V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

BIOTECHNOLOGY AND BIOTECHNOLOGY-BASED AGRIBUSINESS

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	25%	25%	25%	25%
304	Animal Genome	25%	25%	25%	25%
601	Economics of Agricultural Production and Farm Management	10%	10%	10%	10%
602	Business Management, Finance, and Taxation	10%	10%	10%	10%
603	Market Economics	10%	10%	10%	10%
604	Marketing and Distribution Practices	10%	10%	10%	10%
903	Communication, Education, and Information Delivery	10%	10%	10%	10%
	Total	100%	100%	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	0.0	0.2	20.8	1.0
Actual	0.0	0.0	27.1	3.5

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	10141	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	478133	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	4193196	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research and Extension programs will target avian and plant biotechnology. In the avian arena, these projects will be aimed at understanding basic mechanisms of disease etiology and control and emergence of new disease causing agents. Research will continue and expand on sequencing of the chicken genome, as well as the genome of many poultry pathogens, to help provide the tools needed to advance our understanding of poultry growth, health and disease. We plan to apply these tools to diagnosis and treatment of disease and screening for desirable production traits. We also seek to develop genome based diagnostic methods, and study the molecular basis of disease resistance and susceptibility. Some specific avian biotechnology research areas planned include: identification of genomic factors influencing pathogenesis of avian herpesviruses and mycoplasmas; evolution of virulence of Marek's Disease virus; interaction of MDV proteins with host cells; regulation of the immune response to avian pathogens; and gene expression profiles in growth-selected chickens. With regard to plant biotechnology, projects will focus on understanding basic mechanisms of gene control in plants, disease resistance, nitrogen fixation, and plant/environment interactions. Areas of particular interest for basic plant biotechnology research include: RNA turnover or small RNA-mediated gene regulation; understanding disease resistance and signal transduction pathways in plants; understanding and enhancing symbiotic nitrogen fixation via the application of molecular and proteomics approaches; developing biotechnology-based diagnostic methods for major plant diseases; and understanding processes controlling plant/soil interfacial relations at the molecular and atomic levels to enhance crop utilization of nutrients and the effectiveness of plants at remediation of soils contaminated with metals and organics. For both avian and plant biotechnology, findings will be applied as much as possible to existing issues in agriculture with the goal of integrating biotechnology research into new agribusinesses such as those producing plants better adapted to environmental and biological stress, plants used for the production of pharmaceuticals and nutriceuticals, and plant with bioenergy uses.

2. Brief description of the target audience

Farmers, landowners, state agencies (Delaware Development Office, Departments of Agriculture, Health and Human Services, Natural Resources and Environmental Control, Transportation), federal agencies (USDA, USEPA), land use organizations, environmental organizations, business and community leaders, families, students, and the general public.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	200	500	200	1000
Actual	200	500	200	1000

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

Patent Applications Submitted

Year: 2010
Plan: 0
Actual: 8

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Plan	0	13	
Actual	0	44	44

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Competitive Grants Submitted

Year	Target	Actual
2010	14	52

Output #2

Output Measure

- Number of Competitive Grants Awarded

Year	Target	Actual
2010	5	13

Output #3

Output Measure

- Number of Research Projects Completed

Year	Target	Actual
2010	2	14

Output #4

Output Measure

- Number of Undergraduate Researchers

Year	Target	Actual
2010	5	48

Output #5

Output Measure

- Number of M.S. Graduate Students

Year	Target	Actual
2010	2	16

Output #6

Output Measure

- Number of Ph.D. Graduate Students

Year	Target	Actual
2010	4	18

Output #7

Output Measure

- Number of Post-doctoral Research Associates

Year	Target	Actual
2010	4	15

Output #8

Output Measure

- Number of Refereed Journal Articles

Year	Target	Actual

2010	13	44

Output #9

Output Measure

- Number of Books and Book Chapters

Year	Target	Actual
2010	3	11

Output #10

Output Measure

- Number of Technical Reports

Year	Target	Actual
2010	1	8

Output #11

Output Measure

- Number of Extension Bulletins and Factsheets

Year	Target	Actual
2010	1	2

Output #12

Output Measure

- Number of Invited Presentations

Year	Target	Actual
2010	14	49

Output #13

Output Measure

- Number of Volunteered Presentations

Year	Target	Actual
2010	10	8

Output #14

Output Measure

- Number of Websites Established

Year	Target	Actual
2010	0	9

Output #15

Output Measure

- Number of Workshops Conducted

Year	Target	Actual
2010	2	5

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increased awareness by all components of the poultry industry of the opportunities to use biotechnology to prevent, diagnose, and control avian infectious diseases.
2	Increased number of farmers and members of the horticultural industry aware of the opportunities to use advances in plant biotechnology to develop new businesses.
3	Educational programs for K-12 youth and teachers on basic principles and applications of biotechnology to the plant, animal, and environmental sciences.
4	Commercial evaluation in agronomic and horticultural settings of genetically modified plants developed using biotechnology research.
5	Integration of plant and animal biotechnology educational materials developed cooperatively by research and extension staff into K-12 curricula in Delaware schools.
6	Stronger, more formal links between scientists conducting biotechnology research, extension specialists familiar with biotechnology applications, and state and regional economic development agencies and private industry.
7	Avian Biotechnology: basic research will provide an improved understanding of the fundamental causes and modes of action of avian diseases and the factors that influence their potential to spread to other animal species and humans; applied research will provide innovations in surveillance and diagnostic tools that help prevent or contain disease outbreaks and vaccines that prevent or control infectious diseases.
8	Plant Biotechnology: basic research will lead to an improved understanding of the processes by which plants grow, resist or adapt to diseases and other stresses; can be used to produce bio-based products useful for human health and nutrition, and regulate the uptake of plant nutrients in agricultural soils and contaminants (e.g., heavy metals) in polluted soils; applied research will lead to plants that can produce increased yields with lower inputs, resist pest and climatic stresses, and remediate or stabilize polluted soils.
9	Biotechnology-Based Agribusinesses: research and extension programs will link results of biotechnology research to industries interested and capable of marketing advances in animal and plant biotechnology; biotechnology, financial planning, marketing, and risk management will be combined to establish agribusinesses specializing in the diagnosis and control of avian infectious diseases, production of crop varieties that have lower fertilizer requirements and that are more tolerant of climatic stress; utilization of hyper-accumulating plants that can remediate contaminated soils, and the production of high-value plant products useful for human health and nutrition.

Outcome #1

1. Outcome Measures

Increased awareness by all components of the poultry industry of the opportunities to use biotechnology to prevent, diagnose, and control avian infectious diseases.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
304	Animal Genome
603	Market Economics
903	Communication, Education, and Information Delivery

Outcome #2

1. Outcome Measures

Increased number of farmers and members of the horticultural industry aware of the opportunities to use advances in plant biotechnology to develop new businesses.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
304	Animal Genome
602	Business Management, Finance, and Taxation
603	Market Economics
903	Communication, Education, and Information Delivery

Outcome #3

1. Outcome Measures

Educational programs for K-12 youth and teachers on basic principles and applications of biotechnology to the plant, animal, and environmental sciences.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
K-12 teachers and students, university undergraduate and graduate students, and faculty engaged in experiential learning.

What has been done
Research in the area of plant biotechnology has extended to involve undergraduate research interns in metagenomics research projects during the 2010 Summer Metagenomics Institute.

Results
A diverse group of students, with varying academic backgrounds, participated in this summer-long educational and research experience. The collective work of the group is being submitted to a peer-reviewed teaching journal and should be of value to teachers interested in developing course modules for K-12 and university students on metagenomics.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
304	Animal Genome
903	Communication, Education, and Information Delivery

Outcome #4

1. Outcome Measures

Commercial evaluation in agronomic and horticultural settings of genetically modified plants developed using biotechnology research.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Farmers, seed companies, plant breeders, and crop consultants.

What has been done
Plant geneticists are studying the genetic basis of resistance to multiple diseases in field corn.

Results
Using public corn resources and cross-breeding techniques to develop new populations and tracking genes with molecular markers to study inheritance, they are able to pinpoint the genes that condition resistance or susceptibility to multiple diseases. By conducting research that bridges plant molecular genetics with field corn breeding, they are developing methods to study natural variation and understand the genetic basis of plant improvement.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
601	Economics of Agricultural Production and Farm Management
603	Market Economics

Outcome #5

1. Outcome Measures

Integration of plant and animal biotechnology educational materials developed cooperatively by research and extension staff into K-12 curricula in Delaware schools.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
304	Animal Genome
903	Communication, Education, and Information Delivery

Outcome #6

1. Outcome Measures

Stronger, more formal links between scientists conducting biotechnology research, extension specialists familiar with biotechnology applications, and state and regional economic development agencies and private industry.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Farmers, industries investing in crop enhancing biologicals, extension agronomists, and crop consultants.

What has been done
Plant and soil sciences researchers, working collaboratively, have applied promising results from molecular biology studies to field studies involving agronomic crops, such as corn and soybeans. In collaboration with colleagues from UD Cooperative Extension at the Georgetown Field Station and industrial collaborators, plant molecular biologists, have initiated applied field studies on the use of bioinoculants for crop growth enhancement

Results
Initial data shows that by inoculating seeds with high numbers of special strains of naturally-occurring bacteria, they can help plants overcome stresses in the field, including nitrogen limitations, drought, and pathogen pressures. In addition, yields are positively affected by this treatment. As a result, the team will continue to develop new agricultural products to help growers reduce input cost for crop production, reduce environmental damage related to agricultural practices (including well-water quality), and improve food security.

4. Associated Knowledge Areas

KA Code	Knowledge Area

201	Plant Genome, Genetics, and Genetic Mechanisms
304	Animal Genome
601	Economics of Agricultural Production and Farm Management
603	Market Economics
604	Marketing and Distribution Practices
903	Communication, Education, and Information Delivery

Outcome #7

1. Outcome Measures

Avian Biotechnology: basic research will provide an improved understanding of the fundamental causes and modes of action of avian diseases and the factors that influence their potential to spread to other animal species and humans; applied research will provide innovations in surveillance and diagnostic tools that help prevent or contain disease outbreaks and vaccines that prevent or control infectious diseases.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
304	Animal Genome

Outcome #8

1. Outcome Measures

Plant Biotechnology: basic research will lead to an improved understanding of the processes by which plants grow, resist or adapt to diseases and other stresses; can be used to produce bio-based products useful for human health and nutrition, and regulate the uptake of plant nutrients in agricultural soils and contaminants (e.g., heavy metals) in polluted soils; applied research will lead to plants that can produce increased yields with lower inputs, resist pest and climatic stresses, and remediate or stabilize polluted soils.

2. Associated Institution Types

- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Plant and soil scientists, ecologists, industries investing in plant breeding for agriculture, horticulture, and natural ecosystems.

What has been done
Research at UD has discovered how plants recognize their siblings. The newly developed identification system lies in the roots and the chemical cues they secrete. The finding not only sheds light on the intriguing sensing system in plants, but also may have implications for agriculture and even home gardening.

Results
In a series of experiments, young seedlings were exposed to liquid media containing the root secretions or ?exudates? from siblings, from strangers (non-siblings), or only their own exudates. The length of the longest lateral root and of the hypocotyl, the first leaf-like structure that forms on the plant, were measured. Additionally, in one experiment, the root exudates were inhibited by sodium orthovanadate, which specifically blocks root secretions without imparting adverse growth effects on roots. The exposure of plants to the root exudates of strangers induced greater lateral root formation than exposure of plants to sibling exudates. Stranger recognition was abolished upon treatment with the secretion inhibitor. More than 3,000 plants involved in the study were rotated every day for seven consecutive days and with the root patterns documented. The study found strangers planted next to each other are often shorter because so much of their energy is directed at root growth. Because siblings aren't competing against each other, their roots are

often much shallower. As sibling plants grow next to each other, their leaves often will touch and intertwine compared to strangers that grow rigidly upright and avoid touching.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms

Outcome #9

1. Outcome Measures

Biotechnology-Based Agribusinesses: research and extension programs will link results of biotechnology research to industries interested and capable of marketing advances in animal and plant biotechnology; biotechnology, financial planning, marketing, and risk management will be combined to establish agribusinesses specializing in the diagnosis and control of avian infectious diseases, production of crop varieties that have lower fertilizer requirements and that are more tolerant of climatic stress; utilization of hyper-accumulating plants that can remediate contaminated soils, and the production of high-value plant products useful for human health and nutrition.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
304	Animal Genome
602	Business Management, Finance, and Taxation
603	Market Economics
903	Communication, Education, and Information Delivery

V(H). Planned Program (External Factors)

External factors which affected outcomes

- 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

- Retrospective (post program)
- During (during program)

Evaluation Results

Key Items of Evaluation