

Attachment 3  
Academic Affairs Committee - Discussion Agenda Item

**Genetics, Genomics, and Biotechnology Graduate Certificate Program**

**Introduction**

Kansas State University, as a land-grant institution in an agricultural state, has a strong tradition of basic and applied life sciences research. In the last thirty years, as this field has become more technologically oriented nationally, K-State researchers have followed suit. In 2012, we have multiple faculty members in several colleges who conduct research in areas that can broadly fit under an umbrella of genetics, genomics and biotechnology. Interdisciplinary/multidisciplinary collaborations involving faculty from many departments include the Arthropod Genomics Center, Ecological Genomics Institute, Functional Genomics Consortium, Wheat Genetic and Genomic Resources Center, Center for Sorghum Improvement and others. Core facilities that support this research across campus include the Integrated Genomics Facility, the Biotechnology Core/Proteomics Facility and the Plant Transformation Facility. Furthermore, disciplines that formerly did not overlap genetics/genomics now make use of some of its tools and outputs and many of the current tools employed in genomics/bioinformatics are being designed by experts in outside fields such as computer science and engineering.

To provide students in a variety of disciplines with a basic working knowledge of modern biotechnology and genetics/genomics, we propose to establish an interdisciplinary graduate certificate program to be delivered under the umbrella of the existing Interdepartmental Genetics graduate program. We anticipate interest in the certificate by a wide variety of students including 1) traditional on-campus (Manhattan) graduate students earning a master’s or doctoral degree in a traditional disciplinary area such as Agronomy, Animal Sciences, Biochemistry, Biology, Chemistry, Engineering, Entomology, Genetics, Horticulture, Plant Pathology, etc.; 2) part-time students in the biotechnology work force in either the Manhattan or Olathe regions who wish to enhance their credentials; 3) students enrolled in a complementary program at the Olathe campus.

**A. Statement of Educational Objectives**

This certificate is intended to provide a broad-based and hands-on introduction to modern genetics, genomics, and related biotechnology methodology and applications to complement a variety of graduate programs or serve as a stand-alone credential. It is intended to be a flexible program lending itself to meeting the needs of students with a wide array of academic and professional backgrounds and goals.

**B. List of Courses Associated With the Certificate**

Students, in consultation with their advisors, will select a minimum of 15 credits of coursework from existing graduate courses in genetics, genomics and bioinformatics offered at Kansas State University.

<b>Genetics, Genomics and Biotechnology Graduate Certificate</b>		
The graduate certificate requires a minimum of 15 credit hours. To pursue the Genetics, Genomics and Biotechnology graduate certificate the student <b>must</b> file an application for admission with the program coordinator. <i>A genetics course is a pre-requisite for entry into the program.</i>		
<b>Course Title</b>	<b>Cr</b>	<b>Instructor</b>
<b>Choose One Course:</b>		
AGRON 610 - Biotechnology	(3)	Harold Trick
or PLPTH 610 - Biotechnology	(3)	Harold Trick

Attachment 3  
Academic Affairs Committee - Discussion Agenda Item

<b>Required Course:</b>		
PLPTH 612 - Genomics Applications	(3)	Eduard Akhunov
<b>Select a Laboratory course (2-3 cr; *Exemptions from this requirement are discussed below):</b>		
PLPTH 611 - Agricultural Biotechnology Laboratory	(2)	Richard Todd
or BIOL 676 - Molecular Genetics Laboratory	(3)	Stefan Rothenburg
or BIOCH 766 - Recombinant DNA Laboratory I	(1)	Subbarat Muthukrishnan
and BIOCH 767 - Recombinant DNA Laboratory II	(1)	Subbarat Muthukrishnan
<b>Take 6-7 credits from the elective list for a total of 15 credits:</b>		
AGRON 630 Crop Improvement and Biotechnology	(3)	Allan Fritz
AGRON 732 Introduction to Plant Resistance to Pests or ENTOM 732 Introduction to Plant Resistance to Pests or PLPTH 732 Introduction to Plant Resistance to Pests	(2)	C. Michael Smith Tim Todd
AGRON 770 Plant Genetics	(3)	TBA
AGRON 860 - Applied Plant Breeding	(3)	William T. Schapaugh
AGRON 970 Advanced Plant Breeding I	(3)	Tesfaye Tesso
AGRON 980 Molecular Tools for Genetic Analyses	(3)	TBA
ASI 600 Applied Animal Biotechnology	(2)	David Grieger
ASI 749 Advanced Animal Breeding	(3)	Dan Moser
ASI 831 Molecular Reproductive Endocrinology	(1)	David Grieger Timothy Rozell
BIOCH 755 Biochemistry I	(3)	T. Durrett, R. Krishnamoorthi, M. Zolkiewski
BIOCH 765 Biochemistry II	(3)	L. Davis, S. Muthukrishnan, A. Zolkiewska
BIOL 609 Cellular & Molecular Biology of Human Diseases	(3)	Jean Pierre Perchellet
BIOL 640 Population Biology	(3)	Ted Morgan
BIOL 670 Immunology	(4)	Stephen Chapes
BIOL 671 Immunology Lab	(2)	Stephen Chapes
BIOL 675 Genetics of Microorganisms	(3)	Revathi Govind

Attachment 3  
Academic Affairs Committee - Discussion Agenda Item

BIOL 705 Eukaryotic Genetics	(3)	Michael Herman
BIOL 707 Advanced Cell Biology	(3)	Alexander Beeser
BIOL 730 General Virology	(3)	Lorena Passarelli, Rollie Clem
BIOL 734 Introduction to Genomics and Bioinformatics or CIS 734 Introduction to Genomics and Bioinformatics	(4) (4)	Susan Brown Doina Caragea
BIOL 840 Molecular and Cellular Immunology	(3)	Stephen Chapes
BIOL 860 Modern Molecular Approaches	(3)	Rollie Clem, Mike Herman
BIOL 886 Confocal, Fluorescence and Light Microscopy	(3)	Dan Boyle
BIOL 888 Electron Microscopy Techniques	(3)	Dan Boyle
ENTOM 745 Plant Resistance to Insects	(2)	John Reese
ENTOM 910 Insect Genetics	(3)	Jeremy Marshall
HORT 710 Plant Cell, Tissue and Organ Culture	(3)	Sunghun Park
HORT 910 Advances in Plant Cell Culture	(2)	Sunghun Park
PLPTH 613 Bioinformatics Applications	(2)	TBA
PLPTH 755 Plant Resistance to Diseases	(2)	Tim Todd Barbara Valent
PLPTH 768 Population Genetics	(3)	Chris Toomajian
PLPTH 780 Microarray Workshop	(1)	Alina Akhunova
PLPTH 785 Real-Time PCR Workshop	(1)	Alina Akhunova
PLPTH 835 Plant Virology	(2)	Anna Whitfield
PLPTH 880 Plant Molecular Biology	(3)	Staff
PLPTH 910 Molecular Plant-Microbe Interactions	(3)	Barbara Valent Frank White
PLPTH 915 Chromosome and Genome Analysis	(3)	Bikram Gill
PLPTH 916 Chromosome and Genome Laboratory	(1)	Bernd Friebe
PLPTH 927 Fungal Genetics	(3)	Barbara Valent

**\*Students whose graduate research involves use of biotechnology laboratory techniques will not be required to complete a laboratory course. An exemption from this requirement will be granted by the Program Director if the student demonstrates use of the range of covered techniques by coauthor status on a publication (either submitted or published), or first author status on an abstract for a presentation at a national meeting, and/or direct confirmation of the contribution by the student's advisor. In this case, elective courses may be substituted for the laboratory course to reach the 15 hours of minimum credits required.**

Attachment 3  
Academic Affairs Committee - Discussion Agenda Item

**C. Statement of How Courses Meet Educational Objectives**

The core courses associated with the certificate will provide broad-based, hands-on training in genetics, genomics and related biotechnology fields. The courses in the elective list will allow students to gain a deeper understanding of specific fields. The graduate certificate can complement an ongoing master's or doctoral degree or be taken independently of a graduate degree.

**D. Statement of Need for Proposed Certificate**

Modern genetics, genomics, and biotechnology permeate all of the life sciences today. For students to be well-trained and attractive to employers, they need a solid grounding in these fields. The proposed certificate will provide this and will complement a variety of existing graduate degree programs.

The Animal Health Corridor is a description given to a concentration of businesses working in the animal health industry in the Greater Kansas City Area as broadly defined. This group includes approximately 220 companies in locations from Manhattan, KS along I-70 east to Columbia, MO, and north from the Kansas City metropolitan area to St. Joseph, MO. Two surveys were commissioned by the K-State Olathe campus and conducted in 2010 by the Austin Peters Group and by Amanor-Boadu and Stoneman to understand the educational and employee professional development needs of these firms. Results indicated that both the employers and current employees felt a need for further employee professional development. The choice of areas was not open-ended in either study, but in the Amanor-Boadu-Stoneman study, both biotechnology and bioinformatics were identified as areas of interest for further education by Animal Health Corridor company employees.

Businesses focused on plant-derived biofuels and on improvement of major crop plants are also moving into the Manhattan and Greater Kansas City area. Local plant-based businesses include start-up companies and KAB Centers of Innovations such as Edenspace Systems Corporation, Ventria Bioscience, Heartland Plant Innovations Inc., the Kansas Alliance for Biorefining and Bioenergy, and the Center of Innovation for Biomaterials in Orthopedic Research. Local divisions of major corporations include Syngenta's Agri-Pro Wheat, Monsanto's Westbred Wheat, and other local divisions of Monsanto, Pioneer Hybrid and Bayer Crops Sciences. Leaders of these companies have expressed the need for a larger, stronger pool of well-trained, highly-qualified job candidates with expertise in genetics, genomics and biotechnology.

We anticipate that many students enrolled in MS and PhD programs with allied departments (Animal Sciences & Industry, Agronomy, Biochemistry, Biological and Agricultural Engineering, Biology, Entomology, Horticulture, Forestry & Recreation Resources, and Plant Pathology) will be interested in completing the proposed certificate. A reasonable projection would be enrollment by five or six (5-6) students per year in the first two years of the program, eight to ten (8-10) per year in the next three years, reaching a maximum of 15-20 students per year completing the certificate. Students whose programs of study are aligned with major genomics initiatives at K-State are particularly likely to find the certificate program attractive, as it will provide them with an additional credential.

**E. Genetics, Genomics and Biotechnology Graduate Certificate administration**

The Graduate Certificate in Genetics, Genomics and Biotechnology will be administered by the existing Interdepartmental Program in Genetics and Genetics Graduate Program Faculty. The academic department that is home to the Genetics Graduate Program Director will be considered the host for the certificate program. At least one member of the student's supervisory committee should be a Genetics Graduate Program Faculty member.

Attachment 3  
Academic Affairs Committee - Discussion Agenda Item

**F. Estimated Budget to Support Certificate Program**

We are not proposing new courses, new sections or online offerings of existing courses. It is possible that a simulcast distance offering of some existing courses will be provided to students at K-State Olathe. We propose that this graduate certificate be managed by the existing Interdepartmental Genetics Graduate Program, which currently awards the MS and PhD degrees in Genetics. The academic department that is home to the Genetics Graduate Program Director will provide release time for the GPD's efforts. Funding from the Kansas Agricultural Experiment Station administered through the Plant Biotechnology Center will support a 0.25 FTE administrative assistant to help manage the Certificate (student enrollment, tracking, etc.).

**G. Names of Faculty Associated with or Contributing to the Certificate Program**

Interdisciplinary Genetics Faculty who will be teaching a course listed in the graduate certificate, advising students working on the certificate, or serving on certificate student committees.

Agronomy: Guihua Bai; Allan K. Fritz; Jesse Poland; William T. Schapaugh; Tesfaye Tesso; Stephen Welch.  
Animal Sciences & Industry: Dan W. Moser.

Biochemistry: Michael R. Kanost; S. Muthukrishnan.

Biology: Susan J. Brown; Rollie J. Clem; Gary W. Conrad; Carolyn Ferguson; Michael A. Herman; Beth A. Montelone; Kathrin Schrick.

Entomology: Ming-Shun Chen; Yoonseong Park; C. Michael Smith.

Horticulture, Forestry & Recreation Resources: Sunghun Park.

Plant Pathology: Eduard Akhunov; Alina Akhunova; John Fellers; Bernd R. Friebe; Bikram S. Gill; John F. Leslie; James Stack, Richard Todd; Chris Toomajian; Harold N. Trick; Barbara Valent; Frank F. White; Anna Whitfield.

Other Kansas State University faculty who will be teaching a course listed in the Genetics, Genomics and Biotechnology graduate certificate:

Animal Sciences & Industry: David Grieger; Timothy Rozell.

Biochemistry: Tim Durrett; R. Krishnamoorthi; A. Zolkiewska, M. Zolkiewski.

Biology: Stefan Rothenburg; Jean Pierre Perchellet; Ted Morgan; Stephen Chapes; Revathi Govind; Alexander Beeser; Dan Boyle, Lorena Passarelli.

Computing & Information Sciences: Doina Caragea

Entomology: Jeremy Marshall, John Reese.

Plant Pathology: Tim Todd.

**H. Name and Address of Faculty Member Designated as Program Coordinator**

Dr. Barbara Valent

K-State Plant Pathology

4108 Throckmorton Plant Sciences Center

Manhattan, KS 66506

Attachment 3  
Academic Affairs Committee - Discussion Agenda Item

**I. Student Learning Outcomes**

**Assessment of Student Learning Plan**  
 Kansas State University

**A. College, Department, and Date**

College: *Graduate School*  
 Department: *Interdisciplinary Genetics Program*  
 Date: *11/20/2012*

**B. Contact Person(s) for the Assessment Plans**

*Richard Todd, Assistant Professor*  
*Barbara Valent, University Distinguished Professor*

**C. Degree Program**

Graduate Certificate in Genetics, Genomics and Biotechnology

**D. Assessment of Student Learning Three-Year Plan**

**1. Student Learning Outcome(s)**

**a. List (or attach a list) all of the student learning outcomes for the program.**

**SLO1:** *Students who earn the Genetics, Genomics and Biotechnology Graduate Certificate will **have developed a basic understanding** of genomics, classical and molecular genetic analysis and biotechnology and their applications.*

**SLO2:** *Students who earn the Genetics, Genomics and Biotechnology Graduate Certificate will **have an understanding** of approaches to solving problems using genetics, genomics and molecular biotechnology tools.*

**SLO3:** *Students who earn the Genetics, Genomics and Biotechnology Graduate Certificate will **understand** the historical, social and ethical context in which genetics, genomics and biotechnology have developed and are continuing to develop, and implications that these fields have for society as a whole.*

**b. Identify outcomes that will be assessed in the first three years of the plan.**

**SLO1, SLO2, SLO3**

Special rationale for selecting these learning outcomes (optional):

N/A

Relationship to K-State Student Learning Outcomes :

Program SLOs	University-wide SLOs (Graduate Programs)			Program SLO is conceptually different from university SLOs
	Knowledge	Skills	Attitudes and Professional Conduct	
1. SLO1	X	X		
2. SLO2	X			
3. SLO3	X		X	

Attachment 3  
Academic Affairs Committee - Discussion Agenda Item

**2. How will the learning outcomes be assessed? What groups will be included in the assessment?**

**SLO1: Students who earn the Genetics, Genomics and Biotechnology Graduate Certificate will have developed a basic understanding of genomics, classical and molecular genetic analysis and biotechnology and their applications.** *This SLO will be assessed using both a DIRECT and an INDIRECT measure. A pre-test and post-test DIRECT measure covering key knowledge areas will be administered at the start and end of PLPTH 610 Biotechnology (crosslisted as AGRON 610) and PLPTH 612 Genomics Applications, the two required courses for the graduate certificate. All students enrolled for graduate credit in PLPTH 610 Biotechnology and PLPTH 612 Genomics Applications will be tested. An exit interview INDIRECT measure will be conducted with students completing the Genetics, Genomics and Biotechnology graduate certificate. In this interview the students will be asked a standard set of questions where they will relate their program experience and their perceived understanding of genomics, classical and molecular genetic analysis and biotechnology and its applications.*

**SLO2: Students who earn the Genetics, Genomics and Biotechnology graduate certificate will have an understanding of approaches to solving problems using genetics, genomics and molecular biotechnology tools.** *This SLO will be assessed using a DIRECT measure. A pre-test and post-test DIRECT measure covering key knowledge areas will be administered at the start and end of PLPTH 610 Biotechnology and PLPTH 612 Genomics Applications, the two required courses for the graduate certificate. All students enrolled for graduate credit in PLPTH 610 Biotechnology and PLPTH 612 Genomics Applications will be tested.*

**SLO3: Students who earn the Genetics, Genomics and Biotechnology Graduate Certificate will understand the historical, social and ethical context in which genetics, genomics and biotechnology have developed and are continuing to develop, and implications that these fields have for society as a whole.** *This SLO will be assessed by using both a DIRECT and an INDIRECT measure. A pre-test and post-test DIRECT measure covering key knowledge areas will be administered at the start and end of PLPTH 610 Biotechnology and PLPTH 612 Genomics Applications, the two required courses for the graduate certificate. All students enrolled for graduate credit in PLPTH 610 Biotechnology and PLPTH 612 Genomics Applications will be tested. An exit interview INDIRECT measure will be conducted with graduating students earning the Genetics, Genomics and Biotechnology graduate certificate. In this interview the students will be asked a standard set of questions where they will relate their perceived understanding of the implications classical and molecular genetic analysis, genomics and biotechnology applications have for society.*

**3. When will these outcomes be assessed? When and in what format will the results of the assessment be discussed?**

<b>Assessment (SLO)</b>	<b>Mechanism</b>	<b>Timeline</b>
Direct assessment (SLO1)	Pre-and post-test (PLPTH610)	Starting Fall 2013
Direct assessment (SLO1)	Pre- and post-test (PLPTH612)	Starting Spring 2014
Indirect assessment (SLO1)	Exit interview	As students complete the graduate certificate

Attachment 3  
Academic Affairs Committee - Discussion Agenda Item

Direct assessment (SLO2)	Pre-and post-test (PLPTH610)	Starting Fall 2013
Direct assessment (SLO2)	Pre and post-test (PLPTH612)	Starting Spring 2014
Direct assessment (SLO3)	Pre-and post-test (PLPTH610)	Starting Fall 2013
Direct assessment (SLO3)	Pre- and post-test (PLPTH612)	Starting Spring 2014
Indirect assessment (SLO3)	Exit interview	As students complete the graduate certificate

The results of the assessment outcome measures will be discussed by faculty members involved in teaching the Genetics, Genomics and Biotechnology graduate certificate and by faculty members of the curriculum committee.

**4. What is the unit's process for using assessment results to improve student learning?**

- a. The assessment outcome results will be tabulated by the administrative assistant following the post-test and exit interviews at the end of the Spring semester.
- b. The administrative assistant will identify poorly performing areas.
- c. The assessment outcome results and identified poorly performing areas will be distributed and reviewed by the graduate certificate teaching faculty.
- d. The graduate certificate teaching faculty will meet over the summer to discuss content or structural modification to the program/courses to improve weak areas.
- e. Modifications will be implemented by the faculty, as deemed necessary, in the following relevant semester.
- f. The effect on the program SLOs of modifications to the courses/program will be monitored by the assessment outcome results.

**J. Endorsements**

See attached endorsements.