Interdepartmental Genetics Program at Kansas State University

A. Summarized Review of Degree Program Report

1. Mission, Centrality, Uniqueness

The mission of the interdepartmental Genetics Graduate Program at KSU is to educate students with an in-depth knowledge of genetics, the study of the inheritance and function of genes that control all life on earth. The centrality of genetics within biological sciences is illustrated by the genetics courses designed and taught for their own majors in the Division of Biology and the Departments of Agronomy, Animal Science and Industry, Biochemistry, Entomology and Plant Pathology. As the only provider of M.S. and Ph.D. degrees in genetics at KSU, the Genetics Program offers students the opportunity for in depth knowledge across various genetic specialties through genetics courses in multiple departments, as well as specialization in a sub-discipline defined by their major professor. Within the Regents System, the KSU Genetics Graduate Program is unique in training geneticists in agricultural sciences: in plant and animal breeding, and in use of genetic engineering and genome sciences aimed at increasing crop yield and at producing disease, pest and drought resistant crops. Thus, the KSU Genetics Program offers critical educational opportunities for Kansas, which ranks second in total cropland and first in production of wheat and sorghum in the US. The Genetics Program contributes to KSU's strength in ecological and environmental research, in bioinformatics and in biomedicine.

2. Quality of Faculty

The Genetics Graduate Faculty includes members from the Departments of Agronomy, Animal Science and Industry, Biochemistry, Entomology, Horticulture and Plant Pathology; the Division of Biology; and the College of Veterinary Medicine. Genetics faculty include internationally-recognized researchers and teachers who receive external research funding and publish in prestigious journals. Other faculty are internationally-recognized plant breeders directly providing crop varieties to farmers. Five of our 29 faculty are University Distinguished Professors, and many have won state, national and international awards. The international reputations of our faculty attract students to KSU.

3. Quality of Students

The quality of the students in the KSU Genetics Graduate Program is demonstrated by their successes in academic scholarship and their excellent employment record after graduation (Appendices A & B). The Genetics Program is training geneticists who are highly competitive for academic, governmental and industrial jobs within our state, region and nation. Genetics students publish research in prestigious journals, and win numerous awards at University, national, and international levels (Appendix D). The high quality of Genetics students was noted in the External Program Review in 2003.

4. Employer Demand

The employment history for Genetics students who graduated between 1986 and 2004 illustrates the employer demand for these students over time (Appendix A). Opportunities for students with advanced Genetics degrees remains high. Students graduating in the last 3 years with M.S. degrees have obtained high paying jobs in

industry. Graduates with Ph.D. degrees have obtained post-doctoral positions at excellent universities, industry research positions and positions as Assistant Professors at the University of Georgia and North Carolina State University (Appendix B). KSU Genetics graduates are now full professors at Washington State University, the University of Wisconsin, Colorado State University and Purdue University. The success record of our graduates reflects well on the Genetics Program and on Kansas State University.

5. Service Provided to Discipline, the University and Beyond

Genetics is at the heart of the revolutions of biotechnology and genomics that are having growing impact on society, specifically on human health and nutrition, biofuel production and sustainable agriculture. KSU must participate in training Genetics M.S. and Ph.D. graduates to assume jobs in universities, in hospitals, in agricultural, pharmaceutical and biotechnology industries, and in government agencies. An important product of this program is graduates who understand the historical, social and ethical context in which genetics and genomics are impacting society as a whole. The Genetics Program is an excellent recruiting tool for the university. Many students in other departments were attracted to the Genetics Program and later transferred to these departments.

6. Cost Effectiveness

The excellent quality and high impact of the Genetics Program was confirmed by a rigorous external review in 2003, which concluded "*The Genetics Program is well known and provides external prestige for KSU.*" Since the program was initiated by faculty in the 1960s, it has succeeded with no financial support from the university. No faculty time is required specifically for Genetics majors, because all courses taken by genetics students are already being taught for non-genetics students. Special equipment and infrastructure are not required. As noted in the External Review Report, lack of program-specific financial support accounts for the program's small size, especially for the deficiency in M.S. students and degrees compared to the minimum standards set by the Board of Regents. Students in the Genetics program are supported by external research grants awarded to individual faculty, and these grants favor support for Ph.D. students with more time for performing research. However, the M.S. degree option is critical for the strength and competitiveness of the KSU Genetics Program relative to programs at other universities, and the excellent employment history of our graduates demonstrates that excellent jobs are available to Genetics M.S. graduates. Clearly, maintaining the Interdepartmental Genetics program offering both M.S. and Ph.D. degrees as a "high impact, no-cost" program provides significant benefits to the university. However, opportunity exists to strengthen the Genetics program as strongly recommended by the External Review Panel when they concluded that *"the Genetics Program at KSU has had a long and productive history, and steps should be taken to not only continue this legacy, but to significantly improve the program for the future."* Dedicated resources will be required for the Genetics Program to take the next step. Stable KSU funding for Genetics students independent from faculty grants would allow recruitment of excellent domestic students to work with any Genetics faculty member. Our Genetics Program would become competitive with well-funded programs such as Genetics at Iowa State University. Given the growing importance of Genetics in society, a greatly strengthened Genetics Program would play a major role in boosting KSU to the top-10 status we seek.

B Summarized Assessment of Student Learning (ASL) Report

1. What were the students expected to learn in the degree program?

(a) For M.S.: Understand the basic processes of genetics in prokaryotic and eukaryotic systems, including gene transmission, mutation, expression and regulation. (**For Ph.D.:** Understand the basic processes of classical, molecular, developmental, population and evolutionary genetics and cytogenetics in prokaryotic and eukaryotic systems, including gene transmission, mutation, expression and regulation.).

(b) For M.S.: Perform genetic research in an area of specialization. Demonstrate ability to follow instructions; plan and execute experiments; collect information in an organized and timely manner; analyze the data and draw conclusions regarding the hypothesis to be tested. (**For Ph.D.:** Become expert in an area of specialization, conceive and perform original genetic research in this area, and prepare results of the research for publication in a scientific journal.)

(c) For M.S. and Ph.D.: Develop oral and written communication skills that include the ability to publish research and to communicate the importance and excitement of genetic research to others outside the field, including those with a limited scientific background.

2. What forms of evidence were gathered to assess the extent to which student learned?

For SLO (a) above, we are tracking the final grades in the three core courses: Genetics of Microorganisms - BIOL 675; Eukaryotic Genetics - BIOL 705; and Population Genetics - PLPTH 768. As a second direct assessment measure for this SLO, we track the grades received for the student seminars mentioned for SLO (c.). These grades are based on assessment of scientific content and presentation style by faculty, post-docs and students attending the seminar. Additionally, we track overall grade point averages.

For SLO (b) above, we are tracking direct indicators (Thesis research, Preliminary exam passed, and Thesis defense) for each student. Since particular emphasis will be given to assessment by the student's Thesis Research Committee, we developed a rubric for Committee members to use in reporting on the student's performance in the thesis defense (Appendix G).

For SLO (c) above, we are tracking information on three independent direct indicators: student seminars at K-State, manuscripts published, and presentations at scientific meetings.

3. What were the results of the assessment?

The new Genetics core curriculum implemented in the fall of 2004 has had a major impact on our students understanding of basic genetic processes in microbial, eukaryotic and population genetics. Only 21% of students who joined the program prior to implementation have taken all three courses. Current students who are required to take all three courses are making good progress on completing them. The grades achieved are 40% A, 55% B and 5% C. Seminar grades are an independent measure of a student's

genetic skills, and all students presenting seminars in the 2007-2008 reporting period received a grade of "A". We expanded our tracking to include the cumulative GPA for the Genetics students. For our MS students, the average GPA is 3.74, with the range from 3.32 to 4.00. For our PhD students the average GPA is 3.74, with the range from 3.33 to 4.00.

For SLO (b), we are tracking data on student performance in thesis research, preliminary exams and thesis defense. Regarding preliminary exams, of all students in the program for 2 years or more, 70% have completed their preliminary exams. For our students, the average time between program entry and completion of the preliminary exam is 2.8 years. This is regarded as satisfactory progress. During this period, we gathered input from the major advisor and the student's committee members on both the preliminary exam and the final thesis defense using the questionnaire in Appendix G. So far, most responses have been that the student is "highly capable" in the areas assessed, with rare assessments as "capable."

For SLO (c) above, we have assembled information on three direct indicators, student seminars at KSU, manuscripts published, and presentations at national scientific meetings. Genetics M.S. students who have been in the program for more than 2 years have at least one publication (Except for a student specializing in plant breeding where publications are not typical). For Ph.D. students with over 2 years in the program, the number of publications range from 0 to 5, with the best case being 4 first author publications plus one other. All publications are in well-respected journals. Poster presentations range from 0 for newer students to 11 for a more senior student. Senior students have given 2 or 3 invited talks at national meetings. Publications and presentations are a good indicator for some research areas, but may not be as good for others. These data must be assessed on a one-by-one basis in addition to strict number counting. Discussions on this topic are ongoing.

4. How has the evidence or information gathered been used for improvement?

The genetics faculty have discussed the assessment results and they are satisfied with indicators assessed and student productivity. We decided also to track student awards as an indicator of achievement. As a minor change in the process by which information is gathered, we decided that all new students will be required to prepare a professional C.V. and that they will update it and send it to the Genetics Chair annually. Information on publications, presentations and awards will be available in the C.V.s.

5. To what extent have the improvements worked (or are working?)

Our genetics students are obtaining a significantly broader background in genetics across disciplines and specialties than was true before the core curriculum was adopted in the Fall of 2004.