

Grain Science: bachelor's, master's and doctorate, CIP Code: 01.0401

The Department of Grain Science and Industry has a nearly 100-year reputation in the area of grain processing and utilization. It is the *only* department and program in the United States that offers baccalaureate and advanced degrees in these areas. The department enjoys a worldwide reputation for educating and producing outstanding students, global industry influence, and cutting-edge research, teaching, and outreach activities not only in grain but also in biomaterials processing and utilization. The Department of Grain Science offers baccalaureate degrees in baking, feed, and milling science and management, and Master of Science (MS) and Doctor of Philosophy (PhD) degrees in Grain Science. These programs are highly visible and critical to the grain industries which are critical to Kansas and regional economies. This is perhaps best evidenced by the department's strong scholarship programs and the new \$10.5 M teaching facility constructed entirely through private gifts.

Faculty activities in the three spheres are synergistic. Research and outreach activities serve to reinforce and add relevance to the formal instructional program. Likewise, the efforts required to deliver an effective degree or research program provide fundamental information and skills necessary to assure high quality outreach. The Department of Grain Science and Industry during 2002-2008 was led by four department heads, and was a department in transition, because of faculty retirements, faculty leaving the department to accept positions elsewhere, and hiring of new faculty to establish excellent research, teaching, and outreach programs. Faculty in the department are recognized nationally and internationally for their expertise in grain science disciplines, invited to provide keynote addresses and give presentations, convene sessions at national and international meetings, and offer consulting services. In addition, the department's faculty members are frequently invited as participants at national and international technical or training courses as well as at educational opportunities for international trade teams. The faculty is active in garnering extramural support for their research and outreach activities, and between 2002 and 2008, the faculty were successful in obtaining \$12.1 million in grants. Grain Science graduate faculty are instrumental in contributing successfully to many short courses, offered through the International Grain Program at KSU and internationally in Asia, Europe, and Latin/South America. The graduate faculty members in Grain Science served or continue to serve in leadership positions in the grain and food industry.

By any measure, students who graduate with a B.S. from the department are in very high demand. The curricula require (or strongly encouraged) at least one external/industrial internship for all students. Students regularly return from summer internships with offers for full-time employment upon graduation. In addition, it is not uncommon for the undergraduate students to have multiple offers after interviewing for employment. In fact, if the occasional self-imposed restrictions based on geography are excluded, student placement is effectively 100%. For example, the department's graduates occupy positions of responsibility and authority in all aspects of the cereal processing and cereal foods industries (nationally and internationally) the federal government (e.g. USDA/ARS) and educational institutions (e.g. American Institute of Baking), and include vice presidents of research & development, national and international production managers, facilities directors etc. It has been observed, accurately, nearly all cereal (grain) based products have been touched at some point in their development and production by a KSU grain science graduate.

Starting salary packages for a B.S. graduate consistently rank at the top of the College of Agriculture and among the top of the University (including relocation allowances and, occasionally, signing bonuses of up to 10% of the base salary.) The outlook for employment continues to be bright as some companies report that current graduation rates are not keeping pace with their needs. This situation has contributed to the rise in starting salaries and employment related incentives.

Many of the graduate students in the department receive highly competitive awards at professional meetings for their oral, poster, and product development presentations, and there are internal programs to encourage professional development among students. A majority of students entering the graduate program are predominantly Asian, and efforts since 2007 have resulted in balancing the number of domestic and international students admitted to the programs. Incentives have been developed to recruit domestic students, and the hope is for domestic students to make up at least 40-50% of the total graduate student population, especially at the Ph.D. Level.

Excellent employment opportunities exist for Grain Science graduate students to obtain industry internships and permanent positions. For example, all 38 students that graduated with a Ph.D. degree between 2000 and 2006 were gainfully employed with universities, private sector, and government agencies. The training received by the graduate students in Grain Science and Industry makes them well equipped with

the knowledge and skills needed to find suitable positions in the grain and food industries, not only in the US but also anywhere in the world.

Summarized Assessment of Student Learning – B.S., M.S., and Ph.D.

Department of Grain Science and Industry—B.S. Degree (Milling Science Management, Feed Science Management and Baking Science Management)

Student Learning Outcomes were defined as follows, with sections unique to each program shown in *italics*.

SLO 1: Knowledge: **MSM:** The ability to apply the basic principles of mathematics, physics, chemistry, *cereal chemistry and grain milling technology & management to process cereal products*; **FSM:** The ability to apply the basic principles of mathematics, physics, chemistry, *ingredient formulation and feed processing technology to make appropriate feeds for various animal species*; **BSM:** *Understanding of and the ability to apply the basic principles of mathematics, physics, chemistry, cereal chemistry, ingredient functionality, baking technology and management to process consumer baked goods.*

Direct Measures: All programs utilized the analysis of selected questions on regularly scheduled examinations in specified core courses for the respective curricula as well as selected report questions from laboratory sections of those courses. Two programs (BSM & FSM) analyzed the 'experience reports' required of all students enrolled in GRSC 591 (Commercial Feed/Food Manufacturing Internship).

Indirect Measures: All three programs included questions relating to the degree to which students achieved this outcome as a part of the exit interviews conducted by the department head with all graduating seniors. Two programs (BSM & FSM) analyzed reports of interns' knowledge and skills submitted by their direct supervisors at the beginning and completion of the internship.

SLO 2: Critical Thinking: **MSM:** The ability to analyze process and production requirements to manufacture *cereal grain products with proper selection and application of equipment types and capacities required to meet product specifications*; **FSM:** The ability to analyze process and production requirements to manufacture *animal feeds by proper selection of equipment types and capacities required to make specific feed types*; **BSM:** The ability to *solve formula, ingredient function, processing, production and customer problems and make decisions based on appropriate relevant and objective scientific information to meet quality, safety and economic expectations.*

Direct Measures: All three programs utilized analysis of selected questions on regularly scheduled examinations in specified core courses (different than those evaluated for SLO #1) as well as selected report questions from laboratory sections of those courses.

Indirect Measures: All three programs included questions relating to the degree to which students achieved this outcome as a part of the exit interviews conducted by the department head with all graduating seniors.

Results:

All programs determined that the exit interview instrument currently in use was inadequate for the task of properly assessing either of the undergraduate SLOs.

FSM: Additional emphasis was needed in laboratory report organization and writing. Written communication skills in the internship class needed to be improved.

MSM: Analysis of examination questions and laboratory reports indicated that knowledge of some basic principles, all of which were presented in lower level prerequisite classes was weak.

BSM: Laboratory and examination questions indicated slight but general improvement in both knowledge and critical thinking skills. Laboratory report writing level was improved from the previous year. Assessment of internship-related measures confirmed that conclusion but also indicated that more emphasis on the 'real world' (non-technical or business) component of their skill set may be appropriate.

Actions/Revisions:

All programs agreed on a new formal instrument for use in graduating seniors' exit interviews.

FSM: Laboratory exercises and written report formats for two of the classes used in the evaluations were strengthened and made more rigorous. Appropriate questions for assessment were identified in the lab section of one class.

MSM: The level of emphasis in particular sections of a key introductory course was increased in response to the assessment results from higher level, follow-on courses.

BSM: Based on faculty review and input from selected industrial stakeholders, the amount and/or type of 'real world' (business) material presented was increased in four classes required by the curriculum.

Department of Grain Science and Industry—Doctoral and Masters Degree Programs

Student Learning Outcomes Assessed:

M.S. SLOs: (1) Ability to solve advanced problems in the disciplines associated with the Grain Science and Industry Department, and (2) Ability to plan and conduct research, and analyze research data with minimal direction from major professor.

Ph.D. SLOs: (1) Scholarly achievement in basic science or engineering courses that provide a theoretical background relevant to their area of specialization and an understanding of a fundamental field that serves cereal science, (2) In depth knowledge in an area of specialization and mastery of necessary experimental tools and techniques, (3) Possess good communication skills with the ability to report research findings to experts in the field and to the public, and (4) Ability to initiate, develop, and present a worthy original proposition for research.

M.S. 2006 assessment results (17 of 23 M.S. students) and 2007 results (26 of 29 students):

- 71% in 2006 and 33% in 2007 of the students developed their Program of Study (POS) within the first two semesters in residence.
- Over 89% of the students enrolled in core Grain Science courses, attended the graduate orientation and read the Graduate Handbook, and maintained a GPA of 3.0 or above.
- Over 94% of the students reviewed literature pertinent to their research problem.
- 45% in 2006 and 57% in 2007 of the students had an approved experimental design.
- 55 % in 2006 and 71% in 2007 of the students submitted or presented a research proposal to their supervisory committee.
- 100% of the students participated in a professional meeting by the fourth semester in 2006, but only 67% of the students did so in 2007.
- Less than 34% of the students prepared their thesis for publication or defense by their fourth or fifth semester, and there were delays in students defending their M.S. degree on time. These delays were a result of graduate students spending summer internships in the food industry.

Ph.D. 2006 assessment results (10 of 13 Ph.D. students) and 2007 (19 of 21 students):

- In 2006, 80% of the students developed a POS within the first three semesters; in 2007 only 50% of the students developed one.
- Over 80% of the students attended the graduate student orientation and/or read the Graduate Handbook, maintained a GPA of 3.0 or higher, enrolled in all courses listed in their POS.
- In both years, 60-90% of the students identified a problem and reviewed literature during the first three semesters, but only 22-57% of the students had an approved experimental design during the fourth through seventh semesters.
- 40% of the students demonstrated that they were capable of performing independent data analysis and interpret the results in 2006; this number increased to 80% in 2007.
- Only 20% of the students submitted a paper for publication in a scientific journal in 2006; this number increased to 30% in 2007.
- In 2006, nearly 70% of the students attended student oral presentations and participated or contributed at a professional meeting, and in 2007 80% of the students attended oral presentations given by students but only 56% participated in professional meetings.
- In 2007, 50% of the students completed their dissertation research and 60% defended it by the eighth semester (an increase from zero in 2006).

- In both years, 25-29% of the students helped prepare a competitive grant during the fourth through seventh semesters.
- In 2006, 20% of the students submitted their proposal for extramural support. In 2007, none of the students submitted a proposal for extramural support.

Actions/Revisions:

Many of the students surpassed the set target for the learning outcomes. Deficient areas included students not completing their program of study on time, students not presenting their research proposals early enough to the supervisory committee, students not submitting papers for publication in peer-reviewed journals in a timely fashion, and students not completing their degrees within the allotted time. Two revisions have occurred in the graduate program: the development of a professional development class for Ph.D. students, and, a similar class offered as a seminar for M.S. students during their first semester. The revisions should help evaluate the quality of students during the early and mid degree stages and hopefully rectify previous deficiencies noted during 2006 and 2007. A questionnaire to survey graduating M.S. and Ph.D. students was developed to evaluate the quality of the Graduate Program and to make necessary changes to improve it based on the feedback received.