V(A). Planned Program (Summary)

Program # 17

1. Name of the Planned Program

Structure and Function of Macromolecules

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		20%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%		20%	
206	Basic Plant Biology	0%		20%	
211	Insects, Mites, and Other Arthropods Affecting Plants	0%		5%	
212	Pathogens and Nematodes Affecting Plants	0%		5%	
304	Animal Genome	0%		10%	
305	Animal Physiological Processes	0%		10%	
311	Animal Diseases	0%		5%	
312	External Parasites and Pests of Animals	0%		5%	
	Total	0%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	8.0	0.0
Actual Paid Professional	0.0	0.0	8.0	0.0
Actual Volunteer	0.0	0.0	0.0	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**
0	0	315016	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	315016	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	1742518	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

- Basic research will be conducted that will make fundamental discoveries which will enhance our understanding of molecular mechanisms involved in the regulation of physiological processes in plant and animal systems.
- New faculty and staff will be recruited to build, foster and maintain a cohesive critical mass of research faculty with a diverse set of expertise that focus on the study of structural biology.
- Grant proposals will be written to acquire and maintain state of the art equipment to enhance the research capabilities relating to protein structure/ function/ interactions on the OSU campus.
- Funds will be applied for/ solicited from national, state and university sources to acquire, maintain and restore support for "Core" facilities that are critical to the research mission of DASNR and Oklahoma State University.
- Proposals will be submitted to attract sufficient extramural support to establish an extramurally funded "Structural Biology" Center at OSU that will stimulate collaborations and research productivity.
- Design and conduct basic research to fill critical gaps in scientific knowledge that will address needs, issues and problems that ultimately can be translated into an improvement in plant and animal health.
- Develop new research methods and procedures
- Train undergraduate and graduate students, and postdoctoral associates
- Publish scientific articles
- Write and submit grant proposals
- Attend and present scientific findings at professional meetings
- File patents for protection of intellectual property and negotiate licensing agreements for technology transfer
- Interact with other researchers both on and off the OSU campus.

2. Brief description of the target audience

- Departments and department heads
- OSU administrators
- Other faculty and other scientific researchers in DASNR, at OSU & the scientific community
- Students and post-docs
- Federal, state, and private funding agencies
- Scientific journal editors, readers & the scientific community
- Candidates for open faculty and staff positions.

- Patent officers
- Agricultural, environmental, life, and human science industries
- General public and elected officials

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2012

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	0	29	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of graduate students graduated and post doctoral scientists moving on to full employment.

Year	Actual
2012	32

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Research development knowledge taken to patent or license stage.
2	Research productivity - plant cell wall
3	Research productivity - antibiotic resistance
4	Research productivity - stored grain and grain products
5	Number of invitations that faculty members received to present research findings at universities and colleges, and to national and international meetings

Outcome #1

1. Outcome Measures

Research development knowledge taken to patent or license stage.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
206	Basic Plant Biology
304	Animal Genome
305	Animal Physiological Processes

Outcome #2

1. Outcome Measures

Research productivity - plant cell wall

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	32

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Cell walls surround essentially every plant cell protecting the cells from bursting under their turgor, providing shape to the cells, excluding potential invaders, and controlling the growth of the cells. Plants invest the major fraction of their photosynthate into their walls. The structure of cell walls is not completely understood, especially with respect to how cell walls can enlarge without losing their integrity and how they can be deconstructed to produce sugars for fermentation to produce fuels or chemicals. Thus understanding of the structure of plant cell walls could lead to enhancing plant growth, development of plants with higher resistance to pathogens, and production of plants with more biomass.

What has been done
A. nidulans was found to secrete a wide array of enzymes to degrade the major polysaccharides and lipids by 1 day of growth on sorghum. The data shows simultaneous breakdown of hemicellulose, cellulose and pectin. Changes in the relative abundances of enzymes over the time course that were observed indicate that the sets of enzymes secreted are tailored to the specific substrates available. Our findings reveal that A. nidulans is capable of degrading the major polysaccharides in sorghum without any chemical pre-treatment.

Results
Researchers at OSU are developing a sugar-platform based source of chemicals, consisting of hydrolytic enzymes for the efficient and environmentally friendly conversion of renewable plant biomass for industrial applications. These recent results continue to build on past successes and represent a significant step towards this goal. The set of enzymes produced by A. nidulans that degraded cell wall components in Sorgum stover have been identified, which allow them to be cloned and expressed for the development of more efficient conversion of biomass to fermentable sugars.

4. Associated Knowledge Areas

KA Code	Knowledge Area
206	Basic Plant Biology

Outcome #3

1. Outcome Measures

Research productivity - antibiotic resistance

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Wide-spread use of antibiotics on livestock has given rise to increased frequency of outbreaks of disease caused by antibiotic resistant bacteria. The spread of such drug-resistant bacterial species among livestock populations potentially could have a devastating economic impact on agribusiness in the state of Oklahoma. Consequently, there is a need to both characterize the mechanism of developed resistance and develop effective treatments to eradicate the resistant organism.

What has been done
S. aureus strains were isolated from raw milk samples of mastitic and healthy dairy cattle from a Paso Del Norte region dairy and characterized. Molecular epidemiology determined that the 40 S. aureus strains characterized were indeed clonal, meaning they were spreading among the dairy cattle examined. Some strains isolated from cows undergoing antibiotic therapy demonstrated resistance to three or more antimicrobial classes. Roche 454 GS pyrosequencing was used to produce a draft genome sequence of two of the dairy strains, methicillin-resistant strain (MRSA) H29 and methicillin-susceptible S. aureus strain PB32. Analysis of the H29 genome demonstrated its tight relationship to a human MRSA strain, and also revealed why the strain was resistant to penicillins, erythromycin, tetracycline, and ciprofloxacin. Analysis of the PB32 genome demonstrated that this strain was also related to a human MRSA strain.

Results
This work demonstrates the dissemination of human S. aureus strains in cattle and reveals changes to the genome structure of human MRSA that might have been influenced by the introduction and dissemination of these strains in cattle populations. The work also demonstrates the impact that modern NexGen DNA sequencing techniques will be having on identifying the source and cause of outbreaks of infections in live stock that caused by anti-biotic resistant bacterial strains.

4. Associated Knowledge Areas

KA Code	Knowledge Area
305	Animal Physiological Processes
311	Animal Diseases

Outcome #4

1. Outcome Measures

Research productivity - stored grain and grain products

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The red flour beetle, Tribolium castaneum is a globally distributed major pest of stored grain and grain products. T. castaneum has also been the focus of widespread studies on insecticide resistance. The red flour beetle is now an emerging model organism for the study of insect development, reproduction, nutrition, behavior and physiology.

What has been done
The expression and biological functions of two acetylcholinesterase genes (TcAce1 and TcAce2) of Tribolium castaneum were compared. The two genes were expressed at all developmental stages, albeit the transcript level of TcAce1 was 1.2 to 8.7 fold higher. Silencing of TcAce1 in larvae using RNA interference resulted 100% mortality and increased the susceptibility of larvae to anticholinesterase insecticides. In contrast, silencing of TcAce2 in larvae had no such effects, but delayed insect development and reduced female egg-laying and hatching. These findings demonstrate the major roles that TcAce1 and TcAce2 play in cholinergic functions and susceptibility to anticholinesterase insecticides, versus female reproduction, embryo development, and growth of offspring, respectively.

Results
Ongoing studies at OSU are yielding insights into genes that control insecticide susceptibility and the development and reproduction of a major pest of stored grain and grain products. These findings should allow investigators to develop better environmentally-friendly pesticides to control

grain infestations of this pest. Furthermore, as an emerging model organism, these findings may be extended to the development of more effective methods for the control of additional agriculture pest.

4. Associated Knowledge Areas

KA Code	Knowledge Area
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
206	Basic Plant Biology
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants

Outcome #5

1. Outcome Measures

Number of invitations that faculty members received to present research findings at universities and colleges, and to national and international meetings

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	9

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Virally vectored infectious diseases are not only a hazard to human health, but are destructive to the health of livestock and the agricultural economy. Although immunization of animals with vaccines that are conventionally attenuated viruses helps provide some protections, there are still disadvantages. Therefore, attempts to enhance the immunogenicity of vaccines have been actively sought, among which is the administration of immunomodulatory molecules cytokine IL-18. In fact, treatment of animals with IL-18 has been reported to confer protections against viral infections. IL-18 plays a central regulatory role in host immune response to viral and microbial infections. The biological activity of IL-18 is determined in part by its relative affinity for IL-18 binding protein (IL-18BP) that serves as an antagonist in regulating the activation function of IL-18. The structures of IL-18BP and IL-18R are largely unknown. Thus, here is a great need for better understanding the mechanisms of how IL-18 activates its receptors and how this activation is neutralized by IL-18BP. Work at OSU is beginning to address this gap in our knowledge.

What has been done

Dr. Junpeng Deng was invited to speak about his work on "IL-18 & IL-18BP in autoimmune diseases and poxvirus infection", Johns Hopkins University, School of Public Health.

Results
An invitation to present research results at the prestigious Johns Hopkins University, School of Public Health acknowledges the important contributions that are being made by researchers in the Division of Agricultural Sciences and Natural Resources at OSU to the scientific community at large. Dr. Deng's presented his lab's work on the successful determination of the crystal structure of yabapoxvirus IL18 inhibitory protein and the full characterization of its function. The work revealed a unique inhibitory mechanism by which poxvirus use decoy protein to evade human immune response and paves the way for designing future inhibitors for treatment of viral infection, as well as autoimmune diseases. In addition, it will help in development of treatments and prevention strategies against a number of infectious diseases that target livestock animals and are economically devastating.

4. Associated Knowledge Areas

KA Code	Knowledge Area
305	Animal Physiological Processes
311	Animal Diseases

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The number of manuscripts published increased 128%.

The percentage increases in numbers of graduate students graduated/ postdoctoral associates mentored with training in structural biology and placed/ hired into appropriate professional level positions were 250% and 150%, respectfully.

The percentage increase in numbers of invitations that faculty members received to present research findings at universities and colleges, and to national and international meetings increased 64%.

Key Items of Evaluation