V(A). Planned Program (Summary)

Program # 16

1. Name of the Planned Program

Institute of Biological Chemistry

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			15%	
202	Plant Genetic Resources			2%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			31%	
204	Plant Product Quality and Utility (Preharvest)			2%	
205	Plant Management Systems			4%	
206	Basic Plant Biology			27%	
211	Insects, Mites, and Other Arthropods Affecting Plants			8%	
511	New and Improved Non-Food Products and Processes			5%	
701	Nutrient Composition of Food			6%	
	Total			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	0.0	63.0	0.0
Actual	0.0	0.0	63.6	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	214587	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	209826	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	9871797	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

The Institute of Biological Chemistry has a very vigorous graduate research and training program in fundamental plant biology, especially including plant biochemistry, physiology, and molecular genetics. This leads to the graduation and placement of its highly trained (Ph.D./M.S.) scientists, to publications in high quality journals, to developing patents and working with industry to implement the technologies developed, as well as carrying out needed outreach activities (e.g. to focus groups, high school students, general public, etc.).

2. Brief description of the target audience

The primary target audience of the Institute of Biological Chemistry is scientists within various disciplines in plant biotechnology, particularly plant biochemistry. Their research activities attract attention within the biochemical, forest products, and agricultural industries.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	0	0	0	0
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2010
Plan: 2
Actual: 3

Patents listed
1.Production of small molecules in glandular trichome-bearing plants. Lead Inventor, Dr. Bernd M. Lange, PCT/US10/28789. US Patent Application.
2.Arogenate Dehydratases and Lignification. Lead Inventor, Dr. Norman Lewis Ph.D. Provision filed in 2010. Our Intellectual Property Office requires that we not provide application numbers or filing dates until published.
3.Methods to increase plant productivity and Yields. Dr. Thomas Okita. Provision filed in 2010. Our Intellectual Property Office requires that we not provide application numbers or filing dates until published.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Plan	0	30	
Actual	0	41	41

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Peer reviewed journal articles

Year	Target	Actual
2010	30	41

Output #2

Output Measure

- Supporting graduate students on Agricultural Research Center and External Funding

Year	Target	Actual
2010	28	26

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increase numbers of qualified graduate students
2	Patents
3	External Funding in millions of dollars
4	Peer reviewed journal articles

Outcome #1

1. Outcome Measures

Increase numbers of qualified graduate students

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	28	26

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Additional (quality) students will result in more highly trained plant researchers, addressing topical/priority areas, such as bioenergy/biofuel and bioproducts development, photosynthesis, nutritional improvement of protein, starch and lipid quality in seeds and plants, understanding of metabolic pathways (enabling one to re-engineer plant forms to enhance formation of metabolites with health related significance) and other potentially useful basic research. Such areas are critical to plant productivity, human health and nutrition, bioenergy/bioproducts research, as well as to allied industries.

What has been done
The Department of Chemistry at Washington State University began a new graduate program in 2008 entitled Chemistry in Biological Systems. This program recruits students with strong chemistry backgrounds, with an interest in biological systems, to Washington State University. In turn, those interested in plants are drawn into (bio)chemistry-related research programs at the IBC, and this is being used for future active recruiting of chemistry/biology-oriented students. Chemistry holds a recruitment program in March and we also recruit many of our current students through the Molecular Plant Sciences (MPS) Graduate program, and to a lesser extent in the School of Molecular Biosciences (SMB) and Department of Chemical Engineering. MPS holds an Integrated Plant Sciences Retreat and recruitment program each February, as does SMB. Top ranked students in the nation who have applied to these programs are invited to meet with faculty at the retreats. Students with strong biochemistry backgrounds may directly enter IBC laboratories as a result (without undergoing a rotation through various faculty labs during the first year of graduate school) under a program called Accelerated PhD. To help support and recruit these students, most of the IBC faculty are also involved in a NIH-supported Protein Biotechnology grant. Other methods of recruitment involve mailing recruitment posters to various (often including land-grant) universities in the United States. Prospective students also contact IBC researchers directly, e.g. via email.

Results
During 2010, one tenured professor left IBC for employment at another university. The IBC now has nine faculty researchers, of which one is an assistant professor, two are newly promoted associate professors, one is on 50% phased retirement, and another is in a full-time administrative position within the Agricultural Research Center. As the newer members begin to obtain additional extramural funding, the IBC expects to be able to support more graduate students thereby leveraging existing resources. The individual on phased retirement no longer takes graduate students and will retire in 2012.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
206	Basic Plant Biology
701	Nutrient Composition of Food

Outcome #2

1. Outcome Measures

Patents

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	1	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The award of patents for research protects intellectual property. If licenses are obtained by other entities to use the research, this generally results in royalties and/or contracts coming to the University, the IBC and, to some extent, the researcher. Novel and useful research results are an indication that researchers are making important discoveries.

What has been done
Three patent applications were filed in 2010; none were awarded.

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
206	Basic Plant Biology
211	Insects, Mites, and Other Arthropods Affecting Plants
511	New and Improved Non-Food Products and Processes
701	Nutrient Composition of Food

Outcome #3

1. Outcome Measures

External Funding in millions of dollars

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	5	8192364

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Actual fiscal year extramural funds July 1 2009 - June 30, 2010 = $9,331,183. Estimated extramural funds for Fiscal Year July 1, 2010 - June 30, 2011 as of 12/31/2010 are $8,192,364. In addition to the actual funds received, the IBC also had four PhD students who received outside funding to finance their educations. The first three students received two years of stipends and tuition through the NIH Protein Biotechnology Grant managed by Dr. Ray Reeves in the School of

Molecular Biosciences. The fourth student is a Fulbright Scholar who received salary and tuition during her first academic year (2010-2011). This funding for the four student salaries and tuition is extrapolated to be $94,966, raising the 2010-2011 estimate to $8,287,330.

Extramural funds are necessary for financing research at the Institute of Biological Chemistry.

What has been done
Principal Investigators submit competitive research proposals to federal agencies such as the National Science Foundation, United States Department of Agriculture, Department of Energy and the National Institutes of Health, as well as negotiating contracts with private industries (Monsanto, Dow Chemical, Bayer, Boeing, Philip Morris, Mint Industry Council, etc.).

Results
Since fiscal year 2000, extramural funds have increased from $4.8 million to $8.1 million, a positive change of over 70%. Tenured/tenure track faculty FTEs receiving a salary through the Institute was 8.5 in 2010. One additional FTE from the Agricultural Research Center also maintains a research program in the Institute. Average funding per tenured/tenure track faculty in 2010 was 8,192,364/9.5/= $862354.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
206	Basic Plant Biology
211	Insects, Mites, and Other Arthropods Affecting Plants
511	New and Improved Non-Food Products and Processes
701	Nutrient Composition of Food

Outcome #4

1. Outcome Measures

Peer reviewed journal articles

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	30	41

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Peer reviewed journal articles are important because they generate research results that meet certain standards; for example, experiments are repeatable, results are understandable, and the article has been reviewed by credible and knowledgeable individuals. When published in quality journals, these articles generally represent evidence of substantial progress in research.

What has been done
Tenured/tenure-track faculty work with undergraduates, graduate students, postdoctoral research associates and collaborators to write thorough and accurate reports of research and research findings. Graduate students or postdoctoral research associates may be first listed authors who have had the opportunity to learn how to translate their research into scientific publication (products) under the mentoring of the research leader. When complete, an article is submitted to an appropriate journal, such as Phytochemistry or Plant Cell, etc., and is reviewed on its own merit. Articles may be returned to the authors with recommendations for further research before publishing, or for revisions.

Results
Target level has been exceeded for 2010.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
206	Basic Plant Biology
211	Insects, Mites, and Other Arthropods Affecting Plants
511	New and Improved Non-Food Products and Processes
701	Nutrient Composition of Food

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

The Institute was awarded several economic stimulus ARRA grants during 2009, which positively affected extramural income during 2009 and 2010. There also still seems to be a deliberate intention by Congress to support biofuel/bioenergy research. Some funding opportunities in 2009 and 2010 were partially affected (increased) by a nationwide interest in biofuel development, resulting in continued funding to IBC researchers.

The IBC is in an excellent position to conduct research directed to development of potential feedstocks, such as biofuels from poplars and other species. All indications are that this will continue to be a federal/state high priority for future (energy-related) research.

A faculty member left IBC in 2010, transferring to Michigan State University. As his graduate students, laboratory and extramural funding were taken with him, it is expected that our planned outcomes will be reduced somewhat in the future.

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

1. Evaluation Studies Planned

- Before-After (before and after program)
- During (during program)

Evaluation Results

Key Items of Evaluation