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College of Food, Agricultural and Natural Resource Sciences

General Information

The College of Food, Agricultural and Natural Resource Sciences (CFANS) offers 14 undergraduate majors, four pre-majors and 22 minors on a picturesque, close-knit campus where students meet some of the best professors in the world and outstanding students from all over.

CFANS is focused on helping students experience the joy of discovering solutions through science: CFANS calls it Solution-Driven Science™. Its students and faculty are working to discover new agricultural practices that increase yields and improve the environment, more nutritious and flavorful foods, and ways to conserve natural resources and biodiversity in the face of global climate and environmental change.

CFANS is also making discoveries and preparing students for the emerging bioeconomy and biofuels industry. These are important problems to solve, and CFANS is making progress.

The college encourages students to visit. The St. Paul campus offers the convenience of a small college, the rewards of learning at a top research university, and the fun of living in a vibrant and exciting urban area.

CFANS student learning communities help students get to know their major, fellow students, and professors. Distinguished faculty members share their knowledge, enthusiasm, and experience with students every day, teaching undergraduate courses and acting as academic advisors. The St. Paul campus features a wireless learning environment, and when students need extra help, a strong academic support system is in place to make sure they succeed. CFANS is an active participant in the University’s study abroad initiative to send 50 percent of undergraduate students abroad during their four years at the University. The St. Paul Campus Career Center works closely with students to help them land exciting summer internships and, most importantly, great jobs in fields related to their studies after graduation.

Whether students are interested in animals, bioresources and plant sciences, or foods and health, CFANS is the perfect place for academic and personal growth!

Admission

Guidelines for admission to the College of Food, Agricultural and Natural Resource Sciences for high school graduates, transfer students, transfers within the university system, and non-degree-seeking students are explained below. For more information, call the Office of Admissions, 612-625-2008 or 800-725-1000.

Students seeking admission as new freshmen or as transfers from outside the University of Minnesota system apply through the Office of Admissions, 240 Williamson Hall, 231 Pillsbury Drive S.E., Minneapolis, MN 55455 (612-625-2008).

For official and up-to-date information about the University’s admissions policies, procedures, and deadlines, please see the latest edition of the Undergraduate Application Booklet available from the Office of Admissions or online at [http://admissions.tc.umn.edu](http://admissions.tc.umn.edu).

Deadlines—The Office of Admissions typically accepts applications for fall semester beginning the fall of the preceding year and admits students as long as space is available. Admission to the University of Minnesota is competitive. Each application is carefully reviewed and admission decisions are based on an overall assessment of primary and secondary review factors seen at [http://admissions.tc.umn.edu](http://admissions.tc.umn.edu). Final deadlines are June 1 for fall semester and October 15 for spring semester.

High School Graduates—High school graduates need to complete the University’s high school course preparation requirements. (See Freshman Admission in the General Information section of this catalog).

Transfer Students—Students may apply for admission to the College of Food, Agricultural and Natural Resource Sciences from other colleges or universities. Applicants may be accepted if they meet the entrance requirements of CFANS and of the major they wish to pursue. To be competitive for admission, transfer applicants who graduated from high school in 1987 or later should have completed the following:

- Intermediate algebra with a passing grade. CFANS highly recommends that applicants to the major in applied economics or agricultural and food business management must have completed college algebra with a grade of C or higher. AND microeconomics or macroeconomics with a grade of B- or higher.
- A solid foundation in math and science.
- Other high school preparation requirements, including foreign language. (See Core College-Preparatory Subject Requirements in the General Information section of this catalog.)

Applicants who did not complete this coursework during high school may substitute equivalent college coursework. CFANS may admit some students who have not met these guidelines. Students who are admitted but who lack preparation requirements must complete all deficiencies before graduating.

Most successful applicants to majors in food science and nutrition must have completed one semester of inorganic chemistry with lab or one semester of general biology with lab and a grade of C- or better.

After a transfer applicant is admitted, the Office of Admissions and CFANS evaluate all previous college coursework according to University and CFANS standards, and provide the student with a Transfer Credit Evaluation showing how previous coursework has been evaluated. Appropriate credits earned at other accredited colleges and universities or within other units of the University may be applied toward CFANS programs. Most students find they must transfer by their junior year to meet residence and upper division course requirements of CFANS.

Applicants who graduated from high school before 1987 must meet current entrance standards except for the high school preparation and second language requirements.

Transfer students must complete all specific course and area distribution requirements of CFANS regardless of the number of credits accepted for transfer. Therefore, students who begin degree work elsewhere and intend to transfer later should carefully plan pre-transfer courses to meet as many CFANS requirements as possible.
NOTE: A maximum of 3 internship or practical experience credits may be transferred into CFANS.

Change of College Within the University—To transfer to the College of Food, Agricultural and Natural Resource Sciences from another college within the University, students must meet CFANS entrance guidelines. Students must complete an Application for Undergraduate Change of College and apply for transfer at one of the One Stop Student Services Centers on campus. Application deadlines are consistent with posted University admission deadlines.

Non-degree-seeking—Non-degree-seeking admission is primarily for students who are pursuing coursework in CFANS departments but are not seeking a degree, or for students who are preparing to apply to a graduate program offered by CFANS departments but have prerequisites to satisfy. Admission may be processed at any time before the first day of class. The non-degree-seeking category is also open to staff members in CFANS departments who are taking courses through the Regents Scholarship Program and to CFANS graduates returning for coursework.

Students who enter CFANS as non-degree-seeking students with the intention of transferring later to the Graduate School should be aware of restrictions on the number of non-degree-seeking credits that may be transferred to a graduate program. See the Graduate School Catalog.

Degrees/Majors

The College of Food, Agricultural and Natural Resource Sciences offers 14 majors; the major curricula all lead to the bachelor of science degree.

Agricultural and Food Business Management
- Business management
- Financial management
- Individualized
- Marketing, sales, and food industry management

Agricultural Education
- Agricultural leadership, training and development
- Agricultural science and technology education
- Natural and managed environmental education

Agricultural Industries and Marketing
- Crops and soils industries
- Food industries
- Individualized

Animal Science
- Animal industry
- Animal production
- Science/biotechnology/pre-veterinary medicine

Applied Economics
- Food retailing
- Individualized professional
- Management and finance
- Marketing
- Regional and public economics
- Resources and the environment
- Trade and development

Applied Plant Science
- Agroecology
- Plant improvement
- Plant utilization

Bio-Based Products
- Bio-based products marketing and management
- Residential building science and technology

Environmental Horticulture
- Floriculture/nursery production and retail management
- Individualized
- Landscape design
- Landscape implementation and management
- Turfgrass science

Environmental Sciences, Policy and Management
- Conservation and resource management
- Corporate environmental management
- Environmental education and communication
- Environmental science
- Policy, planning, law and society

Fisheries and Wildlife
- Conservation biology
- Fisheries
- Wildlife

Food Science

Forest Resources
- Forest management and planning
- Forest conservation and ecosystem management
- Urban and community forestry

Nutrition
- Nutrition and dietetics
- Nutritional science

Recreation Resource Management
- Recreation resource management
- Resource based tourism

Because the first year of coursework is somewhat similar among many of these programs, students may transfer between majors at the end of their freshman or sophomore year with little or no credit loss.

Each CFANS major requires an orientation class for all incoming students that provides interaction with faculty and alumni in their chosen professional field, and exposure to career, learning abroad, and student life opportunities.

Preprofessional Opportunities

Students may prepare in CFANS for the following upper division/professional programs:

Pre-bioproducts and biosystems engineering (B.S. granted by the Institute of Technology)

Pre-medicine and pre-dentistry

Pre-veterinary medicine

Minors

The College of Food, Agricultural and Natural Resource Sciences offers the following minors:

Agronomy

Animal science

Applied economics

Bio-based products engineering

Climatology

Corporate environmental management

Entomology

Environmental horticulture

Environmental sciences, policy and management

Fisheries and wildlife
Food science
Food systems and the environment
Forest resources
Integrated pest management in cropping systems
International agriculture
Nutrition
Recreation resource management
Soil science
Sustainable agriculture
Sustainability studies
Urban and community forestry
Water science

CFANS students may also apply for a minor in any University department or program. Upon graduation, the minor is listed on the transcript with degree and major. For assistance in planning a minor, contact the Student Services Office. Detailed minor requirements are described in the CFANS Degree Programs and Minors section of this catalog.

Graduate Degrees—The master of science (M.S.) and the doctor of philosophy (Ph.D.) in sixteen areas of study are offered through the Graduate School in cooperation with the College of Food, Agricultural and Natural Resource Sciences. For more information, consult the Graduate School Catalog or CFANS Web site at www.cfans.umn.edu.

Honors

Beginning in fall 2008, the University Honors Program (UHP) will offer rigorous and interdisciplinary curricula along with other honors experiences designed for highly qualified and motivated students. Honors courses, available only to honors students, offer small class sizes, close interaction with world-class faculty, and an engaging learning atmosphere. The University Honors Program serves honors students in all colleges. See the University Honors Program section at the front of this catalog for more information, or visit the University Honors Program Web site at www.honors.umn.edu.

Students admitted before fall 2008 will continue to follow the honors requirements outlined at the time they entered their college honors program. All students admitted to honors as of fall 2008 will follow the requirements of the new University Honors Program. Students admitted to a college honors program before fall 2008 and who change colleges must apply to the UHP if they want to participate in Honors. If admitted, they will be held to the new UHP requirements. See the University Honors Program section of this catalog for further instructions on how to apply.

Graduation With Distinction—See the Policies and University Honors Programs sections of the catalog.

Dean’s List—To be eligible for the Dean’s List, a student must be a current CFANS student and have completed 12 credits (A-F registration) with a GPA of at least 3.667. Students on the Dean’s List receive a letter from the dean and are publicly listed on the college’s Honors and Recognition Web page. The student also receives a notation on his or her transcript for each term he or she is on the Dean’s List.

Policies

Grading—All required courses in the major must be taken A-F with grades of C- or better; students who receive a grade below C- in a major course must repeat the course.

Honor System—Under an honor system adopted on the St. Paul campus, students accept responsibility for the supervision of student behavior during examinations and pledge not to give or receive aid. A student or faculty member who observes an act of dishonesty must report the incident to the Office for Student Conduct and Academic Integrity. For more information about the honor system, contact the Student Services Office.

Directed Study—With instructor approval, students may take custom-designed courses through independent study. Contact the Student Services Office for more information.

Policy Waivers—Occasionally it may be to the educational advantage of both the student and the department to consider an alternative or substitution in an academic policy or curricular requirement, provided the basic spirit of the policy or requirement is maintained. A student may petition for a departure from normal procedure. Students must receive approval from the major coordinator for any major course exceptions and an academic adviser’s recommendation before the petition is routed to the Student Scholastic Standing Committee for consideration of general policy exceptions.

Special Examinations for Credit—Students who believe their knowledge of a subject is equal to that which is required to complete a particular course may request to take an examination for credit. The department and college approve arrangements can be made with an appropriate instructor to take an examination. A fee is assessed for each examination. Credit by special examination is not granted for language or mathematics courses taken in high school.

Suspension—to appeal a suspension (see “Probation” in the Policies section of this catalog), a student must obtain a Petition for Reinstatement from the Student Services Office. The petition must be completed and turned in to the Student Scholastic Standing Committee, along with any supporting documents. The final decision rests with the Student Scholastic Standing Committee, which informs the student of its decision in writing.

Graduation Requirements

To receive the B.S. degree, CFANS students must meet the following requirements.

• Complete the prescribed curriculum as listed in the student’s degree program.
• Achieve a cumulative GPA of at least 2.00, with grades of C- or better in each course in the major. Major course work is defined as all required courses listed in each major program including specialization courses, track courses, concentration courses, professional courses, and writing courses. The only courses not included in this policy are free electives and courses taken beyond those in the major coursework to satisfy liberal education requirements.
• Satisfy liberal education requirements.
• Satisfy residence and other general University requirements.
• Officially apply for graduation.
• Meet all financial obligations to the University.
Advising
Advising services for both current and prospective students are provided by professional academic advisers and by departmental faculty.

Each CFANS student, with adviser assistance, is responsible for learning curricular and graduation requirements and developing a course program and timetable to meet them. All freshmen students are assigned a professional academic adviser for their first year and then assigned a faculty adviser within their major area of study at the beginning of their sophomore year. All transfer students are assigned immediately to a faculty adviser in their major area of study.

Special Learning Opportunities
Many majors in CFANS offer field trips, summer field-sessions, hands-on experiential learning, and other opportunities. Speak with your adviser or major coordinator for more information.

The University of Minnesota’s Undergraduate Research Opportunities Program (UROP) offers financial awards to undergraduates for research, scholarly, or creative projects undertaken in partnership with a faculty member. Applications are accepted in the fall and early spring each year. For more information or an application packet, students should contact the CFANS Student Services Office, 190 Coffey Hall (612-624-6768).

CFANS juniors and seniors may participate in internships 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 or spring semester or during the summer. Students earn 1–3 credits for satisfactory completion of an internship. Students may enroll in two different internships, for a total of 6 credits. Salaries are paid by the cooperating businesses, industries, producers, and agencies participating in the program. For more information, students should consult their adviser or the St. Paul Campus Career Center in 198 McNeal Hall (612-624-2710).

Student Learning Communities in CFANS provide the glue that holds an undergraduate’s college experience together. Students create positive academic and social relationships with faculty and other new students as they make the transition to college and become aware of the many resources available on campus and at the University. Each CFANS major has a learning community that intentionally links or clusters two or more courses and enrolls a common group of students with similar academic interests.

Environment House is open to first-year students in Bailey Hall who are enrolled in one of CFANS’s environment-related majors. Environment House helps students get to know each other and their professors through weekend retreats, field trips, speakers and special programs.

Pre-Veterinary Medicine House, also located in Bailey Hall, offers an array of social and professional programs to help students learn more about animal-related careers and educational opportunities. Programs include study groups and tutoring, opportunities to participate in animal-related service activities, and off-campus visits to sites of interest.

Scholarships
The College of Food, Agricultural and Natural Resource Sciences provides significant scholarship support to its undergraduate students. Scholarships are awarded on the basis of merit. The college makes it easy by using one application form for more than 65 named scholarships. Alumni, friends, and corporate sponsors generously provide scholarship money to encourage outstanding students to prepare for careers in agriculture, business, natural resources, and communications industries.

International Programs
The College of Food, Agricultural and Natural Resource Sciences offers several types of study abroad that can especially enhance degree work, including field study, enrollment in international institutions, and integrated classroom study. International Programs in Food, Agriculture and Natural Resource Sciences (IPFANS) coordinates international opportunities in CFANS (135 Skok Hall; 612-624-3221; http://international.cfans.umn.edu).

Some grants are available through CFANS to help defray costs of overseas study and travel. A written report is required. Preference is given to proposals for study in non-English-speaking countries. Students must initiate and plan the project with the aid of a faculty adviser. For more information, see the Web site at www.cfans.umn.edu/types_of_scholarships.html or contact the CFANS Student Services Office, 190 Coffey Hall (612-624-6768).

Students fluent in their host country’s language can participate in integrated classroom study programs that permit students to take regular university courses alongside students from the host country. The University’s student exchanges and consortium memberships provide access to universities in many countries. Conservation and resource management, agricultural, business and policy, plant, and animal science curricula are available throughout the world.

CFANS students need not always seek credit in their major. Study abroad is encouraged for language acquisition or cultural learning. The resulting credits can often be used as electives or to fulfill second language or liberal education requirements. The University and other institutions sponsor a broad range of intensive language and area studies programs.

MAST Experience Abroad—The MAST Experience Abroad 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 gain a cross-cultural experience by living and working with a host family in Australia, Austria, Brazil, Denmark, Finland, France, Germany, Italy, the Netherlands, New Zealand, Sweden, Switzerland, or the United Kingdom. Departure dates are in January, April, June, and September. For more information, students should contact the MAST International office, 135 Skok Hall (612-624-3740).

The University of Minnesota offers opportunities through 360 universities in over 70 countries around the world. The Learning Abroad Center, 230 Heller Hall on the West Bank has more information for all of these opportunities. In addition, guidance is available from your adviser. IPFANS staff, or on the Learning Abroad Center’s Web site at www.um abroad.umn.edu. Students are encouraged to attend a First Step meeting, held weekly throughout the semester, to investigate how to proceed with planning and selecting a program that fits their individual educational program.
Career Information

The St. Paul Campus Career Center, 198 McNeal Hall, offers assistance and advice to students seeking summer jobs and internships, as well as permanent employment after graduation. Job search assistance for all students is provided by career services staff and by department faculty. A series of workshops are provided by the center on topics such as résumé writing, interviewing, initiating internship and job searches, and summer/seasonal intern hiring updates. See [www.stpaulcareers.umn.edu](http://www.stpaulcareers.umn.edu) for more information.

Student Organizations

CFANS Student Board—The Student Board promotes student involvement in issues related to the quality and content of education both in and out of the classroom. The board creates channels of communication between the students, faculty, and administration of CFANS. Students may file for election to the board or may serve as a representative of one of the clubs or organizations affiliated with the college. More information is available in the Student Services Office in 190 Coffey Hall.

St. Paul Ambassadors—The St. Paul Ambassadors is a voluntary, honorary organization consisting of CFANS undergraduate students who assist in promoting the college to prospective students and their parents, alumni, potential donors, and the community. Ambassadors gain experience in public relations and recruitment, and develop communications skills through public speaking engagements and small group discussions with prospective students. More information is available in the Student Services Office in 190 Coffey Hall.

St. Paul Board of Colleges—The St. Paul Board of Colleges directs and coordinates student activities and encourages student leadership throughout the St. Paul campus. Its membership is drawn from the following colleges: Biological Sciences; Food, Agricultural and Natural Resource Sciences; Continuing Education; Design; Education and Human Development; and Veterinary Medicine. The board cooperates with the Minnesota Student Association, the Twin Cities Student Unions Board of Governors and the respective Student Boards.

The Twin Cities Student Unions Board of Governors—The Twin Cities Student Unions Board of Governors is an advisory board for the St. Paul Student Center and Coffman Memorial Union. Composed of students elected to represent various academic and student organizations on the Minneapolis and St. Paul campuses, the board formulates policies for operation of the student unions and establishes its budget. For more information, call 612-624-4738.

Student Representation on College and University Committees—All CFANS committees and most all-University committees have student representatives.

Governance—Students are encouraged to participate in governance activities at the department, college, or campus level. Within each department, several committees (including curriculum committees) have student representatives. Students serve on CFANS committees and on the Student Board, which advises the dean on student issues and concerns. Students may also participate in the St. Paul Board of Colleges, which directs student activities and acts as a liaison between the student body and administration, and on the Twin Cities Unions Board of Governors, which establishes programs, operation policies, and budgets for the St. Paul Student Center and Coffman Union. Finally, CFANS student senators are elected to serve on the executive committee of the Minnesota Student Association and the University Senate.

Clubs—Student clubs and honor societies in the College of Food, Agricultural and Natural Resource Sciences include:

- Agricultural Education Club
- Alpha Epsilon Delta (pre-med and pre-vet)
- Alpha Tau Alpha
- Alpha Zeta Fraternity (an honor and service fraternity)
- American Association of Bovine and Swine
- American Society of Agricultural Engineers, Student Branch
- Applied Economics Student Association
- Block and Bridle
- Collegiate Agri-Women
- Cornercopia Student Organic Farm
- Environmental Studies Club
- Equestrian Club
- Fisheries and Wildlife Club (with an affiliated student chapter of The Wildlife Society)
- Frenatae—the Entomology Student Association
- Food Science and Nutrition Club
- Forestry Club
- Forest Products Society/Student Chapter
- Gopher Crops and Soils
- Gopher Dairy Club
- Gopher Poultry Science Club
- Horticulture Club
- National Agricultural Marketing Association (NAMA)
- National Society for Minorities in Agriculture, Natural Resources and Related Sciences (MANRRS)
- Pre-Vet Med Club
- Production Animal Medicine Club (Pre-PAM)
- Recreation Resource Management Club
- Residential Building Science and Technology Club
- Student Chapter of the Institute of Packaging Professionals (IOPP)
- Student Chapter of the Paper Industry Management Association (PIMA)
- Student Chapter of the Society of American Foresters
- Student Chapter of the Technical Association of the Pulp and Paper Industry (TAPPI)
- Student Organization of Nutrition and Dietetics (SOND)
- Students in Honors
- Turf Club (Golf Course Superintendent Association, U of M Student Chapter)
- Water Resources Students in Action
- Xi Sigma Pi Honor Society
Directory

Administration

Dean's Office
Dean
Allen S. Levine
277 Coffey Hall, 612-624-1234
Associate Dean for Academic Programs and Faculty Affairs
Jay Bell
190 Coffey Hall, 612-625-6703
Interim Associate Dean for Extension
Carl Rosen
277 Coffey Hall, 612-625-8114
Senior Associate Dean of Research
Abel Ponce de León
277 Coffey Hall, 612-624-2299
Chief of Staff
Lori Enstrom
277 Coffey Hall, 612-626-5985
Director of Development
Cynthia Cashman
235 Skok Hall, 612-624-7489
Director of Alumni Relations
Mary Buschette
190E Coffey Hall, 612-624-1745
Associate Director of Communications
Marty Moen
190M Coffey Hall, 612-624-0793
Associate Director of Public Relations
Becky Beyers
190F Coffey Hall, 612-626-5754
Director of Human Resources
Deb Karner
277 Coffey Hall, 612-625-3195
Director of Budget and Finance
Milly Theis
277 Coffey Hall, 612-624-3487
Director of Diversity Programs
Karl Lorenz
190 Coffey Hall, 612-624-9299

International Programs
Director of International Programs
John Vreyens
135 Skok Hall, 612-624-1774

Student Services
Director of Student Services
Bill Ganzlin
190 Coffey Hall, 612-624-3047
Admissions/Prospective Student Services
General Information
612-624-6768

Departments

Agricultural, Food and Environmental Education
Bradley Greiman, major coordinator
320M Vocational and Technical Education Building
612-624-5644
Agronomy and Plant Genetics
Nancy Ethike, head
411 Borlaug Hall
612-625-1791
Animal Science
James Linn, head
205 Haecker Hall
612-624-1205
Applied Economics
Robert P. King, head
231 Classroom Office Building
612-625-0231
Bioproducts and Biosystems Engineering
Shri Ramaswamy, head
207 Kaufert Lab and 213 Biosystems and Agricultural Engineering Building
612-624-8797
Entomology
Mark Ascerno, head
219 Hodson Hall
612-624-3278
Fisheries, Wildlife, and Conservation Biology
Francesca Cuthbert, head
204 Hodson Hall
612-624-1756
Food Science and Nutrition
Dave Smith, interim head
225 Food Science and Nutrition Building
612-624-3224
Forest Resources
Alan Ek, head
115 Green Hall
612-624-3400
Horticultural Science
Tom Michaels, head
305 Alderman Hall
612-624-7711
Plant Pathology
Carol Ishimaru, head
495 Borlaug Hall
612-625-9736
Soil, Water, and Climate
Edward A. Nater, head
439 Borlaug Hall
612-625-9734

Outreach

Bell Museum of Natural History
Scott Lanyon, museum director
10 Church Street S.E. (Mpls.)
612-624-7217
Cloquet Forestry Center
Ronald Severs, director of operations
Cloquet, Minn.
218-726-6400
Minnesota Landscape Arboretum
Peter Olin, director
Chanhassen, Minn.
952-443-1412
North Central Research and Outreach Center
Daniel L. Erkkila, head
Grand Rapids, Minn.
218-327-4361
Northwest Research and Outreach Center
Larry Smith, head
Crookston, Minn.
218-281-8602
Southern Research and Outreach Center
Forrest Izuno, head
Waseca, Minn.
507-837-5615
Southwest Research and Outreach Center
Pauline Nickel, head
Lamberton, Minn.
507-752-5068
UMore Park
Forrest Izuno, director of operations
Rosemount, Minn.
651-423-2455
West Central Research and Outreach Center
Jerry Wright, interim head
Morris, Minn.
320-589-1711

Note: All offices are located on the St. Paul campus unless otherwise noted.
College of
FOOD, AGRICULTURAL AND NATURAL RESOURCE SCIENCES
Degree Programs and Minors

Agricultural and Food Business Management B.S.

Applied Economics
- Required credits to graduate with this degree: 120.
- Required credits within the major: 64.

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

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

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

Admission Requirements
To be considered for admission, students must meet the following requirements:
1. Complete or have in progress coursework to total 60 credits by the time of admission.
2. Complete the following management “tool” courses on an A-F grading basis before entering the program:
   - ACCT 2050
   - APEC or ECON 1101
   - APEC or ECON 1102
   - OMS 2550
   - MATH 1142 or 1271
3. Earn a cumulative GPA of at least 2.80/4.00 in all coursework.
4. Earn a GPA of at least 2.50/4.00 in the tool courses with grades of C- or better.

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 April 15 for fall semester and October 15 for spring semester. For information about University of Minnesota admission requirements, visit [http://admissions.tc.umn.edu](http://admissions.tc.umn.edu).

Program Requirements
All required courses must be taken A-F, and students must earn a grade of at least C-. Students may not major in both agricultural and food business management and applied economics.

Communication
- WRIT 1152—Writing on Issues of Science and Technology, C/PE, WI (4 cr)
- WRIT 3562W—Technical and Professional Writing, WI (4 cr)
- COMM 1101—Introduction to Public Speaking (3 cr)
- MGMT 3033W—Business Communication, WI (3 cr)
- COMM 3441—Introduction to Organizational Communication (3 cr)
- WRIT 3257—Scientific and Technical Presentations (3 cr)

Professional Courses
- APEC 1001—Orientation to Applied Economics (1 cr)
- APEC 3001—Applied Microeconomics: Consumers, Producers, and Markets, SSCI (4 cr)
- APEC 3002—Applied Microeconomics: Managerial Economics (4 cr)
- APEC 3006—Applied Macroeconomics: Government and the Economy (3 cr)
- APEC 3007—Applied Macroeconomics: Policy, Trade, and Development, IP (3 cr)
- APEC 3501—Agribusiness Finance (3 cr)
- APEC 4821W—Business Economics and Strategy, WI (3 cr)
- ACCT 3001—Introduction to Management Accounting (3 cr)
- MGMT 3001—Fundamentals of Management (3 cr)
- MKTG 3001—Principles of Marketing (3 cr)
- OMS 3001—Introduction to Operations Management (3 cr)

Ethics and Responsible Management
Student must take one course (3 credits) that fosters one or more of the following objectives: responsible judgment about the management of natural resources and the environment; responsible judgment regarding ethical and policy issues related to agriculture; application of global perspectives to agricultural, food, and environmental issues and decisions; application of a historical perspective to the role of science and technology.
- CFAN 1501—Biotechnology, People, and the Environment, ENVT (3 cr)
- AGRG 1103—Crops, Environment, and Society, ENVT (4 cr)
- AGRG 3203W—Environment, Global Food Production, and the Citizen, C/PE, ENVT, WI (3 cr)
- ANSC 1011—Animals and Society, C/PE, ENVT (3 cr)
- BBE 5212—Safety and Environmental Health Issues in Plant and Animal Production and Processing, C/PE, ENVT, H (3 cr)
- BIOL 4501—Social Uses of Biology, C/PE (3 cr)
- EE 1701W—Energy, Environment, and Society, C/PE, ENVT, WI (3 cr)
- EEB 3001—Ecology and Society, ENVT (3 cr)
- ESPM 3011W—Ethics in Natural Resources, C/PE, ENVT, WI (3 cr)
- ESPM 4061W—Water Quality and Natural Resources, ENVT, WI (3 cr)
- ESPM 1011—Issues in the Environment, C/PE, ENVT (3 cr)
- FSCN 1102—Food, Safety, Risks, and Technology, C/PE (3 cr)
- GEO 3005—Earth Resources, C/PE, IP (3 cr)
- GEOG 3401—Geography of Environmental Systems and Global Change, WI (4 cr)
- HSCI 3331—Technology and American Culture, HP (3 cr)
- HSCI 3332—Science and American Culture, CD, HP (3 cr)
- PBIO 1212—Plants and Society, ENVT (3 cr)

For the most up-to-date listing of program requirements, visit the ONLINE CATALOG at [www.catalogs.umn.edu/programs.html](http://www.catalogs.umn.edu/programs.html).
Program Sub-Plans

Students are required to complete one of the following sub-plans.

Business Management

Students must take a minimum of two courses (6-8 credits) in APEC or ECON and a minimum of two courses (6-8 credits) from CSOM or DHA 3242 or 3245 only.

Required Courses for the Sub-Plan

Take 4 or more course(s) from the following:

Required Courses for the Sub-Plan

Take 4 or more course(s) from the following:

Take 2 or more course(s) from the following:

Take 2 or more course(s) from the following:

Financial Management

Students must take a minimum of two courses (6-8 credits) in APEC or ECON and a minimum of two courses (6-8 credits) from CSOM or DHA 3242, 3245 only.

Required Courses for the Sub-Plan

Take 4 or more course(s) from the following:

Take 2 or more course(s) from the following:

Take 2 or more course(s) from the following:

Take 2 or more course(s) from the following:

Take 2 or more course(s) from the following:

Take 2 or more course(s) from the following:

Take 2 or more course(s) from the following:

Take 2 or more course(s) from the following:

Agricultural Education B.S.

• Required credits to graduate with this degree: 128.
• Required credits within the major: 88.
• This program requires summer terms.

The undergraduate agricultural education program is a collaborative partnership between the College of Food, Agricultural and Natural Resource Sciences (CFANS) and the College of Education and Human Development (CEHD). Three specializations are available. The agricultural science and technology education specialization and natural and managed environmental education specialization prepare students for Minnesota state teaching licensure. The agricultural leadership, training, and development specialization prepares students for agricultural industry and leadership careers, focusing on development of interpersonal skills. It does not lead to teaching licensure.

Individualized

Students preparing for career opportunities that emphasize skills such as accounting, communications, law, or information systems may use this alternative to design an area of emphasis. A program of study under the emphasis must be approved by the adviser and the major coordinator. At least 6 of the 12 credits must be completed after receiving approval.

Required Courses for the Sub-Plan

Select 12 credits from individual electives

Marketing, Sales, and Food Industry Management

Students must take a minimum of two courses (6-8 cr) in APEC or ECON and a minimum of two courses (6-8 cr) from CSOM or DHA 3242, 3245 only.

Required Courses for the Sub-Plan

Take 4 or more course(s) from the following:

Take 2 or more course(s) from the following:

Take 2 or more course(s) from the following:

Take 2 or more course(s) from the following:

Take 2 or more course(s) from the following:

Take 2 or more course(s) from the following:

Note: Programs listed in this catalog are current as of March 2008.
Program Requirements

Communications
WRIT 3562W—Technical and Professional Writing, WI (4 cr)
COMM 1101—Introduction to Public Speaking (3 cr)
or PSTL 1461—Multicultural Perspectives in Public Speaking, C/PE (3 cr)

Social Sciences
PSTL 1281—Principles of Psychology, SSCI (4 cr)
or PSY 1001—Introduction to Psychology, SSCI (4 cr)

Physical Sciences and Mathematics
BIOC 2011—Biochemistry for the Agricultural and Health Sciences (3 cr)
CHEM 1011—Introductory Chemistry: Lecture and Laboratory, PHYS SCI/L (4 cr)
MATH 1031—College Algebra and Probability, MATH (3 cr)

Major Courses
AFEE 1001—Introduction to Agricultural Education and Extension (1 cr)
AFEE 1002—Principles of Career Planning for Agricultural Professionals (1 cr)
AFEE 2051—Current Technical Competencies (3 cr)
AFEE 5111W—Agricultural Education: Methods of Teaching, WI (4 cr)
CFAN 3001—Pests and Crop Protection (3 cr)

Program Sub-Plans
Students are required to complete one of the following sub-plans.

Agricultural Leadership, Training, and Development
This specialization provides a unique, futuristic educational opportunity combining agricultural science, management, communication, leadership, education, business and industry, training, and development. It provides a general background in agriculture, with agribusiness and industry associations. Graduates have opportunities and flexibility in employment ranging from human resource development, sales and marketing, extension, and communications in statewide, national, and international situations. This specialization does not lead to teaching licensure.

Business experience is required along with completion of courses. Students must maintain an overall GPA of 2.00.

Required Courses for the Sub-Plan

Physical and Biological Sciences
CFAN 1501—Biotechnology, People, and the Environment, ENVT (3 cr)
AGRO 1101—Biochemistry of Plant Food Systems, BIOL SCI/L, ENV (4 cr)
or BIOL 1009—General Biology, BIOL SCI/L (4 cr)

Plant Science
Take 6 or more credit(s) from the following:
AGRO 2501—Plant Identification for Urban and Rural Landscapes (2 cr)
AGRO 4005—Applied Crop Physiology and Development (4 cr)
ANSC 3203W—Environment, Global Food Production, and the Citizen, C/PE, ENV, WI (3 cr)
HRT 1001—Plant Propagation, BIOL SCI/L (4 cr)
HRT 3005—Environmental Effects on Horticultural Crops (4 cr)

Animal Science
ANSC 1101—Introductory Animal Science (4 cr)
ANSC 1403—Companion Animal Nutrition and Care (3 cr)
or ANSC 2401—Animal Nutrition (3 cr)
Take 3 or more credit(s) from the following:
ANSC 1511—Food Animal Products for Consumers (3 cr)
ANSC 2012—Livestock and Carcass Evaluation (3 cr)
ANSC 3203W—Environment, Global Food Production, and the Citizen, C/PE, ENV, WI (3 cr)

Soils
SOIL 1125—The Soil Resource, ENVT, PHYS SCI/L (4 cr)
or SOIL 2125—Basic Soil Science, ENV (4 cr)

Applied Economics and Agribusiness
APEC 1101—Principles of Microeconomics, SSCI (3 cr)
APEC 1251—Principles of Accounting (3 cr)
APEC 3451—Food and Agricultural Sales (3 cr)
or BIE 3061—Professional Sales Management (3 cr)

Agricultural Leadership and Development
AFEE 2221—People Skills for Leadership (3 cr)
AFEE 3221—Presentations and Meeting Management for Agricultural Industry (3 cr)
AFEE 4221—Leadership Development, C/PE (3 cr)
AFEE 5361—World Leadership Problems (3 cr)

Electives
Students who complete the HRD focus (described below) must fulfill this 6 credit HRD/AFEE requirement by choosing courses from the AFEE, BIE, and WHRE designators.
Take 6 or more credit(s) from the following:
AFEE 5331—History, Philosophy, and Systems of Extension (3 cr)
BIE 3061—Professional Sales Management (3 cr)
WHRE 3105—Introduction to Strategic Planning Through Human Resources (3 cr)
HRD 3301—Introduction to Organization Development (3 cr)
HRD 5106—Evaluation in Human Resource Development (3 cr)
HRD 5202—Training on the Internet (3 cr)
HRD 5302—Managing Work Teams in Business and Industry (3 cr)
HRD 5624—Sales Training (3 cr)
WHRE 5121—Principles of Supervisory Management (3 cr)

Human Resource Development
HRD 3001—Introduction to Human Resource Development (3 cr)
HRD 3201—Introduction to Training and Development (3 cr)

Human Resource Development/AFEE

Electives
Students who complete the HRD focus (described below) must fulfill this 6 credit HRD/AFEE requirement by choosing courses from the AFEE, BIE, and WHRE designators.

Take 6 or more credit(s) from the following:
AFEE 5331—History, Philosophy, and Systems of Extension (3 cr)
BIE 3061—Professional Sales Management (3 cr)
WHRE 3105—Introduction to Strategic Planning Through Human Resources (3 cr)
HRD 3301—Introduction to Organization Development (3 cr)
HRD 5106—Evaluation in Human Resource Development (3 cr)
HRD 5202—Training on the Internet (3 cr)
HRD 5302—Managing Work Teams in Business and Industry (3 cr)
HRD 5624—Sales Training (3 cr)
WHRE 5121—Principles of Supervisory Management (3 cr)

Agricultural Leadership, Training, and Development Focus

Students are required to complete one of the following course groups.

Agricultural Science
Take 10 or more credit(s) from the following:
AGRO 2501—Plant Identification for Urban and Rural Landscapes (2 cr)
AGRO 3203W—Environment, Global Food Production, and the Citizen, C/PE, ENV, WI (3 cr)
AGRO 4005—Applied Crop Physiology and Development (4 cr)
ANSC 1511—Food Animal Products for Consumers (3 cr)
ANSC 2012—Livestock and Carcass Evaluation (3 cr)
ANSC 3203W—Environment, Global Food Production, and the Citizen, C/PE, ENV, WI (3 cr)

Animal Science
Take 10 or more credit(s) from the following:
APEC 3041W—Economic Development of U.S. Agriculture, HP, WI (3 cr)
APEC 3411—Commodity Marketing (3 cr)
APEC 3811—Principles of Farm Management (3 cr)
APEC 3xxx

Communication
Take 10 or more credit(s) from the following:
WRIT 1152W—Writing on Issues of Science and Technology, C/PE, WI (4 cr)
WRIT 3221W—Communication Modes and Methods, C/PE, SSCI, WI (4 cr)

Soils
SOIL 1125—The Soil Resource, ENVT, PHYS SCI/L (4 cr)
or SOIL 2125—Basic Soil Science, ENV (4 cr)

Applied Economics and Agribusiness
APEC 1101—Principles of Microeconomics, SSCI (3 cr)
APEC 1251—Principles of Accounting (3 cr)
APEC 3451—Food and Agricultural Sales (3 cr)
or BIE 3061—Professional Sales Management (3 cr)

Agricultural Leadership and Development
AFEE 2221—People Skills for Leadership (3 cr)
AFEE 3221—Presentations and Meeting Management for Agricultural Industry (3 cr)
AFEE 4221—Leadership Development, C/PE (3 cr)
AFEE 5361—World Leadership Problems (3 cr)

Electives
Students who complete the HRD focus (described below) must fulfill this 6 credit HRD/AFEE requirement by choosing courses from the AFEE, BIE, and WHRE designators.
Take 6 or more credit(s) from the following:
AFEE 5331—History, Philosophy, and Systems of Extension (3 cr)
BIE 3061—Professional Sales Management (3 cr)
WHRE 3105—Introduction to Strategic Planning Through Human Resources (3 cr)
HRD 3301—Introduction to Organization Development (3 cr)
HRD 5106—Evaluation in Human Resource Development (3 cr)
HRD 5202—Training on the Internet (3 cr)
HRD 5302—Managing Work Teams in Business and Industry (3 cr)
HRD 5624—Sales Training (3 cr)
WHRE 5121—Principles of Supervisory Management (3 cr)

Agricultural Leadership, Training, and Development Focus

Students are required to complete one of the following course groups.

Agricultural Science
Take 10 or more credit(s) from the following:
AGRO 2501—Plant Identification for Urban and Rural Landscapes (2 cr)
AGRO 3203W—Environment, Global Food Production, and the Citizen, C/PE, ENV, WI (3 cr)
AGRO 4005—Applied Crop Physiology and Development (4 cr)
ANSC 1511—Food Animal Products for Consumers (3 cr)
ANSC 2012—Livestock and Carcass Evaluation (3 cr)
ANSC 3203W—Environment, Global Food Production, and the Citizen, C/PE, ENV, WI (3 cr)

Animal Science
Take 10 or more credit(s) from the following:
APEC 3041W—Economic Development of U.S. Agriculture, HP, WI (3 cr)
APEC 3411—Commodity Marketing (3 cr)
APEC 3811—Principles of Farm Management (3 cr)
APEC 3xxx

Communication
Take 10 or more credit(s) from the following:
WRIT 1152W—Writing on Issues of Science and Technology, C/PE, WI (4 cr)
WRIT 3221W—Communication Modes and Methods, C/PE, SSCI, WI (4 cr)
Human Resource Development
Take 10 or more credit(s) from the following:
WHRE 3105—Introduction to Strategic Planning Through Human Resources (3 cr)
HRD 3301—Introduction to Organization Development (3 cr)
HRD 5106—Evaluation in Human Resource Development (3 cr)
HRD 5202—Training on the Internet (3 cr)
HRD 5302—Managing Work Teams in Business and Industry (3 cr)
HRD 5624—Sales Training (3 cr)

Agricultural Science and Technology Education Sub-Plan
This specialization serves students preparing to teach agriscience, agribusiness, agriculture, horticulture, food systems, agrimechanics, and natural resource management under the licensure field of agricultural education in public schools at the 5-12 level. Its broad agricultural science and technology curriculum also prepares graduates for a wide range of agriculturally related positions in sales, management, finance, and production aspects of agriculture.

Students may graduate from this program with a minimum 2.00 overall GPA, but a minimum 2.50 overall GPA is required for recommendation for Minnesota teaching licensure. Major coursework (courses with AFEE, BIE, EDHD, HRD, and WHRE designators) must be completed with a minimum 2.00 GPA with no grade lower than C-. A minimum grade of C- is also required for general psychology.

The specialization requires a broad study of agriculture, including plant science (horticulture, agronomy, plant pathology, and entomology), animal science, natural resources, soils, economics and agribusiness, agricultural mechanization, food science, foundations of education, foundations of agricultural education, and a full-year student teaching experience.

Required Courses for the Sub-Plan
Physical and Biological Sciences
CFAN 1501—Biotechnology, People, and the Environment, ENVT (3 cr)
or PSTL 1163—Physics by Inquiry, PHYS SCI/L (4 cr)
or AGRO 1101—Biology of Plant Food Systems, BIOL SCI/L, ENVT (4 cr)
or BIOL 1009—General Biology, BIOL SCI/L (4 cr)
or PSTL 1131—Principles of Biological Science, BIOL SCI/L (4 cr)
FSCN 1021—Introductory Microbiology, BIOL SCI/L (4 cr)
or VBS 2032—General Microbiology With Laboratory (4 cr)
PHYS 1010W—Energy and the Environment, ENV, PHYS SCI/L, WI (4 cr)
or PHYS 1101W—Introductory College Physics I, PHYS SCI/L, WI (4 cr)

Social Sciences
HSCL 1814—Revolutions in Science: The Babylonians to Newton, HP, IP (4 cr)
or HSCL 1815—Revolutions in Science: Lavoisier, Darwin, and Einstein, HP, IP (4 cr)
or any history course that meets HP or IP liberal education requirements

Plant Science
Take 3 or more credit(s) from the following:
AGRO 1103—Crops, Environment, and Society, ENVT (4 cr)
HORT 1001—Plant Propagation, BIOL SCI/L (4 cr)
HORT 1013—Floral Design (2 cr)
HORT 3002W—Greenhouse Management, WI (3 cr)
AGRO 4401—Plant Genetics and Breeding (4 cr)
or HORT 4401—Plant Genetics and Breeding (4 cr)

Animal Science
ANSC 1403—Companion Animal Nutrition and Care (3 cr)
or ANSC 2401—Animal Nutrition (3 cr)
Take 1 or more course(s) from the following:
ANSC 1101—Introductory Animal Science (4 cr)
ANSC 1511—Food Animal Products for Consumers (3 cr)
ANSC 2012—Livestock and Carcass Evaluation (3 cr)
ANSC 3221—Animal Breeding (4 cr)

Natural Resources
Take 6 or more credit(s) from the following:
EEB 3001—Ecology and Society, ENVT (3 cr)
ESPM 1011—Issues in the Environment, C/PE, ENV, ENVT (3 cr)
FW 1002—Wildlife: Ecology, Values, and Human Impact, ENVT, C/PE (3 cr)

Soils
Soil 1125—The Soil Resource, ENV, PHYS SCI/L (4 cr)
or Soil 2125—Basic Soil Science, ENV (4 cr)

Applied Economics and Agribusiness
APEC 1101—Principles of Microeconomics, SSCI (3 cr)
APEC 3451—Food and Agricultural Sales (3 cr)
APEC 1251—Principles of Accounting (3 cr)
or APEC 3811—Principles of Farm Management (3 cr)
or APEC 3821—Retail Center Management (3 cr)

Additional Required Courses
AFEE 3112—Technical Drawing and Production Technologies (3 cr)
or WHRE 3121—Communication, Energy and Power, Transportation and Machinery Technologies (3 cr)

Foundations
CI 5452—Reading in the Content Areas for Initial Licensure Candidates (1 cr)
EDHD 5001—Learning, Cognition, and Assessment (3 cr)
EDHD 5003—Developmental and Individual Differences in Educational Contexts (3 cr)
EDHD 5005—School and Society (2 cr)
EDHD 5007—Technology for Teaching and Learning (1.5 cr)
EDHD 5009—Human Relations: Applied Skills for School and Society (1 cr)
EDPA 5341—The American Middle School (3 cr)
FSCN 1102—Food: Safety, Risks, and Technology, C/PE (3 cr)

AFEE 2096—Professional Practicum in Agricultural Education: Early Experience (1–3 cr)
AFEE 5110—Principles of Microeconomics, SSCI (3 cr)
AFEE 5116—Coordination of SAE Programs: Work-based Learning (2 cr)
AFEE 5112—Agricultural Education Teaching Seminar (1 cr)
AFEE 5114—Agricultural Education Teaching Seminar (1 cr)
AFEE 5116—Coordination of SAE Programs: Work-based Learning (2 cr)
AFEE 5118—Strategies for Managing and Advising the FFA Organization (2 cr)

Work and Human Resource Education
Take 8 credits from the following. Standard first aid and cardiopulmonary resuscitation (CPR) training are required for licensure.
WHRE 5697—Teaching Internship: School and Classroom Settings (2 cr)
WHRE 5698—Teaching Internship (3–8 cr)

Natural and Managed Environmental Education
This specialization serves students preparing to teach agriscience, agribusiness, agriculture, horticulture, food systems, agrimechanics, and natural resource management, all under the licensure field of agricultural education in public schools at the 5-12 level. In addition, graduates have an emphasis in natural resource management and education and are prepared for work in environmental learning centers.

Students may graduate from this program with a minimum 2.00 GPA, but a minimum 2.50 GPA is required for recommendation for a Minnesota teaching license.
The specialization requires a broad study in agriculture focused on the natural and managed environmental education areas. Areas of study include the environment, land, water, climate, economics, soil, plant science, animal science, and agricultural mechanization. It also includes foundations in education, foundations in agricultural education, and a full-year student teaching experience.

Required Courses for the Sub-Plan

Physical and Biological Sciences
- CFAN 1501—Biotechnology, People, and Environment, ENVT (3 cr)
- or PSTL 1163—Physics by Inquiry, PHYS SCI/L (4 cr)
- AGRO 1101—Biological Plant Food Systems, BIOL SCI/L, ENVT (4 cr)
- or BIOL 1009—General Biology, BIOL SCI/L (4 cr)
- or PSTL 1131—Principles of Biological Science, BIOL SCI/L (4 cr)
- or FSCN 1021—Introductory Microbiology, BIOL SCI/L (4 cr)
- or PUB 2032—General Microbiology With Laboratory (4 cr)
- PHYS 1001W—Energy and the Environment, PHYS SCI/L, WI (4 cr)
- or PHYS 1101W—Introductory College Physics I, PHYS SCI/L, WI (4 cr)

Social Sciences
- HSCI 1814—Revolutions in Science: The Babylonians to Newton, HP, IP (4 cr)
- or HSCI 1815—Revolutions in Science: Lavoisier, Darwin, and Einstein, HP, IP (4 cr)
- or Any history course that meets HP or IP liberal education requirements

Natural Resources
- ESPM 1011—Issues in the Environment, C/PE, ENVT (3 cr)
- Take 6 or more credits from the following:
  - EEB 3001—Ecology and Society, ENV (3 cr)
  - FR 2104—Measuring Forest Resources (1 cr)
  - FR 3104—Forest Ecology (4 cr)
  - FW 1002—Wildlife: Ecology, Values, and Human Impact, C/PE, CPE, ENVT (3 cr)
  - FW 2001—Introduction to Fisheries, Wildlife, and Conservation Biology, ENVT (3 cr)

Land, Water, Atmosphere
- SOIL 2125—Basic Soil Science, ENV (4 cr)
- ESPM 1425—The Atmosphere, PHYS SCI/L (4 cr)
- or ESPM 3221—Soil Conservation and Land-Use Management (3 cr)
- or SOIL 3416—Plant Nutrients in the Environment (3 cr)

Applied Economics and Agribusiness
- APEC 1101—Principles of Microeconomics, SSCI (3 cr)
- or APEC 3451—Food and Agricultural Sales (3 cr)

Animal Science
- ANSC 2401—Animal Nutrition (3 cr)
- ANSC 1101—Introductory Animal Science (4 cr)
- or ANSC 1403—Companion Animal Nutrition and Care (3 cr)
- or ANSC 1511—Food Animal Products for Consumers (3 cr)
- or ANSC 2012—Livestock and Carcass Evaluation (3 cr)
- or ANSC 3203W—Environment, Global Food Production, and the Citizen, C/PE, ENVT, WI (3 cr)

Agricultural Mechanization
- Take 1 or more course(s) from the following:
  - AFEE 3112—Technical Drawing and Production Technologies (3 cr)
  - WHRE 3121—Communication, Energy and Power, Transportation and Machinery Technologies (3 cr)

Plant Science
- Take 3 or more credit(s) from the following:
  - AGRO 4401—Plant Genetics and Breeding (4 cr)
  - HORT 4401—Plant Genetics and Breeding (4 cr)
  - AGRO 4xx
  - HORT 4xx

Food Science
- FSCN 1102—Food: Safety, Risks, and Technology, C/PE (3 cr)

Foundations
- CI 5452—Reading in the Content Areas for Initial Licensure Candidates (1 cr)
- EDHD 5001—Learning, Cognition, and Assessment (3 cr)
- EDHD 5003—Developmental and Individual Differences in Educational Contexts (3 cr)
- EDHD 5005—School and Society (2 cr)
- EDHD 5007—Technology for Teaching and Learning (1.5 cr)
- EDHD 5009—Human Relations: Applied Skills for School and Society (1 cr)
- EDPA 5341—The American Middle School (3 cr)
- PUBH 3003—Fundamentals of Alcohol and Drug Abuse (2 cr)
- or PUBH 3005—Fundamentals of Alcohol and Drug Abuse for Teacher Education (1 cr)

Agricultural Education
- AFEE 2096—Professional Practicum in Agricultural Education: Early Experience (1–3 cr)
- AFEE 5112—Agricultural Education Program Organization and Curriculum for Youth (3–6 cr)
- AFEE 5114—Agricultural Education Teaching Seminar (1 cr)
- or AFEE 5116—Coordination of SAE Programs: Work-based Learning (2 cr)
- or AFEE 5118—Strategies for Managing and Advising the FFA Organization (2 cr)

Work and Human Resource Education
- Take 8 credits from the following course list. Standard first aid and cardio-pulmonary resuscitation (CPR) training are required for licensure.
  - WHRE 5697—Teaching Internship: School and Classroom Settings (2 cr)
  - WHRE 5698—Teaching Internship (3–8 cr)

Agricultural Industries and Marketing B.S.
- Required credits to graduate with this degree: 120.
- Required credits within the major: 108.

This major prepares students for careers in agricultural industries. Industries related to modern agriculture include manufacturers and distributors of farm production inputs (such as equipment, structures, health products, seeds, fertilizers, and crop protection products); assemblers, processors, manufacturers, and distributors of products originating from farms (products such as meat, milk, eggs, wool, grains, fruits, vegetables, nursery crops, flowers, and turf); and finance and insurance industries providing agricultural credit. Agribusinesses such as these, as well as state, federal, and marketing agencies, need individuals who have a broad education in the scientific (and technical) aspects of agriculture, effective work and communication skills, and quantitative and qualitative skills to solve business problems.

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 one of three areas of emphasis: crops and soils industries, food industries, or an individualized emphasis.

With 21 free standing elective credits, all AIM majors are encouraged to pursue a CFANS or other minor. Only 6 credits in the AIM major may also be counted towards a minor. For students interested in preparing for the Certified Crop Advisor (CCA) exam or the certified professional agronomist (CPAg) programs, a minor in agronomy is highly recommended.

Admission Requirements
For information about University of Minnesota admission requirements, visit [http://admissions.tc.umn.edu](http://admissions.tc.umn.edu)
Program Requirements

Students must complete at least 14 credits in their sub-plan emphasis plus an internship or a student project. All required courses must be taken A-F, and students must earn a grade of at least C-.

Quantitative Foundations

MATH 1031—College Algebra and Probability, MATH (3 cr)
or MATH 1131—Finite Mathematics, MATH (3 cr)
or MATH 1142—Short Calculus, MATH (4 cr)
ANSC 2211—Biometries for Livestock, MATH (3 cr)
or STAT 3011—Introduction to Statistical Analysis, MATH (4 cr)
or ESPM 3012—Quantitative Methods for Environmental Scientists and Managers II (4 cr)

Communication

COMM 1101—Introduction to Public Speaking (3 cr)
WRIT 3257—Scientific and Technical Presentations (3 cr)
WRIT 3562W—Technical and Professional Writing, WI (4 cr)
COMM 3411—Introduction to Small Group Communication (3 cr)
WRIT 4165—Managerial and Organizational Communication, Planning, and Change (3 cr)
or WRIT 4258—Information-Gathering Techniques in Scientific and Technical Communication (3 cr)
or COMM 3422—Interviewing and Communication (3 cr)
or COMM 3441—Introduction to Organizational Communication (3 cr)

Business Management

APEC 1101—Principles of Microeconomics, SSCI (3 cr)
APEC 1102—Principles of Macroeconomics, IP, SSCI (3 cr)
APEC 1251—Principles of Accounting (3 cr)
MKTG 3001—Principles of Marketing (3 cr)
or APEC 4451—Food and Agricultural Sales (3 cr)
or MGT 1031—Selling and Sales Management (4 cr)
or APEC 3811—Principles of Farm Management (3 cr)
or APEC 3821—Retail Center Management (3 cr)
or PSTL 1513—Small Business Fundamentals With E-Business Applications (3 cr)
or MGMT 3001—Fundamentals of Management (3 cr)

Program Sub-Plans

Students are required to complete one of the following sub-plans.

Crops and Soils Industries

Students must complete at least 14 credits in their area of emphasis and an internship or a student project.

Required Courses for the Sub-Plan

Science Foundations

CHEM 1011—Introductory Chemistry; Lecture and Laboratory, PHYS SCI/L (4 cr)
SOIL 2125—Basic Soil Science, ENVT (4 cr)
AGRO 1101—Biology of Plant Food Systems, BIOL SCI/L, ENVT (4 cr)
or BIOL 1001—Introductory Biology I: Evolutionary and Ecological Perspectives, BIOL SCI/L, ENVT (4 cr)
or BIOL 1009—General Biology, BIOL SCI/L (4 cr)

Crops and Soils Industries

CFAN 3001—Pests and Crop Protection (3 cr)
SOIL 3416—Plant Nutrients in the Environment (3 cr)
AGRO 4005—Applied Crop Physiology and Development (4 cr)
or take the following course pair:
BIOL 3002—Plant Biology: Function (2 cr)
and BIOL 3005W—Plant Function Laboratory, WI (2 cr)
AGRO 3203W—Environment, Global Food Production, and the Citizen, C/PE, ENVT, WI (3 cr)
or AGRO 4103—World Food Problems, C/PE, IP (3 cr)
or AGRO 4401—Plant Genetics and Breeding (4 cr)
or AGRO 4505—Biological, Ecology, and Management of Invasive Plants (3 cr)
or AGRO 4603—Field Crop Scouting and Problem Diagnosis (3 cr)
or AGRO 4605—Management Strategies for Crop Production (4 cr)
or ESPM 3221—Soil Conservation and Land-Use Management (3 cr)

Food Industries

Students must complete at least 14 credits in the area of emphasis and an internship or a student project.

Required Courses for the Sub-Plan

Science Foundations

CHEM 1021—Chemical Principles I, ENVT, PHYS SCI/L (4 cr)
CHEM 1022—Chemical Principles II, ENVT, PHYS SCI/L (4 cr)
AGRO 1101—Biology of Plant Food Systems, BIOL SCI/L, ENVT (4 cr)
or BIOL 1001—Introductory Biology I: Evolutionary and Ecological Perspectives, BIOL SCI/L, ENVT (4 cr)
or BIOL 1009—General Biology, BIOL SCI/L (4 cr)

Agriculture

FSCN 1102—Food: Safety, Risks, and Technology, C/PE (3 cr)
FSCN 1112—Principles of Nutrition, ENVT (3 cr)
FSCN 1021—Introductory Microbiology, BIOL SCI/L (4 cr)
and VBS 2032—General Microbiology With Laboratory (4 cr)
AIM 4011—Student Project/Field Investigation (3 cr)
or FSCN 4096—Professional Experience Program: Internship (1–3 cr)
or AGRO 4093—Directed Studies for Advanced Students (1–4 cr)

Orientation

FSCN 1001—Orientation to Nutrition (1 cr)
or APEEE 1002—Principles of Career Planning for Agricultural Professionals (1 cr)

Food Industries

FSCN 3102—Introduction to Food Science (3 cr)
FSCN 3731—Food Service Operations Management Laboratory (2 cr)
FSCN 3732—Food Service Operations Management (3 cr)
FSCN 4131—Food Quality (3 cr)
ANSC 1511—Food Animal Products for Consumers (3 cr)
or FSCN 3612—Life Cycle Nutrition (3 cr)
or FSCN 3615—Sociocultural Aspects of Food, Nutrition, and Health, CD, SSCI (3 cr)
or FSCN 4614—Community Nutrition, CD (3 cr)
or MGMT 3010—Marketing Research (4 cr)

Individualized

At least 14 credits must be selected in consultation with an adviser and with approval of the AIM major committee. The courses comprising the individualized emphasis must have a definite theme. A collection of unrelated courses is unacceptable.

Required Courses for the Sub-Plan

Science Foundations

CHEM 1011—Introductory Chemistry; Lecture and Laboratory, PHYS SCI/L (4 cr)
SOIL 2125—Basic Soil Science, ENVT (4 cr)
AGRO 1101—Biology of Plant Food Systems, BIOL SCI/L, ENVT (4 cr)
or BIOL 1001—Introductory Biology I: Evolutionary and Ecological Perspectives, BIOL SCI/L, ENVT (4 cr)
or BIOL 1009—General Biology, BIOL SCI/L (4 cr)

Note: Programs listed in this catalog are current as of March 2008.
BIOC 1001—Elementary Biochemistry (3 cr)

or BIOC 2111—Biochemistry for the Agricultural and Health Sciences (3 cr)

**Agriculture**
AGRO 1103—Crops, Environment, and Society, ENVT (4 cr)
AGRO 4660—Senior Capstone: Leadership, Decision Making, and Problem Solving (2 cr)
AGRO 4096—Professional Experience Program: Internship (1–3 cr)
or AIM 4011—Student Project/Field Investigation (3 cr)
or AGRO 4093—Directed Studies for Advanced Students (1–4 cr)

**Orientation**
APEC 1001—Orientation to Applied Economics (1 cr)
or AFEE 1002—Principles of Career Planning for Agricultural Professionals (1–6 cr)
or AGRO 1660—First-Year Colloquium/Experience in Agroecosystems Analysis (2 cr)
or FSCN 1001—Orientation to Nutrition (1 cr)

**Individualized Emphasis Electives**
14 credits from individual electives

**Agronomy Minor**

**Agronomy and Plant Genetics**
- Required credits in this minor: 17.

This minor provides strong science-based courses emphasizing crop management in the context of sustainable ecosystems. It is well suited for students majoring in agriculture, food and environmental education; animal science; business and economics; environmental science, or for students seeking knowledge and principles of crop production. The minor allows students to complete coursework providing the minimal background needed to prepare for the Certified Crop Advisor (CCA) exams. Students must complete a minimum of 17 credits.

**Minor Requirements**
CFAN 3001—Pests and Crop Protection (3 cr)
AGRO 4005—Applied Crop Physiology and Development (4 cr)
AGRO 4660—Senior Capstone: Leadership, Decision Making, and Problem Solving (2 cr)
SOIL 3416—Plant Nutrients in the Environment (3 cr)

**Electives**
Take 5 or more credit(s) from the following:
AGRO 2104—Grain and Seed Technology (2 cr)
AGRO 2501—Plant Identification for Urban and Rural Landscapes (2 cr)
AGRO 4093—Directed Studies for Advanced Students (1–4 cr)
AGRO 4401—Plant Genetics and Breeding (4 cr)
AGRO 4505—Biotechnology, Ecology, and Management of Invasive Plants (3 cr)
AGRO 4605—Management Strategies for Crop Production (4 cr)
AGRO 4603—Field Crop Scouting and Problem Diagnosis (3 cr)

**Animal Science B.S.**

**Animal Science**
- Required credits to graduate with this degree: 120.
- Required credits within the major: 93 to 103.
- This program requires summer terms.

The animal science major prepares students for veterinary school, work as managers and technical advisers for animal production systems, various careers in animal industries or biotechnology, or graduate study in animal related specializations. Areas of emphasis include industry, production, or science/pre-vet. In addition, depending on the area of emphasis, students may select from the following areas of study: biotechnology, dairy, beef, sheep, swine, equine, companion animal, or poultry.

**Admission Requirements**
For information about University of Minnesota admission requirements, visit [http://admissions.tc.umn.edu](http://admissions.tc.umn.edu).

**Program Requirements**

All required courses must be taken A-F, and students must earn a grade of at least C-.

**Foundation Courses**
One semester of calculus is required for biotechnology option in the science/pre-veterinary sub-plan.

APEC 1101—Principles of Microeconomics, SSCI (3 cr)
BIOL 1009—General Biology, BIOL SCI/L (4 cr)
COMM 1101—Introduction to Public Speaking (3 cr)
WRIT 3562W—Technical and Professional Writing, WI (4 cr)
MATH 1031—College Algebra and Probability, MATH (3 cr)
or MATH 1142—Short Calculus, MATH (4 cr)
or MATH 1271—Calculus I, MATH (4 cr)
or MATH 1281—Calculus with Biological Emphasis I, MATH (4 cr)

**Professional Courses**

ANSC 1001—Orientation to Animal Science (1 cr)
ANSC 1101—Introductory Animal Science (4 cr)
ANSC 2211—Biometrics for Livestock, MATH (3 cr)
ANSC 2401—Animal Nutrition (3 cr)
ANSC 3221—Animal Breeding (4 cr)
ANSC 3301—Systemic Physiology (4 cr)

Students must take a minimum of 3 credits of internship or a minimum of 6 credits of senior thesis.

ANSC 4096—Professional Experience Program: Internship (1–3 cr)
or CFAN 4009W—Undergraduate Senior Thesis: Science in Agriculture, WI (1–6 cr)

**Program Sub-Plans**

Students are required to complete one of the following sub-plans.

**Animal Industry**

**Animal Industry Courses**
APEC 1102—Principles of Macroeconomics, IP, SSCI (3 cr)
APEC 1251—Principles of Accounting (3 cr)
CHEM 1011—Introductory Chemistry: Lecture and Laboratory, PHYS SCI/L (4 cr)
BIOC 2111—Biochemistry for the Agricultural and Health Sciences (3 cr)
WRIT 1152W—Writing on Issues of Science and Technology, C/PE, WI (4 cr)
or WRIT 3257—Scientific and Technical Presentations (3 cr)

Students must take a minor in the following:
APEC 3001—Applied Microeconomics: Consumers, Producers, and Markets, SSCI (4 cr)
APEC 3002—Applied Microeconomics: Managerial Economics (4 cr)
APEC 3411—Commodity Marketing (3 cr)
APEC 3811—Principles of Farm Management (3 cr)
APEC 3821—Retail Center Management (3 cr)
APEC 4451W—Food Marketing Economics, C/PE, WI (3 cr)
APEC 4821W—Business Economics and Strategy, WI (3 cr)
APEC 3451—Food and Agricultural Sales (3 cr)
or APEC 3501—Agricultural Finance (3 cr)
or BIE 3061—Professional Sales Management (3 cr)
or JOUR 3201—Principles of Strategic Communication: Advertising (3 cr)

**Animal Science Electives**
Courses in this list cannot be used to fulfill requirements in other areas.

**Take 12 or more credit(s) from the following:**
CFAN 1501—Biotechnology, People, and the Environment, ENV (3 cr)
AGRO 1103—Crops, Environment, and Society, ENV (4 cr)
ANSC 1007—Horse in Your Backyard (2 cr)
ANSC 1011—Animals and Society, C/PE, ENV (3 cr)
ANSC 1021—Avian Sampler (1 cr)

For the most up-to-date listing of program requirements, visit the Online Catalog at [www.catalogs.umn.edu/programs.html](http://www.catalogs.umn.edu/programs.html).
ANSC 1403 — Companion Animal Nutrition and Care (3 cr)
ANSC 1511 — Food Animal Products for Consumers (3 cr)
ANSC 2012 — Livestock and Carcass Evaluation (3 cr)
ANSC 2013 — Beginning Livestock Judging (2 cr)
ANSC 3007 — Equine Nutrition (3 cr)
ANSC 3052 — Equine Anatomy and Exercise Physiology (4 cr)
ANSC 3142 — Advanced Livestock Judging (2 cr)
ANSC 3203W — Environment, Global Food Production, and the Citizen, C/PE, ENVT, WI (3 cr)
ANSC 3305 — Reproductive Biology in Health and Disease (4 cr)
ANSC 3501 — Farm Animal Environment (3 cr)
ANSC 3509 — Animal Biotechnology (3 cr)
ANSC 3511 — Animal Growth and Development (3 cr)
ANSC 4011 — Dairy Cattle Breeding (3 cr)
ANSC 4102 — Equine Management (3 cr)
ANSC 4401 — Swine Nutrition (3 cr)
ANSC 4403 — Ruminant Nutrition (3 cr)
ANSC 4404 — Applied Dairy Nutrition (2 cr)
ANSC 4601 — Pork Production Systems Management (4 cr)
ANSC 4602 — Beef Production Systems Management (4 cr)
ANSC 4603 — Dairy Production Systems Management (4 cr)
ANSC 4605 — Poultry Production Systems Management (4 cr)
ANSC 4609 — Animal Production Systems (2 cr)
ANSC 4611 — Advanced Pork Production Systems Management (2 cr)
ANSC 4613 — Advanced Beef Production Systems Management (2 cr)
ANSC 4614 — Advanced Dairy Production Systems Management (2 cr)
APEC 3811 — Principles of Farm Management (3 cr)
ENT 3281 — Veterinary Entomology (3 cr)
FSCN 1102 — Food: Safety, Risks, and Technology, C/PE (3 cr)
SOIL 2125 — Basic Soil Science, ENVT (4 cr)
VCS 4606 — Small Animal Management (3 cr)
VPM 3502 — Animal Health and Disease (3 cr)
VPM 3700 — Equine Reproduction and Breeding Management (2 cr)

Animal Management
ANSC 4601 — Pork Production Systems Management (4 cr)
or ANSC 4602 — Sheep Production Systems Management (4 cr)
or ANSC 4603 — Beef Production Systems Management (4 cr)
or ANSC 4604 — Dairy Production Systems Management (4 cr)
or ANSC 4605 — Poultry Production Systems Management (4 cr)
or VCS 4606 — Small Animal Management (3 cr)
or ANSC 2055 — Horse Health Management (2 cr)
ANSC 3007 — Equine Nutrition (3 cr)

Animal Production
In the animal production emphases students may select from the following areas of study: dairy, beef, sheep, swine, equine, companion animal, or poultry.

Production
ANSC 1511 — Food Animal Products for Consumers (3 cr)
ANSC 3609 — Animal Production Systems (2 cr)
CHEM 1011 — Introductory Chemistry; Lecture and Laboratory, PHYS SCI/L (4 cr)
BIOC 2011 — Biochemistry for the Agricultural and Health Sciences (3 cr)

Animal Science Electives
AGRO 1103 is required for dairy, beef, swine, sheep, poultry, and companion animal majors.
Courses in this list cannot be used to fulfill requirements in other areas.
Take 2 or more credit(s) from the following:
AEE 2051 — Current Technical Competencies (3 cr)
CFAN 1501 — Biotechnology, People, and the Environment, ENVT (3 cr)
AGRO 1103 — Crops, Environment, and Society, ENVT (4 cr)
ANSC 1007 — Horse in Your Backyard (2 cr)
ANSC 1011 — Animals and Society, C/PE, ENVT (3 cr)
ANSC 1021 — Avian Sampler (1 cr)
ANSC 1403 — Companion Animal Nutrition and Care (3 cr)
ANSC 1511 — Food Animal Products for Consumers (3 cr)
ANSC 2012 — Livestock and Carcass Evaluation (3 cr)
ANSC 2013 — Beginning Livestock Judging (2 cr)
APEC 1251 — Principles of Accounting (3 cr)
SOIL 2125 — Basic Soil Science, ENVT (4 cr)
VBS 2032 — General Microbiology With Laboratory (4 cr)

Take 10 or more credit(s) from the following:
ANSC 3007 — Equine Nutrition (3 cr)
ANSC 3052 — Equine Anatomy and Exercise Physiology (4 cr)
ANSC 3142 — Advanced Livestock Judging (2 cr)
ANSC 3203W — Environment, Global Food Production, and the Citizen, C/PE, ENVT, WI (3 cr)
ANSC 3305 — Reproductive Biology in Health and Disease (4 cr)
ANSC 3501 — Farm Animal Environment (3 cr)
ANSC 3509 — Animal Biotechnology (3 cr)
ANSC 3511 — Animal Growth and Development (3 cr)
ANSC 4011 — Dairy Cattle Breeding (3 cr)
ANSC 4102 — Equine Management (3 cr)
ANSC 4401 — Swine Nutrition (3 cr)
ANSC 4403 — Ruminant Nutrition (3 cr)
ANSC 4404 — Applied Dairy Nutrition (2 cr)
ANSC 4601 — Pork Production Systems Management (4 cr)
ANSC 4602 — Sheep Production Systems Management (4 cr)
ANSC 4603 — Beef Production Systems Management (4 cr)
ANSC 4604 — Dairy Production Systems Management (4 cr)
ANSC 4605 — Poultry Production Systems Management (4 cr)
ANSC 4609 — Animal Production Systems (2 cr)
ANSC 4611 — Advanced Pork Production Systems Management (2 cr)
ANSC 4613 — Advanced Beef Production Systems Management (2 cr)
ANSC 4614 — Advanced Dairy Production Systems Management (2 cr)
APEC 3411 — Commodity Marketing (3 cr)
APEC 3451 — Food and Agricultural Sales (3 cr)
APEC 3811 — Principles of Farm Management (3 cr)
ENT 3281 — Veterinary Entomology (3 cr)
VCS 4600 — Small Animal and Equine Behavior (3 cr)
VCS 4606 — Small Animal Management (3 cr)
VPM 3502 — Animal Health and Disease (3 cr)
VPM 3700 — Equine Reproduction and Breeding Management (2 cr)

Animal Production Focus
Students are required to complete one of the following course groups.

Dairy
ANSC 4011 — Dairy Cattle Breeding (3 cr)
ANSC 4403 — Ruminant Nutrition (3 cr)
ANSC 4604 — Dairy Production Systems Management (4 cr)
ANSC 4614 — Advanced Dairy Production Systems Management (2 cr)

Beef
ANSC 2012 — Livestock and Carcass Evaluation (3 cr)
ANSC 4403 — Ruminant Nutrition (3 cr)
ANSC 4603 — Beef Production Systems Management (4 cr)
ANSC 4613 — Advanced Beef Production Systems Management (2 cr)

Sheep
ANSC 2012 — Livestock and Carcass Evaluation (3 cr)
ANSC 4403 — Ruminant Nutrition (3 cr)
ANSC 4602 — Sheep Production Systems Management (4 cr)

Swine
ANSC 2012 — Livestock and Carcass Evaluation (3 cr)
ANSC 4401 — Swine Nutrition (3 cr)
ANSC 4601 — Pork Production Systems Management (4 cr)
ANSC 4603 — Beef Production Systems Management (4 cr)
ANSC 4604 — Dairy Production Systems Management (4 cr)
ANSC 4605 — Poultry Production Systems Management (4 cr)
ANSC 4609 — Animal Production Systems (2 cr)
ANSC 4611 — Advanced Pork Production Systems Management (2 cr)
ANSC 4613 — Advanced Beef Production Systems Management (2 cr)
ANSC 4614 — Advanced Dairy Production Systems Management (2 cr)

Equine
Take 11 or more credit(s) from the following:
ANSC 2055 — Horse Health Management (2 cr)
ANSC 3052 — Equine Nutrition (3 cr)
ANSC 3057 — Equine Anatomy and Exercise Physiology (4 cr)
ANSC 3203W — Environment, Global Food Production, and the Citizen, C/PE, ENVT, WI (3 cr)
VPM 3700 — Equine Reproduction and Breeding Management (2 cr)

Companion Animal
ANSC 1403 — Companion Animal Nutrition and Care (3 cr)
VCS 4600 — Small Animal and Equine Behavior (3 cr)
VCS 4606 — Small Animal Management (3 cr)
3 credits to be determined in consultation with an adviser.

Note: Programs listed in this catalog are current as of March 2008.
**Poultry**
The three poultry courses must be taken from the Midwest Poultry Consortium (MPC) Summer Program at Madison, Wisconsin. Courses cannot count for requirements in this section and professional courses.
- ANSC 4605—Poultry Production Systems Management (4 cr)
- Three MPC summer courses

**Individualized Option**
Students select 12 credits in consultation with an adviser and with the approval of the Animal Production Systems Committee.
Individual electives

**Science/Pre-Vet**
Students in the science/pre-veterinary emphasis must select either the basic science or biotechnology option.

**Core Courses**
- BIOL 4003 is required for the Biotechnology Option.
- BIOC 3021—Biochemistry (3 cr)
- CHEM 1022—Chemical Principles II, ENVT, PHYS SCI/L (4 cr)
- CHEM 1021—Chemical Principles I, ENVT, PHYS SCI/L (4 cr)
- CHEM 2301—Organic Chemistry I (3 cr)
- CHEM 2311—Organic Lab (4 cr)
- VBS 2032—General Microbiology With Laboratory (4 cr)
- BIOL 4003—Genetics (3 cr)
- or GCD 3022—Genetics (3 cr)
- Take one of the follow pairs of courses
  - PHYS 1101W—Introductory College Physics I, PHYS SCI/L, WI (4 cr)
  - and PHYS 1102W—Introductory College Physics II, PHYS SCI/L, WI (4 cr)
  - OR-
  - PHYS 1201W—Introductory Physics for Biology and Pre-medicine I, PHYS SCI/L, WI (5 cr)
  - and PHYS 1202W—Introductory Physics for Biology and Pre-medicine II, PHYS SCI/L, WI (5 cr)

**Science/Pre-Veterinary Options**
Students are required to complete one of the following course groups.

**Basic Science Option**
Any animal science course not used to fulfill another requirement may also be used as a basic science elective.
- Take 12 or more credit(s) from the following:
  - CFAN 1501—Biotechnology, People, and the Environment, ENVT (3 cr)
  - ANSC 1011—Animals and Society, C/PE, ENVT (3 cr)
  - ANSC 1403—Companion Animal Nutrition and Care (3 cr)
  - ANSC 3203W—Environment, Global Food Production, and the Citizen, C/PE, ENVT, WI (3 cr)
  - ANSC 3305—Reproductive Biology in Health and Disease (4 cr)
  - ANSC 3509—Animal Biotechnology (3 cr)
  - ANSC 3511—Animal Growth and Development (3 cr)
  - ANSC 4011—Dairy Cattle Breeding (3 cr)
  - ANSC 4401—Swine Nutrition (3 cr)
  - ANSC 4403—Ruminant Nutrition (3 cr)
  - ENT 3281—Veterinary Entomology (3 cr)
  - VPM 3502—Animal Health and Disease (3 cr)
  - ANSC 4601—Pork Production Systems Management (4 cr)
  - or ANSC 4602—Sheep Production Systems Management (4 cr)
  - or ANSC 4603—Beef Production Systems Management (4 cr)
  - or ANSC 4604—Dairy Production Systems Management (4 cr)
  - or ANSC 4605—Poultry Production Systems Management (4 cr)
  - or VCS 4606—Small Animal Management (3 cr)
  - or ANSC 2055—Horse Health Management (2 cr)
  - or ANSC 3007—Equine Nutrition (3 cr)

**Biotechnology Option**
- CFAN 1501—Biotechnology, People, and the Environment, ENVT (3 cr)
- ANSC 3509—Animal Biotechnology (3 cr)
- BIOL 4003—Genetics (3 cr)
- Select at least 2 credits of a laboratory.

**Animal Science Science Minor**
- Required credits in this minor: 20.
  - This minor is for students who want to include animal science coursework to enhance or supplement their major program.
  - Students have flexibility in choosing courses to meet the requirements.

**Minor Requirements**
Students must complete at least 20 credits of courses with an animal science (ANSC) designator.

**Required Courses**
At least 10 credits must be 3xxx or higher.
- Take 20 or more credit(s) from the following:
  - ANSC 1xxx, 2xxx
- Take no more than 10 credit(s) from the following:
  - ANSC 3xxx, 4xxx, 5xxx

**Applied Economics B.S.**
**Applied Economics**
- Required credits to graduate with this degree: 120.
- Required credits within the major: 52.
  - The applied economics major prepares students for careers in private industry, government agencies, agribusiness, or graduate work. Students may choose one of six professional application clusters: management and finance; marketing; food retailing; trade and development; resources and environment; or regional and public economics. Students may also, in consultation with their adviser, develop an individualized application cluster.
  - The curriculum emphasizes fundamental written and oral communication skills and a strong foundation in mathematics and economic principles and their applications. Areas of employment for graduates include management, finance, marketing and international trade, domestic and international development, environmental impact assessment, resource management and use, and government-related work in planning, taxation, and development. Entry-level jobs are often in merchandising and sales, credit analysis, management, and other customer contact areas.
Admission Requirements

For information about University of Minnesota admission requirements, visit [http://admissions.tc.umn.edu](http://admissions.tc.umn.edu).

Program Requirements

Every student’s program is capped off with 12 credits of advanced-level coursework, called a professional application cluster. All required courses must be taken A-F, and students must earn a grade of at least C-. Students may not major in both applied economics and agricultural and food business management.

Foundation Courses

Students considering graduate study in applied economics are encouraged to take MATH 1271 and MATH 1272.

MATH 1142—Short Calculus, MATH (4 cr)
or MATH 1271—Calculus I, MATH (4 cr)

Writing Performance

WRIT 3562W—Technical and Professional Writing, WI (4 cr)

COMM 1313W—Analysis of Argument, WI (3 cr)
or WRIT 1152W—Writing on Issues of Science and Technology, C/PE, WI (4 cr)
or WRIT 3221W—Communication Modes and Methods, C/PE, SSCI, WI (4 cr)

Speech Performance

COMM 1101—Introduction to Public Speaking (3 cr)

COMM 3441—Introduction to Organizational Communication (3 cr)
or WRIT 3257—Scientific and Technical Presentations (3 cr)

COMM 3441—Introduction to Small Group Communication (3 cr)

Additional Social Science

Students majoring in applied economics must complete 3 credits in social sciences beyond the 6 credits required for liberal education. The 3 credits may not be in courses with the APEC or ECON designator.

Social science course

Professional Courses

APEC 1001—Orientation to Applied Economics (1 cr)

APEC 1101—Principles of Microeconomics, SSCI (3 cr)

APEC 1102—Principles of Macroeconomics, IP, SSCI (3 cr)

APEC 3001—Applied Microeconomics: Consumers, Producers, and Markets, SSCI (4 cr)

APEC 3002—Applied Microeconomics: Managerial Economics (4 cr)

APEC 3006—Applied Macroeconomics: Government and the Economy (3 cr)

APEC 3007—Applied Macroeconomics: Policy, Trade, and Development, IP (3 cr)

ACCT 2050—Introduction to Financial Reporting (4 cr)
or APEC 1251—Principles of Accounting (3 cr)

OMS 2550—Business Statistics: Data Sources, Presentation, and Analysis (4 cr)
or STAT 3011—Introduction to Statistical Analysis, MATH (4 cr)

Ethics and Responsible Management

Student must take one course (3 credits) from the list below that fosters one or more of the following objectives: responsible judgment about the management of natural resources and the environment; responsible judgment regarding ethical and policy issues related to agriculture; application of global perspectives to agricultural, food, and environmental issues and decisions; application of a historical perspective to the role of science and technology.

Take 1 or more course(s) from the following:

CFAN 1501—Biotechnology, People, and the Environment, ENVT (3 cr)

AGRO 1103—Crops, Environment, and Society, ENVT (3 cr)

AGRO 3203W—Environment, Global Food Production, and the Citizen, C/PE, ENVT, WI (3 cr)

ANSC 1011—Animals and Society, C/PE, ENVT (3 cr)

BBE 5212—Safety and Environmental Health Issues in Plant and Animal Production and Processing, C/PE, ENVT, H (3 cr)

BIOL 4501—Social Uses of Biology, C/PE (3 cr)

EE 1701W—Energy, Environment, and Society, C/PE, ENVT, WI (3 cr)

EEB 3001—Ecology and Society, ENVT (3 cr)

ESPM 3011W—Ethics in Natural Resources, C/PE, ENVT, WI (3 cr)

ESPM 4061W—Water Quality and Natural Resources, ENVT, WI (3 cr)

ESPM 1011—Issues in the Environment, C/PE, ENVT (3 cr)

FSCN 1102—Food: Safety, Risks, and Technology, C/PE (3 cr)

GEO 3005—Earth Resources, C/PE, IP (3 cr)

GEOG 3401—Geography of Environmental Systems and Global Change, WI (4 cr)

HSCI 3331—Technology and American Culture, HP (3 cr)

HSCI 3332—Science and American Culture, CD, HP (3 cr)

PBIO 1212—Plants and Society, ENVT (3 cr)

Program Sub-Plans

Students are required to complete one of the following sub-plans.

Food Retailing

Students take at least two upper division APEC courses (including no more than one of the following: 3991, 4096, 5891, 5991), plus two additional courses from APEC, ECON, Carlson School of Management, or other courses listed below for a total of 12 credits minimum. While students are encouraged to complete credits in one of the following areas, students may select courses across the categories in consultation with their adviser.

Food Retailing Core Courses

Take 12 or more credit(s) from the following:

Take 2 or more course(s) from the following:

APEC 3451—Food and Agricultural Sales (3 cr)

APEC 3821—Retail Center Management (3 cr)

APEC 4096—Professional Experience Program: Internship (1–3 cr)

APEC 4451W—Food Marketing Economics, C/PE, WI (3 cr)

APEC 4481—Futures and Options Markets (3 cr)

Take 2 or more course(s) from the following:

AIM 4011—Student Project/Field Investigation (3 cr)

DHA 3242—Retail Buying (3 cr)

DHA 3245—Multichannel Retailing (3 cr)

HRIR 3032—Training and Development (2 cr)

HRIR 3042—The Individual and Organizational Performance (2 cr)

MKTG 4020—Advanced Logistics and Supply Chain Management (2–3 cr)

MKTG 4040—Buyer Behavior (4 cr)

MKTG 4060—Marketing and Distribution Channels (4 cr)

MKTG 4080—Marketing Strategy (4 cr)

OMS 3001—Introduction to Operations Management (3 cr)

OMS 3056—Operations Planning and Control (4 cr)

Individualized Professional

Students develop a program in consultation with an adviser. Students must take at least 12 credits.

Individualized Professional Application Courses

Courses listed here are suggestions. All courses must be chosen in consultation with an adviser.

Take 12 or more credit(s) from the following:

APEC 3xxx, 4xxx

HRIR 3xx, 4xxx

MGMT 3xx, 4xxx

MKTG 3xx, 4xxx

Management and Finance

Students must take at least two upper division APEC courses (including no more than one of the following: 3991, 4096, 5891, 5991) plus two additional courses from APEC, ECON, Carlson School of Management, or other courses listed below, for a total of at least 12 credits. While students are encouraged to complete credits in one of the following areas, students may select courses across the categories in consultation with their adviser.
Management and Finance Core Courses  
Take 12 or more credit(s) from the following:  
Take 2 or more course(s) from the following:  
APEC 3501—Agribusiness Finance (3 cr)  
APEC 3811—Principles of Farm Management (3 cr)  
APEC 4096—Professional Experience Program: Internship (1–3 cr)  
APEC 4481—Futures and Options Markets (3 cr)  
APEC 4501—Financial Modeling (3 cr)  
APEC 4821W—Business Economics and Strategy, WI (3 cr)  
APEC 5811—Cooperative Organization (3 cr)  
Take 2 or more course(s) from the following:  
ACCT 3001—Introduction to Management Accounting (3 cr)  
ACCT 5100—Corporate Financial Reporting (4 cr)  
ACCT 5160—Financial Statement Analysis (2 cr)  
ECON 4751—Financial Economics (3 cr)  
FINA 4241—Corporate Financing Decisions (4 cr)  
FINA 4242—Corporate Investment Decisions (4 cr)  
HRIR 3021—Human Resource Management and Industrial Relations (3 cr)  
MGMT 3001—Fundamentals of Management (3 cr)  
ECON 3701—Money and Banking (3 cr)  
or ECON 4721—Money and Banking (3 cr)  

Marketing  
Students must take at least two upper division APEC courses (including no more than one of the following: 3991, 4096, 5891, 5991) plus two additional courses from APEC, ECON, Carlson School of Management, or other courses listed below, for a total of at least 12 credits. While students are encouraged to complete credits in one of the following areas, students may select courses across the categories in consultation with their adviser.  

Marketing Core Courses  
Take 12 or more credit(s) from the following:  
Take 2 or more course(s) from the following:  
APEC 3411—Commodity Marketing (3 cr)  
APEC 3451—Food and Agricultural Sales (3 cr)  
APEC 3821—Retail Center Management (3 cr)  
APEC 4096—Professional Experience Program: Internship (1–3 cr)  
APEC 4481—Futures and Options Markets (3 cr)  
Take 2 or more course(s) from the following:  
AIM 4011—Student Project/Field Investigation (3 cr)  
DHA 3245—Multichannel Retailing (3 cr)  
MKTG 3001—Principles of Marketing (3 cr)  
MKTG 3010—Marketing Research (4 cr)  
MKTG 4030—Selling and Sales Management (4 cr)  
MKTG 4040—Buyer Behavior (4 cr)  
MKTG 4050—Integrated Marketing Communications (4 cr)  
MKTG 4060—Marketing and Distribution Channels (4 cr)  
MKTG 4080—Marketing Strategy (4 cr)  

Regional and Public Economics  
Students must take at least two upper division APEC courses (including no more than one of the following: 3991, 4096, 5891, 5991) plus two additional courses from APEC, ECON, Carlson School of Management, or other courses listed below, for a total of at least 12 credits. While students are encouraged to complete credits in one of the following areas, students may select courses across the categories in consultation with their adviser.  

Regional and Public Economics Electives  
Take 12 or more credit(s) from the following:  
Take 2 or more course(s) from the following:  
APEC 4096—Professional Experience Program: Internship (1–3 cr)  
APEC 4311—Tourism Development: Principles, Processes, Policies (3 cr)  
APEC 5321—Regional Economic Analysis (3 cr)  
APEC 5341—Public Finance (3 cr)  
Take 2 or more course(s) from the following:  
ECON 3041—Prospective World Economy (3 cr)  
ECON 3501—Labor Economics (3 cr)  
ECON 3601—Industrial Organization and Antitrust Policy (3 cr)  
ECON 3801—Elements of Public Economics (3 cr)  
ECON 4307—Comparative Economic Systems, IP (3 cr)  
ECON 4357—Comparative Economic Systems, IP (3 cr)  
ECON 4531—Labor Economics (3 cr)  
ECON 4623—Housing Markets and Public Policy (3 cr)  
ECON 4631—Industrial Organization and Antitrust Policy (3 cr)  
ECON 4831—Cost-Benefit Analysis, WI (3 cr)  
URBS 1001W—Introduction to Urban Studies: The Complexity of Metropolitan Life, C/PE, WI (3 cr)  

Resources and the Environment  
Students must take at least two upper division APEC courses (including no more than one of the following: 3991, 4096, 5891, 5991) plus two additional courses from APEC, ECON, Carlson School of Management, or other courses listed below, for a total of at least 12 credits. While students are encouraged to complete credits in one of the following areas, students may select courses across the categories in consultation with their adviser.  

Resources and Environment Electives  
Take 12 or more credit(s) from the following:  
Take 2 or more course(s) from the following:  
APEC 3611—Environmental and Natural Resource Economics, ENVT (3 cr)  
APEC 4096—Professional Experience Program: Internship (1–3 cr)  
APEC 5651—Economics of Natural Resource and Environmental Policy, ENVT (3 cr)  
APEC 5711—U.S. Agricultural and Environmental Policy (3 cr)  
Take 2 or more course(s) from the following:  
ECON 3611—Environmental Economics, ENVT (3 cr)  
ECON 4611H—Honors Course: Environmental Valuation, H (4 cr)  
ECON 4831—Cost-Benefit Analysis, WI (3 cr)  
ESPM 3202W—Environmental Conflict Management, Leadership, and Planning, C/PE, WI (3 cr)  
ESPM 3211—Survey, Measurement, and Modeling for Environmental Analysis (3 cr)  
ESPM 3241W—Natural Resource and Environmental Policy: History, Creation, and Implementation, C/PE, SSCI, WI (3 cr)  
ESPM 3261—Economics and Natural Resources Management, ENVT, SSCI (4 cr)  
GEOG 3331—Geography of the World Economy, IP, SSCI (3 cr)  
URBS 3751—Understanding the Urban Environment, ENVT (3 cr)  

Trade and Development  
Students must take at least two upper division APEC courses (including no more than one of the following: 3991, 4096, 5891, 5991) plus two additional courses from APEC, ECON, Carlson School of Management, or other courses listed below, for a total of at least 12 credits. While students are encouraged to complete credits in one of the following areas, students may select courses across the categories in consultation with their adviser.  

Trade and Development Electives  
Take 12 or more credit(s) from the following:  
Take 2 or more course(s) from the following:  
APEC 3041W—Economic Development of U.S. Agriculture, HP, WI (3 cr)  
APEC 3071—Agriculture and Economic Growth in Developing Countries (3 cr)  
APEC 4096—Professional Experience Program: Internship (1–3 cr)  
APEC 4103—World Food Problems, C/PE, IP (3 cr)  
APEC 5711—U.S. Agricultural and Environmental Policy (3 cr)  
APEC 5751—Global Trade and Policy, IP (3 cr)  
ECON 4041—The Prospective World Economy (3 cr)  
ECON 4301—Economic Development, WI (3 cr)
Applied Economics Minor

- Required credits in this minor: 16.

This minor is for students who want to include a basic core of applied economics coursework to enhance or supplement their major program. Students have flexibility in choosing courses to meet these minor requirements. Students who wish to minor in applied economics should consult with the major coordinator for approval before completion of 9 credits in the minor. No more than 6 credits may be counted for both the major and the applied economics minor. Students must complete at least 16 credits for the minor.

Minor Requirements

APEC 1101—Principles of Microeconomics, SSCI (3 cr)
or ECON 1101—Principles of Microeconomics, IP, SSCI (4 cr)
APEC 1102—Principles of Macroeconomics, IP, SSCI (3 cr)
or ECON 1102—Principles of Macroeconomics, IP, SSCI (4 cr)

Take 8–10 credit(s) from the following:

APEC 3xxx, 4xxx, 5xxx

Applied Plant Science B.S.

Agroecology and Plant Genetics

- Required credits to graduate with this degree: 120.
- Required credits within the major: 73 to 82.
- This program requires summer terms.

The applied plant science major provides options for a broad course of study in plant sciences, as well as options to concentrate more specifically within an area of individual interest. It provides a solid science background and integrates knowledge of science, environment, production and industry in preparation for continuing study in graduate school or careers in improvement of the quality and benefits of plants and plant products; industry, government, and universities as research scientists; agencies and organizations concerned with natural resource management; advisory, inspection and certification services; bio-safety and food security; related fields of biology and agricultural education.

Students choose from three areas of emphasis: agroecology, plant improvement, and plant utilization.

Admission Requirements

For information about University of Minnesota admission requirements, visit [http://admissions.tc.umn.edu](http://admissions.tc.umn.edu)

Program Requirements

All required courses must be taken A-F, and students must earn a grade of at least C-

Students develop a plan of study that fulfills the required science core (43–49 credits) and area electives (12–17 credits). Students enroll in a set of three common courses in their freshman year and a series of three integrative courses in each of the following three years. The last course in the series is the senior capstone course. After fulfilling CLE and major requirements, students should have between 15 and 22 credits available for electives.

Science Foundation Courses

- BIOL 2022—General Botany (3 cr)
- CHEM 1021—Chemical Principles I, ENVT, PHYS SCI/L (4 cr)
- PHYS 1101W—Introductory College Physics I, PHYS SCI/L, WI (4 cr)
- BIOL 1009—General Biology, BIOL SCI/L (4 cr)
or BIOL 1001—Introductory Biology I: Evolutionary and Ecological Perspectives, BIOL SCI/L, ENVT (4 cr)
- AGRO 4005—Applied Crop Physiology and Development (4 cr)
or BIOL 3002—Plant Biology: Function (2 cr)
or BIOL 3005W—Plant Function Laboratory, WI (2 cr)
or BIOL 3002—Plant Biology: Function (2 cr)
or HORT 3005—Environmental Effects on Horticultural Crops (4 cr)

Major Courses

AGRO 1103—Crops, Environment, and Society, ENVT (4 cr)
AGRO 1660—First-Year Colloquium/Experience in Agroecosystems Analysis (2 cr)
AGRO 4660—Senior Capstone: Leadership, Decision Making, and Problem Solving (2 cr)
AGRO 4993—Directed Studies for Advanced Students (1–4 cr)
or AGRO 4996—Professional Experience Program: Internship (1–3 cr)

Take 17 or more credit(s) including 4 or more sub-requirement(s) from the following:

AGRO 1660—First-Year Colloquium/Experience in Agroecosystems Analysis (2 cr)
AGRO 2501—Plant Identification for Urban and Rural Landscapes (2 cr)
ENT 5211—Insect Pest Management (3 cr)
or PBIO 4321—Minnesota Flora (3 cr)
Take 1 or more course(s) from the following:

AGRO 4505—Biological Control of Insects and Weeds (3 cr)
EEB 5341—Biological Control of Insects and Weeds (3–4 cr)
ENT 5341—Biological Control of Insects and Weeds (3–4 cr)
PBIO 5201—Biological Control of Plant Diseases (4 cr)
PPLA 5204—Plant Disease Management (3 cr)
Take 1 or more course(s) from the following:

AGRO 4605—Management Strategies for Crop Production (4 cr)
HORT 4072—Growing Plants Organically: What It Means To Be Green (3 cr)
HORT 5052—Specialty Greenhouse Crop Production (3 cr)
SOIL 3416—Plant Nutrients in the Environment (3 cr)

Program Sub-Plans

Students are required to complete one of the following sub-plans.

Agroecology

Required Courses

- SOIL 2125—Basic Soil Science, ENVT (4 cr)
- BIOC 2011—Biochemistry for the Agricultural and Health Sciences (3 cr)
or BIOC 3021—Biochemistry (3 cr)
- BIOL 3407—Ecology, ENVT (3 cr)
or BIOL 3407—Ecology, ENVT (3 cr)
- BIOL 4005—Applied Crop Physiology and Development (4 cr)
or PBIO 4321—Minnesota Flora (3 cr)
- MATH 1031—College Algebra and Probability, MATH (3 cr)
or MATH 1142—Short Calculus, MATH (4 cr)
or STAT 3011—Introduction to Statistical Analysis, MATH (4 cr)

Electives

Take 17 or more credit(s) including 4 or more sub-requirement(s) from the following:

Take 1 or more course(s) from the following:

AGRO 2501—Plant Identification for Urban and Rural Landscapes (2 cr)
ENT 5021—Insect Taxonomy and Phylogeny (4 cr)
ENT 5371—Principles of Systematics (3 cr)
PBIOL 4321—Minnesota Flora (3 cr)
Take 1 or more course(s) from the following:

AGRO 4505—Biological Control of Insects and Weeds (3 cr)
EEB 5341—Biological Control of Insects and Weeds (3–4 cr)
ENT 5341—Biological Control of Insects and Weeds (3–4 cr)
ENT 5211—Insect Pest Management (3 cr)
ENT 5341—Biological Control of Insects and Weeds (3–4 cr)
PPLA 5201—Biological Control of Plant Diseases (4 cr)
PLPA 5204—Plant Disease Management (3 cr)
Take 1 or more course(s) from the following:

AGRO 4605—Management Strategies for Crop Production (4 cr)
HORT 4072—Growing Plants Organically: What It Means To Be Green (3 cr)
HORT 5052—Specialty Greenhouse Crop Production (3 cr)
SOIL 3416—Plant Nutrients in the Environment (3 cr)
Take 1 or more course(s) from the following:

AGRO 5321—Ecology of Agricultural Systems, ENVT (3 cr)
ESPM 3221—Soil Conservation and Land-Use Management (3 cr)
ESPM 3612W—Soil and Environmental Biology, WI (3 cr)
HORT 5031—Sustainable Viticulture and Fruit Production (2 cr)
HORT 5032—Sustainable Commercial Vegetable Production Systems (3 cr)
HORT 5071—Restoration and Reclamation Ecology, ENVT (3 cr)
PLPA 2001—Introductory Plant Pathology (3 cr)

**Plant Improvement**

**Required Courses**

BIOC 3021—Biochemistry (3 cr)
BIOL 4003—Genetics (3 cr)
CHEM 1022—Chemical Principles I, ENVT, PHYS SCI/L (4 cr)
CHEM 2301—Organic Chemistry I (3 cr)
HORT 4401—Plant Genetics and Breeding (4 cr)
STAT 3011—Introduction to Statistical Analysis, MATH (4 cr)
MATH 1031—College Algebra and Probability, MATH (3 cr)
or MATH 1142—Short Calculus, MATH (4 cr)

**Electives**

Take 12 or more credit(s) from the following:

BBE 4744—Engineering Principles for Biological Scientists (4 cr)
BIOL 3407—Ecology, ENV (3 cr)
EED 3001—Ecology and Society, ENV (3 cr)
FSCN 3102—Introduction to Food Science (3 cr)
FSCN 4111—Food Chemistry (3 cr)
STAT 3011—Introduction to Statistical Analysis, MATH (4 cr)
MATH 1142—Short Calculus, MATH (4 cr)
or MATH 1031—College Algebra and Probability, MATH (3 cr)

**Plant Utilization**

**Required Courses**

BIOC 3021—Biochemistry (3 cr)
CHEM 1022—Chemical Principles II, ENVT, PHYS SCI/L (4 cr)
CHEM 2301—Organic Chemistry I (3 cr)
FSCN 3102—Introduction to Food Science (3 cr)
FSCN 4111—Food Chemistry (3 cr)
STAT 3011—Introduction to Statistical Analysis, MATH (4 cr)
MATH 1127—Calculus I, MATH (4 cr)
or MATH 1142—Short Calculus, MATH (4 cr)

**Electives**

Take 12 or more credit(s) from the following:

BBE 4744—Engineering Principles for Biological Scientists (4 cr)
BIOL 3407—Ecology, ENV (3 cr)
EED 3001—Ecology and Society, ENV (3 cr)
FSCN 3102—Introduction to Food Science (3 cr)
FSCN 4111—Food Chemistry (3 cr)
FSCN 4121—Food Microbiology and Fermentations (3 cr)
FSCN 4332—Food Processing Operations (3 cr)
FSCN 4612—Human Nutrition (3 cr)
FSCN 5101—Food Biotechnology (2 cr)
FSCN 5411—Introduction to New Product Development (2 cr)
FSCN 5531—Grains: Introduction to Cereal Chemistry and Technology (2 cr)

**Bio-Based Products B.S.**

**Bio-Based Products**

- Required credits to graduate with this degree: 120 to 128.
- Required credits within the major: 120 to 128.

Bio-based products are materials, chemicals, and energy derived from renewable, bio-resources, including forestry, agriculture, and other biomass. Many of the commercial products and forms of energy that we use today and come from depleting fossil fuels can be derived from renewable, bio-resources. The molecular building blocks and components of biomass can be harnessed to heat homes, run cars, light buildings, and provide industrial and consumer products. These products include fibers and fiber-based products, paper, board, engineered wood, structural panels, wood-based composites, renewable plastics, and bio-derived chemicals and fuels.

This major provides students with a strong foundation in the sustainable use of bio-resources while protecting the environment. The interdisciplinary bio-based products major combines coursework in science, engineering, technology, and business—all related to the manufacturing and end-use applications of materials, products, and energy from renewable resources.

Students choose one of the following three areas of specialization: pre-bio-based products engineering (Joint program)—see major requirements listed in bio-based products engineering, Institute of Technology; bio-based products marketing and management; or residential building science and technology. In addition, the department also offers a minor in bio-based products engineering that enables students in any of the basic sciences and engineering majors to gain a better understanding of and appreciation for sustainable use of the renewable resources.

**Admission Requirements**

For information about University of Minnesota admission requirements, visit [http://admissions.tc.umn.edu](http://admissions.tc.umn.edu).

**Program Requirements**

All required courses must be taken A-F, and students must earn a grade of at least C-.

**Communication Skills**

COMM 1101—Introduction to Public Speaking (3 cr)

**Physical and Biological Sciences**

BIOL 1001—Introductory Biology I: Evolutionary and Ecological Perspectives, BIOL SCI/L, ENVT (4 cr)
or BIOL 1009—General Biology, BIOL SCI/L, (4 cr)
PHYS 1101W—Introductory College Physics I, PHYS SCI/L, WI (4 cr)
or PHYS 1301W—Introductory Physics I, PHYS SCI/L, WI (4 cr)

**Social Sciences**

PSY 1001—Introduction to Psychology, SSCI (4 cr)
APEC 1101—Principles of Microeconomics, SSCI (3 cr)
or ECON 1101—Principles of Microeconomics, IP, SSCI (4 cr)
or ESPM 3261—Economics and Natural Resources Management, ENVT, SSCI (4 cr)
Program Sub-Plans

Students are required to complete one of the following sub-plans.

Bio-Based Products Marketing and Management

The bio-based products marketing and management specialization combines coursework in liberal arts, basic sciences, communications, and business. Students learn about the physical and social aspects of renewable bio-based products and resources, and the combination of marketing and sales courses with technical bio-based products engineering coursework prepares them for the growing bio-based products industries.

Required Courses for the Sub-Plan

Mathematical Thinking
MATH 1142—Short Calculus, MATH (4 cr)
STAT 3011—Introduction to Statistical Analysis, MATH (4 cr)

Physical and Biological Sciences
Take one of the following pairs of courses.
CHEM 1011— Introductory Chemistry: Lecture and Laboratory, PHYS SCI/L (4 cr) and BIOL 1011—Biochemistry for the Agricultural and Health Sciences (3 cr)
CHEM 1021—Chemical Principles I, ENVNT, PHYS SCI/L (4 cr) and CHEM 1022—Chemical Principles II, ENVNT, PHYS SCI/L (4 cr)

Macroeconomics
APEC 1102—Principles of Macroeconomics, IP, SSCI (3 cr)
or ECON 1102—Principles of Macroeconomics, IP, SSCI (4 cr)

Bio-Based Products
BBE 1003—Wood and Fibre Science Lab (1 cr)
BBE 4413— Systems Approach to Residential Construction (3 cr)

Bio-Based Marketing and Management
ACCT 2050—Introduction to Financial Reporting (4 cr)
BLAW 3058—The Law of Contracts and Agency (4 cr)
ESPM 3504—Environmental Conflict Management, Planning, C/PE, WI (3 cr)
FINA 3001—Introduction to Financial Management (3 cr)
MGMT 2001—Introduction to Management (3 cr)
MKTG 3001—Principles of Marketing (3 cr)

Marketing and Management Focus
Students are required to complete one of the following course groups.

Marketing and Sales
Take 9 or more credits from the following:
ESPM 3202W—Environmental Conflict Management, Leadership, and Planning, C/PE, WI (3 cr)
JOUR 4261—Advertising: Media Strategy (3 cr)
JOUR 4272—Interactive Advertising (3 cr)
MKTG 3010—Marketing Research (4 cr)
MKTG 4030—Selling and Sales Management (4 cr)

Management
Take 9 or more credits from the following:
ACCT 3001—Introduction to Management Accounting (3 cr)
HRIR 3021—Human Resource Management and Industrial Relations (3 cr)
IDSC 3001—Information Systems for Business Processes and Management (3 cr)
IE 4521—Statistics, Quality, and Reliability (4 cr)
IE 5522—Quality Engineering and Reliability (4 cr)
OMS 3001—Introduction to Operations Management (3 cr)
OMS 3056—Operations Planning and Control (4 cr)

Residential Building Science and Technology

The residential building science and technology program is designed to investigate the important relationships between people, their homes, and the environment. From a solid scientific and engineering base, this interdisciplinary program builds critical thinking skills and helps students explore the opportunities that can enhance the performance of houses. The curriculum draws upon a wide range of resources across the University and includes physical science, social science, management, marketing, communications, material sciences, and engineering coursework.

The environment and international perspectives themes are satisfied automatically by completing required courses in the residential building science and technology specialization.

Required Courses for the Sub-Plan

Mathematical Thinking
MATH 1271—Calculus I, MATH (4 cr)
MATH 1272—Calculus II (4 cr)
STAT 3011—Introduction to Statistical Analysis, MATH (4 cr) or STAT 3021—Introduction to Probability and Statistics (3 cr)

Chemistry and Physics
CHEM 1021—Chemical Principles I, ENVNT, PHYS SCI/L (4 cr) or PHYS 1021—Introductory College Physics I, PHYS SCI/L, WI (4 cr)
or PHYS 1022—Introductory College Physics II, PHYS SCI/L, WI (4 cr)

Residential Building Science and Technology
BBE 4413— Systems Approach to Residential Construction (3 cr)
BBE 4414—Advanced Residential Building Science, WI (3 cr)
BBE 4415—Advanced Residential Building Science Lab (1 cr)
BBE 4416—Building Testing and Diagnostics (2 cr)
CE 3402—Construction Materials (3 cr)
CE 4101W—Project Management, WI (3 cr)
DHA 2463—Housing and Community Development, C/PE (3 cr)
ESPM 3511—Natural Resources: Consumption and Sustainability, ENVNT, IP (3 cr)
HRIR 3021—Human Resource Management and Industrial Relations (3 cr)
OMS 3001—Introduction to Operations Management (3 cr)
ARCH 1701—The Designed Environment (3 cr)
or DHA 1101W—Introduction to Design Thinking, OH, WI (4 cr)
or LA 1101W—Introduction to Design Thinking, OH, WI (4 cr)

Electives
Course selections must be approved by RBST faculty adviser.
Take 12 or more credits from the following:
BLAW 3058—The Law of Contracts and Agency (4 cr)
CHEM 1022—Chemical Principles II, ENVNT, PHYS SCI/L (4 cr)
CMGT 4011—Construction Documents and Contracts (3 cr)
CMGT 4021—Construction Planning and Scheduling (3 cr)
CMGT 4022—Construction Estimating (3 cr)
CMGT 4031—Construction Safety and Loss Control (3 cr)
DHA 2402—Residential Technology (3 cr)
IE 6331—Engineering Optimization I, H (4 cr)
OMS 3059—Quality Management and Six Sigma (4 cr)
APEC 1102—Principles of Macroeconomics, IP, SSCI (3 cr)
or ECON 1102—Principles of Macroeconomics, IP, SSCI (4 cr)

Note: Programs listed in this catalog are current as of March 2008.
Bio-Based Products Engineering Minor

Bio-Based Products

• Required credits in this minor: 14.

This program provides students with a strong background in the basic sciences and engineering and their application to manufacturing and end-use applications of materials, chemicals, and energy from renewable resources.

Minor Requirements

Minor Courses
Take 14 or more credit(s) from the following:
BGE 4001—Chemistry of Plant Materials (4 cr)
BGE 4301—Surface and Colloid Science in Bio-based Products Manufacturing (3 cr)
BGE 4302—Organisms Impacting Bio-based Products (3 cr)
BGE 4303—Introduction to Bio-based Materials Science (3 cr)
BGE 4305—Pulp and Paper Technology (3 cr)
BGE 4401—Bioproducts Engineering (3 cr)
BGE 4404—Bio-based Composites Engineering (3 cr)
BGE 4501—Process and Product Design I (2 cr)
BGE 4502W—BBE Capstone Design, WI (4 cr)

Climatology Minor

Agronomy and Plant Genetics

• Required credits in this minor: 20.

The minor lets students broaden their expertise in weather and climate studies. Students who will be working for any industry or agency that depends on understanding weather and climate change will find the minor useful. Students take courses in meteorology, atmosphere, and biometeorology. Electives are in climate models, climate variations, climate change, and atmospheric boundary layer.

To complete the minor, students must complete at least 20 credits.

Minor Requirements

ESPM 1425—The Atmosphere, ENVT, PHYS SCI/L (4 cr)
ESPM 5131—Environmental Biophysics and Ecology (3 cr)

Electives
Take 13 or more credit(s) from the following:
EES 5008—Forest Response to Quaternary Climate Change (2 cr)
EES 5009—Quaternary Vegetation History and Climate (3 cr)
GEOG 3401—Geography of Environmental Systems and Global Change, WI (4 cr)
GEOG 5426—Climatic Variations (3 cr)
GEOG 5423—Climate Models and Modeling (3 cr)

Corporate Environmental Management Minor

Bio-Based Products

• Required credits in this minor: 18.

The corporate environmental management (CEM) minor is designed to provide students with an excellent opportunity to gain a broad exposure to the strategic, analytical, and managerial processes associated with the environmental impact of companies’ and other organizations’ products and processes. Completion of the CEM minor enhances students’ preparation for graduate school and for entering a career in the growing corporate functions of environmental management and regulatory compliance.

The CEM minor is available to students in good standing in all majors at the University of Minnesota, Twin Cities.

Admission Requirements

Students must complete 4 courses before admission to the program.

Preparatory Courses
APEC 1101—Principles of Microeconomics, SSCI (3 cr)
ECON 1101—Principles of Microeconomics, IP, SSCI (4 cr)
ESPM 3261—Economics and Natural Resources Management, ENVT, SSCI (4 cr)
Biol 1001—Introductory Biology I: Evolutionary and Ecological Perspectives, BIOL SCI/L, ENVT (4 cr)
BIOL 1009—General Biology, BIOL SCI/L (4 cr)
MATH 1142—Short Calculus, MATH (4 cr)
Any first semester calculus
OEMS 2550—Business Statistics: Data Sources, Presentation, and Analysis (4 cr)
STAT 3011—Introduction to Statistical Analysis, MATH (4 cr)

Minor Requirements

Minor Courses
ACCT 2050—Introduction to Financial Reporting (4 cr)
ESPM 3603—Environmental Life Cycle Analysis (3 cr)
ESPM 3604—Environmental Management Systems and Strategy (3 cr)
ESPM 5019—Business, Natural Environment, and Global Economy (2 cr)
Take 6 or more credit(s) from the following:
ESPM 3211W—Ethics in Natural Resources, C/PE, ENVT, WI (3 cr)
ESPM 3202W—Environmental Conflict Management, Leadership, and Planning, C/PE, WI (3 cr)
ESPM 3241W—Natural Resource and Environmental Policy: History, Creation, and Implementation, C/PE, SSC/L, WI (3 cr)
ESPM 3602—Regulatory and Ethical Frameworks for CEM (3 cr)
ESPM 3605—Recycling: Extending Raw Materials (3 cr)
ESPM 3606—Minimizing Industrial Emissions (3 cr)
ESPM 4601W—Water Quality and Natural Resources, ENVT, WI (3 cr)
ESPM 4607—Industrial Biotechnology and the Environment (2 cr)
ESPM 4608—Bioremediation (2 cr)
PLPA 3002—Air Pollution, People, and Plants: The Science and the Ethics, C/PE, ENVT (3 cr)

Entomology Minor

Entomology

• Required credits in this minor: 12.

This minor provides a strong background in entomological principles and theory suitable for students interested in a variety of professions or advanced degree programs. Examples include programs in entomology, veterinary science, or public health; teaching biology in secondary educational institutions; or enhancing marketable skills for a variety of professional careers, such as forest health specialist, crop consultant, grounds manager, pest management specialist, agronomist, greenhouse or nursery technician, natural resource manager, or water quality specialist. Specific courses are selected based on students’ educational objectives, in consultation with a minor adviser.

Minor Requirements

Minor Courses
CFAN 3001—Pests and Crop Protection (3 cr)
ENT 3005—Insect Biology, BIOL SCI/L (3 cr)
ENT 4015—Ornamentals and Turf Entomology (3 cr)
ENT 4251—Forest and Shade Tree Entomology (3 cr)
ENT 3281—Veterinary Entomology (3 cr)

For the most up-to-date listing of program requirements, visit the Online Catalog at www.catalogs.umn.edu/programs.html.
Electives
The course used to satisfy the minor requirement may not be used toward fulfilling this 9-credit elective requirement. Students may take a maximum of six credits, total, from the two special entomology courses (ENT 5910 and ENT 5920) toward the 9 credits.

Take 9 or more credits from the following:
- CFAN 3001—Pests and Crop Protection (3 cr)
- ENT 3005—Insect Biology, BIOL SCI/L (3 cr)
- ENT 4015—Ornamentals and Turf Entomology (3 cr)
- ENT 4251—Forest and Shade Tree Entomology (3 cr)
- ENT 3281—Veterinary Entomology (3 cr)
- ENT 3xxx, 4xxx, 5xxx
- ENT 5910—Special Problems in Entomology (1–6 cr)
- ENT 5920—Special Lectures in Entomology (1–3 cr)

Environmental Horticulture B.S.

Horticultural Science
- Required credits to graduate: 120.
- Required credits within the major: 47 to 73.

The environmental horticulture major educates and prepares students in all phases of horticulture: crop and plant production; education (botanic gardens and arboretums); service-oriented activities (landscaping and landscape maintenance); plant use and function (design, restoration, and recreation); and recreation (golf courses and parks). Students gain experience in the use of plants to alter environments, restore damaged landscapes, improve the health and well-being of individuals, educate people about science and agriculture, improve community environments, and provide recreational and practical benefits to the public.

Students choose either a business or science option. Landscape design, a joint offering with the College of Design (CDES), combines architecture and landscape architecture courses available in CDES with the plant-based design courses available in CFANS.

Admission Requirements
For information about University of Minnesota admission requirements, visit [http://admissions.tc.umn.edu](http://admissions.tc.umn.edu)

Program Requirements
Applied courses in horticultural science, soil science, entomology, plant pathology, and applied economics vary depending on program. All required courses must be taken A-F, and students must earn a grade of at least C-.

Foundation Courses
- BIOL 1009—General Biology, BIOL SCI/L (4 cr)
- CHEM 1011—Introductory Chemistry: Lecture and Laboratory, PHYS SCI/L (4 cr)
- or CHEM 1021—Chemical Principles I, ENV'T, PHYS SCI/L (4 cr)
- MATH 1031—College Algebra and Probability, MATH (3 cr)
- or MATH 1142—Short Calculus, MATH (4 cr)

Professional Courses
- HORT 1001—Plant Propagation, BIOL SCI/L (4 cr)
- HORT 1015—Woody and Herbaceous Plants (4 cr)
- HORT 3005—Environmental Effects on Horticultural Crops (4 cr)
- HORT 4096—Professional Experience Program: Internship (1 cr)
- PLPA 2001—Introductory Plant Pathology (3 cr)
- SOIL 2125—Basic Soil Science, ENV'T (4 cr)
- ENT 3005—Insect Biology, BIOL SCI/L (3 cr)
- or ENT 4015—Ornamentals and Turf Entomology (3 cr)
- or ENT 4251—Forest and Shade Tree Entomology (3 cr)

Emphasis Area Requirements
Students are required to complete one of the following course groups.

Science Option
- CHEM 1022—Chemical Principles II, ENV'T, PHYS SCI/L (4 cr)
- CHEM 2301—Organic Chemistry I (3 cr)
- PHYS 1101W—Introductory College Physics I, PHYS SCI/L, WI (4 cr)

Business Option
- APEC 1101—Principles of Microeconomics, SSCI (3 cr)
- APEC 1251—Principles of Accounting (3 cr)
- MGMT 3001—Fundamentals of Management (3 cr)
- or MGMT 3010—Introduction to Entrepreneurship (4 cr)
- OMS 2550—Business Statistics: Data Sources, Presentation, and Analysis (4 cr)
- or STAT 3011—Introduction to Statistical Analysis, MATH (4 cr)

Program Sub-Plans
Students are required to complete one of the following sub-plans.

Floriculture/Nursery Production and Retail Management
21 credits are required.

Emphasis Area Requirements
- APEC 3821—Retail Center Management (3 cr)
- HORT 4015—Advanced Woody and Herbaceous Plant Topics (1 cr)
- HORT 5051—Floriculture Crop Production (4 cr)
- HORT 4141W—Nursery Management, WI (4 cr)
- HORT 3002W—Greenhouse Management, WI (3 cr)
- AGRO 4401—Plant Genetics and Breeding (4 cr)
- or HORT 4071W—Applications of Biotechnology to Plant Improvement, C/PE, WI (4 cr)
- HORT 2100—Agricultural Biochemistry (3 cr)
- or BIOC 3021—Biochemistry (3 cr)

Take 4 or more credits from the following:
- HORT 1xxx, 4xxx, 5xxx

Individualized
Students must submit a course of study in consultation with an adviser to the Department of Horticultural Science Undergraduate Studies Committee at least three semesters before graduation.

Students choose two required courses plus 16 additional credits to total at least 21 credits in consultation with an adviser.

Emphasis Area Requirements
Take 5 or more credits from the following:
- HORT 4401—Plant Genetics and Breeding (4 cr)
- or HORT 4071W—Applications of Biotechnology to Plant Improvement, C/PE, WI (4 cr)
- HORT 2100—Agricultural Biochemistry (3 cr)
- or BIOC 3021—Biochemistry (3 cr)

Emphasis Area Credits
Take 16 or more credits from the following:
- HORT 3xxx, 4xxx, 5xxx

Landscape Design
49 credits are required.

Emphasis Area Requirements
- ARCH 3301—Drawing for Design in Architecture, OH (3 cr)
- ARCH 3711W—Environmental Design and the Sociocultural Context, C/PE, WI (3 cr)
- HORT 4021—Landscape Design and Implementation I (4 cr)
Environmental Horticulture Minor

- Required credits in this minor: 18.

Plants provide many practical and recreational benefits to society—whether it is the food we eat, the parks we play in, or the gardens we enjoy admiring. The horticultural science minor is geared toward students who want to learn more about plants and their many, diverse uses in the landscape. coursework is flexible and can easily be tailored to specific horticultural interests, including floriculture and nursery production, turfgrass science, landscape design and maintenance, fruit and vegetable production, sustainable and organic production practices, therapeutic horticulture, plant physiology, and genetics.

Students wishing to complete a minor in horticultural science should contact the Department of Horticultural Science, 305 Alderman Hall for assistance.

Minor Requirements

- HORT 1001—Plant Propagation, BIOL SCI, (4 cr)

Electives

Students must take at least 14 credits from courses with a HORT designator, of which one horticulture related elective course may be substituted (such as SOIL, PLPA, ENT, and BIOL 3002). At least two HORT courses must be 4xxx or 5xxx. A maximum of 3 credits of HORT 5090 may be applied to the minor. Directed studies may be applied. Take 14 or more credit(s) from the following:

- HORT 1xxx, 2xxx
- HORT 3xx,
- Take 2 or more course(s) from the following:
- HORT 4xxx, 5xxx
- Take 0–3 credit(s) from the following:
- HORT 5090—Directed Studies (1–6 cr)

Environmental Sciences, Policy and Management B.S.

- Required credits to graduate with this degree: 120.
- Required credits within the major: 46.
- This program requires summer terms.

The environmental sciences, policy, and management (ESPM) major is designed to address the needs posed by the complexity of environmental and renewable resource issues that are faced on a state, national, and global level. This interdisciplinary, environmental major prepares graduates to solve environmental problems from an integrated knowledge base.

The mission of the ESPM major is to:
- improve the basis for environmental decision-making by integrating physical, biological, and social sciences with policy analysis and management;
- educate the next generation of environmental professionals and leaders;
- foster innovative approaches for the education of environmental professionals;
- facilitate science/social science/policy linkages within and beyond the University.

Students complete a set of common “integrated core” courses that focus on integrated problem solving using environmental sciences, policy, ethics, management models, and communication theory. Students also incorporate classroom and fieldwork.
Admission Requirements
For information about University of Minnesota admission requirements, visit http://admissions.tc.umn.edu.

Program Requirements
All students complete Required Courses below and choose one of the following ESPM tracks: conservation and resource management (CRM); corporate environmental management (CEM); environmental education and communication (EEC); policy, planning, law and society (PPLS); and environmental science (ES).

Students are strongly encouraged to have an international experience before graduation. Courses completed during an international experience (study, work, volunteer, research) can meet program requirements, liberal education requirements, and/or electives. Discussion with an adviser prior to commencing an international experience is required to plan how courses meet requirements in the ESPM major.

All required courses must be taken A-F, and students must earn a grade of at least C-.

Communication Skills
COMM 1101—Introduction to Public Speaking (3 cr)

Physical and Biological Sciences
CHEM 1011—Introductory Chemistry: Lecture and Laboratory, PHYS SCI/L (4 cr)
or CHEM 1021—Chemical Principles I, ENVVT, PHYS SCI/L (4 cr)
Biol 1001—Introductory Biology I: Evolutionary and Ecological Perspectives, BIOL SCI/L, ENVVT (4 cr)
or BIOL 1009—General Biology, BIOL SCI/L (4 cr)

Integrated ESPM Core
ESPM 1011—Issues in the Environment, CPE, ENVVT (3 cr)
ESPM 2021—Environmental Sciences: Integrated Problem Solving (3 cr)
ESPM 3000—Seminar on Current Issues for ESPM (1 cr)
ESPM 1001—Freshmen Orientation to Environmental Sciences, Policy, and Management (1 cr)
or ESPM 1002—Transfer Orientation Seminar (1 cr)
ESPM 4021W—Problem Solving: Environmental Review, WI (4 cr)
or ESPM 4041W—Problem Solving for Environmental Change, WI (4 cr)

Program Sub-Plans
Students are required to complete one of the following sub-plans.

Conservation and Resource Management
Students in the CRM track are involved in what Thoreau suggested was “environmental wisdom” or the ability to make effective decisions about the environment by synthesizing natural and human created facts and information. Students integrate this understanding with diverse economic and social insight to make effective decisions for the environment and society.

This track prepares students for technical support, operational, and managerial positions in diverse aspects of resource conservation and management with local, state, and federal agencies and the private sector. This track also prepares students for graduate study in a wide range of areas.

Students solve problems in field settings and communicate their understanding, synthesis, and decision-making to diverse audiences. They gain experience in the actual implementation of decisions. Students may also develop special skills through electives (e.g., geographic information systems, geospatial analysis).

Required Courses for the Sub-Plan

Social Sciences
ESPM 3261—Economics and Natural Resources Management, ENVVT, SSCI (4 cr)
or APEC 1101—Principles of Microeconomics, SSCI (3 cr)
or ECON 1101—Principles of Microeconomics, IP, SSCI (4 cr)
ESPM 3241W—Natural Resource and Environmental Policy, History, Creation, and Implementation, CPE, SSCI, WI (3 cr)
or ESPM 3271—Human Environmental Behavior and Policy (3 cr)

CRM Core Courses
MATH 1142—Short Calculus, MATH (4 cr)
or MATH 1271—Calculus I, MATH (4 cr)
ESPM 3012—Quantitative Methods for Environmental Scientists and Managers II (4 cr)
or STAT 3011—Introduction to Statistical Analysis, MATH (4 cr)
BIOL 2012—General Zoology (4 cr)
or BIOL 2022—General Botany (3 cr)
or ESPM 3101—Conservation of Plant Biodiversity, ENVVT (3 cr)
or ESPM 3108—Ecology of Managed Systems (4 cr)
or ESPM 3612W—Soil and Environmental Biology, WI (3 cr)
or FR 1101—Dendrology: Identifying Forest Trees and Shrubs (3 cr)
or FR 3104—Forest Ecology (4 cr)
or BIOL 1009—General Biology, BIOL SCI/L (4 cr)
or SOIL 2125—Basic Soil Science, ENVVT (4 cr)

Internship
Requires approval and supervision by faculty adviser from track.
ESPM 4096—Professional Experience Program: Internship (1 cr)

CRM Contract Courses
Courses taken to meet other requirements cannot be double counted here, nor can courses count for multiple groups. Course selections from contract area must be made through a faculty adviser. A contract is required.
Take 36 or more credit(s) including 4 or more sub-requirement(s) from the following:

Conservation and Management
Take 10 or more credit(s) from the following:
ESPM 3101—Conservation of Plant Biodiversity, ENVVT (3 cr)
ESPM 3108—Ecology of Managed Systems (3 cr)
ESPM 3221—Soil Conservation and Land-Use Management (3 cr)
ESPM 3575—Wetlands Conservation (3 cr)
ESPM 3612W—Soil and Environmental Biology, WI (3 cr)
ESPM 4061W—Water Quality and Natural Resources, ENVVT, WI (3 cr)
ESPM 4216—Contaminant Hydrology (2 cr)
ESPM 4601—Soils and Pollution (3 cr)
ENT 3925—Insects, Aquatic Habitats, and Pollution (3 cr)
EEB 3603—Science, Protection, and Management of Aquatic Environments (3 cr)
FR 3104—Forest Ecology (4 cr)
FR 3114—Hydrology and Watershed Management (3 cr)
FR 3411—Managing Forest Ecosystems: Silviculture (3 cr)
FR 5153—Forest and Wetland Hydrology (3 cr)
FW 4102—Principles of Conservation Biology (3 cr)
FW 4103—Principles of Wildlife Management (3 cr)
FW 5411—Aquatic Toxicology, ENVVT (3 cr)
FW 5604W—Fisheries Ecology and Management, ENVVT, WI (3 cr)
HORT 5071—Restoration and Reclamation Ecology, ENVVT (3 cr)
SOIL 3416—Plant Nutrients in the Environment (3 cr)
SOIL 5555—Wetland Soils (3 cr)
SOIL 5711—Forest Soils (2 cr)

Take 7 or more credit(s) including 4 or more sub-requirement(s) from the following:
ESPM 3211—Survey, Measurement, and Modeling for Environmental Analysis (3 cr)
ESPM 4021W—Problem Solving: Environmental Review, WI (4 cr)
FR 3131—Geographical Information Systems (GIS) for Natural Resources (4 cr)

Note: Programs listed in this catalog are current as of March 2008.
Corporate Environmental Management

The CEM track provides graduates with the fundamental skills to systematically determine the environmental burdens associated with a firm’s products or manufacturing processes and to identify opportunities that generate value from environmental risk reduction, regulatory compliance programs, and other alternatives for improving environmental performance. The CEM track prepares students for positions in growing environmental, health, and safety organizations housed within private enterprises, consultancies, and governmental institutions, as well as for graduate study in business, public policy, environmental sciences, and industrial ecology.

Student experiences within this track focus on analytical tools; the business, legal, regulatory, and ethical framework in which corporations operate; physical, chemical, and biological processes and to identify opportunities that generate value.

The CEM track provides graduates with the fundamental set of skills for teaching effectively in informal settings and for communicating clearly in written, oral, and electronic forms. This track prepares students to work at government agencies, nature centers, parks, non-governmental organizations, and similar institutions, and is appropriate for students who wish to gain a broad understanding of environmental issues and the choices humans can make to mitigate unwanted impacts of human behavior on the environment.

Students may specialize in a content area through a minor, study abroad experience in ESPM topics, and/or a student designed content area. Students are encouraged to make choices that strengthen their expertise in an area and/or provide comparative understanding from another culture or discipline. Courses listed in the track but not taken are good possibilities for use in a content area, as are courses listed below. ESPM students should see their adviser for a list of minors.

Required Courses for the Sub-Plan

Social Sciences

ESPM 3261—Economics and Natural Resources Management, ENVT, SSCI (4 cr)
or APEC 1101—Principles of Microeconomics, SSCI (3 cr)
or ECON 1101—Principles of Microeconomics, IP, SSCI (4 cr)
ESPM 3241W—Natural Resource and Environmental Policy: History, Creation, and Implementation, C/PE, SSCI, WI (3 cr)
or ESPM 3271—Human Environmental Behavior and Policy (3 cr)

Prerequisite CEM Courses

ACCT 2050—Introduction to Financial Reporting (4 cr)
MATH 1271—Calculus I, MATH (4 cr)
MATH 1272—Calculus II (4 cr)
STAT 3011—Introduction to Statistical Analysis, MATH (4 cr)
MGMT 3001—Fundamentals of Management (3 cr)
PHYS 1301W—Introductory Physics for Science and Engineering I, PHYS SCI/L, WI (4 cr)
PHYS 1302W—Introductory Physics for Science and Engineering II, PHYS SCI/L, WI (4 cr)
CHEM 1022—Chemical Principles II, ENVT, PHYS SCI/L (4 cr)
or BIOC 2011—Biochemistry for the Agricultural and Health Sciences (3 cr)

CEM Track Required Courses

CE 3501—Environmental Engineering, C/PE, ENVT (3 cr)
ESPM 3602—Regulatory and Ethical Frameworks for CEM (3 cr)
ESPM 3603—Environmental Life Cycle Analysis (3 cr)
ESPM 3604—Environmental Management Systems and Strategy (3 cr)
ESPM 3606—Minimizing Industrial Emissions (3 cr)
ESPM 5019—Business, Natural Environment, and Global Economy (2 cr)
ESPM 4096—Professional Experience Program: Internship (1 cr)
or ESPM 3111—Hydrology and Water Quality Field Methods (3 cr)
or Appropriate study abroad or take all of the following in the same term:
FR 2101—Identifying Forest Plants (1 cr)
FR 2102—Northern Forests: Field Ecology (2 cr)
FR 2104—Measuring Forest Resources (1 cr)

Track Contract Courses

Take 12 or more credit(s) from the following:
ESPM 3202W—Environmental Conflict Management, Leadership, and Planning, C/PE, WI (3 cr)
ESPM 3202W—Environmental Conflict Management, Leadership, and Planning, C/PE, WI (3 cr)
ESPM 3605—Recycling: Extending Raw Materials (3 cr)
ESPM 4607—Industrial Biotechnology and the Environment (2 cr)
ESPM 4608—Bioremediation (2 cr)
ESPM 4216—Contaminant Hydrology (2 cr)

Environmental Education and Communication

Students in the EEC track gain a solid base of knowledge in the environmental sciences, environmental ethics, and the social context of environmental issues, and they develop a practical set of skills for teaching effectively in informal settings and for communicating clearly in written, oral, and electronic forms.

This track prepares students to work at government agencies, nature centers, parks, non-governmental organizations, and similar institutions, and is appropriate for students who wish to gain a broad understanding of environmental issues and the choices humans can make to mitigate unwanted impacts of human behavior on the environment.

Students may specialize in a content area through a minor, study abroad experience in ESPM topics, and/or a student designed content area. Students are encouraged to make choices that strengthen their expertise in an area and/or provide comparative understanding from another culture or discipline.

Courses listed in the track but not taken are good possibilities for use in a content area, as are courses listed below. ESPM students should see their adviser for a list of minors.

Required Courses for the Sub-Plan

Mathematical Thinking

STAT 3011—Introduction to Statistical Analysis, MATH (4 cr)
or SOC 3811—Basic Social Statistics, MATH (4 cr)
or ESPM 3012—Statistical Methods (Take only if your CLE mathematical thinking requirement is satisfied by another course.)

Social Sciences

ESPM 3261—Economics and Natural Resources Management, ENVT, SSCI (4 cr)
or APEC 1101—Principles of Microeconomics, SSCI (3 cr)
or ECON 1101—Principles of Microeconomics, IP, SSCI (4 cr)
ESPM 3241W—Natural Resource and Environmental Policy: History, Creation, and Implementation, C/PE, SSCI, WI (3 cr)
or ESPM 3271—Human Environmental Behavior and Policy (3 cr)

Education and Communication

ESPM 2401—Environmental Education/Interpretation (3 cr)
WRIT 3404—Environmental Communication (3 cr)
or COMM 3441—Introduction to Organizational Communication (3 cr)
or COMM 3451W—Intercultural Communication: Theory and Practice, IP, WI (3 cr)
College of Food, Agricultural and Natural Resource Sciences

- WRIT 1152W—Writing on Issues of Science and Technology, C/PE, WI (4 cr)
- WRIT 3221W—Communication Modes and Methods, C/PE, SSCI, WI (4 cr)
- WRIT 3401—Internet Communication: Tools and Issues (3 cr)
- WRIT 5664—Science Writing for Popular Audiences (3 cr)
- ESPM 4811—Environmental Interpretation (3 cr)
- CI 5534—Studies in Science Education (3 cr)
- CI 5537—Principles of Environmental Education (3 cr)
- CI 5747—Global and Environmental Education: Content and Practice (3 cr)
- REC 5301—Wilderness and Adventure Education (4 cr)
- REC 5311—Programming Outdoor and Environmental Education (3 cr)
- EPSY 5243—Principles and Methods of Evaluation (3 cr)
- REC 5281—Research and Evaluation in Recreation, Park, and Leisure Studies (4 cr)
- RRM 5259—Visitor Behavior Analysis (3 cr)

Human Dimensions
- ESPM 3011W—Ethics in Natural Resources, C/PE, ENVT, WI (3 cr)
- PHIL 3301—Environmental Ethics, C/PE, ENVT (4 cr)
- WRIT 3362—Applied Environmental Ethics (3 cr)
- Take 2 or more course(s) from the following:
  - CSCL 3860W—Landscape, Nature, Society, ENVT, WI (3 cr)
  - ESPM 2041—Natural Resources Consumption and Sustainability, ENVT, IP (3 cr)
  - ESPM 3001—Treaty Rights and Natural Resources, CD, HP (3 cr)
  - ESPM 3202W—Environmental Conflict Management, Leadership, and Planning, C/PE, WI (3 cr)
- ESPM 3245—Sustainable Land Use Planning and Policy, ENVT (3 cr)
- GEOG 3376—Political Ecology of North America, C/PE, ENVT (3 cr)
- HIST 3452—African Conservation Histories, HP, ENVT (3 cr)
- HSCI 3244—History of Ecology and Environmentalism (3 cr)
- POL 4210—Topics in Political Theory (3–4 cr)
- WRIT 1315—The Land in American Experience, CD, OH (3 cr)
- WRIT 3302—Science, Religion, and the Search for Human Nature, OH (3 cr)
- WRIT 3383—In Search of Nature, ENVT, OH (3 cr)
- CSCL 3361—Visions of Nature: The Natural World and Political Thought, C/PE, ENVT (4 cr)
- EEB 3361—Visions of Nature: The Natural World and Political Thought, C/PE, ENVT (4 cr)

Natural Sciences

Ecology
- BIOL 3407—Ecology, ENVT (3 cr)
- BIOL 3408W—Ecology, ENVT, WI (3 cr)
- EEB 3001—Ecology and Society, ENVT (3 cr)
- FR 3104—Forest Ecology (4 cr)
- FW 2003—Introduction to Marine Biology (3 cr)

Physical Environment
- EEB 3603—Science, Protection, and Management of Aquatic Environments (3 cr)
- EEB 5601—Limnology (3 cr)
- ESPM 4061W—Water Quality and Natural Resources, ENVT, WI (3 cr)
- FR 3114—Hydrology and Watershed Management (3 cr)
- GEO 1001—Earth and Its Environments, ENVT, PHYS SCI/L (4 cr)
- PHYS 1001W—Energy and the Environment, ENVT, PHYS SCI/L, WI (4 cr)
- PLPA 3002—Air Pollution, People, and Plants: The Science and the Ethics, C/PE, ENVT (3 cr)
- SOIL 1125—The Soil Resource, ENVT, PHYS SCI/L (4 cr)

Organismal Biology
- Take 3 or more course(s) including 2 or more sub-requirement(s) from the following:
  - BIOL 2022—General Botany (3 cr)
  - FR 1101—Dendrology: Identifying Forest Trees and Shrubs (3 cr)
  - PBIO 4321—Minnesota Flora (3 cr)
  - PBIO 4511—Flowering Plant Diversity (3 cr)

Animal
- Take 1 or more course(s) from the following:
  - BIOL 2012—General Zoology (4 cr)
  - EEB 4129—Mammalogy (4 cr)
  - EEB 4134—Introduction to Ornithology (4 cr)
  - ENT 3005—Insect Biology, BIOL SCI/L (3 cr)
  - FW 3136—Biology of Fishes (4 cr)
  - FW 4101—Herpetology (4 cr)

Complex Human and Natural Systems
- ESPM 3108—Ecology of Managed Systems (4 cr)
- or EEB 5146—Science and Policy of Global Environmental Change (3 cr)
- or FR 5146—Science and Policy of Global Environmental Change, ENVT (3 cr)
- or FW 2001—Introduction to Fisheries, Wildlife, and Conservation Biology, ENVT (3 cr)
- or FW 4102—Principles of Conservation Biology (3 cr)
- or HORT 5071—Restoration and Reclamation Ecology, ENVT (3 cr)

Field Experience
- ESPM 4096—Professional Experience Program: Internship (1 cr)
- or take all of the following in the same term:
  - FR 2101—Identifying Forest Plants (1 cr)
  - FR 2102—Northern Forests: Field Ecology (2 cr)
  - FR 2104—Measuring Forest Resources (1 cr)

Environmental Science

The ES track focuses on the application and integration of basic and applied sciences to solve complex environmental problems. Students can earn professional licenses and certification in several areas and will be qualified to work as soil scientists, hydrologists, water quality and wetland ecologists, environmental remediation scientists, climatologists, and atmospheric scientists. Graduates find jobs with environmental regulatory agencies, private consulting firms, and nonprofit organizations. This track provides a diverse basic and applied science background that also prepares students for scientific research through advanced graduate studies.

Students in this track use an understanding of biology, chemistry, physics, and mathematics to develop a broad knowledge base in soil, hydrologic, atmospheric, and biological sciences. Students study the interaction between science and the functioning of urban, forested, and agricultural lands as well as hydrologic, atmospheric, soil, and wetland resources.

Required Courses for the Sub-Plan

Social Sciences
- ESPM 3261—Economics and Natural Resources Management, ENVT, SSCI (4 cr)
- or APEC 1101—Principles of Microeconomics, SSCI (3 cr)
- or ECON 1101—Principles of Microeconomics, IP, SSCI (4 cr)
- ESPM 3241W—Natural Resource and Environmental Policy: History, Creation, and Implementation, C/PE, SSCI, WI (3 cr)
- or ESPM 3271—Human Environmental Behavior and Policy (3 cr)

Additional Basic Science and Math Courses
- ESPM 3131—Environmental Physics (3 cr)
- CHEM 1022—Chemical Principles II, ENVT, PHYS SCI/L (4 cr)
- PHYS 1101W—Introductory College Physics I, PHYS SCI/L, WI (4 cr)
- MATH 1142—Short Calculus, MATH (4 cr)
- or MATH 1271—Calculus I, MATH (4 cr)
- or MATH 1281—Calculus with Biological Emphasis I, MATH (4 cr)
- or BIOL 1022—General Botany (3 cr)
- or BIOL 2022—General Botany (3 cr)
- or BIOL 2032—General Microbiology With Laboratory (4 cr)
- ESPM 3012—Quantitative Methods for Environmental Scientists and Managers, C/PE, SSCI, WI (3 cr)
- or ESPM 4096—Professional Experience Program: Internship (1 cr)
- or take all of the following in the same term:
  - FW 2001—Introduction to Fisheries, Wildlife, and Conservation Biology, ENVT (3 cr)
  - FR 2101—Identifying Forest Plants (1 cr)
  - FR 2102—Northern Forests: Field Ecology (2 cr)
  - FR 2104—Measuring Forest Resources (1 cr)

Applied Sciences and Technology Courses
- ESPM 1425—The Atmosphere, ENVT, PHYS SCI/L (4 cr)
- ESPM 4096—Professional Experience Program: Internship (1 cr)
- or MATH 1142—Short Calculus, MATH (4 cr)
- or MATH 1271—Calculus I, MATH (4 cr)
- or MATH 1281—Calculus with Biological Emphasis I, MATH (4 cr)
- or BIOL 1022—General Botany (3 cr)
- or BIOL 2022—General Botany (3 cr)
- or BIOL 2032—General Microbiology With Laboratory (4 cr)
- ESPM 3012—Quantitative Methods for Environmental Scientists and Managers, C/PE, SSCI, WI (3 cr)
- or ESPM 4096—Professional Experience Program: Internship (1 cr)
- or take all of the following in the same term:
  - FW 2001—Introduction to Fisheries, Wildlife, and Conservation Biology, ENVT (3 cr)
  - FR 2101—Identifying Forest Plants (1 cr)
  - FR 2102—Northern Forests: Field Ecology (2 cr)
  - FR 2104—Measuring Forest Resources (1 cr)

Note: Programs listed in this catalog are current as of March 2008.
Take 15–21 credit(s) from the following:

- FR 3101—Geographical Information Systems (GIS) for Natural Resources (4 cr)
- ESPM 3111—Hydrology and Water Quality Field Methods (3 cr)
- EOBI 4321—Minnesota Flora (3 cr)
- SOIL 3521—Soil Judging (1 cr)
- SOIL 4903—Directed Study (1–7 cr)
- SOIL 4511—Field Study of Soils (2 cr)

Take all of the following in the same term:

- FR 2101—Identifying Forest Plants (1 cr)
- FR 2102—Northern Forests: Field Ecology (2 cr)
- FR 2104—Measuring Forest Resources (1 cr)

ES Contract Courses

Students must develop a contract with their faculty adviser to create an area of specialization. All track electives must be upper division. Depending on the selected courses, students have the opportunity to become certified or licensed as a professional soil scientist, hydrologist, wetland delineator, erosion control specialist, or site evaluator for individual sewage treatment system. Below are sample courses that could be taken to complete a contract; it is not a comprehensive list.

Take 15–21 credit(s) from the following:

- ESPM 3221—Soil Conservation and Land-Use Management (3 cr)
- ESPM 3612W—Soil and Environmental Biology, WI (3 cr)
- GEO 4631W—Earth Systems: Geosphere/Biosphere Interactions, WI (3 cr)
- GEO 4703—Glacial Geology (4 cr)
- GEO 5108—Principles of Environmental Geology (3 cr)
- GEOG 3441—Quaternary Landscape Evolution (3 cr)
- SOIL 3416—Plant Nutrients in the Environment (3 cr)
- SOIL 3521—Soil Judging (1 cr)
- SOIL 4511—Field Study of Soils (2 cr)
- SOIL 5515—Soil Genesis and Landscape Relations (3 cr)
- SOIL 5555—Wetland Soils (3 cr)
- SOIL 5711—Forest Soils (2 cr)

Take 0–21 credit(s) from the following:

- ESPM 4061W—Water Quality and Natural Resources, ENVT, WI (3 cr)
- ESPM 4216—Contaminant Hydrology (2 cr)
- EEB 3603—Science, Protection, and Management of Aquatic Environments (3 cr)
- EEB 5605—Linnology Laboratory (2 cr)
- FR 5153—Forest and Wetland Hydrology (3 cr)
- FW 5604W—Fisheries Ecology and Management, ENVT (3 cr)
- GEO 5701—General Hydrogeology (3 cr)
- PUBH 6190—Environmental Chemistry (3 cr)
- WRS 5101—Water Resources: Individuals and Institutions (3 cr)

Take 0–21 credit(s) from the following:

- ESPM 3612W—Soil and Environmental Biology, WI (3 cr)
- ESPM 5311—Environmental Biophysics and Ecology (3 cr)
- ESPM 5402—Biometeorology (3 cr)
- AGRO 3203W—Environment, Global Food Production, and the Citizen, C/PE, ENVT, WI (3 cr)
- AGRO 4505—Biological, Ecology, and Management of Invasive Plants (3 cr)
- AGRO 4605—Management Strategies for Crop Production (4 cr)
- AGRO 5321—Ecology of Agricultural Systems, ENVT (3 cr)
- BIOL 3002—Plant Biology: Function (2 cr)
- BIOL 3009W—Plant Function Laboratory, WI (2 cr)
- BIOL 3007W—Plant, Algal, and Fungal Diversity and Adaptation, WI (4 cr)
- EEB 3963—Modeling Nature and the Nature of Modeling (3 cr)
- EEB 4609W—Ecosystem Ecology, WI (3 cr)
- EEB 4611—Biogeochemical Processes (3 cr)
- EEB 4631—Global Ecology (4 cr)
- EEB 5009—Quaternary Vegetation History and Climate (3 cr)
- EEB 5122W—Plant Interactions with Animals and Microbes, WI (3 cr)
- ENT 5361—Aquatic Insects (4 cr)
- FR 3104—Forest Ecology (4 cr)
- FR 3203—Forest Fire and Disturbance Ecology (3 cr)
- FR 3204—Landscape Ecology and Management (3 cr)
- FR 3411—Managing Forest Ecosystems: Silviculture (3 cr)
- FR 4118—Trees: Structure and Function (3 cr)
- FR 5146—Science and Policy of Global Environmental Change, ENVT (3 cr)
- FW 4566—Fisheries and Wildlife Ecology and Management: Field Trip (1 cr)
- HORT 5071—Restoration and Reclamation Ecology, ENVT (3 cr)
- LA 3204—Landscape Ecology (3 cr)
- MIB 4121—Microbial Ecology and Applied Microbiology (3 cr)

Take 0–21 credit(s) from the following:

- BIOL 3407—Ecology, ENVT, WI (3 cr)
- SOIL 5711—Forest Soils (2 cr)
- SOIL 5515—Soil Genesis and Landscape Relations (3 cr)
- SOIL 4511—Field Study of Soils (2 cr)
- PUBH 6171—Exposure Assessment for Air Contaminants (3 cr)
- PUBH 6132—Air, Water, and Health (2 cr)
- PUBH 6105—Environmental and Occupational Health Policy (2 cr)
- PUBH 6171—Exposure Assessment for Air Contaminants (3 cr)
- PUBH 6103—Exposure to Environmental Hazards (2 cr)
- PUBH 6104—Environmental Health Effects: Introduction to Toxicology (2 cr)
- PUBH 6105—Environmental and Occupational Health Policy (2 cr)
- PUBH 6132—Air, Water, and Health (2 cr)
- PUBH 6171—Exposure Assessment for Air Contaminants (3 cr)
- PUBH 6175—Healthcare Quality Assurance (2 cr)

Policy, Planning, Law and Society

The PLPS track focuses on developing understanding and problem-solving skills germane to the interaction between human and natural systems. Students will be well prepared for policy development and analysis, strategy development, and decision-making in a range of positions and institutional settings. Example positions include those as a policy analyst, community planner, social researcher, or lawyer in public agencies, with legislative bodies, consulting firms, and conservation organizations. This track also prepares students for graduate study in policy, planning, and law programs. Students study concepts, issues, and problem-solving approaches that address the policy, legal, economic, political, planning and sociological aspects of environment and natural resource management. This study includes ethics and conflict...
management. The track further emphasizes an interdisciplinary approach for examining problems such as sustainable land use planning, resource conservation and management, law, and environmental protection at a range of political levels and spatial scales and developing effective and innovative solutions. Students develop skill in integrating knowledge from the physical, biological, and social sciences to develop policy and planning alternatives and appropriate strategies to provide real solutions to complex problems.

**Required Courses for the Sub-Plan**

**PPLS Core Courses**
- ESPM 3241W—Natural Resource and Environmental Policy: History, Creation, and Implementation, C/PE, SSCI, WI (3 cr)
- ESPM 3261—Economics and Natural Resources Management, ENVT, SSCI (4 cr)
- ESPM 3271—Human Environmental Behavior and Policy (3 cr)
- ESPM 3108—Ecology of Managed Systems (3 cr)
- ESPM 3211—Survey, Measurement, and Modeling for Environmental Analysis (3 cr)
- FR 3131—Geographical Information Systems (GIS) for Natural Resources (4 cr)
- RRM 4232W—Managing Recreational Lands, ENVT, WI (4 cr)
- FR 3104—Forest Ecology (4 cr)
- FR 3114—Hydrology and Watershed Management (3 cr)
- FR 3141—Managing Forest Ecosystems: Silviculture (3 cr)
- FR 5146—Science and Policy of Global Environmental Change, ENVT (3 cr)
- SOIL 1125—The Soil Resource, ENVT, PHYS SCI/L (4 cr)
- SOIL 2125—Basic Soil Science, ENVT (4 cr)
- STAT 3011—Introduction to Statistical Analysis, MATH (4 cr)
- SOC 3811—Basic Social Statistics, MATH (4 cr)
- ESPM 3012 Statistical Methods. Take only if your CLE mathematical thinking requirement is satisfied by another course.
- ESPM 3202W—Environmental Conflict Management, Leadership, and Planning, C/PE, WI (3 cr)
- ESPM 3245—Sustainable Land Use Planning and Policy, ENVT (3 cr)
- ESPM 3251—Natural Resources in Sustainable International Development, ENVT, IP (3 cr)
- ESPM 4242—Methods for Environmental and Natural Resource Policy Analysis (3 cr)
- ESPM 4256—Natural Resource Law and the Management of Public Lands and Waters (3 cr)

**Field Session Options**
- ESPM 4096—Professional Experience Program: Internship (1 cr)
  -OR-
- Cloquet Field Session
  *Take all of the following in the same term:*
  - FR 2101—Identifying Forest Plants (1 cr)
  - FR 2102—Northern Forests: Field Ecology (2 cr)
  - FR 2104—Measuring Forest Resources (1 cr)
- ESPM 4096—Professional Experience Program: Internship (1 cr)

**PPLS Contract Courses**
Students may specialize in a content area through a minor, study abroad experience in ESPM topics, and/or a student designed content area. Students are encouraged to make choices that strengthen their expertise in an area and/or provide comparative understanding from another culture or discipline.

Courses listed in the track but not taken are good possibilities for use in a content area, as are courses listed below. PPLS students should see their adviser for a list of minors.

**Take 12 or more credit(s) from the following:**
- AGRO 3xxx
- APEC 3xxx
- BBE 3xxx
- COMM 3xxx
- ECON 3xxx
- FR 3xxx

**Environmental Sciences, Policy and Management Minor**

- **Required credits in this minor: 16.**

  The environmental sciences, policy and management minor provides students in programs such as biology, education, journalism, political science, and others with the basic understanding to recognize, evaluate, and develop solutions to a range of environmental problems. Students interested in the minor should contact Student Services in 190 Coffey Hall.

**Minor Requirements**

**Minor Core**

- **Take 2 or more course(s) totaling 6–8 credit(s) from the following:**
  - ESPM 1011—Issues in the Environment, C/PE, ENVT (3 cr)
  - ESPM 2041—Natural Resources Consumption and Sustainability, ENVT, IP (3 cr)
  - FW 2001—Introduction to Fisheries, Wildlife, and Conservation Biology, ENVT (3 cr)
  - SOIL 2125—Basic Soil Science, ENVT (4 cr)
  - EEB 3001—Ecology and Society, ENVT (3 cr)
  - FR 3104—Forest Ecology (4 cr)
  - BIOL 3407—Ecology, ENVT (3 cr)
  - FR 3114—Hydrology and Watershed Management (3 cr)
  - FR 3141—Managing Forest Ecosystems: Silviculture (3 cr)
  - FR 5146—Science and Policy of Global Environmental Change, ENVT (3 cr)

**Electives**

See your minor adviser for a list of these courses arranged by the following themes: environmental education and communication; environmental management and policy; and environmental and biological sciences. Students may but are not required to take all 10 credits in one thematic area.

**Note:** at least two courses MUST have an ESPM designator.

- **Take 10 or more credit(s) from the following:**
  - CI 5537—Principles of Environmental Education (3 cr)
  - CI 5747—Global and Environmental Education: Content and Practice (3 cr)
  - EEB 3603—Science, Protection, and Management of Aquatic Environments (3 cr)
  - EEB 4609W—Ecosystem Ecology, WI (3 cr)
  - EEB 4611—Biogeochemical Processes (3 cr)
  - ENT 3925—Insects, Aquatic Habitats, and Pollution (3 cr)
  - ENT 5241—Ecological Risk Assessment (3 cr)
  - ESPM 2401—Environmental Education/Interpretation (3 cr)
  - ESPM 3002—Colloquium: Exotic Plants and Animals (1 cr)
  - ESPM 3003—Sustainable People, Sustainable Planet, ENVT, C/PE (3 cr)
  - ESPM 3011W—Ethics in Natural Resources, C/PE, ENVT, WI (3 cr)
  - ESPM 3101—Conservation of Plant Biodiversity, ENVT (3 cr)
  - ESPM 3108—Ecology of Managed Systems (4 cr)
  - ESPM 3202W—Environmental Conflict Management, Leadership, and Planning, C/PE, WI (3 cr)
  - ESPM 3211—Survey, Measurement, and Modeling for Environmental Analysis (3 cr)
  - ESPM 3221—Soil Conservation and Land-Use Management (3 cr)
  - ESPM 3241W—Natural Resource and Environmental Policy: History, Creation, and Implementation, C/PE, SSCI, WI (3 cr)
  - ESPM 3245—Sustainable Land Use Planning and Policy, ENVT (3 cr)
  - ESPM 3261—Economics and Natural Resources Management, ENVT, SSCI (4 cr)
  - ESPM 3271—Environmental Policy, Law, and Human Behavior (3 cr)
  - ESPM 3575—Wetlands Conservation (3 cr)
  - FI 3997—Field Work (3 cr)
  - FR 3114—Hydrology and Watershed Management (3 cr)
  - FR 5146—Science and Policy of Global Environmental Change, ENVT (3 cr)
  - ENVT 3925—Insects, Aquatic Habitats, and Pollution (3 cr)
  - ENG 3151—Introduction to Literature, ENVT (3 cr)

**Note:** Programs listed in this catalog are current as of March 2008.
ESPM 3602—Regulatory and Ethical Frameworks for CEM (3 cr)
ESPM 3603—Environmental Life Cycle Analysis (3 cr)
ESPM 3604—Environmental Management Systems and Strategy (3 cr)
ESPM 3605—Recycling: Extending Raw Materials (3 cr)
ESPM 3606—Minimizing Industrial Emissions (3 cr)
ESPM 3612W—Soil and Environmental Biology, WI (3 cr)
ESPM 4061W—Water Quality and Natural Resources, ENVT, WI (3 cr)
ESPM 4216—Contaminant Hydrology (2 cr)
ESPM 4256—Natural Resource Law and the Management of Public Lands and Waters (3 cr)
ESPM 4295W—GIS in Environmental Science and Management, WI (4 cr)
ESPM 4601—Soils and Pollution (3 cr)
ESPM 4607—Industrial Biotechnology and the Environment (2 cr)
ESPM 4608—Bioremediation (2 cr)
ESPM 4811—Environmental Interpretation (3 cr)
ESPM 5601—Principles of Waste Management (3 cr)
FR 1101—Dendrology: Identifying Forest Trees and Shrubs (3 cr)
FR 3114—Hydrology and Watershed Management (3 cr)
FR 3131—Geographical Information Systems (GIS) for Natural Resources (4 cr)
FR 3203—Forest Fire and Disturbance Ecology (3 cr)
FR 3204—Landscape Ecology and Management (3 cr)
FR 3218—Measuring and Modeling Forests (3 cr)
FR 3411—Managing Forest Ecosystems: Silviculture (3 cr)
FR 5146—Science and Policy of Global Environmental Change, ENVT (3 cr)
FW 4102—Principles of Conservation Biology (3 cr)
FW 5411—Aquatic Toxicology, ENVT (3 cr)
FW 5604W—Fisheries Ecology and Management, ENVT, WI (3 cr)
HSCI 3244—History of Ecology and Environmentalism (3 cr)
PBIO 4321—Minnesota Flora (3 cr)
PBIO 4511—Flowering Plant Diversity (3 cr)
PHIL 3301—Environmental Ethics, CPE, ENVT (4 cr)
PLPA 3002—Air Pollution, People, and Plants: The Science and the Ethics, C/PE, ENVT (3 cr)
REC 5301—Wilderness and Adventure Education (4 cr)
SOIL 5555—Wetland Soils (3 cr)
WRIT 3362—Applied Environmental Ethics (3 cr)
WRIT 3383—In Search of Nature, ENVT, OH (3 cr)
WRIT 3404—Environmental Communication (3 cr)

Fisheries and Wildlife B.S.
Fisheries, Wildlife, and Conservation Biology
• Required credits to graduate with this degree: 120.
• Required credits within the major: 85 to 92.
• This program requires summer terms.

The fisheries and wildlife curriculum gives students a broad science background emphasizing biological and environmental sciences and other coursework needed for careers in fisheries, wildlife, conservation biology, and other natural resource and environmental fields. Graduates are prepared to research, plan, and implement the management, protection, and enhancement of fisheries and aquatic resources, wildlife resources, and biological diversity. Graduates find employment as fisheries and wildlife scientists and managers, naturalists, zoo biologists, environmental biologists, environmental educators, and other natural resource professionals. The program also provides students with the fundamental science background needed to enter a wide variety of graduate programs in biological and natural resource sciences as well as professional programs in veterinary medicine, environmental law, and environmental education.

Students select an area of specialization, usually by the end of the sophomore year. Areas of specialization include conservation biology, fisheries, and wildlife. Although no computer course is required, students are expected to be computer literate and competent using word processing, spreadsheet, and e-mail software.
Economics
APEC 1101—Principles of Microeconomics, SSCI (3 cr)
or APEC 1102—Principles of Macroeconomics, IP, SSCI (3 cr)
or ECON 1101—Principles of Microeconomics, IP, SSCI (4 cr)
or ECON 1102—Principles of Macroeconomics, IP, SSCI (4 cr)
or ESPM 3261—Economics and Natural Resources Management, ENVT, SSCI (4 cr)

Program Sub-Plans
Students are required to complete one of the following sub-plans.

Conservation Biology
The conservation biology specialization is for students interested in careers dealing with a broad range of conservation issues in aquatic or terrestrial habitats. Positions typically focus on protection of endangered species and management for biodiversity. Careers as environmental educators or naturalists are also options.

All required courses in the specialization must be taken A-F and completed with a grade of at least C-.

Required Courses for the Sub-Plan

Human Dimensions
Take 3 or more course(s) from the following:
ESPM 3011W—Ethics in Natural Resources, C/PE, ENVT, WI (3 cr)
ESPM 3202W—Environmental Conflict Management, Leadership, and Planning, C/PE, WI (3 cr)
ESPM 3241W—Natural Resource and Environmental Policy: History, Creation, and Implementation, C/PE, SSCI, WI (3 cr)
ESPM 3245—Sustainable Land Use Planning and Policy, ENVT (3 cr)
FW 5003—Human Dimensions of Biological Conservation, C/PE, ENVT (3 cr)

Animals and Plants
BIOL 2022—General Botany (3 cr)

Take 2 or more course(s) from the following:
Take 1 or more course(s) from the following:
EEB 4129—Mammalogy (4 cr)
EEB 4134—Introduction to Ornithology (4 cr)
ENT 5021—Insect Taxonomy and Phylogeny (4 cr)
ENT 5361—Aquatic Insects (4 cr)
FW 2003—Introduction to Marine Biology (3 cr)
FW 3136—Biological Fishes (4 cr)
FW 4101—Herpetology (4 cr)
Take 1 or more course(s) from the following:
BIOL 3007W—Plant, Algal, and Fungal Diversity and Adaptation, WI (4 cr)
FR 1101—Dendrology: Identifying Forest Trees and Shrubs (3 cr)
PBIO 4321—Minnesota Flora (3 cr)
PBIO 4511—Flowering Plant Diversity (3 cr)

Community and Ecosystem Ecology
FR 3204—Landscape Ecology and Management (3 cr)
Take 1 or more course(s) from the following:
EEB 4014—Ecology of Vegetation (3 cr)
EEB 4016W—Ecological Biogeography, WI (3 cr)
EEB 5601—Limnology (3 cr)
EEB 4699W—Ecosystem Ecology, WI (3 cr)
ESPM 3575—Wetlands Conservation (3 cr)
FR 3104—Forest Ecology (4 cr)

Conservation Biology
FR 3131—Geographical Information Systems (GIS) for Natural Resources (4 cr)
FW 4102—Principles of Conservation Biology (3 cr)
FW 4103—Principles of Wildlife Management (3 cr)
or FW 5051—Analysis of Populations (3 cr)
or FW 5601—Fisheries Population Analysis (3 cr)
or FW 5605W—Habitats and Regulation of Wildlife, ENVT, WI (3 cr)
or FW 5604W—Fisheries Ecology and Management, ENVT, WI (3 cr)

Note: This sub-plan is optional and does not fulfill the sub-plan requirement for this program.

Fisheries
The fisheries area of specialization is for students who wish to pursue careers in fisheries and aquatic resource science, management, and administration; fish hatchery management; and aquaculture, aquatic education, and aquatic environmental assessment. The curriculum meets the education criteria for the Certified Fisheries Professional designation established by the American Fisheries Society, the major professional organization for fisheries scientists and managers in North America.

All required courses in the specialization must be taken A-F and completed with a grade of at least C-.

Required Courses for the Sub-Plan

Human Dimensions
Take 2 or more course(s) from the following:
ESPM 3011W—Ethics in Natural Resources, C/PE, ENVT, WI (3 cr)
ESPM 3202W—Environmental Conflict Management, Leadership, and Planning, C/PE, WI (3 cr)
ESPM 3241W—Natural Resource and Environmental Policy: History, Creation, and Implementation, C/PE, SSCI, WI (3 cr)
ESPM 3245—Sustainable Land Use Planning and Policy, ENVT (3 cr)
FW 5003—Human Dimensions of Biological Conservation, C/PE, ENVT (3 cr)

Animals and Plants
FW 3136—Biological Fishes (4 cr)
FW 4401—Fish Physiology and Behavior (2 cr)
Take 1 or more course(s) from the following:
EEB 4129—Mammalogy (4 cr)
EEB 4134—Introduction to Ornithology (4 cr)
ENT 5021—Insect Taxonomy and Phylogeny (4 cr)
ENT 5361—Aquatic Insects (4 cr)
FW 2003—Introduction to Marine Biology (3 cr)
FW 4101—Herpetology (4 cr)

Community and Ecosystem Ecology
EEB 5601—Limnology (3 cr)

Take 1 or more course(s) from the following:
EEB 4699W—Ecosystem Ecology, WI (3 cr)
ESPM 3575—Wetlands Conservation (3 cr)
ESPM 4061W—Water Quality and Natural Resources, ENVT, WI (3 cr)
FR 3204—Landscape Ecology and Management (3 cr)

Fisheries
CHEM 1022—Chemical Principles II, ENVT, PHYS SCI/L (4 cr)
FW 5601—Fisheries Population Analysis (3 cr)
FW 5604W—Fisheries Ecology and Management, ENVT, WI (3 cr)
Take one of the following pairs of courses.
BIOC 2011—Biochemistry for the Agricultural and Health Sciences (3 cr)
and CHEM 2301—Organic Chemistry I (3 cr)
CHEM 2101—Introductory Analytical Chemistry Lecture (3 cr)
and CHEM 2111—Introductory Analytical Chemistry Lab (2 cr)
CHEM 2301—Organic Chemistry I (3 cr)
and CHEM 2302—Organic Chemistry II (3 cr)

Pre-Veterinary Medicine
Note: This sub-plan is optional and does not fulfill the sub-plan requirement for this program.

The doctor of veterinary medicine degree (D.V.M.) is a rigorous four-year professional program preceded by three to four years of pre-professional study. Although a bachelor’s degree is not required for admission to the D.V.M. program, approximately 70 percent of the students entering the program each year have completed their bachelor’s degree. Fisheries and wildlife is one of the primary college majors at the University of Minnesota that offers a pre-veterinary program.
The following courses are required in addition to the fisheries and wildlife core requirements and courses in one of three areas of specialization. These courses may be substituted for the "suggested courses" in the areas of specialization.

**Required Courses for the Sub-Plan**
- CHEM 1022—Chemical Principles II, ENVT, PHYS SCI/L (4 cr)
- BIOC 3021—Biochemistry (3 cr)
- CHEM 2301—Organic Chemistry I (3 cr)
- CHEM 2311—Organic Lab (4 cr)
- VBS 2032—General Microbiology With Laboratory (4 cr)
  - or MICB 3301—Biotechnology of Microorganisms (5 cr)
  - Take one of the following pairs of courses.
    - PHYS 1101W—Introductory College Physics I, PHYS SCI/L, WI (4 cr)
    - and PHYS 1102W—Introductory College Physics II, PHYS SCI/L, WI (4 cr)
    - PHYS 1201W—Introductory Physics for Biology and Pre-medicine I, PHYS SCI/L, WI (5 cr)
    - and PHYS 1202W—Introductory Physics for Biology and Pre-medicine II, PHYS SCI/L, WI (5 cr)
    - PHYS 1301W—Introductory Physics for Science and Engineering I, PHYS SCI/L, WI (4 cr)
    - and PHYS 1302W—Introductory Physics for Science and Engineering II, PHYS SCI/L, WI (4 cr)

**Other Recommended Courses**
- CVM 1000—Introduction to Veterinary Medicine (1 cr)
- ANSC 1101—Introductory Animal Science (4 cr)

**Wildlife**
The wildlife specialization is for students who wish to pursue careers in wildlife science, management, and administration; zoo biology; terrestrial ecology; environmental assessment; and education. With proper selection of electives, students can meet the education criteria for the Certified Wildlife Biologist designation established by the Wildlife Society, the major professional organization for wildlife scientists and managers in North America.

All required courses in the specialization must be taken A-F and completed with a grade of at least C-.

**Required Courses for the Sub-Plan**

**Human Dimensions**
- Take 2 or more course(s) from the following:
  - ESPM 3011W—Ethics in Natural Resources, C/PE, ENVT, WI (3 cr)
  - ESPM 3202W—Environmental Conflict Management, Leadership, and Planning, C/PE, WI (3 cr)
  - ESPM 3241W—Natural Resource and Environmental Policy: History, Creation, and Implementation, C/PE, SSCI, WI (3 cr)
  - ESPM 3245—Sustainable Land Use Planning and Policy, ENVT (3 cr)
  - FW 5003—Human Dimensions of Biological Conservation, C/PE, ENVT (3 cr)

**Animal and Plants**
- BIOL 2022—General Botany (3 cr)

Take 2 or more course(s) from the following:
- FW 4101—Herpetology (4 cr)
- EEB 4129—Mammalogy (4 cr)
- EEB 4134—Introduction to Ornithology (4 cr)

Take 2 or more course(s) from the following:
- BIOL 3007W—Plant, Algal, and Fungal Diversity and Adaptation, WI (4 cr)
  - and FR 1101—Dendrology: Identifying Forest Trees and Shrubs (3 cr)
  - or PBIO 4321—Minnesota Flora (3 cr)
  - or PBIO 4511—Flowering Plant Diversity (3 cr)

**Community and Ecosystem Ecology**
- EEB 4014—Ecology of Vegetation (3 cr)
- or EEB 4609W—Ecosystem Ecology, WI (3 cr)
- or ESPM 3575—Wetlands Conservation (3 cr)
- or FR 3104—Forest Ecology (4 cr)
- or FR 3204—Landscape Ecology and Management (3 cr)

**Wildlife**
- ESPM 3211—Survey, Measurement, and Modeling for Environmental Analysis (3 cr)
- FR 3131—Geographical Information Systems (GIS) for Natural Resources (4 cr)
- FW 4103—Principles of Wildlife Management (3 cr)
- FW 5051—Analysis of Populations (3 cr)
- FW 5603W—Habitats and Regulation of Wildlife, ENVT, WI (3 cr)

**Fisheries and Wildlife Minor**

**Minor Requirements**

**Preparatory Courses**
- BIOL 2012—General Zoology (4 cr)
- BIOL 3407—Ecology, ENVT (3 cr)

**Minor Courses**
- FW 2001—Introduction to Fisheries, Wildlife, and Conservation Biology, ENVT (3 cr)
- FW 5603W—Habitats and Regulation of Wildlife, ENVT, WI (3 cr)
- FW 5604W—Fisheries Ecology and Management, ENVT, WI (3 cr)
  - and FW 1001—Orientation in Fisheries, Wildlife, and Conservation Biology (1 cr)
  - or any natural resources orientation course
- EEB 4129—Mammalogy (4 cr)
- or EEB 4134—Introduction to Ornithology (4 cr)
  - or FW 3136—Biogeography and Ecology (4 cr)
- FW 5051—Analysis of Populations (3 cr)
  - or FW 5455—Sustainable Aquaculture, ENVT, IP (3 cr)
  - or FW 5571—Avian Conservation and Management (3 cr)
  - or FW 5601—Fisheries Population Analysis (3 cr)

**Food Science B.S.**

**Food Science and Nutrition**
- Required credits to graduate with this degree: 120.
- Required credits within the major: 95.

Food science applies chemistry, microbiology, and engineering to the science and technology of making foods.

**Chemistry**—because foods undergo chemical reactions when they are heated, frozen, mixed with each other, and stored.

**Microbiology**—because many foods are made by microorganisms (e.g., bread, cheese, yogurt, sauerkraut, tempeh) and because microorganisms cause extensive, rapid, and often dangerous spoilage.

**Physics and engineering**—because foods must be constructed, moved through the factory, made safe, and distributed intact to the consumer.

Food science involves creating new food products and making current products more stable, nutritious, convenient, reliable, and safe.

The food science program is offered through the College of Food, Agricultural and Natural Resource Sciences.
Admission Requirements
For information about University of Minnesota admission requirements, visit [http://admissions.tc.umn.edu](http://admissions.tc.umn.edu).

Program Requirements
All required courses must be taken A-F and completed with a grade of at least C-.

Foundation Courses
BIOL 1009—General Biology, BIOL SCI/L (4 cr)
CHEM 1021—Chemical Principles I, ENV, PHYS SCI/L (4 cr)
CHEM 1022—Chemical Principles II, ENV, PHYS SCI/L (4 cr)
CHEM 2301—Organic Chemistry I (3 cr)
CHEM 2302—Organic Chemistry II (3 cr)
CHEM 2311—Organic Lab (4 cr)
MATH 1271—Calculus I, MATH (4 cr)
MATH 1272—Calculus II (4 cr)
MICB 3301—Biology of Microorganisms (5 cr)
PHYS 3301W—Introductory Physics for Science and Engineering I, PHYS SCI/L, WI (4 cr)
PHYS 3302W—Introductory Physics for Science and Engineering II, PHYS SCI/L, WI (4 cr)
STAT 3011—Introduction to Statistical Analysis, MATH (4 cr)
BIOC 3021—Biochemistry (3 cr)
or take the following course pair
BIOC 4331—Biochemistry I: Structure, Catalysis, and Metabolism in Biological Systems (4 cr)
and BIOC 4332—Biochemistry II: Molecular Mechanisms of Signal Transduction and Gene Expression (4 cr)

Communication
COMM 1101—Introduction to Public Speaking (3 cr)
WRIT 3562W—Technical and Professional Writing, WRIT (4 cr)

Professional Courses
BBE 4744—Engineering Principles for Biological Scientists (4 cr)
FSCN 1102—Food: Safety, Risks, and Technology, C/PE (3 cr)
FSCN 1112—Principles of Nutrition, ENV (3 cr)
FSCN 3102—Introduction to Food Science (3 cr)
FSCN 4111—Food Chemistry (3 cr)
FSCN 4121—Food Microbiology and Fermentations (3 cr)
FSCN 4122—Laboratory Methods in Food Microbiology and Fermentations (2 cr)
FSCN 4131—Food Quality (3 cr)
FSCN 4312W—Food Analysis, WI (4 cr)
FSCN 4332—Food Processing Operations (3 cr)

Food Science Minor
- Required credits in this minor: 20 to 28.
See major description for more information.

Minor Requirements
Many courses in the minor have prerequisites that do not count towards the 20 credits.

Minor Courses
Take 20 or more credit(s) from the following:
BBE 4744—Engineering Principles for Biological Scientists (4 cr)
FSCN 1102—Food: Safety, Risks, and Technology, C/PE (3 cr)
FSCN 3102—Introduction to Food Science (3 cr)
FSCN 4111—Food Chemistry (3 cr)
FSCN 4121—Food Microbiology and Fermentations (3 cr)
FSCN 4122—Laboratory Methods in Food Microbiology and Fermentations (2 cr)
FSCN 4131—Food Quality (3 cr)
FSCN 4312W—Food Analysis, WI (4 cr)
FSCN 4332—Food Processing Operations (3 cr)

Food Systems and the Environment Minor
- Required credits in this minor: 15.
This interdisciplinary minor, based in CFANS, serves students from other colleges who have an interest in and a desire to acquire some breadth about food systems and the environment. Students completing this minor will be better prepared to understand the complexity of modern global food systems, interdependence of rural and urban societies, and environmental impact of consumer driven food systems choices; manage natural resources used for food and fiber for the benefit of society; and make more responsible personal and public decisions impacting food systems and the environment.

Admission Requirements
This minor is limited to non-CFANS majors. Interested students should contact the minor adviser at 612-625-6754 or the CFANS Student Services Office at 612-624-6768.
For information about University of Minnesota admission requirements, visit [http://admissions.tc.umn.edu](http://admissions.tc.umn.edu).

Minor Requirements
Students may only choose one course from each designator, in consultation with the minor adviser.
Take 15 or more credit(s) from the following:
CFAN 1501—Biotechnology, People, and the Environment, ENV (3 cr)
CFAN 3001—Pests and Crop Protection (3 cr)
CFAN 3500—International Field Studies Seminar (3 cr)
AGRO 1103—Crops, Environment, and Society, ENV (4 cr)
ANSC 1101—Animals and Society, C/PE, ENV (3 cr)
ANSC 1101—Introductory Animal Science (4 cr)
APEC 3041W—Economic Development of U.S. Agriculture, HP, WI (3 cr)
APEC 3611—Environmental and Natural Resource Economics, ENV (3 cr)
BBE 5203—Environmental Impacts of Food Production (3 cr)
ENT 4015—Ornamentals and Turf Entomology (3 cr)
ESPM 3221—Soil Conservation and Land-Use Management (3 cr)
FSCN 1102—Food: Safety, Risks, and Technology, C/PE (3 cr)
FSCN 1112—Principles of Nutrition, ENV (3 cr)
WRIT 1315—The Land in American Experience, CD, OH (3 cr)
WRIT 3383—in Search of Nature, ENV, OH (3 cr)
SOIL 1125—The Soil Resource, ENV, PHYS SCI/L (4 cr)
AGRO 3203W—Environment, Global Food Production, and the Citizen, C/PE, ENV, WI (3 cr)
or ANSC 3203W—Environment, Global Food Production, and the Citizen, C/PE, ENV, WI (3 cr)
or APEC 4103—World Food Problems, C/PE, IP (3 cr)
or APEC 4103—World Food Problems, C/PE, IP (3 cr)

Forest Resources B.S.

Forest Resources
- Required credits to graduate with this degree: 120.
- Required credits within the major: 120.
- This program requires summer terms.
The forest resources curriculum prepares students to plan, implement, and research the management, protection, and sustainable use of forest and related resources and environments, including timber, water, wildlife, recreation, and aesthetic resources. The curriculum provides a unique integration of the physical, biological, and social sciences with managerial sciences and policy, field skill development, and technologies for measuring and monitoring natural resources. Students are also trained in problem solving approaches to address specific local, regional, and global issues. Students select one of three tracks: 1) forest management and planning,
2) forest conservation and ecosystem management, and 3) urban and community forestry. Students should choose one of these tracks early in their college careers. A minor is also available.

Graduates find positions as foresters, urban foresters, land and water resource managers, conservationists, researchers, habitat managers, ecologists, geographic information systems specialists, resource analysts/consultants, silviculture specialists, nursery managers, land acquisition specialists, environmental planners, and educators. Principal employers are federal, state and local forestry, wildlife, parks, conservation and related natural resource agencies; forest products industry companies; landowner organizations; consulting firms; and nongovernmental conservation organizations and international development agencies.

Additionally, the curriculum provides excellent preparation in the fundamental and applied sciences that is essential for graduate study and careers in research and teaching.

Admission Requirements

For information about University of Minnesota admission requirements, visit [http://admissions.tc.umn.edu](http://admissions.tc.umn.edu).

Program Requirements

All required courses must be taken A-F, and students must earn a grade of at least C-.

Communication Skills

COMM 1101—Introduction to Public Speaking (3 cr)

Mathematical Thinking

ESPM 3012—Quantitative Methods for Environmental Scientists and Managers II (4 cr)

or STAT 3011—Introduction to Statistical Analysis, MATH (4 cr)

or MATH 1142—Short Calculus, MATH (4 cr)

or MATH 1271—Calculus I, MATH (4 cr)

Physical and Biological Sciences

BIOL 2022—General Botany (3 cr)

BIOL 1001—Introductory Biology I: Evolutionary and Ecological Perspectives, BIOL SCI/L, ENV (4 cr)

or BIOL 1009—General Biology, BIOL SCI/L, ENV (4 cr)

or SOIL 1125—The Soil Resource, ENV, PHYS SCI/L (4 cr)

or SOIL 2125—Basic Soil Science, ENV (4 cr)

Social Sciences

ESPM 3201—Economics and Natural Resources Management, ENV, SSCI (4 cr)

ESPM 3241W—Natural Resource and Environmental Policy: History, Creation, and Implementation, C/PE, SSCI, WI (3 cr)

Professional Courses

FR 1001—Orientation and Information Systems (1 cr)

FR 3131—Geographical Information Systems (GIS) for Natural Resources (4 cr)

RRM 4232W—Managing Recreational Lands, ENVT, IP (4 cr)

FR 1101—Dendrology: Identifying Forest Trees and Shrubs (3 cr)

FR 3142—Forest Planning and Management (3 cr)

FR 3114—Hydrology and Watershed Management (3 cr)

FR 3114—Managing Forest Ecosystems: Silviculture Lab (1 cr)

ESPM 3011W—Ethics in Natural Resources, C/PE, ENV, WI (3 cr)

FR 3202W—Environmental Conflict Management, Leadership, and Planning, C/PE, WI (3 cr)

FW 2001—Introduction to Fisheries, Wildlife, and Conservation Biology, ENV (3 cr)

or FW 5603W—Habitats and Regulation of Wildlife, ENV, WI (3 cr)

ENT 4251—Forest and Shade Tree Entomology (3 cr)

Additional Professional Courses

With faculty adviser approval, students select professional courses chosen from the list below. Courses used to satisfy other requirements may not be used to fill this 12-credit requirement.

Take 12 or more credit(s) from the following:

ESPM 3245—Sustainable Land Use Planning and Policy, ENV (3 cr)

ESPM 3251—Natural Resources in Sustainable International Development, ENV, IP (3 cr)

ESPM 3703—Agroforestry in Watershed Management (3 cr)

ESPM 4061W—Water Quality and Natural Resources, ENV, WI (3 cr)

ENT 5241—Ecological Risk Assessment (3 cr)

ESPM 5555—Wetland Soils (3 cr)

FR 3203—Forest Fire and Disturbance Ecology (3 cr)

FR 3204—Landscape Ecology and Management (3 cr)

FR 3431—Timber Harvesting and Road Planning (2 cr)

FR 3612—Silviculture and Timber Harvesting Practices in Minnesota (1 cr)

FR 4118—Trees: Structure and Function (3 cr)

FR 5142—Tropical Forest Ecology, ENV (3 cr)

FR 5153—Forest and Wetland Hydrology (3 cr)

Program Sub-Plans

Students are required to complete one of the following sub-plans.

Forest Conservation/Ecosystem Management

The forest conservation and ecosystem management track prepares students for forest and related resource management with a focus on conservation issues and strategies. It is designed for students who seek a thorough understanding of ecosystem structure and function and the role of forests and their management in environmental quality. Graduates pursue careers as forest managers and conservationists or provide specialized expertise for resource management organizations. Principal employers are federal and state forestry, wildlife, parks and related agencies; forest products companies; and nongovernmental conservation organizations. This track includes courses in a field session.

All required courses in this track must be taken A-F and completed with a grade of at least C-.

Required Courses for the Sub-Plan

Additional Physical and Biological Sciences

CHEM 1021—Chemical Principles I, ENV, PHYS SCI/L (4 cr)

CHEM 1022—Chemical Principles II, ENV, PHYS SCI/L (4 cr)

PHYS 1001W—Energy and the Environment, ENV, PHYS SCI/L, WI (4 cr)

or “B” or better in H.S. physics

Forest Conservation and Ecosystem Management Core

FR 3218—Measuring and Modeling Forests (3 cr)

FR 3262—Remote Sensing of Natural Resources and Environment (4 cr)

FR 3471—Forest Planning and Management (3 cr)

FR 3114—Managing Forest Ecosystems: Silviculture Lab (1 cr)

ESPM 3011W—Ethics in Natural Resources, C/PE, ENV, WI (3 cr)

FR 3202W—Environmental Conflict Management, Leadership, and Planning, C/PE, WI (3 cr)

FW 2001—Introduction to Fisheries, Wildlife, and Conservation Biology, ENV (3 cr)

or FW 5603W—Habitats and Regulation of Wildlife, ENV, WI (3 cr)

ENT 4251—Forest and Shade Tree Entomology (3 cr)

or PLPA 3003—Diseases of Forest and Shade Trees (3 cr)

Additional Professional Courses

For the most up-to-date listing of program requirements, visit the ONLINE CATALOG at [www.catalogs.umn.edu/programs.html](http://www.catalogs.umn.edu/programs.html).
FR 5228—Advanced Assessment and Modeling (3 cr)
FR 5264—Advanced Forest Management Planning (3 cr)
FR 5611—Field Silviculture (2 cr)
FR 5615—Field Remote Sensing and Resource Survey (2 cr)
FW 5603W—Habitats and Regulation of Wildlife, ENVT, WI (3 cr)
FW 5604W—Fisheries Ecology and Management, ENVT, WI (3 cr)
GEO 1001—Earth and Its Environments, ENVT, PHYS SCI/L (4 cr)
HORT 5071—Restoration and Reclamation Ecology, ENVT (3 cr)
LA 3501—Environmental Design and Its Biological and Physical Context, ENVT (3 cr)
SOIL 3416—Plant Nutrients in the Environment (3 cr)
Biol 3407—Ecology, ENV (3 cr)
or EEB 4014—Ecology of Vegetation (3 cr)
or EEB 4609W—Ecosystem Ecology, WI (3 cr)
ENT 4251—Forest and Shade Tree Entomology (3 cr)
or PLPA 3003—Diseases of Forest and Shade Trees (3 cr)
ESPM 3011W—Ethics in Natural Resources, C/PE, ENVT, WI (3 cr)
or ESPM 3202W—Environmental Conflict Management, Leadership, and Planning, C/PE, WI (3 cr)

Electives
Choose electives from courses listed above, or consult with your adviser about other options to reach the required 120 credits.

Forest Management and Planning
Students taking the forest management and planning track learn the principles, practices, and techniques of forest and related resource management. It is designed for students who wish to become directly involved in forest land management or specializations such as resource analysis, planning, timber harvesting, forest protection, or policy. Graduates may also pursue advanced positions in these areas. Principal employers include federal and state forestry, wildlife, and conservation agencies; forest products companies; landowner organizations; consulting firms; and international agencies. This track includes courses in two field sessions at the Cloquet Forestry Center.

All required courses in this track must be taken A-F and completed with a grade of at least C-.

Required Courses for the Sub-Plan

Additional Physical and Biological Sciences
CHEM 1011—Introduction to Chemistry: Lecture and Laboratory, PHYS SCI/L (4 cr) and BIOC 2011—Biochemistry for the Agricultural and Health Sciences (3 cr) -OR-
CHEM 1021—Chemical Principles I, ENVT, PHYS SCI/L (4 cr) and CHEM 1022—Chemical Principles II, ENVT, PHYS SCI/L (4 cr)

Physics Requirement
PHYS 1001W—Energy and the Environment, ENVT, PHYS SCI/L, WI (4 cr) or “B” or better in H.S. physics

Forest Management and Planning Core
BBE 1002—Wood and Fiber Science (3 cr)
FR 3114—Hydrology and Watershed Management (3 cr)
FR 3218—Measuring and Modeling Forests (3 cr)
FR 3262—Remote Sensing of Natural Resources and Environment (4 cr)
FR 3431—Timber Harvesting and Road Planning (2 cr)
FR 3471—Forest Planning and Management (3 cr)
FR 3612—Silviculture and Timber Harvesting Practices in Minnesota (1 cr)
FR 5413—Managing Forest Ecosystems: Silviculture Lab (1 cr)
ESPM 3011W—Ethics in Natural Resources, C/PE, ENVT, WI (3 cr)
or ESPM 3202W—Environmental Conflict Management, Leadership, and Planning, C/PE, WI (3 cr)
ENT 4251—Forest and Shade Tree Entomology (3 cr)
or PLPA 3003—Diseases of Forest and Shade Trees (3 cr)

FW 2001—Introduction to Fisheries, Wildlife, and Conservation Biology, ENV (3 cr)
or FW 5603W—Habitats and Regulation of Wildlife, ENV, WI (3 cr)

Advanced Training in Assessment and Management of Forests
These courses are taught at the Cloquet Forestry Center during May session.
FR 5611—Field Silviculture (2 cr)
FR 5615—Field Remote Sensing and Resource Survey (2 cr)
FR 5621—Field Timber Harvesting and Road Planning (2 cr)

Additional Professional Courses
With faculty adviser approval, students select professional courses from the list below. Courses used to satisfy other requirements may not be used to fill the 6-credit professional requirement.
Take 6 or more credit(s) from the following:
ESPM 3031—Applied Global Positioning Systems for Geographic Information Systems (3 cr)
ESPM 3245—Sustainable Land Use Planning and Policy, ENV (3 cr)
ESPM 3251—Natural Resources in Sustainable International Development, ENV, IP (3 cr)
ESPM 4061W—Water Quality and Natural Resources, ENV, WI (3 cr)
FR 3203—Forest Fire and Disturbance Ecology (3 cr)
FR 3204—Landscape Ecology and Management (3 cr)
FR 4118—Trees: Structure and Function (3 cr)
FR 5142—Tropical Forest Ecology, ENV (3 cr)
FR 5153—Forest and Wetland Hydrology (3 cr)
FR 5228—Advanced Assessment and Modeling (3 cr)
FR 5264—Advanced Forest Management Planning (3 cr)
FR 5412—Digital Remote Sensing (3 cr)
FW 5603W—Habitats and Regulation of Wildlife, ENV, WI (3 cr)
FW 5604W—Fisheries Ecology and Management, ENV, WI (3 cr)
GEO 1001—Earth and Its Environments, ENV, PHYS SCI/L (4 cr)
ESPM 3011W—Ethics in Natural Resources, C/PE, ENVT, WI (3 cr)
or ESPM 3202W—Environmental Conflict Management, Leadership, and Planning, C/PE, WI (3 cr)
ENT 4251—Forest and Shade Tree Entomology (3 cr)
or PLPA 3003—Diseases of Forest and Shade Trees (3 cr)

Urban and Community Forestry
The urban and community forestry track prepares students for planning and managing vegetation and related resources in or near urban communities, and for specializations such as urban planning and environmental education. Urban forests include areas along streets, in parks, private lands, greenbelts, and open spaces. Graduates help plan, design, and protect these forests including supervision of tree selection, planting, and plant health care programs. Employers include city government, tree care/arboricultural firms, state and federal forestry agencies, nurseries, and utility companies. Graduates may also qualify for traditional forestry positions. This track includes a field session.

All required courses in this track must be taken A-F and completed with a grade of at least C-.

Required Courses for the Sub-Plan

Additional Physical and Biological Sciences
CHEM 1011—Introduction to Chemistry: Lecture and Laboratory, PHYS SCI/L (4 cr) and BIOC 2011—Biochemistry for the Agricultural and Health Sciences (3 cr) -OR-
CHEM 1021—Chemical Principles I, ENV, PHYS SCI/L (4 cr) and CHEM 1022—Chemical Principles II, ENV, PHYS SCI/L (4 cr)

Additional Social Science
POL 1001—American Democracy in a Changing World, C/PE, SSCI (4 cr)
Urban and Community Forestry Core
FR 3218—Measuring and Modeling Forests (3 cr)
or ESPM 3211—Survey, Measurement, and Modeling for Environmental Analysis (3 cr)
HORT 1015—Woody and Herbaceous Plants (4 cr)
HORT 5041W—Nursery Management, WI (4 cr)
FR 3501—Arboriculture: Selection and Maintenance of Trees (3 cr)
FR 4501—Urban Forest Management: Managing Greenspaces for People, C/PE (3 cr)
ENT 4251—Forest and Shade Tree Entomology (3 cr)
PLPA 3003—Diseases of Forest and Shade Trees (3 cr)
URBS 1001W—Introduction to Urban Studies: The Complexity of Metropolitan Life, C/PE, WI (3 cr)
FR 3114—Hydrology and Watershed Management (3 cr)
or ESPM 4061W—Water Quality and Natural Resources, ENVT, WI (3 cr)
FR 4118—Trees: Structure and Function (3 cr)
or BIOL 3002—Plant Biology: Function (2 cr)

Additional Professional Courses
With faculty adviser approval, students select professional courses from the list below. Courses used to satisfy other requirements may not be used to fill the 6-credit professional requirement.

Take 6 or more credit(s) from the following:
ANTH 3041—Ecological Anthropology, C/PE, ENVT (3 cr)
BEE 1002—Wood and Fiber Science (3 cr)
COMM 3411—Introduction to Small Group Communication (3 cr)
FR 3204—Landscape Ecology and Management (3 cr)
FR 3262—Remote Sensing of Natural Resources and Environment (4 cr)
FW 2001—Introduction to Fisheries, Wildlife, and Conservation Biology, ENVT (3 cr)
FW 5603W—Habitats and Regulation of Wildlife, ENVT (3 cr)
GEOG 3371W—Cities, Citizens, and Communities, CD, SSCI, WI (4 cr)
HORT 4021—Landscape Design and Implementation I (4 cr)
LA 3501—Environmental Design and Its Biological and Physical Context, ENVT (3 cr)
MGMT 3001—Fundamentals of Management (3 cr)
ESPM 3031—Applied Global Positioning Systems for Geographic Information Systems (3 cr)
ESPM 3101—Conservation of Plant Biodiversity, ENVT (3 cr)
ESPM 3202W—Environmental Conflict Management, Leadership, and Planning, C/PE, WI (3 cr)
ESPM 3703—Agroforestry in Watershed Management (3 cr)
SOC 1001—Introduction to Sociology, CD, SSCI (4 cr)
SOC 3451W—Cities and Social Change, SSCI, WI (3 cr)
SOIL 3416—Plant Nutrients in the Environment (3 cr)

Forest Resources Minor

• Required credits in this minor: 18.

The forest resources minor helps students in natural resources and other areas gain deeper understanding of the scientific foundations of forestry, the management of forest resources, and the importance of forest resources to society. Students select from an array of courses in forest assessment, forest biology and management, and forest economics and policy. Students may include a three-week, hands-on field session at the Cloquet Forestry Center as part of their minor. Students interested in the minor should contact the CFANS Student Services Office.

Minor Requirements
The sequence of courses in the Cloquet Forestry Center may be used to either meet the minor courses requirement or as an elective, but they cannot be used to satisfy both requirements.
FR 3104—Forest Ecology (4 cr)
FR 3411—Managing Forest Ecosystems: Silviculture (3 cr)

Take one of the following field experiences.
FR 1101—Dendrology: Identifying Forest Trees and Shrubs (3 cr)
-OR-

Cloquet Program
Take all of the following in the same term:
FR 2101—Identifying Forest Plants (1 cr)
FR 2102—Northern Forests: Field Ecology (2 cr)
FR 2104—Measuring Forest Resources (1 cr)

Electives
Take 8 or more credits from the following (NOTE: If student takes the Cloquet Program only 7 credits are required):
Forest Policy, Management, and Planning
Take 3 or more credit(s) from the following:
ESPM 3241W—Natural Resource and Environmental Policy; History, Creation, and Implementation, C/PE, SSCI, WI (3 cr)
ESPM 3261—Economics and Natural Resources Management, ENVT, SSCI (4 cr)
FR 3471—Forest Planning and Management (3 cr)
FR 4501—Urban Forest Management: Managing Greenspaces for People, C/PE (3 cr)
RRM 4232W—Managing Recreational Lands, ENVT, WI (4 cr)

Resource Assessment
Take 0 or more credit(s) from the following:
FR 3131—Geographical Information Systems (GIS) for Natural Resources (4 cr)
FR 3218—Measuring and Modeling Forests (3 cr)
FR 3262—Remote Sensing of Natural Resources and Environment (4 cr)

Management of Vegetation, Wildlife, Water and Soil Resources
Take 0 or more credit(s) from the following:
ESPM 3703—Agroforestry in Watershed Management (3 cr)
ENT 4251—Forest and Shade Tree Entomology (3 cr)
FR 3501—Arboriculture: Selection and Maintenance of Trees (3 cr)
FR 3114—Hydrology and Watershed Management (3 cr)
FR 3431—Timber Harvesting and Road Planning (2 cr)
FR 5142—Tropical Forest Ecology, ENVT (3 cr)
FR 5413—Managing Forest Ecosystems: Silviculture Lab (1 cr)
PLPA 3003—Diseases of Forest and Shade Trees (3 cr)

Cloquet Program
Take all of the following in the same term:
FR 2101—Identifying Forest Plants (1 cr)
FR 2102—Northern Forests: Field Ecology (2 cr)
FR 2104—Measuring Forest Resources (1 cr)

Integrated Pest Management in Cropping Systems Minor

Agronomy and Plant Genetics

• Required credits in this minor: 20.

Students selecting this interdisciplinary minor learn how the environment and cropping systems interact with the biology of the major agronomic or horticultural crop pests. Students also learn to select and apply efficient, environmentally sound pest management procedures. Courses come from agronomy and plant genetics; entomology; horticultural science; plant pathology; and soil, water, and climate.

The minor provides sufficient knowledge and skills for employment in agricultural crop protection, product development and sales, crop management consultation, pest regulation, research, or application of agricultural crop protection materials. Students must complete at least 20 credits for this minor.

For the most up-to-date listing of program requirements, visit the ONLINE CATALOG at www.catalogs.umn.edu/programs.html.
Minor Requirements
AGRO 2501—Plant Identification for Urban and Rural Landscapes (2 cr)
AGRO 4505—Biology, Ecology, and Management of Invasive Plants (3 cr)
ENT 3005—Insect Biology, BIOL SCI/L (3 cr)
PLPA 3002—Air Pollution, People, and Plants: The Science and the Ethics, C/PE, ENVT (3 cr)
AGRO 4005—Applied Crop Physiology and Development (4 cr)
or BIOL 3002—Plant Biology: Function (2 cr)
HORT 3005—Environmental Effects on Horticultural Crops (4 cr)

Management
AGRO 4605—Management Strategies for Crop Production (4 cr)
or ENT 5211—Insect Pest Management (3 cr)
or HORT 4061W—Turfgrass Management, WI (3 cr)
or HORT 5032—Sustainable Commercial Vegetable Production Systems (3 cr)
or HORT 5041W—Nursery Management, WI (4 cr)
or PLPA 5204—Plant Disease Management (3 cr)

Applied Courses
AGRO 4603—Field Crop Scouting and Problem Diagnosis (3 cr)
or AGRO 4888—Issues in Sustainable Agriculture (2 cr)
or ESPM 3612W—Soil and Environmental Biology, WI (3 cr)
or PLPA 5202—Field Plant Pathology (2 cr)

International Agriculture Minor
• Required credits in this minor: 18.

Due to the international nature of food and agricultural systems, and the interdependence of environmental systems, CFANS students are strongly encouraged to incorporate an international experience during their academic degree program. Students with a particular interest in international agriculture can minor in international agriculture and choose between a self-contained block of courses or a series of courses integrated into the degree program. The minor is structured to include a general overview of international agriculture, followed by area, culture, or language studies; expanded coursework in agriculture; and an international experience. Students are required to travel outside the United States for a minimum two-week academic experience.

The program for a minor in international agriculture must be developed in coordination with International Programs in the college. Students must complete 18 credits with a minimum GPA of 2.00.

Minor Requirements
International Opportunities: The University of Minnesota is partnering with universities in Austria, Germany, and Italy to provide semester study abroad opportunities comparing U.S. and the European Union’s biotechnology, food safety, and regulatory policies. The US-EU FIPSE Program offers courses taught in English, as well as the chosen country’s language. Courses include: agricultural economics, tropical agriculture, organic food chain management, and environmental and agricultural food production. German or Italian language studies are required of participants. Admitted students will receive financial support for language classes and a semester of study at one of the EU partner universities.

Additional international practical or internship experiences may qualify for the minor. Arrangements can be made through MAST International or the St. Paul Campus Career Center.

Travel grants for overseas experience are available through the Academic Enrichment Program. Students are also eligible for scholarships through the Learning Abroad Center.

Minor Courses
CFAN 3500—International Field Studies Seminar (3 cr)
Take 6 credits 3xxx or 4xxx area culture or language studies
Take 2–4 credit(s) from the following:
CFAN 3000—Directed Studies in International Agriculture (2–4 cr)
Take 7 or more credit(s) from the following:
AFEE 5331—History, Philosophy, and Systems of Extension (3 cr)
AFEE 5361—World Development Problems (3 cr)
AGRO 3203W—Environment, Global Food Production, and the Citizen, C/PE, ENVT, WI (3 cr)
APEC 3007—Applied Macroeconomics: Policy, Trade, and Development, IP (3 cr)
APEC 3071—Agriculture and Economic Growth in Developing Countries (3 cr)
APEC 5751—Global Trade and Policy, IP (3 cr)
FSCN 3615—Sociocultural Aspects of Food, Nutrition, and Health, CD, SSCI (3 cr)
PLPA 3001—Plant Disease Biology and Management (1 cr)
PLPA 3002—Air Pollution, People, and Plants: The Science and the Ethics, C/PE, ENVT (3 cr)
WRIT 3384—From Soil to Civilization: Agriculture and the Emergence of the Modern World, IP, SSCI (3 cr)
WRIT 3376W—Terrorism, C/PE, WI (3 cr)
AGRO 4103—World Food Problems, C/PE, IP (3 cr)
or APEC 4103—World Food Problems, C/PE, IP (3 cr)
or FSCN 4103—World Provenience Problems, C/PE, IP (3 cr)

Nutrition B.S.
Food Science and Nutrition
• Required credits to graduate with this degree: 120.
• Required credits within the major: 95 to 100.

The major explores how nutrients and the foods from which they are derived aid the body in health, growth, and development. With major national and international concern for how food and nutrition affect health and disease, registered dietitians and nutritionists have many career opportunities. Students choose one of two options: nutrition and dietetics or nutritional science.

Students expecting to apply to an internship or graduate school should maintain a GPA of at least 3.00. A cumulative GPA of at least 3.30 is highly recommended.

The Didactic Program in Dietetics (nutrition and dietetics option) is currently granted accreditation by the Commission on Accreditation for Dietetics Education of the American Dietetic Association, 120 South Riverside Plaza, Suite 2000, Chicago, IL 60606-6995 (312-899-4772).

Admission Requirements
For information about University of Minnesota admission requirements, visit [http://admissions.tc.umn.edu](http://admissions.tc.umn.edu).

Program Requirements
All required courses must be taken A-F and completed with a grade of at least C-.

Foundation Courses
CHEM 1021—Chemical Principles I, ENVT, PHYS SCI/L (4 cr)
CHEM 1022—Chemical Principles II, ENVT, PHYS SCI/L (4 cr)
CHEM 2301—Organic Chemistry I (3 cr)
COMM 1101—Introduction to Public Speaking (3 cr)
or PSTL 1461—Oral Communication in the Public Sphere, C/PE (3 cr)
WRIT 3562W—Technical and Professional Writing, WI (4 cr)
BIOL 1009—General Biology, BIOL SCI/L (4 cr)
or PSTL 1131—Principles of Biological Science, BIOL SCI/L (4 cr)
ANSC 3301—Systemic Physiology (4 cr)
or PHSL 3051—Human Physiology (4 cr)
or take the following course pair
BIOL 2005—Animal Diversity Laboratory (1 cr)
and BIOL 3211—Animal Physiology (3 cr)
Nutritional Science

The nutritional science option is for students planning to do graduate work in nutrition, related sciences, or professional programs such as medicine or dentistry.

Required Courses for the Sub-Plan

Nutritional Science Courses

BIOC 3021—Biochemistry (3 cr)
CHEM 2302—Organic Chemistry II (3 cr)
CHEM 2311—Organic Lab (4 cr)
NUTR 5621W—Macronutrient Metabolism, WI (4 cr)
NUTR 5622—Vitamin and Mineral Biochemistry (3 cr)
NUTR 5624—Nutrition and Genetics (2 cr)
PHYS 1201W—Introductory Physics for Biology and Pre-medicine I, PHYS SCI/SCIL, WI (5 cr)
PHYS 1202W—Introductory Physics for Biology and Pre-medicine II, PHYS SCI/SCIL, WI (5 cr)

BIOL 4003—Genetics (3 cr)

or

GCD 3022—Genetics (3 cr)

MATH 1142—Short Calculus, MATH (4 cr)

or

MATH 1271—Calculus I, MATH (4 cr)

and

MATH 1272—Calculus II (4 cr)

STAT 3011—Introduction to Statistical Analysis, MATH (4 cr)

or

STAT 3021—Introduction to Probability and Statistics (3 cr)

or

STAT 5021—Statistical Analysis (4 cr)

BIOL 2032—General Microbiology With Laboratory (4 cr)

or

MICB 3301—Biology of Microorganisms (5 cr)

or

VBS 2032—General Microbiology With Laboratory (4 cr)

Nutrition Minor

- Required credits in this minor: 14 to 16.

See major for description.

Minor Requirements

Some of the courses listed in the minor have prerequisites that do not count toward the 14–16 credits.

Minor Courses

- FSCN 1112—Principles of Nutrition, ENV/S (3 cr)
- FSCN 3612—Life Cycle Nutrition (3 cr)
- FSCN 4612—Human Nutrition (3 cr)

Take 2 or more course(s) from the following:

- FSCN 3614—Nutrition Education and Counseling (3 cr)
- FSCN 3615—Sociocultural Aspects of Food, Nutrition, and Health, CD, SSCI (3 cr)
- FSCN 4613—Experimental Nutrition (2 cr)
- FSCN 4614—Community Nutrition, CD (3 cr)
- FSCN 461W—Nutrition and Metabolism, WI (4 cr)

Recreation Resource Management B.S.

Forest Resources

- Required credits to graduate with this degree: 120.
- Required credits within the major: 120.
- This program requires summer terms.

The recreation resources management curriculum prepares students to plan and manage natural and non-urban recreational land and water, as well as manage the people and organizations that depend on these important resources. The curriculum emphasizes natural and managed non-urban areas; natural resources-oriented recreation programs in public and private sectors; social science aspects of natural resources use; and skills in communication, planning, and management. Students select between two tracks: 1) recreation resource management and 2) resource based tourism. Students taking the recreation resource management track receive more training in principles and techniques of resource management; students taking the resource based tourism track receive more training in organizational and visitor management, policy, and administration. Graduates serve as educators, naturalists, wilderness managers, park or river rangers, adventure trip leaders, recreation supervisors, or recreation area and facilities planners and managers. Principal employers are federal, state and local parks, forestry, wildlife, nature conservation and related natural resource agencies and nongovernmental education and conservation organizations. Graduates may also work with tourism boards, related planning organizations, and with hospitality and resort industries. A minor is also available. Additionally, this curriculum provides excellent preparation in the human dimensions of natural resource sciences that is essential for graduate study and careers in research and teaching.
Admission Requirements
For information about University of Minnesota admission requirements, visit [http://admissions.tc.umn.edu](http://admissions.tc.umn.edu).

Program Requirements
All required courses must be taken A-F, and students must earn a grade of at least C-.

Communication Skills
COMM 1101—Introduction to Public Speaking (3 cr)

Mathematical Thinking
MATH 1031—College Algebra and Probability, MATH (3 cr)

or MATH 1051—Precalculus I (3 cr)

SOC 3811—Basic Social Statistics, MATH (4 cr)

or ESPM 3012—Quantitative Methods for Environmental Scientists and Managers II (4 cr)

or STAT 3011—Introduction to Statistical Analysis, MATH (4 cr)

or STAT 5021—Statistical Analysis (4 cr)

Social Sciences
ESPM 3261—Economics and Natural Resources Management, ENVT, SSCI (4 cr)

or PSY 1001—Introduction to Psychology, SSCI (4 cr)

or PSY 3201—Introduction to Social Psychology (4 cr)

or SOC 3411W—Organizations and Society, IP, WI (3 cr)

or SOC 3711—Principles of Social Organization (3 cr)

or SOC 3721—Principles of Social Psychology (3 cr)

Professional Orientation
RRM 1001—Orientation and Information Systems (1 cr)

Program Sub-Plans
Students are required to complete one of the following sub-plans.

Recreation Resource Management
The recreation resource management (RRM) track is designed for students who wish to develop careers in planning or managing the use of recreational land and water, and for students wishing to pursue graduate study in this area. Graduates may become directly involved in recreation resource management and planning and public relations. Principal employers are federal, state, and county land management agencies with recreation resource responsibilities. Nongovernmental organizations and conservation foundations are also significant employers. Graduates may also pursue graduate study to facilitate career advancement or develop a foundation for research and teaching in this area.

Required Courses for the Sub-Plan
Physical and Biological Sciences
BIOL 2022—General Botany (3 cr)

GEO 1001—Earth and Its Environments, ENVT, PHYS SCI/L (4 cr)

CHEM 1011—Introductory Chemistry: Lecture and Laboratory, PHYS SCI/L (4 cr)

or BIOL 2011—Biochemistry for the Agricultural and Health Sciences (3 cr)

or BIOL 1001—Introductory Biology I: Evolutionary and Ecological Perspectives, PHYS SCI/L, ENVT (4 cr)

or BIOL 1009—General Biology, PHYS SCI/L (4 cr)

SOIL 1125—The Soil Resource, ENVT, PHYS SCI/L (4 cr)

or SOIL 2125—Basic Soil Science, ENVT (4 cr)

Professional Courses
ESPM 3211—Survey, Measurement, and Modeling for Environmental Analysis (3 cr)

FR 3131—Geographical Information Systems (GIS) for Natural Resources (4 cr)

FR 1101—Dendrology: Identifying Forest Trees and Shrubs (3 cr)

or FR 3411—Managing Forest Ecosystems: Silviculture (3 cr)

BIOL 3407—Ecology, ENVT (3 cr)

or BIOL 3408W—Ecology, ENVT, WI (3 cr)

or EEB 3001—Ecology and Society, ENVT (3 cr)

or FR 3104—Forest Ecology (4 cr)

ESPM 4061W—Water Quality and Natural Resources, ENVT, WI (3 cr)

or FR 3114—Hydrology and Watershed Management (3 cr)

ESPM 3101—Conservation of Plant Biodiversity, ENVT (3 cr)

or FW 2001—Introduction to Fisheries, Wildlife, and Conservation Biology, ENVT (3 cr)

ESPM 3245—Sustainable Land Use Planning and Policy, ENVT (3 cr)

ESPM 4041W—Problem Solving for Environmental Change, WI (4 cr)

FRM 4232W—Managing Recreational Lands, ENVT, WI (4 cr)

RRM 5259—Visitor Behavior Analysis (3 cr)

or ESPM 3011W—Ethics in Natural Resources, C/PE, ENVT, WI (3 cr)

or ESPM 3202W—Environmental Conflict Management, Leadership, and Planning, C/PE, WI (3 cr)

or APEC 4311—Tourism Development: Principles, Processes, Policies (3 cr)

or RRM 3201—Introduction to Travel and Tourism (3 cr)

Additional Professional Courses
Take 9-10 credits, choosing one course from each of the three groups. RRM 3201 may be used only if it was not used to fulfill another requirement.

Social and Managerial Sciences
ANTH 3041—Ecological Anthropology, C/PE, ENVT (3 cr)

or APEC 4321—Regional Economic Analysis (3 cr)

or ESPM 3241W—Natural Resource and Environmental Policy: History, Creation, and Implementation, C/PE, SSCI, WI (3 cr)

or GEOG 3361W—Land Use, Landscapes, and the Law, C/PE, ENVT, WI (3 cr)

or GEOG 4393—The Rural Landscape (4 cr)

or COMM 3411—Introduction to Small Group Communication (3 cr)

Recreation Programming and Management Services
ESPM 4811—Environmental Interpretation (3 cr)

or REC 3551—Administration and Finance of Leisure Services (4 cr)

or REC 5191—Commercial Recreation and Tourism (3 cr)

or REC 5301—Wilderness and Adventure Education (4 cr)

or REC 5511—Programming Outdoor and Environmental Education (3 cr)

or REC 5801—Legal Aspects of Sport and Recreation (4 cr)

or RRM 3201—Introduction to Travel and Tourism (3 cr)

Management of Vegetation, Soil, and Water Resources
FR 3204—Landscape Ecology and Management (3 cr)

or FR 3262—Remote Sensing of Natural Resources and Environment (4 cr)

or GEOG 5565—Geographical Analysis of Human-Environment Systems (3 cr)

or HORT 5071—Restoration and Reclamation Ecology, ENVT (3 cr)

or LA 3204—Landscape Ecology (4 cr)

or LA 3501—Environmental Design and Its Biological and Physical Context, ENVT (3 cr)

-or-

Cloquet Program
Take all of the following in the same term:

FR 2101—Identifying Forest Plants (1 cr)

FR 2102—Northern Forests: Field Ecology (2 cr)

FR 2104—Measuring Forest Resources (1 cr)

Resource Based Tourism
The resource based tourism (RBT) track is intended for students who wish to understand the fundamentals of resource management, but focus on managing the businesses and visitors who depend on these resources for recreation and revenue. Graduates are likely to pursue opportunities developing and managing resource based tourism operations, programs, and visitors in both domestic and international locations. Principle employers are hospitality and resort industries and...
state, county, and local tourism based agencies and providers. Graduates may also pursue graduate study to facilitate career advancement or develop a foundation for research and teaching in this area.

Required Courses for the Sub-Plan

**Physical and Biological Sciences**

- **Biol 2022**—General Botany (3 cr)
- **Chem 1011**—Introductory Chemistry: Lecture and Laboratory, PHYS SCI/L (4 cr)
- or **Biol 2011**—Biochemistry for the Agricultural and Health Sciences (3 cr)
- **Biol 1001**—Introductory Biology I: Evolutionary and Ecological Perspectives, BIOL SCI/L, ENVT (4 cr)
- or **Biol 1009**—General Biology, BIOL SCI/L (4 cr)
- **GEO 1001**—Earth and Its Environments, ENVT, PHYS SCI/L (4 cr)
- or **Soil 1125**—The Soil Resource, ENVT, PHYS SCI/L (4 cr)
- or **Soil 2125**—Basic Soil Science, ENVT (4 cr)

**Professional Courses**

- **ESPM 3202W**—Environmental Conflict Management, Leadership, and Planning, C/PE, WI (3 cr)
- **ESPM 3245**—Sustainable Land Use Planning and Policy, ENVT (3 cr)
- **REC 5101**—Commercial Recreation and Tourism (3 cr)
- **RRM 3101**—Nature and Heritage Based Tourism (3 cr)
- **RRM 3201**—Introduction to Travel and Tourism (3 cr)
- **RRM 4232W**—Managing Recreational Lands, ENVT, WI (4 cr)
- **Blaw 3058**—The Law of Contracts and Agency (4 cr)
- or **REC 5801**—Legal Aspects of Sport and Recreation (4 cr)
- **ESPM 4811**—Environmental Interpretation (3 cr)
- or **ESPM 5311**—Programming Outdoor and Environmental Education (3 cr)
- **RRM 5259**—Visitor Behavior Analysis (3 cr)
- or **MKTG 3010**—Marketing Research (4 cr)
- **ESPM 3251**—Natural Resources in Sustainable International Development, ENVT, IP (3 cr)
- **Biol 3407**—Ecology, ENVT (3 cr)
- **ESPM 3408W**—Ecology, ENVT, WI (3 cr)
- **EEB 3001**—Ecology and Society, ENVT (3 cr)
- or **FR 3104**—Forest Ecology (4 cr)
- **MGMT 3001**—Fundamentals of Management (3 cr)
- **MKTG 3001**—Principles of Marketing (3 cr)

Additional Professional Courses

Area of Concentration Contract required. Course selections must be made in consultation with a faculty adviser and have faculty adviser signature. Take 15 or more credit(s) from the following:

- **COMM 5451W**—Intercultural Communication Processes, IP, WI (3 cr)
- **ESPM 1011**—Issues in the Environment, C/PE, ENVT (3 cr)
- **ESPM 3011W**—Ethics in Natural Resources, C/PE, ENVT, WI (3 cr)
- **ESPM 3241W**—Natural Resource and Environmental Policy: History, Creation, and Implementation, C/PE, SSCI, WI (3 cr)
- **FINA 3001**—Finance Fundamentals (3 cr)
- **FR 3204**—Landscape Ecology and Management (3 cr)
- **FW 2001**—Introduction to Fisheries, Wildlife, and Conservation Biology, ENVT (3 cr)
- **FW 4104**—Hunting and Fishing Traditions: Field Sports Reflected in Literature, and Practice (3 cr)
- **FW 5003**—Human Dimensions of Biological Conservation, C/PE, ENVT (3 cr)
- **GEOG 3361W**—Land Use, Landscapes, and the Law, C/PE, ENVT, WI (3 cr)
- **JOUR 3201**—Principles of Strategic Communication: Advertising (3 cr)
- **LA 3501**—Environmental Design and Its Biological and Physical Context, ENVT (3 cr)
- **MGMT 4008**—Entrepreneurial Management (4 cr)
- **MKTG 4030**—Selling and Sales Management (4 cr)
- **MKTG 4040**—Buyer Behavior (4 cr)
- **MKTG 4050**—Integrated Marketing Communications (4 cr)
- **MKTG 4060**—Marketing and Distribution Channels (4 cr)
- **MKTG 4070**—International Marketing (2 cr)
- **MKTG 5012**—Museum Practices (3 cr)
- **PA 5531**—Strategies for Sustainable Development: Theory and Practice (2 cr)
- **REC 5301**—Wilderness and Adventure Education (4 cr)
- **SOC 4305**—Society and the Environment: A Growing Conflict, C/PE, ENVT (3 cr)

Recreation Resource Management Minor

- **Required credits in this minor**: 19 to 20.

Students may pursue a recreation resource management (RRM) minor in either one of two tracks: the resource based tourism (RBT) track or the standard RRM track. Students must complete the minor core courses and then choose either the RBT track or the RRM track.

**Minor Requirements**

- **ESPM 3245**—Sustainable Land Use Planning and Policy, ENVT (3 cr)
- **RRM 4232W**—Managing Recreational Lands, ENVT, WI (4 cr)
- **RRM 5259**—Visitor Behavior Analysis (3 cr)

**Recreation Resource Management Options**

Students are required to complete one of the following course groups.

**Recreation Resource Management**

- **Take 3 or more course(s) from the following**: 
  - **ESPM 3202W**—Environmental Conflict Management, Leadership, and Planning, C/PE, WI (3 cr)
  - **ESPM 3241W**—Natural Resource and Environmental Policy: History, Creation, and Implementation, C/PE, SSCI, WI (3 cr)
  - **FR 3104**—Forest Ecology (4 cr)
  - **ESPM 4811**—Environmental Interpretation (3 cr)
  - or **REC 5311**—Programming Outdoor and Environmental Education (3 cr)

**Resource Based Tourism**

- **REC 5191**—Commercial Recreation and Tourism (3 cr)
- **RRM 3101**—Nature and Heritage Based Tourism (3 cr)
- **RRM 3201**—Introduction to Travel and Tourism (3 cr)
- or **AEC 4311**—Tourism Development: Principles, Processes, Policies (3 cr)

Soil Science Minor

Soil, Water, and Climate

- **Required credits in this minor**: 20.

This minor provides a strong background in basic soil sciences, covering such topics as soil biology, conservation, contaminants, water movement, and land use. Students completing the minor meet the minimum requirements for employment with the Natural Resources Conservation Service as a soil conservationist. They are also prepared to take the Professional Soil Science Examination for geoscientists. Students must complete at least 20 credits for the minor.

**Minor Requirements**

- **SOIL 3416**—Plant Nutrients in the Environment (3 cr)
- **SOIL 4511**—Field Study of Soils (2 cr)
- **ESPM 3221**—Soil Conservation and Land-Use Management (3 cr)
- **ESPM 3612W**—Soil and Environmental Biology, WI (3 cr)
- **ESPM 4601**—Soils and Pollution (3 cr)
- **SOIL 2125**—Basic Soil Science, ENVT (4 cr)
- or **SOIL 1125**—The Soil Resource, ENVT, PHYS SCI/L (4 cr)

**Electives**

- **SOIL 5515**—Soil Genesis and Landscape Relations (3 cr)
- or **ESPM 4021W**—Problem Solving: Environmental Review, WI (4 cr)
- or **ESPM 4216**—Contaminant Hydrology (2 cr)
- or **ESPM 5555**—Wetland Soils (3 cr)

For the most up-to-date listing of program requirements, visit the Online Catalog at www.catalogs.umn.edu/programs.html
Sustainability Studies Minor

- Required credits in this minor: 15 to 18.

One of the greatest challenges facing the world in the 21st century is jointly sustaining the environment as well as human health and well-being. The sustainability studies minor provides students from across the University with a unique opportunity to address this sustainability challenge. Students will explore the fundamental ecological, social, ethical, political, and economic forces that influence the long-term quality and viability of human society and the natural environment. The introductory core course provides a conceptual overview of various models for understanding sustainability, and uses case studies to demonstrate the challenges of putting sustainability into practice. Additional electives are chosen from courses that explore multiple disciplinary perspectives related to sustainability. Finally, the capstone experience allows students to synthesize and apply their knowledge to real sustainability problems.

For this minor, students must complete 6 credits of required courses for the core and the capstone, and 9-12 restricted electives, for a total of 15-18 credits.

Required Courses for the Minor

Core Courses

- ESPM 4004—Sustainable Communities (3 cr)
- ESPM 3003—Sustainable People, Sustainable Planet, ENVT, C/PE (3 cr)
- or GLOS 3304—Sustainable People, Sustainable Planet, ENVT, C/PE (3 cr)

Electives

Interdisciplinary

Choose one course from the following:

- AGRO 3203W—Environment, Global Food Production, and the Citizen, C/PE, ENVT, WI (3 cr)
- or ANSC 3203W—Environment, Global Food Production, and the Citizen, C/PE, ENVT, WI (3 cr)
- or AGRO 5321—Ecology of Agricultural Systems, ENVT (3 cr)
- or ENT 5321—Ecology of Agricultural Systems, ENVT (3 cr)
- or EEB 5146—Science and Policy of Global Environmental Change (3 cr)
- or FR 5146—Science and Policy of Global Environmental Change, ENVT (3 cr)
- or ESPM 3603—Environmental Life Cycle Analysis (3 cr)
- or ESPM 3245—Sustainable Land Use Planning and Policy, ENVT (3 cr)
- or ESPM 3251—Natural Resources in Sustainable International Development, ENVT, IP (3 cr)
- or FW 5455—Sustainable Aquaculture, ENVT, IP (3 cr)
- or ID 3592—HECUA Off-Campus Study Program: Environmental Sustainability: Dimensions of Environmental Change (4 cr)
- or HSCI 3244—History of Ecology and Environmentalism (3 cr)
- or PHIL 3301—Environmental Ethics, C/PE, ENVT (4 cr)

Maximum of one course from each grouping

Take 2 or more course(s) from the following:

Economics and Policy

- APEC 3611—Environmental and Natural Resource Economics, ENVT (3 cr)
- or ECON 3611—Environmental Economics, ENVT (3 cr)
- or APEC 5611—Economic Aspects of Environmental Management (3 cr)
- or ATEE 5361—World Development Problems (3 cr)
- or CE 5212—Transportation Policy, Planning, and Deployment (4 cr)
- or PA 5232—Transportation Policy, Planning, and Deployment (4 cr)
- or CE 5214—Transportation Systems Analysis (4 cr)
- or ESPM 3261—Economics and Natural Resources Management, ENVT, SSCI (4 cr)
- or ESPM 3241W—Natural Resource and Environmental Policy: History, Creation, and Implementation, C/PE, SSCI, WI (3 cr)
- or ESPM 3604—Environmental Management Systems and Strategy (3 cr)

Social Science and Humanities

- ANTH 3041—Ecological Anthropology, C/PE, ENVT (3 cr)
- or ANTH 3212—Globalization, Markets, and Inequality (3 cr)
- or GLOS 3212—Globalization, Markets, and Inequality (3 cr)
- or ANTH 4053—Economy, Culture, and Critique, IP, SSCI (3 cr)
- or ANTH 4069—Environmental Archaeology, SSCI, ENVT (3 cr)
- or ENGL 3501—Public Discourse: Coming to Terms With the Environment, C/PE, LIT (3 cr)
- or ESPM 3011W—Ethics in Natural Resources, C/PE, ENVT, WI (3 cr)
- or GEOG 3379—Environment and Development in the Third World, ENVT, IP (3 cr)
- or GLOS 3303—Environment and Development in the Third World, ENVT, IP (3 cr)
- or HIST 3452—African Conservation Histories, HP, ENVT (3 cr)
- or SOC 3613W—Food, Culture, and Society, WI (3 cr)
- or SOC 4305—Society and the Environment: A Growing Conflict, C/PE, ENVT (3 cr)
- or SOC 4311—Race, Class, and the Politics of Nature, ENVT, IP (3 cr)

Biophysical Sciences

- BIOL 3407—Ecology, ENVT (3 cr)
- or BIOL 3408W—Ecology, ENVT, WI (3 cr)
- or EEB 3001—Ecology and Society, ENVT (3 cr)
- or EEB 4609W—Ecosystem Ecology, WI (3 cr)
- or FW 4102—Principles of Conservation Biology (3 cr)
- or GEOG 3401—Geography of Environmental Systems and Global Change, WI (4 cr)
- or GEO 3005—Earth Resources, C/PE, IP (3 cr)
- or HORT 4021—Landscape Design and Implementation I (4 cr)
- or HORT 4072—Growing Plants Organically: What It Means To Be Green (3 cr)
- or ID 3591—HECUA Off-Campus Study Program: Environmental Sustainability: Adaptive Ecosystem Management (4 cr)
- or PLPA 3002—Air Pollution, People, and Plants: The Science and the Ethics, C/PE, ENVT (3 cr)

Design and Technology

- ARCH 4561—Architecture and Ecology (3 cr)
- or BBE 4733—Renewable Energy Technologies (3 cr)
- or CE 3501—Environmental Engineering, C/PE, ENVT (3 cr)
- or CE 4561—Solid Hazardous Wastes (3 cr)
- or CHEN 5551—Survey of Renewable Energy Technologies (3 cr)
- or ESPM 3601—Our Home, Our Environment (3 cr)
- or DHA 3482—Our Home, Our Environment (3 cr)
- or LA 3501—Environmental Design and Its Biological and Physical Context, ENVT (3 cr)
- or LA 5712—Infrastructure, Natural Systems and the Space of Inhabited Landscapes (3 cr)
- or URBS 3751—Understanding the Urban Environment, ENVT (3 cr)

Sustainable Agriculture Minor

- Required credits in this minor: 17.

This minor allows students to study the sustainability of agricultural food systems from an integrated perspective, including coursework, practical experience, and community reflection. Required courses and courses from the foundational clusters—land and public policy; agriculture, environment, and natural resources; and citizens, science, and society—define the students’ minor curriculum.

In addition, each student works with a minor adviser to design an individualized practical experience (e.g., internship, experiential learning opportunity) in some aspect of sustainable agriculture. Through the student-led seminar series, What’s Up in Sustainable Agriculture (WUSA), and the senior capstone, students synthesize their learning about sustainability for local, national and global agricultural food systems. For this minor, students must complete 8-10 credits of required courses and a minimum of 9 credits of foundational coursework, for a total of at least 17 credits.

Note: Programs listed in this catalog are current as of March 2008.
Minor Requirements
AGRO 4660 should be taken concurrently with or after completion of the internship.
AGRO 4660—Senior Capstone: Leadership, Decision Making, and Problem Solving (2 cr)
AGRO 4888—Issues in Sustainable Agriculture (2 cr)
AGRO 3203W—Environment, Global Food Production, and the Citizen, C/PE, ENVT, WI (3 cr)
or ANSC 3203W—Environment, Global Food Production, and the Citizen, C/ PE, ENVT, WI (3 cr)
Take 1–3 credit(s) from the following:
AFEE 3096—Professional Experience Program: Internship (1–8 cr)
AGRO 4096—Professional Experience Program: Internship (1–3 cr)
ANSC 4096—Professional Experience Program: Internship (1–3 cr)
APEC 4096—Professional Experience Program: Internship (1–3 cr)
ESPM 4096—Professional Experience Program: Internship (1 cr)
HORT 4096—Professional Experience Program: Internship (1 cr)
FSCN 4096—Professional Experience Program: Internship (1–3 cr)
PLPA 4096—Professional Experience Program: Internship (1–3 cr)
Foundation Course Clusters
Select one course from each of the following clusters. Other courses may be substituted with approval of the minor adviser and coordinator.
Take 9 or more credit(s) including 3 or more sub-requirement(s) from the following:

Land and Public Policy
APEC 3041W—Economic Development of U.S. Agriculture, HP, WI (3 cr)
or GEOG 3301W—Land Use, Landscapes, and the Law, C/PE, ENVT, WI (3 cr)
or PA 5002—Introduction to Policy Analysis (1.5 cr)
or WRIT 1315—The Land in American Experience, CD, OH (3 cr)
or AGRO 4103—World Food Problems, C/PE, IP (3 cr)
or APEC 4103—World Food Problems, C/PE, IP (3 cr)
or FSCN 4103—World Food Problems, C/PE, IP (3 cr)

Agriculture/Environment and Natural Resources
CFAN 3001—Pests and Crop Protection (3 cr)
or AGRO 1103—Crops, Environment, and Society, ENVT (4 cr)
or AGRO 5999—Special Topics: Workshop in Agronomy (1–6 cr)
or ANSC 1101—Introductory Animal Science (4 cr)
or ESPM 3221—Soil Conservation and Land-Use Management (3 cr)
or GEOG 3355—Environmental Quality, C/PE, ENVT (3 cr)
or HORT 4072—Growing Plants Organically: What It Means To Be Green (3 cr)
or SOIL 1125—The Soil Resource, ENVT, PHYS SCI/L (4 cr)
or SOIL 2125—Basic Soil Science, ENVT (4 cr)

Citizens/Science and Society
CFAN 1501—Biotechnology, People, and the Environment, ENVT (3 cr)
or BBE 5212—Safety and Environmental Health Issues in Plant and Animal Production and Processing, C/PE, ENVT, H (3 cr)
or GEOG 3371W—Cities, Citizens, and Communities, CD, SSCI, WI (4 cr)
or WRIT 3371—Technology, Self, and Society, C/PE, HP (3 cr)
or SOC 3451W—Cities and Social Change, SSCI, WI (3 cr)

Urban and Community Forestry Minor

Forest Resources
• Required credits in this minor: 16.
The urban and community forestry minor enables students in programs such as education, landscape architecture, horticultural sciences, natural resources, and related areas to understand the science and practice underlying the management of urban and community forests. The minor incorporates fundamental science, arboriculture, forest health, and resource management coursework. Students must complete 16 credits for this minor. Students interested in the minor should contact the CFANS Student Services Office.

Minor Requirements
ENT 4251—Forest and Shade Tree Entomology (3 cr)
or PLPA 3003—Diseases of Forest and Shade Trees (3 cr)
FR 3501—Arboriculture: Selection and Maintenance of Trees (3 cr)
or FR 4501—Urban Forest Management: Managing Greenspaces for People, C/ PE (3 cr)

Electives
Take 10 or more credit(s) from the following:
ESPM 3211—Survey, Measurement, and Modeling for Environmental Analysis (3 cr)
FR 3104—Forest Ecology (4 cr)
FR 3218—Measuring & Modeling Forests (3 cr)
FR 4118—Trees: Structure and Function (3 cr)
HORT 1015—Woody and Herbaceous Plants (4 cr)
HORT 4232W—Managing Recreational Lands, ENVT, WI (4 cr)

Cloquet Program
Take all of the following in the same term:
FR 2101—Identifying Forest Plants (1 cr)
FR 2102—Northern Forests: Field Ecology (2 cr)
FR 2104—Measuring Forest Resources (1 cr)

Water Science Minor

Soil, Water, and Climate
• Required credits in this minor: 20.
The minor provides students the opportunity to broaden their expertise in the area of water science. Students interested in qualifying as a hydrologist should determine the exact requirements for the Minnesota civil service position by checking the Hydrologist I (Hydrogeology) and Hydrologist I (Water Resources) position descriptions.

Students must complete at least 20 credits for the minor.

Minor Requirements
FR 3114—Hydrology and Watershed Management (3 cr)
GEO 5701—General Hydrogeology (3 cr)
or EEB 5601—Limnology (3 cr)
ESPM 5555—Wetland Soils (3 cr)
or SOIL 5232—Vadose Zone Hydrology (3 cr)

Electives
Courses used to fulfill requirements above cannot be chosen to fulfill electives.
Take 11 or more credit(s) from the following:
CE 5541—Environmental Water Chemistry (3 cr)
EEB 5605—Limnology Laboratory (2 cr)
ESPM 4061W—Water Quality and Natural Resources, ENVT, WI (3 cr)
ESPM 4216—Contaminant Hydrology (2 cr)
ESPM 5311—Environmental Biophysics and Ecology (3 cr)
GEOE 4351—Groundwater Mechanics (3 cr)
FR 5153—For est and Wetland Hydrology (3 cr)
or GEO 5701—General Hydrogeology (3 cr)
ESPM 5555—Wetland Soils (3 cr)
or SOIL 5232—Vadose Zone Hydrology (3 cr)