V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Animal Health and Production

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
301	Reproductive Performance of Animals	15%		15%	
302	Nutrient Utilization in Animals	15%		15%	
303	Genetic Improvement of Animals	0%		15%	
305	Animal Physiological Processes	0%		15%	
307	Animal Management Systems	30%		10%	
311	Animal Diseases	0%		15%	
315	Animal Welfare/Well-Being and Protection	0%		10%	
806	Youth Development	40%		5%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	8.0	0.0	25.0	0.0
Actual	11.5	0.0	27.7	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
377570	0	1132375	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
377570	0	1132375	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
3506200	0	11582734	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research activities in 2010 included efforts to better understand the PRRSV-S. suis superinfection in an effort to develop better treatment and prevention of this serious disease in pigs and emerging disease in humans, a study of the effect of grooming devices on performance and behavior in feedlot cattle, a study to monitor environmental conditions on a swine transport trailer during journeys from the farm to the slaughter plant, research that developed the first metagenomics dataset, including phylogeny and functional capacity, of the canine gastrointestinal microbiome, a significant expansion of the base for teaching manure nutrient management plan development through the Illinois Manure Management Plan program, improved treatments for pig castration [with improved treatments, swine producers would realize significant decreases in their production costs while experiencing similar rates of average daily gain in the pigs], findings that have helped contribute to our understanding of the effects of two commonly used intra-articular drugs, sodium hayaluronate and triamcinolone, on joint metabolism, results that will be used to further delineate better isolation techniques for progenitor cells from tendon [the research will benefit clinical cases of tendon injury], a finding that the nutraceutical approach of providing natural or synthetic dietary receptor mimetics for protection against gastrointestinal virus infectious disease in all species is plausible, the discovery that expensive storage media is not necessary for improving fecal detection method but that the choice of extraction methods seems paramount, and the first survey and characterization of the prohormones in three main livestock species [cattle, chicken, and pig].

Additional research activities in 2010 included results that provide a foundation for understanding how sperm releases acrosome, the development of design constructs to improve the safety of the very effective Pinnacle IN vaccine in treating strangles in horses, the application of microfluidics to embryo production in vitro [which should alleviate some of the limits that traditional microdrop culture places on embryo development and research into gamete and embryo physiology], a project designed to develop a behavioral assay for neonatal piglets to assess learning and memory and determine the effects of acute viral infection on learning and memory, and the development of a DNA-based diagnostic test for neuropathic hydrocephalus that accurately determines an individual's genotype [over 80,000 animals have already been screened using this technique].

Conference presentations of research in 2010 included the Ceva Vector Vaccines Symposium, the American Association of Avian Pathologists/American Veterinary Medicine Association Western Poultry Disease Conference, the Waltham International Nutritional Sciences Symposium, the American Dairy Science Association Annual Meeting, the American Society for Animal Sciences, the National Institute of Biomedical Innovation, the Japanese Society of Developmental Biologists, the Third Pan Pacific Symposium on Stem Cell Research, the Society for the Study of Reproduction, the Gordon Conference on Fertilization and Activation of Development, the American Society for Cell Biology, the International Embryo Transfer Society Annual Meeting, the International Society on Stem Cell Research, the Society for the Study of Reproduction Meetings, and the Korean National Academy of Science Biotechnology Conference.

The use of technology is a growing delivery system for Extension programs addressing animal production and health. The **Illinois Livestock Trail** website is the key source for a wealth of information related to livestock production and manure management. **MarketMaker**, an interactive web-based multi-state market system developed by the University of Illinois that locates businesses and markets for agricultural products, has expanded geographically with over half the states in the nation considering a formal partnership in developing the network. The data currently encompasses 489,942 profiles of farmers and other food-related enterprises in Illinois, Iowa, Georgia, Mississippi, Nebraska, Kentucky, Michigan,

Indiana, Ohio, and New York that can be queried by users. Data for Arkansas, Colorado, Florida, Louisiana, Pennsylvania, South Carolina, Washington, D.C., Texas, and Alabama are under development [see Agricultural Global Food Security and Hunger planned program]. **Illinois Horse Breeders Short Courses**, swine reproductive programming for Spanish-speaking employees, **Illinois Dairy Days**, and **Pet Extravaganza** are examples of programs delivered by Extension staff to audiences at campus and off-campus sites. In addition, 1,288 Illinois 4-H and FFA members completed the seven modules of the online **Quality Assurance and Ethics Certification** training and quiz for 2010 for beef, dairy, goats, horses, sheep and swine covering topics related to care and administration of medicine for livestock.

2. Brief description of the target audience

Members of the target audience include pig farmers and the swine industry, beef cattle producers, feedlot operators, cattle veterinarians, swine transport companies, the swine slaughter sector, the pet food industry, custom manure haulers, regulatory agency representatives, livestock commodity group representatives, equine veterinarians and horse owners, dairy scientists, the genetic dairy industry, dairy producers, basic and applied biomedical and agricultural researchers and livestock industries using genome-based selection tools, scientists focusing on animal reproduction issues, commercial egg producers and poultry nutritionists, and companies that produce veterinary biologics and researchers working on PRRS virus biology. Extension also targeted companion animal owners and youth.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	40000	20000	10000	0
Actual	74903	31959	40394	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2010
Plan: 1
Actual: 3

Patents listed

[1] Carbohydrate Binding Molecule With Affinity For Insoluble Xylan; [2] Microfluidic Systems And Methods; [3] Thermostable Enzymes For The Hydrolosis Of Mannan-Containing Polysaccharides

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Plan	0	75	
Actual	1	56	57

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Research Projects

Year	Target	Actual
2010	9	11

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

Outcome #1

1. Outcome Measures

Youth Passing A Livestock Ethics Knowledge Quiz After Participating In Extension Training

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Knowledge To Ensure Meat Is Safe For Consumption

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	3000	1288

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Humane care of animals helps develop social and emotional skills in young people.

What has been done
An online module and certification on ethical treatment of animals continues to be provided to 4-H members. In addition, face-to-face training is offered that combines ethics and basic livestock production training.

Results
Online module training records indicate that 1,288 youth were certified.

4. Associated Knowledge Areas

KA Code	Knowledge Area
305	Animal Physiological Processes
307	Animal Management Systems

311	Animal Diseases
806	Youth Development

Outcome #3

1. Outcome Measures

Increased Knowledge Of Livestock Care And Management

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Improving On Current Methods Of Surgical Castration Of Swine

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Surgical castration is a practice chosen by most swine producers because it is relatively easy to perform and is an inexpensive and effective method to reduce boar odor in pork. It can also alleviate potential behavioral problems associated with raising intact males. This practice has come under major scrutiny in the past 20 years as animal welfare concerns are being raised regarding the pain associated with surgical removal of the testes.

What has been done
Boars were given a single injection of a time-released progestin, depot medroxyprogesterone acetate [DMPA], at ten weeks of age and monitored weekly and biweekly for serum testosterone and androstendione measurements as well as for testicular size, length and width as measured by calipers. Animals were sacrificed at 180 days of age and samples of subcutaneous fat and muscle as well as testes were collected for further analysis. The information currently gained from this project has been shared with large, integrated swine operations and veterinary practices as to its use and efficacy. Additionally, industry representatives have been consulted on the current research and modifications that need to be made for future experiments.

Results
With improved treatments, swine producers would realize significant decreases in their production costs while experiencing similar rates of average daily gain in the pigs. Not only would this result in a substantial reduction in labor costs, but losses due to mortality and costs of post-surgical castration complications such as swelling of the incision, anorexia, and infection would be reduced. Additionally, there would be less risk of employee injuries during surgical castration of piglets. This would improve employee and animal welfare.

4. Associated Knowledge Areas

KA Code	Knowledge Area
305	Animal Physiological Processes
315	Animal Welfare/Well-Being and Protection

Outcome #5

1. Outcome Measures

Improved Cattle DNA Amplification And Sequencing Through Optimal Sampling

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In order to maximize the ability to amplify and sequence DNA from cattle, we have tested various collection and storage media.

What has been done
The cattle fecal samples were collected locally at the facilities of the University of Illinois, with minimal exposure of samples to the environment before collection. Samples were collected into one of three different media to test the success rate of DNA extraction and amplification for the three media: [1] A saturated salt/DMSO solution; [2] The commercially available RNAlater [Qiagen] storage medium; and [3] The commercially available SCSR fecal transport medium [Noninvasive Technologies], which is specifically designed to keep exfoliated cells alive during sampling. Two different commercially available kits were used to extract DNA from each of the cattle fecal samples collected in each of the different media. The DNA Stool Mini Kit [Qiagen] is

specifically designed to extract DNA from fecal samples, and to reduce the presence of PCR inhibitors in the resulting extracted DNA. A second commercially available kit not specifically designed for use with dung was also tested.

Results
The medium into which the fecal samples were collected did not appear to have a great effect on the ability to amplify DNA extracted from the samples. By contrast, the type of DNA extraction kit used had a major impact on the utility of the extract for PCR amplification. The kit designed for use with fecal DNA had a much higher success rate, presumably due to the use of an adsorption resin and a buffer optimized for removal of PCR inhibitors. The storage media were all found to be similarly effective in producing DNA of sufficient quality and quantity for downstream amplification. This suggests that expensive storage media is not necessary for improving fecal detection methods. However, the choice of extraction method seems paramount, as methods specifically designed for use with fecal DNA [by incorporating the use of resins and buffers to minimize the presence of downstream inhibitors] greatly improved the ability to amplify the DNA.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
305	Animal Physiological Processes
307	Animal Management Systems
315	Animal Welfare/Well-Being and Protection

Outcome #6

1. Outcome Measures

Establishing A New Model For Assessing The Effects Of Acute Viral Infections On Learning And Memory In Piglets

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Pigs are used in a myriad of research disciplines related to human health, but no studies have employed the piglet to directly assess cognitive function during the neonatal period or to assess how viral infection affects cognition. An objective was to develop a behavioral assay for neonatal piglets to assess learning and memory and determine the effects of acute viral infection on learning and memory.

What has been done
At two weeks of age, piglets were trained to locate a milk reward in an eight arm radial maze, using colored intra-maze cues. Cue colors were then reversed and pigs re-tested to assess learning and working memory. Piglets quickly learned the simple associative acquisition task, and proficiency greatly improved throughout reversal testing. To further assess the behavioral assay, piglets received an i.p. injection of saline or polyinosinic:polycytidylic acid [poly I:C; 5 mg/kg body weight] immediately preceding reversal testing. Poly I:C-treated piglets exhibited acute sickness behaviors, but observationally, were asymptomatic for twelve hours post-injection. Pro-inflammatory cytokine mRNA expression was elevated four hours post-injection in both peripheral and central compartments, and plasma cytokine protein levels were concurrently elevated. At 24, 48, and 72 hours post-injection, poly I:C-treated piglets committed more incorrect arm entries, required more time to complete the reversal task, and moved a greater distance in the maze compared with control piglets. Collectively, these data demonstrate that neonatal piglets are capable of being trained in traditional learning and memory tests, and peripheral immune activation elicits alterations in cognitive processing in the neonate.

Results
The present study established a new model for assessing the effects of acute viral infections on learning and memory. Viral infections are common in swine but how they impinge upon the brain to affect behavior and cognition is largely unknown. The brain is rapidly growing and developing in the postnatal period and infection at this time may have long-lasting programming effects on future behavior. Understanding how early-life infection affects brain and cognitive development will be relevant to animal health and well being. Further, the piglet may be an excellent preclinical translational model for studying the developmental origins of behavioral disorders.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
305	Animal Physiological Processes
311	Animal Diseases
315	Animal Welfare/Well-Being and Protection

Outcome #7

1. Outcome Measures

An Improved Diagnostic Test For Neuropathic Hydrocephalus In Pigs

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The expression pattern of bhmt and bhmt-2 genes in pigs is similar to humans and further supports the use of the pig as an appropriate animal model to study diseases and gene regulation associated with bhmt and bhmt-2 genes.

What has been done
Nonsynonymous SNPs recognized in this study are located in regions of the pTLR gene that are implicated either in binding microbial products or intracellular signaling. Thus, they could be significant in host responses to important swine diseases. In addition, the protein domain architecture of these three pTLRs was examined between human, mouse, cow, and pig, revealing 12 regions of conservation in the TLR variable leucine-rich-repeat patterning. Using the DNA sequence information that has been generated, a DNA-based diagnostic test has been developed for neuropathic hydrocephalus that accurately determines an individual's genotype.

Results
The genotype of an animal can be obtained through analysis of any DNA containing sample such as blood, semen, tissue or hair follicles. Internationally, more than 80,000 animals have been screened using this diagnostic.

4. Associated Knowledge Areas

KA Code	Knowledge Area
303	Genetic Improvement of Animals
305	Animal Physiological Processes
311	Animal Diseases
315	Animal Welfare/Well-Being and Protection

Outcome #8

1. Outcome Measures

Utilization Of Waste Management Tools Such As The Illinois Manure Management Plan Workbook And Website

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	100

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
This project studies improvements of livestock waste management and emissions control in two contexts, specific technologies and the overall impact of livestock production on the surroundings.

What has been done
The Illinois Manure Management Plan website [www.immp.uiuc.edu] has been further developed. Discussions with the Illinois EPA regarding changes that need to be made to the website language and forms to maintain compliance with new CAFO/NPDES rules are ongoing. Illinois will see a dramatic increase in NPDES permits over the next couple of years and IMMP will be helpful to those new to the permit program.

IMMP is one of several products available, but is the only one that combines Illinois-specific requirements and information for livestock production. It is supplied free of charge to users. Approximately 1,000 Illinois livestock producers now have access to this reporting and record keeping tool, the Illinois Manure Management Plan Workbook and website, which can help producers meet compliance guidelines with existing and new water quality regulations. The IMMP tools are useful to Illinois livestock facilities of all sizes.

During the 2009-2010 workshop series "Certified Livestock Manager Training", we used anonymous polling at 8 workshops around the state to get answers to the question "My manure plan is: [1] in my head [13%]; [2] a work in progress [23%]; [3] written, but not updated regularly [20%]; or [4] written, updated annually and constantly used [45%]." The last choice is the desirable situation. Attendance at the CLM training series every three years is required by Illinois state law for producers having large facilities, and 279 producers and consultants participated in 2010. Since each year in the three year cycle we have a different group, it has been encouraging to see the [4] responses slightly increase each year.

Results
Limited web usage data are available to IMMP site administrators. 64 new plans were created in 2010. 36 plans were modified in 2010, and the website had 18,550 total page views.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
307	Animal Management Systems
315	Animal Welfare/Well-Being and Protection

Outcome #9

1. Outcome Measures

Mitigating Impacts Associated With The Reuse Of Concentrated Animal Feeding Operations Wastewater

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Large volumes of manure-contaminated wastewater, wash water, and storm water runoff can be generated at concentrated animal feeding operations [CAFOs]. The reuse of CAFO wastewater on agricultural lands can decrease the amount of wastewater discharge into sensitive water bodies and use the nutrients in the discharge as fertilizers for irrigation applications. However, the wastewater from large confined-animal farms usually retains many contaminants such as excess amounts of nutrients, salts, pathogens, heavy metals, hormones and antibiotics, which could pose environmental and public health risks if the wastewater is widely applied for agricultural irrigation.

What has been done
This project addresses how wastewater reuse from dairy and beef farms contributes to the problem of animal hormones and veterinary antibiotics in the environment. The initial phase of the study focused on established robust analytical methods for extraction and detection of three free hormones [17a-estradiol, 17b-estradiol, and estrone], three hormone conjugates [17a-estradiol-3-sulfate, 17b-estradiol-3-sulfate, and estrone-3-sulfate], and two new veterinary antibiotics

[ceftiofur and tulathromycin] in water, manure contaminated wastewater, and soil matrices. To compensate for matrix effects observed in the analysis of environmental samples when using high performance liquid chromatography combined with tandem mass spectrometry [HPLC-MS/MS], we also utilized an isotope dilution method to provide more accurate analysis for those complex samples. All developed methods are applicable for the studies regarding fates and transport of these hormones and antibiotics as well as their monitoring in various environmental samples. We also investigated the transformation kinetics and mechanisms of three steroid hormones and two antibiotics in dairy lagoon water and beef recycled wastewater during the reporting period.

Results

We found a reversible transformation occurred among three hormones in the dairy lagoon water, which resulted in the hormone contaminant persistence in the environment. A biological degradation mechanism for cefitiofur in beef recycled wastewater was proposed through identifying its metabolites. Also, our initial results suggest that increasing the residence time of wastewater in a lagoon or using aerobic settling tanks may be economical, feasible, and efficient practices to degrade hormone and antibiotic contaminants and thus reduce their loads to the environment. These results will be useful for development of integrated management strategies to mitigate potential adverse impacts associated with the reuse of CAFO wastewater.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
305	Animal Physiological Processes
307	Animal Management Systems
311	Animal Diseases
315	Animal Welfare/Well-Being and Protection

Outcome #10

1. Outcome Measures

Utilization Of Yeast-Based Mannan Oligosaccharide Products For Improved Growth Performance And Disease Resistance

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
We expect the results of our research to be of significant practical importance to the swine industry. There is widespread adoption in the industry of yeast-based mannan oligosaccharide [MOS] products, largely for improvement of growth performance but to some extent for increased disease resistance. However, the impacts on disease resistance are not well defined nor well understood.

What has been done
Our previous results suggested that MOS stimulates the immune system under normal conditions, but reduces inflammation during disease. Our present results suggest that it is important to define mannan products precisely, because a more refined product [Actigen] may have somewhat different impacts on the immune system. We must now confirm these results and then define more clearly the immune effects of the two related products. That will be necessary in order to use these products to greatest advantage. There is widespread interest in the use of physiologically active plant extracts in animal diets to improve productive performance and protect against disease. Our current data provides the clearest available evidence that some of these products can reduce diarrhea in disease-challenged animals.

Results
We expect the swine industry to consider the use of these plant extracts under certain conditions. Our demonstration of effects on intestinal morphology provides further support for beneficial effects. The anti-inflammatory effects that several plant extracts showed in our in vitro work may be important in management of diseased animals. Overall, our work this year has continued the process of clarifying which of the many candidate dietary factors will be useful in maintaining health of pigs, and how they may be used most effectively.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
305	Animal Physiological Processes
311	Animal Diseases

V(H). Planned Program (External Factors)

External factors which affected outcomes
- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

Evaluation Results

Key Items of Evaluation