

## University of Minnesota Mission Statement

The University of Minnesota, founded in the belief that all people are enriched by understanding, is dedicated to the advancement of learning and the search for truth; to the sharing of this knowledge through education for a diverse community; and to the application of this knowledge to benefit the people of the state, the nation, and the world.

The University's mission, carried out on multiple campuses and throughout the state, is threefold:

### Research and Discovery

Generate and preserve knowledge, understanding, and creativity by conducting high-quality research, scholarship, and artistic activity that benefit students, scholars, and communities across the state, the nation, and the world.

### Teaching and Learning

Share that knowledge, understanding, and creativity by providing a broad range of educational programs in a strong and diverse community of learners and teachers, and prepare graduate, professional, and undergraduate students, as well as non-degree-seeking students interested in continuing education and lifelong learning, for active roles in a multiracial and multicultural world.

### Outreach and Public Service

Extend, apply, and exchange knowledge between the University and society by applying scholarly expertise to community problems, by helping organizations and individuals respond to their changing environments, and by making the knowledge and resources created and preserved at the University accessible to the citizens of the state, the nation, and the world. In all of its activities, the University strives to sustain an open exchange of ideas in an environment that embodies the values of academic freedom, responsibility, integrity, and cooperation; that provides an atmosphere of mutual respect, free from racism, sexism, and other forms of prejudice and intolerance; that assists individuals, institutions, and communities in responding to a continuously changing world; that is conscious of and responsive to the needs of the many communities it is committed to serving; that creates and supports partnerships within the University, with other educational systems and institutions, and with communities to achieve common goals; and that inspires, sets high expectations for, and empowers the individuals within its community.

## A Message From the Dean

We're very pleased you're interested in learning about the College of Agricultural, Food, and Environmental Sciences. We believe you'll find this an exciting place to pursue your education. This college has one of the nation's premier faculties devoted to making every student experience meaningful and exciting. And we strive to maintain first-rate facilities and teaching resources.

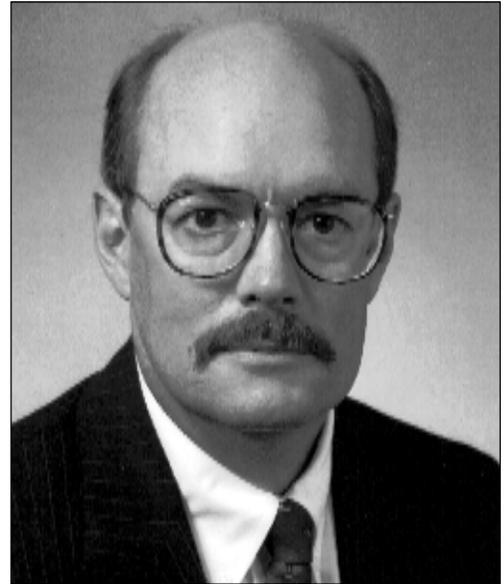
The college is among the oldest at the University. For more than 125 years it has made important contributions to the state and, indeed, the world. We intend to carry this tradition of excellence and service into the 21st century.

The challenges are significant, but the future is bright for those who choose to lead America's food and environmentally related industries. From production agriculture to food consumption, from processing and transportation to environmental protection, the demand for qualified graduates has never been greater. Emerging new areas of applied science and management offer a wide array of opportunities.

We equip our graduates with skills and expertise to become leaders in their careers and in their communities. This includes providing the basis for life-long learning so that our graduates can quickly adapt to an ever changing world.

As you'll discover from this bulletin, our curricula are relevant, practical, and dynamic. The college's programs cover basic and applied biological sciences related to plants and animals, environmental science, nutrition, food science and technology, finance, communications, engineering, education, marketing, production and processing management, and applied economics. The college also offers a wide range of experiential learning programs, including international study/travel, undergraduate research opportunities, and internships. You can take advantage of these programs while enjoying a small campus environment in the middle of the city. You can participate in clubs, teams, and the full range of activities offered by a major university.

We're confident you can find something for you in the College of Agricultural, Food, and Environmental Sciences. We invite you to share our strength, tradition, and excellence.



A handwritten signature in black ink that reads "Michael V. Martin". The signature is written in a cursive, flowing style.

Michael V. Martin

Dean, College of Agricultural, Food, and Environmental Sciences

# A great place to....

## ...Look Back

On March 10, 1858, a bill drafted for the Minnesota Legislature, establishing an agricultural college in Glencoe, Minnesota, became law. There were to be two terms: a long summer term, April to October, and a short winter term, December to February. The students were to do three to four hours of manual labor each day on the farm, and tuition was to be free. A contract to construct a college building in Glencoe would have been signed in February 1861, but Governor Ramsey was in Washington, D.C., meeting with President Lincoln offering the first Minnesota Infantry Regiment for the defense of the Union. Plans for the College at Glencoe lay dormant during the Civil War.

In 1866, after several disputes over the use of land granted to Minnesota through the terms of the Morrill Land Grant Act, it was agreed that Glencoe was too remote for an agricultural college. The Reorganization Act of February 18, 1868, provided that the regents of the University of Minnesota were to secure suitable land near the University's Minneapolis campus for an agricultural college and experimental farm.

Regent John Pillsbury, who held title to a piece of land east of the University, sold the land to the University for his cost. The land straddled University Avenue starting at Oak Street and continued east to the foot of the hill in Prospect Park. The land was sandy and swampy and little of it was suitable for farming. In 1873, President William Watts Folwell, the University's first president, reported, "So far as I am aware, not a single young man has come to the University desirous to learn the science of farming." Historian James Gray indicated that "on that arid soil of the University farm, nothing was sown but dissension and nothing reaped but problems."

In 1882, a new farm was purchased four miles east of the Minneapolis campus—155 acres for \$200 per acre. The old farm had cost \$8,500 and was sold for \$150,000. The proceeds were used to buy the new farm for \$59,000 and paid for at least four buildings: a farmhouse, a main barn, an experimental station building, and the home building for the School of Agriculture.\*

More than 110 years later, thousands of students have come to study at the College of Agricultural, Food, and Environmental Sciences (COAFES). The stature of the college and its programs has attracted an excellent faculty and student body. It is consistently ranked among the top colleges of agriculture in the U.S. In 1995-96, more than 900 students were enrolled in undergraduate programs. The student body has a near equal split of women and men. And while some students come to learn the science of farming, the college's majors represent a broad spectrum of

programs in the applied sciences of soil, plant, animal, food and environment, education, communication, business and the social sciences.

The college is on the St. Paul campus. It shares the 700-acre campus with the colleges of Human Ecology, Natural Resources, Biological Sciences, and Veterinary Medicine. The Minnesota Agricultural Experiment Station borders the campus and supports a comprehensive agricultural research program. The Experiment Station provides a sizable teaching laboratory for undergraduate and graduate education. The campus also is home to the Minnesota Extension Service.

As a part of the University of Minnesota, COAFES is fully committed to its Land Grant mission of teaching, research and service to the citizens of Minnesota, the U.S. and the world. The college's reputation and influence stretch around the world through the work of both faculty and alumni.

## ...Look Forward

As a current or prospective undergraduate student, you will have access to the college's traditions and resources through the classroom and laboratory as well as through your faculty adviser. The college has a strong commitment to undergraduate education. In 1987, the faculty articulated that commitment in the following mission statement: "The goal of the College of Agricultural, Food, and Environmental Sciences is to provide students with varied educational experiences and an environment that promotes professional competence, the capacity to attain career success in agriculture, including food or related professions, and a sense of social responsibility."

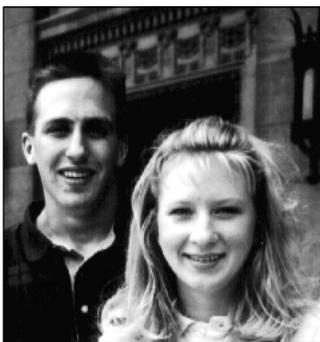
To help achieve this goal, the faculty of COAFES identified 14 objectives that students should accomplish while earning a degree in the college. These objectives are designated as learner outcomes. The establishment of the learner outcomes was the result of a joint effort by faculty, employers, and students. Employers were consulted to determine the skills they seek in recruiting COAFES graduates for positions in their companies or organizations. The curricula of the college have tried to ensure that students are able to meet these outcomes. Your COAFES education will provide you with skills needed to be an effective, responsible citizen in your workplace and community, because as a graduate of COAFES you should be able to:

- Demonstrate fundamental knowledge in the biological and physical sciences.
- Communicate effectively and use communication technologies.
- Evaluate and integrate diverse viewpoints or data.
- Make responsible judgments about management of natural resources and the environment.
- Make responsible judgments on ethical and policy issues.
- Apply global perspectives to agricultural, food, and environmental issues and decisions.



*"All of the programs offered by the University present many more opportunities than you could find at a smaller university," says Cynthia Bryant, a COAFES student.*

\* Condensed from Ralph E. Miller, *The History of the School of Agriculture 1851-1960 (St. Paul: University of Minnesota Institute of Agriculture, Forestry & Home Economics, 1979).*



*Students have access to the college's traditions and resources through the classroom and laboratory as well as through their faculty adviser.*

- Apply an historical perspective to the role of science and technology.
- Retrieve, analyze, and use information.
- Manage human resources and provide leadership.
- Appreciate and interpret literature and the arts.
- Solve problems in a profession.
- Demonstrate specialized expertise in at least one collegiate major.
- Develop breadth of knowledge in additional areas.
- Work effectively as a team member.

### ...Be Advised

COAFES is proud of the academic advising available to students. Perhaps no other relationship that students develop with faculty on the campus can be as positive as the advising relationship. Advisers can provide guidance and insight, advice and counsel, as well as challenge and support for students. The faculty of COAFES is committed to providing quality advising support for students. To accomplish that goal, almost all advising is handled by the regular faculty. COAFES is unique in that advisers have all volunteered to advise undergraduates and have gone through training to familiarize themselves with the curriculum as well as University policies and resources.

New students in COAFES are assigned an academic adviser. Your adviser will be able to help guide you through your major curriculum requirements, assist you with course selection, provide references for scholarships and employment, supervise internships, provide advice and counsel, and listen to your questions and concerns during your stay in the college. While we are committed to helping you make your way through your program in the most efficient way possible, we know there are many other opportunities available at the University of Minnesota. Your adviser will be able to provide you with information about some of those opportunities. He or she can be a valuable link in making the connections you need to take full advantage of the resources available to you on the campus and in the community.

You may change advisers if your interests or career goals change. Most students prefer to have an adviser whose specialty matches their interests. You should consult your major coordinator or the COAFES Student Services Office for information or assistance in changing advisers.

What can you do to make your advising appointments more productive? Read this bulletin and become familiar with the basic requirements and core courses of your major.

Be aware of important dates on the academic calendar. The COAFES Student Services Office publishes a quarterly update of important deadlines and other pieces of information in a newsletter called *KIOSK*. The newsletter is available in 120 Biosystems and Agricultural Engineering or you may visit the Student Services link on the COAFES World Wide Web home page at <http://www.agri.umn.edu>. Dates for changing your grade base, dropping and adding, late withdrawal and graduation application

deadlines are important, and most require some assistance from your adviser. Know what they are and try to avoid waiting until the last minute to act on them. You will also find important registration information at the World Wide Web site of the Office of the Registrar at <http://www.umn.edu/registrar/>.

Make an appointment in advance of your registration date. Most advisers don't do their best advising when they are in the hallway, rushing off to class being pursued by a student who just needs to have a signature on their course registration. Faculty are busy with teaching, research, outreach, and even have other advising responsibilities. Call a couple days ahead or stop by their office to set up an appointment. If you can't make your scheduled appointment, call to cancel and reschedule.

Go to sessions prepared. Make a list of courses that you know you need to take or are considering for the next quarter. Update your program sheet if you are keeping one to include all courses you have finished. Write down your questions ahead of time so you get them answered. Use your session to review your course list or to ask about other courses. Your adviser will be willing to suggest another course to meet your program requirements, but probably won't be excited about helping you look for "something I can fit in at 11 a.m."

Don't be afraid to ask for your adviser's opinion or advice on your program of study, internships, or career plans. Their knowledge of the curriculum, the campus, and world of work can be valuable to you. Tap that resource.

What can you expect from your adviser? Your adviser will have office hours. They will change quarterly as teaching schedules change. Some faculty post their office hours on their door or you can call to find out what they are.

Your adviser will know the curriculum of your major. She/he will also have a working knowledge of most of the courses that are required. Most advisers also know some of the basic requirements about other majors or programs and can help you consider other options if your interests change.

Advisers can also assist students with petitions when it is appropriate to request a variation from specific program requirements.

Your adviser will have a record of your work. Most advisers have advising files for the students assigned to them. They get regular transcript updates of your work from the COAFES office.

He or she will be familiar with services and resources around the campus. They are not likely to know every detail about every program or service, but most undergraduate advisers know how to find information or can make an appropriate referral.

Your adviser could be a source for a letter of recommendation for a scholarship, job or graduate school application.

### ...Find Committed Teachers

In June 1994, COAFES faculty adopted the following teaching philosophy: "The College of Agricultural, Food, and Environmental Sciences at

the University of Minnesota firmly believes that an educated public, constantly increasing its knowledge, is absolutely essential for sustaining a healthy environment and safe food supply.

To establish and foster excellent teaching, faculty in the COAFES make these commitments:

- Teaching is our primary responsibility.
- Quality research is essential for excellent teaching—just as quality teaching is essential for quality research.
- Undergraduate and graduate education are of equal importance.
- Excellence in teaching is recognized in performance evaluation.
- Interdisciplinary and interdepartmental teaching is encouraged.
- Personalized communication between students and faculty is essential.
- Creative and innovative teaching is valued.

### ... Succeed

What does it take to succeed? It takes hard work. You may feel that you have heard that comment so often that it has become cliché. However, academic programs in the COAFES are demanding. The University of Minnesota and the COAFES attract excellent students. Those students make for keen competition in classes. The combination of demanding course material and strong class competition will stretch your abilities. The faculty of the college and the University have high expectations of students in their classrooms. Professors expect that students are spending time outside of class reading and completing class assignments. The well-worn adage of spending two hours of study or preparation for every hour of class time is still valid.

*Get to know your instructors or teaching assistants.* All have office hours and are available to help outside of regular class hours. Some may ask that you call for an appointment, while others are available for walk-ins. Most professors will list their office hours or will provide information for reaching them outside of class on the course syllabus they distribute at the beginning of the quarter. If you are having trouble with a class, get help early.

*Form a study group in your classes.* It is a great way to make new friends and be more efficient in studying and learning. Check with other students in your class, roommates, or acquaintances in your residence hall or where you live to see if they would be interested in forming a study group. Members of a study group can often help one another with problems or difficult concepts.

*Learn about the resources available to you on the campus.* The University is a big place, but that size brings with it resources. Several departments and service offices have tutors available for students who are seeking help. There are also service areas and offices that will help students with the development of study skills or time management skills. It is often some of the best students who figure out how to access that help.

*Keep your priorities in order.* Many students have jobs. Keeping jobs and school in balance is often a

challenge. If you work more hours, you may have to cut back on the number of class hours you carry. If you want to carry a full class schedule, then you need to keep your number of work hours down. For most students carrying a full-time course load, 15-20 hours of work a week should be the maximum.

### ... Get Started

All new COAFES students, whether entering freshmen or transfer students, are mailed an invitation to an orientation-registration program. At this program, in addition to becoming acquainted with the campus, students receive general information about the college and the University, and have an opportunity to meet with a faculty adviser in the academic area they have chosen. Advisers help students select and register for courses.

**Registration**—Registration is done quarterly, and students have the option of early registration. Early registration normally begins about the eighth week of the quarter for the following quarter. All students have the option of doing on-line registration from any computer that can be linked to the University's public access information system. That system is available through University student computer labs or can be accessed via modem from students' homes. Registration will also continue to be available in the Office of the Registrar, 130 Coffey Hall.

The *Class Schedule* is available each quarter in the University bookstores. The *Class Schedule* lists University day school courses throughout the University of Minnesota complete with hours, rooms, instructors, prerequisites, registration instructions, fees, maps, final exam schedules, grading definitions, and other valuable information. The Office of the Registrar also has a great deal of information, plus special registration tools available electronically at <http://www.umn.edu/registrar/> on the World Wide Web. Students should also check with the COAFES office for other registration materials that are specific to the College of Agricultural, Food, and Environmental Sciences.

Evening and summer courses are featured in the *Extension Classes Bulletin* and *Summer Session Bulletin*, respectively. Separate bulletins are also published for other University colleges. Most can be obtained from the Office of the Registrar, 130 Coffey Hall.

**Majors**—As you look at the list of majors for COAFES they may appear different from what you expected. They may not match the language or titles that you have heard from other sources. The college's 10 majors represent a bold new way of approaching education for agriculture. The majors, all of them interdisciplinary, incorporate teaching resources from many academic departments, and offer you the broad base of knowledge you will need for the dynamic future of agriculture. You will find a matrix listing general interests and occupations with corresponding majors and primary COAFES departments on the following page. Detailed information about each follows in the next sections of this bulletin.

## COAFES Student Affairs Directory

Mailing address:  
120 Biosystems and Agricultural Engineering  
1390 Eckles Avenue  
St. Paul, MN 55108

*COAFES services listed below are in 120 Biosystems and Agricultural Engineering unless otherwise noted.*

Admission to the College (Prospective Student Services)	
General Information .....	624-3045
Transfer Students .....	624-4748
High School Students .....	624-4755
Career Services .....	624-2710
Includes:	
• Career decision-making, and resources	
• Career Day	
• Internship opportunities	
• Full-time employment opportunities	
• Mentor Program	
Honors Program (COAFES) .....	624-9299
International Study/Travel .....	624-2710
Student Services .....	624-7254
Includes:	
• Advising information	
• Change of major	
• Course cancellation and late withdrawal	
• Graduation clearance	
• Petitions	
Undergraduate Research Program (UROP) .....	624-2710

### COAFES Administrative Offices

Dean of the College	
Michael V. Martin .....	277 Coffey Hall
.....	624-5387
Associate Dean for Curricular and Student Affairs	
Laurie Hayes .....	120 Biosystems and
.....	Agricultural Engineering
.....	624-4212

### Other Helpful Offices

Office of Admissions .....	625-2008
or toll free .....	1-800-752-1000
application status or receipt of transcripts	
University Counseling and Consulting Services .....	624-3323
Office of Scholarships and Financial Aid .....	624-1665
Housing Services .....	624-2994
Learning and Academic Skills Center	624-7546
University Information .....	625-5000
.....	or dial 0 on campus
University College (formerly Continuing Education and Extension) .....	
.....	625-3333
Disability Services .....	626-1333
.....	(voice or TTY)
Office of the Registrar-St. Paul .....	624-3731
African American	
Learning Resource Center .....	625-1363
Asian/Pacific	
Learning Resource Center .....	624-2317
American Indian	
Learning Resource Center .....	624-2555
Chicano/Latino	
Learning Resource Center .....	625-6013

## Key to Majors

AgBu .....	Ag and Food Business Management
AgEd .....	Ag Education
AnPl .....	Animal and Plant Systems
AIM .....	Ag Industries & Marketing
ApEc .....	Applied Economics
BAE .....	Biosystems and Agricultural Engineering
FdSc .....	Food Science
ES .....	Environmental Science
Nutr .....	Nutrition
PreLA .....	Pre-Landscape Architecture
ScAg .....	Science in Agriculture
STC .....	Scientific & Technical Communication

**This is the Programs, Premajors, and College Information and Policies sections of the 1996-1999 University of Minnesota College of Agricultural, Food, and Environmental Sciences Bulletin.**



Programs

## Liberal Education Requirements

*Effective for all freshmen with fewer than 39 credits enrolling from fall 1994 to summer session II 1996. Beginning fall 1996, the liberal education requirements apply to all students entering a baccalaureate degree program, regardless of prior credits.*

A liberal education introduces you to the modes of inquiry and subject matter of the major branches of knowledge, including the factual information and theoretical or artistic constructs that form their foundations; the “ways of knowing”—the kinds of questions asked and how insight, knowledge, and data are acquired and used; the changes over time of their central ideas or expressive forms; and the interrelationships among them and with human society in general. To these ends, study by all undergraduate students on the Twin Cities campus is guided by a common framework.

### The Diversified Core Curriculum

#### Physical and Biological Sciences.

Comprehension of physical and biological principles; understanding of and ability to use the methods of scientific inquiry—the ways in which scientists investigate physical and biological phenomena; and appreciation of the importance of science and the value of a scientific perspective.

*Requirement:* A minimum of three courses totaling at least 12 credits, including one course with a laboratory or field experience in the physical sciences and one course with a laboratory or field experience in the biological sciences.

**History and Social Sciences.** Knowledge of how historians and social scientists describe and analyze human experiences and behavior; study of the interrelationships among individuals, institutions, structures, events, and ideas; understanding of the roles individuals play in their historical, cultural, social, economic, and political worlds.

*Requirement:* A minimum of three courses totaling at least 12 credits, including one course with historical perspective.

**Arts and Humanities.** Understanding of approaches to the human condition through works of art, literature, and philosophy; knowledge of how artists create and humanistic scholars think; ability to make aesthetic judgments.

*Requirement:* A minimum of three courses totaling at least 12 credits including courses in two of the following: literature, philosophical perspective, and visual or performing arts.

**Mathematical Thinking.** Acquisition of mathematical modes of thinking; ability to evaluate arguments, detect fallacious reasoning, and evaluate complex reasoning chains; appreciation of the breadth of applications of mathematics and its foundations.

*Requirement:* A minimum of one course totaling at least four credits.

### The Designated Themes of Liberal Education

The designated themes of liberal education offer a dimension to liberal learning that complements the diversified core curriculum. Each of the themes focuses on an issue of compelling importance to the nation and the world, the understanding of which is informed by many disciplines and interdisciplinary fields of knowledge.

*Requirement:* A minimum of six courses (or five courses if one includes an approved practicum), including one course in each of the following:

**Cultural Diversity.** Understanding of the roles gender, ethnicity, and race play in structuring the human experience in and developing the social and cultural fabric of the United States.

**International Perspectives.** Comprehension of the ways in which you are part of a rapidly changing global environment dominated by the internationalization of most human endeavors.

**Environment.** Knowledge of the interaction and interdependence of the biophysical systems of the natural environment and human social and cultural systems.

**Citizenship and Public Ethics.** Reflection on and determination of a clearer sense of your present and future civic relationships and your obligations to the community.

### Writing Skills

The ability to communicate effectively is a hallmark of a liberally educated individual and a key to a successful and satisfying life. To encourage refining of writing skills, the liberal education curriculum includes both writing courses and writing across the curriculum.

*Requirement:* Writing skills requirements are being revised. Until the new requirements are in effect, all students will complete the writing requirement specified by the college awarding their baccalaureate degree.

You may satisfy the liberal education requirements with a number of courses and credits different from those of other students because some courses serve multiple goals in the curriculum; e.g., some courses will satisfy a diversified core requirement and a designated theme requirement, and other courses will satisfy the requirements for each of two themes. Thus, you may satisfy the designated theme requirements with a smaller number of courses than is stated in the requirement. Each quarter, the *Class Schedule* will publish the requirements and list all courses that satisfy them. In addition, the *Class Schedule* will list which of these courses are offered that quarter and which are tentatively scheduled for the subsequent quarters during the academic year.

### Minnesota Transfer Curriculum

If you complete the Minnesota Transfer Curriculum at any participating Minnesota college or university, you fulfill the University's Twin Cities campus liberal education requirements. However, you will still need to complete a portion of the writing skills requirements. Contact your college advising office concerning these requirements. For more information on using transfer credits for the liberal education requirements, contact the Office of Admissions (612/625-2008).

The College of Agricultural, Food, and Environmental Sciences (COAFES) views each of its majors as a four-year program that integrates liberal education courses, preparation or foundation courses, and professional courses in areas of special expertise. The program information below details the requirements for each of the college's majors. The liberal education requirements are outlined in the box to the left. Students will need to consult with their adviser and the quarterly printed *Class Schedule* to determine which University courses have been approved to meet the liberal education core and designated theme requirements.

*Note:* Several courses listed under the designation of foundation and professional courses in each major will also meet the liberal education requirements.

*Students enrolled in a degree program before 1994 at the University of Minnesota–Twin Cities Campus, and who have been following the general education requirements designated as areas A-D, have the option of completing their COAFES degrees using those requirements. Please consult with your academic adviser, or the COAFES Student Services Office for a summary of the requirements and a complete list of courses to fulfill these requirements.*

All other transfer students will be held to the current University of Minnesota–Twin Cities campus liberal education requirements. The number of credits required for graduation is dictated by the liberal education program you follow. Students in the environmental science major must complete the current University liberal education requirements.

Students should work closely with their adviser to make efficient use of their time in meeting both major and liberal education requirements.

**Program Requirements**—Students assume the program requirements for their major that are in effect the quarter they enter the college. COAFES Student Services Office provides students with a current program sheet or Academic Progress Audit System Report at orientation/registration.

Students can choose to move to newer program requirements as the program changes in subsequent years or quarters, but they must assume the new requirements in total. To move to a newer program, students file a Change of Major form, available in the COAFES Student Services Office. Upon processing the Change of Major, the Student Services Office will provide students an updated program sheet. The student and his/her adviser should follow those requirements for graduation. The final degree clearance will be processed using the student's declared major.

## Agricultural and Food Business Management

Dr. Vernon Eidman, Major Coordinator  
316 Classroom-Office Building  
1994 Buford Avenue  
St. Paul, MN 55108  
612/625-5229  
E-mail: veidman@dept.agecon.umn.edu

The agricultural and food business management major is offered jointly by COAFES and the Carlson School of Management. The agricultural and food business management curriculum emphasizes the use of concepts and methods from economics and business management in the identification, analysis, and solution of management problems related to food, agriculture, natural resources, and economic development. The program provides a balance between applied economics and business administration studies, with a limited amount of agricultural science. Students may elect a variety of courses in their junior and senior years to accommodate special interests and career goals.

Graduates of this curriculum are prepared for a wide range of employment opportunities in the food system and other agribusiness. Examples of employment areas include commodity trading and analysis, finance, management, farm input marketing, marketing food products, sales management, administration, public and industrial relations, production management, economic and statistical analysis, managerial accounting, and transportation analysis.

Students completing this program may also pursue graduate studies in preparation for research, teaching, or continuing education positions in academic institutions, government agencies, and industry.

### Admission to the Major

Students are admitted to the major after satisfactory completion of a pre-agricultural and food business management program. Admission standards are developed in conjunction with the Carlson School of Management. Application deadlines are June 15 for fall quarter, October 15 for winter quarter, and January 15 for spring quarter.

To be considered for admission to the agricultural and food business management major you must meet the following requirements:

- 1) Complete or have in progress coursework to total 85 credits by the time of admission.
- 2) Complete the following management “tool” courses on an A-F grading basis by the time you enter the program:  
Acct 1050 or ApEc 1250  
ApEc 1101, 1102 or Econ 1101, 1102  
BA 1550  
Math 1142 or 1251
- 3) Earn a minimum GPA of 2.80 in all coursework.
- 4) Earn a minimum GPA of 2.5 in the tool courses and at least a C in each course.

COAFES students planning to major in agricultural and food business management who have not completed the pre-agricultural and food business management program are assigned a faculty adviser but retain a pre-major status until they are accepted into the program.

Additional information about admission to the program and application materials can be obtained from the major coordinator for the agricultural and food business management program in 316 Classroom-Office Building, or from the COAFES Student Services Office, 120 Biosystems and Agricultural Engineering.

### Major Requirements

Agricultural and food business management students must complete the requirements listed below. Consult with your adviser to determine a suitable sequence for completing the required courses. Course substitutions in the professional requirements can be made only with the approval of your adviser and the agricultural and food business management major coordinator.

**Liberal Education**—See the liberal education requirements on page 8 and information at the beginning of this section. Students who enrolled in a degree program at the University of Minnesota–Twin Cities campus before fall 1994 see the liberal education requirements on page 8.

#### Foundation Requirements

##### Communication

- Rhet 1101—Writing to Inform and Persuade (4)
- Rhet 1104—Library Research Methods (1)
- Rhet 1151—Writing in Your Major (4)
- Rhet 1222—Public Speaking (4)
- Rhet 3562—Writing in Your Profession (4)

##### Mathematics and Science

- Biol 1009—General Biology (5)
- Chem 1001—General Principles of Chemistry (4)  
or Chem 1051 Chemical Principles I(4)
- Math 1142—Short Calculus (5)  
or Math 1251—One-Variable Differential and Integral Calculus (4)

##### Plus one from the following:

- BioC 1401—Elementary Biochemistry (4)
- Biol 1103—General Botany (5)
- Biol 1106—General Zoology (5)
- Chem 1002—Elementary Organic Chemistry (4)
- Chem 1052—Chemical Principles II(4)

#### Professional Requirements

##### From the College of Agricultural, Food, and Environmental Sciences

- ApEc 1000—Orientation to Agricultural and Applied Economics (1)
- ApEc 1101—Principles of Microeconomics (4)\*
- ApEc 1102—Principles of Macroeconomics (4)\*
- ApEc 3001—Applied Microeconomics: Consumers and Markets (4)
- ApEc 3002—Applied Microeconomics: Managerial Economics (4)
- ApEc 3006—Applied Macroeconomics: Government (4)
- ApEc 3007—Applied Macroeconomics: Policy (4)
- ApEc 3240—Strategic Management of Agribusinesses(4)
- ApEc 3260—Operations Management of Agribusinesses (4)
- ApEc 3400—Markets, Marketing, and Prices (4)
- ApEc 3500—Agribusiness Finance (4)

\* *History and Social Science—Students must complete two additional courses beyond the minimum 12 credits required for liberal education. The courses must come from the list of approved courses for the History and Social Sciences category of the liberal education curriculum.*



Coffey Hall on the St. Paul campus.

Plus two elective courses in agricultural economics (an internship or special project is encouraged).  
*An additional 16 credits is required in agricultural science.*  
 At least one course must be 3xxx or 5xxx. Courses in agricultural education, fisheries and wildlife, landscape architecture, rhetoric or physical and biological sciences may not be used to meet this requirement. In agricultural engineering, only AgET 3025 and AgET 5410 may be used.

Students choosing the food processing wholesaling and retailing emphasis who want to develop technical expertise in food processing are encouraged to complete 16 credits from:

- FScN 1020—Introductory Microbiology (4)
- AnSc 1510—Consumer Meat Science (2)
- FScN 1102—Technology of Food Processing (4)
- FScN 3102—Introduction to Food Processing (4)
- FScN 3135—Food Processing I (4)
- FScN 3136—Food Processing II (4)

Students interested in a technical expertise in food wholesaling and retailing are encouraged to complete 16 credits from:

- FScN 1020—Introductory Microbiology (4)
- AnSc 1510—Consumer Meat Science (4)
- FScN 1612—Principles of Nutrition (4)
- FScN 3472—Food Selection Principles (4)
- FScN 5390—Introduction to Food Law (4)

Students choosing an emphasis in business management, commodity and farm input marketing, finance and banking, or the individualized area of emphasis should contact the major coordinator for a list of courses that can be used to fulfill the agricultural science requirements.

*From the Carlson School of Management*  
 Acct 1050—Introduction to Financial Reporting (4)  
 Acct 3001—Introduction to Management Accounting (4)

BA 1550—Business Statistics (4)  
 Mgmt 3001—Fundamentals of Management (4)  
 Mktg 3000—Principles of Marketing (4)  
*Plus three elective courses in the Carlson School of Management.*

Emphasis Areas (16 credit minimum)

*1. Business Management*

BFin 3100—Financial Management (4)  
*Choose additional credits from the following*  
 Acct 3201—Intermediate Management Accounting (4)  
 ApEc 3450—Agricultural Input Marketing Economics (4)  
 ApEc 3920—Agricultural Law (4)  
 ApEc 5440—Cooperatives and Agribusiness Organization (4)  
 BLaw 3058—Introduction to Law, Law of Contracts and Sales Contracts (4)  
 IR 3002—Personnel and Industrial Relations (4)  
 IR 3010—The Individual and the Organization (4)  
 Mgmt 3002—Psychology in Management (4)  
 Mgmt 3008—Entrepreneurship and the Smaller Enterprise (4)  
 OMS 3056—Production and Inventory Management (4)

*2. Commodity and Farm Input Marketing*

ApEc 5480—Futures Markets and Prices (4)  
 LM 3000—Introduction to Logistics Management (4)  
*Choose additional credits from the following:*  
 ApEc 3300—Agricultural and Food Sales (3)  
 ApEc 3420—Grain Marketing Economics (4)  
 ApEc 3430—Dairy Marketing Economics (4)  
 ApEc 3440—Livestock and Meat Marketing Economics (3)  
 ApEc 3450—Agricultural Input Marketing Economics (4)  
 ApEc 5400—Intermediate Market and Price Analysis (4)  
 ApEc 5750—Agricultural Trade and Commercial Policies (3)  
 LM 5020—Advanced Logistics Management (4)

*3. Finance and Banking*

ApEc 5500—Financial Markets and Agricultural Credit Institutions (4)  
 BFin 3100—Financial Management (4)  
*Choose additional credits from the following*  
 Acct 3201—Intermediate Management Accounting (4)  
 Acct 5160—Financial Statement Analysis (4)  
 ApEc 3920—Agricultural Law (4)  
 ApEc 5480—Futures Markets and Prices (4)  
 BFin 3300—Securities Analysis and Portfolio Management (4)  
 BFin 3400—International Financial Management (4)  
 BFin 3601—Financial Management of Depository Institutions (4)  
 BLaw 3058—Introduction to Law, Law of Contracts and Sales Contracts (4)  
 Econ 5432—International Finance (4)  
 Ins 5100—Risk Management and Insurance (4)

*4. Food Processing, Wholesaling and Retailing*

ApEc 5550—Food Marketing Economics (4)  
 Mktg 3080—Marketing Strategy (4)  
*Choose additional credits from the following:*  
 ApEc 3300—Agricultural and Food Sales (3)  
 ApEc 5480—Futures Markets and Prices (4)  
 ApEc 5750—Agricultural Trade and Commercial Policies (3)  
 DHA 5241—Retail Promotion (4)  
 DHA 5242—Managerial Decision Making (4)  
 Mktg 3010—Buyer Behavior and Market Analysis (4)  
 Mktg 3030—Sales Management (4)  
 Mktg 3050—Marketing Communications (4)  
 Mktg 3065—Retail Management (4)

*5. Individualized Area of Emphasis*

Students preparing for career opportunities that emphasize skills such as communication, law, or information systems may use this alternative to design an area of emphasis. A program of study under this emphasis must be approved by the advisor and the major coordinator. At least 12 of the 16 credits must be completed after receiving approval. Electives to reach 180 credits required for graduation with a B.S. degree. Students following the old general education distribution of Areas A-D must have 192 credits for graduation.

## Agricultural Education

Dr. Roland Peterson, Major Coordinator  
325 Vocational and Technical Education Building  
1954 Buford Avenue  
St. Paul, MN 55108  
612/624-4736

The undergraduate major in agricultural education, offered jointly by COAFES and the College of Education and Human Development (CEHD), is for students who plan to teach agriscience, agriculture, horticulture, agribusiness, food systems, or natural resource management education in public schools, technical colleges, or community colleges, or for those who plan to work in educational positions in agricultural development and in various agricultural-related organizations. The program provides comprehensive education for those preparing for teaching; extension work; local, national, and international development; other professional careers in sales and marketing; financial management; or production agriculture. The program requires a broad study of agriculture and permits emphasis in animal science, crop science, agricultural economics, agricultural business, horticulture, soils, natural resources, and agricultural engineering technology. The agricultural education and the natural and managed environmental systems specializations offer special preparation in education necessary to qualify for licensure in agricultural education for teaching agribusiness, agriscience education, horticulture, and natural resources.

### Admission Procedures

Students may enter a pre-agricultural education major in COAFES as freshmen or transfer students. Students must earn 90 credits in the pre-agricultural education major before transferring to CEHD. Students should apply for admission to the college in the final quarter of their sophomore year. This application may be completed with the faculty of Agricultural Education, 325 Vocational and Technical Education Building. Students must complete the application requirements as directed by the agricultural education staff. Applications must be submitted within the first three weeks of the quarter preceding the desired quarter of admission.

**The Natural and Managed Environmental Systems Specialization and the Agricultural Education Specialization**—Students in these specializations will be eligible to teach agriculture, horticulture, natural resources, forestry, agribusiness, agriscience, food systems, and agricultural mechanics at the secondary or postsecondary levels and adult farm business management education with the agricultural education specialization provided they have the appropriate work experience to accompany their degree. In addition, graduates from this specialization may seek employment in all of the other areas listed in the general features section.

Applicants for teaching licensure must have the appropriate work experience.

To be eligible for admission to the natural and managed environmental systems or the agricultural education specializations in CEHD, students must have a minimum overall GPA of at least 2.50. Before admission, students will be required to complete the Praxis I: Pre-Professional Skills Tests (PPST) which is a test of basic reading, writing, and mathematics knowledge. Students must maintain a GPA of 2.50 to be eligible for student teaching.

**The Agricultural Development Specialization**—Students in this specialization will be eligible for a wide range of positions in agricultural development. They will guide the process of change for improving an individual, organization, community, or society within the context of agriculture. They may seek employment in all fields listed in the general features section except teaching. This specialization provides an emphasis in experiential education in both the production and agribusiness phases of agriculture.

To be eligible for admission to the agricultural development specialization in CEHD, you must have a minimum overall GPA of at least 2.30.

Transfer students who have completed less than two years of college work apply for admission to COAFES. These students will then apply to CEHD in the quarter in which they complete their sophomore year.

Transfer students who have completed two or more years of college work apply for admission to the College of Agricultural, Food, and Environmental Sciences, Office of the Registrar—St. Paul, University of Minnesota, 130 Coffey Hall, 1420 Eckles Avenue, St. Paul, MN 55108. COAFES reviews the application and evaluates the credits earned. During the first quarter of enrollment in COAFES, students apply for admission to CEHD.

**Student Teaching Internship Experience**—In the natural and managed environmental systems and the agricultural education specializations, students must have an overall GPA of 2.50 to be eligible for the student teaching experience.

**Graduation Requirements**—Students must have an overall GPA of 2.50 to meet graduation requirements in the natural and managed environmental systems and agricultural education specializations. They must have an overall GPA of 2.30 to graduate from the agricultural development specialization.

**Work Experience**—To obtain a teaching license, students must have a baccalaureate degree and satisfactory relevant work experience in any of the broad emphasis areas of agriculture. When applying for a license, students will be expected to verify at least 2,000 hours of work experience in any of a broad range of emphasis areas relevant to agriculture for a secondary license and 4,000 hours for adult farm management institutions. Special rules apply for work experience for adult teaching.

**Major Requirements**—Students majoring in agricultural education must complete the liberal education requirements listed below. Changes in the liberal education requirements require the approval of the University’s Council on Liberal Education. Changes in any of the foundation areas such as composition, psychology, mathematics, or biological and physical sciences require the approval of your adviser and COAFES. Changes in the education categories require the approval of the adviser and CEHD. Changes in the agriculture and natural resources categories may be made with the adviser’s recommendation and approval of the agricultural education coordinator.

**Liberal Education Diversified Core and Designated Themes**—See the liberal education requirements on page 8 and information at the beginning of this section. Students who enrolled in a degree program at the University of Minnesota–Twin Cities campus before fall 1994 see the liberal education requirements on page 8.

**Foundation Requirements**

- Two writing courses (8) (At least one at the 3xxx level)
- Two oral communication courses (8)
- One mathematics course—check specialization
- Psy 1001—Introduction to Psychology (4)
- Biol 1009—General Biology (5)
- Phys 1041—General Physics (5)
- Chem 1001, 1002—General Principles of Chemistry (4,4)  
or Chem 1051, 1052 Chemical Principles I, II (4,4)
- Biol 1103—General Botany (5)  
or Biol 1106—General Zoology (5)
- BioC 1401—Elementary Biochemistry (4)  
or Chem 3301—Organic Chemistry I (4)

**Professional Requirements**

- AgEd 1001—Introduction to Agricultural Education (1)
- AgEd 1002—Principles of Career Planning in Agriculture (1)
- AgEd 3029—Directed Experience in Agricultural Education (1)

**Emphasis Areas**

1. *Agricultural Education* (Teacher Licensure Program)
- Math 1031—College Algebra and Probability (4)

**General Education**

- EPsy 5119—Learning and Cognitive Foundations of Education (4)
- EPsy 5139—Building a Learning Community (4)
- EPsy 5229—Classroom Assessment Methods (2)
- EdPA 5090—School and Society (3)
- Kin 5530—Biological and Physical Foundations of Education (2)
- CI 5300—Technology for Teaching and Learning (2)
- PubH 3004—Basic Concepts in Personal and Community Health (5)  
or PubH 3001—Personal and Community Health (3)  
and PubH 3003—Fundamentals of Alcohol and Drug Abuse (2)

**Agricultural Education**

- AgEd 5028—Teaching Methods in Agricultural Education (5)
- AgEd 5049—Agricultural Education for Adults (3)
- AgEd 5061—Program Planning and Evaluation (3)
- AgEd 5072—Practicum: Agricultural Business and Industry (3)
- WCFE 5602, 5603, 5604—Student Teaching Internship (2,2,8)
- WCFE 5300—Philosophy and Practice of Vocational Education (3)
- WCFE 5330—Coordination Techniques in Cooperative Education (3)

**Animal Science (14 credits)**

- AnSc 1100—Introduction to Animal Science (5)  
or AnSc 3131—Live Animal Performance and Selection (3)
- AnSc 3220—Animal Breeding (4)  
or AnSc 3301—Systemic Physiology (6)  
or GCB 3022—Genetics (4)

**Applied Economics/Business (20 credits)**

- ApEc 1101—Principles of Microeconomics (4)
- ApEc 3300 Agricultural and Food Sales (3)  
or BIE 3060—Professional Sales Management (3)  
or GC 1537—Professional Selling (3)  
plus 13 additional credits in marketing, management (1 course), and accounting (1 course)



*Teaching about agriculture also involves community outreach, such as helping a youngster plant a tree.*

*Mechanical Technology and Environment (6 credits)*

AgEd 1042—Current Technical Competencies (3)  
 AgEd 5042—Agricultural Mechanics (3)

*Natural Resources (9 credits)*

*Plant Science/Plant Pathology or Entomology (12 credits)*

*Soil Science (5 credits)*

Soil 1020—The Soil Resource (5)  
 or Soil 3125—Basic Soil Science (5)

Electives to complete the 198 credits required for a bachelor of science degree.

**2. Agricultural Development**

Math 1031—College Algebra and Probability (4)

*General Education*

AdEd 5401—Adult Learning and Development Through the Life Span (3)

*Agricultural Education*

AgEd 5010—Rural Development Leadership (3)  
 AgEd 5021—Education Through Extension Methods (3)  
 AgEd 5023—Methods for Change in Developing (3)  
 WCFE 5025—Extension Program Development (3)  
 AgEd 5055—Methods in Farming Systems Research and Extension (3)

*Plus 10 credits from the following:*

AgEd 3001—Experiential Learning: Production Agriculture (0-10)  
 AgEd 3002—Experiential Learning: Agricultural Business (0-10)

*Development*

*Two from the following:*

ApEc 3070—Agriculture and Economic Growth in Developing Countries (4)  
 ApEc 5790—World Food Problems (3)  
 Econ 5401—International Economics (4)  
 Pol 3477—Political Development (4)  
 Pol 3835—The International System (4)

*Two from the following:*

ApEc 3006—Applied Macroeconomics: Government and the Economy (4)  
 ApEc 3007—Applied Microeconomics: Trade, Policy and Development (4)  
 ApEc 3040—Economic Development of American Agriculture (4)  
 ApEc 3610—Resource Development and Environmental Economics (4)  
 Econ 5301—Economic Development (4)  
 Econ 5307—Comparative Economic Systems (4)  
 FScN 1102—Technology of Food Processing (4)  
 FScN 1612—Principles of Nutrition (4)

*Animal Science (7 credits)*

*Agricultural Economics (18 credits)*

ApEc 3300 Agricultural and Food Sales (3)  
 or BIE 3060—Professional Sales Management(3)  
 or GC 1537—Professional Selling (4)  
 ApEc 1250—Principles of Accounting (4)  
 or Acct 1050 —Principles of Accounting (4)  
 ApEc 3810—Principles of Farm Management (4)  
*Plus select two courses from the following:*  
 ApEc 3420—Grain Marketing Economics (4)  
 ApEc 3430—Dairy Marketing Economics (4)  
 ApEc 3440—Livestock and Meat Marketing Economics (3)  
 ApEc 3450—Agricultural Input Marketing Economics (4)

*Mechanical Technology and Environment (5 credits)*

*Natural Resource Management (6 credits)*

*Plant Science or Plant Pathology or Entomology (12 credits)*

*Soil Science (5 credits)*

Soil 1020—The Soil Resource (5)  
 or Soil 3125—Basic Soil Science (5)

Electives to complete the 198 credits required for a bachelor of science degree.

**3. Natural and Managed Environmental Systems (Teacher Licensure Program)**

Math 1142—Short Calculus (5)  
 or Math 1251, 1252—One-Variable Differential and Integral Calculus I, II (4,4)  
 Stat 3011—Statistical Analysis (4)  
 or Agro 3060—Field Plot Design in Agronomy (4)  
 Geol 1001—The Dynamic Earth: An Introduction to Geology (4)  
 or Geol 1012—Planet Earth (4)  
 or Geol 1701—Faces of the Earth (4)  
 Biol 3008—Ecology and Evolution (4)

*General Education*

EPsy 5119—Learning and Cognitive Foundations of Education (4)  
 EPsy 5139—Interpersonal and Personality Effects on Learning (4)  
 EPsy 5229—Classroom Assessment Methods (2)  
 EdPA 5090—School and Society (3)  
 CI 5300—Technology in Education (2)  
 Kin 5530—Biological Foundations of Education (2)  
 PubH 3004—Basic Concepts in Personal and Community Health (5)  
 or PubH 3001—Personal and Community Health (3) and PubH 3003—Fundamental of Alcohol and Drug Abuse (2)

*Agricultural Education*

AgEd 5028—Teaching Methods in Agricultural Education (5)  
 AgEd 5061—Program Planning and Evaluation (3)  
 AgEd 5072—Practicum: Agricultural Business and Industry (3)  
 WCFE 5602, 5603, 5604 Student Teaching Internship (2,2,8)  
 WCFE 5300—Philosophy and Practice of Vocational Education (3)  
 WCFE 5330—Coordination Techniques in Cooperative Education (3)

*Animal Science (6 credits)*

AnSc 3401—Principles of Animal Nutrition (4)

*Select two from the following:*

AnSc 1301—Management Technique: Swine (1)  
 AnSc 1302—Management Technique: Sheep (1)  
 AnSc 1303—Management Technique: Beef (1)  
 AnSc 1304—Management Technique: Dairy (1)  
 AnSc 1305—Management Technique: Poultry (1)

*Soil and Plant Science (25 credits)*

Soil 1020—The Soil Resource (5)  
 or Soil 3125—Basic Soil Science (5)  
 Soil 3220—Soil Conservation and Land Use Management (4)  
 or Soil 3416—Soil Fertility (4)  
 Soil 1425—Introduction to Meteorology (4)  
 or Geog 1425—Introduction to Meteorology (4)  
 AnPI 3010—Environment and World Food Production (4)  
 or AnPI 5060—Integrated Management of Cropping Systems (4)  
 Agro 1010—Principles of Agronomy (5)  
 or Hort 1021—Woody Plant Materials (5)  
 or FR 1100—Dendrology (4)  
 Agro 3020—Growth and Development of Field Crops (4)  
 or Hort 3001—Growth Regulation of Horticultural Plants (5)

*Natural Resources and Environment Studies (15 credits)*

*One from the following:*

NRES 1010—Issues in the Environment (3)  
 or FR 1201—Conservation of Natural Resources (3)  
 or FW 1002—Wildlife: Ecology Values, and Human Impact (3)  
 or FW 1101—Ethics and Values in Research Management (3)  
 or FW 3052—Introduction to Fisheries and Wildlife (3)  
 or PIPa 3004—Air Pollution, People and Plants (3)

*Each of the following:*

NRES 3001—Colloquium in Natural Resources and Environmental Studies (1)  
 NRES 3060 —Water Quality in Natural Resource Management (3)  
 or AgET 5410—Hydrology and Water Quality (5)  
 NRES 5100—Problem Solving in Natural Resources and Environmental Studies (5)  
 NRES 5210—Survey, Measurement, and Modeling Methods for Natural Resource Analysis (3)

*Mechanical Technology and Environment (6 credits)*

AgEd 1042—Current Technical Competencies (3)  
 AgEd 5042—Agricultural Mechanics (3)  
*Agricultural Economics/Business (8 credits)*  
 ApEc 1250—Principles of Accounting (4)  
 or ApEc 3810—Principles of Farm Management (4)  
 ApEc 3610—Resource Development and Environmental Economics (4)  
 Electives to reach 198 credits required for graduation with a bachelor of science degree.

## Agricultural Industries and Marketing

Dr. Gary L. Malzer  
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1991 Upper Buford Circle  
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612/625-6728  
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Industries related to modern agriculture include the manufacturers and distributors of farm production inputs (such as equipment, structures, animal feed, health products, seeds, fertilizers, and crop protection products), and the assemblers, processors, manufacturers, and distributors of products originating from farms (such as meat, milk, eggs, wool, grains, fruits, vegetables, nursery crops, flowers, and turf) and the finance and insurance industries providing agricultural credit. These agribusiness industries employed about 18 million workers in 1988 and created nearly 16 percent of the U.S. Gross National Product that year. "Agribusinesses," such as these, regularly search for individuals who have a broad education in the scientific aspects of agriculture, effective work and communication skills, and the ability to competently use quantitative methods to solve business problems.

All departments in COAFES contribute to and are represented by the agricultural industries and marketing (AIM) major. This educational program achieves two objectives. It

- 1) provides a broad-based educational program reflecting the academic strengths of COAFES and the University at large, and
- 2) prepares students for a challenging career in agricultural industries.

The scientific knowledge and technical skills necessary to become an effective agribusiness professional are provided through requirements in the basic and agricultural sciences and are strengthened by selection of an area of emphasis in one of five areas: animal industries, horticultural industries, crops/soils industries, food industries, or an individualized emphasis. Certified advisers assist students with course selection in their area of emphasis, identify appropriate internships or practicum experiences, and select electives to develop breadth and depth in their undergraduate programs.

In addition, this major emphasizes development of oral and written communication skills in various interactive settings. Courses in business methods and economic analysis help students recognize and solve fiscal, marketing, and managerial problems in the modern agribusiness world.

The cross-disciplinary AIM major requires that students become involved in "real-world"

\* For Professional Experience Program (PEP) registration, use the four-character designator (xxxx) that represents your PEP adviser's department (e.g., Agro 5000 or Hort 5000).

experiences (industry internships) and/or in marketing problem solving (marketing practicum). As students progress through the program, regular meetings with faculty, agribusiness leaders, student organizations, alumni, and fellow students are a part of the educational experience.

### Major Requirements

All students in the AIM major must complete the requirements listed below. Faculty advisers assist students in selecting required courses, the use of electives, and the professional project (internship or practicum).

**Liberal Education Diversified Core and Designated Themes**—See the liberal education requirements on page 8 and information at the beginning of this section. Students who enrolled in a degree program at the University of Minnesota–Twin Cities campus before fall 1994 see the liberal education requirements on page 8.

#### Foundation Requirements

##### Quantitative Foundations

Math 1142—Short Calculus (5)

or Math 1251—One-Variable Differential and Integral Calculus (4)

ApEc 1250—Principles of Accounting (4)

or Acct 1050—Introduction to Financial Reporting (5)

Plus one from the following:

Stat 3011—Statistical Analysis (4)

BA 1550—Business Statistics (4)

Agro 3060—Field Plot Design in Agronomy (4)

##### Science Foundations

Biol 1009—General Biology (5)

Chem 1001—General Principles of Chemistry (4) and

Chem 1002—Elementary Organic Chemistry (4)

or Chem 1051—Chemical Principles (4)

and BioC 1401—Elementary Biochemistry (4)

#### Professional Requirements

##### Experiential

AgEd 1002—Principles of Career Planning in Agriculture (1)

xxxx 5000\*—Professional Experience Program (4)

or AIM 5001, 5002—Marketing Practicum I, II (2,2)

One from the following:

GC 1537—Professional Selling (4)

or BIE 3060—Professional Sales Management (3)

or ApEc 3300—Agriculture and Food Sales (4)

##### Communication

Rhet 1101—Writing to Inform and Persuade (4)

Rhet 1104—Library Research Methods (1)

Rhet 1151—Writing in Your Major (4)

Rhet 1222—Public Speaking (4)

Rhet 3562—Writing in Your Profession (4)

Two from the following:

Rhet 3254—Advanced Public Speaking (4)

Rhet 3266—Communication, Discussion in Small

Groups (4) or Spch 3411—Small Group

Communication Process (4)

Rhet 5258—Interviewing (4)

##### Business

ApEc 1101—Principles of Microeconomics (4)

ApEc 3001—Applied Microeconomics:

Consumers and Markets (4)

ApEc 3002—Applied Microeconomics:

Managerial Economics (4)

ApEc 3920—Agricultural Law (4)

ApEc 3400—Markets, Marketing, and Prices (4)

One from the following:

ApEc 3420—Grain Marketing Economics (4)

ApEc 3430—Dairy Marketing Economics (4)

ApEc 3440—Livestock and Meat Marketing Economics (3)

ApEc 3450—Agricultural Input Marketing Economics (4)

ApEc 5480—Futures Markets and Prices (4)  
 ApEc 5550—Food Marketing Economics (4)  
 FScN 5474—Food Marketing Economics (4)

One from the following:

ApEc 3500—Agribusiness Finance (4)  
 ApEc 5440—Cooperatives and Agribusiness Organization (4)  
 GC 1513—Small Business Fundamentals (4)  
 Spch 3441—Communicating Organizations (4)  
 Jour 3201—Principles of Advertising (4)

## Agriculture

AnSc 1100—Introduction to Animal Science (5)  
 AgET 3025—Engineering Principles and Applications (4)  
 or FScN 1102—Technology of Food Processing (4)  
 Agro 1010—Principles of Agronomy (5)  
 or Hort 1036—Plant Propagation (5)  
 One from the following:  
 Soil 3125—Basic Soil Science (5)  
 FScN 1612—Principles of Nutrition (4)

## Emphasis Areas

Contact: Leslie Hansen, Animal Science, 130 Haecker Hall

### 1. Animal Industries

Biol 1106—General Zoology (5)  
 or Biol 3011—Animal Biology (5)  
 or Biol 1103—General Botany (5)  
 or Biol 3012—Plant Biology (5)  
 AnSc 3220—Principles of Animal Breeding (5)  
 AnSc 3301—Systemic Physiology (6)  
 AnSc 3401—Principles of Animal Nutrition (4)  
 One from the following:  
 AnSc 5401—Swine Nutrition and Feeding (4)  
 AnSc 5403—Ruminant Nutrition (4)  
 AnSc 5405—Poultry Nutrition (3)

### 2. Crops/Soils Industries

Contact: Vernon B. Cardwell, Crops/Soils, 307 Agronomy

Biol 1103—General Botany (5)  
 or Biol 3012—Plant Biology (5)  
 Agro 3020—Growth and Development of Field Crops (4)  
 Soil 3416—Plant Nutrients in the Environment (4)  
 Plus at least 7 credits from the following:

Agro 3030—Harvest, Storage and Utilization of Field Crops (4)

Agro 3060—Field Plot Design in Agronomy (4)  
 Agro 3120—Grain Grading and Crop Utilization (2)  
 Agro 3150—Advanced Seed and Grain Evaluation (4)  
 Agro 3200—Seminar (1)

Agro 5020—Introduction to Plant Breeding (4)  
 Agro 5030—Weed Control (5)

Agro 5050—Management Technology For Crop Production (4)

AnPI 3010—Environment and World Food Production (4)  
 AnPI 5060—Integrated Management of Cropping Systems (4)

Ent 1005—Economic Entomology (4)  
 PIPa 3001—Management and Control of Field Crop Diseases (4)

Soil 3220—Soil Conservation and Land-Use Management (4)

Soil 3417—Plant Nutrients in the Environment Laboratory (1)

Soil 5104—Computer Applications in Soils (2)  
 Soil 5510—Field Study of Soils (1)

Soil 5240—Microclimatology (3)  
 Soil 5610—Soil Biology (4)

### 3. Horticultural Industries

Contact: Bradley Pedersen, Horticulture, 454 Alderman Hall

Biol 1103—General Botany (5)  
 or Biol 3012—Plant Biology (5)

Hort 1021—Woody Plant Materials (5)

Hort 3001—Growth Regulation of Horticultural Plants (5)

Hort 3002—Horticultural Cropping Systems (5)

Plus four courses from the following:

Hort 3003—Plant Genetics and Improvement (4)

Hort 3004—Applications of Plant Biotechnology (4)

Hort 3072—Turf Management (4)

Hort 5026—Landscape Management (4)

Hort 5030—Landscape Design of Residential and Small Commercial Sites (4)

Hort 5031—Temperate Fruit Production (4)

Hort 5034—Commercial Vegetable Agriculture (5)

Hort 5041—Landscape Design and Implementation (5)



The Twin Cities are home to several multinational agribusinesses.

Hort 5042—Turf Grass Science (5)  
 Hort 5046—Nursery Management (4)  
 Hort 5047—Nursery Scheduling and Enterprise Development (2)  
 Hort 5048—Nursery Management II (4)  
 Hort 5054—Commercial Floriculture Crop Production (4)  
 Hort 5055—Commercial Glasshouse Systems, Practices and Problems (5)

### 4. Food Industries

Contact: Elaine Asp, Food Science and Nutrition, 261 Food Science and Nutrition

FScN 1020—Introductory Microbiology (4)  
 FScN 3102—Introduction to Food Science (4)

ApEc 5550—Food Marketing Economics (4)  
 or FScN 5474—Food Marketing Economics (4)

Plus at least 8 credits from the following:

FScN 3112—Food Analysis (4)

FScN 3400—Food Communication Techniques (3)

FScN 3472—Food Selection Principles (4)

FScN 3730—Quantity Food Production Management (3)

FScN 3732—Lecture in Quantity Food Production Management (2)

FScN 5643—World Food Problems (3)

FScN 5524—Sensory Evaluation of Dairy Products (1)

### 5. Individualized Emphasis (20 credits minimum)

Courses may be selected according to the student's interests in consultation with the student's adviser and with approval of the AIM major committee.

Electives to reach 180 credits required for graduation with a B.S. degree. Students following the old general education distribution of areas A-D must have 192 credits for graduation.

## Animal and Plant Systems

Dr. Tony Seykora, Major Coordinator  
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The animal and plant systems major prepares students to work as managers and technical advisers for animal and plant production systems, maintenance and sales. This curriculum provides a science-based agricultural education with an applied principle emphasis. Students majoring in animal and plant systems are prepared to pursue careers in animal, plant, and environmental industries through a curriculum that increases their understanding of agriculture, science, mathematics, business, and social science. Quality performance in this curriculum also allows students to pursue graduate studies in animal- and plant-related specializations. The following requirements are common for all students in the major.

**Liberal Education Diversified Core and Designated Theme Requirements**—See the liberal education requirements on page 8 and information at the beginning of this section. Students who enrolled in a degree program at the University of Minnesota—Twin Cities campus before fall 1994 see the liberal education requirements on page 8.

Foundation Requirements  
ApEc 1101 or Econ 1101—Principles of Microeconomics (4)  
Biol 1009—General Biology (5)  
Biol 1106—General Zoology (5)  
    or Biol 1103—General Botany (5)  
    or Biol 3011—Animal Biology (5)  
    or Biol 3012—Plant Biology (5)  
BioC 1401—Elementary Biochemistry (4)  
Chem 1051—Chemical Principles I (4)  
    or Chem 1001—General Principles of Chemistry (4)  
    and Chem 1002—Elementary Organic Chemistry (4)  
Phys 1041—Introductory Physics (5)  
    or Phys 1001,1005—The Physical World, Lab (4,1)  
Rhet 1101—Writing to Inform and Persuade (4)  
Rhet 1104—Library Research Methods (1)  
Rhet 1151—Writing in Your Major (4)  
Rhet 1222—Public Speaking (4)  
    or Spch 3431—The Role of Persuasion in the Modern World (4)  
Rhet 3562—Writing in Your Profession (4)  
Math 1031—College Algebra and Probability (4)

Professional Requirements  
AgEd 1002—Principles of Career Planning in Agriculture (1)  
xxxx 5000\*—Professional Experience Program (4)  
Soil 1020—The Soil Resource (5)  
    or Soil 3125—Basic Soil Science (5)  
AgET 3025—Engineering Principles and Applications (4)  
    or NRES 3060—Water Quality in Natural Resource Management (3)  
*One from the following:*  
Ent 1005—Economic Entomology (4)  
Ent 3005—Insect Biology (3)  
Ent 5250—Forest Entomology (4)  
Ent 5280—Livestock Entomology (4)

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\* For Professional Experience Program (PEP) registration, use the four-character designator (xxxx) that represents your PEP adviser's department (e.g., Agro 5000 or Hort 5000).

## Major Requirements

Students majoring in animal and plant systems select an area of emphasis based on their interests and career goals. The four areas available are outlined in detail below. They are animal production, crops and soils/horticultural food, integrated pest management and environmental horticulture.

All students in animal and plant systems must complete the requirements listed below. All course substitutions and/or waivers must have the approval of the student's adviser and the Coordinating Committee for Animal and Plant Systems and the COAFES Office.

### 1. Animal Production

Contact:  
Department of Animal Science,  
Dr. Tony Seykora, 130 Haecker Hall, 624-3448

*Animal Production* prepares students for careers in farm animal and poultry production. Career opportunities include farming, farm management, county extension work, dairy production, meat packing, farm supply, genetic and nutritional consulting, appropriate government positions, and artificial insemination.

**Liberal Education Diversified Core and Designated Theme Requirements**—See the liberal education requirements on page 8 and information at the beginning of this section. Students who enrolled in a degree program at the University of Minnesota—Twin Cities campus before fall 1994 see the liberal education requirements on page 8.

Foundation Requirements  
ApEc 1101 or Econ 1101—Principles of Microeconomics (4)  
Biol 1009—General Biology (5)  
Biol 1106—General Zoology (5)  
    or Biol 1103 General Botany (5)  
    or Biol 3011—Animal Biology (5)  
    or Biol 3012—Plant Biology (5)  
BioC 1401—Elementary Biochemistry (4)  
Chem 1051—Chemical Principles I (4)  
    or Chem 1001—General Principles of Chemistry (4)  
    and Chem 1002—Elementary Organic Chemistry (4)  
Phys 1041—Introductory Physics (5)  
    or Phys 1001,1005—The Physical World, Lab (4,1)  
Rhet 1101—Writing to Inform and Persuade (4)  
Rhet 1104—Library Research Methods (1)  
Rhet 1151—Writing in Your Major (4)  
Rhet 1222—Public Speaking (4)  
    or Spch 3431—The Role of Persuasion in the Modern World (4)  
Rhet 3562—Writing in Your Profession (4)  
Math 1031—College Algebra and Probability (4)

Professional Requirements  
AgEd 1002—Principles of Career Planning in Agriculture (1)  
xxxx 5000\*—Professional Experience Program (4)  
Soil 1020—The Soil Resource (5)  
    or Soil 3125—Basic Soil Science (5)  
AgET 3025—Engineering Principles and Applications (4)  
    or NRES 3060—Water Quality in Natural Resource Management (3)  
*One from the following:*  
Ent 1005—Economic Entomology (4)  
Ent 3005—Insect Biology (3)  
Ent 5250—Forest Entomology (4)  
Ent 5280—Livestock Entomology (4)

## Animal Production Emphasis Courses\*

Agro 1010—Principles of Agronomy (5)  
 AnSc 1100—Introductory Animal Science (5)  
 AnSc 1510—Consumer Meat Science (2)  
 AnSc 3220—Principles of Animal Breeding (5)  
 AnSc 3301—Systemic Physiology (6)  
 AnSc 3401—Principles of Animal Nutrition (4)  
 CAPS 3502—Animal Health and Disease (5)

### One from the following:

AnSc 5401—Swine Nutrition and Feeding (4)  
 AnSc 5403—Ruminant Nutrition (4)  
 AnSc 5405—Poultry Nutrition (3)

### One from the following:

AnSc 5601—Swine Production (4)  
 AnSc 5602—Sheep Production (4)  
 AnSc 5603—Beef Cattle Production (4)  
 AnSc 5604—Dairy Farm Management (4)  
 AnSc 5605—Poultry Production (4)

### One from the following:

Biol 5003—Genetics (4)  
 GCB 3022—Genetics (4)  
 Hort 3003—Plant Genetics and Improvement (4)

### One from the following:

Agro 3060—Field Plot Design in Agronomy (4)  
 BA 1550—Business Statistics (4)  
 Stat 3011—Statistical Analysis (4)

### Two from the following:

ApEc 3001—Applied Microeconomics:  
 Consumers and Markets (4)  
 ApEc 3002—Applied Microeconomics:  
 Managerial Economics (4)  
 ApEc 3430—Dairy Marketing Economics (4)  
 ApEc 3440—Livestock and Meat Marketing Economics (3)  
 ApEc 3810—Principles of Farm Management (4)  
 AnPI 3010—Environment and World Food Production (4)  
 GC 1513—Small Business Fundamentals (4)  
 GC 1537—Professional Selling (4)

\* *Students interested in poultry study should inquire about courses available through the Midwest Poultry Consortium. Check with your adviser, the Department of Animal Science, or COAFES.*

Electives to reach 180 credits required for graduation with a B.S. degree. Students following the old general education distribution of Areas A-D must have 192 credits for graduation.

## 2. Crops and Soils/ Horticultural Food Production

### Contacts:

Department of Agronomy and Plant Genetics,  
 Dr. Lee Hardman, 411 Borlaug Hall, 625-8700

Department of Horticultural Science,  
 Dr. Emily Hoover, 160 Alderman Hall, 624-6220

Department of Soil, Water, and Climate,  
 Dr. Gary Malzer, 401 Soils, 625-6728

*Crops and soils/horticultural food production* prepares students for careers in the production and improvement of field crops, vegetables, and fruits. Career opportunities include positions as technical representatives of agricultural chemical and seed companies, field specialists for crops, environmental protection specialists, state and federal crop regulatory agents, grain buyers and merchandisers, storage elevator operators, farm managers, field agronomists and horticulturists for production consulting firms, soil and water specialists, and conservationists.

**Liberal Education Diversified Core and Designated Theme Requirements**—See the liberal education requirements on page 8 and information at the beginning of this section. Students who enrolled in a degree program at the University of Minnesota—Twin Cities campus before fall 1994 see the liberal education requirements on page 8.

## Foundation Requirements

ApEc 1101 or Econ 1101—Principles of Microeconomics (4)  
 Biol 1009—General Biology (5)  
 Biol 1103—General Botany (5)  
     or Biol 3012—Plant Biology (5)  
 BioC 1401—Elementary Biochemistry (4)  
 Chem 1051—Chemical Principles I (4)  
     or Chem 1001—General Principles of Chemistry (4)  
     and Chem 1002—Elementary Organic Chemistry (4)  
 Phys 1041—Introductory Physics (5)  
     or Phys 1001,1005—The Physical World, Lab (4,1)  
 Rhet 1101—Writing to Inform and Persuade (4)  
 Rhet 1104—Library Research Methods (1)  
 Rhet 1151—Writing in Your Major (4)  
 Rhet 1222—Public Speaking (4)  
     or Spch 3431—The Role of Persuasion in the Modern World (4)  
 Rhet 3562—Writing in Your Profession (4)  
 Math 1031—College Algebra and Probability (4)

## Professional Requirements

AgEd 1002—Principles of Career Planning in Agriculture (1)  
 xxxx 5000\*—Professional Experience Program (4)  
 Soil 1020—The Soil Resource (5)  
     or Soil 3125—Basic Soil Science (5)  
 AgET 3025—Engineering Principles and Applications (4)  
     or NRES 3060—Water Quality in Natural Resource Management (3)

### One from the following:

Ent 1005—Economic Entomology (4)  
 Ent 3005—Insect Biology (3)  
 Ent 5250—Forest Entomology (4)  
 Ent 5280—Livestock Entomology (4)

\* *For Professional Experience Program (PEP) registration, use the four-character designator (xxxx) that represents your PEP adviser's department (e.g., Agro 5000 or Hort 5000).*

## Crops and Soils/Horticultural Food Production

### Emphasis Requirements

Agro 5030—Weed Control (5)  
 AnPI 5060—Integrated Management of Cropping Systems (4)  
 Hort 1036—Plant Propagation (5)  
     or Agro 3130—Seed Technology (2)  
 Soil 3416,3417—Plant Nutrients in the Environment and Lab (4,1)  
 One from the following:  
 Agro 3020—Growth and Culture of Field Crops (4)  
 Hort 3001—Growth Regulation of Horticultural Plants (5)  
 PBio 3131—Survey of Plant Physiology (4)

### One from the following:

Agro 3030—Harvest, Storage and Utilization of Field Crops (4)  
 Agro 5020—Introduction to Plant Breeding (4)  
 Hort 5001—Harvest to Market of Horticultural Crops (3)

### One from the following:

Biol 5003—Genetics (4)  
 GCB 3022—Genetics (4)  
 Hort 3003—Plant Genetics and Improvement (4)

### One from the following:

Agro 3060—Field Plot Design in Agronomy (4)  
 BA 1550—Business Statistics (4)  
 Stat 3011—Statistical Analysis (4)

### One from the following:

ApEc 3420—Grain Marketing Economics (4)  
 ApEc 3810—Principles of Farm Management (4)  
 GC 1513—Small Business Fundamentals (4)  
 GC 1537—Professional Selling (4)

Select either sequence below: a.) Crops and Soils or

b.) Horticultural Food Production

### a. Crops and Soils

Agro 3200—Seminar (1)  
 PIPa 3001—Management and Control of Field Crop Diseases (4)  
     or PIPa 3002—Management of Horticultural Crop Diseases (4)  
 Soil 3220—Soil Conservation and Land Use Management (4)  
     or Soil 5510—Field Study of Soils for Environmental Assessment (4)

### One course in animal science

### Three from the following:

Agro 3030—Harvest, Storage and Utilization of Field Crops (4)  
 Agro 3150—Advanced Seed and Grain Evaluation (4)  
 Agro 5020—Introduction to Plant Breeding (4)



Associate Professor Deborah Allan watches a student working in the plant pathology laboratory.

- Agro 5050—Management Techniques for Crop Production in Minnesota (4)
- Agro 5070—Ecology of Field Crops (3)
- AnPI 3010—Environment and World Food Production (4)
- NRES 3020—Plant Resource Management and the Environment (4)
- Soil 5240—Microclimatology (3)
- Soil 5610—Soil Biology (4)

**b. Horticultural Food Production**

- Hort 3002—Horticultural Cropping Systems (5)
- Hort 3099—Seminar (1)
- Hort 5031—Temperate Fruit Production (4)
- Hort 5034—Commercial Vegetable Agriculture (5)
- PIPa 3002—Management of Horticultural Crop Diseases (4)
- Electives to reach 180 credits required for graduation with a bachelor of science degree. Students following the old general education distribution of Areas A-D must have 192 credits for graduation.

**3. Integrated Pest Management**

Contacts:  
 Department of Plant Pathology,  
 Dr. James Percich, 495 Borlaug Hall, 625-6240  
 Entomology,  
 Dr. David Ragsdale, 219 Hodson Hall, 624-6771  
 Agronomy and Plant Genetics,  
 Dr. Lee Hardman, 411 Borlaug Hall, 625-8700  
 Horticultural Science,  
 Dr. Mark Strefeler, 305 Alderman Hall, 624-6701  
 Soil, Water and Climate,  
 Dr. Gary Malzer, 401 Soils, 625-6728

*Integrated Pest Management (IPM)* prepares students to identify and control major insect, weed, and disease problems on principal agronomic and horticultural crops. Students emphasizing IPM learn how the environment and various cropping systems affect pests. Students learn selection and application of the most comprehensive, cost-efficient, and environmentally safe IPM procedures. This integrated approach considers such factors as soil fertility, cultivar selection, economics, and ethical concerns. This emphasis prepares students for the following career opportunities: agricultural crop protection products sales representative, crop management consultant, plant pest regulatory official for state or federal agencies, research assistant, and applicator of agricultural crop protection materials.

**Liberal Education Diversified Core and Designated Theme Requirements**—See the liberal education requirements on page 8 and information at the beginning of this section. Students who enrolled in a degree program at the University of Minnesota—Twin Cities campus before fall 1994 see the liberal education requirements on page 8.

- Foundation Requirements
- ApEc 1101 or Econ 1101—Principles of Microeconomics (4)
- Biol 1009—General Biology (5)
- Biol 1103—General Botany (5)
  - or Biol 3012—Plant Biology (5)
- BioC 1401—Elementary Biochemistry (4)
- Chem 1051—Chemical Principles I (4)
  - or Chem 1001—General Principles of Chemistry (4)
  - and Chem 1002—Elementary Organic Chemistry (4)
- Phys 1041—Introductory Physics (5)
  - or Phys 1001,1005—The Physical World and Lab (4,1)
- Rhet 1101—Writing to Inform and Persuade (4)
- Rhet 1104—Library Research Methods (1)
- Rhet 1151—Writing in Your Major (4)

\* For Professional Experience Program (PEP) registration, use the four-character designator (xxxx) that represents your PEP adviser's department (e.g., Agro 5000 or Hort 5000).

- Rhet 1222—Public Speaking (4)
  - or Spch 3431—The Role of Persuasion in the Modern World (4)
- Rhet 3562—Writing in Your Profession (4)
- Math 1031—College Algebra and Probability (4)

- Professional Requirements
- AgEd 1002—Principles of Career Planning in Agriculture (1)
- xxxx 5000\*—Professional Experience Program (4)
- Soil 1020—The Soil Resource (5)
  - or Soil 3125—Basic Soil Science (5)
- AgET 3025—Engineering Principles and Applications (4)
  - or NRES 3060—Water Quality in Natural Resource Management (3)
- One from the following:
  - Ent 1005—Economic Entomology (4)
  - Ent 3005—Insect Biology (3)
  - Ent 5250—Forest Entomology (4)
  - Ent 5280—Livestock Entomology (4)

- Integrated Pest Management Emphasis Requirements
- ApEc 3450—Agricultural Input Marketing Economics (4)
  - or ApEc 3810—Principles of Farm Management (4)
- Agro 3020—Growth and Development of Field Crops (4)
  - or Hort 3001—Growth Regulation of Horticultural Plants (5)
- Agro 5030—Weed Control (5)
- AnPI 5060—Integrated Management of Cropping Systems (4)
- PBio 3131—Survey of Plant Physiology (4)
- PIPa 3001—Management and Control of Field Crop Diseases (4)
  - or PIPa 3002—Management of Horticultural Crop Diseases (4)
- PIPa 5205—Plant Disease Diagnosis (2)
- One course in animal science

- One from the following:
  - Agro 3060—Field Plot Design in Agronomy (4)
  - BA 1550—Business Statistics (4)
  - Stat 3011—Statistical Analysis (4)
- One from the following:
  - Biol 5003—Genetics (4)
  - GCB 3022—Genetics (4)
  - Hort 3003—Plant Genetics and Improvement (4)

- Three from the following:
  - Agro 3020—Growth and Development of Field Crops (4)
  - Agro 3030—Harvest, Storage and Utilization of Field Crops (4)
  - Agro 5050—Management Techniques for Crop Production in Minnesota (4)
  - AnPI 3010—Environment and World Food Production (4)
  - Hort 1036—Plant Propagation (5)
  - Hort 3001—Growth Regulation of Horticultural Plants (4)
  - Hort 3002—Horticultural Cropping Systems (5)
  - Hort 3003—Plant Genetics and Improvement (4)
  - Hort 3072—Turf Management (4)
  - Hort 5026—Landscape Management (4)
  - Hort 5031—Temperate Fruit Production (4)
  - Hort 5034—Commercial Vegetable Agriculture (5)
  - Hort 5042—Turfgrass Science (5)
  - Hort 5046—Nursery Management I (4)
  - Hort 5047—Nursery Scheduling and Enterprise Development (2)
  - Hort 5048—Nursery Management II (4)
  - Hort 5054—Commercial Floriculture Production Practices (4)
  - Hort 5055—Commercial Floriculture Production Systems (5)

- One from the following:
  - Ent 5020—Insect Taxonomy (5)
  - Ent 5040—Insect Ecology (4)
  - Ent 5215—Insects in Relation to Plant Diseases (3)
  - Ent 5250—Forest Entomology (4)
  - Ent 5280—Livestock Entomology (4)

- One from the following:
  - PIPa 5201—Biology of Plant Diseases (3)
  - PIPa 5202—Biology of Plant Diseases Laboratory (2)
  - PIPa 5203—Phys. and Molecular Plant-Microbe Interactions (3)
  - PIPa 5204—Plant Pathology (2)
  - PIPa 5206—Biology of Fungi (4)
  - PIPa 5209—Biochemistry of Plant Disease (3)
  - PIPa 5211—Fungal Genetics (4)
  - PIPa 5212—Diseases of Forest and Shade Trees (4)
  - PIPa 5213—Plant Nematology (4)
  - PIPa 5214—Plant Virology (4)
  - Soil 3416,3417—Plant Nutrients in the Environment and Lab (4,1)
  - Soil 5610—Soil Biology (4)



Whatever the season, the St. Paul campus offers plenty of quiet spots for studying.

Electives to reach 180 credits required for graduation with a B.S. degree. Students following the old general education distribution of Areas A-D must have 192 credits for graduation.

## 4. Environmental Horticulture

Contact:  
Department of Horticultural Science,  
Dr. Mark Strefeler, 305 Alderman Hall, 624-6701

*Environmental horticulture* prepares students for professional positions requiring a thorough understanding of the technical and managerial aspects of environmental horticulture. Career opportunities include floriculture; landscape design, installation, and management; nursery management and production; turf management; and urban horticulture. Students learn environmental enhancement and management techniques required in state, city, and county agencies as well as in private industry. Students in the environmental horticulture emphasis may supplement their program with a minor in environmental design in landscape architecture outlined on page 35.

**Liberal Education Diversified Core and Designated Theme Requirements**—See the liberal education requirements on page 8 and information at the beginning of this section. Students who enrolled in a degree program at the University of Minnesota—Twin Cities campus before fall 1994 see the liberal education requirements on page 8.

Foundation Requirements  
ApEc 1101 or Econ 1101—Principles of Microeconomics (4)  
Biol 1009—General Biology (5)  
BioC 1401—Elementary Biochemistry (4)  
Chem 1051—Chemical Principles I (4)  
    or Chem 1001—General Principles of Chemistry (4)  
    and Chem 1002—Elementary Organic Chemistry (4)  
Phys 1041—Introductory Physics (5)  
    or Phys 1001,1005—The Physical World and Lab (4,1)  
Rhet 1101—Writing to Inform and Persuade (4)  
Rhet 1104—Library Research Methods (1)  
Rhet 1151—Writing in Your Major (4)  
Rhet 1222—Public Speaking (4)  
    or Spch 3431—The Role of Persuasion in the Modern World (4)  
Rhet 3562—Writing in Your Profession (4)  
Math 1031—College Algebra and Probability (4)

Professional Requirements  
AgEd 1002—Principles of Career Planning in Agriculture (1)  
xxxx 5000\*—Professional Experience Program (4)  
Soil 1020—The Soil Resource (5)  
    or Soil 3125—Basic Soil Science (5)  
AgET 3025—Engineering Principles and Applications (4)  
    or NRES 3060—Water Quality in Natural Resource Management (3)

*One from the following:*  
Ent 1005—Economic Entomology (4)  
Ent 3005—Insect Biology (3)  
Ent 5250—Forest Entomology (4)  
Ent 5280—Livestock Entomology (4)

Environmental Horticulture Emphasis Requirements  
Hort 1021—Woody Plant Materials (5)  
Hort 1022—Herbaceous Plants (5)  
Hort 1036—Plant Propagation (5)  
Hort 3001—Growth Regulation of Horticultural Plants (5)  
Hort 3002—Horticultural Cropping Systems (5)  
Hort 3099—Seminar (1)  
PIPa 3002—Management of Horticultural Crop Diseases (4)  
    or PIPa 5212—Diseases of Forest and Shade Trees (4)

\* For Professional Experience Program (PEP) registration, use the four-character designator (xxxx) that represents your PEP adviser's department (e.g., Agro 5000 or Hort 5000).

Soil 3416,3417—Plant Nutrients in the Environment and Lab (4,1)

*Three from the following:*

Acct 1050—Introduction to Financial Accounting (5)  
    or ApEc 1250—Principles of Accounting (4)  
Acct 3001—Introduction to Management Accounting (4)  
ApEc 1102—Principles of Macroeconomics (4)  
ApEc 3001—Applied Microeconomics:  
    Consumers and Markets (4)  
ApEc 3002—Applied Microeconomics:  
    Managerial Economics (4)  
ApEc 3006—Applied Macroeconomics:  
    Government and the Economy (4)  
ApEc 3007—Applied Macroeconomics:  
    Policy, Trade, and Development (4)  
ApEc 3240—Strategic Management of Farms and Agribusinesses(4)  
ApEc 3260—Operations Management of Farms and Agribusinesses(4)  
ApEc 3400—Markets, Marketing, and Prices (4)  
BFin 3000—Finance Fundamentals (4)  
    or ApEc 3500—Agribusiness Finance (4)  
BLaw 3058—Introduction to Law, Law of Contracts and Sales Contracts (4)  
    or ApEc 3920—Agricultural Law (4)  
GC 1513—Small Business Fundamentals (4)  
BA 1550—Business Statistics (4)  
IDSC 3030—Information Systems and Information Management (4)  
Ins 5100—Risk Management and Insurance (4)  
IR 3002—Personnel and Industrial Relations (4)  
IR 3010—Individual in the Organization (4)  
IR 3032—Governing in the Work Place (4)  
IR 5002—Systems of Conflict and Dispute Resolution (4)  
Jour 3201—Principles of Advertising (4)  
Mgmt 3001—Fundamentals of Management (4)  
Mgmt 3004—Business Policy (5)  
Mgmt 5101—Advanced Topics in Management: Small Business Management (4)  
Mktg 3000—Principles of Marketing (4)  
Mktg 3010—Buyer Behavior and Marketing Analysis (4)  
NRES 3010—Ethics and Values in Resource Management (3)  
OMS 3000—Introduction to Operations Management (4)  
Rhet 1200—Information Technology in Scientific and Technical Professions (3)  
    or GC 1571—Introduction to Microcomputer Applications (5)  
    or GC 1572—Introduction to Computer Programming (5)  
    or GC 1575—Introduction to Computers (4)  
    or Rhet 3400—Managing Information on the Internet  
Rhet 3266—Communication, Discussion in Small Group Decision Making(4)  
Rhet 5170—Managerial Communication (4)  
Stat 3011—Statistical Analysis (4)

*Select either sequence below: a.) Landscape, Nursery, and Turf or b.) Floriculture*

*a. Landscape, Nursery, and Turf*

Hort 5030—Landscape Design of Residential and Small Commercial Sites (4)  
Hort 5041—Landscape Design and Implementation (5)  
*Six courses from the following:*  
Hort 3072—Turf Management (4)  
Hort 5026—Landscape Management (4)  
Hort 5042—Turf Grass Science (5)  
Hort 5046—Nursery Management I (4)  
Hort 5047—Nursery Scheduling and Enterprise Development (2)  
Hort 5048—Nursery Management II (4)  
Hort 5054—Commercial Floriculture Production Practices (4) or 5055 Commercial Floriculture Production Systems(4)

*b. Floriculture*

Hort 3004—Applications of Plant Biotechnology (4)  
    or Hort 5001—Harvest to Market of Horticultural Crops (3)  
Hort 5054—Commercial Floriculture Production Practices (4)  
Hort 5055—Commercial Floriculture Production Systems (5)  
Three additional horticultural science courses

Electives to reach 180 credits required for graduation with a B.S. degree. Students following the old general education distribution of Areas A-D must have 192 credits for graduation.

## Applied Economics

Dr. Kent D. Olson, Major Coordinator  
316 Classroom-Office Building  
1994 Buford Avenue  
St. Paul, MN 55108  
612/625-7723  
E-mail: kolson@dept.agecon.umn.edu

The applied economics major prepares students for careers in private industry, government agencies, agribusinesses, or for graduate work. Areas of emphasis include: management and finance; marketing; food retailing; trade and development; resources and environment; and regional and public economics as well as individualized areas of emphasis that students may design in consultation with their adviser. This curriculum offers flexibility and emphasizes both fundamental written and oral communication skills as well as development of a strong foundation in economic principles and their applications. The core group of professional courses includes basic economic principles, applied micro/macroeconomic theory, accounting, and statistics. Students may select the remainder of their courses according to their interests.

**Liberal Education Diversified Core and Designated Themes**—See the liberal education requirements on page 8 and information at the beginning of this section. Students who enrolled in a degree program at the University of Minnesota–Twin Cities campus before fall 1994 see the liberal education requirements on page 8.

### Foundation Requirements

#### Writing performance courses:

- Rhet 1101—Writing to Inform (4)
- Rhet 1104—Library Research Methods (1)
- Rhet 1151—Writing in Your Major (4)
- Rhet 3562—Writing in Your Profession (4)

#### Speech performance courses:

- Rhet 1222—Public Speaking (4)
- Rhet 3254—Advanced Public Speaking (4)
- or Rhet 3266—Communication, Discussion in Small Group Decision Making (4)
- Math 1142—Short Calculus (5)
- or Math 1251—One Variable Differential and Integral Calculus I (4)

Note: Students contemplating graduate study are encouraged to take Math 1251,1252 (4,4)

### Professional Requirements

- ApEc 1000—Orientation to Agricultural and Applied Economics (1)
- ApEc 1101—Principles of Microeconomics (4)\*
- ApEc 1102—Principles of Macroeconomics (4)\*
- ApEc 1250—Principles of Accounting (4)
- or Acct 1050—Introduction to Financial Reporting (4)
- BA 1550—Business Statistics (4)
- ApEc 3001—Applied Microeconomics: Consumers and Markets (4)
- ApEc 3002—Applied Microeconomics: Managerial Economics (4)
- ApEc 3006—Applied Macroeconomics: Government and the Economy (4)

\* *History and Social Science—Students must complete two additional courses beyond the minimum 12 credits required for liberal education. The courses must come from the list of approved courses for the History and Social Sciences category of the liberal education curriculum. See the quarterly Class Schedule for a current list.*

ApEc 3007—Applied Macroeconomics: Policy, Trade, and Development (4)

ApEc 3400—Agricultural Markets, Marketing and Prices (4)

A. Professional Application Cluster (16 credits minimum)  
At least two ApEc courses plus two more courses from ApEc, Econ, or Carlson School of Management. Students are encouraged, but not required, to take 12 or more of these 16 additional credits in one of the following areas:

#### 1. Management and Finance

- ApEc 3240—Strategic Management of Agribusinesses (4)
- ApEc 3260—Operations Management of Agribusinesses (4)
- ApEc 3500—Agribusiness Finance (4)
- ApEc 5020—Applied Linear Programming (4)
- ApEc 5440—Cooperatives and Agribusiness Organization (4)
- ApEc 5500—Financial Markets and Agricultural Credit Institutions (4)

#### 2. Marketing

- ApEc 3300—Agricultural and Food Sales (3)
- ApEc 3420—Grain Marketing Economics (4)
- ApEc 3430—Dairy Marketing Economics (4)
- ApEc 3440—Livestock and Meat Marketing Economics (3)
- ApEc 3450—Agricultural Input Marketing Economics (4)
- ApEc 5400—Intermediate Market and Price Analysis (4)
- ApEc 5440—Cooperatives and Agribusiness Organization (4)
- ApEc 5480—Futures Markets and Prices (4)
- ApEc 5550—Food Marketing Economics (4)

#### 3. Food Retailing

- ApEc 3260—Operations Management of Agribusinesses (4)
- ApEc 5550—Food Marketing Economics (4)
- DHA 5241—Retail Promotion (4)
- DHA 5242—Managerial Decision Making (4)
- Mktg 3000—Principles of Marketing (4)
- IR 3010—The Individual and the Organization (4)

#### 4. Trade and Development

- ApEc 3040—Economic Development of American Agriculture (4)
- ApEc 3070—Agriculture and Economic Growth in Developing Countries (4)
- ApEc 5710—US Agriculture: Farm, Food, and Environmental Policy (3)
- ApEc 5720—Economics of World Agriculture (3)
- ApEc 5730—European Agriculture: Farm, Food, and Environmental Policy (4)
- ApEc 5750—Agricultural Trade and Commercial Policies (3)
- ApEc 5790—World Food Problems (3)

#### 5. Resources and Environment

- ApEc 3610—Resource Development and Environmental Economics (4)
- ApEc 5600—Land and Water Economics (3)
- ApEc 5630—Regional Development Systems (3)
- ApEc 5640—Financing State and Local Governments (4)
- ApEc 5650—Economics of Natural Resource Policy (4)
- Econ 5611—Resource and Environmental Economics (4)
- Econ 5831—Cost-benefit Analysis (4)

#### 6. Regional and Public Economics

- ApEc 5620—Regional Economic Analysis (3)
- ApEc 5630—Regional Development Systems (3)
- ApEc 5640—Financing State and Local Government (3)
- Econ 3801—Elements of Public Finance (4)
- Econ 5621—Urban Economics (4)
- Econ 5623—Housing Markets and Public Policy (4)

#### 7. Individualized Professional Cluster

Consult with adviser to develop such a program.

#### B. Technical Emphasis (16 credits minimum)

Applied economists need both knowledge of economics and expertise in scientific or technical areas. With the help of an adviser, students select at least four courses from at least two departments. At least one course should be 3xxx or above. Courses selected should be consistent with career interests. For example, students interested in the food industry should take food science and nutrition courses; those interest in grain marketing, grain handling and storage courses; those interested in natural resources, soils, water, forestry, or ecology courses, etc. Electives to reach 180 credits required for graduation with a B.S. degree. Students following the old general education distribution of Areas A-D must have 192 credits for graduation.

## Environmental Science

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The environmental science (ES) curriculum is for students interested in an interdisciplinary science education that prepares them to deal with environmental problems. The basic natural resources of land, air, and water are studied in the context of protecting and sustaining the environment. Students will become knowledgeable about environmental issues and the science behind policy decisions. Students will gain an appreciation of the important role of managed and natural systems in managing the environment in a sustaining way at the local, regional, national and international levels.

As concern for the environment grows, opportunities for ES graduates increase in agencies and firms involved in control technology, regulation of environmental contamination, and remediation of contaminated sites. Recent ES graduates have found employment in areas such as: environmental consulting firms; state and local agencies such as the Minnesota Pollution Control Agency, Minnesota Office of Waste Management, Minnesota Department of Natural Resources,

Minnesota Department of Health, Minnesota Department of Agriculture, and Metropolitan Council; federal agencies such as the Environmental Protection Agency, Soil Conservation Service, U.S. Forest Service, and Bureau of Land Management; waste management firms; environmental engineering firms; environmental education; and extension service-resource management.

Graduates would also be prepared to go on to professional school (law or public policy) or graduate school in selected disciplines.

All students require training in math and science, social science, humanities, communication and applied technical aspects of environmental problems. Resolving environmental problems involves working with people and therefore emphasis in oral and written communication is required. The environmental science core draws courses from atmospheric science, soil science, hydrology, and plant science.

Students in the University of Minnesota's environmental science program:

- Have analytical skills and a broad understanding of environmental problems;
- Have demonstrated their abilities in scientific courses;
- Have worked with computers in courses and can use many current software tools;
- Have developed skills to communicate effectively with technical and non-technical audiences;



*The Twin Cities campus is in the heart of a major metropolitan area, but green space abounds.*

- Have practiced the necessary problem solving skills to develop creative solutions to environmental problems;
- Are highly motivated and committed to solving environmental problems.

**Liberal Education Diversified Core and Designated Themes**—See the liberal education requirements on page 8 and information at the beginning of this section. Students who enrolled in a degree program at the University of Minnesota–Twin Cities campus before fall 1994 see the liberal education requirements on page 8.

#### Foundation Requirements

##### *Basic Sciences*

- Biol 1009—General Biology (5)  
 Chem 1051, 1052—Chemical Principles I, II (4,4)  
 Phys 1041, 1042—Introductory Physics I, II (5,5)  
 Biol 1103—General Botany (5)  
     or Biol 1106—General Zoology (5)  
 BioC 1401—Elementary Biochemistry (4)  
     or Chem 3301—Elementary Organic Chemistry I (4)

##### *Math and Statistics*

- Math 1251, 1252—One-Variable Differential and Integral Calculus I, II (4,4)

##### *One from the following:*

- Stat 3011—Statistical Analysis (4)  
 Stat 3091—Introduction to Probability and Statistics (4)  
 Agro 3060—Field Plot Design in Agronomy (4)

##### *Computer competency*

Computer skills are necessary for today's student. As a student in COAFES, you will use computer applications in your coursework no matter which major you choose. You will be expected to have basic computer competency in word processing, spreadsheets, database management, and telecommunications. Your level of computer competency will be assessed in the advising process. If you lack needed skills, you will be given advice on which courses you will be required to take in order to learn those skills.

##### *Writing and Speaking*

- Rhet 1101—Writing to Inform and Persuade (4)  
 Rhet 1151—Writing in Your Major (4)  
 Rhet 3562—Writing in Your Profession (4)  
 Rhet 1222—Public Speaking (4)  
     or Rhet 3266—Communication, Discussion in Small Group Decision Making (4)  
 plus two other writing intensive courses (8)

##### *History and Social Sciences*

- ApEc 1101—Principles of Microeconomics (4)  
 ApEc 1102—Principles of Macroeconomics (4)  
 ApEc 3610—Resource Developing and Environmental Economics (4)

#### Professional Requirements

##### *Environmental Courses*

- ES 1001—Orientation to Environmental Science (1)  
 NRES 3001—Colloquium in Natural Resources and Environmental Studies (1)  
 ES 3050—Experience and Training in a Field Setting (1-4)  
 Biol 1051—Environmental Studies (4)  
     or Biol 3051—Environmental Studies (4)  
 ES 1010—Issues in the Environment (3)  
     or NRES 3010—Ethics and Values in Resource Management (3)  
 Soil 5020—Environmental Impact Assessment (4)  
 Soil 5100—Problem Solving in Environmental Science (5)  
*Land, Water, Atmosphere, and Ecology Courses*  
 Soil 3125—Basic Soil Science (5)  
 Soil 3416—Plant Nutrients in the Environment (4)  
 Soil 5510—Field Study of Soils: Morphology (1)  
 AgET 5410—Hydrology and Water Quality (5)  
     or FR 5114—Forest Hydrology (3) and NRES 3060—Water Quality in Natural Resource Mgmt (3)  
 Biol 3008—Ecology and Evolution (4)  
 Soil 1425—Introduction to Meteorology (4)  
 Geo 1001—Introduction to Geology (4)  
     or Geo 1111—Introductory Physical Geology (5)

##### *Soil, Plant and Animal Courses*

##### *Soil—select one from the following:*

- Soil 3220—Soil Conservation and Land Use Management (4)  
 Soil 5210—Environmental Biophysics (4)  
 Soil 5555—Wetland Soils (4)

##### *Plant—select one from the following:*

- NRES 3020—Plant Resource Management and the Environment (4)  
 Agro 3020—Growth and Development of Field Crops (4)  
 Hort 3001—Growth Regulation of Horticultural Plants (5)  
 PIPa 3001—Management and Control of Field Crop Diseases (4)  
 PIPa 3002—Management of Horticultural Crop Diseases (4)  
 PIPa 5212—Diseases of Forest and Shade Trees (4)

##### *Animal—select one from the following:*

- FW 3054—Biological Conservation (3)  
 Ent 1005—Economic Entomology (4)  
 AnSc 1100—Introduction to Animal Science (5)  
 AnSc 3113—Animal Welfare (4)

#### Emphasis Areas (24 credits)

There are no required courses. See major coordinator for suggested course lists. Specific courses are chosen with an adviser in such areas as:

*Land and water resources:* land use management, soil resources, sustainable agriculture, and water resources (hydrology and climatology)

*Environmental management:* bioremediation, environmental measurement, and waste management

*Environmental education:* natural and managed environmental systems education

Electives to reach 180 credits required for graduation with a B.S. degree.

## Food Science

Dr. Zata Vickers, Major Coordinator

225 Food Science and Nutrition

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Food science applies scientific principles to the manufacture, distribution, marketing, and consumer aspects of food. Food scientists apply basic principles and techniques of many disciplines, including chemistry, physics, and microbiology, to food processing and preservation and new product development. Food scientists are concerned with the theoretical and practical aspects of the food chain from the production of raw materials to the use of food products by consumers.

This curriculum balances fundamental principles and practical applications of theory within a flexible program that permits students to tailor their studies to fit personal career goals. They can develop proficiency in a related discipline through an optional area of specialization such as engineering or biochemistry or by designing their own area of emphasis in related areas such as chemistry, microbiology, or consumer issues. Graduates of the program work in a variety of technical, marketing, and promotional positions in the food industry.

The program is open to students registered in either COAFES or the College of Human Ecology. Faculty advisers are from the Department of Food Science and Nutrition, which is jointly administered by the two colleges.

Many graduates of the program seek employment after earning the bachelor of science degree, while others continue on to graduate study. Career areas include production management, product and process research and development, public health and regulatory agency service, education, marketing, management, technical sales and promotion, and quality control supervision. Admission to the food science program requires a GPA of at least 2.50.

**Liberal Education Diversified Core and Designated Themes**—See the liberal education requirements on page 8 and information at the beginning of this section. Students who enrolled in a degree program at the University of Minnesota–Twin Cities campus before fall 1994 see the liberal education requirements on page 8.

### Foundation Requirements

ApEc 1101—Principles of Microeconomics (4)

Biol 1009—General Biology (5)

Chem 1051, 1052—Chemical Principles I, II (4,4)

Chem 3301, 3305—Organic Chemistry I and Lab (4,2)

Chem 3302, 3306—Organic Chemistry II and Lab (4,2)

BioC 3021—Biochemistry (4)

Math 1142—Short Calculus (5)

or Math 1251, 1252—One Variable Differential and Integral Calculus (4,4)

Phys 1041, 1042—Introductory Physics (5,5)

or Phys 1251, 1252, 1253 (4,4,4)

Rhet 1101—Writing to Inform and Persuade (4)

Rhet 1104—Library Research Methods (1)

Rhet 1222—Public Speaking (4)

Rhet 3562—Writing in Your Profession (4)

Stat 3011, 3012—Statistical Analysis (4,4)

or Stat 5021—Statistical Analysis (5)

VPB 3103—General Microbiology (5)

or MicB 5105—Biology of Microorganisms (5)

### Professional Requirements

FScN 1102—Food: Safety, Risks, and Technology (4)

FScN 1612—Principles of Nutrition (4)

FScN 3102—Introduction to Food Science (4)

FScN 3112—Food Analysis (4)

FScN 3135—Food Processing I (4)

FScN 3136—Food Processing II (4)

FScN 5100—General Seminar (1)

FScN 5110—Food Chemistry (4)

FScN 5120—Food Microbiology (5)

FScN 5122—Control Systems in Food Microbiology (2)

FScN 5123—Food Fermentation and Biotechnology (3)

FScN 5135—Food Engineering Unit Operations (5)

FScN 5312—Instrumental Analysis of Foods (3)

*Plus a minimum of 16 credits from the following*

*(a maximum of 4 credits in FScN 5000/5111 may be used to meet the 16-credit requirement):*

FScN 3400—Food Marketing Communications (4)

FScN 3472—Food Selection Principles (4)

FScN 5000—Professional Experience Program (4)

FScN 5111—Independent Study in Food Science and Nutrition (1-5)

FScN 5314—Physiochemistry of Foods (4)

FScN 5360—Sensory Evaluation of Food Quality (4)

FScN 5380—Food Packaging (3)

FScN 5390—Introduction to Food Law (4)

FScN 5474—Food Marketing Economics (4)

FScN 5512—Meat Technology (4)

FScN 5522—Technology of Fluid and Concentrated Milk Products (4)

FScN 5523—Technology of Fermented Dairy Products (4)

FScN 5524—Sensory Evaluation of Dairy Products (1)

FScN 5550—Grains: Introduction to Cereal Chemistry and Technology (4)

FScN 5555—Freezing and Dehydration of Foods (5)

FScN 5560—Introduction to New Product Development (3)

FScN 5562—Flavor Technology (4)

FScN 5620—Nutrition and Metabolism (5)

### Emphasis Areas

Food science students may complete one of the two following areas of emphasis or design an area of emphasis that meets their own educational and career goals. Consult with your adviser about appropriate courses.

#### *a. Physical/Biochemistry Emphasis*

Students must substitute Phys 1251, 1252, and 1253 (4, 4, 4) for Phys 1041 and 1042

Chem 5501—Introduction to Thermodynamics and Kinetics (3)

Chem 5502—Introduction to Quantum Theory and Spectroscopy (3)

Math 1261—Calculus III (4)

Math 3251—Multivariable Differential Calculus (4)

Math 3252—Multivariable Integral Calculus (4)

*Select 8 additional credits or more from:*

BioC 5525—Physical Biochemistry: Solution Structure and Interactions of Biological Macromolecules (4)

BioC 5528—Physical Biochemistry: Enzyme Kinetics(4)

BioC 5331—Structure, Catalysis, and Metabolism in Biological Systems (4)

BioC 5333—Molecular Mechanism of Gene Action (4)

#### *b. Engineering Emphasis*

Students must substitute Phys 1251, 1252, and 1253 (4, 4, 4) for Phys 1041 and 1042

Math 1261—Calculus III (4)

Math 3251—Multivariable Differential Calculus (4)

Math 3252—Multivariable Integral Calculus (4)

Math 3261—Differential Equations with Linear Algebra (4)

ChEn 5001—Computational Methods in Chemical Engineering and Material Science (4)

ChEn 5101—Principles of Chemical Engineering I (4)

ChEn 5102—Principles of Chemical Engineering II (4)

Electives to complete the 180 credits required to graduate with a B.S. degree. Students following the old general education distribution of Areas A-D must have 192 credits for graduation.

## Nutrition

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Nutrition explores how nutrients and the foods from which they are derived aid the body in health, growth, and development. National and international concern for how nutrition affects health and disease has generated many career opportunities for registered dietitians and nutritionists.

The nutrition major offers excellent preparation in the basic sciences and liberal education, a background in food science, and a focus on human needs related to nutrition. Each nutrition student should identify several areas of interest and develop a strong, varied portfolio of competencies and experience. At least one internship or work experience in nutrition is strongly recommended along with elective courses and extracurricular activities that develop communication and leadership skills. Graduates of this program take positions in a variety of positions related to food, nutrition, industry, community programs, and other areas.

Nutrition and dietetics is for students planning to become registered dietitians by meeting the American Dietetic Association requirements. These include completion of an approved baccalaureate program, an approved or accredited professional experience, and a national registration examination. Students transferring to the program must have a minimum GPA of at least 2.50. Students complete the degree program and apply for a postbaccalaureate dietetic internship, or apply, before their junior year, to the University of Minnesota's Coordinated Program in Dietetics and complete both the academic and professional experience requirements in a two-year program.

Students expecting to apply to the Coordinated Program in Dietetics, an internship, or graduate school should maintain a GPA of 2.80 or better (a cumulative GPA of 3.00 or better is highly recommended). Registered dietitians work in a wide variety of health care, community, educational, and corporate positions relating to food and health. Nutrition graduates choosing not to become registered dietitians may pursue a variety of career options based on their preparation in the sciences, liberal education and nutrition.

The nutrition science option is for students planning to do graduate work in nutrition, related sciences, or professional programs such as medicine or dentistry. Students should be aware of the entrance requirements for the graduate or professional program of their choice and maintain a cumulative GPA of 3.00 or higher.

**Computer Competency**—As a nutrition student you will use computer applications in your coursework and will be expected to have basic

computer competency in word processing, spreadsheets, database management, and telecommunications. Computer competency will be assessed in the advising process, and students lacking the needed skills may seek advice on courses required to learn those skills.

### 1. Nutrition

**Liberal Education Diversified Core and Designated Themes**—See the liberal education requirements on page 8 and information at the beginning of this section. Students who enrolled in a degree program at the University of Minnesota–Twin Cities campus before fall 1994 see the liberal education requirements on page 8.

Foundation Requirements  
 Biol 1009—General Biology (5) Biol/L  
 BioC 3021—Biochemistry (4)  
 CBN 3001—Elementary Anatomy (4-5)  
 Chem 1051, 1052—Chemical Principles I, II (4,4)  
 Chem 3301, 3305—Elementary Organic Chemistry I and Lab (4,2)  
 Chem 3302, 3306—Elementary Organic Chemistry II and Lab (4,2)  
 Math 1031—College Algebra and Probability (4)  
 Phsl 1001—Physiology : Introductory Survey for Allied Health Sciences (4)  
 or Phsl 3051—Human Physiology (5)  
 VPB 3103—General Microbiology (5)  
 or MicB 5105—Biology of Microorganisms (5)  
 or FScN 1020—Introductory Microbiology (4)  
 Rhet 1101—Writing to Inform and Persuade (4)  
 Rhet 1104—Library Research Methods (1)  
 Rhet 1151—Writing in Your Major (4)  
 Rhet 1222—Public Speaking (4)  
 Rhet 3562—Writing in Your Profession (4)  
*One from the following:*  
 EPsy 5260—Introductory Statistical Methods (4)  
 PubH 5404—Introduction to Biostatistics and Statistical Decision (4)  
 PubH 5450—Biostatistics I (4)  
 Soc 3801—Sociological Methods I: Descriptive Statistics (5)  
 Stat 1001—Introduction to Ideas of Statistics (4)  
 Stat 3011—Statistical Analysis (4)  
 Stat 3091—Introduction to Probability and Statistics (4)  
 Stat 5021—Statistical Analysis I (5)

Professional Requirements  
 FScN 1612—Principles of Nutrition (4)  
 FScN 3102—Introduction to Food Science (4)  
 FScN 3112—Food Analysis (4)  
 FScN 3472—Food Selection Principles (4)  
 FScN 3610—Community Nutrition (3)  
 FScN 3612—Life Cycle Nutrition (4)  
 FScN 3730—Quantity Food Production Management (Lab) (3)  
 FScN 3732—Lecture in Quantity Food Production Management (2)  
 FScN 5100—General Seminar (1)  
 FScN 5612—Experimental Nutrition (2)  
 FScN 5620—Nutrition and Metabolism (5)  
 FScN 5665—Applied Medical Nutrition Therapy I (3)  
 FScN 5666—Applied Medical Nutrition Therapy II (3)  
 FScN 5667—Applied Medical Nutrition Therapy III (3)  
 FScN 5750—Principles of Food Service Management  
 LAMP 5177—Pathology for Allied Health Students:  
 General and System Pathology (4)  
 or LAMP 5172—Pathology for Allied Health Students (4)  
 Mgmt 3001—Fundamentals of Management (4)  
*One from the following:*  
 AnPI 3010—Environment and World Food Production (4)  
 FScN 3400—Food Marketing Communications (4)  
 FScN 5110—Food Chemistry (4)  
 FScN 5120—Food Microbiology (5)  
 FScN 5360—Sensory Evaluation of Food Quality (4)  
 FScN 5474—Food Marketing Economics (4)  
 FScN 5643—World Food Problems (3)

One from the following:

- HSU 5011—The Teaching-Learning Process in the Health Care Setting (3)
- EPsy 5114—Psychology of Student Learning (3)
- EPsy 5115—Adult Learning and Educational Practice (3)
- FScN 5614—Nutrition Education (3)

Electives to complete the 180 credits required to graduate with a B.S. degree with any of the three emphasis areas in nutrition. Students following the old general education distribution of areas A-D must have 192 credits for graduation.

## 2. Coordinated Program in Dietetics

The basic curriculum is similar to that specified above. However, it also includes field experience courses in which didactic and clinical phases of instruction are coordinated. A detailed plan of the coordinated program may be obtained from the Department of Food Science and Nutrition. A limited number of students are admitted to the program each year.

Minnesota law requires each student admitted to a supervised practice in dietetics to have a criminal background study conducted by the state of Minnesota. The dietetic program director arranges this check. Failure to pass the check results in dismissal from the program.

## 3. Nutrition Science

Students considering applying to medical school should check the social science and humanities requirements of the specific schools of interest. For example, the University Medical School requires 27 credits (non-specified courses) in Social Science and Humanities. Thus a student in Nutrition Science would need to take an 9 extra credits in these categories.

**Liberal Education Diversified Core and Designated Themes**—See the liberal education requirements on page 8 and information at the beginning of this section. Students who enrolled in a degree program at the University of Minnesota–Twin Cities campus before fall 1994 see the liberal education requirements on page 8.

Foundation Requirements

- BioC 3021—Biochemistry (4)
- BioC 5025—Biochemistry Lab (2)
- Biol 1009—General Biology (5)
- Biol 1106—General Zoology (5)
  - or Biol 3011—Animal Biology (5)
- Biol 5003—Genetics (4)
  - or GCB 3022—Genetics (4)
- Chem 1051, 1052—Chemical Principles I, II (4,4)
- Chem 3301, 3305—Elementary Organic Chemistry I and Lab (4,2)
- Chem 3302, 3306—Elementary Organic Chemistry II and Lab (4,2)
- Math 1142—Short Calculus (5)
  - or Math 1251,1252—One Variable Differential and Integral Calculus I, II (4,4)
- Physics 1104,5,6—General Physics (4,4,4)
- Physics 1107,8,9—General Physics Lab (1,1,1)
- VPB 3103—General Microbiology (5)
  - or MicB 5105—Biology of Microorganisms (5)

One from the following:

- Phsl 1001—Physiology: Introductory Survey for Allied Health Sciences (4)
- Phsl 3051—Human Physiology (5)
- AnSc 3301—Systemic Physiology (6)
- Rhet 1101—Writing to Inform and Persuade (4)
- Rhet 1104—Library Research Methods (1)
- Rhet 1151—Writing in Your Major (4)



*A nutrition student examines cereal as part of her study of food analysis.*

- Rhet 1222—Public Speaking (4)
- Rhet 3562—Writing in Your Profession (4)

One from the following:

- EPsy 5260—Introductory Statistical Methods (4)
- PubH 5404—Introduction to Biostatistics and Statistical Decision (4)
- PubH 5450—Biostatistics I (4)
- Soc 3801—Sociological Methods I: Descriptive Statistics (5)
- Stat 1001—Introduction to Ideas of Statistics (4)
- Stat 3011—Statistical Analysis (4)
- Stat 3091—Introduction to Probability and Statistics (4)
- Stat 5021—Statistical Analysis I (5)

Professional Requirements

- FScN 1612—Principles of Nutrition (4)
- FScN 3102—Introduction to Food Science (4)
- FScN 3610—Community Nutrition (3)
  - or FScN 5665—Applied Medical Nutrition Therapy I (3)
- FScN 3612—Life Cycle Nutrition (4)
- FScN 5100—General Seminar (1)
- FScN 5110—Food Chemistry (4)
  - or another advanced chemistry course (4)
- FScN 5612—Experimental Nutrition (2)
- FScN 5620—Nutrition and Metabolism (5)
- FScN 5623—Vitamin and Mineral Biochemistry (4)
- FScN 5624—Human Protein and Energy Utilization (4)

Electives to complete the 180 credits required to graduate with a B.S. degree with any of the three emphasis areas in nutrition. Students following the old general education distribution of areas A-D must have 192 credits for graduation.

## Science in Agriculture

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Science is the basis for progress in modern agriculture. Advances in the agricultural sciences are responsible for the unprecedented growth in quantity and quality of human food, animals, feeds, plant fibers, industrial products and aesthetic plants. Science in agriculture will be critical in addressing the environmental, resource, and technological issues facing humankind into the 21st century. Students completing the science in agriculture major in COAFES will be well prepared for scientific careers of the future.

The science in agriculture major is an interdisciplinary program of seven departments in COAFES. Students in this major obtain a thorough understanding of biological/physical science and mathematics principles and their applications to food and agriculture. Students may elect an area of emphasis within the major or they may choose to construct an individualized program combining courses from several disciplines. Host departments for this major are agronomy and plant genetics, animal science, entomology, food science and nutrition, horticultural science, plant pathology, and soil science. Students in this major complete an undergraduate research thesis under the guidance of a faculty member in one of the host departments.

Students pursuing the science in agriculture major should be well prepared to undertake graduate studies in the disciplines represented by the host departments and related areas, as well as in veterinary or human medicine. Students considering veterinary medicine should consult the science in agriculture/doctor of veterinary medicine joint degree option. The major is also excellent preparation for employment in bachelor's degree-level research positions as field or laboratory specialists in academia, government, or industry.

The host departments for the science in agriculture major offer excellent opportunities and facilities for gaining experience in scientific research. Students may offset some costs of their education and gain valuable experience by working part-time as undergraduate technicians on research projects of the Minnesota Agricultural Experiment Station. Experience may also be gained by working on a university, government, or industry internship through the Professional Experience Program (PEP).

### Major Requirements

All students in the science in agriculture major must complete the requirements listed below. A minimum of 180 credits is required for completion of the degree. Faculty academic advisers will assist students in selecting suitable courses for completion of electives. Students planning to seek admission for particular graduate

programs should consult the specific admissions requirements for those programs as guidance in selecting coursework options. The academic advisers also assist students in selecting an undergraduate thesis topic and thesis mentor.

**Liberal Education Diversified Core and Designated Themes**—See the liberal education requirements on page 8 and information at the beginning of this section. Students who enrolled in a degree program at the University of Minnesota–Twin Cities campus before fall 1994 see the liberal education requirements on page 8.

#### Foundation Requirements

##### *Basic Sciences*

- Biol 1009—General Biology (5)
- Chem 1051, 1052—Chemical Principles I, II (4,4)
- Chem 3301, 3305—Elementary Organic Chemistry I and Lab (4,2)
- Chem 3302, 3306—Elementary Organic Chemistry II and Lab (4,2)
- Phys 1041, 1042—Introductory Physics (5,5)  
or Phys 1251, 1252, 1253—General Physics I, II, and III, and Lab (5,5,5)
- BioC 3021—Biochemistry (4)
- One from the following:*
  - Biol 1103—General Botany (4)
  - Biol 1106—General Zoology (5)
  - Biol 3012—Plant Biology (5)
  - Biol 3011—Animal Biology (5)

##### *Math and Statistics*

- Math 1142—Short Calculus (5)  
or Math 1251, 1252—One-Variable Differential and Integral Calculus I, II (4,4)
- Rhet 1200—Information Technology in Scientific and Technical Professions  
or computer competency
- Stat 5021—Statistical Analysis (5)  
or Stat 3011, 3012—Statistical Analysis I, II (4,4)

##### *Writing and Speaking*

- Rhet 1101—Writing to Inform and Persuade (4)
- Rhet 1104—Library Research Methods (1)
- Rhet 1151—Writing in Your Major (4)
- Rhet 1222—Public Speaking (4)
- Rhet 3562—Writing in your Profession (4)

##### *Arts and Humanities*

One course from the approved list of liberal education courses in Arts and Humanities (4-5 cr) beyond the three courses required to meet the core curriculum requirement.

#### Professional Requirements

- ScAg 1001—Orientation to Science in Agriculture (1)  
or AgEd 1002—Principles of Career Planning in Agriculture (1)
- ScAg 5009—Undergraduate Research Thesis (9)
- One from the following:*
  - Biol 5013—Microbiology (5)
  - VPB 3103—General Microbiology (5)
  - MicB 5105—Biology of Microorganisms (5)
- One from the following:*
  - GCB 3022—Genetics (4)
  - Biol 5003—Genetics (4)
  - Hort 3003—Plant Genetics and Improvement (4)

#### *A minimum of 8 credits from the following:*

- AnPl 3010—Environment and World Food Production (4)
- AnSc 5609—Principles of Farm Animal Environment (4)
- Biol 1103—General Botany (5)
- Biol 1106—General Zoology (5)
- Biol 3011—Animal Biology (5)
- Biol 3012—Plant Biology (5)
- Chem 1133—Elementary Quantitative Analysis (3)
- Chem 5520—Elementary Physical Chemistry (3)
- EBB 3001—Introduction to Ecology (4)
- FScN 1102—Technology of Food Processing (4)
- Hort 3004—Applications of Plant Biotechnology (4)
- Math 3066—Elementary Differential Equations (4)
- PBio 3109—Plant Anatomy (5)
- PBio 3201—Introductory Plant Taxonomy (4)
- PIPa 5206—Biology of Fungi (4)

Soil 1020—The Soil Resource (5)  
 Soil 1425—Introduction to Meteorology (4)  
 ScAg 1500—Biotechnology (3)  
 (Students may substitute other basic science courses with the approval of their adviser.)

## Emphasis Areas

### 1. Animal Science (32 credits)\*

AnSc 1100—Introductory Animal Science (5)  
 AnSc 3220—Principles of Animal Breeding (5)  
 AnSc 3301—Systemic Physiology (6)  
 AnSc 3401—Principles of Animal Nutrition (4)  
 Plus a minimum of 12 additional credits from:  
 AnSc 3111—Introduction to Animal Behavior (4)  
 AnSc 3305—Reproductive Physiology, AI, and Lactation (5)  
 AnSc 3510—Growth and Development of Animal Tissues (3)  
 AnSc 5327,5328—General Endocrine Physiology and Lab (4)  
 AnSc 5330—Current Topics in Endocrinology (1)  
 AnSc 5401—Swine Nutrition and Feeding (4)  
 AnSc 5403—Ruminant Nutrition (4)  
 AnSc 5405—Poultry Nutrition (3)  
 AnSc 5609—Principles of Farm Animal Environment (4)

\* Students interested in poultry study should inquire about courses available through the Midwest Poultry Consortium. Check with your adviser, the Department of Animal Science, or COAFES.

### 2. Climatology (35 credits)

AgET 5410—Hydrology and Water Quality (5)  
 Agro 3020—Growth and Development of Field Crops (4)  
 Geol 1601—Oceanography (4)  
 Geog 3421—Climatology (4)  
 PIPa 3004—Air Pollution, People and Plants (3)  
 Soil 3125—Basic Soil Science (5)  
 Soil 5240—Microclimatology (3)  
 Soil 5424—Applied Climatology (3)  
 Hort 5041—Environmental Physiology of Horticultural Plants (3)

### 3. Food Science (31 credits)

FScN 1612—Principles of Nutrition (4)  
 FScN 3102—Introduction to Food Science (4)  
 FScN 5120—Food Microbiology (5)  
 A minimum of 18 additional credits from:  
 FScN 3112—Food Analysis (4)  
 FScN 5110—Food Chemistry (4)  
 FScN 5122—Control Systems in Food Microbiology (2)  
 FScN 5123—Food Fermentations and Biotechnology (3)  
 FScN 5135—Food Engineering Unit Operations (5)  
 FScN 5312—Instrumental Analysis of Foods (3)  
 FScN 5360—Sensory Evaluation of Food Quality (4)  
 FScN 5403—Experimental Study of Foods (5)  
 FScN 5414—Ingredient Interactions (3)  
 FScN 5512—Meat Technology (4)  
 FScN 5522—Technology of Fluid and Concentrated Milk Products (4)  
 FScN 5530—Industrial Processing of Fruits and Vegetables (4)  
 FScN 5540—Fats and Oils Chemistry and Technology (4)  
 FScN 5555—Freezing and Dehydration of Foods (5)  
 FScN 5562—Flavor Technology (4)

### 4. Nutrition (31 credits)

FScN 1612—Principles of Nutrition (4)  
 FScN 3612—Biological Aspects of Nutrition (4)  
 FScN 5622—Macro-Nutrient Metabolism (4)  
 FScN 5623—Vitamin and Mineral Biochemistry (4)  
 BioC 5025—Biochemistry Laboratory (2)  
 A minimum of 12 additional credits from:  
 FScN 3102—Introduction to Food Science (4)  
 FScN 5612—Experimental Nutrition (2)  
 FScN 5624—Human Protein and Energy Utilization (4)  
 FScN 5643—World Food Problems (3)  
 AnSc 3401—Principles of Animal Nutrition (4)  
 AnSc 5401—Swine Nutrition and Feeding (4)  
 AnSc 5403—Ruminant Nutrition (4)  
 AnSc 5405—Poultry Nutrition (3)  
 Chem 3100—Quantitative Analysis (3)

### 5. Plant Sciences

(27-41 credits, depending upon specialization)

Soil 3125—Basic Soil Science (5)

Agro 5030—Weed Control (5)

One from the following:

Agro 3020—Growth and Development of Field Crops (4)  
 Hort 3001—Growth Regulation of Horticultural Crops (5)  
 Hort 3002—Horticultural Cropping Systems (5)  
 Ent 1005—Economic Entomology (4)  
 or Ent 3005—Insect Biology (3)  
 PIPa 3001—Management and Control of Field Crop Diseases (4)  
 or PIPa 3002—Management of Horticultural Crop Diseases (4)

In addition, choose one plant science specialization:

#### a. Agronomy

Agro 5020—Introduction to Plant Breeding (4)  
 Soil 3416, 3417—Plant Nutrients in the Environment and Lab (4,1)

One from the following:

Agro 5010—Forage Production and Utilization (4)  
 Agro 5050—Management Techniques for Crop Production in Minnesota (4)  
 AnPI 5060—Integrated Management of Cropping Systems (4)

#### b. Entomology

Ent 5020—Insect Taxonomy (5)

Two from the following:

Ent 5030—Insect Physiology (3)  
 Ent 5040—Insect Ecology (4)  
 Ent 5210—Insect Pest Management (4)  
 Ent 5215—Insects in Relation to Plant Disease (3)  
 Ent 5280—Livestock Entomology (3)  
 Ent 5310—Sampling Biological Populations (4)  
 Ent 5350—Insect Pathology (3)

#### c. Horticultural Science

Hort 1036—Plant Propagation (5)  
 Hort 3001—Growth Regulation of Horticultural Plants (5)

At least one from the following:

Hort 3002—Horticulture of Cropping Systems (5)  
 Hort 3004—Applications of Plant Biotechnology (4)  
 Hort 3072—Turf Management (4)  
 Hort 5001—Harvest to Market of Horticultural Crops (3)  
 Hort 5031—Temperate Fruit Production (4)  
 Hort 5034—Commercial Vegetable Agriculture (5)  
 Hort 5046—Nursery Management I (4)  
 Hort 5047—Nursery Scheduling and Enterprise Development (2)  
 Hort 5048—Nursery Management II (4)  
 Hort 5054—Commercial Floriculture Production Practices (4)  
 Hort 5055—Commercial Floriculture Production Systems (5)

#### d. Plant Pathology

PIPa 5201, 5202—Biology of Plant Diseases and Lab (3,2)

Plus three from the following:

PIPa 5203—Physics and Molecular Plant-Microbe Interactions (3)  
 PIPa 5204—Field Plant Pathology (2)  
 PIPa 5205—Plant Disease Diagnosis (2)  
 PIPa 5206—Biology of Fungi (4)  
 PIPa 5209—Biochemistry of Plant Disease (3)  
 PIPa 5211—Fungal Genetics (4)  
 PIPa 5212—Diseases of Forest and Shade Trees (4)  
 PIPa 5213—Plant Nematology (4)  
 PIPa 5214—Plant Virology (4)  
 PIPa 5500—Epidemiology and Ecology of Plant Disease (3)

### 6. Soil Science (31 credits)

Agro 3020—Growth and Development of Field Crops (4)  
 Soil 3125—Basic Soil Science (5)  
 Soil 3220—Soil Conservation and Land Use Management (4)  
 Soil 3416, 3417—Plant Nutrients in the Environment, Lab (4,1)  
 Soil 5240—Microclimatology (3)  
 Soil 5510—Field Study of Soils for Environmental Assessment (4)

Remaining credits selected from:

Soil 5210—Soil Physical Properties and the Environment (4)  
 Soil 5232—Soil Physics (4)  
 Soil 5310—Soil Chemistry (3)  
 Soil 5515—Soil Development, Classification, and Geography (4)  
 Soil 5560—Interpretation of Land Resources (3)  
 Soil 5610—Soil Biology (4)  
 Soil 5710—Forest Soils (3)



*Science in agriculture majors enjoy excellent opportunities and facilities for gaining experience in scientific research.*

*7. Science in Agriculture/  
Doctor of Veterinary Medicine Joint Degree  
(64 credits)*

The science in agriculture/doctor of veterinary medicine joint degree is a cooperative program between COAFES and the University's College of Veterinary Medicine (CVM). Students satisfying the specified curriculum requirements will earn a B.S. degree in science in agriculture from COAFES and, later, a doctor of veterinary medicine from CVM.

New entering freshmen students enrolling in COAFES' science in agriculture major will have the option of completing three years of undergraduate coursework and then applying to CVM. Upon being accepted into CVM and successfully completing the courses specified in the first quarter of the veterinary medicine curriculum, students will earn the B.S. degree from COAFES.

This program gives highly qualified students the opportunity to earn both a B.S. degree and a D.V.M. degree in seven years. It also allows integration of a significant set of animal science courses into the student's preparation for veterinary education.

This program is only available to students who enter COAFES with no previous coursework and start in fall quarter. The science in agriculture/D.V.M. curriculum is very structured and the COAFES portion must be completed in three academic years. COAFES students enrolled in this program must meet CVM application standards and admission is competitive. COAFES students applying under this agreement will receive special consideration because of the animal knowledge and experience gained in the animal science courses required in the curriculum. Application to CVM must be made in the junior year. Students not admitted to CVM are expected to complete the normal science in

agriculture requirements for the B.S. degree. Students can also reapply to CVM or any other college of their choice at a later date.

- AnSc 1100—Introductory Animal Science (5)
- AnSc 3220—Principles of Animal Breeding (5)
- AnSc 3301—Systemic Physiology (6)
- AnSc 3401—Principles of Animal Nutrition (4)
- AnSc 3305—Reproductive Physiology, AI, and Lactation (5)
- AnSc 5401—Swine Nutrition and Feeding (4)
- AnSc 5403—Ruminant Nutrition (4)
- AnSc 5405—Poultry Nutrition (3)
- AnSc 5609—Principles of Farm Animal Environment (4)

*Plus one from the following:*

- AnSc 5601—Swine Production (4)
- AnSc 5603—Beef Production (4)
- AnSc 5604—Dairy Farm Management (4)
- AnSc 5605—Poultry Production (4)

*Plus fall quarter, first-year veterinary courses (20)*

*Note:* Successful completion of the first quarter of the University's College of Veterinary Medicine will constitute the fourth year of the animal science/D.V.M. joint program and will lead to bachelor's degree in science in agriculture from COAFES.

*8. Individualized area of emphasis*

Students wanting to design a program with an emphasis different from these options should consult their adviser. Individualized programs must be approved by the major coordinating committee and have a minimum of 31 credits.

Electives to reach 180 credits required for graduation with a degree. Students following the old general education distribution of Areas A-D must have 192 credits for graduation.

## Scientific and Technical Communication

Dr. Laura Gurak, Major Coordinator  
201 Haecker Hall  
1364 Eckles Avenue  
St. Paul, MN 55108  
612/624-3773

World Wide Web: <http://rhetoric.agoff.umn.edu/>

Scientific and technical communicators apply modern techniques and technologies to the distribution of knowledge in industry, business, education, and government. They write for audiences ranging from scientists to management to the consumer of technological products and services. To accomplish their objectives, scientific and technical communicators must first be generalists, well acquainted with the basic principles of science, engineering, the social sciences, and management practices. In addition, they must be familiar with and able to apply the principles of writing and editing, visual communication, communication technology, communication research and theory, and oral communication. The interdisciplinary curriculum combines the necessary theory and practical experience in a program flexible enough to allow you to plan a course of study appropriate to your career goals.

As a graduate of the program, you may be employed in government, education, and organizations in such fields as agriculture, communication, computer science, health sciences, research and development, and natural resources. You may pursue a career as a writer-editor, extension specialist, corporate trainer, or media specialist.

If you plan to pursue a graduate program in scientific and technical communication, you should consult with your adviser about selection of appropriate coursework early in your program.

**Admission Requirements**—Admission to COAFES does not automatically admit you to major status in the Scientific and Technical Communication (STC) program; students enter at pre-major status. To move from pre-major to major status, students must meet the following prerequisites.

Completion of the following coursework (with a minimum GPA of 2.50):

- 8 credits in basic rhetoric, English, or composition
  - 8 credits in physical and biological sciences
  - 8 credits in social science
  - 8 credits in math, computer science, or engineering
  - 4 credits of rhetoric at the 3xxx level
- For suggested course lists, contact the Department of Rhetoric.

To apply for major status, students must submit the following information to the STC Program:

- application form—available in 201 Haecker Hall
- pre-major checklist—available in 201 Haecker Hall
- college transcripts
- letter of intent
- portfolio

A portfolio consists of documents showing written work, examples of graphic display and design (e.g., projects from art, drafting, or design classes, or photographs, slides, or videos), and a résumé.

Deadlines for submitting applications are: fall quarter admission, April 15; winter quarter admission, October 15; spring quarter admission, January 27.

*Note:* Although you only need a 2.00 GPA to be admitted to COAFES, a 2.50 GPA is required in the 36 required credit hours for acceptance to the major.

Students will retain pre-major status until they are formally accepted into the major program. Keep in mind that you cannot graduate from COAFES unless you are officially enrolled in a major in the college. In addition to meeting COAFES residency requirements, as a degree candidate in scientific and technical communication, you must earn at least 30 of your last 45 credits in the major following the quarter you are accepted into the major. For more information, contact the STC Program secretary, pre-major adviser, or major coordinator, 201 Haecker Hall (612/624-4761).

### Major Requirements

Students majoring in the undergraduate program in Scientific and Technical Communication must complete requirements in each of the areas listed below. Required classes are listed. Course substitutes require program and/or COAFES Student Services Office approval. Your adviser can offer guidance when you plan your schedule.

### Liberal Education Diversified Core and

**Designated Themes**—See the liberal education requirements on page 8 and information at the beginning of this section. Students who enrolled in a degree program at the University of Minnesota–Twin Cities campus before fall 1994 see the liberal education requirements on page 8.

#### Foundation Requirements

- Rhet 1101—Writing to Inform and Persuade (4)
- Rhet 1104—Library Research (1)
- Rhet 1151—Writing in Your Major (4)
- Rhet 1222—Public Speaking (4)
- Rhet 3266—Communication, Discussion in Small Group Decision Making (4)
- Rhet 3562—Writing in Your Profession (4)

#### Professional Requirements

- Writing and Editing* (14 credits minimum)
- Rhet 3565—Writing for Publication (4)
- Rhet 5560—Editing for Technical Communication (4)

#### *Two from the following:*

- Rhet 3572—Procedures and Policies Manual (3)
- Rhet 5573—Grant Proposal (3)
- Rhet 3575—Newsletter (3)



Students, faculty, and staff can relax inside and outside the St. Paul Student Center.

*Recommended:*

- Comp 3014—Writing in the Social Sciences (4)
- Comp 3015—Writing About Science (4)
- Comp 3027—Advanced Expository Writing (4)
- EngW 5401—Introduction to Professional Editing (4)

*Oral Communication* (8 credits minimum)

- Rhet 3257—Scientific and Technical Presentations (4)
- Rhet 5258—Interviewing: Dynamics of Face-to-Face Communication (4)

*Recommended:*

- Rhet 3254—Advanced Public Speaking (4)
- Spch 3201—Introduction to Broadcasting Production (4)
- Spch 3411—Small Group Communication Processes (4)

*Communication Systems* (8 credits minimum)

- Rhet 5170—Managerial Communications (4)

*One from the following:*

- Rhet 5165—Studies in Organizational Communication, Conflict, and Change (4)
- Rhet 5400—Communications Program Planning and Evaluation (4)
- Rhet 5600—Transfer of Technology (4)

*Recommended:*

- Spch 3111—Leadership Communication (3)
- Spch 3441—Communicating in Organizations (4)

*Information Design and Management*

(14 credits minimum)

- Rhet 1200—Information Technology in Scientific and Technical Professions (3)
- Rhet 3574—Publications Management (3)
- Rhet 3670—Visual Rhetoric: Theories and Applications (4)
- Rhet 5581—Document Design (4)

*Recommended:*

- ArtS 1401 Color (4)
- BIE 1000—Technical Drawing (3)
- BIE 1101—Technical Design and Product Development (3)
- BIE 1120—Communication Technology (3)
- BIE 1122—Photography (3)
- BIE 3121—Graphic Communication (3)
- DHA 1300—Introduction to Design (3)
- Rhet 3101—Functional Photography (4)
- Rhet 3105—Corporate Video for Technical Communicators (4)
- Rhet 3400 Managing Information on the Internet (3)

*Communication Theory and Research*

(7 credits minimum)

- Rhet 1220—Principles of Human Communication (4)
- Rhet 3700—Rhetorical Theory: Persuasion and the Literature of Science (3)

*Recommended:*

- Engl 3851—The English Language (4)
- Engl 3852—Aspects of the English Language (4)
- Engl 5815—History of English Language (4)
- Engl 5831—Development of American English (4)
- EPsy 5115—Psychology of Adult Learning (4)
- EPsy 5240—Principles and Methods of Evaluation (3)
- Jour 1001—Introduction to Mass Communication (4)
- Ling 3001—Introduction to Linguistics (5)
- Psy 3011—Introduction to Psychology of Learning (4)
- Rhet 5500—Research in Communication Strategies (4)
- Rhet 5531—Scientific and Technical Communication Course Development: Philosophy and Methodology (4)
- Rhet 5562—Theory and Practice in International and Intercultural Communication (4)
- Spch 3431—Role of Persuasion in the Modern World (4)
- Spch 3601—Approaches to Public Discourse (4)

*Culture, Values and Technology* (10 credits minimum)

- Rhet 3390—Technology, Self, and Society (4)
- Rhet 3582—Senior Seminar (3)

*One from the following:*

- Rhet 3690—Scientific Controversy (3)
- Rhet 5680—Gender and the Rhetoric of Science and Technology (4)
- Rhet 1303—Science, Religion, and the Search for Human Nature (4)

*Recommended:*

- HMed 5400 or 5401 or 5402—Introduction to the History of Medicine (4)
- HSci 1711 or 1712 or 1713—Technology and Western Civilization (4)
- HSci 1811 or 1812 or 1813—Introduction to History of Science (4)
- Hum 1003—Humanities in the Modern World III (4)
- Phil 3601—Scientific Thought (4)
- Phil 560X—The Philosophy of Science (4)
- Rhet 3395—In Search of Nature (4)

*Internship* (4 credits minimum)

- Rhet 5180—Internship in Scientific and Technical Communication (2-6)

This course may only be taken S-N. Students can earn credits in two-credit increments, but no more than six internship credits can be applied toward the scientific and technical communication program. The internship cannot be completed until you are officially enrolled as a major.

For the internship, you must complete the following:

- internship proposal, including duration, hours, duties
- internship journal of work experiences
- final internship report
- evaluation letter from the internship supervisor

*Science and Technology Emphasis* (20 credits minimum)

While scientific and technical communicators need a general knowledge of math, science, and technology, they also must develop expertise in a scientific and technical area. With the help of an adviser, students will select at least five additional classes in a scientific or technological area. Eight credits must be at the 3xxx level or above. Possible areas of emphasis are:

- Agricultural science: animal
- Agricultural science: plant
- Health sciences
- Human ecology
- Biological science
- Mathematics
- Management information systems
- Cognitive science/psychology
- Computer science
- Natural resources
- Engineering
- Physical science
- Food science/nutrition
- Vocational education

The areas listed above are not your only options.

Students also have the option of designing their own area of emphasis. All classes in the area of emphasis do not need to be from the same department.

Electives to reach 180 credits required for graduation with a B.S. degree. Students following the old general education distribution of areas A-D must have 190 credits for graduation.



Pre-Majors

The College of Agricultural, Food, and Environmental Sciences offers five pre-major programs for students intending to complete the coursework needed to enter an upper division college or professional program: pre-biosystems and agricultural engineering; pre-biological sciences; pre-landscape architecture; pre-medicine or pre-dentistry; and pre-veterinary medicine.

## Pre-Biosystems and Agricultural Engineering

(College of Agricultural, Food, and Environmental Sciences)

For additional information contact:

Dr. Chuck Clanton, P. E.

Department of

Biosystems and Agricultural Engineering

213 Biosystems

and Agricultural Engineering Building

1390 Eckles Avenue

St. Paul, MN 55108

612/625-7733

E-mail: [clant001@maroon.tc.umn.edu](mailto:clant001@maroon.tc.umn.edu)

Fax: 612/624-3005

You can learn more about the program, faculty and students of the Department of Biosystems and Agricultural Engineering by visiting <http://www.bae.umn.edu> on the World Wide Web.

Students interested in becoming biosystems and agricultural engineers may start their coursework in COAFES. Benefits include having a biosystems and agricultural engineering faculty member as an adviser, being eligible for the COAFES scholarship program, the advantages of a small college, and the St. Paul campus. In addition you'll find the pre-biosystems and agricultural engineering track provides you the opportunity to be part of the department community and to get to know other students in the program.

After you satisfactorily complete lower division courses, you take upper division courses in Institute of Technology (IT). You continue to work with an adviser from the biosystems and agricultural engineering department while you complete your last two years of courses as an IT student. You graduate from IT but are invited to join the alumni societies of both IT and COAFES.

Engineers use mathematics, science, creativity, and design to create solutions that meet people's needs. These solutions must satisfy constraints of time and money while considering health, safety, environmental, political, and social issues.

Biosystems and agricultural engineers integrate engineering, biology, and computing to:

- design efficient, economical processes to improve the quality and safety of food products for consumers,
- protect and enhance the environment through design of sustainable practices to maintain and improve soil, water, and air quality,

- design efficient, profitable food production systems that protect the environment, humans, plants, and animals,
- design safe, efficient machines and processes for biological systems.

The biosystems and agricultural engineering curriculum can be completed in four years by earning a minimum of 190 credits. Emphasis is on the physical, biological and engineering sciences, and engineering design. Students also study communications, social science, and humanities to provide a liberal education and prepare to work effectively with professionals in many disciplines (see page 8 for liberal education requirements). The program provides students with a background for continued professional growth and prepares them to contribute to an ever-changing society.

The curriculum includes emphases in environment, agricultural systems, and biological systems. Students, with the assistance of an adviser, plan a curriculum tailored to their individual interests in one of these three emphases.

Engineering internships are available to supplement classroom instruction by providing practical education and experience with an employer. Students may begin their internships in the summer following either their first or second year.

The biosystems and agricultural engineering program is accredited by the Accreditation Board for Engineering and Technology (ABET).

Liberal education requirements are the same for all students on the Twin Cities campus (see page 8 in this bulletin). Students must satisfy both the diversified core and designated theme requirements.

Students must apply to be admitted to upper division (junior and senior years) in IT. Requirements for admission into upper division biosystems and agricultural engineering in IT are based on a GPA calculated using the grades from all courses taken, including repeated courses. Applications and GPA requirements are available in 105 Lind Hall.

Lower Division (94-95 credits)

Comp 1011—Writing Practice I (5)

or Rhet 1101—Writing to Inform and Persuade (4)

Math 1251, 1252—Differential and Integral Calculus I, II (4,4)

Math 1261—Calculus III (4)

Math 3261—Differential Equations With Linear Algebra (4)

Math 3251—Vector Differential Calculus (4)

Math 3252—Multivariable Integral Calculus (4)

Phys 1251-1252-1253—General Physics I-II-III (4,4,4)

Chem 1051-1052—Chemical Principles I-II (4,4)

Biol 1009—General Biology (5)

BAE 1060—Biosystems and Agricultural Engineering Orientation (1)

AEM 1015—Statics (4)

BAE 3031—Computations in Biosystems and Agricultural Engineering (4)

BAE 3150—Biology for Engineering (4)

AEM 3016—Deformable Body Mechanics (4)

CE 3400 or AEM 3200—Fluid Mechanics (4)

CSci 3101 or CSci 3102, or CSci 3113—Computer Programming (4)

ME 3301—Thermodynamics (4)

Liberal education electives (12)

Upper Division (95-96 credits)

Comp 3031—Technical Writing for Engineers (4)

or Rhet 3562—Writing in Your Profession (4)

EE 1400—Circuits Laboratory (1)  
 EE 3009—Linear Circuits I (4)  
 ME 5342—Heat Transfer (4)  
 ME 3900 or Stat 3091—Statistics (4)  
 Biological science elective (at 3xxx or 5xxx level,  
 including agricultural science courses with significant  
 biological content) (7-8)  
 BAE 3052—Engineering Principles of Soil-Water-Plant  
 Systems (4)  
 BAE 5891-5892—Senior Design I-II (3,3)  
 Two courses (8 credits) from  
 BAE 5070—Automatic Controls and Instrumentation (4)  
 BAE 5072—Finite Element Methods (4)  
 BAE 5074—Microcomputer Interfacing (4)  
 Students must follow one of the following emphases:

1. *Environment*

ME 1025—Engineering Graphics (4)  
 AEM 3036—Dynamics (4)  
 BAE 5540—Watershed Engineering (4)  
 BAE 5550—Water Management Engineering (4)  
 or BAE 5910—Agricultural Waste Management  
 Engineering (4)  
 Biosystems and agricultural engineering elective\* (4)  
 Engineering electives in environmental areas\* (12)

2. *Agricultural Systems*

ME 1025—Engineering Graphics (4)  
 AEM 3036—Dynamics (4)  
 Biosystems and agricultural engineering electives\* (12)  
 Engineering electives in agricultural systems\* (12)

3. *Biological Systems*

Chem 3301-3302—Organic Chemistry I-II (4,4)  
 Chem 3305-3306—Organic Chemistry Lab I-II (2,2)  
 BioC 3021—Biochemistry (4)  
 BAE 5751—Biochemical Engineering I (3)  
 Biosystems and agricultural engineering electives\* (8)  
 Engineering electives in biological systems\* (8)

Liberal education electives (15-16)

Electives to consider student interest and to meet  
 graduation requirements of 190 credits (1-7)

Electives are chosen to develop further professional  
 competence in an area of particular interest to the  
 student. Sample programs are available from the  
 department office or from individual advisers.

\* *Engineering electives to satisfy ABET engineering  
 topics requirements*



*Biological science majors have the opportunity to do  
 fieldwork in diverse settings.*

## Pre-Biological Sciences

For additional information contact:

Kathleen Peterson  
 Student Services—Advising and Registration  
 College of Biological Sciences  
 223 Snyder Hall  
 1475 Gortner Avenue  
 St. Paul, MN 55108  
 612/624-9717

Students interested in pursuing a degree in the  
 College of Biological Sciences (CBS) may start  
 their coursework in COAFES and transfer to CBS  
 once admission prerequisites have been met.  
 While in COAFES students work with a CBS  
 adviser who assists them in selecting courses and  
 planning for a career in biology. In addition,  
 students are encouraged to participate in biology  
 clubs and other CBS sponsored activities. Most  
 pre-CBS students spend from three to six quarters  
 in COAFES completing prerequisites before  
 transferring to CBS. CBS and COAFES are  
 located on the St. Paul campus providing students  
 with the advantages of small colleges, including  
 easy access to student services. As an added  
 benefit, students whose academic or career plans  
 change will find that their prerequisite courses  
 apply to most COAFES majors.

For further information about biological  
 sciences programs, see the *College of Biological  
 Sciences Bulletin*, or contact the College of  
 Biological Sciences.

### Admission to CBS

Students may enter CBS at the beginning of their  
 sophomore, junior, or senior year. The first years  
 may be completed in COAFES or the College of  
 Liberal Arts. Because CBS is an upper division  
 college, certain requirements must be completed  
 before admission:

- Successful completion of 84 credits (with a  
 GPA of at least 2.00) including General  
 Biology, Biol 1009, or 1201-1202 (or  
 equivalent); Principles of Chemistry, Chem  
 1051-1052 (or equivalent) and Calculus, Math  
 1251-1252 (or equivalent) with grades of at  
 least C are required for admission at the junior  
 level.
- Students who are admitted as sophomores  
 must have completed a minimum of 40 credits  
 with a GPA of 2.50 or better including grades  
 of C or better in Chem 1051-1052 (or  
 equivalent); Math 1251, 1252 (or equivalent);  
 and a college level biology course. During the  
 freshman and sophomore years, students  
 should plan to complete as a minimum the  
 beginning English composition course,  
 mathematics, general chemistry, and general  
 biology. Students are encouraged to take  
 organic chemistry during their sophomore year  
 thereby allowing ample time for major  
 coursework and research experience.

## Pre-Landscape Architecture

For additional information contact:

Dr. Roger Martin  
 Department of Landscape Architecture  
 125 Architecture Building  
 89 Church Street S.E.  
 Minneapolis, MN 55455  
 612/625-6860

Freshmen or sophomores planning to complete a degree in landscape architecture should start their coursework in COAFES. COAFES offers a pre-landscape architecture track through the animal and plant systems major that prepares students to apply to the bachelor of environmental design (B.E.D.) degree program in the Department of Landscape Architecture. If your original academic and career plans change in regard to pursuing a landscape architecture degree, COAFES offers an alternative program through the environmental horticulture emphasis in the Animal and Plant Systems major. While in the pre-landscape architecture (pre-LA) students will be assisted with program planning by the director of undergraduate studies in landscape architecture.

Landscape architecture is concerned with the impact, disposition, and management of natural resources as well as the quality of experience that results from the development and management of land for specific human use.

Landscape architects are concerned with a wide range of projects: large-scale regional landscape planning; design of exterior environments for working, living, and recreation; commercial, institutional, and industrial development; transportation systems; and multiple-use areas. Projects may vary in scale from single-family residences to regional open space systems. Professional services include studies of land use feasibility, suitability, and capability; site selection studies; proposals for site layout and regional land use allocation and management; detail grading; construction drawings; and planting plans.

Regional resource planning and design, recreation planning and design, urban landscape design, and detail site-planning projects involve landscape architects, architects, planners, engineers, geographers, physical scientists, social scientists, and others. The relationship between regional or single-site qualities of terrain, soil, climate, vegetation, wildlife, orientation, visual quality, and the management or development program are studied carefully to ensure sound recommendations.

### Master of Landscape Architecture (M.L.A.) Program

This program is available for students with baccalaureate degrees who wish to pursue both professional and scholarly studies in landscape architecture. The program is jointly offered by the College of Architecture and Landscape Architecture and the Graduate School. It provides professional training for the practice of landscape architecture and theoretical inquiry into the discipline.

Specific requirements for this degree are defined in the *Graduate School Bulletin*.

### Bachelor of Environmental Design (B.E.D.) in Landscape Architecture

This nonprofessional program allows students to explore a broad range of environmental courses while preparing for the professional M.L.A. degree. After completing the B.E.D. degree requirements, students may apply to the Graduate School and, upon acceptance, receive advanced standing in the M.L.A. professional program. Graduates of the B.E.D. program may choose to pursue work in environmental design or planning that does not require an accredited degree.

A total of 180 credits are required for the B.E.D. degree. All required core courses with an LA prefix plus Hort 1021 and Hort 1022 must be completed with a minimum grade of C. It is recommended that students also complete 400 hours of summer work in landscape architecture. Individualized study programs may be arranged with faculty approval.

Admission procedures and major requirements for the bachelor of environmental design program are detailed below. For additional information about the bachelor of environmental design program, see the *College of Architecture and Landscape Architecture Bulletin*.

### Admission Procedures

All applications for the B.E.D. in landscape architecture must be submitted by January 15 of the year of desired entry. Admission is for fall only unless advanced standing is granted. The following policies and admission procedures change periodically. Students should check with their adviser or the Department of Landscape Architecture for current admission procedures.

1. Apply to the University of Minnesota if not already a University student.
2. Complete a minimum of 90 credits of required pre-landscape architecture coursework (may include current enrollment). See the pre-environmental design curriculum below.
3. Complete the bachelor of environmental design degree application available from the Department of Landscape Architecture, University of Minnesota, 125 Architecture Building, 89 Church Street S.E., Minneapolis, MN 55455.
4. Submit a letter of intent stating the reasons for selecting landscape architecture as a profession. This letter, generally consisting of one or two pages, should give an account of the student's reason for becoming interested in the field and in becoming a landscape architect, experience in landscape architecture or related fields (art, horticulture, natural resource management, architecture, engineering, construction), experience or participation in other interests (travel, hobbies, avocations), and perception of herself or himself in the role of a landscape architect.
5. Submit official transcripts of all college work completed to date at the University of Minnesota

and other colleges. Generally, a student must have a GPA of 2.75 or higher for admittance.

- Submit a portfolio of art or design work, environmental or design reports, photographs of sculptural work, slides, or similar examples of creative work. It is suggested that the portfolio be a bound 8-x-11-inch booklet. Portfolios larger than 24 x 36 inches or materials not enclosed in a carrying case will not be accepted. Slides must be submitted in an 8-x-11-inch transparent slide carrier.

Applicants are encouraged to visit the design studios, talk to students in the program, and find out as much about the profession as they can.

The landscape architecture faculty vote on each applicant. The applicant may be admitted to the program, rejected, or assigned pre-landscape architecture status. Approval for admission is based on consideration of the following: (1) the student's academic standing and GPA; (2) the student's maturity and experience; (3) the student's letter of intent; (4) the estimated design potential of the student; and (5) the availability of staff and space.

Applicants will be notified by letter of the admission decision by May 15. Those admitted must notify the Department of Landscape Architecture by June 15 of their intention to attend or their place will be forfeited. Those not accepting the opportunity in the year for which it is offered must reapply if they wish to enter the program at a later date.

## B.E.D. Degree Requirements

Pre-environmental Design (91 credits)  
*Preparation for the Major* (39 credits)  
 Arch 1601—Design Professions and Society (4)  
 Arch 3411/3412—History of Architecture to/Since 1750 (4)  
 Arts 1101—Drawing (4)  
 LA 1301—Introduction to Architectural Drawing (4)  
 LA 1401—The Designed Environment (4)  
 LA 3413—History of Landscape Architecture (4)  
 Biol 1103—General Botany (5)  
 Hort 1021—Woody Plant Materials (5)  
 Hort 1022—Herbaceous Plant Materials (5)

### *Liberal Education Requirements* (52 credits)

*Communication and Language Skills*  
 Rhet 1101—Writing to Inform and Persuade (4)  
 Rhet 1104—Library Research (1)  
 Rhet 1151—Writing in Your Major (4)  
 Rhet 1222—Public Speaking (4)

### *Mathematical Thinking*

Math 1031—College Algebra (4)

### *Physical and Biological Sciences*

Biol 1009—General Biology (5)  
 Geol 1001/1021—Introduction to Geology and Lab (5)  
 Soil 1020—The Soil Resource (5)

### *History and Social Sciences*

Geog 13xx-15xx—Introduction to Geography (4)  
 Geog 3xxx—Regional or Topical Studies (4)  
 Historical perspective elective (4)

### *Arts and Humanities*

Phil 3502—Introduction to Aesthetics (4)  
 Literature or philosophy elective (4)  
 Visual and performing arts satisfied by LA 1301/3413

### *Designated Themes*

Major courses meet requirements (see below). If these particular courses are not taken, choose courses to fulfill designated themes requirements.

Citizenship and public ethics satisfied by Arch 1601  
 Cultural diversity satisfied by Rhet 1101  
 Environment satisfied by Geol 1001  
 Environment satisfied by Arch 1401  
 Environment satisfied by Soil 1020  
 International perspective satisfied by Arch 3411/3412

Students *must* complete the above courses (or their equivalent), have completed 90 credits (may include current enrollment), *and* have an overall GPA of 2.75 or above to apply to the B.E.D. degree program.

Upper Division Requirements (89 credits)

### *Major Requirements* (20 credits)

These courses may be taken *before* admission to the B.E.D program; *all* are prerequisites to landscape design and technology courses.

### *Writing Skills*

Rhet 3562—Writing in Your Profession (4)

### *Graphic Communication*

LA 3311—Drawing for Design (4)  
 LA/Arch 3-5xxx—Advanced Graphics course (4)

### *Geography/Ecology/Geology*

One of the following:

EEB 3001—Introduction to Ecology (4)  
 EEB 3101—Ecology for Engineers and Physical Scientists (4)

One of the following:

Geol 5251—Geomorphology (4)  
 Geol 5261—Glacial Geology (4)

### *Landscape Design and Technology* (41 credits)

Students must be admitted to the B.E.D. program to enroll in the following courses.

#### Landscape Design

LA 5211—Making Landscape Space (6)  
 LA 5212—Ecological Informants of Design (6)  
 LA 5213—Making Landscape Types (6)  
 LA 5221—Planted Form (5)

#### Landscape Technology

LA 5201—Field Tech for Landscape Analysis (3)  
 LA 5202—Landscape Ecology (3)  
 LA 5571—Landscape Const: Landform Systems (4)  
 LA 5572—Landscape Const: Spatial Performance (4)

#### Architecture/Urban Design

Arch 5711—Design Princ of Urban Landscape (4)

### Electives Supporting the Major (20-28 credits)

Electives supporting the professional degree, selected in consultation with an adviser, to complete the 180 credits required for graduation.

## Undergraduate Minor in Environmental Design in Landscape Architecture

An undergraduate minor in environmental design requires a minimum of 28 credits. Two courses are required; the remainder are chosen from the list of optional courses.

### Required Courses

LA 3413—The History of Landscape Architecture (4 cr)  
 LA 5431—Landscape Architecture History: Individual Influences (4 cr)

### Optional Courses

Hort 1021—Woody Plant Materials (5 cr)  
 LA 1024—Landscape Theory (4 cr) (UC only)  
 LA/Arch 1301—Introduction to Landscape Architecture Drawing (4 cr)  
 LA/Arch 1401—The Designed Environment (4 cr)  
 LA 3098—Making Landscape Space (4 cr) (UC only)  
 LA/Arch 3311—Drawing for Design (4 cr)  
 LA 5202—Landscape Ecology (4 cr)  
 LA 5213—Making Landscape Types (4 cr)  
 LA/Geog 5562—Introduction to Geographic Information Systems (4 cr)  
 LA 5571—Landscape Construction: Land Form Systems (4 cr)  
 LA 5572—Landscape Construction: Spatial Performance (4 cr)  
 LA 5621—Professional Practice (4 cr)

### Transfer Credits

A maximum of 12 transfer credits may be used for the minor. Overlapping courses taken for a major degree may also be used toward the minor.

### Grades

Courses for the minor may be taken S-N; however, courses taken S-N may not later be used for the B.E.D. major. A minimum grade of C (or S) is required in all courses for the minor.

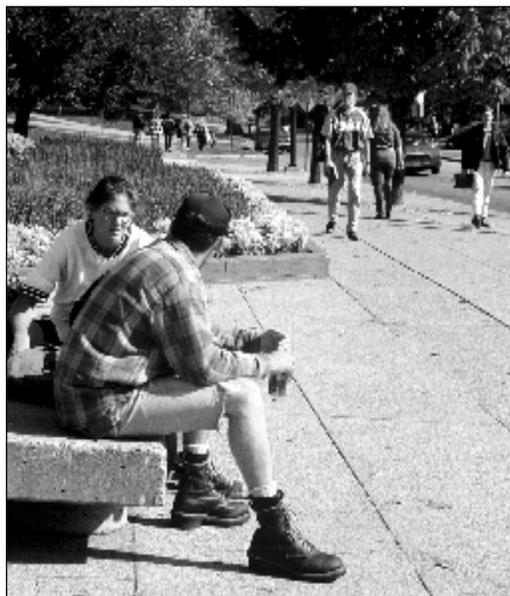
*Note:* All courses may not be offered every quarter; care must be taken in scheduling.

## Pre-Medicine and Pre-Dentistry

Students considering careers in the health sciences will discover most medicine and dental schools require that students entering their programs have a bachelor's degree or a specific set of courses. Competition for admission is normally very competitive and requires that students have demonstrated high ability and achievement in the physical and biological sciences. The nutrition science track in COAFES provides pre-health science students an alternative route into medical or dental school while also providing them a bachelor of science degree option that provides an excellent background and alternative career options.

Students should enroll in the nutrition major and pursue the nutrition science emphasis. You will find the curriculum outlined on page 25. Students enrolling in the program in COAFES will have the benefit of a faculty adviser, a small college and department setting and easy access to St. Paul campus services, as well as the opportunity to be considered for COAFES scholarships. If you succeed in your academic and career goals as a health care professional, you'll have a solid background in nutrition that will serve as a valuable tool in assisting patients to better health. If your career plans change, you will have the benefit of completing a bachelors degree in nutritional science.

Entrance requirements to graduate and professional programs are always competitive and requirements vary from school to school. Students should work closely with their adviser to meet the requirements for the school(s) they are considering. A cumulative GPA of at least a 3.00 is essential.



*The small campus setting in St. Paul promotes community building and lasting friendships.*

## Pre-Veterinary Medicine

Students may complete the minimum requirements for admission to the University of Minnesota's College of Veterinary Medicine requirements through COAFES's pre-veterinary animal science track in the science in agriculture major. Entering freshmen may want to explore the science in agriculture/doctor of veterinary medicine degree option outlined on page 28. The joint degree program allows students to complete a bachelor's degree in science in agriculture and, later, a doctor of veterinary medicine degree in seven years. Admission is competitive, but science in agriculture students will receive special consideration because of the animal knowledge and experience gained in University of Minnesota animal science courses.

COAFES's pre-veterinary track is interdisciplinary, bringing the benefits of a strong science foundation along with animal science courses. Most students are able to complete their prerequisite course requirements in three years. Students can apply to veterinary medicine upon completion of those requirements or can complete their bachelor's degree before pursuing veterinary medicine. Gaining the bachelor's degree allows students additional academic skills and other career alternatives.

COAFES provides an excellent setting for pre-veterinary medicine preparation. Students are assigned advisers from the animal science faculty who hold joint appointments in COAFES and the College of Veterinary Medicine. Students gain the benefit of a small campus atmosphere, easy access to student services, an active pre-vet club and the opportunity to work with livestock on the St. Paul campus. The curriculum meets vet school admission requirements while increasing student animal-based knowledge and experience, enhancing chances for admission.

Competition for admission to the University's College of Veterinary Medicine, as well as other U.S. veterinary medicine, is very keen. Students are encouraged to gain experience by working with animals in laboratory, clinic, or production situations. Most recently, the average GPA in required courses for Minnesota, South Dakota, and North Dakota residents entering the College of Veterinary Medicine was 3.49. The average GPA for students from other states admitted was 3.76. The University of Minnesota admits about 76 students each year with 80 percent being from Minnesota, South Dakota, and North Dakota.

For information on procedures and requirements for admission to the College of Veterinary Medicine, criteria for selection, degree programs and courses offered by the college, and related subjects, consult the annual College of Veterinary Medicine brochure or the Office of Student Affairs and Recruitment, College of Veterinary Medicine, University of Minnesota, 460 Veterinary Teaching Hospitals, 1365 Gortner Avenue, St. Paul, MN 55108 (612/624-4747).



College Information and Policies

## Degrees Offered

**Baccalaureate Degrees**—The major curricula of COAFES lead to a bachelor of science degree.

**Graduate Degrees**—The departments in COAFES, through the Graduate School, offer the master of science and the doctor of philosophy degrees. For information about these programs, see the *Graduate School Bulletin*.

## Admission

Requirements for admission to COAFES for high school graduates and transfer students are explained below. Information for adult special students, international and minority students, and senior citizens is also included. For more information, contact Prospective Student Services, 612/624-3045 or 1-800-866-AGRI (toll-free).

**Deadlines**—The Office of Admissions will typically accept applications for fall quarter beginning October 1 of the preceding year and will admit students as long as space is available. Freshman applicants who meet the admission requirements and apply by December 15 will be guaranteed space in the following fall quarter class. Final deadlines are June 1 for fall quarter; October 15 for winter quarter; and January 15 for spring quarter.

Applications for spring quarter are accepted from transfer students only.

**High School Graduates**—High school graduates planning to begin their studies as freshmen fall quarter 1996 or later will be expected to have completed as a minimum the following courses while in grades 9-12:

- Four years of English, with emphasis on writing, including instruction in reading and speaking skills and in literary understanding and appreciation;
- Three years of mathematics, including one year each of elementary algebra, geometry, and intermediate algebra;
- Three years of science, including one year each of biological and physical science;
- Two years of a single second language;
- Two years of social studies, including U.S. history.

Students who graduated from high school before 1987 will not be expected to meet these course requirements, although they are strongly encouraged to do so. For further information on admission requirements, please consult the current University of Minnesota Undergraduate Application Booklet.

**Tuition Deposit**—If you are admitted to COAFES as a freshman, you must submit a nonrefundable \$50 tuition deposit to hold your place in the freshman class. When you enroll, your deposit will be applied to your first quarter's tuition. You must pay the deposit by May 1 or within two weeks after the date on your admission notification letter. If you do not submit the deposit by the deadline, you may lose your place in the freshman class.

If you are admitted through and certified by the Office of Minority Student Affairs (i.e., as a disadvantaged or minority student), you are exempt from this requirement and do not need to pay a deposit.

**Transfer Students**—You may apply for admission to COAFES from other colleges or universities. You may be accepted if you meet the entrance requirements of the college and of the major you wish to enter. Transfer students who graduated from high school during 1987 or later and wish to be admitted must:

- Have passed intermediate algebra with a grade of "C" or better
- Have at least a "C" average in your transfer coursework
- Have demonstrated a solid foundation in math and science
- Completed at the high school level the following coursework:
  - Four years of English
  - Three years of science, including one year each of biological and physical science
  - Two years of a single second language
  - Two years of social studies, including U.S. history.

If you did not complete this coursework during your high school years, equivalent college coursework may be substituted. COAFES may admit some students who have not met these requirements. Students admitted lacking preparation requirements must complete all deficiencies early in their program.

If you graduated from high school before 1987, admission criterion are:

- Passed intermediate algebra with a grade of "C" or better
- Have at least a "C" average in your transfer coursework
- Demonstrated a solid foundation in math and science.

After you have applied for and been accepted as a transfer student, the Office of Admissions and COAFES will evaluate all previous college work according to the standards of the University and COAFES. You will then be provided with a Transfer Credit Evaluation showing how your previous work has been evaluated.

As a transfer student, you must complete all specific course and area distribution requirements of the college regardless of the number of credits accepted for transfer. Therefore, if you begin your degree work elsewhere intending to transfer later, you should carefully plan your pretransfer courses to meet as many COAFES requirements as possible. See the requirements for the various curricula in the Transfer Students section and take special note of the distribution requirements. Please note that a maximum of 4 internship or practical experience credits may be transferred into COAFES.

**Change of College Within the University**—To transfer to COAFES from another college within the University, you must meet COAFES entrance

requirements. Apply for transfer at the Office of Admissions on the campus where you are currently registered or where you last attended classes. Application deadlines are consistent with deadlines listed above.

**International Students**—International students must demonstrate competency in the English language by achieving an acceptable score on an English proficiency test. In addition, they must present evidence that they have met all admission requirements applicable to United States students and maintained a good academic record at their previous schools. International students should apply by April 1 for fall quarter admission, October 1 for winter quarter, and January 1 for spring quarter.

**Commitment to Diversity**—COAFES is committed to recruiting, enrolling, and educating a diverse population of students who represent the overall composition of our society. Advancing this commitment is a high priority for the college. A scholarship program for students with strong academic ability underscores our active recruiting effort. We invite your application.

**Adult Special Students**—The adult special category of admission in COAFES is primarily for (1) students who are pursuing course work in COAFES departments, but who are not degree-seeking students, or (2) students who are preparing for application to graduate programs offered by COAFES departments, but who still have some prerequisites to satisfy. Admission may be processed at any time prior to the first day of class. The AS category is also open to (3) staff members in COAFES departments taking courses through the Regents Scholarship Program and (4) COAFES graduates returning for course work to improve their skills.

If you enter the college as an adult special student with the intention of transferring later to the Graduate School, you should be aware that there are restrictions on the number of credits that may be transferred to a graduate program while you are registered as an adult special. Consult the *Graduate School Bulletin*.

**Senior Citizens**—Minnesota residents 62 years or older are admitted to all University of Minnesota classes on a space-available basis, provided they have completed specified prerequisites. If a course is taken without credit, there is no fee unless materials or other special charges are involved. If a course is taken for credit, students must pay a modest fee per credit and any materials or special charges. Eligible persons should check with the Office of the Registrar—St. Paul, 130 Coffey Hall.

## Planning to Transfer?

Minnesota's public colleges and universities are working to make transfer easier. You can help if you PLAN AHEAD, ASK QUESTIONS, and USE PATHWAYS created by transfer agreements.

## Preparing for Transfer

If you are currently enrolled in a college or university:

- Discuss your plans with the campus transfer specialist in Prospective Student Services, 120 Biosystems and Agricultural Engineering.
- Call or visit your intended transfer college. You should obtain the following materials and information:
  - college catalog
  - transfer brochure
  - information on admissions criteria and on materials required for admission (e.g., portfolio, transcripts, test scores). Note that some majors have limited enrollments or their own special requirements such as a higher grade point average.
  - information on financial aid (how to apply and by what date)
- After you have reviewed these materials, make an appointment to talk with an adviser/counselor in the college or program you want to enter. Be sure to ask about course transfer and admission criteria.

If you are not currently enrolled in a college or university, you might begin by meeting with a transfer specialist or an admission officer at your intended transfer college to plan the steps you need to take.

## Understanding How Transfer of Credit Works

- The receiving college or university decides what credits transfer and whether those credits meet its degree requirements. The accreditation of both your sending and your receiving institution can affect the transfer of the credits you earn.
- Institutions accept credits from courses and programs like those they offer. They look for similarity in course goals, content, and level. "Like" transfers to "like."
- Not everything that transfers will help you graduate. Baccalaureate degree programs usually count credits in three categories: general education, major/minor courses and prerequisites, and electives. The key question is, "Will your credits fulfill requirements of the degree or program you choose?"
- If you change your career goal or major, you might not be able to complete all degree requirements within the usual number of graduation credits.

## Applying for Transfer Admission

- Application for admission is always the first step in transferring. Fill out the application as early as you can prior to the deadline. Enclose the application fee.
- Request that official transcripts be sent from every institution you have attended. You might be required to provide a high school transcript or GED test scores as well.
- Recheck to be certain you supplied the college or university with all the necessary paperwork.

Most colleges make no decisions until all required documents are in your file.

- If you have heard nothing from your intended college of transfer after one month, call to check on the status of your application.
- After the college notifies you that you have been accepted for admission, your transcribed credits will be evaluated for transfer. A written evaluation should tell you which courses transfer and which do not. How your courses specifically meet degree requirements may not be decided until you arrive for orientation or have chosen a major.
- If you have questions about your evaluation, call the Office of Admissions and ask to speak with a credit evaluator. Ask why judgments were made about specific courses. Many concerns can be cleared up if you understand why decisions were made. If not satisfied, you can appeal. See “Your Rights as a Transfer Student” below.

#### Your Rights as a Transfer Student

- A clear, understandable statement of an institution’s transfer policy.
- A fair credit review and an explanation of why credits were or were not accepted.
- A copy of the formal appeals process. Usual appeals steps are: 1) Student fills out an appeals form. Supplemental information you provide to reviewers—a syllabus, course description, or reading list—can help. 2) Department or committee will review. 3) Student receives, in writing, the outcome of the appeal. 4) Student can appeal decision to Student Services, 120 Biosystems and Agricultural Engineering.
- At your request, a review of your eligibility for financial aid or scholarships.

*For help with your transfer questions or problems, see your campus transfer specialist.*

## Residence and Reciprocity

**Residence**—Because the University is a state institution, Minnesota residents pay lower tuition than nonresidents and, in many programs, receive priority consideration for admission. To qualify for resident status, students must reside in Minnesota for at least one calendar year before the first day of class attendance. For more information, contact the Resident Classification and Reciprocity Office, 240 Williamson Hall, 231 Pillsbury Drive S.E., Minneapolis, MN 55455 (612/625-6330), or the residency office on your campus.

**Reciprocity**—The University has reciprocity agreements with North Dakota, South Dakota, Wisconsin, and Manitoba. The University also participates in a reciprocity program with Kansas, Michigan, Missouri, and Nebraska, for students in the following undergraduate colleges: Agricultural, Food, and Environmental Sciences; Architecture and Landscape Architecture; Biological Sciences; Education and Human Development; Human

Ecology; Liberal Arts; Natural Resources; Carlson School of Management; Division of Dental Hygiene; School of Nursing; and Institute of Technology. If you are a resident of any of these states or this province, you may qualify for reciprocity tuition rates, which are lower than nonresident tuition rates and, in some cases, comparable to resident rates. For more information, contact the Resident Classification and Reciprocity Office, 240 Williamson Hall, 231 Pillsbury Drive S.E., Minneapolis, MN 55455 (612/625-6330), or the residency office on your campus.

## Financial Aid

Financial aid for students is available in the form of grants, loans, scholarships, and work-study.

To apply for financial aid through the Office of Scholarships and Financial Aid (OSFA), students must obtain an application packet and complete the Free Application for Federal Student Aid (FAFSA) and all other required documents. Although applications are accepted throughout the academic year, priority consideration for the following fall is given to applications that are complete and in OSFA by April. Exact deadlines are in the application packet.

For an application packet and more information, contact the Office of Scholarships and Financial Aid. The St. Paul campus office is in 130 Coffey Hall, 1420 Eckles Avenue, St. Paul, MN 55108. The Minneapolis campus office is in 210 Fraser Hall, 106 Pleasant Street S.E., Minneapolis, MN 55455 (612/624-1665).

## Scholarships

COAFES has an extensive scholarship program for freshmen, transfer, and continuing students. Scholarship brochures and applications are usually available in December. Students can pick them up in 120 Biosystems and Agricultural Engineering. Deadlines for applications are published in the applications and brochures.

## Disabled Students

Wherever possible, special consideration is given to disabled students to minimize any problems. Through the COAFES Student Services Office, help is available to arrange for early registration, adviser accessibility and classroom locations for students using a wheelchair, and specific resource aids. Other services are available through the University’s Disability Services, 30 Nicholson Hall (612/626-1333, voice or TTY).

## Registration

Each quarter you and the University complete a contract through the registration and payment process. The University agrees to provide certain instruction and facilities; you agree to attend and pay tuition and fees for the classes you have chosen.

Although changes sometimes occur in course listings, the responsibility for accurate, timely registration and payment rests primarily with you.

**Special Registration Procedures**—Certain special registration procedures allow you to audit courses, to take them as independent study or reading courses, or to take them for extra credit.

**Auditing**—Auditors attend and complete all work for a course, but do not take the final examination or receive credit. As an auditor, you must enroll officially in a course and pay regular tuition and fees. Both your adviser and the course instructor must approve your registration. Enter a course you are going to audit on your registration card with a V after the course number (e.g., Rhet 3280V).

**Independent Study**—You have two options for obtaining credit through independent study. In some University courses, you may request an examination (or other evaluation) after preparing for it in any way you choose. If you pass the examination, you will receive credit for the course. You must pay a fee for each examination attempted. Check with the COAFES Student Services Office for further information and for Request for Special Examination application forms.

A second method of independent study is to take a course without attending classes. Under this method, you pay the usual tuition and fees for the course, meet all deadlines, and take the final examination at the regular time. All usual regulations concerning grades, incompletes, and cancellations apply to students taking independent study in this manner. A course completed under independent study counts as part of the total credit load for the quarter. Check with the department offering the course concerning permission to take it for independent study. You will need approval from the course instructor on a registration override permit. Return the completed override to the Office of the Registrar—St. Paul, 130 Coffey Hall. Enter the course you are going to take by independent study on your course request form with a Y after the course number (e.g., Rhet 3280Y).

**Extra Credit**—With the course instructor's approval, you may earn 1 to 3 additional credits for a course you are currently taking or have already taken. You may, for example, explore a course topic intensively or extend it to a related topic. You will do the extra work on your own according to standards set by the instructor.

You will need approval from the course instructor on a registration override permit. Submit the completed override along with your course enrollment request form with an X after the course number (e.g., Rhet 3280X). The usual regulations concerning tuition and fees, grades, and cancellations apply.

**Cancel/Add Procedures**—You can process your cancel/add on-line or in person at the Office of the Registrar. If you change your registration in person, use a course request form available from the Office of the Registrar—St. Paul or the COAFES

Student Services Office. Make all such changes as early as possible in the quarter. *Note:* You must use the official course request form.

**Cancel**—When you cancel a course, you are subject to the following procedures and requirements:

- Cancellations during the first two weeks of a quarter are deleted from your record.
- Cancellations during the third through sixth weeks of a quarter require your instructor's signature on the course request form. A W is assigned. The withdrawal (W) does not affect your GPA but does affect your coefficient of completion.
- Cancellations after the sixth week require the signatures of the adviser, instructor, and Scholastic Standing Committee representative on the course request form. Withdrawal from a course after the sixth week of a quarter is seldom approved by the Scholastic Standing Committee unless there are extenuating circumstances. (See Scholastic Requirements below for information on the effect cancellation has on your coefficient of completion.)

**Add**—No signatures are required to add a class during the first week of a quarter. You must have your instructor's signature during the second through sixth weeks of the quarter. After the sixth week of the quarter, adding a course requires the signatures of your instructor and the Scholastic Standing Committee representative. Approval after the sixth week of the quarter is rarely granted.

**Grading Change**—A change from one grading system selected for a course to another (e.g., from A-F to S-N or Audit) must be made during the first two weeks of a quarter. The choice of grading system may not be changed after the end of the second week.

**Cancellation of Entire Registration**—If you leave the University before the end of a quarter, you must cancel your registration when you stop attending classes. Submit a course request form to the Office of the Registrar—St. Paul, 130 Coffey Hall. Cancellations are effective the day they are processed. Refunds are based on the date you officially cancel. You are entitled to a full refund if you cancel before the first day of classes. Contact the Office of the Registrar—St. Paul, 130 Coffey Hall, for current refund information.

## Petition Procedures

To request permission to depart from usual procedures and regulations, you must complete a petition form available at the COAFES Student Services Office, 120 Biosystems and Agricultural Engineering, or at the Office of the Registrar—St. Paul, 130 Coffey Hall. Consult your adviser about writing the petition and for recommendation for approval. Present your petition to the COAFES Student Services Office for review by the Scholastic Standing Committee. You may pick up a copy of the decision about one week later.

## Credits and Class Attendance

**Advanced Placement**—The Advanced Placement (AP) program of the College Board provides a way for high schools to offer college-level studies to their more advanced students and for such students to demonstrate satisfactory achievement in those studies. Through this program students may earn college credit, exemption from requirements, or placement in advanced courses when they enroll in college. For more information, contact the Office of Admissions, University of Minnesota, 240 Williamson Hall, 231 Pillsbury Drive S.E., Minneapolis, MN 55455 (612/625-2008).

**College Level Examination Program**—An alternative method of earning credit is through the College Level Examination Program (CLEP). Inquire at the COAFES Student Services Office for details.

**Course Load**—Graduation in four years requires an average course load of 15 credits per quarter. The typical course load per quarter is 14 to 18 credits. A credit requires an average of three hours of work each week. To carry more than 18 credits, a C average (that is, a cumulative grade point average of not less than 2.00) is required. To carry more than 21 credits, a B average (3.00 GPA) in work of the previous quarter and permission from the Scholastic Standing Committee are required. Undergraduates must carry at least 12 credits each quarter to be considered full-time students. In some cases, financial aid programs stipulate credit minimums. Consult the Office Scholarships and Financial Aid for more information.

**Class Attendance**—Attendance for certain classes in COAFES is compulsory because of the nature of such classes. If you miss a class for a valid reason, you may request the instructor's assistance in making up the work missed. Instructors are under no obligation to give assistance if the absence is not justifiable.

The following three situations are accepted by instructors as justifiable reasons for absence from class and for a request for assistance in making up work: (a) illnesses certified by Boynton Health Service or by your family physician; (b) emergencies caused by a death or serious illness in your immediate family; (c) participation, certified by the Office of Student Affairs (130 Coffey Hall), in University-approved, cocurricular activities.

To make up classwork, you should confer directly with instructors concerning the reason for the absence and the possibility and ways of completing work missed. The Scholastic Standing Committee intervenes as an appeal agency only when emergencies are involved.

**Use of Elective Credits**—With the approval of your adviser and the Scholastic Standing Committee, you may request that some elective

courses you have completed be omitted from the list of courses counted toward your degree. A maximum of 10 credits of elective courses may be withheld to raise your GPA, but only to satisfy the graduation requirement of a 2.00 GPA. When a course is withheld from the undergraduate record, it can be reinstated only by an examination for credit or by repeating the course.

Students in agriculture are not required to take courses in physical education or music.

Students who wish to use excess credits earned as an undergraduate for credit in the Graduate School should consult the *Graduate School Bulletin* for current policies or the Graduate School Office, University of Minnesota, 316 Johnston Hall, 101 Pleasant Street S.E., Minneapolis, MN 55455.

## Special Study Opportunities

Several study opportunities that allow you to earn credits in special ways are described below. In addition to these programs, many majors offer internship or work-study opportunities. Check with your adviser.

**Honors Program**—The COAFES Undergraduate Honors Program provides a special educational opportunity for all COAFES students who qualify and accept the challenge of broadening, deepening, and enriching their education. The program is designed to give COAFES students and faculty from diverse areas of interest and expertise the opportunity to interact with each other academically and socially. Honors students explore broad and varied aspects of agriculture through a COAFES Honors Colloquium Course Series (Agri 1000H) and enhance their backgrounds through a COAFES Honors Experience Course (Agri 3100H). The honors experience is student-designed to meet their special interests and is supervised by experienced COAFES faculty. The college-wide honors program leads to the cum laude degree designations in all COAFES majors.

Check with the COAFES Student Services Office for more information and an application.

**Study Abroad**—COAFES encourages students to study in another country as part of their degree program. Options range from a few weeks to an entire academic year. Study in English is possible at a number of sites. If a University of Minnesota program does not meet a student's needs, many other options are also available.

**Identifying Study Abroad Opportunities**—The International Study and Travel Center and the Global Campus together form a work/study/travel abroad advising center in 102 Nicholson Hall. You can learn about the many opportunities from an options adviser (612/626-9000). After identifying one of many options of interest, students should see a program adviser (612/625-3379) for detailed

program information and credit and financial aid planning. Program information is also available at <http://www.isp.acad.umn.edu/> on the World Wide Web.

#### **Study Abroad Opportunities in COAFES—**

Two types of study abroad that can especially enhance degree work in COAFES are field study and integrated classroom study. Minnesota Studies in International Development (MSID) is a field study program offering two-quarter winter/spring grassroots internships in Ecuador, India, Jamaica, Kenya, Morocco, or Senegal, preceded by on-campus preparatory courses in the fall; some sites require no prior language study. The Student Project for Amity and Nations (SPAN) consists of summer overseas research on a topic of the student's choosing, preceded by a year's on-campus preparation and followed by project write-up in the fall; the four destinations change from year to year. Students may also seek directed or independent study credit from COAFES departments for academic projects arranged as a part of a MAST International Outbound experience (see below).

Integrated classroom study programs permit students to take regular university courses alongside host-country nationals. The University's student exchanges and consortium memberships provide access to universities in many countries. Agriculture curricula taught in English are available in Australia, Fiji, Finland, and the United Kingdom. Students with sufficient language fluency may instead choose to study in Dutch (the Netherlands), Finnish (Finland), French (France, Togo), German (Germany), Korean (South Korea), Spanish (Argentina, Dominican Republic, Honduras, Mexico). For students majoring in Applied Economics the range of options is even greater.

**Other Study Abroad Opportunities—**COAFES encourages study abroad for language acquisition or cultural learning. The resulting credits can often be used as electives. The University and other institutions sponsor a broad range of intensive language programs and area studies programs. Contact your adviser for more information.

**Credit and Financial Aid—**Advance planning and COAFES endorsement are essential to assure that credit from study abroad fits smoothly into the student's degree program. Students who enroll in a University of Minnesota program will receive procedural information from the sponsoring office on campus. Students seeking other options should make an appointment with a study abroad program adviser (104 Nicholson Hall, 612/625-3379) as early as possible to discuss credit procedures and obtain a Foreign Study Checklist. Through the checklist, the COAFES Student Services Office for Student Affairs, 120 Biosystems and Agricultural Engineering, will record agreements concerning credit. The checklist also helps maintain students' enrollment status and financial aid eligibility while abroad.

For nearly all study abroad programs, students can arrange to retain their University financial aid eligibility and/or to defer past loans. Additional financial aid is available for some programs. Contact a study abroad options adviser (102 Nicholson Hall, 612/626-9000) for more information. Some scholarships are available through COAFES to help defray costs of overseas study-travel. A written report is required. Preference is given to proposals from non-English speaking countries. You must initiate and plan the project yourself with the aid of a faculty adviser. Contact the COAFES Career Services Office, 120 Biosystems and Agricultural Engineering (612/624-2710), for more information.

**MAST International Outbound—**The MAST International Outbound program provides qualified individuals the opportunity to broaden their agricultural/horticultural skills and knowledge as well as develop or improve international language skills. Practical training programs of 3 to 12 months are available to individuals between the ages of 18 and 30. Participants will gain a cross-cultural experience by living and working with a host family in one of fifteen countries—Australia, Austria, Brazil, Denmark, Finland, France, Germany, Italy, the Netherlands, New Zealand, Sweden, Switzerland and the United Kingdom. Departure dates are in January, April, June and September each year. For more information, contact the MAST International office, 240 Vocational and Technical Education Building (612/624-3740).

#### **Undergraduate Research Opportunities**

**Program (UROP)—**The University of Minnesota's Undergraduate Research Opportunities Program offers financial awards to undergraduates for research, scholarly, or creative projects undertaken in partnership with a faculty member.

UROP affords undergraduates the unique educational experience of collaborating with a faculty member on the design and implementation of a project. Faculty also have the opportunity to work closely with students and receive valuable assistance with their own research or professional activity. UROP adds a new dimension to the undergraduate experience. It encourages students to conduct research and pursue academic interests outside of their regular courses by employing them to work on special projects. To qualify you must be a full-time undergraduate student at the University of Minnesota in good academic standing.

For more information and an application packet, contact the COAFES Career Services Office, 120 Biosystems and Agricultural Engineering (612/624-2710).

**Professional Experience Program (PEP)—**Junior and senior students enrolled in curricula offered by COAFES may participate in the Professional Experience Program (PEP). This program is designed for students who wish to reinforce their academic experience by working in an area related to their course of study. Students work full time either fall, winter, or spring quarter or during the summer. They earn 4 credits for satisfactory

completion of a PEP program and may enroll in two PEP programs for a total of 8 credits. Salaries are paid by the cooperating businesses, industries, producers, and agencies participating in the program. For more information, consult your adviser or the COAFES Career Services Office, 120 Biosystems and Agricultural Engineering (612/624-2710). Registration is arranged by the Career Services Office through University College only.

## Minors

COAFES offers three minor concentrations designed to enhance the major programs of students in agriculture or non-agriculture areas. For assistance in planning a minor, contact the COAFES Student Services Office, 120 Biosystems and Agricultural Engineering (612/624-7254).

**International Agriculture (30 credits)**—The international agriculture minor is an interdisciplinary program that deals with the political, social, and cultural background against which agriculture and agricultural technology must operate throughout the world. Students gain insight into the problems of production, distribution, and consumption of food, feed, fiber, and domestic animals and attempted solutions in specific geographical areas. At least 30 credits are required, of which 5 must be for either an approved work/study experience or a major literature review, and 1 for a seminar in international agriculture. Students must develop their course of study in cooperation with an adviser in one of the departments of COAFES.

Required Courses (24 credits minimum)

Courses in agriculture outside the major (14 credits)  
Courses in language, cultural aspects, geography, and history of an area of special interest (10 credits)

These courses should form a planned, coherent program that develops competencies in a geographical area of interest to the student.

*Research Paper* (5 credits minimum)

Select one of the following:

1. Field experience including work/study in some area of international agriculture. Students should keep a log book.
2. Extensive literature review in some area of international agriculture. Students should work with a faculty member who has international experience in an area of interest to them.

*Seminar*

Seminar in International Agriculture—1 credit (Agri 3000)

**Sustainable Agriculture (30 credits)**—Agricultural systems are complex and dynamic. In recent years, questions have been raised regarding the sustainability of energy and resource intensive agricultural systems. While all agriculturally oriented majors of the college consider issues of sustainability in agriculture, the Sustainable Agriculture minor provides a concentration of courses giving students greater understanding of scientific, technological, and socioeconomic factors affecting the viability of agriculture. Students examine ecological features of agriculture and work through decision-making case studies involving integrated management of specific agricultural systems. The minor provides a degree of flexibility and individuality through several elective options. Students should develop their course of study

in consultation with an adviser in one of COAFES major programs.

Required Courses (12 credits)

AgET 5027—Appropriate Technology for International Development (4)

AnPI 5060—Integrated Pest Management of Cropping Systems (4)

Ent 5320—Ecology of Agriculture (4)

Remaining 18 credits must be taken from at least three of the following four areas. Students should consult a COAFES major adviser in selecting these courses.

*Pest Control*

Agro 5030—Weed Control (5)

Ent 5210—Insect Pest Management (4)

Ent 5280—Livestock Entomology (4)

PIPa 3001—Management and Control of Field Crop Diseases (4)

PIPa 3002—Management of Horticultural Crop Diseases (4)

*Crops, Soils, and Water*

AgET 5410—Hydrology and Water Quality (5)

Soil 3416, 3417—Plant Nutrients in the Environment and Lab (4,1)

Soil 5610—Soil Biology (4)

*Applied Economics*

ApEc 3420—Grain Marketing Economics (4)

ApEc 3430—Dairy Marketing Economics (4)

ApEc 3440—Livestock and Meat Marketing Economics (3)

ApEc 3450—Agricultural Input Marketing Economics (4)

ApEc 3610—Resource Development and Environmental Economics (4)

ApEc 3810—Principles of Farm Management (4)

*Integration of Agriculture and Society*

ApEc 5790/Agro 5200/FScN 5643—World Food Problems (3)

AgEd 5055—Methods in Farming Systems Research and Extension (3)

AnSc 3113—Animal Welfare (4)

Biol 3052—Environmental Health and Toxicology (4)

Pol 3970—Ethics and the Environment (4)

Rhet 3390—Technology, Self, and Society (4)

**Agriculture for Non-COAFES Students**—This minor is for non-COAFES students who wish to explore some technical aspects of agriculture so they are better prepared as future leaders. The minor will help prepare them to:

- Understand the interdependence of rural and urban societies.
- Better manage the natural resources used by agriculture for the benefit of humanity.
- Understand the factors regulating supply and demand and the policies which determine the economics of food and fiber production.
- Understand the production practices used by agricultural producers and the environmental and social consequences of these practices.
- Understand the scientific basis of modern agriculture.

The college also offers minor concentrations in seven areas of agriculture to complement the studies of students in non-agriculture programs. Students currently pursuing a University of Minnesota major outside of COAFES may pursue minors in agricultural and applied economics, agronomy, animal science, entomology, horticulture, scientific and technical communication, and soil science.

Contact the COAFES Student Services Office, 120 Biosystems and Agricultural Engineering (612/624-7254), for details and applications. *COAFES students with an interest in one of these areas may want to incorporate it into an area of emphasis in their major.* Consult your major adviser.

## Grading

Academic progress in COAFES is evaluated by one of two grading systems: the letter grade (A-F) system or the satisfactory-no credit (S-N) system. A-F System—Under the A-F (A-B-C-D-F) system, each letter grade carries the following meaning:

A—Represents achievement that is outstanding relative to the level necessary to meet course requirements.

B—Represents achievement that is significantly above the level necessary to meet course requirements.

C—Represents achievement that meets the basic course requirements in every respect.

D—Represents achievement that is worthy of credit even though it does not fully meet the basic course requirements in every respect.

F—Represents performance that fails to meet basic course requirements. No credit is earned.

The GPA is determined by dividing the sum of the grade points earned (A=4.00, B=3.00, C=2.00, D=1.00, F=0.00) by the sum of the credits attempted. A cumulative average of 2.00 (C) is required for graduation. Additional GPA requirements may be found under the individual curricular listings.

**S-N System**—The S-N system is an alternative to the traditional grading system and encourages students to seek greater breadth in their educational experience.

Under the S-N system, the grade S stands for satisfactory and the grade N for no credit. The S represents achievement that is satisfactory to the instructor, for the program in which you are registered. This definition is intended to imply that the standards for S may vary from one program to another. The instructor is obligated to define to a class in its early meetings, as explicitly as possible, the performance necessary to earn an S. An N is assigned if you do not earn an S.

The following principles have been adopted as a guide for using the grading system by COAFES students:

- Courses identified by number and title as being required must be taken under the A-F system. Prerequisites for required courses and courses in the major must also be taken under the A-F system, unless exceptions are established. Generally, you may take under the S-N system only elective courses and courses used to satisfy all-college requirements that are not specified by number and title for your major requirements.
- All courses open to undergraduate students (those numbered below 8000) may be taken S-N or A-F, except where specifically restricted by the department offering the course or by the college, in the case of distribution requirements. Consult the course descriptions section for courses with restricted grading.

- Candidates for the baccalaureate degree from the college may present a maximum of 25 percent of the residence credits offered for graduation in courses in which they received grades of S.
- The grading system may be selected by students of the college regardless of their academic standing.
- The choice of grading must be declared at the time of registration and may be changed only up to the opening day of the third week of classes.

Your adviser or staff members in the COAFES Student Services Office can answer questions concerning the use of the grading system.

**Other Symbols**—The following symbols may be assigned under either grading system:

I—Assigned by an instructor to indicate incomplete work, in accordance with provisions announced in class at the beginning of the quarter, when in the instructor's opinion there is a reasonable expectation that the student can complete successfully the work of the course. An I that is not made up by the end of the next quarter in residence becomes an F; instructors may set dates within the quarter for make up of examinations or work. When an I is changed to a grade, the I or F is removed from the record.

W—Indicates official withdrawal from a course without a grade. The W is assigned in all cases of official cancellation during the first six weeks of a quarter. After the second week, the approval of the instructor is required for withdrawal.

Withdrawal from a course after the sixth week is rarely permitted unless extenuating circumstances exist. Withdrawals (W) if approved, after the sixth week of the quarter are factored into your coefficient of completion.

V—Indicates registration as an auditor or visitor, a noncredit, nongrade registration.

T—Posted on the transcript as a preceding supplement to the original grade to indicate credits transferred from another institution or from one college or campus to another within the University when reevaluation is required.

X—Reported in a two- or three-quarter continuing course in which a grade cannot be determined until the full sequence is completed. The instructor submits a grade for each X when the student has completed the sequence.

**Dean's List**—The Dean's List, published at the end of fall, winter, and spring quarters, is one way that COAFES recognizes outstanding academic performance by its students. To qualify for the COAFES Dean's List, students must complete at least 12 credits for the quarter (day school and Continuing Education and Extension combined) with a GPA of 3.70 or better. At least one course for that quarter must be completed in day school.

## Scholastic Requirements

COAFES students are expected to maintain an academic standing that will enable them to meet minimum requirements for graduation upon completion of the required number of credits in the major that they have selected. To aid in the early identification of students who are not making satisfactory progress so that appropriate assistance can be provided, the following system has been developed.

### **Academic Difficulty: Probation and**

**Suspension Status**—See your adviser regularly, especially if you are having difficulty in any of your courses. COAFES' mechanism for dealing with academic difficulty is called academic probation.

There are three levels of probation: academic warning (P1), academic contract (P2) and suspension (P3). A student is placed on academic warning if his/her quarterly or cumulative GPA is less than 2.00 but 1.50 or better. A student on academic warning must see an adviser in order to register and will be issued an override to register at their normal queued time. If the student's quarterly and cumulative GPAs at the end of the probationary quarter are 2.00, the student is removed from academic warning. If not, the student is placed on probation contract.

In addition to GPA, each student's coefficient of completion is monitored annually. The coefficient of completion indicates the percentage of courses being completed successfully. A coefficient of .75 is considered a minimum standard. If students fail to meet the minimum of .75, they are placed on probation and their progress is monitored in the same manner detailed below.

The formula for determining this is:

$$\frac{\text{Credits Completed with grade A, B, C, D, S}}{\text{Credits Attempted with grade A, B, C, D, S, F, N, I, W}} = \text{percentage of successful completion.}$$

A student is placed on probation contract if his/her quarterly or cumulative GPA is less than 1.50. A student on probation contract must complete a specific contract drawn up by the college for academic performance and will not be allowed to register for subsequent quarters until grades for the probationary quarter are reviewed. If the contract goals are met quarterly and cumulative GPAs are at least 2.00, the student is removed from probation. If goals are not met, the student is placed on suspension. The period of suspension is normally one academic year.

A student who is suspended may appeal the suspension. A determination of readmittance will be made jointly by the Student Services Office and the Scholastic Affairs Committee. Readmission is not automatic; to be readmitted, a student must show evidence in writing of changes in circumstances that make it more likely that the student will succeed in the academic program. Any collegiate coursework completed while a

student is suspended, including courses from the University's Continuing Education and Extension program, must be petitioned to the COAFES Scholastic Affairs Committee for approval to be applied to student's degree program once readmitted.

**Appeal System**—Decisions by the adviser, department Scholastic Standing Committee and the subcommittees of the Scholastic Standing Committee may be appealed to the COAFES Scholastic Affairs Committee whose decision in turn may be appealed to the COAFES dean.

**Repeating Courses**—Students may repeat, for credit, courses in which they have received grades of N or F, and only the first passing grade will be counted in the cumulative grade point average and honor point total. (The grades previously earned, however, will remain on the transcript.) Students who want to repeat courses in which they received grades of D, C, or S must petition the Scholastic Standing Committee for approval before registering for the course(s). Repeating for credit courses in which grades of A or B have been received is not permitted.

## Scholastic Conduct

The college has defined scholastic misconduct broadly as any act that violates the rights of another student in academic work or that involves misrepresentation of a student's own work. Scholastic misconduct includes (but is not necessarily limited to) cheating on assignments or examinations; plagiarizing, which means misrepresenting as a student's own work any part of work done by another; submitting the same paper, or substantially similar papers, to meet the requirements of more than one course without the approval and consent of all instructors concerned; depriving another of necessary course materials; or interfering with another student's work.

When a case of scholastic misconduct arises, the COAFES faculty member who is the instructor for the course may modify the grade for the exam or piece of work in question or the course grade, or refer the incident to the Scholastic Affairs Committee for disposition. In any case, the instructor must report the incident and the action taken by the instructor to the college Scholastic Affairs Committee. At the time of the action, the student is informed by the instructor of his or her right to ask for a hearing by the Scholastic Affairs Committee. Information on this process is available from the COAFES Student Services Office.

The Scholastic Affairs Committee reviews all reports of academic dishonesty filed with it by faculty members. The committee maintains confidential records of such reports for five years. These records are separate from students' academic records and are used only by the committee and in consideration of cases of scholastic misconduct.

If the student involved is a COAFES student, then the Scholastic Affairs Committee may also, in addition to the actions available to the instructor, place the student on disciplinary probation or suspend the student from the college. If the case involves students or faculty from another college, the committee refers the matter to the Office of Student Judicial Affairs.

Students wishing to report an incident of misconduct should contact the Scholastic Affairs Committee through the COAFES Dean's Office, 120 Biosystems and Agricultural Engineering.

A student may appeal the decision of an instructor to the Scholastic Affairs Committee, and may appeal the decision of the Scholastic Affairs Committee to the Office of Student Judicial Services. This may lead to the President's Student Behavior Review Panel, which has final jurisdiction.

**Access to Student Educational Records**—In accordance with regents' policy on access to student records, information about a student generally may not be released to a third party without the student's permission. (Exceptions under the law include state and federal educational and financial aid institutions.) The policy also permits students to review their educational records and to challenge the contents of those records.

Some student information—name, address, electronic (e-mail) address, telephone number, dates of enrollment and enrollment status (full time, part time, not enrolled, withdrawn and date of withdrawal), college and class, major, adviser, academic awards and honors received, and degrees earned—is considered public or directory information. Students may prevent the release of public information only during their terms of enrollment. To do so, they must notify the records office on their campus.

Students have the right to review their educational records. The regents' policy, including a directory of student records, is available for review at 150 Williamson Hall, Minneapolis, and at records offices on other campuses of the University. Questions may be directed to the Office of the Registrar, 150 Williamson Hall (612/625-5333).

## Graduation Requirements

**Bachelor's Degrees**—Candidates are recommended for graduation after they:

1. Complete the prescribed curriculum, including required and elective courses to meet the total number of credits required;
2. Earn a minimum GPA of 2.00 in all coursework taken at the University after admission to COAFES;
3. Earn a minimum GPA of 2.00 in your major coursework;
4. Earn a coefficient of completion of .75 or greater in COAFES.

Graduation application deadlines are set by the COAFES Student Services Office and are two quarters before your expected graduation. The deadline will be published in the college *Kiosk*, an information sheet that you will receive each quarter with your registration materials. You will be responsible for knowing these deadlines. Extensions of deadlines are rarely granted. You may turn in your application with an official program sheet signed by your adviser to the Office of the Registrar—St. Paul, 130 Coffey Hall.

**Residency Requirements**—In addition to meeting University residency requirements, baccalaureate degree candidates must earn a minimum of 30 of their last 45 credits in professional courses in the program at the 3xxx or 5xxx level while enrolled in COAFES. Ordinarily this will include courses described in this bulletin as well as appropriate advanced courses required in intercollegiate programs.

**Graduation With Honors**—Graduating with honors is determined by a combination of accumulated COAFES GPA (you must have a minimum of 60 credits taken while in COAFES at the University of Minnesota) and fulfillment of the Honors Colloquia and Honors Experience requirements.

The following Latin designations are used for COAFES Honors students:

- *Cum laude*—3.4 GPA for all coursework in COAFES plus honors requirements.
- *Magna cum laude*—3.6 GPA for all coursework in COAFES plus honors requirements.
- *Summa cum laude*—3.8 GPA for all coursework in COAFES plus honors requirements.

Information and applications for all the Honors Programs are available in 120 Biosystems and Agricultural Engineering (612/624-3009).

**Graduation With Distinction and High Distinction**—Graduation “with high distinction” is limited to the top three percent (usually 3.80 GPA or above) of the graduating class; “with distinction” to the next seven percent (usually 3.50 GPA or above) of the graduating class.

The calculation of the GPA to determine class rank is based on the last 90 credits taken before graduation. Only graduating students who have completed at least 90 credits as students in COAFES are eligible for distinction designations, regardless of the level of their academic performance.

## Career Services Office

To help you secure employment after graduation, the Career Services Office, 120 Biosystems and Agricultural Engineering, announces job opportunities and assists in arranging interviews with employers. The Career Services Office manages the recruiting activity for both full-time and internship positions. The internship program, Professional Employment Program (PEP), is

offered to juniors and seniors currently enrolled in the college. Students are encouraged to take advantage of the Career Services Office for career information beginning their freshman year.

## Student Organizations

**COAFES Student Board**—The COAFES Student Board promotes student involvement in issues related to the quality and content of education both in and out of the classroom. This purpose is achieved through channels of communication created by the board between the students, faculty, and administration of COAFES. Through the board, students participate in such matters as consideration of proposed curricula, questions related to instruction, improvement of educational facilities, development of administrative policy, and establishment of the goals of COAFES. Further information related to the board and its operation may be obtained in 120 Biosystems and Agricultural Engineering.

**St. Paul Campus Board of Colleges**—The St. Paul Campus Board of Colleges directs and coordinates student activities and encourages student leadership throughout the St. Paul campus. Its membership is drawn from the colleges of Agriculture, Biological Sciences, Natural Resources, Human Ecology, and Veterinary Medicine. The board brings questions from the student bodies to the administration of the colleges and discusses problems and reaches decisions on matters of general interest. The board cooperates with the Minnesota Student Association and the Assembly Committee on Student Affairs (ACSA).

As a student in COAFES, you may file for election to this board. Inquire at the Office for Student Affairs, 130 Coffey Hall, for more information.

**Student Center Board of Governors**—The St. Paul Student Center provides a varied program of social, cultural, and recreational activities and contributes in many ways to the educational objectives of the campus. The St. Paul Student Center Board of Governors, composed of students elected to represent the academic units on the St. Paul campus, formulates policies for operation of the student center and establishes its budget. For information about the St. Paul Student Center, its operation, and opportunities to serve on its various planning and programming committees, inquire at the information desk on the first floor of the student center.

**Agricultural Ambassadors**—This group of selected undergraduate students from COAFES volunteer their time to serve as goodwill ambassadors for the college and its students. They foster communications among the college, prospective students, and the community at large. Each ambassador gains experience in public relations and recruitment and develops valuable communications skills through public speaking

engagements and small group discussions with prospective students. Agricultural Ambassadors develop leadership/management talents by participating on the executive board and special committees. For more information, contact the COAFES Student Services Office, 120 Biosystems and Agricultural Engineering.

**Student Representation on College and University Committees**—All COAFES committees and most all-University committees have student representatives. For college committees, selection is made by the COAFES Student Board. For all-University committees, watch for announcements in *The Minnesota Daily* and on bulletin boards around the campuses about filing for positions.

**Other COAFES Student Organizations**—Many of the undergraduate programs sponsor student clubs. Membership and participation in these organizations can add a valuable dimension to your academic program and contribute a great deal to your professional development. Check with your adviser or the COAFES Student Services Office, 120 Biosystems and Agricultural Engineering, for further information.

Other clubs affiliated with the College of Agricultural, Food, and Environmental Sciences include:

- Agricultural Education Club
- Block and Bridle
- Gopher Dairy Club
- Gopher Crops and Soils
- Food Science and Nutrition Club
- Horticulture Club
- National AgriMarketing Association, Student Chapter (NAMA)
- Environmental Studies Club
- Nutrition Club
- American Society of Agricultural Engineers, Student Branch
- Society of Technical Communicators, Student Chapter
- Students in Honors
- Frenatar: Entomology Student Association
- Pre-Vet Med Club
- The Sheep and Goat Club
- Alpha Epsilon Delta (Pre-Med and Pre-Vet)
- American Association of Bovine and Swine

**This is the Course Descriptions section of the 1996-1999 University of Minnesota College of Agricultural, Food, and Environmental Sciences Bulletin.**



Course Descriptions

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## Agriculture (Agri)

Agri 1000H. Honors Colloquium. (2 cr; prereq COAFES Honors Program; A-F only)  
Colloquium courses for the College of Agriculture, Food, and Environmental Sciences Honors Program. Topics change quarterly. Each colloquium introduces a topic related to "Agriculture in the 1990's" and is designed for all COAFES majors. Flexible format may include learning opportunities such as symposia, field trips, guest speakers, and other college/university events. Contact college office for topics.

Agri 3000. Seminar in International Agriculture. (1 cr)

Oral presentation and discussion of students' research papers, literature review of selected topics, discussions with students and staff about their experiences in international agriculture.

Agri 3100H. Honors Experience. (3-4 cr; prereq COAFES Honors Program, Honors Committee approval; A-F only)

Honors experience course for the College of Agriculture, Food, and Environmental Sciences Honors Program individually tailored by student in conjunction with a COAFES faculty supervisor. The experience could include such things as: foreign study-travel, research experience, a position or policy paper, or any experience demonstrating advanced study-service-understanding.

## Agricultural Education (AgEd)

AgEd 1001. Introduction to Agricultural Education. (1 cr)

Orientation to employment and service in agricultural education; qualifications of teachers, survey of preparatory offerings, the program in Minnesota.

AgEd 1002. Principles of Career Planning in Agriculture. (1 cr)

Self-assessment and analysis of interests, skills, abilities, values, and life goals. Analysis of various agricultural occupations, employment potential, and demands in relation to employee expectations for work. Industries will be examined using information interviews.

AgEd 1042. Current Technical Competencies. (3 cr)

Preparation of teachers for mechanical/technical/technology instruction. Basic competencies in the skills and knowledge used in planning, implementing, operating and maintaining structural and mechanical systems are developed. Experiential learning principles, applied problem solving, observation and practice are key elements.

AgEd 3001. Experiential Learning: Production Agriculture. (1-14 cr [max 14 cr]; prereq #; S-N only)

Experiential learning in a production agriculture business. Planned, organized, monitored, and evaluated based on a pre-experience diagnosis of learning prerequisite to higher level courses in technical agriculture.

AgEd 3002. Experiential Learning: Agricultural Business. (1-14 cr [max 14 cr]; prereq #; S-N only)

Experiential learning in an agricultural non-farm business. Planned, organized, monitored, and evaluated based on a pre-experience diagnosis of learning required to meet competency expectations for persons employed in agricultural businesses.

AgEd 3029. Directed Experience in Agricultural Education. (1-3 cr)

Observation of activities of teachers of agriculture; familiarization with the staff, curriculum, and physical facilities and equipment in a department of vocational agriculture, with opportunity to participate in the functions of a teacher.

AgEd 3041. Practicum: Agricultural Education Technology. (1-3 cr [may be repeated for max 5 cr])

Individualized study packages of 1 credit each of technology in agriculture, horticulture, off-farm agriculture, agricultural mechanics, adult and beginning farmer programs, youth organizations, program evaluation, and visual aids.

AgEd 5000. Professional Experience Program. (4 cr; prereq #; not for grad cr; UC only)

Professional experience in agricultural education or government agencies gained through supervised practical experience; evaluative reports and consultations with faculty advisers and employers.

AgEd 5010. Rural Leadership Development. (3 cr, §1010)

Role, function, and unique features of rural community leaders; personal leadership and vision development for individuals and rural community groups. Focus on unique aspects of rural communities, leadership environment, and qualities essential in successful rural leaders.

AgEd 5021. Education Through Extension Methods. (3 cr; prereq grad or #)

Methods and techniques of formal and nonformal education used by Extension Service and other organizations.

AgEd 5023. Methods for Change in Developing Countries. (3 cr)

Devising strategies, programs, projects, and methodologies for individual and community, economic and social change in developing countries.

AgEd 5028. Teaching Methods in Agricultural Education. (5 cr)

Methods used in teaching agriculture in public schools; use of media, principles of learning, problem solving, test construction, classroom management, and specific practice in problem-solving teaching techniques; use of competency-based individualized instruction as a medium for course presentation and a model for teaching methods.

AgEd 5032. High School Curriculum in Agriculture. (3 cr; prereq 10 cr education)

Philosophy, organization, and administration of instruction in agriculture departments in secondary schools.

AgEd 5034. Procedures in Teaching Agriculture. (3 cr)

New developments in methodology; assessment of innovations and procedures; consideration of various levels of instruction.

AgEd 5041. Workshop: Agricultural Education Technology. (1-6 cr [max 12 cr])

New understandings, techniques, and materials in animal science, plant science, horticulture, soil science, agricultural mechanics, forestry, natural resources, youth organization, visual aids, and occupational exploration.

AgEd 5042. Agricultural Mechanics. (1-3 cr [max 12 cr])

Technical and managerial information, techniques, and materials. Facilitates participant's instructional planning, resource development, and instruction. Topic to be identified with each offering.

AgEd 5043. Farm Management. (1-3 cr [max 12 cr])

Application of agricultural economic theory, principles, techniques, and materials. Facilitates participant's instructional planning, resource development, and instruction. Topic to be identified with each offering.

AgEd 5049. Agricultural Education for Adults. (3 cr)

Organization and implementation of systematic education programs for beginning and established farmers; organization of local programs to meet needs of production agriculture in areas of enterprises; agricultural mechanics and management; development of continuing programs.

AgEd 5051. Enterprise Analysis. (3 cr)

Analyzing farm business as basis for identifying problems; planning learning experiences to improve farm management at high school, young farmer, and adult levels.

AgEd 5052. Farm Business Management Education. (3 cr)

Administration, organization, and operation of farm business management education programs for adults; development and use of curriculum materials based on farm business record data.

AgEd 5055. Methods in Farming Systems Research and Extension. (3 cr, §Agro 5055)  
Methodology for integrating research and extension programs designed to identify and solve farm family system problems using interdisciplinary and holistic approaches.

AgEd 5061. Program Planning and Evaluation. (3 cr; prereq sr or grad)  
Development of program of agricultural education in community school, integration with total school program, administrative relationships, techniques and use of program evaluation in planning.

AgEd 5071. Supervised Occupational Experiences in Agriculture. (3 cr)  
Organization and administration of an occupational experience program in agriculture for high schools and area schools.

AgEd 5072. Practicum: Agricultural Business and Industry. (1-3 cr per qtr [max 9 cr]; prereq 5071 or #)  
Observation, study, and experience in agricultural business and industry; application to educational problems in agriculture.

AgEd 5078. FFA Organization and Management. (2 cr)  
Development of FFA (vocational agribusiness education student organization) knowledge, organization, and integration of activities into the curriculum, and management of chapter operations.

AgEd 5080. Organization and Management. (3 cr; prereq #)  
Administrative structure and function of subcollegiate programs.

AgEd 5081. Current Issues for the Beginning Agriculture Teacher. (1-3 cr [max 3 cr]; prereq #)  
Teaching methods, organizing learning resource materials, managing classroom and lab learning activities, curriculum planning and organization, managing discipline situations, school and community relationships for the beginning teacher.

AgEd 5082. Current Issues in Agricultural Education. (1-3 cr [max 9 cr]; prereq #)  
Emphasizes study and clarification of current issues, strategies of response, implications of response actions, and related leadership roles.

AgEd 5087. Mentorship for Beginning Ag Teachers. (6 cr [2 cr per qtr]; prereq less than 2 yrs exper as an ag teacher, ¶15081, #; continuous regis required in 3 consecutive qtrs; S-N only)  
Year-long program of professional development during the induction year of teaching agriculture in the public schools. Emphasis on solving problems, dealing with issues and concerns of new teachers, and making a smooth transition into the teaching profession.

AgEd 5090. Independent Study. (1-3 cr; prereq sr or #)  
Topics chosen to permit study of areas within education or to supplement areas of inquiry not provided in the regular course structure.

AgEd 5095. Integrating Paper: Master of Education. (3 cr; prereq MEd candidate in agricultural ed)  
Preparing a paper dealing with studies in agricultural education applied to professional responsibilities.

AgEd 5128. Methods of Teaching. (3 cr; prereq non-agricultural ed major or #)  
Methods of teaching agriculture or related subjects; development of competencies in planning, organizing, implementing, and evaluating instruction, with practice in instructional techniques.

AgEd 5244. Topics in Program Planning for Extension Education. (1-6 cr [max 9 cr], §FE 5244)  
Effective extension education programming in relation to situation and needs analysis; coordination of content, people, methodology; development of program models; managing available resources.

AgEd 5245. Topics in Administering Extension Education. (1-6 cr [max 9 cr], §FE 5245)  
Issues and current literature; focus on personnel hiring and supervision, financial management, leadership styles, long-range planning; application of theory to administrative practice.

AgEd 5246. Topics in Teaching and Delivering Extension Education. (1-6 cr [max 9 cr], §FE 5246)  
Teaching techniques involving media, telecommunications, computers, group process methods, experiential learning in extension education settings.

AgEd 5247. Topics in Evaluating Extension Education. (1-6 cr [max 9 cr], §FE 5247)  
Overall evaluation design; issues in choosing quantitative versus qualitative evaluation methods; developing skills and conceptual frameworks to apply theory to extension settings.

## For Graduate Students Only

(For descriptions, see *Graduate School Bulletin*)

AgEd 8001. Research in Agricultural Education

AgEd 8020. Seminar: Agricultural Education

AgEd 8091. Field Problems

AgEd 8303. Seminar: Graduate Studies Review

## Agricultural Industries and Marketing (AIM)

AIM 5001. Marketing Practicum I. (2 cr)  
Multidisciplinary lecture/seminar involving development of a marketing plan for an agricultural input or product. Includes market definition and feasibility analysis, business proposition, action plan, financial evaluation, and monitoring and measurement strategies.

AIM 5002. Marketing Practicum II. (2 cr; prereq AIM 5001)  
Multidisciplinary lecture/seminar involving development of a marketing plan for an agricultural input or product. Includes planning and development of promotion and advertising materials, critique of marketing plan, and presentation of completed marketing plan.

## Agronomy and Plant Genetics (Agro)

Agro 1007. Biology of Plant Food Systems and the Environment. (4 cr)  
Biological principles and processes are learned in the context of food production systems and the environment. Basic elements of biology, whole plant and animal systems, and plants and animals in ecosystems. Lecture and lab.

Agro 1010. Principles of Agronomy. (5 cr, §3010, §3020, §3030)  
Principles and practices of plant and related sciences as they apply to increasing efficiency, productivity, and genetic improvement of field crops. Topics include crop selection, improvement of crops through plant breeding, seeds and seeding, growth and development, minimizing production hazards, harvesting and storage. Lecture and lab.

Agro 1020. Special Problems. (1-3 cr; prereq 5 cr agro, #)  
In-depth research or studies in agronomy. Intended for students who wish to pursue aspects of agronomy in greater depth than that offered in formal courses or who wish to investigate areas not presently offered in courses. Tutorial instruction under staff guidance.

Agro 3020. Growth and Development of Field Crops. (4 cr; prereq 1007 or Biol 1009, Chem 1002, Chem 1051 or equiv)  
Principles of growth and development of field crops to achieve maximum crop productivity. Emphasis on physiological basis of growth and development, and effects of physical and biological environmental factors on crop growth and development. Lecture and lab.

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Agro 3030. Harvest, Storage and Utilization of Field Crops. (4 cr; prereq 1007 or Biol 1009, Chem 1002 or Chem 1051 or equiv)

Crop quality traits associated with use as they influence crop harvest, processing, and storage. Principles and technology used in crop storage to minimize damage from fungi and insects and maximize crop quality. Lecture and lab.

Agro 3060. Field Plot Design in Agronomy. (4 cr; prereq jr)

Principles of field plot technique and design as applied to field demonstrations and experiments involving one or two variables. Experiment interpretation procedures including analysis of data, tests of significance, and treatment comparisons. Computers are used for some data processing and statistical procedures.

Agro 3120. Grain Grading and Utilization. (2 cr; ¶AgEc 3420 recommended)

Practice and principles of grain grading; factors influencing U.S. grain grades and their importance in affecting market value and subsequent use. Lecture and lab.

Agro 3130. Seed Technology. (2 cr; prereq 1010)

Principles and practices of seed analysis, seed handling, conditioning and viability testing.

Agro 3200. Seminar. (1 cr; prereq jr or sr, #)

Investigation through literature review and group discussion of selected topics in agronomy. Emphasis on recent advances in agronomy.

Agro 5000. Professional Experience Program. (4 cr; prereq #; not for grad cr; S-N only; UC only)

Supervised practical professional experience in agronomic industries and farm enterprise systems, together with studies of various aspects of the industry and related fields.

Agro 5001. Problems in Agronomy for Advanced Students. (1-5 cr; prereq 20 cr agro, #)

In-depth research or studies in agronomy. Intended for advanced students who wish to pursue aspects of agronomy in greater depth than that offered in formal courses or who wish to investigate areas not presently offered in courses. Independent study and research under staff guidance.

Agro 5020. Introduction to Plant Breeding. (4 cr; prereq GCB 3022, Hort 3003 or equiv)

Applying genetic principles to improve crop plants. Includes self-pollinated, cross-pollinated, and asexually propagated crops. Lecture. Discussion for graduate students only.

Agro 5030. Weed Control. (5 cr; prereq 1010 or #; 3020 or PBio 3131 recommended)

Survey of the magnitude of the weed problem. Regulatory aspects of weed control and herbicide usage. Principles and methods of weed control. Lecture and discussion.

Agro 5050. Management Technologies for Crop Production in Minnesota. (4 cr; prereq one course in Agro)

Appropriate solutions to crop management problems, emphasizing corn/soybean, small grains, and forage crop systems. Quality, productivity, and profitability emphasized in discussion, lectures, and reading.

Agro 5070. Agroecology. (3 cr; prereq 3020, 3030 or #)

Designing, managing, and evaluating agricultural ecosystems. Emphasis on structure-function relationships in agricultural ecosystems. How current agricultural problems can be effectively addressed by ecological analysis of agricultural systems. Case studies, discussion, experiential learning, field trips.

Agro 5095. History of U.S. Agriculture. (3 cr; prereq jr, sr, or grad, 2 courses in phys and biol sciences, 2 courses in history and social sciences or #)

Social, scientific, and political development of U.S. agriculture, focusing on issues of food supply and consumption and the interaction with nature/soil, water "pests," and with fellow humans (including cooperation, competition, surpluses, subsidies); basis for contemporary sustainable agriculture.

Agro 5120. Growth and Development of Field Crops. (4 cr, §3020; prereq 1007 or Biol 1009, Chem 1002, Chem 1051 or equiv)

Principles of growth and development of field crops to achieve maximum crop productivity. Emphasis on physiological basis of growth and development, and effects of physical and biological environmental factors on crop growth, development. Lecture, lab, and discussion.

Agro 5130. Harvest, Storage and Utilization of Field Crops. (4 cr, §3030; prereq 1007 or Biol 1009, Chem 1002, Chem 1051 or equiv)

Crop quality traits associated with use as they influence crop harvest, processing, and storage. Principles and technology used in crop storage to minimize damage from fungi and insects and maximize crop quality. Lecture, lab and discussion.

Agro 5200. World Food Problems. (3 cr, §ApEc 5790, §CAPS 5280, §FScN 5643; prereq sr or grad with #)

Multidisciplinary approach to the social, economic, and technical problems of feeding the world's growing population. Principles sought from the social and economic sciences and plant, animal, and food sciences for their application to world food problems.

Agro 5310. Orientation to Field Crop Breeding. (1 cr; prereq 5020 or #)

Field study of plant breeding programs and techniques.

Agro 5320. Orientation to Agronomy and Soils Field Research. (1 cr; prereq 5050 or equiv)

Field survey and discussion of research techniques in crop physiology, crop and soil management, and weed science programs in agronomy and soils.

Agro 5330. Plant Biotechniques. (2 cr; prereq 3xxx genetics and biochemistry courses)

Molecular and traditional biotechniques will be discussed by postdoctoral research associates in the Department of Agronomy and Plant Genetics to give a broader understanding of molecular and quantitative techniques in agricultural research.

Agro 5999. Special Workshop in Agronomy. (1-4 cr; prereq #)

Workshops on a variety of topics in Agronomy and Plant Genetics offered for credit in locations other than the Twin Cities campus. Consult *Class Schedule* or department for current offerings.

Also see these courses taught by faculty from Agronomy and Plant Genetics: ANPL 3010, 5060; AIM 5001, 5002; NRES 3020, 5020.

## For Graduate Students Only

(For descriptions, see *Graduate School Bulletin*)

Agro 8000. Supervised Teaching Experience

Agro 8010. Research in Agronomy

Agro 8020. Seminar: Agronomy

Agro 8030. Mode of Action of Herbicides

Agro 8050. Physiology of Field Crops

Agro 8080. Current Topics in Agronomy

Agro 8200. Plant Breeding Principles and Methods I

Agro 8210. Plant Breeding Principles and Methods II

Agro 8220. Application of Quantitative Genetics to Plant Breeding

Agro 8230. Cytogenetics

Agro 8240. Cellular and Molecular Genetics of Plant Improvement

Agro 8250. Advanced Plant Genetics

Agro 8260. Statistical Topics in Plant Sciences

Agro 8270. Seminar: Plant Breeding

Agro 8280. Current Topics in Plant Breeding

Agro 8330.\* Research in Plant Genetics

## Animal and Plant Systems (AnPI)

AnPI 3010. Environment and World Food Production. (4 cr)

Ecological properties of world agricultural systems including issues of biodiversity, natural resource conservation, agricultural pollution, water quality, and waste management.

AnPI 5060. Integrated Management of Cropping Systems. (4 cr)

Case study/simulation and discussions considering integrated production management of selected agronomic and horticultural cropping systems. Emphasis on problem analysis, principle application, and decision making involving the integration of disciplines.

## Animal Science (AnSc)

AnSc 1100. Introductory Animal Science. (5 cr)

Emphasis on fundamental concepts of physiology, nutrition, animal breeding, and management as they apply to production of livestock and poultry. Species surveys.

AnSc 1110. Dairy Cattle Judging. (2 cr; prereq #)

Evaluation of dairy animals on the basis of physical appearance, including classes of heifers and cows from the six major breeds. Visits to many herds in the area. Training in presentation of oral reasons.

AnSc 1120. Market Livestock and Carcass Evaluation. (4 cr)

Evaluation, grading, and pricing of market cattle, swine, and sheep; followed by evaluation of the conformation, quality, and finish of carcasses and cuts.

AnSc 1143. Beginning Meats Judging and Grading. (1 cr; prereq 1510 or ¶)

Introduction to meat judging grading and specifications; permits students to enroll in AnSc 3143.

AnSc 1301. Management Technique: Swine. (1 cr; prereq #; S-N only)

Practical experience in management skills and routines in the care of swine.

AnSc 1302. Management Technique: Sheep. (1 cr; prereq #; S-N only)

Practical experience in management skills and routines in the care of sheep.

AnSc 1303. Management Technique: Beef. (1 cr; prereq #; S-N only)

Practical experience in management skills and routines in the care and production of beef cattle.

AnSc 1304. Management Technique: Dairy. (1 cr; prereq #; S-N only)

Practical experience in management skills and routines in the care of dairy cattle and production of milk.

AnSc 1305. Management Technique: Poultry. (1 cr; prereq #; S-N only)

Practical experience in management skills and routines in the care of poultry and the production of poultry meat and eggs.

AnSc 1306. Introduction to Equine Science. (2 cr)

Survey of visual appraisal, structure, uses and care of light horses. Breeds of horses and their characteristics; soundness of evaluation. Course lectures via ITV from University of Minnesota, Crookston. Lab (AnSc 1307) taught summer session at Crookston Equestrian Center; half-day sessions for two weeks.

AnSc 1307. Introduction to Equine Science Laboratory. (1 cr; prereq 1306)

Lab for AnSc 1306. Taught summer session at Crookston Equestrian Center; half-day sessions for two weeks.

AnSc 1510. Consumer Meat Science. (2 cr)

Compositional variation, processing, selection, storage, cookery, palatability, and nutritional value of red meat.

AnSc 1520. Milk Production. (3 cr; prereq 1100 or #) Relationships of production and management concepts to dairy farm planning and production and marketing of high-quality milk.

AnSc 1530. Stable Management. (3 cr; 1306 or equivalent)

Fundamentals of horse care and management, efficient stable management including computer record keeping, marketing, and sales techniques. Course lectures via ITV from University of Minnesota, Crookston. Lab (AnSc 1531) taught summer session at Crookston Equestrian Center; half-day sessions for two weeks.

AnSc 1531. Stable Management Laboratory. (1 cr; prereq 1530)

Lab for AnSc 1530. Taught summer session at Crookston Equestrian Center; half-day sessions for two weeks.

AnSc 3111. Introduction to Animal Behavior. (4 cr; prereq Biol 1008 or Biol 1009 or #)

Survey of the biological study of animal behavior including questions of causation, development, function, and evolution; emphasizes the evolution of adaptive behavior, especially social behavior, in the natural environment.

AnSc 3113. Animal Welfare. (4 cr; prereq soph or above)

Socioeconomics of the use of other animals by humans. Assessment of animal suffering and welfare. Historical roots of attitudes toward other animals. Management practices and welfare of domestic and wild animals.

AnSc 3120. Advanced Meat Animal, Carcass Evaluation. (1-2 cr; prereq 1120, #; 3130 or 3131, 3142, 3143 recommended)

Evaluation, grading, and pricing of live meat animals and carcasses; judging, placing, breeding animals using growth and reproduction records. Preparation for collegiate meat animal evaluation team competition.

AnSc 3130. Beginning Livestock Judging. (2 cr; prereq soph or above or #; 1120 recommended)

Visual evaluation of beef cattle, swine, and sheep for type, muscling, degree of finish, structure, and soundness. Short oral presentations. For students with limited livestock judging experience; preparation for collegiate livestock judging team competition.

AnSc 3131. Live Animal Performance and Selection. (3 cr)

Meat animal performance and selection through the use of live animal, carcass, and record evaluation. Each class includes a one-hour lecture and a two-hour lab. Recommended for students planning vocations in meat animal production, extension, vocational agriculture, and agribusiness.

AnSc 3141. Advanced Dairy Judging. (1 cr; prereq 1110)

Evaluation and selection of dairy cattle. Visits to local dairy herds. Training in presentation of oral and written reasons. Students selected from this course participate in intercollegiate judging contests.

AnSc 3142. Advanced Livestock Judging. (2 cr; prereq 1120, 3130)

Visual evaluation of beef cattle, swine, and sheep for type, muscling, finish, structure, and soundness. Use of production (growth and reproduction) records in evaluation. Oral presentations. For students with previous livestock judging experience; preparation for national collegiate livestock judging team competition.

AnSc 3143. Advanced Meats Judging and Grading. (2 cr; prereq 1143)

In-depth training in beef, pork, and lamb judging, writing reasons, and carcass grading. Field trips to packing plants. Students selected from this course participate in Intercollegiate Meats Judging Contests.

AnSc 3144. Wool Evaluation. (2 cr)

Principles of classification and grading. Active learning with practical experience to determine fiber diameter, yield, and economic value of fleeces. Evaluation and judging of fleece classes. Preparation for collegiate wool judging team competition.

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AnSc 3220. Principles of Animal Breeding. (5 cr; GCB 3022 recommended)

Application of qualitative genetic principles to animal breeding. Quantitative genetics. Concepts of livestock improvements through breeding and selection systems.

AnSc 3301. Systemic Physiology. (6 cr; prereq Biol 1009; BioC 3021 recommended)

Animal physiology, emphasizing the function of the organ systems.

AnSc 3305. Reproductive Physiology, Artificial Insemination, and Lactation. (5 cr; prereq 3301)

Functions of the reproductive organs, fertilization, the estrous cycle and its endocrine control, reproductive efficiency, and problems and principles of artificial insemination. Anatomy, physiology, and biochemistry of the mammary gland.

Mammary growth, initiation and maintenance of lactation, milk synthesis, and factors influencing the lactation curve.

AnSc 3401. Principles of Animal Nutrition. (4 cr; prereq Chem 1002 or Chem 3301)

Classification and function of nutrients; use of nutrients for body maintenance, growth, egg production, gestation, and lactation; comparative study of the digestive systems of farm animal species.

AnSc 3510. Introduction to Human and Animal Growth and Development. (4 cr; prereq 3301, Biol 1009)

Basic principles of human and animal growth; critical evaluation of interaction of nutrition, hormones, exercise, heredity, and disease in regulating growth.

AnSc 3520. Horse Production. (3 cr; prereq 1530 or equivalent)

Capstone course combining knowledge from previous equine courses with business to complete a management project; involves establishing, maintaining, and improving an equine business using computer technology.

AnSc 3521. Horse Production Laboratory. (1 cr)

Lab for AnSc 3520. Taught in a two-week session at the Crookston Equestrian Center.

AnSc 5000. Professional Experience Program. (4 cr; prereq #; S-N only; free elective for animal science undergrads; not for grad cr; UC only)

Professional experience in animal science firms or government agencies through supervised practical experience; evaluative reports and consultations with faculty advisers and employers.

AnSc 5231. Dairy Cattle Breeding. (4 cr; prereq 3220 or #)

Applying quantitative genetic principles to the breeding of dairy cattle. Primary emphasis on evaluation of males, females, and systems of breeding. Rates of genetic improvement with and without artificial insemination.

AnSc 5322. Physiology of Reproduction. (5 cr; prereq 6 cr systemic physiology)

Principles of reproductive physiology with emphasis on endocrinological aspects.

AnSc 5327. General Endocrine Physiology. (3 cr; prereq 3301 or #)

Biological effects, biochemistry, methods of assay, and regulatory aspects of hormones.

AnSc 5328. General Endocrine Physiology Laboratory. (2 cr; prereq 5327 or #)

Demonstration of concepts in endocrinology using experimental approaches.

AnSc 5330. Current Topics in Endocrinology. (1 cr; prereq 3301, BioC 3021 or Biol 5001)

Current developments in endocrinology including introductory and review material, methodology, applicability of results to basic and applied research, and impact on existing endocrine principles.

AnSc 5401. Swine Nutrition and Feeding. (4 cr; prereq 3401)

Nutrient requirements of swine, all phases of life cycle considered; feed sources, their composition and use in formulation of adequate diets. Least cost formulations, nutritional interrelationships, and feeding systems. Use of feed additives.

AnSc 5403. Ruminant Nutrition. (4 cr; prereq 3401)

Nutrient requirements of ruminants (beef and dairy cattle, sheep); nutrient content of feedstuffs, primarily forages; protein and nonprotein nitrogen use; energy use; nutritional disorders; and formulation of adequate rations.

AnSc 5404. Applied Animal Nutrition. (2 cr; prereq CAPS 5165)

Applying nutrition principles to feeding programs for livestock, poultry, and small animals. For veterinary students without previous nutrition courses.

AnSc 5405. Poultry Nutrition. (3 cr; prereq 3401)

Nutrient requirements of chickens and turkeys; feed composition and use in formulation of adequate diets. Role of feed additives. Least cost formulations, nutritional interrelationships, and feeding systems.

AnSc 5601. Swine Production. (4 cr; prereq 3401; 3220 recommended)

Applying principles of animal breeding, nutrition, physiology, and economics. Swine production systems including swine feeding, breeding programs, selection of breeding animals, management of all classes of swine, housing, diseases, parasites.

AnSc 5602. Sheep Production. (4 cr; prereq 3401 or #; 3220, 5403 recommended)

Status and characteristics of the sheep industry; applying principles of animal breeding, nutrition, physiology, and economics to management of sheep flocks. Sheep production systems including breeding programs, selection of breeds and breeding animals, feeding, health programs, dairy sheep, marketing and budgets.

AnSc 5603. Beef Cattle Production. (4 cr; prereq 3401; 3220, 5403 recommended)

Status and characteristics of the beef cattle industry; applying principles of animal breeding, nutrition, physiology, and economics to management of beef cattle breeding herds. Ration formulation, management, and marketing of feedlot cattle.

AnSc 5604. Dairy Farm Management. (4 cr; prereq 1520, 5403 or #; 3220 recommended)

Applying principles of animal breeding, nutrition, physiology, and economics to planning and management of the dairy farm; genetic influences, housing requirements, health programs for large herds, feed budgets, and record analysis emphasized.

AnSc 5605. Poultry Production. (4 cr; prereq 3401; 5405 recommended)

Physiology, genetics, diseases, and nutrition of poultry and their relation to current management practices for production of eggs, broilers, and turkeys. Technical and practical phases of production and marketing in relation to their underlying principles. Visits to commercial production units.

AnSc 5609. Principles of Farm Animal Environment. (4 cr; prereq jr, 3301 or #)

Biological and physical processes involved in the adjustment of animals to ambient environments and their applications to farm animal management.

AnSc 5710. Special Problems. (Cr ar; prereq #)

Research in an area of animal science under supervision of a staff member. Written report on the research required.

AnSc 5715. Tutorial. (Cr ar; prereq #)

Informally structured course to encourage study in depth of a specific discipline in animal science. Pertinent readings, centered on fundamental propositions suggested; preparation of written essays of high quality required. Tutorials available in cryobiology, cytogenetics, genetics, meats, nutrition, and physiology.

AnSc 5999. Special Workshop in Animal Science. (1-4 cr; prereq #)

Workshops on a variety of topics in animal science offered for credit at locations other than the Twin Cities campus. Consult *Class Schedule* or department for current offerings.

## For Graduate Students Only

(For descriptions, see *Graduate School Bulletin*)

- AnSc 8210. Genetic Improvement of Animals
- AnSc 8230. Linear Model Methods
- AnSc 8325. Physiology of Fertilization and Gestation
- AnSc 8326. Immunoreproduction
- AnSc 8332. Preservation of Spermatozoa and Embryo
- AnSc 8335. Molecular Biology Techniques in Animal Science
- AnSc 8420.\* Animal Bioenergetics and Nutritional Physiology
- AnSc 8421.\* Protein and Amino Acid Nutrition
- AnSc 8440.\* Ruminant Nutrition
- AnSc 8441. Research Techniques in Ruminant Nutrition
- AnSc 8740. Concepts and Developments in Ruminant Nutrition
- AnSc 8741. Concepts and Developments in Avian Nutrition
- AnSc 8742. Concepts and Developments in Swine Nutrition
- AnSc 8743. Concepts and Developments in Nutritional Physiology
- AnSc 8810.\* Research in Animal Science
- AnSc 8820.\* Research in Animal Genetics
- AnSc 8830. Research in Animal Physiology
- AnSc 8840.\* Research in Animal Nutrition

## Applied Economics (ApEc)

- ApEc 1000. Orientation to Agricultural and Applied Economics. (1 cr; S-N only)  
Curricula, areas of specialization, coursework, employment opportunities, faculty, and functions of the Department of Agricultural and Applied Economics.
- ApEc 1101. Principles of Microeconomics. (4 cr, §Econ 1101)  
Economics of the firm and household; factor and product price determination; theory of production, consumption, and distribution; supply and demand analysis, equilibrium analysis.
- ApEc 1102. Principles of Macroeconomics. (4 cr, §Econ 1102)  
Determinants of national income and employment levels; prices and money; the banking system; monetary and fiscal policy; economic growth and development; role of government in the economy.
- ApEc 1250. Principles of Accounting. (4 cr)  
Fundamentals of business accounting; basic finance concepts; use of accounting data for income tax and managerial decision making.
- ApEc 3000. Seminar in International Agriculture. (1 cr; prereq Agri 3000; S-N; free elective for ApEc undergrads)  
Oral presentation and discussion of students' research papers, literature review of selected topics, discussions with students and staff about their experiences in international agriculture.
- ApEc 3001. Applied Microeconomics: Consumers and Markets. (4 cr, §Econ 3101; prereq 1101 or Econ 1101, Math 1142 or Math 1251, Stat 1001, BA 1550 or IDSc 1010, OMS 1020 or #)  
Microeconomic theory relating to the consumer, the household, and demand for both public and private goods. Empirical applications integrated with theory, including the estimation of demand functions from actual data.

- ApEc 3002. Applied Microeconomics: Managerial Economics. (4 cr; prereq 3001, Acct 1050 or AgEc 1250 or #)  
Microeconomic theory relating to the firm and its application to managerial problems. Empirical applications integrated with theory, including programming and the estimation of cost and production functions.
- ApEc 3006. Applied Macroeconomics: Government and the Economy. (4 cr, §Econ 3102; prereq 1101, 1102 or Econ 1101, Econ 1102)  
Relationship between the public sector and the market economy. Public goods, externalities, and other allocation issues. Government and the stabilization of the national economy. Overview of the new classical and Keynesian models. Principles of taxation. The individual income tax, sales, business, and property taxes. Intergovernmental fiscal relations.
- ApEc 3007. Applied Macroeconomics: Policy, Trade, and Development. (4 cr, prereq 1101, 1102 or Econ 1101, Econ 1102)  
History of agricultural and economic development; determinants of development on factor and commodity markets; elements and effects of agricultural and trade policy in the course of economic development; macroeconomic and international aspects of agricultural development, policy, and trade.
- ApEc 3040. Economic Development of American Agriculture. (4 cr; prereq 1101 or Econ 1101)  
Review of the economic, political, social, and technical forces that have shaped the development of American agriculture; role of agricultural development in national economic development in the United States; implications for presently developing countries.
- ApEc 3070. Agriculture and Economic Growth in Developing Countries. (4 cr; prereq 1101, 1102 or Econ 1101, Econ 1102)  
Agricultural development problems; contribution of economics to analyzing these problems; use of economics in agricultural development policy and planning.
- ApEc 3240. Strategic Management of Agribusinesses. (4 cr; prereq 3002, 3500 or #)  
Identifying and analyzing strategic issues and problems of farms and agribusinesses, establishing business goals and developing realistic plans of action; strategy formulation, implementation and control issues; analysis of case studies.
- ApEc 3260. Operations Management of Agribusiness. (4 cr; prereq 3002, 3500 or #)  
Operations strategy, quality management, process selection, forecasting, risk management, aggregate planning, scheduling, inventory, materials, just-in-time, work force management. Taught from systems viewpoint for agribusiness production, wholesaling, retailing, and service.
- ApEc 3300. Agricultural and Food Sales. (3 cr; prereq GC 1537 or equiv or #)  
Applied sales of agricultural and food products. Emphasis on development and refinement of technical sales abilities. Discussion of career preparation for sales occupations.
- ApEc 3400. Markets, Marketing and Prices. (4 cr; prereq AgEc 1101 or equiv, Math 1142 recommended)  
Market structure, demand and supply structure, regulations, and institutions that influence the behavior of firms in agricultural marketing systems will be examined. Performance in food assembly, manufacturing, and distribution industries will be investigated with respect to conduct and strategies of firms.
- ApEc 3410. Economic Organization of the Hospitality Industry. (4 cr; prereq Mktg 3000 or #)  
Principles of economics applied to markets and firms serving people away from home, including food, lodging, travel, recreation, health care, and related activities.
- ApEc 3420. Grain Marketing Economics. (4 cr; prereq 1101 or Econ 1101)  
Economic relationships in the marketing of grain and grain products; analysis of supply and demand; grain grades, storage, and transportation; market structure, channels, pricing, and competition; government programs and policies.

## Symbols

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1011, 1012, 1013

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1011-1012-1013

..... Sequence courses, separated by hyphens; must be taken in order listed.

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ApEc 3430. Dairy Marketing Economics. (4 cr; prereq 1101 or Econ 1101)

Economic relationships in the marketing of milk and milk products; analysis of supply and demand; market structure, channels, pricing, and competition; federal milk market price regulations; dairy programs and policies.

ApEc 3440. Livestock and Meat Marketing Economics. (3 cr; prereq 1101 or Econ 1101)

Economic relationships in the marketing of livestock and livestock products; analysis of supply and demand; livestock grades, inspection, and transportation; market structure, channels, pricing, and competition; government regulations and policies.

ApEc 3450. Agricultural Input Marketing Economics. (4 cr; prereq 1101 or Econ 1101)

Demand for farm inputs: structure of farm sector, factors affecting input purchases, derived demand from production functions, time series demand analysis, farmland as a production input; farmland markets; farm labor input; farm labor usage and markets; farm-generated inputs and alternative enterprise combinations. Purchased farm inputs: farm machinery and buildings, animal production input markets, crop production input markets.

ApEc 3500. Agribusiness Finance. (4 cr; prereq 1250 or Acct 1050, AgEc 3002 or #)

Analysis of financing and investment strategies for agribusiness firms and their effects on liquidity, solvency and profitability; financial intermediaries in agriculture.

ApEc 3610. Resource Development and Environmental Economics. (4 cr; prereq 1101, 1102 or Econ 1101, 1102 or #)

Basic concepts of resource use including physical and economic classifications; physical and economic feasibility; benefits and costs; external effects; cost sharing; selected resource use problems. Economic areas and units for planning and development; generation of alternative program elements and development of consequences; problems in choosing elements for an optimum resource development program.

ApEc 3810. Principles of Farm Management. (4 cr; prereq 1101 or Econ 1101; not open to ag bus and applied econ majors)

Strategic and operations aspects of farm management. Economic principles, financial analysis, and budgeting procedures; strategic management, quality management, process selection; forecasting and investment analysis, materials requirements, and whole-farm planning; scheduling; risk, work force, and control management.

ApEc 3920. Agricultural Law. (4 cr; prereq 1101 or Econ 1101)

The legal system; contracts; torts; labor; property; meaning, acquisition, rights; water drainage; environmental concerns; animals; credit, finance; UCC; sales; transportation; tenancy; partnerships, corporations, cooperatives; estate and tax planning.

ApEc 3980. Current Issues in Agricultural Economics. (Cr ar; prereq #)

Discussion and analysis of important and timely problems in agricultural economics. Topics vary quarterly and are listed in *Class Schedule*. For full details, inquire at the department office before registration.

ApEc 3990. Independent Study in Agricultural and Applied Economics. (Cr ar; prereq #)

Independent study and supervised reading and research on subjects and problems not covered in regularly offered courses.

ApEc 5000. Professional Experience Program. (4 cr; prereq #; S-N only; not for grad cr; UC only)

Professional experience in agribusiness firms or government agencies gained through supervised practical experience; evaluative reports and consultations with faculty advisers and employers.

ApEc 5020. Applied Linear Programming. (4 cr; prereq 3002 or Econ 3101 or #)

Applications of linear programming to economic problems of the firm. Resource allocation, product mix, investment and distribution decision in the context of cost minimization and profit maximization.

ApEc 5030. Methods of Economic Data Analysis. (4 cr; prereq Stat 5021 or equiv; familiarity with matrix algebra recommended)

Primarily for M.S. students. Emphasizes practical aspects of economic data analysis and familiarizes students with various econometric methods and models commonly used in applied economics, and the economic and statistical theory underlying these methods.

ApEc 5400. Intermediate Market and Price Analysis. (4 cr; prereq 3002 or Econ 3101 or #)

Development of analytical models and their application in various market situations. Unique market institutions that have developed in response to marketing problems and policies.

ApEc 5440. Cooperatives and Agribusiness Organization. (4 cr; prereq 3002 or Econ 3101 or #)

Analysis of economic problems and issues facing agricultural cooperatives, including changing market organization, financing, taxation, and antitrust regulations.

ApEc 5480. Futures Markets and Prices. (4 cr; prereq 3002 or Econ 3101 or #)

Economics of futures trading; the basis and theoretical price relationships in storable and nonstorable commodities; hedging and commercial use of futures markets with illustrations; arbitrage; options on agricultural futures; financial futures; speculation; futures market performance and regulation.

ApEc 5500. Financial Markets and Agricultural Credit Institutions. (4 cr; prereq 3500 or BFin 3000 or grad or #)

Analysis of financial institutions and financial markets; managerial policy issues confronting managers of financial intermediaries with particular reference to those operating in an agricultural setting; current problems confronting financial intermediaries.

ApEc 5550. Food Marketing Economics. (4 cr; \$FScN 5474; prereq 3001 or Econ 3101 or #)

Economics of food marketing in the United States. Food consumption trends; consumer food behavior; food expenditure and consumption data; consumer survey methodology; the food distribution retailing system; food policy issues related to food marketing. Students pursue individual and group projects.

ApEc 5580. Household Economics: Time Labor and Human Capital Around the Globe. (3 cr; prereq 3002 or Econ 3101 or #)

Investment in household formation, child education, health, labor force participation and non-market work will be analyzed in the context of household economics and national productivity; effects of economic variables on investment decisions and returns.

ApEc 5600. Land and Water Economics. (3 cr; prereq 3002 or Econ 3101 or #)

Land and water as public resources and as factors of production; economic analysis of policies that influence asset use; sale and rental markets; valuation of rights to land and water; taxation and regulation as instruments and influencing private management decisions; comparative land and water legal and market settings.

ApEc 5620. Regional Economic Analysis. (3 cr; prereq 3006 or Econ 3102 or #)

Analysis of regional economics; alternative theories of firm location (neoclassical profit cycle, competitive advantage, cumulative causation); labor markets and migration; alternative development approaches and public incentive; special emphasis on medium-sized metro areas, rural areas and value-added industries.

ApEc 5630. Regional Development Systems. (3 cr; prereq 3006 or Econ 3102 or #)

Regional system analysis (economic base, input-output, and computable general equilibrium); application of impact models to development problems; theoretical foundations of models; basic skills in developing and interpreting regional input-output analyses with real-world data and problems.

ApEc 5637. Law and Agricultural Policy. (3 cr; prereq grad in applied economics)

Economic regulation of agriculture. Industrial organization and market structure in agribusiness, public lands and water law, agricultural cooperative, farm labor, farm finance, crop insurance and disaster assistance, agricultural biotechnology, food and drug law, price and income regulation and international agricultural markets. Same as Law 5637.

ApEc 5640. Financing State and Local Governments. (4 cr; prereq 3002 or Econ 3101 or #)

Problems and issues in financing state and local public services in the United States. State and local revenue systems, debt and expenditures. Intergovernmental fiscal relations. Budget analysis.

ApEc 5650. Economics of Natural Resource and Environmental Policy. (4 cr; prereq 3002 or 3610 or Econ 3101 or #)

Application of economic analysis, including project evaluation, to current natural resource and environmental issues. Emphasis on conservation and resource scarcity, environmental quality, and resource use issues and their implications for public policy.

ApEc 5660. Economics of Public Services. (3 cr; prereq 3002 or Econ 3101 or #)

Issues of finance and supply and demand for public services; pricing, producing, and financing public goods; bureaucratic decision making; implementing policies.

ApEc 5710. U.S. Agriculture: Farm, Food, and Environmental Policy. (3 cr; prereq ApEc 3002 or Econ 3101, ApEc 3006, ApEc 3007 or Econ 3102 or #)

Development of U.S. agriculture and U.S. agricultural and trade policy; agricultural input and commodity markets; U.S. environmental policies effects on agriculture; design and economic effects of U.S. agricultural policy; determinants of U.S. agricultural and trade policies.

ApEc 5720. Economics of World Agriculture. (3 cr; prereq ApEc 3002 or Econ 3101, ApEc 3006 or Econ 3102 or #)

Theories of agricultural development, comparative agricultural organization and structure, technical and institutional change on agricultural development, national development policies, bilateral and multilateral assistance, international policy conflicts.

ApEc 5730. European Agriculture: Farm, Food and Environmental Policy. (4 cr; prereq 3002 or Econ 3101 or #)

Characteristics of agriculture in Europe; determinants of development of European agriculture; goals and instruments of European Community agricultural policy.

ApEc 5740. Agricultural Policy in Planned Economies. (4 cr; prereq 3001 or Econ 3101 or #)

Principle of economics used to analyze agricultural policy and performance in centrally planned economies. Emphasis on Soviet agriculture; some attention to China and Eastern Europe.

ApEc 5750. Agricultural Trade and Commercial Policies. (3 cr; prereq 3002 or Econ 3101 or #)

Trade policies and practices of export and import nations, commodity agreements; agricultural trade policies of common market areas; negotiations and potential trade developments.

ApEc 5790. World Food Problems. (3 cr, \$Agro 5200, \$FScN 5643, \$CAPS 5280; prereq ag or pre-vet med or home econ or soc sci major or # or agricultural econ grad with #)

Multidisciplinary approach to the social, economic, and technical problems of feeding the world's growing population. Principles sought from the social, economic, plant, and animal sciences for their application to food problems.

ApEc 5860f. Economics of Agricultural Production. (3 cr; prereq 3002 or 3101 or #)

Production economics applied to agriculture; profitable combination of production factors; comparative advantage and location production.

ApEc 5890. Independent Study: Advanced Topics in Farm and Agribusiness Management. (1-6 cr; prereq #)

Special topics or individual work suited to the needs of particular groups of students.

ApEc 5990. Special Topics and Independent Study in Applied Economics. (Cr ar; prereq #)

Special classes, independent study, and supervised reading and research on subjects and problems not covered in regularly offered courses.

ApEc 5999. Special Workshop in Applied Economics. (1-4 cr; prereq #)

Workshops on a variety of topics in applied economics offered for credit in locations other than the Twin Cities campus. Consult *Class Schedule* or department for current offerings.

## For Graduate Students Only

(For descriptions, see *Graduate School Bulletin*)

ApEc 8100. Graduate Seminar

ApEc 8110. Master's Paper: Plan B Project

ApEc 8200. Advanced Topics in Agriculture and Applied Economics

ApEc 8210. Applied Econometrics

ApEc 8220. Applied Mathematical Programming

ApEc 8231. Agricultural Prices

ApEc 8245. Agricultural Marketing Economics

ApEc 8264. Resource Economics

ApEc 8266. Applied Regional Economics

ApEc 8270. Applied Welfare Economics and Public Policy

ApEc 8278. Agricultural and Economic Development

ApEc 8287. Production and Supply

ApEc 8288. Dynamic Production Economics

ApEc 8345. Seminar: Agricultural Marketing

ApEc 8360. Seminar: Land and Institutional Economics

ApEc 8364. Seminar: Resource Economics and Policy

ApEc 8366. Seminar: Applied Regional Economics

ApEc 8370. Agricultural and Trade Policy in Developed Countries

ApEc 8373. Seminar: Food and Agricultural Policy in the United States

ApEc 8378. Seminar: Agricultural Development

ApEc 8382. Seminar: Farm Management and Production Economics

ApEc 8590. Economics of Food and Consumer Policy

ApEc 8591. Consumption Economics

ApEc 8777. Thesis Credits: Master's

ApEc 8888. Thesis Credits: Doctoral

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## Biosystems and Agricultural Engineering

### Courses in Agricultural Engineering Technology (AgET)

Agricultural engineering technology is the application of scientific and engineering knowledge and methods combined with technical skills for problem solving in agriculture.

Agricultural engineering technology courses may be required by certain majors or taken as electives.

AgET 3025. Engineering Principles and Applications. (4 cr; prereq Math 1031 or Math 1142 or equiv, 5 cr phys or chem)

Introduction to engineering principles for non-engineering students. Application of principles to solve agricultural problems in animal and plant production, processing, soil and water management. Systems, mechanics, power, mechanisms, fluid flow, heat transfer, psychometrics, and controls.

AgET 5027. Appropriate Technology for International Development. (4 cr; prereq Math 1031, Chem 1001 or Chem 1051, Phys 1041; 3 lect, 3 lab hrs per wk; joint day school/UC)

Definitions, history, successes and failures of appropriate technology. Social and technical appropriateness. Water supply, treatment, storage, and conveyance. Water pumps, sanitation. Power; pedal, wind, water, solar, rice-hull furnace, methane, Stirling-cycle engine. Building materials. Agricultural machinery and animal power. Transfer and adoption of technology.

AgET 5091. Special Problems in Agricultural Engineering. (2-5 cr per qtr; prereq #)

Individual study project in agricultural engineering at advanced level. Application of engineering principles to a specific problem.

AgET 5200. Health and Safety in Agricultural Work Environments. (3 cr; A-F only)

Exploration of various hazards and control strategies for at-risk populations working in agricultural production and processing. Hazards examined include machinery, confined spaces, pesticides, fire, airborne contaminants, and animals.

AgET 5410. Hydrology and Water Quality. (5 cr; prereq Math 1031, Phys 1041, Chem 1051, Chem 1052; 3 lect, 3 lab, 1 rec hrs per wk)

Hydrologic cycle—precipitation, infiltration, evaporation, surface and subsurface runoff, ground water recharge. Flow in streams, flow in aquifers, flow measurement. Soil erosion, sediment transport and deposition. Chemical pollution of surface water and groundwater.

AgET 5450. Environmental Impacts of Food Production. (4 cr)

Exploration of the environmental changes resulting from food production. Topics include crop production intensity, animal raising options, food processing waste alternatives, and pest control. Course is offered on the World Wide Web.

AgET 5999. Special Workshop in Biosystems and Agricultural Engineering. (1-4 cr; prereq #)

Workshops on a variety of topics in Biosystems and Agricultural Engineering offered for credit in locations other than the Twin Cities campus. Consult class schedule or department for current offerings.

### Courses in Biosystems and Agricultural Engineering in IT (BAE)

The following courses, offered by the Institute of Technology, are open to students in the four-year engineering curriculum and those who have completed the prerequisite courses.

BAE 1060. Biosystems and Agricultural Engineering Orientation. (1 cr; S-N only; 2 hrs per wk) Lectures, readings, discussions, and presentations by practicing engineers and fellow students. For students interested in majoring in biosystems and agricultural engineering or exploring the profession. Discussion of various areas of specialization along with the environment, safety, ethics, and professionalism. Identification of internships, employment opportunities, and advanced studies.

BAE 3031. Computations in Biosystems and Agricultural Engineering. (4 cr; prereq IT student, CSci 3101, CSci 3102 or CSci 3113, Math 3261 or ¶Math 3261; 3 lect, 2 rec hrs per wk)

Computational techniques applied to biosystems and agricultural engineering problems: spreadsheets, elementary numerical methods, computer drafting, engineering economics, selected engineering software. Effective presentation of quantitative and graphical information.

BAE 3052. Engineering Principles of Soil-Water-Plant Systems. (4 cr; prereq IT student, 3031, AEM 3200 or CE 3400, Biol 1009; 3 lect, 3 lab hrs per wk)

Mechanical and hydraulic properties of soil; moisture relations; strength parameters for structural and mechanical design. Soil-machine action in tillage and traction. Energy and water balance in the soil-water-plant system. Plant structure and growth. Engineering and management requirements.

BAE 3150 Biology for Engineering. (4 cr; prereq IT student, 3031, Biol 1009, ME 3301 or ¶ME 3301; 3 lect, 3 lab hrs per week)

Introduction to the fundamentals of biological science for engineers. Understanding biology in terms of mathematics, chemical reactions, transport phenomena, material science, mechanics, and electronics. Applications to engineering.

BAE 3970. Directed Studies in Biosystems and Agricultural Engineering. (1-5 cr; prereq #)

Independent study of topic(s) involving physical principles as applied to agricultural production and land resources.

BAE 5050. Intern Reports. (2 cr per qtr; S-N only; prereq IT or COAFES student in BAE, #)

Student exposure to engineering practice through an intern program. Engineering reports on work assignments are reviewed by faculty and coordinated with industry advisers.

BAE 5070. Instrumentation and Control for Biological Systems. (4 cr; prereq upper div IT or forest products major or grad, EE 1400, EE 3009, ME 3900 or Stat 3091; 3 lect, 2 lab hrs per wk)

Measurement of motion, force, pressure, flow, temperature, size, shape, color, texture, rheology, moisture, water mobility, fat, and pH. Control principles and instrumentation for biological systems. Linking of physical and biological control systems.

BAE 5072. Finite Element Method:

Fundamentals and Applications. (4 cr; prereq upper div IT or grad IT major, Math 3261; 4 lect hrs per wk)

Basic theory and principles of implementation of the finite element method for a number of fundamental engineering areas. Applications in heat transfer, fluid mechanics, solid mechanics, radial and axisymmetric field problems, and time-dependent field problems.

BAE 5074. Microcomputer Interfacing. (4 cr; prereq upper div IT or grad IT major, CSci 3101, CSci 3102 or CSci 3113, EE 1400, EE 3009; 2 lect, 4 lab hrs per wk)

Introduction to digital components, integrated circuits and microcomputers. Interfacing of microcomputers for data acquisition and control.

BAE 5140. Thermal Processes for Food. (4 cr; prereq upper div IT or grad IT major, ChEn 5103 or ME 5342; 3 lect, 3 lab hrs per wk)

Engineering principles of thermal processing of food, pasteurization, microwave heating, heat exchange, evaporation, refrigeration and freezing. Process design and evaluation.

BAE 5191-5192. Special Problems in Biosystems and Agricultural Engineering. (1-5 cr per qtr; prereq #)

Individual study project at an advanced level involving application of engineering principles to a specific problem.

BAE 5350. Agricultural Machinery and Terramechanics. (4 cr; prereq upper div IT or grad IT major, AEM 3016, AEM 3036; 3 lect, 3 lab hrs per wk)

Engineering principles governing the performance of machinery used in agriculture. Emphasis on soil-machine interaction (traction and tillage), off-road vehicle dynamics, operator-machine interaction, drive-line design, power unit selection, and duty cycle analysis.

BAE 5540. Watershed Engineering. (4 cr; prereq upper div IT or grad IT major, 3052 or 3052 or CE 3300, CE 3400; 3 lect, 3 lab hrs per wk)

Application of engineering principles to the management of surface runoff and soil water in agricultural, range and urban lands. Designing facilities for control of surface runoff to mitigate problems of flooding and degradation of surface water quality.

BAE 5550. Water Management Engineering. (4 cr; prereq upper div IT or grad IT major, 3052 or CE 3300, CE 3400; 3 lect, 3 lab hrs per wk)

Application of engineering principles to the management of water for production and environmental protection in agricultural systems. Design of facilities to irrigate and drain croplands and to enhance water quality.

BAE 5560. Mechanics of Flow in the Unsaturated Zone. (4 cr; prereq upper div IT or grad IT or COAFES grad student, Math 3261, Soil 5232 or #; 3 lect hrs per wk)

Fluid retention and transmission properties of unsaturated porous media. Equations of mass conservation and Darcy's law for unsaturated porous media. Simultaneous flow of immiscible fluids. Analytical, finite difference and finite element solutions to the governing equations.

BAE 5745. Ventilating Systems for Indoor Air Quality. (4 cr; prereq upper div IT or grad IT major, AEM 3200 or CE 3400, ME 3301; 4 lect hrs per wk)

Impact of indoor air quality on humans, animals, and plants. Contaminant sources. Ventilating processes, systems, control strategies, and equipment for indoor air quality control. Case studies from residential, commercial and agricultural systems.

BAE 5751. Biochemical Engineering I. (3 cr; §ChEn 5751; prereq BAE major or grad student in Chem Eng major or #; 3 lect hrs per wk)

Applications of material and energy balances and concepts from thermodynamics, kinetics, and transport phenomena to cellular and enzyme systems.

BAE 5891. Senior Design I. (3 cr; prereq upper div IT, 20 or BAE completed or in progress; 4 rec hrs per wk)

Introduction to design processes. Safety and ethics in design. Development of a proposal for a senior design project (individual or group). Poster presentation of proposal to the department at mid-quarter. Development of product specifications, timeline and concepts for the design. Review of case studies, constructive review of existing designs

BAE 5892. Senior Design II. (3 cr; prereq 5891; 4 rec hrs per wk)

Completion of a design project started in BAE 5891 culminating in a design report and poster display of the final design. Continuation of the development of design methodology including decision making, hazard analysis, and detailed system descriptions.

BAE 5910. Agricultural Waste Management Engineering. (4 cr; prereq upper div IT or grad IT major, 3052; 3 lect, 3 lab hrs per wk)

Sources and characteristics of agricultural wastes including livestock, food processing, and domestic wastes. Physical, biological, chemical, rheological, and microbiological properties. Effects on the environment. Collection, storage, treatment (aerobic and anaerobic), and use/disposal. Land application of livestock and food processing wastes, municipal effluents, and sludges. On-site sewage treatment.

## For Graduate Students Only

(For descriptions, see *Graduate School Bulletin*)

BAE 8000. Supervised Teaching Experience

BAE 8100. Seminar

BAE 8190, 8191, 8192. Advanced Problems and Research

BAE 8500. Hydrologic Modeling—Small Watersheds

BAE 8700. Coupled Moisture, Heat, and Chemical Transfer in Porous Media

## Clinical and Population Sciences (CAPS)

Offered by the College of Veterinary Medicine

CAPS 3502. Animal Health and Disease. (5 cr)

For nonveterinary students. Veterinary science as it applies to health and disease of domestic animals. Emphasis on basic concepts of disease and common animal diseases that demonstrate these concepts. How stress and management practices aggravate and create new disease conditions.

CAPS 5280. World Food Problems. (3 cr, §ApEc 5790, §Agro 5200, §FScN 5643; prereq major in ag or vet med or nutr sci or social sci or #; grads by #)

Multidisciplinary approach to the social, economic, and technical problems of feeding the world's growing population. Principles sought from the social, economic, plant, animal, and nutritional sciences for their application to food problems.

## Entomology (Ent)

Ent 1005. Economic Entomology. (4 cr; prereq Biol 1009 or #)

Introduction to structure and classification of insects; management of insect populations; life histories, habits and recognition of insect pests of livestock, orchards, field crops, vegetables, and landscape plants. One hundred specimen insect collection is required.

Ent 3005. Insect Biology. (3 cr; prereq Biol 1009 or equiv)

Biodiversity and natural history of insects; functional roles in natural and managed environment; effects of insects on human history and approaches to managing problems caused by insects.

Ent 3020. Honeybee Biology and Management. (4 cr; prereq Biol 1009 or #)

Lecture and lab demonstrations. History of beekeeping; life history and behavior of honey bees; colony and apiary management; pollination and hive products; honey bee diseases and their control.

Ent 3200. Social Insects. (4 cr; prereq college level course in general biology)

Termites, ants, social wasps, and social bees. Natural history, caste determination and regulation, group effects and control of nestmates, communication and pheromones, the superorganism concept, and the evolution of sociality.

Ent 5000. Professional Experience Program.

(4 cr; prereq #; S-N only; free elective for ag undergrads; not for grad cr; UC only)

Professional experience in entomology firms or government agencies through supervised practical experience; evaluative reports and consultations with faculty advisers and employers.

Ent 5010. Insect Morphology. (5 cr; prereq 3005 or #; offered 1997 and alt years)

Comparative study of insect structure within an evolutionary and phylogenetic perspective.

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f,w,s,su .. Following a course number, indicates fall, winter, spring, or summer terms.

1011, 1012, 1013

..... Series courses, separated by commas; may be entered any quarter.

1011-1012-1013

..... Sequence courses, separated by hyphens; must be taken in order listed.

Courses primarily for freshmen and sophomores are numbered 1000 through 1998; for juniors and seniors, 3000 through 3998; for juniors, seniors, and graduate students, 5000 through 5998. Courses numbered 8000 and above are restricted to students registered in the Graduate School. A prerequisite course listed by number only (e.g., prereq 5246) is in the same department as the course being described.

Ent 5020. Insect Taxonomy. (5 cr; prereq 3005 or equiv)

Identification of adult insects to family; evolution and classification of insects; techniques of collecting and curating insects; principles of phylogeny reconstruction.

Ent 5030. Insect Physiology. (3 cr; prereq 5010, biochemistry course or #)

Essential processes of insects. Nerve and muscle mechanisms, energy metabolism, respiration, nutrition and digestion, excretion, regulation and interactions of processes, sensory mechanisms, and behavior. Reproductive behavior, embryology, and postembryonic development of insects.

Ent 5040. Insect Ecology. (4 cr; prereq Biol 5041 or EBB 5122 or #, offered 1998 and alt yrs)

Synthetic analysis of the causes of insect diversity and of fluctuations in insect abundance. Focus on abiotic, biotic, and evolutionary mechanisms influencing insect populations and communities.

Ent 5210. Insect Pest Management. (4 cr; prereq 1005 or #)

Prevention or suppression of injurious insects by the comprehensive and coordinated integration of multiple control tactics, e.g., chemical, biological, cultural. Strategies to optimize the dynamic integration of control methodologies in context of their economic, environmental, and social consequences.

Ent 5215. Insects in Relation to Plant Diseases. (3 cr, §PIPa 5215; prereq 5 cr ent, 5 cr plant path or equiv or #; offered 1997 and alt yrs)

Insect transmission and dissemination of plant pathogens; development of plant-insect relationships and habits of principal insect vectors.

Ent 5250. Forest and Shade Tree Entomology. (4 cr; prereq any two courses among the forestry, zoological, botanical, biological, or agricultural sciences)

Lectures and lab concerning ecology and population management of forest and shade tree insects, with heavy emphasis on tree factors and integrated control.

Ent 5275. Medical Entomology. (3 cr; prereq 3005 or #; offered 1998 and alt yrs)

Biology of arthropod vectors of human disease. Emphasis on disease transmission and host, vector, and pathogen interactions.

Ent 5280. Livestock Entomology. (4 cr)

Biology and management of insects, mites, and ticks that affect domestic livestock and pets.

Ent 5310. Sampling Biological Populations. (4 cr; prereq Stat 5021 or equiv; offered 1997 and alt yrs)

Design of sampling plans for studying field and lab populations of living organisms. Sampling distributions and techniques for detecting and coping with aggregation. Randomization, required sample size, and optimal resource allocation within alternative sampling designs.

Ent 5320. Ecology of Agriculture. (4 cr; prereq one 3xxx+ level course in agro or hort or an sci, one 3xxx+ level course in ent or plant path or soil or #)

Ecological perspective on post-industrial agriculture; origins of agriculture, social functions, and ecology of contemporary and extinct agricultural systems. Soils, plant development, pest ecology, forage quality, animal production, and food quality as an interactive network of factors.

Ent 5340. Biological Control of Insects. (2 cr; prereq 5210, intro ent course, course in ecol)

Principles of biological control: history, ecological basis, classical biological control, augmentation, analysis of selected projects.

Ent 5350. Insect Pathology. (3 cr; prereq 5030; offered 1997 and alt yrs)

Survey of the major pathogenic microorganisms that cause diseases in insects; routes of infection of insects; lab propagation of disease agents; factors involved in application of disease to control of pest insects with safety considerations.

Ent 5360. Aquatic Insects. (3 cr; prereq 3005 or equiv or #; offered 1997 and alt yrs)

Taxonomy and natural history of aquatic insects, including their importance in aquatic ecology, water resource management, recreation, and conservation. Emphasis on family level identification. Field trips scheduled to local aquatic habitats. A collection is required.

Ent 5370. Principles of Systematics. (3 cr; prereq #; offered 1998 and alt yrs)

Theoretical and practical procedures of biological systematics, including phylogeny reconstruction, classification, systematic literature, nomenclature, and presentation of results of systematic research.

Ent 5380. Lepidopteroogy. (2 cr /3 cr with term paper; prereq one ent course or #, one course each in ecology and genetics recommended)

Overview of Lepidoptera, with emphasis on processes and phenomena such as polymorphism, mimicry, and individual quality that are well demonstrated by this insect order.

Ent 5480. Invertebrate Neurobiology. (2 cr, §NSc 5480) Fundamental principles and concepts underlying cellular bases of behavior and "systems" neuroscience. Particular invertebrate preparations discussed.

Ent 5900. Basic Entomology. (Cr ar; prereq #) Opportunity to make up certain deficiencies in biological background.

Ent 5910. Special Problems in Entomology. (Cr ar; prereq #)

Individual field, lab, or library studies in various aspects of entomology.

Ent 5920. Special Lectures in Entomology. (Cr ar; offered when feasible)

Lectures or laboratories in special fields of entomological research given by a visiting scholar or regular staff member.

Ent 5999. Special Workshop in Entomology. (1-4 cr; prereq #)

Workshops on a variety of topics in entomology offered for credit in locations other than the Twin Cities campus. Consult *Class Schedule* or department for current offerings.

## For Graduate Students Only

(For descriptions, see *Graduate School Bulletin*)

Ent 8040. Advanced Insect Genetics

Ent 8050. Toxicology

Ent 8200. Colloquium in Social Insects

Ent 8210. Colloquium in Insect Evolution

Ent 8240. Colloquium in Insect Ecology

Ent 8300. Graduate Seminar

Ent 8500.\* Research in Entomology

## Environmental Science (ES)

ES 1001. Orientation to Environmental Science. (1 cr)

Students explore the environmental science major through discussions of current events, faculty research, alumni reports and portfolio preparation.

ES 1010. Issues in the Environment. (3 cr)

Critical analysis of environmentally stressed situations, and modes of avoiding and redressing pollution.

ES 3050. Field or Work Experience in Environmental Science. (1-4 cr)

Students are required to obtain internship forms prior to registering. A written and oral report on the student's internship is required. For 1 credit, the written report is 4-8 pages. Additional credits require a more in-depth report.

## Food Science and Nutrition (FScN)

**FScN 1020. Introductory Microbiology.** (4 cr)  
Fundamental principles of microbiology. Characteristics of bacteria, yeasts, molds, and other microorganisms; their importance in the preparation and preservation of foods, and their relation to the health and well-being of the individual and the family.

**FScN 1102. Food: Safety, Risks and Technology.** (4 cr)  
Processing technology in relationship to risk, benefits and safety issues for the prevention of biological, microbiological and physical and chemical deterioration of foods while enhancing nutritional and sensory quality.

**FScN 1612. Principles of Nutrition.** (4 cr; prereq high school biol, high school chem)  
Fundamental concepts: human nutritional requirements, the function of nutrients, and nature of deficiencies. Vegetarianism, weight loss, fad diets, activity, obesity, cancer, heart disease, food processing, safety, and world food problems.

**FScN 3102. Introduction to Food Science.** (4 cr; prereq Chem 1002 or Chem 1052)  
Composition and chemical and physical properties of foods; interaction, reaction, and evaluation of foods due to formulation, processing, and preparation.

**FScN 3112. Food Analysis.** (4 cr; prereq 3102)  
Application of analytical techniques in the analysis of food composition (proximate, mineral, vitamins, and food contamination). Physical methods of analysis.

**FScN 3135. Food Processing I.** (4 cr; prereq 1102, 3102, Math 1031)  
Qualitative and quantitative discussion of principles of product movement and modification used in food processing. Operations needed for proper functioning of a food processing facility such as pumping, homogenization, membrane separations, milling, and dry blending.

**FScN 3136. Food Processing II.** (4 cr; prereq 3135)  
Discussion of major food processing operations including heating and cooling, evaporation, drying, and process automation, from the perspective of the introduction and principles of equipment and quantitative base for operations.

**FScN 3400. Food Marketing Communications.** (3 cr; prereq Rhet 1222)  
Communication of information associated with food marketing, including developing proposals, project planning, and creative innovative marketing and strategies for food products selected. Individual and team oral product presentations and demonstration, written plans, memos and reports; videotaping TV commercials; food photography.

**FScN 3472. Food Selection Principles.** (4 cr; prereq 4 or food sci and nutr)  
Consumer trends and food selection. Food distribution system. Food selection principles. Information used when making and evaluating food selection decisions. Use of computer-based nutrient calculation systems.

**FScN 3610. Community Nutrition.** (3 cr; prereq 1612 or equiv, 5 cr anth or psych or soc)  
Goals of community food and nutrition programs including national, international, public and private programs; an overview of cultural food patterns; and the management of (assessing needs, planning, implementation, and evaluating) food and nutrition programs for groups of people.

**FScN 3612. Life Cycle Nutrition.** (4 cr; prereq 1612, Chem 3302 or equiv)  
Nutrition changes through the life cycle, especially nutrient needs during pregnancy and lactation; nutritional needs as affected by exercise; digestion and absorption, other nutrient balances; nutrition and immunology.

**FScN 3662. Introduction to the Clinical Practice of Dietetics.** (2 cr; prereq 12 cr in food sci and nutr, regis in coordinated program in dietetics)  
Introduction to the practice of dietetics in hospitals, outpatient clinics, public service agencies, and food services.

**FScN 3703. Field Experience in Food Service Management.** (3-18 cr; prereq regis in coordinated program in dietetics or #)  
Supervised food service production and management experience in a community or health care facility.

**FScN 3730. Quantity Food Production Management.** (3 cr; prereq 3102, 3472)  
Participation in the management procedures used in the selection, storage, preparation, pricing, and service of food in quantity. Quantity food service facilities used as laboratories. Field trips may be required.

**FScN 3732. Lecture in Quantity Food Production Management.** (2 cr; prereq 3102, 3472)  
Understanding of management procedures used in selection, storage, preparation, pricing, and service of food in quantity.

**FScN 5000. Professional Experience Program.** (4 cr; prereq 15 cr in food sci and nutr, #; not for grad cr; UC only)  
Up to 12 weeks of planned experience in a selected position in the food industry; evaluative reports and consultations with faculty advisers and employers.

**FScN 5100. General Seminar.** (1 cr; A-F only; prereq sr or #)  
Literature review and presentation of papers in selected areas of food science and nutrition.

**FScN 5110. Food Chemistry.** (4 cr; prereq 3102, BioC 3021 or Biol 5001)  
Study of chemical structures and functional properties of food components in relationship to their roles as parts of complex biochemical systems and as modified by various environmental and processing factors.

**FScN 5111. Independent Study in Food Science and Nutrition.** (1-5 cr [may be repeated for cr]; prereq Δ)  
Individual lab or library research in some area related to food science or nutrition.

**FScN 5120. Food Microbiology.** (5 cr; prereq 1102, 3112, MicB 5105 or VPB 3103 or #)  
Relationship of environment to occurrence, growth, and survival of microorganisms in foods: methods of evaluation, mechanisms to control, genera and species of importance, control of food-borne pathogens and toxins. Enumeration, isolation, and identification of microbes in foods.

**FScN 5122. Control Systems in Food Microbiology.** (2 cr; prereq 5120)  
Control and destruction of microorganisms in foods; hazard analysis; critical control points for control of microbes; chemical, physical, and microbiological considerations in cleaning and sanitizing food contact surfaces and equipment; microbiological criteria for raw and processed foods; sampling methodologies.

**FScN 5123. Food Fermentations and Biotechnology.** (3 cr; prereq 5120)  
Food fermentation processes; characteristics of microorganisms involved in food fermentations and production of food ingredients; composition and factors influencing activity of starter culture; microbiology of natural and controlled fermentation; properties of lactic bacteriophages and methods of control during dairy fermentations.

**FScN 5135. Food Engineering Unit Operations.** (5 cr; prereq 3136, Phys 1042)  
Principles and food system applications of these unit operations: fluid flow, heat transfer, drying, evaporation, contact equilibrium (distillation, extraction, crystallization, and membrane processes), and mechanical separation (filtration, centrifugation, sedimentation, and sieving).

**5312. Instrumental Analysis of Foods.** (3 cr; prereq 3112, 5110)  
Applying instrumental methods of analysis to the examination of food products.

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FScN 5314. Physicochemistry of Foods. (4 cr; prereq 5100)  
Characterization of crystalline systems, gels, emulsions, and foams; functionality of food macromolecules in these systems.

FScN 5316. Quantitative Light Microscopy in Agriculture and Food Research. (4 cr; prereq Biol 1009 or Chem 1052)  
The light microscope and its variants. Description and applications of quantitative instruments for characterizing cell, tissue, and other raw or processed materials. Digital image analysis, scanning microspectrophotometry, laser scanning microscopy.

FScN 5360. Sensory Evaluation of Food Quality. (4 cr; prereq 3102, Stat 3012 or Stat 5021)  
Fundamentals of sensory perception. Test designs and methods used in studying sensory quality of foods.

FScN 5380. Food Packaging. (3 cr; prereq 1102, 3102, Phys 1042)  
Basics of packaging materials and the principles of packaging development and product protection as they apply to foods.

FScN 5390. Introduction to Food Law. (4 cr; prereq 1102 or #)  
Federal and state legal requirements and case law history affecting production, processing, packaging, marketing, and distribution of food and food products.

FScN 5401. Special Topics in Food Science and Nutrition. (1-4 cr; prereq varies with topic, check with department)  
In-depth investigation of a specific topic not covered by other courses. Announced in advance.

FScN 5404. Current Issues in Food and Nutrition. (2-4 cr; prereq 15 cr food sci and nutr or #)  
Evaluation of popular and scientific literature dealing with nutrition, food additives, food safety, food fads, health foods, environmental contamination, the consumer movement, naturally occurring food toxicants, processed foods, synthetic foods, organically grown foods.

FScN 5474. Food Marketing Economics. (4 cr, \$ApEc 5550; prereq AgEc 3001 or equiv)  
Economics of food marketing in the United States. Food consumption trends; consumer food behavior; food expenditure and consumption data; consumer survey methodology; the food distribution and retailing system; food policy issues related to food marketing. Students pursue individual and group projects.

FScN 5512. Meat Technology. (4 cr; prereq 5110)  
Industrial processing of meat, fish, and poultry products, including protein functionality, thermal processing, curing, smoking, and deterioration during storage. Use of preblending and least-cost analysis in product development and formulation.

FScN 5522. Technology of Fluid and Concentrated Milk Products. (4 cr; prereq 3136, 5110)  
Applying scientific principles to problems involved in processing fluid and dehydrated milk systems and their control. Demonstration of basic processing operations, including heating, cooling, homogenization, evaporation, drying, crystallization, and freezing.

FScN 5523. Technology of Fermented Dairy Products. (4 cr; prereq 5110, 5123)  
Integration of chemical, microbiological, and physical principles involved in the manufacture and storage of cheeses and fermented milks.

FScN 5524. Sensory Evaluation of Dairy Products. (1 cr; prereq 3102)  
Lab and commercial procedures for evaluating the sensory properties and market quality of dairy products. Cause and identification of common defects in flavor, physical properties, and appearance.

FScN 5550. Grains: Introduction to Cereal Chemistry and Technology. (4 cr; prereq Biol 1009 or Chem 1052)  
Origins, structure, biochemistry and cellular properties of major cereal grains, as they relate to primary processing (milling), and secondary processing (production of cereal products). Relationship between structure and functionality as determinants of quality in grains and grain products. Quality evaluation technologies.

FScN 5555. Freezing and Dehydration of Foods. (5 cr; prereq 1102, 5135)  
Principles involved in the processing, handling, and storage of frozen, dry, and intermediate moisture food with emphasis on physicochemical properties of water in foods.

FScN 5560. Introduction to New Product Development. (3 cr; prereq 8 cr food sci)  
Identifying and testing new product concepts, prototype testing, and basic process design; interactive format and industrial examples. Statistical and chemical control of new processes and methods for evaluating consumer acceptance.

FScN 5562. Flavor Technology. (4 cr; prereq 1102, 5110)  
Flavor and off-flavor development in foods. Industrial production of food flavorings and their proper application to food systems.

FScN 5600. Nutrition Seminar. (1 cr; prereq #; UC only)  
Literature review and presentation of papers in selected areas of nutrition.

FScN 5612. Experimental Nutrition. (2 cr; prereq 3612, ¶BioC 3021 or Biol 5001)  
Lab experience in chemical and biochemical methods of analysis of nutritional status.

FScN 5614. Nutrition Education. (3 cr; prereq 3610)  
Application of educational principles, models, and theories to the development, delivery, and evaluation of nutrition lessons, curricula, and communications.

FScN 5620. Nutrition and Metabolism. (3 cr; prereq 3612 or #, BioC 3021 or Biol 5001)  
Physiological function and metabolic fate of carbohydrates, lipids, and proteins and their involvement in fulfilling energy needs for maintenance, growth, and work. Physiological function of vitamins and minerals.

FScN 5622. Macro-Nutrient Metabolism. (4 cr; prereq 3612, BioC 3021 or Biol 5001, Phsl 3051)  
Physiological function and metabolic fate of carbohydrates, lipids, and proteins and their involvement in fulfilling energy needs for maintenance, growth, and work.

FScN 5623. Vitamin and Mineral Biochemistry. (4 cr; prereq 3612, BioC 3021 or Biol 5001, Phsl 3051)  
Nutritional, biochemical, and physiological function of essential vitamins and minerals in humans and experimental and animal models.

FScN 5624. Human Protein and Energy Utilization. (4 cr; prereq 5622, 5623)  
Regulation of human protein and energy use, interactions, adaptations; critical evaluations of methods of determining requirements; technical and ethical problems in human experimentation, and determination of recommended levels of intake.

FScN 5642. Field Experience in Community Nutrition. (3-18 cr; prereq one human nutr course, #)  
Application of nutrition information to problems of health and welfare; assigned readings, discussions, and experience in a community agency.

FScN 5643. World Food Problems. (3 cr, \$ApEc 5790, \$Agro 5200, \$CAPS 5280, Soc 5675; prereq sr or grad; limited enrollment)  
Multidisciplinary approach to the social, economic, and technical problems of feeding the world's growing population. Principles sought from the social, economic plant, animal, and food sciences for their application to world food problems.

FScN 5662. Current Issues in Clinical Nutrition. (3 cr; prereq 5620, 5667)  
Evaluation of current scientific research and literature related to clinical nutrition.

FScN 5664. Field Experience in Clinical Nutrition. (3-18 cr; prereq one human nutr course, #) Applying nutrition information to problems of health and disease; assigned readings, discussions, and experience in a clinical facility.

FScN 5665. Applied Medical Nutrition Therapy I. (3 cr; prereq BioC 3021 or Biol 5001, LaMP 5177 or ¶5177, Phsl 1001 or Phsl 3051) Nutritional assessment and support; fluid and electrolyte balance; diet/drug interactions. Nutritional intervention in disorders of the gastrointestinal system and in cancer.

FScN 5666. Applied Medical Nutrition Therapy II. (3 cr; prereq 5665, 5662 or ¶5662) (Continuation of 5665.) Pathology, treatment, and nutritional therapy of diseases of cardiovascular and respiratory systems and common disorders of endocrine system, notably diabetes mellitus; nutrition intervention in obesity.

FScN 5667. Applied Medical Nutrition Therapy III. (3 cr; prereq 5666) Pathology, treatment, and nutrition therapy for diseases of urinary tract, inborn errors of metabolism and allergies. Nutritional considerations in eating disorders, and neurological, muscular, and skeletal disorders. Special nutrition considerations in the care of pediatric patients.

FScN 5693. Selected Aspects of Nutrition. (2-4 cr [may be repeated for max 12 cr]; prereq sr, 3102, 3612) In-depth investigation of a single, preselected aspect of nutrition in any one offering. Teaching procedure and approach determined by nature of topic and student needs. Specific topic announced in advance of course offering.

FScN 5694. Metabolic Basis for Therapeutic Nutrition. (4 cr; prereq 5664 or #) Physiological and biochemical bases for dietary treatment, dietary principles related to adequate nutrition. Case study presentations and clinical experience included.

FScN 5702. Selected Aspects of Food Service Management in Health Care Facilities. (3 cr; prereq 3 cr elem stat, 6 cr econ, #) Management techniques applied to food services for health care facilities. Methods of analysis and control.

FScN 5705. Field Experience in Food Service Management. (3 cr; prereq 3 cr elem stat, 6 cr econ, #) Management techniques applied to food services for health care facilities. Methods of analysis and control.

FScN 5732. Principles of Food Service Organization and Management. (4 cr; prereq sr, 3732, Mgmt 3001, regis in coordinated program in dietetics) Management of food service personnel, financial control, regulations, related administrative problems.

FScN 5750. Principles of Food Service Management. (4 cr; prereq 3730 or 3732, Mgmt 3001) Applying management principles in a food service. Business procedures, personnel management, cost control, financial management, and related administrative problems. Field trips may be required.

FScN 5999. Special Workshop in Food Science and Nutrition. (1-4 cr; prereq #) Workshops on a variety of topics in food science and nutrition offered for credit in locations other than the Twin Cities campus. Consult class schedule or department for current offerings.

## For Graduate Students Only

(For descriptions, see *Graduate School Bulletin*)

FScN 8101. Research Seminar

FScN 8205. General Seminar

FScN 8311. Flavor Chemistry

FScN 8312. Reaction Kinetics of Food Deterioration

FScN 8315. Food Proteins

FScN 8322. Microbiology and Engineering of Food Sterilization Processes

FScN 8323. Microbial Starter Cultures

FScN 8324. Microbial Toxins and Toxic Microorganisms in Foods

FScN 8401. Independent Study: Food Science

FScN 8403. Advanced Topics in Food Science

FScN 8603. Advanced Topics in Nutrition

FScN 8621. Independent Study: Nutrition

FScN 8777. Thesis Credits: Masters

FScN 8888. Thesis Credits: Doctoral

Nutr 8745. Seminar

Nutr 8777. Thesis Credits: Master's

Nutr 8888. Thesis Credits: Doctoral

Nutr 8990. Graduate Research

## Horticultural Science (Hort)

Hort 1010. Home Horticulture. (4 cr) For non-horticulture majors. Fundamental concepts of plant identification, growth, and culture with practical applications to home landscape, floral design, house plants, and fruit, flower, and vegetable gardening. Lecture and lab.

Hort 1020 Floral Design. (4 cr; UC only) Design for use in commercial flower shops or at home, including principles and elements of design, wedding and funeral arrangements, corsages, and the decorative use of dried materials.

Hort 1021. Woody Landscape Plants. (5 cr) Taxonomy, ecology, and landscape uses of trees, shrubs, and evergreens. Lecture, lab, field trips.

Hort 1022. Herbaceous Landscape Plants. (5 cr) Taxonomy, ecology, and landscape uses of perennial and annual flowers, ferns, weeds, tender and hardy bulbs, grasses, herbs and native plants. Lecture, lab, field trips and garden experience.

Hort 1023. Indoor Plants and Landscapes. (3 cr) Indoor plants and landscapes benefit people in many ways. This course focuses on the selection, identification, care, growth, and use of plants in the home and other human environments. Field trips provide examples of interior landscaping.

Hort 1036. Plant Propagation. (5 cr) Principles and techniques of propagating plants by seeds, cuttings, grafts, buds, layers, division, and plant tissue culture. Lecture and lab.

Hort 3001. Growth Regulation of Horticultural Plants. (5 cr; prereq Biol 1103 or equiv) Scientific basis for horticultural practices that manipulate growth, development, and yield. Comparative approach including lab encourages active learning.

Hort 3002. Horticultural Cropping Systems. (5 cr; prereq 1036, Biol 1103) Identification, manipulation, and management of production systems generic to all horticulture commodities. Greenhouse, field, and container production studied to provide basic optimum conditions for yield maximization with appropriate resources.

Hort 3003. Plant Genetics and Improvement. (4 cr; prereq Biol 1009)

Principles of plant genetics, genetic and environmental variation, relationships of genetics to crop evolution and plant breeding, conservation and use of wild crop relatives in breeding. Lab experiments investigate hybridization, variation, and selection in horticultural crops and other plants.

Hort 3004. Applications of Plant Biotechnology. (4 cr; prereq 3003 or GCB 3022, Chem 1002 or Chem 1052 or BioC 1401)

Fundamentals of plant molecular biology and biotechnology and their practical applications to plant propagation, crop improvement, and research. Labs on biotechnology skills.

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Courses primarily for freshmen and sophomores are numbered 1000 through 1998; for juniors and seniors, 3000 through 3998; for juniors, seniors, and graduate students, 5000 through 5998. Courses numbered 8000 and above are restricted to students registered in the Graduate School. A prerequisite course listed by number only (e.g., prereq 5246) is in the same department as the course being described.

Hort 3010. Growing Plants Organically: What It Means to Be "Green." (3 cr; prereq 1036 or Biol 1103 or PBio 3012 or equiv, jr or sr)

Science and ethics of organic cultivation. What is meant by "green" from a legal, scientific, and ethical perspective. Students explore original literature in organic practices, prepare written reports, and lead a class discussion.

Hort 3072. Turf Management. (4 cr; prereq 1036 or Agro 3020, Soil 3125, PBio 1103)

General landscape maintenance and turf culture. Work in areas of industrial grounds maintenance, park and recreation area maintenance, and general lawn care.

Hort 3097. Horticulture Practicum. (2-4 cr; prereq upper div hort emphasis or sequence, Δ)

Approved field, lab, or greenhouse experiences in application of horticultural information and practices.

Hort 3099. Seminar. (1 cr [may be repeated for max 2 cr]; prereq jr)

Horticultural problems, research projects, work experience, and employment opportunities.

Hort 3100. Special Topics in Horticulture. (1-5 cr; prereq varies with topic, #)

Topics of public and scientific interest in horticulture. Content varies quarterly. For full details inquire at department office (305 Alderman Hall) before registration. Lab fees may be assessed.

Hort 5000. Professional Experience Program. (4 cr; prereq #; S-N only; free elective for hort undergrads, not for grad; UC only)

Professional experience in horticulture firms or government agencies through supervised practical work evaluation of reports and consultations with faculty advisers and employers.

Hort 5001. Harvest to Market of Horticultural Crops. (3 cr; prereq PBio 3131)

Physiological processes of horticultural crops after harvest related to maturity, time to harvest, quality, ripening, senescence, handling, storage, and marketing. Interdisciplinary approaches to problem solving and decision management.

Hort 5015. Restoration and Reclamation Ecology. (4 cr; prereq 1 course in plant biology or botany and ecology)

Ecological and physiological concepts as a basis for the revegetation of grasslands, wetlands, forests, and other landscapes. Methods for plant materials selection, stand establishment, evaluating revegetation success. Overview of state and federal programs that administer restoration and reclamation programs. Weekend and evening trips to examine reclamation and restoration sites in several areas of Minnesota.

Hort 5020. Topics in Plant Sciences for Teachers. (1-4 cr; prereq 1 plant science or education course; UC only)

Explore inquiry-based science instruction for elementary/secondary school educators while developing skills and activities for teaching plant science. Learn to manage classroom/schoolyard plant growth. Intensive workshop format. For non-horticulture majors. Not eligible for credit in the horticulture graduate program.

Hort 5026. Landscape Management. (4 cr; prereq completion of 75 percent of credits required in landsc, nursery, and turf sequence and business enrichment)

This course integrates the environmental horticulture industry disciplines and commodities, including appropriate business management principles. Use scientific methods and technical applications in problem solving and case studies.

Hort 5030. Landscape Design of Residential and Small Commercial Sites. (4 cr; prereq 1021, 1022, LA 1301 or #)

Fundamentals of landscape design theory including organization of space, complementary shapes and forms, site analysis, and the relationship of structure, texture, and seasonal interest in the landscape; includes further study of plans and environmental requirements as they influence design.

Hort 5031. Temperate Fruit Production. (4 cr; prereq 3001; PBio 3131 recommended; offered fall qtr of odd yrs)

Principles of fruit production emphasizing temperate fruit crops. Integrated management of fruit cropping systems, including site selection, cultural management practices, taxonomic classification, physiological and environmental control of plant development. Integration of writing into understanding various fruit cropping systems.

Hort 5034. Commercial Vegetable Agriculture. (5 cr; prereq 3002, Agro 1010 or Soil 3125)

Crop cultural and product handling and use systems in various world regions. History and evolution of species and product development. Seed and stand establishment, propagation, pest management. Applied physiology and genetics of fruit, bulb, tuber initiation; sink development, maturation, and quality. Lecture, lab, field trips.

Hort 5040. Plant Growth Regulation. (4 cr; prereq 15 cr plant sci incl 3 cr plant physiology; offered winter qtr of even years)

Principles of plant growth and development in relation to optimizing cropping efficiency and product quality. Emphasis on analysis of physiological and morphogenetic basis of horticultural practices to regulate growth and development. Exercises in using these principles to solve horticultural problems.

Hort 5041. Landscape Design and Implementation. (5 cr; prereq 5030)

Builds on design techniques from 5030. Architectural and graphic techniques as well as design concepts in relation to horticultural plant performance and maintenance. Grading, site manipulation, and plant installation.

Hort 5042. Turfgrass Science. (5 cr; prereq 3001, 3072, PIPa 3002)

For advanced students in turf with career objectives in professional turf management. All phases of the turf industry, with emphasis on the ecology, physiology, and theory of turf population dynamics and on specialized management situations such as golf course, commercial sod production, and fine turf athletic situations.

Hort 5046. Nursery Management I. (4 cr; 5046-5047-5048†; prereq 1021, 1036)

Introduction, history, organization, and scope of the nursery industry. General nursery business administration, production schedules, and cultural management for seed beds and field grown stock. Field trips required.

Hort 5047. Nursery Scheduling and Enterprise Development. (2 cr; 5046-5047-5048†; prereq 5046)

Development of specific crop schedules using current technical and economic data for efficient production. Development of a total nursery enterprise designed for a workable and profitable business establishment.

Hort 5048. Nursery Management II. (4 cr; 5046-5047-5048†; prereq 5047)

Pest management and government regulations concerning the nursery industry. Container growing operations and marketing of all products. Specific topic research and nursery operation development by the student. Lab includes field trips and greenhouse and field training in nursery operations. Field trips required.

Hort 5054. Commercial Floriculture Production Practices. (4 cr; prereq 1036, 3002, PBio 3131)

Principles of commercial bedding plant production systems. Major bedding plant crops and their cultural practices will be emphasized. Lecture, laboratories and field trips will illustrate commercial production techniques and provide opportunities for application of these methods to bedding plant crops.

Hort 5055. Commercial Floriculture Production Systems. (5 cr; prereq 1036, 3002, PBio 3131 or #)

Emphasis on problem-solving and management practices in floriculture crop production. Topics include cultural practices, diagnosis of problems, interpretation of soil/leaf analyses, scheduling crop production, and mechanization and computerization of greenhouse operations. Lecture, lab, field trips.

Hort 5091. Directed Studies. (2-6 cr; prereq 8 cr upper div hort course, Δ)  
 Opportunities for in-depth exploration of concepts, technology, materials, or programs in specific area to expand professional competency and self-confidence. Planning, organizing, implementing, and evaluating knowledge obtained from formal education and experience.

Hort 5999. Special Workshop in Horticulture. (1-4 cr; prereq #)  
 Workshops on a variety of topics in horticultural science offered for credit in locations other than the Twin Cities campus. Consult *Class Schedule* or department for current offerings.

## For Graduate Students Only

(For descriptions, see *Graduate School Bulletin*)

Agro 8200. Plant Breeding Principles and Methods I

Agro 8210. Plant Breeding Principles and Methods II

PBio 8281. Growth and Differentiation of Plants

Hort 8022. Breeding Asexually Propagated Crops

Hort 8023. Evolution of Crop Plants

Hort 8041. Discussions in Administrative Organization

Hort 8042. Horticultural Seminar

Hort 8045.\* Plant Hardiness

Hort 8051.\* Advanced Problems in Horticultural Crop Breeding

Hort 8052.\* Advanced Problems in Physiology of Horticultural Crops

Hort 8060. Discussions in Potato Research

Hort 8062.\* Discussions in Plant Hardiness

Hort 8063.\* Discussions in Horticultural Plant Breeding

Hort 8065.\* Discussions in Postharvest Physiology

Hort 8066. Discussions in Horticultural Research

Hort 8090. Graduate Horticultural Research

## Landscape Architecture (LA)

The courses listed below are the landscape architecture courses most frequently required for pre-landscape architecture students. A complete list of landscape architecture courses is published in the *College of Architecture and Landscape Architecture Bulletin*.

LA 1024. Landscape Theory. (4 cr; UC only)  
 Analysis of design elements and forms involving direction, shape, proportion and color with emphasis on their function in design perception and our relationship to the environment and the social effects of and psychological basis for design.

LA 1301. Introduction to Landscape Architectural Drawing. (4 cr, §Arch 1301; A-F only)  
 Visualization and drawing of form and space in the physical environment. Basic elements of form using design drawing systems and conventions. Development of skills in visual literacy and expression through drawing.

LA 1401. The Designed Environment. (4 cr, §1031, §Arch 1401; A-F only)  
 Principles and traditions in architecture, landscape architecture, and urban design, with references in the arts, sciences, and literature explored in a review of the formal constructs of the designed environment.

LA 3411. History of Architecture to 1750. (4 cr, §Arch 3411; A-F only)  
 History of architecture and city planning from antiquity to 1750, as illustrated by major monuments from Western and non-Western cultures.

LA 3412. History of Architecture Since 1750. (4 cr, §Arch 3412; A-F only)  
 A history of the major monuments, concepts, and theories of urbanism and architecture since 1750.

LA 3413. History of Landscape Architecture. (4 cr; A-F only)  
 History and theoretical issues of landscape architecture in topologically based survey format. Landscape design from the ancient to the modern period.

## Natural Resources and Environmental Studies (NRES)

NRES 3001. Colloquium in Natural Resources and Environmental Studies. (1 cr)  
 Roundtable discussions of current topics in NRES.

NRES 3010. Ethics and Values in Resource Management. (3 cr)  
 Formulating a natural resources philosophy based on ethical behavior. Ethical dilemmas inherent in managing natural resources.

NRES 3020. Plant Resource Management and the Environment. (4 cr; prereq ¶15020, Biol 1009 or Biol 1201, Biol 1202, soph standing)  
 Same as NRES 5020. World vegetation management practices, extent. Emphasis on forest management; agriculture and agro-forestry; historical, current, and prospective practices and environmental and societal implications.

NRES 3060. Water Quality in Natural Resource Management. (3 cr)  
 Same as NRES 5060. Global and ecological perspective on managing surface and groundwater resources. Water quality concerns.

NRES 5100. Problem Solving in Natural Resources and Environmental Studies. (5 cr; prereq sr)  
 Solving a real-world natural resources and/or environmental problem. Discussions and assignments reflect diverse aspects of the problem. Oral and written presentations. Students participate as a member of a team.

NRES 5210. Survey, Measurement, and Modeling Methods for Natural Resources I. (4 cr; prereq 1020 or CSci 3101 or CSci 3102 or CSci 3113 or GC 1571, Math 1142 or Math 1251, Stat 3011 or Stat 5021)  
 Introduction to survey design, measurement concepts, and modeling methods useful in studying natural resources and environmental issues. Emphasis on data collection and analysis.

## Plant Pathology (PIPa)

PIPa 1001. The Good, Bad, and Ugly Effects of Microorganisms on Plants and Human Society. (2 cr)  
 Positive or negative effects of microorganisms on plants and the ultimate effect on human history and society.

PIPa 1002. Plant Diseases and Your Garden. (2 cr)  
 Characteristics of causes of plant diseases that can affect the growth of flowers, small fruits, and vegetables in Upper Midwestern gardens. Diseases that may appear in your garden, why they can occur and how to avoid them.

PIPa 1003. Diseases of Trees. (2 cr)  
 Tree diseases with emphasis on diseases in the Upper Midwest. Labs emphasize disease diagnosis.

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PIPa 1004. Diseases of Turfgrass. (2 cr)  
Turf diseases with emphasis on diseases in the Upper Midwest. Labs emphasize disease diagnosis.

PIPa 3001. Management and Control of Field Crop Diseases. (4 cr; prereq Biol 1009 or #)  
Crop pathology in selected cropping rotations and procedures used to identify plant diseases and appropriate control measures. Field level problem solving using integrated pest management.

PIPa 3002. Management of Horticultural Crop Diseases. (4 cr; prereq Biol 1009 or equiv)  
Characteristics of pathogens and incitants that cause horticultural crop diseases. Biological principles that affect disease incidence, and severity.

PIPa 3004. Air Pollution, People and Plants. (3 cr; prereq Biol 1009 or equiv or #, Chem 1052)  
History of air pollution, its sources and types; global climate change; air pollution effects on human health, crops and forests; air pollution control and international perspective.

PIPa 3090. Research in Plant Pathology. (Cr ar; prereq 1001 or equiv or #)  
Assignment of special problems to undergraduates desiring opportunity for independent research in plant pathology.

PIPa 5000. Professional Experience Program. (4 cr; prereq 15 cr plant path. #; not for grad cr; UC only)  
Open to advanced students in integrated pest management. Up to 12 weeks of experience in a selected agricultural industry; evaluative reports and consultations with faculty advisers and employers.

PIPa 5090. Issues in Plant Pathology. (Cr ar; prereq grad status or #)  
Consult *Class Schedule* or department for current offerings.

PIPa 5102. Ecology of Fungi. (3 cr; prereq 6 cr botany or #; limited to 20 students; offered at Lake Itasca alt yrs)  
Ecological studies and identification of fungi. Fungal symbioses, morphology, coevolution, and applicable ecological theory. Student teams determine species richness in aquatic, grassland, and forest habitats.

PIPa 5109. Molecular Genetics and Biochemistry of Yeasts and Filamentous Fungi. (4 cr; prereq one course each in gen and biochem or #; offered alt yrs)  
Chromosome structure and function, regulation of nuclear gene expression, mitochondrial gene organization and expression, membrane and organelle biogenesis, cell cycle regulation, morphogenesis, mating and reproduction, recombination and gene switching, spore formation and germination, viruses, plasmids and toxins.

PIPa 5201. Biology of Plant Diseases. (5 cr; prereq Biol 3012 or equiv)  
Principles and concepts of plant disease caused by selected bacteria, fungi, viruses and nematodes. Pathogen biology, factors that cause disease and interaction of pathogens with plants. Epidemiology and control measures for appropriate plant diseases.

PIPa 5203. Physiology and Molecular Plant-Microbe Interactions. (3 cr; prereq intro course in biochemistry or plant physiology or #)  
A course for upper division undergraduates or graduate students covering the genetics, physiology, and molecular biology of plant-microbe interactions. Major topics include: communication between plants and microbes, signal transduction, control of gene expression, symbiosis and parasitism, plant host response mechanisms and plant disease physiology.

PIPa 5204. Field Plant Pathology. (2 cr; prereq 3001 or 3002 or 5201, 5202)  
Characteristics and management of plant diseases in the field, forest, golf course, greenhouse, and urban environment.

PIPa 5205. Plant Disease Diagnosis. (2 cr; prereq intro plant pathology course or #)  
Principles and methodology of diagnosing plant diseases. Biotic and abiotic disease agents, disease diagnosis at both field and lab level, and current detection methods utilizing immunological and electrophoretic techniques.

PIPa 5206. Biology of Fungi. (4 cr; prereq Biol 1009 or #)

Major groups of fungi, their roles in ecosystems and human society, environmental and nutritional needs, and their modes of dissemination and survival. Representative species of fungi will be observed and manipulated.

PIPa 5209. Biochemistry of Plant Disease. (3 cr; prereq organic chemistry, biochemistry or equiv)  
Biochemistry of metabolic reactions in diseased plants; phytoalexins, phytotoxins, induced resistance mechanisms, carbon metabolism, metabolic sinks.

PIPa 5211. Fungal Genetics. (4 cr; prereq intro genetics; offered alt yrs)  
Attributes of the genetics of fungi using classical approaches, including Mendelian and quantitative traits, ecological and population genetics, incompatibility systems, tetrad analysis, heterokaryosis, somatic recombination, plasmids, genetics of parasitism, and molecular genetics techniques.

PIPa 5212. Diseases of Forest and Shade Trees. (4 cr)  
Tree diseases and ecological relationships among trees, microbes and the environment.

PIPa 5213. Plant Nematology. (4 cr; prereq 3002 or 5200, 5201 or 3001)  
Modified case study approach to evaluation of significance of plant parasitic nematodes in upper midwest field, garden, turfgrass, and greenhouse situations.

PIPa 5214. Plant Virology. (4 cr; prereq PBio 3012 or equiv)  
Importance, symptomatology, transmission and identification of viroid, virus and virus-like diseases of plants. Epidemiology and principles of control. Biological and biochemical properties of virus, viroid and virus-like pathogens. Techniques for plant virus identification and characterization using transmission, immunodiagnosis, electron microscopy, and other experimental manipulation.

PIPa 5215. Insects in Relation to Plant Diseases. (3 cr; prereq one ent course, one plant path course or #; offered alt yrs)  
Insect transmission and dissemination of plant pathogens; development of plant-insect relationships; habits of principal insect vectors.

PIPa 5500. Epidemiology and Ecology of Plant Disease. (3 cr; prereq 5002 or 5050 or #)  
Concepts and methodology in the quantitative study of plant disease epidemics emphasizing the ecology of interacting host and microbial populations. Includes discussion of disease forecasting, disease in natural (non-agricultural) systems, and biological and chemical approaches to disease control.

PIPa 5999. Special Workshop in Plant Pathology. (1-4 cr)  
Workshops on a variety of topics in plant pathology offered for credit at locations other than the Twin Cities campus. Consult *Class Schedule* or department for current offerings.

## For Graduate Students Only

(For descriptions, see *Graduate School Bulletin*)

PIPa 8000. Supervised Teaching Experience

PIPa 8090. Advanced Procedures and Research in Plant Pathology

PIPa 8200. Current Topics in Plant Pathology

PIPa 8201. Seminar

PIPa 8500. Research in Plant Pathology

## Rhetoric (Rhet)

Rhet 1000. Introduction to Scientific and Technical Communication. (1 cr)

Discussion, lectures, and guest speakers provide introduction to topics within STC and address application of STC to other areas such as health science, computer science, agriculture, and engineering.

Rhet 1101. Writing to Inform and Persuade. (4 cr, §Comp 1011; A-F only)

Relationship of thesis construction and clear thinking to informative and persuasive writing. Importance of thesis sentence, evidence, coherence, clarity, and correctness. Emphasis on the writing process in producing several short papers (250-750 words).

Rhet 1104. Library Research Methods. (1 cr; S-N only)

On-site and interactive video instruction in information retrieval techniques to strengthen skills in using the library. Students work independently to satisfactorily complete all exercises and problem-solving assignments. Students must attend an orientation session. Computer-assisted instruction.

Rhet 1151. Writing in Your Major. (4 cr; prereq Rhet 1104, fr comm req, soph status; A-F only)

Students investigate and write about subjects related to their majors. Emphasis on gathering, evaluating, synthesizing, and summarizing information; adapting it for various audiences. Assignments include literature review, abstract, fact sheet, instructions, and feature article.

Rhet 1200. Information Technology in Scientific and Technical Professions. (3 cr; prereq COAFES undergrad; A-F only)

How to use computers to communicate, gather, analyze, manage, and store information in scientific and technical professions. Main functions of and integration of data from word processing, telecommunications, database, and spreadsheet applications.

Rhet 1220. Principles of Human Communication. (4 cr)

Elements and contexts of human communication. Readings, discussions, lectures, and experiential assignments; focus on communication that affects interpersonal gatherings and entertains, persuades, and instructs public audiences.

Rhet 1222. Public Speaking. (4 cr; prereq fr comm req; A-F only)

Practical course in fundamentals of effective speechmaking. Emphasis on researching and organizing a speech and communicating with an audience.

Rhet 1301. Humanities: Modern Thought and the Enlightenment. (4 cr)

Tracing the impact of the scientific revolution on human thought. Emphasis on scientific and religious movements and countermovements as they influence modern thinking.

Rhet 1302. Humanities: Modern Thought and the Industrial Revolution. (4 cr)

The industrial transformation of Europe; rise of laissez-faire capitalism, socialism, Marxism; modern "individualism" and traditional views of community; utilitarianism and deontological approaches to ethics.

Rhet 1303. Humanities: Science, Religion, and the Search for Human Nature. (4 cr)

Investigation of Darwin's theory of evolution and its effect on 19th- and 20th-century institutions. Emphasis on attempts of social philosophers to extrapolate from biological theory to political, cultural, and religious life; scientific and religious ways of knowing; rise of existentialism.

Rhet 1310. Humanities: The Land in American Experience. (4 cr)

American attitudes toward the land from colonial times to the present as expressed in social history, literature, and the fine arts. Social thought and the relationship between farm and city, wilderness and countryside. The changing appearance of America.

Rhet 1311. Humanities: The Family in American Experience. (4 cr)

American attitudes toward family life from colonial times to the present as expressed in literature, the fine arts, and social history. Impact of Protestantism, democracy, capitalism, and reform movements, including women's rights, on the family ideal.

Rhet 1376. Special Topics in Humanities. (4 cr)

Topics vary quarterly and are listed in *Class Schedule*. For full details, inquire at the department office before registration.

Rhet 1380. Fictional History: Twentieth Century Through the Eyes of Novelists. (3 cr)

Reading of 20th-century documentary novels; the nature of artistic/historical truth; rhetoric of novels; cross cultural comparisons. Typical reading: novels about colonialism in Africa; partition of India; the Holocaust; Palestinian-Israeli conflict.

Rhet 1441. College Reading and Learning Skills. (4 cr)

Lecture and individual and small group practice in developing speed, comprehension, retention and flexibility in reading college assignments; clarity and precision in written expression; accurate and effective listening; control of communication related anxiety, including test-taking; vocabulary power.

Rhet 3101. Functional Photography. (4 cr; prereq 3562 or DHA 1300)

Practical course in basic photographic communication. Techniques of producing 35mm color transparencies for use in group presentations, teaching, publications, and audiovisual productions.

Rhet 3105. Corporate Video for Technical Communicators. (4 cr; prereq 3562 or equiv)

Video production including video team roles, production technology, and the development process. Students will apply rhetorical principles in analyzing video, develop a treatment, and write a script.

Rhet 3254. Advanced Public Speaking. (4 cr; prereq 1222)

Training for specific speech situations most likely to be encountered professionally. Emphasis on analysis, design, preparation, and delivery of presentations to provide greater flexibility within a variety of speech environments.

Rhet 3257. Scientific and Technical Presentations. (4 cr; prereq 1222, 3562 or #)

Presentations for specific situations related to technical or scientific topics. Audience analysis and adaptation, techniques of support and visualization, organization for clarity and accuracy, and techniques of interpreting and answering questions. Students make and evaluate technical and scientific presentations. Emphasis on seminar reports and professional conference papers.

Rhet 3266. Communication, Discussion in Small Group Decision Making. (4 cr; prereq 1222 or #)

Role of communication techniques in the small group decision making process. Emphasis on problem-solving discussion requiring some kind of formal outcome.

Rhet 3270. Speech: Special Problems. (1-5 cr; prereq #, Δ)

Supervised reading and research on advanced speech-communication topics not covered in regularly scheduled speech offerings. Because of the advanced and independent nature of this course, the primary burden of development usually rests with the student.

Rhet 3276. Special Topics in Rhetoric and Communication. (1-6 cr; prereq #, Δ)

Supervised reading and research on advanced rhetoric, communication, speech topics not covered in regularly scheduled offerings.

Rhet 3370. American Humanities. (4 cr)

Examination of the American character and changes it has undergone in the 19th and 20th centuries as exemplified by social, artistic, literary, and architectural records.

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Rhet 3374. Humanities: Special Problems. (1-2 cr; prereq #, Δ)

Primarily for supervised reading and research on topics not covered in regularly scheduled humanities offerings.

Rhet 3375. Humanities: Agricultural Heritage. (4 cr) Examination and analysis of significant events or periods affecting rural agricultural peoples as expressed in historical, cultural, and literary documents. Understanding of major values, attitudes, and philosophies related to agricultural change and development.

Rhet 3380. Humanities: The Literature of Social Reflection. (2 cr)

Brief examination of contemporary social issues as reflected in cultural documents. Use of imaginative literature as a forum where social questions are discussed, evaluated, and resolved.

Rhet 3381. Humanities: 20th-Century Culture. (4 cr)

The changing structure of 20th-century culture from World War I to the present. Communism, fascism, and democracy. Modern movements in literature, the visual arts, and architecture.

Rhet 3382. Humanities: Ethics of Total War. (3 cr)

World War II included combatants and noncombatants in the ethical dilemmas of total war: the holocaust, unrestricted submarine warfare, indiscriminate bombing, the atomic bomb. These dilemmas are experienced through works of art: films, novels, music, painting.

Rhet 3390. Humanities: Technology, Self, and Society. (4 cr; prereq jr, STC major or preSTC or Δ)

Major shifts in technology from 19th century to the present in the United States, especially in relation to capitalism. Technology and the concepts of nature, work, political and social organization, and self. Interdisciplinary materials used.

Rhet 3395. In Search of Nature. (4 cr)

The human need for a relationship with nature, images of nature developed from this need, and the ways humans organize their surroundings to reflect this need. Contemporary American response.

Rhet 3400. Managing Information on the Internet. (3 cr; prereq 1200 or equiv; A-F only)

Explore and construct information on the Internet. Discuss issues and controversies associated with the Internet. Prepare an on-line hypertext document that provides examples of Internet resources for students in their major.

Rhet 3441. Reading and Analyzing Scientific and Technical Text. (4 cr, \$1441; prereq 1104 or equiv)

Efficiently and effectively identify, read, analyze, and comprehend scientific and technical text.

Rhet 3562. Writing in Your Profession. (4 cr; prereq fr comm req, 1151, jr or sr status; A-F only)

Projects in writing professional reports. Analyses of audience and situation; writing effectively to meet the needs of particular readers. Assignments include writing instructions, feasibility report, proposal, memorandum, letter of application, and résumé.

Rhet 3565. Writing for Publication. (4 cr; prereq 3562, #)

Writing and preparing manuscripts for publication; adaptation to specialized and general reader; professional, trade, and general publications; information sources and topic selection; marketing techniques.

Rhet 3572. Procedures and Policies Manual. (3 cr; prereq STC major or preSTC, fr comm req, 3562 or #)

Problem analysis, process management, gathering information, writing procedures, verification, constructing the finished manual.

Rhet 3574. Publications Management. (3 cr; prereq 3562; A-F only)

Management of publications from initial receipt of manuscript to first publication. Scheduling, layout and design, liaisons with printers or authors, typography, processing illustration.

Rhet 3575. Newsletter. (3 cr; prereq STC major or preSTC, fr comm req, 3562 or #)

Newsletter design and production. Students learn to write and edit newsletter articles and gain hands-on experience in typography, graphic design, formatting, layout, and distribution procedures. Production of a newsletter using desktop publishing software on Macintosh computer.

Rhet 3582. Senior Seminar. (3 cr; prereq sr)

Discussions of professional and ethical issues and problems related to technical communication. A capstone course, integrating oral, written, visual, organizational, and theoretical competencies.

Rhet 3670. Visual Rhetoric: Theories and Applications. (4 cr; prereq 1200 or equiv, 3562 or equiv, STC or preSTC major or #)

Theoretical and practical aspects of visual rhetoric in scientific and technical communication. Develops visual literacy by introducing terms, rhetorical considerations, design principles, tools and applications, and ethical and social responsibilities. Lecture and lab.

Rhet 3690. Scientific Controversy. (3 cr; prereq 1101 or equiv)

Personal, social, and political challenges created by science and technology. Controversies include animal experimentation, organ transplants, frozen embryos, ozone depletion, pollution, and nuclear waste. Public discourse on these issues examined from a rhetorical point of view.

Rhet 3700. Rhetorical Theory: Persuasion and the Literature of Science. (3 cr; prereq fr comm req)

Principles and history of rhetorical theory and criticism. Emphasis on classical theories, especially those of Plato and Aristotle. Practice of rhetorical criticism of contemporary communication, including scientific communication.

Rhet 5100. Technical Communication: Special Problems. (Cr ar; prereq #, Δ)

Supervised reading, research, and work on advanced technical communication projects not covered in regularly scheduled courses.

Rhet 5105. Corporate Video for Technical Communicators. (4 cr, \$3105)

Video production including video team roles, production technology, and the development process. Students apply rhetorical principles in analyzing video, develop a treatment, write a script, and prepare an annotated bibliography on a video-related topic.

Rhet 5165. Studies in Organizational Communication, Conflict, and Change. (4 cr; prereq fr comm req or equiv or grad status)

Roles of internal and external organizational communication, conflict-problem identification, and change processes. Contemporary theory and research in organizational development. Methods of problem identification and diagnosis. Change processes and applications to actual organizational settings.

Rhet 5170. Managerial Communications. (4 cr; prereq fr comm req or equiv or grad status)

Analysis of a manager's position in an organizational communication network. Focus on the possible forms, contexts, and functions of a manager's communication. Assessing and developing personal competence and confidence in managerial communication. Lectures, discussions, readings, experiential exercises, field research.

Rhet 5180. Internship in Scientific and Technical Communication. (2-6 cr; prereq STC major or grad, #, Δ; S-N only)

On-the-job experience at the University or in industry or government.

Rhet 5258. Interviewing: Dynamics of Face-to-Face Communication. (4 cr)

Intrapersonal and interpersonal skills in interviewing situations. Students learn to understand and use appraisal, reprimand, complaint, persuasion, problem solving, and counseling interview techniques, and participate in a research interview project. Equal emphasis on the interviewer and interviewee roles.

Rhet 5400. Communication Program Planning and Evaluation. (4 cr; prereq jr, sr or grad status and/or comm work exper)

Methods and process for planning and evaluating communication and information activities in organizations. Study of examples, materials and resources for planning, budgeting, and assessing organizational communication programs.

Rhet 5500. Research in Communication Strategies. (4 cr)

Fundamental terminology of descriptive and experimental research, communication research, questionnaire techniques, interviewing techniques, survey and experimental designs, the steps in organizing and conducting field and empirical research, and basic statistical and computer techniques. Emphasis on application of various research methods to particular communication strategies or settings.

Rhet 5531. Scientific and Technical Communication Course Development: Philosophy and Methodology. (4 cr; prereq 3562, STC sr or RSTC grad or #)

Reading, observation, and discussion of teaching theories and methodologies as they relate to composition and to scientific and technical communication. Emphasis on learning to teach first-year college students written or oral persuasive strategies. Students practice assignment and course development, justification and evaluation.

Rhet 5532. Scientific and Technical Communication Course Development: Mentored Teaching. (2 cr; prereq 5531, STC or RSTC grad or #)

With a faculty mentor, students teach course units, prepare and evaluate course assignments, and conduct conferences with student writers or speakers. Through observation and practice, students help oversee the educational process within an actual course.

Rhet 5533. Scientific and Technical Communication Course Development: Teaching Seminar. (1 cr; prereq 5532, STC or RSTC grad or #)

Usually concurrently with their first teaching assignments, students share observations and solve teaching problems within the seminar setting.

Rhet 5540. Topics in Scientific and Technical Communication. (Cr ar; prereq #)  
Topics announced in *Class Schedule*.

Rhet 5560. Editing for Technical Communication. (4 cr; prereq STC premajor or major or grad; A-F only)  
Editorial process; editor-writer relationship; copyediting; preparing scientific and technical documents; handling format, visuals, and quantitative materials.

Rhet 5562. Theory and Practice in International and Intercultural Communication. (4 cr; prereq 3562 or #)

Differences between international, intercultural, and development communication. Cultural contexts examined by comparing research and theoretical models in three types of communication and, on the personal level, through interviews; case studies demonstrate impact of cultural contexts on business globalization.

Rhet 5573. Grant Proposal. (3 cr; prereq STC major or preSTC, fr comm req, 3562 or grad status or #)

Writing the grant proposal, including establishing credibility, problem statement, program objectives, plan of action, evaluation, budget presentations, and proposal summary. Both real and hypothetical situations.

Rhet 5581. Document Design. (4 cr; prereq 3562, STC sr or grad; A-F only)

Designing document to meet user's need, completing draft, and evaluating effectiveness. Forms and software documentation (user guides, reference manuals, tutorials, and input sheets) for databases, decision aids, computer-aided instruction, on-line programs, or visual displays. Mandatory lab time as part of project team of programmers, subject matter specialists, and communication specialists.

Rhet 5600. Transfer of Technology. (4 cr; prereq sci comm work exper or #)

Methods of transferring scientific and technical knowledge and practice. Review of research in diffusion and transfer methods at different technical levels. Tools, methodologies, and assessment procedures for managing a program. Assessment and design plan.

Rhet 5680. Gender and the Rhetoric of Science and Technology. (4 cr; prereq 1101 or equiv)

How cultural gender roles and biological sex attributes influence communication within scientific and technical communities. Communication strategies of professional writers, scientists, and technologists.

Rhet 5700. Rhetorical Theory and Scientific and Technical Communication (4 cr; prereq grad or #; A-F only)

Principles and history of rhetorical theory and criticism. Classical theories, especially those of Plato and Aristotle. Practice of rhetorical criticism of contemporary communication, including scientific communication. Study of contemporary scholarship in the rhetoric of science and technical communication.

Rhet 5999. Special Workshop in Rhetoric. (1-4 cr; prereq #)

Workshops on a variety of topics in rhetoric offered for credit at locations other than the Twin Cities campus. Consult *Class Schedule* or department for current offerings.

## For Graduate Students Only

(For descriptions, see Rhetoric in the *Graduate School Bulletin*)

Rhet 8100. Research Methods in Rhetoric and Scientific and Technical Communication

Rhet 8101. Rhetoric and Technical Communication Writing Seminar

Rhet 8110. Theory and Research in Audience Analysis

Rhet 8170-8171. Design Project

Rhet 8210. Theory and Research in Media Selection

Rhet 8258. Informational Research Interviewing in Scientific and Technical Communication

Rhet 8500. Qualitative Research: Strategies in Technical Communication

Rhet 8510. Theory and Practice in Designing Messages

Rhet 8515. Topics in the Rhetoric of Science and Technology

Rhet 8525. Topics in Culture and Communication

Rhet 8535. Topics in Scientific and Technical Communication Pedagogy

Rhet 8666. Doctoral Pre-Thesis Credits

Rhet 8777. Thesis Credits: Master's

Rhet 8888. Thesis Credits: Doctoral

Rhet 8990. Special Problems in Rhetoric and Scientific and Technical Communication

## Science in Agriculture (ScAg)

ScAg 1001f. Orientation to Science in Agriculture. (1 cr; S-N only)

Introduction to the Science in Agriculture major. Discussion of program and career planning and professional development. Interviews with faculty and other resource persons. Current issues concerning science in agriculture.

## Symbols

The following symbols are used throughout the course descriptions in lieu of page footnotes.

\* ..... Courses in which graduate students may prepare Plan B projects.

, ..... The comma, used in prerequisite listings, means "and."

† ..... All courses preceding this symbol must be completed before credit will be granted for any quarter of the sequence.

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UC ..... University College (formerly Continuing Education and Extension)

f,w,s,su .. Following a course number, indicates fall, winter, spring, or summer terms.

1011, 1012, 1013

..... Series courses, separated by commas; may be entered any quarter.

1011-1012-1013

..... Sequence courses, separated by hyphens; must be taken in order listed.

Courses primarily for freshmen and sophomores are numbered 1000 through 1998; for juniors and seniors, 3000 through 3998; for juniors, seniors, and graduate students, 5000 through 5998. Courses numbered 8000 and above are restricted to students registered in the Graduate School. A prerequisite course listed by number only (e.g., prereq 5246) is in the same department as the course being described.

ScAg 1500. Biotechnology: Society and the Environment. (3 cr)

Biotechnology as part of a liberal education or as preparation for careers in science. Genetic engineering, applications of biotechnology to microbes, plants and animals, and legal and ethical issues.

ScAg 5009. Undergraduate Senior Thesis: Science in Agriculture. (1-5 cr)

In-depth undergraduate research and thesis experience for senior students (9 credits total required for Science in Agriculture major). Research conducted under the supervision of a COAFES faculty member; recommended course length is one full academic year. The research experience culminates with a written, bound thesis and oral presentation of research results.

## Soil, Water, and Climate (Soil)

Soil 1020. The Soil Resource. (5 cr, §3125)

Physical, chemical, and biological aspects of soils. Use of the soil classification system to understand the use of soil survey information for land-use planning. Concepts of soil fertility for understanding plant growth requirements. Introduction to urban soils and their management. Understanding soil's role in environmental planning and conservation decisions.

Soil 1425. Introduction to Meteorology. (4 cr, §Geog 1425)

Pre-calculus introduction to nature of atmosphere and its behavior. Atmospheric composition, structure, stability, and motion; precipitation processes, air masses, fronts, cyclones and anticyclones; general weather patterns; meteorological instruments and observations; plotting and analysis of maps; forecasting.

Soil 3125. Basic Soil Science. (5 cr, §1020; prereq Chem 1051)

Basic physical, chemical, and biological properties of soil. Soil genesis, classification, and principles of soil fertility. Lecture, lab, recitation.

Soil 3220. Soil Conservation and Land-Use Management. (4 cr; prereq 1020 or 3125 or #)

Soil erosion and land degradation processes on rural and urban landscapes. Technical, historical, economic, social, and international considerations of soil conservation. Land-use management practices for soil conservation and methods of natural resource assessment. Lecture, field trips, computer lab.

Soil 3416. Plant Nutrients in the Environment. (4 cr; prereq 3125)

Basic concepts related to plant nutrient availability in soils. Emphasis on the dynamic reactions of mineral elements in soil and water, and subsequent evaluation for plant growth and the environment. Lecture and recitation.

Soil 3417. Plant Nutrients in the Environment Laboratory. (1 cr; ¶Soil 3416)

Diagnostic techniques by measuring specific soil fertility parameters. Lab and recitation.

Soil 3421. Climatology. (4 cr, §Geog 3421; prereq 1425 or Geog 1425)

Radiation and energy budgets; the hydrologic cycle; general circulation; climatic classifications and world distribution of climatic types; climatic change and fluctuations.

Soil 3521. Collegiate Soil Judging. (1 cr; may enroll for max 3 cr; prereq 5510)

Methods of collegiate soil judging. Participation on soil judging team during regional or national contests required.

Soil 3612. Soil Biology and Fertility: Reaching for Sustainable Agricultural Production. (4 cr; Chem 1001 recommended)

Developments in soil biology and fertility, role and significance of different groups of organisms in the soil, and how the interaction of humans and microbes affects the soil fertility and plant growth. It assumes minimum knowledge of chemistry and biology, and explains broad change rather than specific chemical reactions.

Soil 5000. Professional Experience Program. (4 cr; prereq 12 cr soil, #; not for grad cr; UC only)

Up to 12 weeks of experience in a position related to soil science. Evaluation of work experience by employer and faculty adviser in consultation with student and employer.

Soil 5020. Environmental Impact Assessment. (4 cr; prereq jr or sr, 5510, 16 cr sci, ApEc 3610, or #)

Understanding the environmental impact assessment process. Roles of governmental agencies, consultants, and private citizens. Steps needed to write an environmental impact statement (EIS). Examining case studies, writing additional components of EIS, and preparing an EIS for a small local project.

Soil 5022. Introductory Soil Science for Teachers. (4 cr, §1020; prereq 1 college chemistry course, ed degree, #; limited to 10)

Physical, chemical, and microbiological properties of soil. Soil classification system used to understand soil survey information for land use planning. Soil fertility as it relates to environmental planning and conservation decisions. Qualified students may register for graduate credit at the University of Minnesota. Meets concurrently with 1020.

Soil 5100. Problem Solving in Environmental Science. (5 cr; prereq sr)

Solving a real world problem. Discussion, assignments, and problems reflect diverse aspects of the environmental problem. Oral and written presentations. Students participate as a member of a team.

Soil 5104. Computer Applications in Soil Science. (2 cr; prereq 1020/3125 or equiv, #)

Problem-solving methods in soil science. Applications in soil climatology, chemistry-fertility-microbiology, genesis-inventory, and physics. Use of spreadsheets, relational databases, geographic information systems, and simulation models. Hands-on experience in computer lab. Computer programming experience not required.

Soil 5110. Practicum Internship in Precision Agriculture. (2-4 cr; prereq sr or grad, #)

Precision agriculture internship in agri-industry or a governmental agency.

Soil 5114. Special Problems in Soils. (1-7 cr per qtr; prereq 3125 or #, Δ)

Research, readings, and instruction.

Soil 5183. Water Relations, Mineral Nutrition, and Translocation in Higher Plants. (4 cr; prereq PBio 3131 or equiv)

Transport processes in plants, including water and nutrient absorption and distribution, effects of and adaptations to water and nutrient stress, functions of mineral nutrients, translocation of photosynthesis.

Soil 5210. Environmental Biophysics. (3 cr; prereq Math 1251, Phys 1041 or #)

Physical microenvironment and energy/mass exchange processes among soils, plants, animals, and atmosphere. Energy transfer (sensible, latent, radiation, mass [H<sub>2</sub>O, CO<sub>2</sub> trace gases]) calculation using mathematical models and energy budget analyses. Lecture and recitation.

Soil 5211. Environmental Instrumentation. (2 cr; prereq 5210, 5240 or #)

Measuring environmental variables and analyzing energy and mass exchange based on such measurements. Operating environmental instruments and finding sources of error in measurements. Hands-on use of instruments is emphasized. Lecture, recitation, and instrumentation lab.

Soil 5232. Soil Physics: Transport Processes in Soil. (4 cr; prereq Math 1142, 2 qtrs physics or #)

Fundamentals of soil physical properties and processes. Physical laws governing transport of water, chemicals, air, and heat in soils. Lecture, lab, problem-solving sessions.

Soil 5241. Microclimatology. (3 cr; prereq Math 1031 or 10 cr physics or #)

Meteorology and climatology in relation to the soil-atmosphere interface with emphasis on the microclimate, physical processes taking place within the microclimate, modification of the microclimate description of meteorological instruments, and use of weather data.

Soil 5310. Soil Chemistry. (3 cr; prereq Chem 3100 or #)

Chemical processes in soil; composition of soil minerals and organic matter, solubility equilibria, adsorption/desorption, ion exchange, formation of soluble complexes, oxidation/reduction, acidity, alkalinity. Discuss solution of problems related to environmental degradation, plant nutrition, and soil genesis.

Soil 5311. Soil Chemistry Lab. (2 cr; ¶5310)

Lab exercises illustrate principles of soil chemistry discussed in Soil 5310. Lab techniques used include pH, atomic adsorption spectrophotometry, ion specific electrodes, colorimetry, redox potential, and titration.

Soil 5360. Soil Clay Mineralogy. (3 cr; prereq sr or grad)

Structural chemistry, origin, and identification of crystalline and noncrystalline soil clay materials. Extent, importance, and pedologic implications.

Soil 5361. Soil Clay Mineralogy Laboratory.

(1-4 cr; prereq ¶5360, #)

Individual lab assignments emphasizing techniques of clay mineral identification and analysis. X-ray diffraction, electron optical, thermal, selective dissolution, FTIR spectrosopic, and other methods of analysis.

Soil 5424. Applied Climatology. (3 cr; prereq 5240 or Geog 3421 or #)

For advanced undergraduates and beginning graduate students who have a background in climatology or microclimatology principles. Sources of climatic data, methods of analysis, and selected set of specific applications focusing on agricultural and environmental management problems.

Soil 5510. Field Study of Soils: Morphology.

(1 cr; prereq 1020 or 3125 or #)

The art and science of writing and classifying soil profile descriptions in the field.

Soil 5511. Field Study of Soils: Mapping (1 cr; prereq 5510 or ¶5510)

The art and science of making soil maps based on soil profile descriptions.

Soil 5515. Soil Development, Classification, and Geography. (4 cr; prereq 3125 or #)

Soil profile characteristics; influence of parent material, climate, topography, vegetation, and time on soil development; system of soil classification and geographical distribution of soil orders.

Soil 5550. Peatlands: Formation, Classification, and Utilization. (3 cr; prereq 1020 or 3125 or #)

Formation, properties, and management of peatlands important to crop, forestry, and energy production in this state and worldwide. Lecture.

Soil 5555. Wetland Soils. (4 cr; prereq 1020 or 3125 or #)

Lecture and field-based instruction on the formation, classification and utilization of wetland soils with emphasis on hydric soil identification. Emphasis on soil hydrologic and biochemical processes. Field-based exercises to map hydric soils plus two Saturday field trips and laboratory exercises.

Soil 5600. Principles of Waste Management. (4 cr; prereq Biol 1009 or Chem 1051, Stat 3011 or #)

Issues, problems, and solutions in remediating waste. Waste stream dynamics, municipal solid waste and yard waste composting, waste to energy incineration operation, ash disposal, recycling, landfill and direct land disposal requirements, regulatory trends, case studies.

Soil 5605. Microbial Ecology. (3 cr; prereq 5610 or Biol 5013 or MicB 5105 or #)

Interrelationship of microorganisms with terrestrial, aquatic, and organismal environments; survey of bacterial, fungal, and algal components of ecosystems; evolution and structure of microbial communities; population interactions within ecosystems; quantitative and habitat ecology; biogeochemical cycling; biotechnological approaches to studying microbial ecology.

Soil 5610. Soil Biology. (4 cr; prereq sr or grad)

Soil environment and its biological population. Role of living organisms in soil-plant environment and mineral transformations of agronomic importance (carbon, nitrogen, phosphorus, sulfur, and heavy metals). Effects of soil microflora on soil fertility and plant nutrition. Lecture, lab, weekly discussion.

Soil 5611. Soil Biology Laboratory. (1 cr; ¶5610)

Lab exercises demonstrating principles discussed in Soil 5610. Techniques include counting microbes in the soil, purification and classification of soil microorganisms, the role of earthworms in nutrient cycling, nodulation and N<sub>2</sub> fixation, serology.

Soil 5710. Forest Soils. (3 cr; prereq 1020 or 3125)

Factors affecting tree growth; estimation, modification, and management effects on site productivity; regeneration.

Soil 5999. Special Workshop in Soil, Water, and Climate. (1-4 cr; prereq #)

Workshops on a variety of topics in soil, water, and climate offered for credit at locations other than the Twin Cities campus. Consult *Class Schedule* or department for current offerings.

## For Graduate Students Only

(For descriptions, see *Graduate School Bulletin*)

Soil 8000. Supervised Teaching Experience

Soil 8111. Colloquia: Tropical Soils

Soil 8112. Colloquia in Soil Science II

Soil 8124. Research Problems in Soils

Soil 8128. Seminar

Soil 8250. Advanced Soil Physics

Soil 8330. Advanced Soil Chemistry

Soil 8400. Advanced Topics in Soil Fertility Plant Nutrition

Soil 8630. Current Topics in Biological Nitrogen Fixation

## Statistics (Stat)

Offered by the College of Liberal Arts

Stat 1001. Introduction to Ideas of Statistics. (4 cr; prereq high school higher algebra)

Controlled vs. observational studies; presentation and description of data; correlation and causality; sampling; accuracy of estimates; tests.

Stat 3011-3012. Statistical Analysis. (4 cr per qtr; prereq college algebra)

Descriptive statistics; elementary probability; estimation; one- and two-sample tests; correlation; regression. ANOVA; randomized blocks; multiple comparisons; factorial experiments; multiple regression; goodness of fit; nonparametric methods; contingency tables; selected topics.

Stat 5021. Statistical Analysis. (5 cr, §3012; prereq college algebra or #)

Intensive version of Stat 3011-3012. Primarily for graduate students needing statistics as a research technique.

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## Veterinary Medicine, College of (CVM)

Offered by the College of Veterinary Medicine

CVM 1100. Introduction to Veterinary Medicine. (1 cr)

History of the veterinary profession, careers within the profession, employment trends. Resources available to those interested in a career in the profession, including the College of Veterinary Medicine and animal health technology courses offered in Minnesota.

CVM 3100. Perspectives: Interrelationships of People and Animals in Society Today. (2 cr, §PubH 3301, §PubH 5301)

Interrelationships of people and animals from several viewpoints. The social, economic, and health consequences of these relationships, including issues such as pets and people sharing an urban environment, animal rights, and the influence of cultural differences on animal-human relationships.

## Veterinary PathoBiology (VPB)

Offered by the College of Veterinary Medicine

VPB 3103. General Microbiology. (3-5 cr; prereq 4 cr biol sci, 10 cr chem; not open to vet med students)

Lectures and lab exercises on the morphology, taxonomy, genetics, physiology, and ecology of microorganisms. Practical application of fundamental principles of microbiology to other phases of science and industry.

VB 5140. Vertebrate Microanatomy. (1-6 cr; prereq 5120 or #)

Microscopic structure and cytochemical and functional aspects of cells, tissues, and organs of representative examples of vertebrates. Four units: basic tissues (2 cr); gastrointestinal tract (1 cr); respiratory and integumentary systems (1 cr); and excretory, reproductive, and endocrine systems (2 cr). Depending on background and interest, students may register for any or all units.

VB 5320. Avian Physiology. (5 cr; prereq AnSc 3301 or 6 cr systemic phys or equiv, #; offered even yrs) Physiology of wild and domestic birds.

VPB 5603. Parasites of Wildlife. (2 cr; prereq 5601, 5602 or #; offered odd yrs)

In-depth examination of the epidemiology and disease potential of some of the more significant helminth, arthropod, and protozoan parasites of regional wild mammals and birds. Term paper required.

VPB 5707. Poultry Disease Control. (3 cr; prereq AnSc 1100, Biol 1106, VPB 3103 or equiv; not open to vet med students)

General anatomy; physiology of digestion and reproduction; prevention and control of the more important diseases affecting poultry.

**This is the Policies, Department Directory, and Administration and Faculty sections of the 1996-1999 University of Minnesota College of Agricultural, Food, and Environmental Sciences Bulletin.**



Directory

**Equal Opportunity**—The University of Minnesota is committed to the policy that all persons shall have equal access to its programs, facilities, and employment without regard to race, color, creed, religion, national origin, sex, age, marital status, disability, public assistance status, veteran status, or sexual orientation.

In adhering to this policy, the University abides by the Minnesota Human Rights Act, Minnesota Statute Ch. 363; by the Federal Civil Rights Act, 42 U.S.C. 2000e; by the requirements of Title IX of the Education Amendments of 1972; by Sections 503 and 504 of the Rehabilitation Act of 1973; by the Americans With Disabilities Act of 1990; by Executive Order 11246, as amended; by 38 U.S.C. 2012, the Vietnam Era Veterans Readjustment Assistance Act of 1972, as amended; and by other applicable statutes and regulations relating to equality of opportunity.

Inquiries regarding compliance may be directed to Stephanie Lieberman, Director, Office of Equal Opportunity and Affirmative Action, University of Minnesota, 419 Morrill Hall, 100 Church Street S.E., Minneapolis, MN 55455 (612/624-9547).

**Bulletin Use**—The University of Minnesota will change to a semester-based academic calendar beginning academic year 1999-2000. This bulletin is the last quarter-based bulletin that will be produced for the College of Agricultural, Food, and Environmental Sciences. It covers academic years 1996-97, 1997-98, and 1998-99. Information about semester-based academic programs will be provided in the fall of 1998 in semester-transition publications.

The information in this bulletin and other University bulletins, publications, or announcements is subject to change without notice. University offices can provide current information about possible changes.

This publication is available in alternative formats upon request. Please contact the Office of Admissions, University of Minnesota, 240 Williamson Hall, 231 Pillsbury Drive S.E., Minneapolis, MN 55455 (612/625-2008; e-mail admissions@tc.umn.edu).

This bulletin also is available in electronic format on the Internet and may be accessed via the World Wide Web.

**Course Guide**—The *Course Guide*, a quarterly publication distributed at the University Bookstores, provides course information in addition to college bulletins and the *Class Schedule*.

**Immunization**—Students born after 1956 who take more than one University class are required under Minnesota law to submit an Immunization Record form.

The form, which is sent along with the official University admission letter, must be filled out and returned to Boynton Health Service within 45 days of the first term of enrollment in order for students to continue registering for classes at the University. Complete instructions accompany the form.

**Extracurricular Events**—No extracurricular events requiring student participation may be scheduled from the beginning of study day to the end of finals week. Exceptions to this policy may be granted by the Senate Committee on Educational Policy. The Senate advises all faculty that any exemption granted pursuant to this policy shall be honored and that students who are unable to complete course requirements during finals week shall be provided an alternative and timely opportunity to do so.

**Smoke-Free Campus Policy**—Smoking is prohibited in all facilities of the University of Minnesota, Twin Cities campus except for designated private residence hall rooms.

## Departments

The College of Agricultural, Food, and Environmental Sciences is organized by academic departments. Each department is made up of faculty with teaching, research, and extension interests that correspond with the department's academic discipline(s). Following is a list of departments in the College of Agricultural, Food, and Environmental Sciences. Several departments and units also have formal affiliations or administrative links to colleges outside of Agriculture: Agricultural Education with the College of Education and Human Development (CEHD), Agricultural Engineering with the Institute of Technology (IT), Food Science and Nutrition with the College of Human Ecology (CHE).

Each of the departments in COAFES offers courses and most have ties with several of the undergraduate majors offered by the college. If you are interested in a major with ties to a specific department or academic discipline, you will find a reference list below along with the department location.

### Department Directory

#### *Agricultural Education*

Edgar A. Persons, head  
320 Vocational and Technical Education Building  
1954 Buford Avenue  
St. Paul, MN 55108  
612/624-2221

#### Affiliated majors

- Agricultural Education (CEHD) (p. 11)
- Agricultural Development (CEHD) (p. 11)
- Natural and Managed Environmental Systems (CEHD) (p. 11)

#### *Agromony and Plant Genetics*

Kent Crookston, head  
411 Borlaug Hall  
1991 Upper Buford Circle  
St. Paul, MN 55108  
612/625-8761

#### Affiliated majors

- Agricultural Industries and Marketing (p. 14)
- Animal and Plant Systems (p. 16)
- Science in Agriculture (p. 26)

#### *Animal Science*

Donald Otterby, head  
122 Peters Hall  
1404 Gortner Avenue  
St. Paul, MN 55108  
612/624-1205

#### Affiliated majors

- Agricultural Industries and Marketing (p. 14)
- Animal and Plant Systems (p. 16)
- Science in Agriculture (p. 26)

#### *Applied Economics*

James Houck, head  
231 Classroom Office Building  
1994 Buford Avenue  
St. Paul, MN 55108  
612/625-0231

#### Affiliated majors

- Applied Economics (p. 20)
- Agricultural Business Management (p. 9)
- Agricultural Industries and Marketing (p. 14)

#### *Biosystems and Agricultural Engineering*

R. Vance Morey, head  
213 Agricultural Engineering  
1390 Eckles Avenue  
St. Paul, MN 55108  
612/625-7733

#### Affiliated majors

- Biosystems and Agricultural Engineering (IT) (p. 32)
- Environmental Science (p. 21)
- Food Science (p. 23)

#### *Entomology*

Mark Ascerno, head  
219 Hodson Hall  
1980 Folwell Avenue  
St. Paul, MN 55108  
612/624-3278

#### Affiliated majors

- Agricultural Industries and Marketing (p. 14)
- Animal and Plant Systems (p. 16)
- Science in Agriculture (p. 26)

#### *Food Science and Nutrition*

Francis F. Busta, head  
225 Food Science and Nutrition  
1334 Eckles Avenue  
St. Paul, MN 55108-6099  
612/624-3086  
E-mail: fbusta@maroon.tc.umn.edu or  
sahlers@che2.che.umn.edu  
World Wide Web: <http://www.fsci.umn.edu>

#### Affiliated majors

- Agricultural Industries and Marketing (p. 14)
- Food Science (p. 23)
- Nutrition (p. 24)

#### *Horticultural Science*

Gary Gardner, head  
305 Alderman Hall  
1970 Folwell Avenue  
St. Paul, MN 55108  
612/624-3606

#### Affiliated majors

- Agricultural Industries and Marketing (p. 14)
- Animal and Plant Systems (p. 16)
- Science in Agriculture (p. 26)

#### *Plant Pathology*

Neil A. Anderson  
495 Borlaug Hall  
1991 Upper Buford Circle  
St. Paul, MN 55108  
612/625-8200

#### Affiliated majors

- Agricultural Industries and Marketing (p. 14)
- Animal and Plant Systems (p. 16)
- Science in Agriculture (p. 26)

#### *Rhetoric*

Billie J. Wahlstrom, head  
202 Haecker Hall  
1364 Eckles Avenue  
St. Paul, MN 55108  
612/624-7750  
World Wide Web: <http://rheteoric.agoff.umn.edu/>

#### Affiliated majors

- Agricultural Industries and Marketing (p. 14)
- Scientific and Technical Communication (p. 27)

#### *Soil, Water, and Climate*

H.H. Cheng, head  
439 Borlaug Hall  
1991 Upper Buford Circle  
St. Paul, MN 55108  
612/625-9734  
World Wide Web: <http://www.soils.agri.umn.edu>

#### Affiliated majors

- Agricultural Industries and Marketing (p. 14)
- Animal and Plant Systems (p. 16)
- Environmental Science (p. 21)
- Science in Agriculture (p. 26)

## University Regents

Thomas R. Reagan, Gilbert, Chair  
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