles.

Government and industry have funded several research projects at Kansas State University (K-State), making K-State 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 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 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 opportunity 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 massive deployment of clean technologies.

Research related to power-distribution networks will focus on large-scale integration of solar rooftop genetration 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 $4,000,000 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

In order to reduce dependence on foreign oil and reduce carbon emmissions, the promotion of clean technologies has been a top priority of the U.S. government. In his inaugural address in 2012, and in his weekly media address on Feb. 8, 2016, President Obama emphasized the need to double research funding for clean energy to combat climate change and create new jobs. The proposed research is aligned with President Obama's vision and world leadership in research and education that, related to clean energy generation and utilization, advances the K-State 2025 plan to be a Top 50 public research university.

## Agency Contact Information

U.S. Department of Energy
202-586-5000 or 303-275-4808

National Wind Technology Center
303-684-6905

# Innovation in High-Performance Building Envelopes Collaborative Research Program

## Background

Building envelopes — the walls, windows, roofs and foundations of buildings — are a critical factor in the energy efficiency of today's and tomorrow's buildings. The International Energy Administration (Source: Technology Roadmap: Energy Efficient Building Envelopes - 2013) estimates that 40 percent of total target energy reduction can be made by improving the performance of building envelopes, suggesting technological innovation in envelopes is as critical as innovation in mechanical systems.

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. Envelopes are complex composites of different materials and products whose performance must balance climate appropriateness, appearance, constructability, cost-effectiveness and serviceability. Due to this complexity, effective innovation in envelopes is difficult when approached from a single discipline or specialization. These issues are better addressed by collaborating professionals from the design, science and engineering fields.

## Description

During the last four years at Kansas State University, a collaborative research program in the area of high performance building envelopes has brought together leading academics in the area of building science with expert professional architects, engineers and industry leaders to identify and explore unique challenges in building envelopes that can only be addressed collaboratively using advanced technology and hands-on experimentation.

Past work under the program has focused on the energy impact of building envelopes, studying how thermal resistance, daylighting and special materials can reduce energy use in buildings. Insulated concrete building systems, glass and composite wall systems, and ventilated metal cladding have been the subject of past projects involving direct collaboration with Kansas manufacturers to carry out research and support the teaching objectives of the project.

With research conducted by graduate students in professional degree programs, an important parallel goal of the program is to prepare future professionals with an advanced set of skills and methods, shaped by their research and interaction with collaborators. Research teams use Kansas State's in-house fabrication resources extensively for the designing and manufacturing of experimental prototypes, while state-of-the-art equipment and facilities permit the testing of large mockups. Hands on experimentation is complemented by advanced computer analysis tools that serve teams in studying larger energy and economic impacts of proposed envelope systems. As the program enters its fifth year of activity, continuing research support is sought to expand the research capabilities of the program, develop inherent commercialization opportunities from past research work and involve an increasing number of the students and faculty in the research.

## Relevance

In 2014, 40 percent of energy used in the U.S. was consumed by buildings (Source: EIA), showing that buildings place the largest demand on energy resources — more than the transportation or industrial sectors. 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. Innovations in building envelopes offer clear opportunity for commercialization for work emerging from this research project, via the professional community involved or the manufacturer-collaborators.

Working with professionals and industry has also assisted projects in maintaining relevance to the issue of building energy use, while also addressing related concerns such as project cost, manufacturing and constructability that can sometimes be overlooked in academic research. Lastly, this project intends to support the state economy by benefitting Kansas professionals and manufacturers who collaborate in the project.

## Agency Contact Information

U.S. Department of Energy
Building Technologies Office (BTO)
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U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
Technology-to-Market Program
1000 Independence Ave, SW
Washington, DC 20585

# Developing a Better Understanding of Controls on the Quality of Water Resources

## Background

Water is essential to our ability to sustain growth of human populations, industry, and agriculture in the USA and worldwide. Population growth, human activities, land use change and climate variability all pose challenges to ensuring that water supplies of sufficient quality are available. Understanding the fundamental chemical, biological and hydrological controls on water resources is essential to our ability to meet future water resources challenges.

## Description

A team of students and faculty in the Department of Geology are working to expand knowledge of water quality and ensure that a diverse workforce is available to meet future demands for water scientists and managers.

Research: Studies in which faculty members and students are actively engaged include:

1) *Impacts of human activities on groundwater resources*. Current efforts include research aimed at identifying how agricultural activities impact groundwater quality in the High Plains aquifer system in south-central Kansas.
2) *Investigation of environmental controls on aquifer microbiology*. Aquifer microbes strongly influence the quality of water resources. In turn, aquifer environments represent a fundamental control on the activity of the microbial populations they host.
3) *Controls on the mobility of toxic trace elements*, including arsenic, manganese, tungsten, selenium and lead. These elements are hazardous to human health even at very low concentrations. Factors that control their mobility directly influence their accumulation and dispersion along water flow paths.
4) *Controls on water quality in urban and rural reaches of a freshwater stream over time*. Human activities and natural processes affect the quality of water in our streams. The nature and magnitude of these effects vary seasonally and with the type of setting. Artificial Aquifer Recharge processes are being studied for vadose and saturated zone transportation for efficiency of replenishment of groundwater. Flood monitoring and examining flood mitigation strategies via rainfall-runoff modeling.
5) *Investigating the consequences of CO2 injection into the subsurface and its impact on water resources*. CO2 is being injected into the deep saline aquifer at Wellington Oil Field, KS. Pre- and post-injection monitoring and analysis of water and head gas from the shallow unconfined freshwater aquifers. Variations in dissolved gases, rare earth elements, organic constituents, isotopic fractionations, trace and major elements are being combined to develop a model to predict the consequence of CO2 injection in the years to come and hence protecting shallow drinking water reserves from CO2 mixing.
6) *Education*: Geoscience courses that train future water scientists include introduction to geochemistry, water resources geochemistry, hydrogeology, geochemical and biogeochemical modeling, geomicrobiology, environmental geology.
7) *Extension and Outreach*: Geoscience faculty and students promote water science to elementary and middle school students and underrepresented groups through participation in the Kansas Louis Stokes Alliance for Minority Participation (KS LSAMP), the K-State Developing Scholars Program (DSP), and the K-State program Girls Researching Our World (GROW). Additionally, our researchers participate in the K-State Urban Water Institute and Natural Resources Educational Sources as a Secondary Major.

## Relevance

Groundwater resources in western Kansas and much of the U.S. are dwindling and yet expected to be relied on more heavily in the future. These resources are hydrologically linked to surface water bodies. To ensure sufficient supply of quality resources in the future, we need to consider both settings.

Our efforts will better enable us to:

1) Predict and manage consequences of future environmental change, including those caused by human activities, climate change and land-use pattern changes.
2) Limit human impacts to surface water resources in urban and rural areas.
3) Develop strategies to remediate contaminated water supplies.
4) Preserve ecosystem services that help cleanse water supplies naturally.

## Agency Contact Information

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# Networking, Security and Resiliency for Critical Infrastructures

## 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 have 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 into the impact of these interdependencies related to reliability of the coupled system, 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), K-State networking resources and the Global Environment for Network Innovations (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 demonstrates that an OpenFlow communication network could perform equally well to or better than its Multiprotocol Label Switching (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 (EPAP). This research has also received national contributions from Raytheon BBN Technologies, KanREN, Internet2, the National Science Foundation and National LambdaRail.

## Agency Contact Information

U.S. Department of Energy
202-586-5000

# 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 (UV) light-emitting diodes (LEDs), two technologies poised to develop into multi-billion-dollar-per-year industries within five to seven years. Kansas State University (K-State) and the start-up 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 talent, technical skills and entrepreneurial spirit 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 that are 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 (the current choice for power eletronics), its devices can switch more than ten 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 (HFI) systems, superior light detection and ranging (LIDAR), three-dimensional (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, KSU has been a research leader of the synthesis of nitride semiconductors. In fact, former K-State students founded Nitride Solutions in order 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.

## Agency Contact Information

U.S. Department of Energy
Advanced Manufacturing Office
202-586-9488

# 21st Century Technology for Legacy Engines

## Background

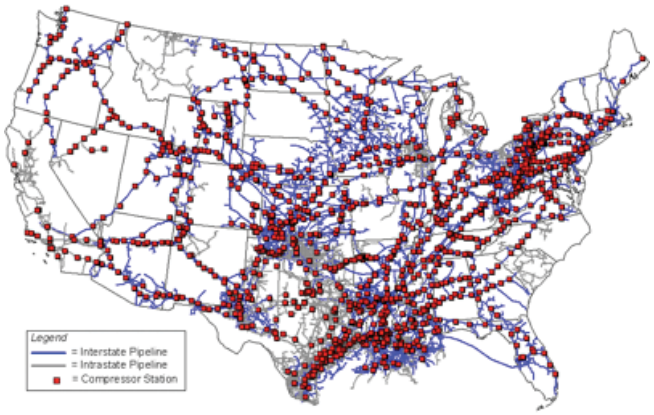
Legacy engine is a term applied to industrial engines designed and manufactured before low-emmision levels were required, and before advanced control systems were employed. Typically, they are 20 to 50 years old. Most large legacy engines are mechanically sound and capable of operating reliably for many 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 a myriad of air quality regulations. Regulations vary widely with locality and application, and literally hundreds of different requirements can potentially apply to a given engine.

Pipeline compression engine (Source: CTS, Combined Technology Solutions)

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




Major natural gas pipelines and compressor stations (Source: US Energy Information Administration)

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. We propose to develop 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 the design of a new engine that will be reproduced 1 million times. We plan to seek funding to form an NSF Industry/University Cooperative Research Center and simultaneously seek major funding through the DOE Natural Gas Infrastructure R&D Program initiative.

## Relevance

The pipline 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 contine 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.

## Agency Contact Information

U.S. Department of Energy
202-586-5000 or 202-586-1657

# HOMELAND SECURITY

# National Bio and Agro-defense Facility: Bio/Agro Security Innovation System

## Background

The U.S. Department of Homeland Security (DHS) wants to create a Bio/Agro Security Innovation System (BASIS) around the National Bio and Agro-defense Facility (NBAF) under construction in Manhattan, Kansas. BASIS is intended to be a highly networked technology development ecosystem. It is designed to catalyze bio/agro security innovation via enhanced public and private-sector engagement, the creation of key strategic alliances and increased investment.

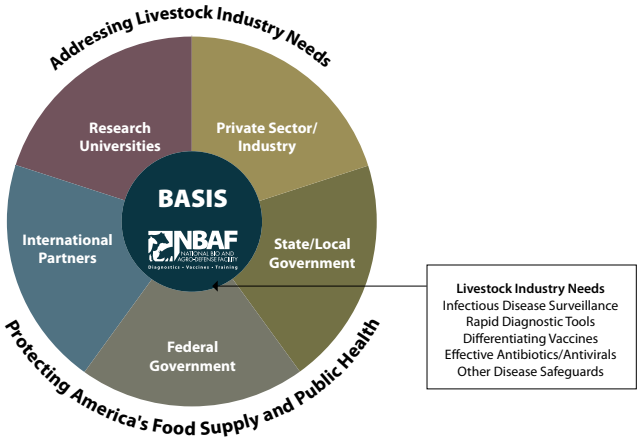
The already evolving ecosystem consists of a network of capabilities, services and know-how that work together to provide a variety of benefits and outcomes upon which all BASIS participants depend — access to innovation, talent and training. As envisioned, active contributors will interact with each other in a synergistic manner which should enhance the missions of all parties, particularly, long-term.

## Description

***BASIS Vision:*** To protect animal health, public health and the food supply by shaping public/private strategic alliances to accelerate technology development.

***BASIS Mission:*** To create a highly networked bio/agro security innovation system for the diagnosis, treatment and prevention of high-hazard infectious diseases that threaten the U.S. BASIS is intended to: (1) materially enhance public-sector/private-sector cooperation and collaboration; (2) leverage participants' knowledge and capabilities; (3) accelerate the advancement/ transition of technologies and products into the marketplace; and (4) enable skilled worker training, talent development and regional economic growth.

### Public/Private Stakeholders




***BASIS Strategy:*** To catalyze and enhance bio/agro security innovation for America's livestock industry.

1) ***Engage public/private stakeholders:*** Undertake the systematic engagement of private sector, producer/ industry, university and government stakeholders for the purpose of understanding their innovation, talent and training needs, plus their proficiencies and major challenges.
2) ***Align capabilities and needs:*** Identify natural alignments that exist within the constituent network and determine which of those alignments can provide a foundation for more significant, committed BASIS partnerships.
3) ***Enable tactical connectivity:*** Assist in connecting the tactical interests and needs of livestock industry stakeholders to other parties' capabilities for the purpose providing a new framework by which to protect animal health, public health and the food supply.
4) ***Advance foundational partnerships:*** Secure key partnerships, identify specific shared goals within each of these, ascertain progressive benchmarks for success, and help operationalize each partnership.
5) ***Enrich, enhance and evolve strategic alliances:*** Mature ecosystem alliances that support regional economic growth and further develop the partnerships nationally/ internationally if/when appropriate. And finally, evolve the strategy to reflect dynamic market conditions and global events for the enrichment of all BASIS public/ private partners.

KANSAS STATE UNIVERSITY | Institute for Commercialization

**Development of Strategic Alliances**

**Engage** Public/Private Stakeholders » **Align** Capabilities and Needs » **Enable** Tactical Connectivity » **Advance** Foundational Partnerships » **Enrich** Strategic Alliances

## Relevance

Accelerating the delivery of new technologies into the marketplace to meet the needs of America's livestock industry will help ensure the safety and security of animal health, public health and the global food supply. It will also serve as an engine of economic growth locally, regionally and beyond.

## Agency Contact Information

Department of Homeland Security
NBAF Program Executive Office
DHS Science & Technology Directorate

# National Bio and Agro-defense Facility: U.S. Department of Agriculture Research

## Background

The U.S. Department of Homeland Security (DHS) is constructing the National Bio and Agro-defense Facility (NBAF) in Manhattan, Kansas. It will replace the Plum Island Animal Disease Center (PIADC) on Plum Island, New York, that was constructed in the 1950s.

Due to antiquated PIADC facilities in need of major repairs, livestock research on Plum Island will be shut down for a significant portion of FY 2017 and perhaps longer. Two foreign animal diseases (FADs) that have been studied on Plum Island and are targeted for NBAF research are African swine fever (ASF) and classical swine fever (CSF). The research was conducted by the U.S. Department of Agriculture's (USDA's) Agricultural Research Service (ARS), but has been funded by DHS the past few years. However, DHS funding of ASF and CSF research at PIADC has ramped down and future work there on either FAD is questionable.

Zoonotic diseases (those that can be transmitted from animals to people) cannot be studied on Plum Island due to the poor infrastructure; it would be unsafe for the scientists, animal handlers and technicians. Zoonotic FADs targeted for NBAF include Rift Valley fever (RVF) and Japanese encephilitis (JE), among others.

## Description

Kansas State University (K-State) is conducting ASF, CSF, RVF and JE research in the Biosecurity Research Insitute (BRI) located immediately adjacent to the NBAF site. USDA scientists at the Center for Grain and Animal Health Research (CGAR) in Manhattan, Kansas, conduct their reseach in the BRI when it requires biosafety level-3 (BSL-3) and/or BSL-3Ag (livestock) biocontainment, and they also collaborate with K-State scientists on some of the FAD projects noted.

KANSAS STATE UNIVERSITY | Biosecurity Research Institute


NBAF is not scheduled to be operational for a few more years, but the NBAF workforce cannot be fully trained on Plum Island even if the current infrastructure issues are resolved; plus, more breakdowns could still occur. Moreover, as already noted, zoonotic disease research cannot be done on Plum Island regardless. Thus, growing NBAF-relate research activities in the BRI on both zoonotic and non-zoonotic FADs could be beneficial for multiple reasons.

## Relevance

Based on the fact that USDA will conduct the primary research mission in NBAF, moving some PIADC research to USDA's CGAHR might be helpful for a number of reasons:

1) Livestock research at PIADC has been shut down.
2) It's unknown if the repairs currently underway on Plum Island will be sufficient for PIADC to be fully operational until NBAF opens.
3) ASF and CSF research has been done on Plum Island, and research on those two FADs has been ongoing in the BRI since 2015.
4) With NBAF becoming operational in a few years, growing the USDA FAD research program in Manhattan will need to be undertaken soon.
5) USDA cannot undertake NBAF zoonotic FAD livestock research on Plum Island.
6) USDA CGAHR scientists have been collaborating with K-State scientists on zoonotic RVF research in the BRI since 2014.
7) More zoonotic and non-zoonotic FAD research could be undertaken by USDA CGAHR scientists in the BRI.

Additionally, the NBAF research budget must be ramped up prior to NBAF becoming operational and growing the R&D budget at USDA CGAHR could initiate that required process. For decades, PIADC research has focused primarily on one FAD — food and mouth disease (FMD) — while NBAF is expected to conduct research on six to eight FADs concurrently, thereby better protecting the nation.

DHS or USDA should fund this important USDA research at CGAHR in Manhattan, Kansas, so there is no delay in developing much-needed countermeasures to FAD threats to America. By doing so, the USDA FAD research program can grow in preparation for the opening of NBAF.

## Agency Contact Information

U.S. Department of Homeland Security
Science and Technology Directorate

# National Bio and Agro-defense Facility: U.S. Department of Agriculture Workforce Development

## Background

The Department of Homeland Security (DHS) in 2004 called for the establishment of a new National Bio and Agro-defense Facility (NBAF), which will 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.

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

A unique partnership between Kansas State University and (K-State) Mississippi State University (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 (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 (USDA's) Agricultural Research Service (ARS) and Animal and Plant Health Inspection Service (APHIS), respectively; the same will be true at NBAF. However, the breadth of ARS R&D activities and 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 (CVMs) can educate a workforce to meet the NBAF mission.

MSU CVM and K-State CVM have established D.V.M./ Ph.D. programs to meet NBAF's long-term needs for D.V.M./Ph.D. veterinary research scientists in these disciplines. K-State and MSU CVMs provide unique capacity and the faculty expertise to train D.V.M./Ph.D. scientists proficient in developing vaccines, monoclonal antibodies, diagnostic tests, new state-of-the-art analytical tools, and transgenic animals to enable rapid response to transboundary and emerging disease threats.

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 (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. Therefore, it is proposed that:

1) $1 million be provided to ARS to develop the necessary mechanisms to ensure a viable and qualified scientific workforce is available, and to implement a program to recruit and train scientists, and other technical positions, focused on pathology, virology, immunology, entomology, epidemiology, microbiology, and computational biology for productive USDA careers at NBAF; and

2) $3 million be provided to APHIS to ensure necessary steps are taken to develop a qualified workforce with subject matter experts in foreign, emerging and zoonotic diseases capable of developing, validating and conducting needed diagnostics, performing epidemiologic studies, and completing bioinformatics analyses.

## Agency Contact Information

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# High Consequence Pathogens, Including Potential Bioweapons: Countermeasure Development at the Biosecurity Research Institute

## Background

The growing public health problems associated with mosquito and tick-transmitted diseases such as Zika, chikungunya, West Nile and Lyme disease are currently receiving a great deal of attention and causing great fear to individuals and the general public. The vectors, such as mosquitoes and ticks, 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. Lack of funding for training and research in arthropod-borne diseases is creating a void that is making it difficult to respond to the threat of increased vector-borne diseases and address the public's concerns in a timely manner.

## Description

The Biosecurity Research Institute (BRI) at 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 (SA). 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.

This state-of-the-art facility is comprised of an ACL/BSL-3 insectary suite (3 rooms at BSL-3E) 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 (BSL-3E), as well as education, training and administrative spaces.

The BRI is the first nonfederal facility ever to be approved to work with African swine fever (ASF) and classical swine fever (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 SAs worked with at the BRI include highly pathogenic avian influenza, anthrax, glanders, plague and brucellosis.

Non-SAs used at the BRI include Japanese encephalitis (JEV), yellow fever and Zika virus, all of which are zoonotic pathogens that can infect humans with high morbidity and potentially high mortality. All three of these viruses are transmitted by mosquitoes, and the BRI has capabilities for research with mosquito vectors. 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. This virus is closely related to West Nile virus that has probably infected more than 2 million people and more than 1,900 deaths since 1999. 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., includes investigating mosquito transmission and 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 (PIADC) to the National Bio and Agro-defense Facility (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 important to develop new programs that will provide comprehensive training in basic and applied aspects of vector biology/medical entomology, arbovirology, and the epidemiology of arthropod-borne diseases.

Providing education and training to graduate students and postdoctoral fellows will help create a competent cadre of interdisciplinary professionals who will work together to anticipate and respond to arthropod-borne disease outbreaks. Working with some viruses can only be performed in high containment and the BRI is equipped and ready to undertake this research.

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# Biosecurity, Biosafety and Biocontainment Research, Training and Education at the Biosecurity Research Institute

## 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 (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 (NBAF) adjacent to the BRI.

## Description

The Biosecurity Research Institute 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 state-of-the-art 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 (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.

Within the 31,000 square feet dedicated to education, integrated classroom and laboratory spaces exist to make student's learning expeditious and efficient. A tiered classroom seating 18 to 25 people is adjoined to a fully-equipped biocontainment laboratory. A wall-size glass window allows students to observe and learn how to do 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 institutes such as NIH's National Biosafety and Biocontainment Training Program (NBBTP) offer 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 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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# Development and Curation of Datasets for Research and Analysis Critical for NBAF

## Background

The research infrastructure provided by the NBAF is necessary for continuing protection of the U.S. food and agriculture industries. These highly integrated, global and complex industries are inherently vulnerable to transboundary animal, emerging and zoonotic disease outbreaks that could threaten economic stability, food security, and the nation's public health. DHS has the responsibility and the national stewardship mandate to detect, prevent, protect against and respond to terrorist attacks within the U.S. (Homeland Security Act of 2002, 6 U.S.C 182). DHS shares these responsibilities, as they apply to the defense of animal agriculture, with the U.S. Department of Agriculture (USDA); hence, a coordinated agricultural research strategy (as called for in the Homeland Security Act of 2002 and Homeland Security Presidential Directive 9 (HSPD-9), "Defense of U.S. Agriculture and Food," Jan. 30, 2004) has been developed. HSPD-9 also specifically identified the need for "safe, secure, and state-of-the-art agriculture biocontainment laboratories that support research and develop diagnostic capabilities for foreign animal and zoonotic diseases." NBAF will contribute to the infrastructure needed to satisfy needs for modern biocontainment laboratories.

Safety and security are of paramount importance in the planning, design and operations of the NBAF. From site selection and design of the facility to the outfitting and operation of the NBAF, DHS is committed to understanding the associated safety and security risks and mitigating those risks through the necessary design, engineering, operational protocols and response planning efforts.

## Description

The objective of this initiative is to establish and maintain data, program documentation and response planning required for responsive DHS NBAF reporting, assessments and documentation purposes. The initiative will leverage Kansas State University's (K-State) Biosecurity Research Institute (BRI) and National Agricultural Biosecurity Center (NABC) infrastructure and capabilities, and integrate activities of K-State with DHS. The objective is accomplished through the following activities:

- Development and maintenance of curated datasets in a responsive manner that is to be used in support of NBAF programs, contracts, response planning and risk-based decision tools. This would also include the necessary data for reporting, assessments and ongoing documentation purposes to meet DHS requirements.
- Assessment and analysis of emergency response plans at all levels of government to ensure support of DHS NBAF specific emergency response planning and documentation.
- Development and maintenance of activities to support the four phases (Mitigation, Preparedness, Response and Recovery) of emergency management. Mitigation and Preparedness are critical for minimizing the effects of a negative event and promoting rapid Response and Recovery phases. This would require but not be limited to activities such as training and exercises in support of emergency planning and response.
- Support and maintain information technology, secure communications architecture and infrastructure needed to support the areas of interest outlined in this initiative.
- Promote capabilities to conduct risk and vulnerability analysis of infectious disease agents in biocontainment environments using foreign animal, plant, foodborne and zoonotic disease agents to support threat characterization analysis.

## Relevance

In support of DHS and NBAF, this initiative significantly enhances the development and maintenance of the necessary data to support DHS's needs for assessment, reporting, and other data analysis needs.

This effort will assist with campus community configuration for opportunities related to the operations and science within NBAF as they develop through the two major contracting vehicles for service and support.

In addition, this will facilitate DHS in the development of training, plans and exercises in the broad scope of the four phases of emergency management.

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# Securing Food, Agricultural and Veterinary Public Health Preparedness via Animal Disease Response Training

## Background

The National Agricultural Biosecurity Center's (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 (FEMA) National Preparedness Directorate, National Training and Education Division (NTED) course catalog. This catalog provides high-quality training to equip first responders to prevent, protect against, respond to, and recover from both man-made 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 (EMA)
- Emergency Medical Services (EMS)
- Veterinarians
- Agriculture Emergency Responders
- Firefighters
- 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; including 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 (PEDV) and High Pathogenic Avian Influenza (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 responders understand and can communicate the basic concepts necessary for an effective response effort.

ADRT builds on prior NABC research coordination projects and translates knowledge products from K-State and other institutions around the country into training that helps protect our global food systems.

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# Development of a National Agricultural Response Framework for Food, Agriculture and Veterinary Public Health Emergency Preparedness

## Background

Department of Homeland Security (DHS) - Office of Health Affairs (OHA) has identified multiple Food, Agriculture, and Veterinary Defense (FAVD) needs that are being addressed through projects performed by the National Agricultural Biosecurity Center (NABC) at Kansas State University (K-State).

***Lessons Learned Information Sharing (LLIS):*** Review and analysis of AAR/IP's from training exercises or agriculture-based incidents are integral to the continuous evolution of agricultural emergency response. Lessons learned and their associated corrective actions serve little purpose if their value is left buried within the text of an exercise or incident report. Once lessons learned have been identified and corrective actions made available to agriculture emergency response planners, identified needs may be addressed by matching them to training available within existing educational programs of DHS.

***Planning and Curriculum for Food and Agriculture Emergency Response:*** Currently, no uniform planning, training and education process for the development of emergency operation plans for the defense of food and agriculture exists. The FAVD branch within DHS/OHA seeks to promote a common understanding of the fundamentals of risk-informed planning and decision-making. Such an understanding will allow for the development of integrated, coordinated and synchronized emergency operation plans through the integration of a uniform planning process, across food and agriculture sectors by national, state, local, tribal and territorial government entities.

## Description

Identifying Corrective Actions from Agricultural Response (ICAAR)/Food, Agriculture, and Veterinary Defense (FAVD)

- Review of agriculture related After Action Reports/ Improvement Plans (AAR/IP) from emergency response exercises or incidents and addition of identified corrective actions to a searchable ICAAR database.
- Provide corrective action database for access and use by agriculture emergency response planners nationwide to share lessons learned.
- Lessons learned from the AAR/IP's highlight gaps identified in emergency response training exercises or actual events and are cross-matched with existing training programs offered by DHS. Deficits in training availability are identified and reported to DHS.

Planning and Curriculum for Food and Agriculture Emergency Response:

- Development of the Livestock Emergency Response Plan (LERP) toolkit to ensure a risk-informed planning process by stakeholders involved in agriculture emergency response.
- Integrate format and curriculum of the existing Food Emergency Response Plan (FERP) toolkit and USDA/ APHIS FADPReP documents with the recently developed Livestock Emergency Response Plan (LERP) toolkit.

## Relevance

Areas for incorporation of planning, training and education expertise involving agricultural emergency response, biosecurity awareness and veterinary defense are into intersectional elements of One Health (human health, animal health and environmental health). International public health bodies call for stronger cooperation between national human health authorities and animal health authorities. This can address the call for the Global Health Security Agenda's vision for a world safe and secure from global health threats posed by infectious diseases.

NABC's aim at increasing bio-threat preparedness strengthens efforts to secure against risks to America's agricultural system, food supply, health and economic security.

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# Pathway Risk Analyses and Technical Information Knowledge Products for Transboundary Animal and Vector-Borne Diseases to Assess Risks

## Background

The United States' food and animal agriculture industry is highly integrated, open, global and complex. Introduction of a high-consequence transboundary animal disease (TAD) into U.S. livestock would have a crippling effect on the overall economy, international trade and the public's perception of food safety. To address potential threats arising from TAD introduction into the U.S., whether accidental or intentional, pathways of introduction must be investigated, understood and documented.

The Department of Homeland Security (DHS), which will own NBAF, has developed a list of priority agents to be studied. Included on the list are CSFV, ASFV and RVFV.

NABC recognizes a need for a defined, consistent and reliable methodology for pathways analysis describing the potential routes of entry, impacts, and information gaps associated with introduction into the U.S. of any high-consequence disease organisms. Through pathways analysis, NABC provides information and analysis used by policy officials, animal health officials and NBAF scientists to make more informed decisions concerning strategies to prevent or control the spread of high-consequence TADs. Initial pathways analyses focus on three of the NBAF-targeted agents and can be effectively expanded to include the remaining agents and also other World Organization of Animal Health (OIE) reportable diseases, additional government agencies' needs and industry prioritized agents.

## Description

In support of the National Bio and Agro-defense Facility (NBAF), the National Agricultural Biosecurity Center (NABC) developed a defined, consistent, and reliable method for assessing pathways through which transboundary animal disease (TAD) agents might enter the U.S.

- In order to address threats arising from TADs, the pathways of potential introduction should be identified, understood and documented. An up-to-date template for investigating pathways along with an established process for information acquisition provides the framework for analysis.
- The 10-year old pathways analysis for Classical Swine Fever Virus (CSFV) using current science and data served as the initial study and model for this project.
- Pathways analysis for African Swine Fever Virus (ASFV), currently on the DHS/USDA priority agent list for research in NBAF, will serve as the second high-consequence disease approved for pathways analysis.
- Pathways analysis for Rift Valley Fever Virus (RVFV), also currently on the DHS/USDA priority agent list for research in NBAF, will be the third high-consequence disease approved for pathways analysis.

## Relevance

Pathways analysis will assist policy officials making informed recommendations for strategic preparedness planning to optimize surveillance and response strategies. Pathways analyses for agents of concern will enable proactive strategies to manage and respond to TAD introductions and outbreaks. Knowledge gaps identified through pathways analysis will prove useful in determining future NBAF research needs.

Knowledge products created are relevant to agencies concerned with protecting U.S. animal health and food safety, security, and defense. Potential users of pathways analysis include the USDA, DHS Science and Technology (DHS S&T), and livestock commodity groups such as the National Pork Board (NPB) and National Cattleman's Beef Association (NCBA). NABC's ability to work in the classified arena will provide a more robust analysis to U.S. Government agencies on potential threats.

Research on NBAF-targeted agents is relevant to U.S. interests due to the critical importance of protecting the nation from devastating economic effects resulting from introduction and spread of TADs. Creation of a defined, consistent and reliable methodology of pathways analysis provides infrastructure and capabilities for an agricultural knowledge center capable of serving the information needs of NBAF, government, industry and partnering agencies.

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# Fusion Centers and their Roles in Global Food Security and Preparedness

## Background

Multiple Homeland Security Presidential Directives (HSPD) identify improved information sharing as a key component of homeland protection. These HSPDs also identify that many of critical areas that must be protected are under the control and/or oversight of state and local governments, and the private sector. These critical infrastructures and key resources provide the essential services that underpin American society and national security and thus it must be protected from disruption from natural, accidental or deliberate events. Improving information sharing constitutes a cornerstone of our national strategy to protect the American people, our institutions, and to defeat terrorists and terrorism support networks at home and abroad. The National Commission on Terrorist Attacks upon the United States (the 9/11 Commission) identified the breakdown in information sharing as a key factor contributing to the failure to prevent the Sept. 11, 2001 attacks.

Since the tragedy of 9/11 local, state, tribal and federal officials across the country have been working hard to restore public order and confidence. These officials have also been working to find ways to prevent or mitigate future terrorist acts, which has led to the development of a number of strategies and programs designed to strengthen domestic security. Many of these strategies focus on improving ways to combine relevant information from disparate data sources, in order to maximize the usefulness and quality of available information.

Improvements in communication, information sharing and analysis must continue for those gains that have been made to be realized going forward. Specific assets have been deployed in Kansas, which serve as a national model. The State Legislature authorized the Adjutant General for Kansas (TAG) to establish the Kansas Information Fusion Center (KIFC) and directed the KIFC be housed in a Sensitive Compartmented Information Facility (SCIF). Placement of the KIFC in a SCIF enables the KIFC to access classified threat information pertaining to the nation. This ensures the KIFC has the best information available to predict, prevent and respond to threats facing its citizens. The National Agricultural Biosecurity Center (NABC) provides the agriculture, food, and veterinary components of the federal, state, and local mission of the KIFC to protect the nation by providing a multi-discipline, information sharing network designed to gather, analyze and disseminate information in a timely manner.

## Description

A global paradigm for the peaceful coexistence of nations is the security of the food, water and energy resources by which nations sustain their citizenry. NABC, through its interactions with both the intelligence community at large, and the Department of Homeland Security (DHS) sponsored statewide fusion centers, has been working to make this security paradigm a reality.

This paradigm is underpinned by both classified and unclassified work, and involves a close cooperation and collaboration between the NABC and the KIFC. Subject matter experts, largely based within the University science and research environment, are linked synergistically with intelligence community analysts. The objective of this initiative is to continue to enhance the capabilities of NABC to proctor food safety, veterinary public health and agricultural security subject matter expertise (SME) to DHS and KIFC in both an unclassified and classified role.

NABC brings several assets to this topic. It has stood up a SCIF and continually identifies SME's to support the university's role in safeguarding food, water and energy supplies. Beginning in 2005, NABC entered into a strategic relationship with DHS and the KIFC to leverage expertise in support of efforts toward global food and water security.

## Relevance

At the federal level, the U.S. Intelligence Community, led by DHS and the Federal Bureau of Investigation (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 maintenance 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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# INTERIOR, ENVIRONMENT

# Great Plains Center for Urban Watersheds (GPCUW): Joining Sustainable Water Science, Planning, and Management

## Background

Kansas communities are facing water supply shortages, the necessity of replacing aging water infrastructure, and the need for cost-effective, sustainable water conservation measures. Seventy-three percent of Kansas' population (most of which is in eastern Kansas) relies on surface water for all or part of their water needs. Three of the five major river basins that supply water to the cities and towns of eastern Kansas show potential for shortages within the next 10 years (perhaps sooner given current climate change and drought predictions). The remaining basins rely heavily upon reservoir storage which continues to decrease due to accelerated erosion and sedimentation. Thus the need for water conservation is real and pressing.

Most Kansas communities are addressing the replacement of aging, water related infrastructure as a result of design life expiration or due to CSOs (Combined Sewer Outflows), as well as searching for less expensive, longer lasting ways of handling storm water in newly developing areas. Cities, towns, environmental planners and engineers, architects and landscape architects, are in great need of green, sustainable water solutions. Yet, little research has been conducted regarding green infrastructure, natural channel design restoration, or innovative water conservation strategies in the Midwest.

Currently there is little to no extension or outreach to assist communities, agencies or private entities regarding green infrastructure and water conservation. The requisite interdisciplinary expertise and experience are here at Kansas State; the coordination, synergy and conveyance of the Great Plains Center for Urban Watersheds (GPCUW) allows for the application of this expertise.

## Description

GPCUW is a nexus of research, application and outreach focused on sustainable green infrastructure and urban stream restoration in the communities of Kansas, the Midwest and the Great Plains. GPCUW research focuses on sustainable stormwater management, natural stream channel design and restoration, and innovative water conservation techniques in the cities and towns of Kansas. GPCUW communication joins teaching, service learning and outreach with entrepreneurial opportunities between Kansas State University, K-State Olathe, and those involved with sustainable water infrastructure in Kansas communities. GPCUW facilitates the development of new technologies and hybridization of current practices for sustainable water planning and management. GPCUW practices rigorous and sustained monitoring of stormwater management, stream restoration and water conservation measures for this is how we learn, improve, invent and move closer to sustainability.

## Relevance

Innovative, green technologies are being implemented throughout Kansas and the Midwest, yet there is no research hub focused on gauging efficacy or developing the most place-appropriate and sustainable measures. The Great Plains Center for Urban Watersheds — its work of developing new technologies and practices for sustaining the waters of Kansas — is poised to address the needs of the communities of the Great Plains. The sharing of new knowledge through education, extension, service-learning and innovative public-private partnerships is the mission of a land-grant university. The GPCUW is an intergral part of the 2025 plans of the LARCP department, the College of Architecture, Planning & Design, and falls within three of the five priority research topical areas of Kansas State University. GPCUW at Kansas State University will focus and facilitate a more resilient and sustainable water future for the communities and people of Kansas, the Midwest and Great Plains.

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# LABOR, HHS, EDUCATION

# Educational Leadership in K-12 Schools

## Background

In an era dominated by higher standards and greater accountability for America's schools, the K-State response is to prepare great leaders at all levels who know how to implement change. The College of Education (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 activities in the College are led by the university's 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. The COE believes that partnering for a new generation of leaders produces better results by focusing on the different leadership needs associated with various community and school contexts. This foundational premise accounts for the success of current programs and informs the design of future programs.

## Description

The COE at K-State 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. These include:

- 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 over 500 school leaders at principal and superintendent levels. New academies are in development that expand to include indigenous populations.
- The Kansas Educational Leadership Institute (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: Kansas Association of School Boards, Kansas State Department of Education, Kansas School Superintendents Association, Kansas State University and 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, leadership coaching and academic work. The KELI mission and model are unique in the country.
- COE has a long history of collaboration to provide educational leadership opportunities at Fort Leavenworth with the Command and General Staff College (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 also has 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 the university's 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 educational 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 Educational Leadership Program and relates to the college's 2025 plan, Themes III (provide quality graduate education that prepares students for leadership), and IV, (increase service to communities through systematic engagement). These activities also relate to K-State 2025, 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, the Office of Career, Technical and Adult Education, and the Office of Elementary and Secondary Education. The National Science Foundation, Directorate of Education and Human Services.

# Physical Activity, Cancer and Treatment Outcomes

## Background

A recent large (1.4 million people) epidemiological study, funded by the National Institute of Cancer, demonstrated a significant risk reduction for 26 major cancers in those who are physically active, with an obesity-independent risk reduction for many of these cancers. In addition, once diagnosed with cancer, patients who exercise have an increased survivability versus sedentary counterparts. This data suggests that exercise has both preventive and therapeutic effects on cancer and cancer treatment(s), respectively. However, the effect(s) of exercise on the tumor microenvironment, as well on the cardiovascular system with traditional cancer treatments, are unknown.

## Description

The department of kinesiology in the College of Human Ecology is conducting translational research, incudling determining molecular mechanisms of cancer genesis and treatment outcomes in pre-clinical models through cardiovascular function in the exercising human cancer survivor. Main themes, description and departmental expertise are:

- ***Exercise, the tumor microenvironment and outcomes with radiation therapy.*** Tumors contain areas of low oxygen that make them resistant to radiotherapy and more likely to metastasize, thus strategies to enhance tumor oxygenation are clinically relevant. The department of kinesiology's data demonstrate that exercise training can greatly enhance tumor oxygenation, which would enhance patient prognosis as well as responses to radiation therapy. Dr. Brad Behnke is using (exercise — real and simulated) as an intervention to impact the tumor microenvironment and potentially enhance outcomes and prognosis of cancer patients.
- ***Long-term cardiovascular effects of cancer treatment.*** In cancer patients and survivors, exercise is prescribed to specifically combat the fatigue associated with cancer treatment, as well as improve depression and other psychological aspects associated with the diagnosis and treatment of cancer. Dr. Carl Ade has demonstrated that chemotherapy treatment can have long-term (10+ years) deleterious effects on the capacity of the body to increase blood flow, which would contribute to the chronic fatigue reported by cancer survivors. Drs. Carl Ade and Brad Behnke plan to assess the impact of cancer treatment on cardiovascular outcomes in human (Ade) and pre-clinical models (Behnke).
- ***Enhanced nitric oxide signaling to improve tumor oxygenation.*** Cyclic hypoxia within the core of solid tumors upregulates at least 35 genes associated with enhanced tumor growth and metastasis. This cyclic hypoxia is associated with vasomotion and poor nitric oxide mediated signaling in the blood vessels perfusing tumors. Dr. David Poole has identified a role of nitrate/nitrite supplementation in human patients with heart failure as a means to enhance oxygen delivery to poorly perfused tissue. Dr. Poole is extending this original line of research to determine if nitrate supplementation can enhance nitric oxide bioavailablity within tumor blood vessels to mitigate cyclic hypoxia and down-regulate pro-metastatic genes.
- ***Cancer and reduced exercise capacity.*** Cancer patients universally report fatigue after diagnosis through treatment and recovery. In fact, many cancer patients ascribe fatigue as the most distressing side-effect of cancer and its treatment. This cancer-related fatigue is typically attributed to the side-effects of cancer treatment. However, Dr. Steven Copp has recently demonstrated that the disease itself, prior to diagnosis (i.e., before any tumor burden occurs), reduces the capacity to perform work and exercise. Dr. Copp is investigating mechanisms responsible for this early loss of functional capacity and whether exercise training can prevent fatigue in cancer patients prior to treatment.

## Relevance

Roughly one in two people will hear the words "you have cancer" in their lifetime. It is becoming evident that many of these cancers are preventable with a healthy lifestyle involving exercise. In addition, exercise in cancer patients may enhance outcomes (e.g., kill fraction of the tumor) with traditional therapies (chemotherapy and radiation) and prevent cardiovascular dysfunction associated with the primary tumor as well as treatment. Faculty in the department of Kinesiology have received local and national funding (e.g., NIH, American Cancer Society) for their research endeavors and are synergistically attacking this disease using what is often referred to as aerobic exercise therapy in cancer patients.

## Agency Contact Information

National Institute of Health
National Cancer Institute, Division of Cancer Biology

# Military-Connected Learners: Research and Teacher Preparation

## Background

The College of Education at Kansas State University is committed to a military/veteran focus as part of our work. The needs and strengths of military personnel, veterans and their families have been systematically addressed by the faculty of the College of Education (COE), who educate teachers, principals, superintendents, adult educators, school counselors, special educators, postsecondary advisors and college student personnel services staff. The college's award-winning military initiative is a college-wide program that has been in place for several years. The focus of the initiative is military-connected learners at all education levels, recognizing especially that veterans in college face challenges in adjusting to a college culture that differs greatly from the highly structured military culture. Therefore, this college is designing programs and conducting research related to military-connected learners.

- The college became one of the first 100 universities to join Operation Educate the Educators, a nationwide Joining Forces initiative that was given guiding principles set forth by the American Association of Colleges for Teacher Education and the Military Child Education Coalition.
- The school counseling program has developed a Certificate of Competence in Counseling Military-connected Students for school counselors and candidates in counselor education graduate programs based on the theoretical and research framework and best practices in parent/family counseling and education strategies and interventions.
- The Military Child Education Coalition awarded the College of Education the 2014 LTG (Ret.) H.G. "Pete" Taylor Higher Education Partnership of Excellence award in recognition of our work with school partners in educating military-connected students.
- A faculty-developed leadership-training program, the Brigade Command Team Spouse Development Program, awarded the Malcolm Knowles Award for Outstanding Program in Adult Education in 2010.
- The college produced a widely-disseminated documentary, "A Walk in My Shoes: Military Life" (http://coe.ksu.edu/about/military/militarylife.html), in which seven people currently connected to the College of Education — retired soldiers, spouses, a child and educators — share their perspectives on the rewards and challenges of being connected to the military. Topics include the realities of deployments for the family and the soldier, Post-Traumatic Stress Disorder (PTSD) and the social/emotional needs of military-connected children.
- Our adult education graduate program is active at Fort Leavenworth and has awarded over 600 graduate degrees to officers at the Command and General Staff College in the past 25 years.
- Faculty and graduate students conduct research related to timely topics in education. Several recent dissertations have addressed military and veterans' issues, such as the impact of deployment on school behavior, creativity and cognitive development in military courses, effects of stress in the military classroom, military faculty self-efficacy, and faculty development at military colleges.

The COE has focused experience in working with military- and former military-connected adult learners and it has an award-winning teacher preparation program. Therefore, K-State's College of Education has the potential to make a significant contribution to remediating the shortage of teachers in Kansas and across the country.

## Description

The College of Education at Kansas State University has the capacity and commitment to recruit, support and prepare former military personnel to become K-12 teachers via its outstanding teacher preparation program. A special emphasis is on science and math teachers, and the college's current National Science Foundation funded program provides fellowships for individuals with math or science degrees to become teachers. The COE also has in place a cooperative dual-degree for those interested in concurrent math or science and education degrees. Although these programs do not focus primarily on former military personnel, they are actively recruited to the programs. The college is seeking funds to develop a full veteran-focused recruitment and teacher preparation program that is designed specifically for former military personnel who seek to become teachers.

## Relevance

This initiative is aligned with K-State and the College of Education's commitment to serve the military and their families. In addition, these endeavors align with K-State's 2025 themes I-IV, and three of the college's 2025 goals, one of which relates specifically to engagement in issues, activities and research related to the military.

## Agency Contact Information

U.S. Department of Education: Fund for the Improvement of Postsecondary Education; Office of Elementary and Secondary Education, and Department of Defense Education Activity (DoDEA).

# Diversity and Inclusion in Educational Settings: Research and Practice

## Background

The College of Education (COE) recognizes the important and continuing work of preparing students for the 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 programs and research. The College of Education's longstanding commitment to diversity can be seen throughout the collective work of its departments, centers, and programs since the early 1990s. Guiding these initiatives is the College 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 Midwest Equity Assistance Center (MEAC) provides technical assistance, professional development, and information about race, gender and national origin equity to educational agencies in the region. It is the predominant regional source of best practices for culturally responsive education. This includes the new C4 Database that houses exemplary lesson plans that integrate both the National Diversity Standards and the Common Core Standards. In collaboration with the Kansas Department of Education, MEAC is working to review the Accreditation System for bias and sensitivity related to diversity.
- The Center for Intercultural and Multilingual Advocacy (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 ESL 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 post-secondary education. Several CIMA programs have won national and international awards. In addition, CIMA researchers have produced highly ranked books and peer-reviewed publications.
- The College is a partner in the Kansas Louis Stokes Alliances for Minority Participation (LS-AMP) funded by the National Science Foundation (NSF). This award funds four colleges at K-State who partner with community colleges in Kansas designated as Hispanic Serving Institutions (HSI). This pipeline project promotes the recruitment, retention and graduation of underrepresented minorities in STEM. College faculty provide expertise and professional development for their partners related to culturally responsive practices in recruitment, retention and teaching. The college also is 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 the college.

Examples are:

- Bhattacharya, K. (2013). Performing gender as "Third-World-Other" in higher education: De/colonizing transnational feminist possibilities. *Creative Approaches to Research*, 6(3), 30-4.
- Losinski, M., Cuenca-Carlion, Y., Zablocki, M., & Teagarden, J. (2014). Examining the efficacy of self-regulated strategy development for students with emotional or behavioral disorders: A meta-analysis. *Behavioral Disorders*, 40(1), 52-67.
- Craft, C. M., & Seley, J. (2014). Review of "Intersections of Religious Privilege: Difficult Dialogues and Student Affairs Practice." *Journal of Student Affairs Research and Practice*, 51(1), 98-100.
- Herrera, S.G. (2010). *Biography-driven culturally responsive teaching*. New York: Teachers College Press.
- Herrera, S.G., & Murry, K.G. (2011). *Mastering ESL and bilingual methods: Differentiated instruction for the culturally and linguistically diverse student* (2nded.). Boston: Allyn & Bacon.
- Herrera, S.G., Kavimandan, S.K., & Holmes, M.A. (2011). *Crossing the vocabulary bridge: Differentiated strategies for diverse secondary classrooms*. New York: Teachers College Press.
- Herrera, S.G., Cabral, R.M., & Murry, K.M. (2013). *Assessment accommodations for classroom teachers of culturally and linguistically diverse students* (2nd ed.). Boston, MA: Allyn & Bacon.

## Relevance

The College of Education's current and planned work in this area aligns with tall themes of the college's 2025 plan as well as to the mission of the college. 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; Office of English Language Acquisition (OELA).

# 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). Indicators of whole family, couples and individual family member stress and relationship strain include:

- 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 K-State's School of Family Studies and Human Services (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, applied research, clinical services, and programming are underway across units in the School of FSHS to:

1. Support healthy relationships across life-course transitions, cultures, family development, and in long-term relationships.
2. Assess the impact of witnessing inter-parental violence across generations.
3. Examine the impact that treatment of depression has on intimate relationships.
4. Support healthy partner and/or or parenting relationships.
5. Develop and test a violence risk assessment tool to guide prevention and treatment of partner violence efforts in military families.
6. Assess the impact romantic relationships and parenting behaviors have on child outcomes.
7. Implement and evaluate a relationship education program for pregnant and parenting adolescents.
8. Study communication technologies on relationships between former partners and between parents and children following divorce.
9. Support and encourage parent-child communication about health and well-being.
10. Develop 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 in the College of Human Ecology are conducting applied studies that support 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

# Food Security: Food-Borne Pathogens in Pre- and Post-Harvest Livestock Research at the Biosecurity Research Institute

## Background

Food-borne 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 due to 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 (BRI) in 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, with an adjacent industry-standard slaughter floor, 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, as well as contamination of post-harvest products, such as ground meat products. Most processing equipment is movable, which enables 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 alkali hydrolysis tissue digester, autoclaves and effluent disposal systems.

Ongoing USDA-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 (anthrax) and Yersinia pestis (plague) that could be deliberately introduced into the food system, which would pose great risks to the public and 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, 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 (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.

## Agency Contact Information

Deputy Commissioner for Operations and Chief Operating Officer (COO)
Food and Drug Administration
Department of Health and Human Services

# Antimicrobial Resistance

## Background

Antimicrobial (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 and Prevention (CDC) 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 also is 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, the first is preventing the need for antimicrobials: The second is 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:*** There are significant gaps 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 anlaysis of full-sequence genome data from isolated pathogens in collaboration with the USDA. At the same time, another part of the team was evaluating techology 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 foodchain. Escherichia coli, Salmonella and Campylobacter are frequent research targets.

***Veterinary practitioner outreach:*** There is an increasing call 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 routinely interact 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.

## Agency Contact Information

FDA Center for Veterinary Medicine
240-402-7002
askcvm@fda.hhs.gov

# High Consequence Pathogens, Including Potential Bioweapons: Countermeasure Development at the Biosecurity Research Institute

## Background

The growing public health problems associated with mosquito and tick-transmitted diseases such as Zika, chikungunya, West Nile and Lyme disease are currently receiving a great deal of attention and causing great fear to individuals and the general public. The vectors, such as mosquitoes and ticks, 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. Lack of funding for training and research in arthropod-borne diseases is creating a void that is making it difficult to respond to the threat of increased vector-borne diseases and address the public's concerns in a timely manner.

## Description

The Biosecurity Research Institute (BRI) in 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 (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.

This state-of-the-art facility is comprised of an ACL/BSL-3 insectary suite (3 rooms at BSL-3E) 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 (BSL-3E), as well as education, training and administrative spaces.

The BRI is the first non-federal facility ever to be approved to work with African swine fever (ASF) and classical swine fever (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 SAs worked with at the BRI include highly pathogenic avian influenza, anthrax, glanders, plague and brucellosis.

Non-SAs used at the BRI include Japanese encephalitis (JEV), yellow fever and Zika virus, all of which are zoonotic pathogens that can infect humans with high morbidity and potentially high mortality. All three of these viruses are transmitted by mosquitoes, and the BRI has capabilities for research with mosquito vectors. 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. This virus is closely related to West Nile virus that has probably infected over 2 million people and more than 1,900 deaths since 1999. 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., includes investigating mosquito transmission and 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 (PIADC) to the National Bio and Agro-defense Facility (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 important to develop new programs that will provide comprehensive training in basic and applied aspects of vector biology/medical entomology, arbovirology, and the epidemiology of arthropod-borne diseases.

Providing education and training to graduate students and post-doctoral fellows will help create a competent cadre of interdisciplinary professionals who will work together to anticipate and respond to arthropod-borne disease outbreaks. Working with some viruses can only be performed in high containment and the BRI is equipped and ready to undertake this research.

## Agency Contact Information

Deputy Commissioner for Operations and COO
Food and Drug Administration
Department of Health and Human Services

# Biosecurity, Biosafety and Biocontainment Research, Training and Education at the Biosecurity Research Institute

## 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 (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 (NBAF) adjacent to the BRI.

## Description

The Biosecurity Research Institute 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 state-of-the-art 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 (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.

Within the 31,000 square feet dedicated to education, integrated classroom and laboratory spaces exist to make student's learning expeditious and efficient. A tiered classroom seating 18 to 25 people is adjoined to a fully-equipped biocontainment laboratory. A wall-size glass window allows students to observe and learn how to do 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 institutes such as NIH's National Biosafety and Biocontainment Training Program (NBBTP) offer 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 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.

## Agency Contact Information

NIH Office of National Biosafety and Biocontainment Training Program
Marcus Hodges, Fellowship Program Director
301-451-3290, info@nbbtp.org

# 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 (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, including:

- Programs and community support networks for military-connected children and youth, with local 4-H Clubs, schools and Operation Military Kids (OMK) youth/family camps.
- Research and training programs on violence prevention in military families, quality childcare and childhood social-emotional health.
- Clinical programs for military personnel, veterans and families.
- Research on the long-term effects of deployment and combat-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.

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 Kansas State University, the College of Human Ecology and the Institute for the Health and Security of Military Families to capitalize on the expertise available here.

## Agency Contact Information

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National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK)

# TRANSPORTATION, HUD

# National Transit Survey Institute (NTSI): Advancing Transport Justice, Resilience and Sustainability Through Data, Research and Outreach

## 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 reslience 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, healthcare, 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. There is no single public repository for this information 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 peers to inform their own surveying efforts or compare results.

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

## Description

The National Transit Survey Institute (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 is quite limited. The NTSI is working to greatly expand the public return on those investments. The NTSI first makes those data available and second 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 intergral part of the 2025 Plans of the Department of Landscape Architecture and Regional & Community Planning, the College of Architecture, Planning & Design, and Kansas State University.

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# Unmanned Aircraft Systems Maintenance Training Programs

## Background

In today's National Airspace System (NAS) environment, as the roles and uses of UAS are evolving at an ever-increasing rate, which is expected to continue as the FAA implements NextGen, the FAA is challenged to keep up with the demands of airspace access from the UAS community. At present, there is a known gap that exists between the design, certification and continued airworthiness standards for manned aircraft and those for UAS. Most UAS are composed of modular systems, commercial-off-the-shelf (COTS) parts, and other replaceable/repairable components. In addition, they usually feature ground support equipment; the equipment is just as critical to the performance and safety of the UAS as the UAS airframe.

The focus on UAS maintenance training programs emerged as a high priority in the FAA's UAS integration office. UAS maintenance and repair research is critical in achieving the FAA's vision of safe, efficient and timely integration of UAS in the NAS. In addition, it has been noted that the sponsoring office needs to address the growing concern of the UAS community toward integration by tackling aspects of UAS maintenance programs. A key aspect of these programs is that the UAS manufacturer typically assumes the role of a repair station, which is not permitted under part 145. Furthermore, questions remain that must be answered in terms of continuous airworthiness, maintenance, and inspection issues, as well as requirements for dealing with the consequences of maintenance-induced failures in the NAS.

## Description

The purpose of this research is to identify the maintenance, modification, repair, inspection, training and certification (hereafter shortened to "maintenance" as a collective term) considerations that are necessary to ensure continued airworthiness of UAS. Part of this process is to determine the current state in the industry of UAS maintenance practices and determine if that state is adequate to ensure the safe operation of the systems in a complex airspace environment. If the current state of the industry's maintenance practices is found to be lacking, then there is a need to identify the gaps between current and ideal states, and propose solutions for filling these gaps. This research will consider all of the prior research on this topic and investigate the unique aspects of UAS maintenance at great length.

The key components of this research include:

1) Review existing data available for maintaining UAS of all sizes.
2) Compare existing maintenance data for UAS with the type of data available for manned aircraft.
3) Determine if a delineation between different types/sizes of UAS is needed to establish varying thresholds of maintenance rigor.
4) Identify best practices for maintaining various classes of UAS within the context of their operational environment.
5) Compile the current training materials and qualifications required for various UAS platforms.
6) Recommend training and certification requirements for UAS maintenance technicians and repair stations across the spectrum of all UAS classes.

All of these research components will build upon prior research to develop solid, justifiable recommendations on how UAS should be maintained to support the FAA's roadmap to integration of UAS into the NAS.

## Relevance

In addition to the federal impact this research has on aviation, it also is important to highlight that this critical work is being accomplished through the FAA's newly awarded small UAS Center of Excellence (COE), of which Kansas State University is a core entity. Additionally, the COE has been "binned" into focus areas. In recognition of a strong UAS reputation, the Kansas State Polytechnic Campus was designated as the lead of the training focus. This is a 5-year award, with options to continue, which has very strong potential for additional FAA funded research work within the state.

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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, 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 (K-State) 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 the safety and durability of concrete railroad ties. Additionally, K-State researchers are assisting KDOT to evaluate track infrastructure for heavier car loads and to evaluate track ballast non-destructively. 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 (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 in order to determine if they are properly assembled at the manufacturing plant, to prevent cracking and failure in the track.

K-State researchers also are 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 has 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 (CRIDS). The proposed center will be used to further develop and deploy existing K-State-developed technologies, in order 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. The 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 has 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.

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# Human Factors Considerations of UAS Procedures and Control Stations

## Background

This research seeks to provide guidance toward the development of new regulatory and guidance materials related to Unmanned Aircraft Systems (UAS) control station design and ergonomics, and pilot and crewmember procedures and operational requirements. This research will extend research being conducted under the ASSURE task A7 "UAS Human Factors Control Station Design Standards (plus Function Allocation, Training and Visual Observer)." This research includes two parallel, collaborating efforts. One will focus on the development of control station requirements including (a) an evaluation of the minimum workstation control and display requirements, and (b) control station ergonomics, safety, and work area design parameters. The second, on which Kansas State University is collaborating, will focus on crewmember procedures and operational requirements. A literature survey will help to determine the operational differences between nominal and off-nominal UAS operation vs. piloting of a manned aircraft to identify minimum pilot-and-crew procedures and operational requirements. The second effort will leverage the control station study to ensure the recommendations are based on the best practices for future control stations.

This research addresses research gaps identified in "A11G.HF.5, HF-15-05, Unmanned Aircraft Systems (UAS) Human Factors Considerations." These address control station standards and guidelines, and control station ergonomics, safety and security as well as procedures and operational requirements.

## Description

Currently, there is no standard for common UAS procedural requirements, and operational tasks need development. There is a significant lack of knowledge and understanding regarding a common set of tasks, and conditions for UAS pilots performing civil UAS operations in the NAS and how those procedures may differ from manned aircraft pilots. There are components of UAS, such as control stations and communication links, which create new concerns including, control station handoff procedures; lost link control procedures; lost link troubleshooting procedures; establishing procedural roles and responsibilities of crewmembers; duty and rest requirements; minimum flight crew requirements; operations during data link degradation and loss; and operations during periods of decreased sensory cues from aircraft and environment. A common set of operational procedures must be established to safely integrate UAS into the National Airspace System with the same level of safety assurance that currently exists in manned aviation. The research will examine the procedures and operational requirements on a prototype control station and other control stations to provide a determination of the effectiveness of procedures and operational requirements.

The following research questions are addressed for UAS pilot and crewmember procedures, and operational requirements:

1. What are the recommended crew procedures for hand-off of UAS control?
2. What are the unique considerations for UAS crewmember procedures and operational requirements, based on the various sizes of UAS?
3. What are the unique UAS crewmember-induced failures in UAS, and what are their consequences?

This research will address pilot and crewmember procedures and operational requirements. It will address current UAS operational procedure gaps including operation in off-nominal conditions such as degraded or lost data link, or degraded sensory data/cues from the aircraft. It will address handoff between physically remote UAS pilots/control stations.

## Relevance

In addition to the federal impact this research has on aviation, it also is important to highlight that this critical work is being accomplished through the FAA's newly awarded small UAS Center of Excellence (COE), of which Kansas State University is a core entity. Additionally, the COE has been "binned" into focus areas. In recognition of a strong UAS reputation, the Kansas State Polytechnic Campus was designated as the lead of the training focus. This is a 5-year award, with options to continue, which has very strong potential for additional FAA funded research work within the state.

## Agency Contact Information

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# ALERT SHEETS

# Structured Environment for Animal Data and Simulation (SEADS)

## Background

Kansas State University and the University of Missouri-Kansas City have developed a partnership to develop a Structured Environment for Animal Data and Simulation (SEADS). Other organizations in the region also are part of the development of SEADS, including Kansas City Area Life Sciences Institute, Children's Mercy Hospital, University of Kansas Medical Center, Cerner, and MRIGlobal. Together, this collaboration can take advantage of "big data" and the wealth of computational approaches to significantly impact research in animal and human health.

## Description

The vision for SEADS is to bring together pre-clinical human and animal health and comparative genomic data to develop a cohesive and structured environment to collect and disseminate information, which will improve the quality of animal and human health through improved, refined, and enhanced collaborative research and education. This will be done by leveraging existing animal databases without unnecessarily sacrificing additional animals.

This collaboration across state lines and disciplines will help to develop a platform for mining shared data that can accelerate the development of human and animal drugs, help enhance the regulatory approval process, decrease the use of animal models by employing in silico virtual animal populations, and have other applications to advance research and technology. Together, this collaboration can take advantage of "big data" and the wealth of computational approaches to significantly impact research in animal and human health.

Key Elements of Success:

1. Collect and Disseminate Data: Develop a cohesive and structured environment to collect data to be used for human and animal health research and regulatory drug approval.
2. Interdisciplinary Education: Comprehensively train students and researchers in bioinformatics, modeling and analytical methods to maximally benefit animal and human health researchers.
3. Systemic Change in Regulatory Approval Process: Work with regulatory agencies to scientifically prove the benefits of using population data for modeling and simulations, therefore reducing animal testing while increasing accuracy for accelerated drug approvals.
4. Collaborative Research and Engagement: Develop the infrastructure needed to encourage and conduct research across institutions, and between academia and industry.

## Relevance

The long, tedious approval process to develop novel drugs and therapeutics to help treat diseases is a major threat to individuals facing health challenges, and is impacting the pharmaceutical industry's willingness to invest in research for new drug discoveries for both humans and animals. The current approval process was developed to assure drugs and therapies were safe for humans; however, over time, it has not substantially changed to keep up with modern scientific methods. The current regulatory system poorly integrates modern computational science into the approval process in either a timely or efficient manner. Furthermore, it does not optimally use available animal/pre-clinical resources and well-established modern computational techniques. As a result, needless animal studies are often conducted to obtain controls when much better data exists — if only it could be captured and documented as proposed in SEADS.

This approach is unique in that it will be public and available to researchers, compared to for-profit initiatives where data and structure are proprietary. Data generated and analyzed can be used by researchers to:

- Develop applications to perform simulations with existing data, saving time and resources.
- Develop methods to integrate sparse and incomplete data sets to create usable in silico (via computer simulations) virtual animal populations to replace, reduce and refine animal use.
- Develop a platform to enable the use of curated and validated animal health data into the human health sphere and vice versa.
- Identify congruencies between human and animal diseases, and match and integrate animal and human data to predict functional information.
- Assist with efforts to integrate information on emerging zoonotic diseases and improve bio surveillance.
- Use of naturally occurring cancer and other diseases in animals to accelerate development of human therapeutics.
- Develop new software for computational medicine.
- Develop opportunities for outcomes research in both human and animal medicine.
- Advance research efforts in antibiotic resistance.
- Develop integrated training opportunities for undergraduate and M.S. students.

# 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. K-State's project is funded under this program.

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 K-State Research and Extension 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. Kansas State University research has shown increases between 18 percent and 51 percent in wheat yield the first year following winter canola. Growing canola enables the use of conservation tillage and/or no tillage, decreases soil erosion, improves water infiltration of soils, and enhances cropping system sustainability.

## Description

The long-term goal of this multi-state, interdisciplinary project is to facilitate the adoption of winter canola as an agronomically and economically viable rotation crop in the southern Great Plains. To stimulate winter canola acreage and production increases in the region, the project focuses on the high priority areas of developing and testing of superior cultivars, improving methods of production, and transferring new knowledge to producers. Success will be measured by an increase in planted acres, the testing and release of new cultivars with yields above the national average, improved consistency of production using best management practices, and attendance, participation, and feedback at extension activities. The following objectives support the project. (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 (*Leptosphaeria maculans*) resistance. (2) Improve canola cropping systems by addressing agronomic management issues through scientific research. Results will enable producers to identify cropping systems that are effective, feasible and profitable. Management studies include: crop establishment, seeding rate and row spacing, irrigation management, crop rotation, harvest management, herbicide efficacy, fungicide and growth regulator use, on-farm testing and crop modeling in DSSAT. (3) Deliver cultivar and agronomic management technologies to new and experienced growers through appropriate extension programs. These multifaceted programs include participation by faculty, industry personnel, grower organizations and producers. Methods of delivery may include, but are not limited to, field days, field tours, risk management schools, extension and peer-reviewed journal publications, professional society meetings, agronomy updates, radio and television interviews, web-based applications, peer-to-peer interactions and social media.

## Relevance

A high-value market exists for the heart-healthy oil and high-protein meal derived from canola seed. The U.S. imports over 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. As a result, winter canola planted acres have increased substantially in the Great Plains. 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 strong demand.

Kansas State University's canola breeding and research program focuses on developing cultivars adapted specifically to the southern Great Plains. It is the only public canola breeding program in the region. Seven 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.

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 (NWCVT) also is coordinated by Kansas State University and this trial is planted at 35 locations in 18 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.

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# USDA-ARS Ogallala Aquifer Program

## Background

Funding in the USDA-ARS budget for FY 2018 is requested for the Ogallala Aquifer Program. This program is conducting 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 four 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. 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 to 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 policy makers.
- 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 multi-state, university and federal program. The group will develop, evaluate and transfer technologies that will allow efficient water utilization while conserving and protecting the Ogallala 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 Research and Extension
West Texas A&M University
Texas Tech University

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# National Plant Diagnostic Network (NPDN)

## Background

The National Plant Diagnostic Network (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 (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 on 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 U.S. territories through five regional centers, and reports detections to the NPDN National Data Repository. The U.S. is dependent on exports to stimulate an economic recovery. Plants and plant products contribute one half to two thirds of U.S. agricultural exports worth more than $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 (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 per 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 more than 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 (PDIS), a lab management software system developed at K-State, 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 Diagnoistic Network (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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# TITLE XII – USAID Feed the Future Innovation Labs

## Background

Feed the Future is the U.S. Government's global hunger and food security initiative and under this initiative are 24 Feed the Future Innovation Labs. The Feed the Future Innovation 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. Kansas State University is the recipient of four of the 24 labs and is positioned as a leader among the 65 U.S. universities active in the initiative.

## Description

The establishment of the Innovation Labs is creating new partnerships between U.S. and developing-nation universities across the globe with a focus on building human and institutional capacity while advancing scientific frontiers beneficial domestically as well as internationally.

It is evident:

- 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. Economic growth in foreign nations benefits the United States by creating new markets for U.S. products.
- A World Bank study shows the returns to higher education investments 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. They solve critical agricultural problems that impact food security and poverty through research conducted collaboratively between U.S. and developing country students and scientists while also building the developing country capacity to solve their own problems in the future. The U.S. has benefited immensely through pest management research in foreign coutries. For example, research on the sugar cane aphid took place in southern Africa in the 1980's and we are reaping the benefit of that research today in Kansas and other areas affected by this pest infestation.
- More than 65 U.S. universities throughout the nation are engaged in the labs. This 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. We have trained many global leaders, including the current president of the International Fund for Agricultural Development and many scientific leaders.
- The Innovation Labs are tackling the world's most challenging agricultural development problems and sharing scientific knowledge throughout the world on issues such as productivity, climate resiliency, income generation and human nutrition. To remove dependency on development assistance, it is essential to train a workforce of well-educated citizens to enable the transition to independent economic growth.

***Sustaining Progress.*** In July 2016, the "Global Food Security Act of 2016" was signed into law. The legislation codifies the U.S. Government's commitment to international agriclture. It strengthens the initiative's existing accountability mechanisms and establishes parameters for robust Congressional oversight, monitoring and evaluation of impact toward this commitment.

## Relevance

Kansas State University is currently leading four USAID Feed the Future Innovation Labs that are directly funded under the Global Food Security Act of 2016.

They are the:

1) Applied Wheat Genomics Innovation Lab.
2) Reduction of Post-Harvest Loss Innovation Lab.
3) Sorghum and Millet Innovation Lab.
4) Sustainable Intensification Innovation Lab.

Kansas State University is the only university in the U.S. to have successfully competed for four of the new innovation labs.

Kansas State University chairs the Innovation Lab Council, which is a board that interacts with USAID on behalf of all labs.

## Agency Contact Information

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# Food Animal Residue Avoidance and Depletion (FARAD) Program

## Background / Description

The Food Animal Residue Avoidance and Depletion (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 (www.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 also is used when food-producing animals are mistakenly exposed to environmental contaminants (pesticides or biotoxins, melamine, etc), or for example to nuclear fall-out 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 (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 clearing house for residue data.

## Relevance

The FARAD program was developed in 1981 by pharmacologists and toxicologists at four land-grant universities. Dr. Jim Riviere of the College of Veterinary Medicine at K-State 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 2015, FARAD experienced a 23.5 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.

## Agency Contact Information

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# National Agricultural Biosecurity Center: The National Animal Health Laboratory Network

## Background

Homeland Security Presidential Directive–9 (HSPD-9), Defense of U.S. Agriculture and Food, states that America's agriculture 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." Historically, the U.S. Dept. of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) has served as the vanguard to protect America's pre-harvest resources. The National Animal Health Laboratory (NAHLN) represents a cooperative effort between two USDA agencies: APHIS and the National Institute of Food and Agriculture (NIFA), and the American Association of Veterinary Laboratory Diagnosticians (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 (NABC) at K-State 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 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

The National Animal Health Laboratory Network (NAHLN) provides an automated high throughput diagnostic protocol to facilitate rapid and accurate examination of samples from diseases of importance to food animal security. A major paradigm for the success of a great nation is its ability to provide food and water resources to its citizens. An essential element in this process is the health and wellbeing of our food animals, and NAHLN is at the forefront of diagnosing and preventing the spread of important limitations to our food supply and our ability to export food supplies to our global partners.

Kansas State University (K-State) has participated with NAHLN in significant ways, including both the Kansas State Veterinary Diagnostic Laboratory (KSVDL) and the National Agricultural Biosecurity Center (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 of personnel and conducting surveillance testing for CSF, HPAI, CWD, PRV and emerging diseases; 4) increased testing capacity of the KSVDL by conducting research on new methodologies; and 5) development of training strategy framework for NAHLN laboratories by assessing lessons learned.

## Relevance

At the Federal level, USDA's National Veterinary Services Laboratories (NVSL) serves 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 (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.

## Agency Contact Information

U.S. Dept. of Agriculture
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# NSF National Ecological Observatory Network (NEON)

## Background

The National Ecological Observatory Network (NEON) is a continental-scale ecological observation facility sponsored by the National Science Foundation (NSF) 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 and 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 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 K-State's Konza Prairie Biological Station, and an additional relocatable site is 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. NEON funding has been approved by congress, 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.

## Agency Contact Information

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# NSF Long-Term Ecological Research (LTER) Program at Konza Prairie: Contributing to the Conservation and Management of Grasslands Worldwide

## Background

The Long Term Ecological Research (LTER) program was created by the National Science Foundation (NSF) 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

K-State's Konza Prairie Biological Station is the core research site for the Konza Prairie LTER (KNZ) program. Konza Prairie, an 8,600-acre native tallgrass prairie research station, is jointly owned by Kansas State University and The Nature Conservancy and managed by K-State's Division of Biology. Konza Prairie was one of the 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 (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 Kansas State University 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 1,600 publications including more than 260 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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# USDA-ARS Center for Grain and Animal Health Research (CGAHR)

## Description

The Agricultural Research Service's Center for Grain and Animal Health Research (CGAHR) is the only United States 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-vectored animal diseases, and in the production, storage, and utilization of grain to ensure a safe, abundant, and high quality food supply."

CGAHR is made up of four research units. Each research unit has a unique mission and interacts with key customers and stakeholders. CGAHR scientists are recognized worldwide for innovative research and technology development.

1) The Arthropod-Borne Animal Disease Research Unit studies animal disease transmitted 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 & Structure Research Unit investigates relationships between physical and chemical attributes and end-use quality for various wheat and sorghum products, and 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 develops technology to measure and preserve grain quality.

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# Protecting Swine from Foreign Diseases

## Description

The Arthropod-Borne Animal Disease Research Unit (ABADRU), in the Center for Grain and Animal Health Research, is conducting research on animal diseases including Rift Valley Fever, Vesicular Stomatitis, and Blue Tongue that threaten US livestock. Collaborative research including Kansas State University (KSU) scientists in the Colleges of Agriculture and Veterinary Medicine has recently been initiated on several swine diseases including African Swine Fever, Japanese encephalitis and Classical Swine Fever that pose a serious risk to producers and the entire industry because of the trade impacts that outbreaks could cause if these diseases are introduced into the US. This initiative will strengthen on-going 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-parasite relationships involved in arbovirus transmission to swine, and the understanding the epidemiology and progression of both diseases. There is critical need 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 in 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 KSU 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 U.S.
    - 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.

## USDA ARS CGAHR Local Contact

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## USDA ARS CGAHR Center Director

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# 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) has responsibility to develop 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 percent of the hard winter wheat commercially released in the U.S. that is used in the $70 billion bakery and snack food industries. 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 predicts protein, starch, processing and end-product quality.
    - Rapid, accurate and non-destructive 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.

The National Wheat Improvement Committee, National Association of Wheat Growers, North American Millers' Association, and US Wheat Associates strongly recommend additional funding for a multidisciplinary initiative to improve wheat quality and competitiveness, and security in our domestic and export markets. 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.

## USDA ARS CGAHR Local Contact

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# Heat and Drought-Tolerant Wheat

## Description

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 rain fed 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 become even greater in the future. Unfortunately, breeding for tolerance to heat and drought stress is difficult. New research investment is urgently needed to accelerate efforts to improve wheat resilience to heat and drought stress.

An 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) Category 1 Research Plant Physiologist/Biochemist
2) Category 1 Research Plant Molecular Biologist
3) Category 3 Support Scientist

The requested addition to permanent base funds for salaries, materials, supplies and equipment, as well as overhead, is $1,100,000.

## Justification

- Tolerance to heat stress is the single most important genetic improvement that is 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 of 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

## K-State Contacts

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## USDA ARS CGAHR Local Contact

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## USDA ARS CGAHR Center Director

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# Resistance to Hessian Fly in Wheat

## Description

The Hard Winter Wheat Genetics Research Unit, in the Center for Grain and Animal Health Research, in close cooperation with Kansas State University (K-State), 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 percent 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. Also needed is a greater understanding of the mechanistic basis of insect virulence and host resistance. 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. The resurgence of the Hessian fly can be attributed to the 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 under-funded 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.

## K-State Contacts

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# NATIONAL INITIATIVES

# College of Veterinary Medicine/Association of American Veterinary Medical Colleges

## 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, and 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.

There are only 30 veterinary medical colleges in the country, 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 due to 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 due to 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 load. 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 life style. 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 load, 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 the Secretary 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 (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 three based on current appropriations.

# College of Veterinary Medicine/Association of American Veterinary Medical Colleges

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 (FARAD), and the Competitive, Special and Facilities Research Grant Act, as well as the new funding for the Veterinary Services Grant Program (VSGP) to develop, implement, and sustain veterinary services 2) tax exemption for awards made under the Veterinary Medicine Loan Repayment Program (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 (NAHLN) as well as for the National Institutes of Health (NIH).

Aspirations for the appropriations for FY 2017 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 (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 College of Veterinary Medicine, 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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