COLLEGE OF AGRICULTURE AND LIFE SCIENCES

INTRODUCTION

College Focus

The College of Agriculture and Life Sciences offers men and women broad-based educational programs to provide them with technical, management, and leadership skills in four primary areas of focus. These areas were developed in response to the global challenges of the 21st century. They are fluid, overlapping, and interdependent and represent agriculture and life sciences at its broadest and most dynamic meaning. These four areas are:

- Land-grant, or agricultural sciences
- Applied social sciences
- Environmental sciences
- New life sciences

Faculty members challenge students with educational programs that promote problem-solving, basic and applied research, extension, and outreach. The programs are geared to the discovery and dissemination of knowledge for the purpose of advancing agriculture and food systems, health and nutrition, food security, biological sciences, education, communication, natural resources and environmental quality, and community, urban and rural development throughout New York State, the nation, and the world.

Administration

Susan A. Henry, dean

William E. Fry, senior associate dean

John M. Finamore, associate dean for financial affairs

Mary Lou Doyle, assistant dean for human resources

Michael P. Riley, assistant dean for alumni affairs, development, and communications

Donald R. Viands, associate dean and director of academic programs

Mark W. Wysocki, associate director of academic programs

Jeffrey J. Doyle, director of undergraduate biology

vacant, associate dean and director of the Cornell University Agricultural Experiment Station

Susan J. Riha, director for sponsored research in the senior associate dean's office

Helene R. Dillard, associate dean and director of cooperative extension

Michael P. Hoffmann, associate director of cooperative extension

W. Ronnie Coffman, director of international programs

James E. Haldeman, associate director of international programs

Terry W. Tucker, associate director of international programs

vacant, director of Cornell International Institute for Food, Agriculture, and Development

Department Chairs

Animal science: Alan W. Bell, 149 Morrison Hall

Applied economics and management: William H. Lesser, 154 Warren Hall

Atmospheric science unit (part of Earth and Atmospheric Sciences): Stephen J. Colucci, 1116 Bradfield Hall; Teresa E. Jordan, 4108 Snee Hall

Biological and environmental engineering: Michael F. Walter, 104 Riley-Robb Hall

Biological statistics and computational biology: Martin T. Wells, 435 Warren Hall

Communication: Geri K. Gay, 303 Kennedy Hall

Crop and soil sciences: Stephen D. DeGloria, 232 Emerson Hall

Development sociology: Philip D. McMichael, 133A Warren Hall

Ecology and evolutionary biology: Nelson G. Hairston, E305 Corson Hall

Education: Rosemary S. Caffarella, 435 Kennedy Hall

Entomology: Jan P. Nyrop, 2130 Comstock Hall

Food science: Joseph H. Hotchkiss, 119 Stocking Hall

Horticulture: Marvin P. Pritts, 134A Plant Science Building

Landscape architecture: Kathryn L. Gleason, 446 Kennedy Hall

Microbiology: William C. Ghiorse, B75C Wing Hall

Molecular biology and genetics: Charles F. Aquadro, 235 Biotechnology Building

Natural resources: Barbara A. Knuth, 117 Fernow Hall

Neurobiology and behavior: Thomas D. Seeley, W159 S. G. Mudd Hall

Plant breeding and genetics: W. Ronald Coffman, 241 Emerson Hall

Plant pathology: George W. Hudler, 318 Plant Science Building

Statistical sciences: Bruce W. Turnbull, 227 Rhodes Hall

Student Services

Office of Academic Programs

The College of Agriculture and Life Sciences (CALS) provides a variety of services for students, faculty and alumni. The hub of these services is the Office of Academic Programs in Roberts Hall, including the director, associate director, the Admissions Office, the Career Development Office, the Counseling and Advising Office, the Multicultural and Diversity Office, and the Registrar's Office. Although most of the student services are in the Office of Academic Programs, significant efforts are located across the college in the Office of Undergraduate Biology and in various departments.

The Counseling and Advising Office coordinates the faculty advising program, serves as the college's central undergraduate advising office, and offers personal counseling. Academic advising is available for students who are interested in international study, need to file petitions to waive college academic regulations, have disability concerns, are experiencing academic difficulties, or have requests for tutoring. The staff coordinates new student orientation, award ceremonies, commencement activities, and the activities of Ho-Nun-De-Kah, the college's honor society. Students seek counseling and advising on a variety of issues including academic problems, course problems and college procedures, graduation requirements, personal and family problems, stress management, and time management. Two counselors provide short-term counseling with an expertise in college policies and guidelines. Counseling is framed as appropriate to each student's academic circumstances. The staff is available on a walk-in basis, as well as by appointment in 140 Roberts Hall. Visit www.cals.cornell.edu/Counseling_and_Advising.cfm. Counseling and Advising staff: Lisa Ryan, Bonnie Shelley, Pamela Torelli, Tamara Durham.

Faculty members in the College of Agriculture and Life Sciences consider advising to be an important and integral part of the undergraduate program. Each student enrolled in the college is assigned to a faculty adviser in his or her major field of study for assistance and guidance in developing a program of study, and to enhance the student's academic experience.

The Office of Multicultural and Diversity Programs serves to monitor, support, and influence policy on behalf of all underrepresented students within the College of Agriculture and Life Sciences. This population is defined as encompassing, but not limited to, all African American, Latin American, Asian American, and Native American students. Its constituency includes students, faculty, and the general public. In the past academic year this represented approximately 20 percent of the college's undergraduate population. Additionally, the office is charged with monitoring and programming for the Educational Opportunity Program (EOP) and Prehealth Collegiate Science and Technology Entry Program (CSTEP). EOP and CSTEP are state-supported programs intended to assist New York State students who meet economic and academic criteria set by the college, State Programs Office, and New York State Board of Regents. For further information, please contact Catherine Thompson in 140 Roberts Hall.

Within the university, the Office of Multicultural and Diversity Programs is charged with acting as the college liaison with the central Office of Minority Education Affairs, Learning Strategies Center and the State Programs Office. Other University connections include the University Career

Center and the Office of Financial Aid regarding concerns of the underrepresented student population. The director provides support for the CALS Diversity Committee. The director together with peer advisers carries out the duties of the office. The staff acts as a major advocacy group, as well as an information and referral center.

Given the college's policy on nonexclusionary programming, the Office of Multicultural and Diversity Programs is also responsible for some functions which serve the college's entire population. At present, that includes general college diversity activities, serving as the college prehealth adviser and providing ongoing support at all levels for the Office of Counseling and Advising.

The CALS Registrar's Office ensures the accuracy, confidentiality, and reliability of student records and serves as an important link between the university's and college's policies and procedures and the student. The Registrar's Office maintains student records and reviews degree progress on a semester basis, maintains the Dean's List, evaluates and applies non-Cornell credit (transfer credit, study abroad credit, and advanced placement credit), provides registration and enrollment information, consults individually with students on graduation requirements, and schedules all CALS courses. Specific information can be found at www.cals.cornell.edu/registrar.cfm.

The CALS Registrar's Office holds walk-in hours to assist students with any registrar-related issue. Walk-in hours are Tuesdays from 1:00 to 3:00 P.M. and Wednesdays from 10:00 A.M. to 12:00 P.M. in 140 Roberts Hall. No appointment is necessary during these times. Registrar's Office staff: Melanie Holland, Torrey Jacobs, Amy Paolangeli, Elisa Rafferty.

The Office of Career Development offers a variety of helpful services to all students and alumni of the college. Career development includes self-assessment, career exploration, decision making, and transition to employment or further study. Services are designed to assist students and alumni with those activities and to help them develop the career planning and job search skills they will find useful as their career paths progress and change.

The Career Library contains an extensive collection of current and useful material, including career information books, extensive internship files, employer directories, and job listings. Alumni Career Link is a database of more than 400 college alumni who have offered to help students and alumni with their career development in a variety of ways. Job search talks on topics such as résumé writing, cover letter writing, and interview skills are presented throughout the semester and are available on videotape. An active on-campus recruiting program brings more than 50 employers to campus each year to interview students for full-time and summer jobs. Additionally, the office provides information on hundreds of internships.

The office, in conjunction with a network of college faculty and staff members, assists students throughout their undergraduate years and beyond. For further information, students should contact Amy Benedict-Augustine, Laurie Gillespie, or Sharon Radcliffe in 177 Roberts Hall.

The CALS Admissions Office is responsible for admitting and enrolling a talented and diverse class of students each year in the college. The process and outcome must reflect and support the college mission and help to meet college and institutional enrollment goals. This includes freshman, transfer and intra-university transfer student processes. The office hosts on-campus and off-campus information sessions for prospective students, evaluates and makes decisions on more than 4,000 applications each year, and coordinates Cornell Days for admitted students each April. The Admissions Office staff advises and supports the CALS Ambassador program. The office is located in 177 Roberts Hall. Staff members include Ann LaFave, Cathy Sheils, Tara Bubble, Jared Rivers, and Lorie Fessenden.

Financial aid is administered through the university office in Day Hall. Endowment funds and annual donations in the college provide supplemental aid for students who are eligible for financial aid. Information about these college grants is available from the Office of Academic Programs in 140 Roberts Hall for students who have their financial aid package established through the university office in Day Hall. Grants are processed through the university's Office of Financial Aid.

Students

Undergraduate enrollment is approximately 3,100, with about 56 percent in the upper division. Each year about 850 students are graduated, while 645 freshmen and 250 new transfer students are enrolled. College faculty members serve as chairs of the Special Committees of roughly 1,000 graduate students.

Admission

The CALS Admissions Office selects applicants who are academically well prepared and appear most likely to benefit from the college's various curricula.

While most students come from New York State, about 43 percent come from other parts of the United States or abroad. Slightly more than half of the undergraduates are women. Approximately 22 percent are self-identified as members of minority ethnic groups.

The CALS Admissions Office is in 177 Roberts Hall (255-2036; www.cals.cornell.edu/admissions/).

Transfer Students

All accepted transfer credit must be from a regionally accredited college or university. Transfer credit is awarded on a case-by-case basis. Additional course information may be required. Contact the CALS Registrar's Office for information. A maximum of 60 non-Cornell credits is allowed.

Approximately 20 percent of CALS undergraduate students are transfers who have completed part of their collegiate work at community colleges, agricultural and technical colleges, or four-year institutions. Many of them hold an associate degree. Detailed information on transfer admission is available from the CALS Admissions Office.

Intra-University Transfer

A Cornell student in good standing may apply for an intra-university transfer to pursue a course of study unavailable in his or her current college. Guidelines are available in the CALS Admissions Office. The procedure involves filing a transfer request, meeting with a faculty member in the proposed area of study, and submitting a letter of interest in the new area.

Consideration is given to students who have demonstrated an interest in their proposed field of study by taking appropriate prerequisite subjects and courses within the area of study. Academic achievement is also considered. Students are not encouraged to transfer during their freshman year. In certain cases, a student may be referred to the Internal Transfer Division (ITD) to study for one semester before entering the college. A second semester in ITD is considered only in unusual circumstances. During this trial semester, the student must achieve a predetermined average (usually 2.7) and take approved courses to assure acceptance.

Special Students

A limited number of nondegree candidates who want to take courses in the college are admitted each year. Applicants should submit the standard Cornell transfer application, a résumé of their work experience, and a list of the courses in which they are interested. For more information and guidelines, students should contact the CALS Admissions Office.

Off-Campus Students

Programs in which students study off campus but enroll for Cornell credit include SEA semester, field study in human ecology or industrial and labor relations, Albany programs, Cornell in Washington, student teaching, IPM internship, and clinical microbiology internship. **Students intending to receive Cornell credit for work done off campus should inform the college registrar at the time of enrolling for courses to ensure that proper registration will occur.**

Facilities

The College of Agriculture and Life Sciences is located on the upper campus, up the hill from the central area of Cornell University, on land that was once part of the Ezra Cornell family farm.

Buildings around the area commonly known as the Ag Quad house classrooms, offices, and laboratories. Flanking them are the greenhouses, gardens, and research facilities. Nearby orchards, barns, field plots, forests, and streams extend as far as the Animal Science Teaching Research Center at Harford and the New York State Agricultural Experiment Station at Geneva.

Roberts Hall serves as headquarters for the administrative units, including offices of the deans and directors of academic programs, Cornell University Agricultural Experiment Station, and cooperative extension. Included in the Office of Academic Programs are the director and associate director, the Admissions Office, the Career Development Office, the Counseling and Advising Office, the Office of Multicultural and Diversity Programs, and the Registrar's Office.

Mann Library, with its extensive collections of materials in the agricultural and life sciences, is at the east end of the Ag Quad. The student lounge and service center, known as the

Alfalfa Room, and many of the college classrooms are in Warren Hall. Public computer facilities are available in Warren Hall, Riley-Robb Hall, and Mann Library.

DEGREE PROGRAMS

The College of Agriculture and Life Sciences offers programs leading to the degrees bachelor of science, master of science, and doctor of philosophy. Professional degrees include the master of professional studies and the master of arts in teaching. Some registered professional licensing and certification programs are also available.

Each curriculum in the college creditable toward a degree is registered with the New York State Education Department.

Bachelor of Science Degree

Departments in the College of Agriculture and Life Sciences sponsor study for the B.S. degree in 23 major programs. To qualify for the degree, students must fulfill requirements established by the faculty of the college and administered through the Office of Academic Programs. Students are admitted into a single major but afterwards may pursue and graduate with two or more majors within the College of Agriculture and Life Sciences. Students need an adviser in each major. Course requirements for double majors may overlap. The Counseling and Advising Office (140 Roberts Hall) and department representatives have a form for students to complete to officially recognize the double major. The following units offer major fields of study for undergraduates. A faculty advising coordinator is listed for each unit. Students should consult with the faculty coordinator regarding requirements and opportunities for concentrations in the major.

Majors

Agricultural science education: Leah Hershey, 418 Kennedy Hall, lrs55@cornell.edu

Animal sciences: W. Bruce Currie, 434 Morrison Hall, wbc1@cornell.edu

Applied economics and management: Dale Grossman, 205 Warren Hall, dag14@cornell.edu

Atmospheric science: Mark Wysocki, 1114 Bradfield Hall, mww3@cornell.edu

Biological Engineering: James Bartsch, 314 Riley-Robb Hall, jab35@cornell.edu

Biological Sciences: Jeffrey Doyle, 216 Stimson Hall, jjd5@cornell.edu; Bonnie Comella, 216 Stimson Hall, bec3@cornell.edu

Biology and society: Brian Chabot, E309A Corson Hall, bfc1@cornell.edu

Biometry and statistics: Steven Schwager, 424 Warren Hall, sjs5@cornell.edu

Communication: Brian Earle, 328 Kennedy Hall, boe1@cornell.edu

Crop and soil sciences: Gary Fick, 507 Bradfield Hall, gwf2@cornell.edu

Development sociology: Max Pfeffer, 133 Warren Hall, mjp5@cornell.edu

Entomology: John Losey, 4126 Comstock Hall, jel27@cornell.edu

Environmental engineering: James Bartsch, 314 Riley–Robb Hall, jab35@cornell.edu

Food science: Janice Brown, 107 Stocking Hall, jmb14@cornell.edu

Information science: Lindsay Marzano, 303 Upson Hall, lindsay@cis.cornell.edu

Interdisciplinary studies: Lisa Ryan, 140 Roberts Hall, major@infosci.cornell.edu

International agriculture and rural development: Terry Tucker, 33 Warren Hall, twt2@cornell.edu

Landscape architecture: Peter Trowbridge, 440 Kennedy Hall, pjt4@cornell.edu

Natural resources: Tim Fahey, 12 Fernow Hall, tjf5@cornell.edu

Nutritional sciences: J. Thomas Brenna, B38 Savage Hall, jtb4@cornell.edu

Plant sciences (plant biology; plant genetics and breeding; horticulture, plant pathology/protection): Peter Davies, 255 Plant Sciences Bldg., pjd2@cornell.edu

Science of earth systems: Bryan Isacks, 3110 Snee Hall, bli1@cornell.edu

Science of natural and environmental systems: Tim Fahey, 12 Fernow Hall, tjf5@cornell.edu

Minors

Students in the College of Agriculture and Life Sciences may pursue one or more minor fields of study. Minor fields of study do not require an academic adviser, but each minor field has a contact person who will provide information and verify on the application to graduate that the student will successfully complete the requirements of the minor by graduation. Students may complete as many minors as they wish; the requirements of minors may overlap. Minors are described along with the majors later in the CALS section of this catalog. Not all majors or departments offer minors. Minors available in CALS at the printing of this catalog are listed below with contact person, e-mail address, and location. For minors outside of CALS, please consult with the specific department.

American Indian studies: AIP office, 4th floor, Caldwell Hall

Animal science: Deloris Bevins, 149 Morrison Hall, dgb1@cornell.edu

Atmospheric science: Pam Vitale, 1123 Bradfield Hall, pmv2@cornell.edu

Biological sciences: Bonnie Comella, 216 Stimson Hall, bec3@cornell.edu; Wendy Aquadro, 216 Stimson Hall, gsa8@cornell.edu

Biometry and statistics: Steven Schwager, 424 Warren Hall, sjs5@cornell.edu

Business: Dale Grossman, 205 Warren Hall, dag14@cornell.edu; Marge Arcangeli, 104 Warren Hall, mfa2@cornell.edu

Communication: Linda Van Buskirk, 309 Kennedy Hall, lpv1@cornell.edu; Brian Earle, 328 Kennedy Hall, boe1@cornell.edu

Crop management: Gary Fick, 507 Bradfield Hall, gwf2@cornell.edu; Sue Murphy, 233 Bradfield Hall, sm17@cornell.edu

Development sociology: Tom Hirschl, 333 Warren Hall, tah4@cornell.edu; Renee Hoffman, 118 Warren Hall, rmh6@cornell.edu

Education: Betty Heath-Camp, 408 Kennedy Hall, bh76@cornell.edu

Entomology: John Losey, 4126 Comstock Hall, jel27@cornell.edu

Environmental and resource economics: Jon Conrad, 455 Warren Hall, jmc16@cornell.edu; Greg Poe, 454 Warren Hall, glp2@cornell.edu; Marge Arcangeli, 104 Warren Hall, mfa2@cornell.edu

Farm business management and finance: Wayne Knoblauch, 358 Warren Hall, wak4@cornell.edu; Marge Arcangeli, 104 Warren Hall, mfa2@cornell.edu

Food industry management: Dale Grossman, 205 Warren Hall, dag14@cornell.edu; Marge Arcangeli, 104 Warren Hall, mfa2@cornell.edu

Food science: Janice Brown, 107 Stocking Hall, jmb14@cornell.edu

Information science: Lindsay Marzano, 303 Upson Hall, minor@infosci.cornell.edu

International studies: Kenna Morehouse, 33 Mann Library, klm3@cornell.edu

Landscape studies: Andrea Hammer, 440 Kennedy Hall, agh24@cornell.edu

Natural resources: Marian Hovencamp, 12 Fernow Hall, mth6@cornell.edu

Nutrition and health, Cha-Sook You, 348 MVR Hall, cy12@cornell.edu

Plant sciences: Peter Davies, 255 Plant Science Bldg., pjd2@cornell.edu

Soil science: Gary Fick, 507 Bradfield Hall, gwf2@cornell.edu; Sue Murphy, 233 Bradfield Hall, sm17@cornell.edu

Early Enrollment in Cornell Graduate Programs

The College of Veterinary Medicine may accept students who are then permitted to double-register in their seventh and/or eighth semester and complete requirements for the bachelor of science degree in the College of Agriculture and Life Sciences. Students should consult with the college registrar, 140 Roberts Hall, to ensure that degree requirements have been fulfilled.

Students who have been offered admission to the S. C. Johnson Graduate School of Management may take management courses in their senior year if approved by their college faculty adviser as part of their undergraduate program. These courses count toward the endowed college credits (maximum 55 without additional tuition charge). Students may consult with the college registrar, 140 Roberts Hall, to verify degree requirements and endowed credits earned.

The Department of Landscape Architecture offers a first professional degree curriculum in landscape architecture at both undergraduate (BSLA) and graduate levels (MLA I), as well as a second professional graduate degree program (MLA II). The curricula for both the undergraduate and graduate programs are accredited by the Landscape Architecture Accreditation Board (LAAB). The graduate program is cosponsored by the Department of Landscape Architecture in the College of Agriculture and Life Sciences and by the College of Architecture, Art, and Planning.

Graduate Fields of Study

Graduate study is organized by fields that generally coincide with the academic

departments but may draw faculty from several disciplines in the various colleges of the university. The following graduate fields have primary affiliation in Agriculture and Life Sciences. Current directors of graduate studies are also listed. For more information on graduate programs, please refer to the Graduate Bulletin, or www.gradschool.cornell.edu/. Information following this list refers to undergraduate studies.

Agriculture and life sciences [M.P.S. (agr.)]: Don Viands, 151 Roberts Hall, drv3@cornell.edu

Agricultural and biological engineering: Dan Aneshansley, 306 Riley–Robb Hall, dja4@cornell.edu

Agricultural economics: David Lee, 248 Warren Hall, drl5@cornell.edu

Animal breeding: John Pollak, B-47 Morrison Hall, ejp6@cornell.edu

Animal science: Richard Quaas, B-47 Morrison Hall, rlq1@cornell.edu

Atmospheric sciences: Dan Wilks, 1113 Bradfield Hall, dsw5@cornell.edu

Biochemistry, molecular, and cell biology: staff, 107 Biotechnology Bldg., dmc18@cornell.edu

Biometry: Marty Wells, 435 Warren Hall, mtw1@cornell.edu

Communication: Bruce Lewenstein, 321 Kennedy Hall, bvl1@cornell.edu

Development sociology: Tom Lyson, 236 Warren Hall, ta12@cornell.edu

Ecology and evolutionary biology: Harry Greene, E251 Corson Hall, hwg5@cornell.edu

Education [also M.A.T.]: Dawn Schrader, 407 Kennedy Hall, des14@cornell.edu

Entomology: staff, 2134 Comstock Hall, fieldofent2@cornell.edu

Environmental toxicology: Andrew Yen, Stocking Hall, ay13@cornell.edu

Food science and technology: Harry Lawless, 106 Stocking Hall, htl1@cornell.edu

Genetics and development: Kenneth Kemphues, 435 Biotechnology Bldg,, kjk1@cornell.edu

Horticulture: Nina Bassuk, 33 Plant Science Building, nlb2@cornell.edu

International agriculture and rural development [M.P.S. (agr.)]: Steven Kyle, 249 Warren Hall, sck5@cornell.edu

International development: Norman Uphoff, 31 Warren Hall, ntu1@cornell.edu

Landscape architecture [M.L.A.]: Dan Krall, 440 Kennedy Hall, dwk5@cornell.edu

M.P.S. agriculture with Peace Corps option (offered by most agriculture fields with M.P.S. programs): Terry Tucker, 16 Warren Hall, or see director of graduate studies for chosen field, twt2@cornell.edu

Microbiology: Stephen Winans, 360A Wing Hall, scw2@cornell.edu

Natural resources: Marianne Krasny, 16 Fernow Hall, mek2@cornell.edu

Neurobiology and behavior: David Deitcher, W125 Mudd Hall, dld14@cornell.edu

Nutritional sciences: Michael Kazarinoff, 230 Savage Hall, mnk1@cornell.edu

Physiology: Mark Roberson, T6-008a Vet Research Tower, msr14@cornell.edu

Plant biology: Thomas Owens, 217 Plant Science Bldg., tgo2@cornell.edu; Robert Turgeon, 256 Plant Science Bldg., ert2@cornell.edu

Plant breeding: Lisa Earle, 514 Bradfield Hall, ede3@cornell.edu

Plant pathology: staff, 309 Plant Science Bldg., mlh2@cornell.edu

Plant protection [M.P.S. (agr.)]: William Reissig, Barton Laboratory, Geneva Campus, whr1@cornell.edu

Soil and crop sciences: Harold van Es, 1005 Bradfield Hall, hmv1@cornell.edu

Statistics: Robert Strawderman, 437 Warren Hall, rls54@cornell.edu

Zoology: John Hermanson, T5002A Vet Research Tower, jwh6@cornell.edu

OPPORTUNITIES IN RESEARCH

Undergraduate Research

A multitude of opportunities to be engaged in research exists across the College of Agriculture and Life Sciences and the university.

Students may be able to work on a faculty member's research project for pay. Opportunities can be explored by contacting individual faculty members; departmental offices; the CALS Career Development Office, in 177 Roberts Hall; or Cornell Career Services, in 103 Barnes Hall. Another option is to receive credit through a 499-level course within a department by conducting your own research project under a faculty mentor. More than 600 students each year conduct research for credit. Upperclass students usually have the course background to engage in research, but freshmen and sophomores also may be equipped to do some types of research. Off-campus research experiences are also available for pay or as internships.

The following web sites provide information about research and internships:

CALS Career Development Office:
cals.cornell.edu/Careers.cfm

CALS Undergraduate Research Opportunities:
cals.cornell.edu/CALSUndergraduate_Research_Opportunities.cfm (information on how to explore research opportunities)

CALS Research Honors Program:
cals.cornell.edu/CALS_Research_Honors_Program2.cfm

CALS Undergraduate and Graduate Student Grants Proposal Development:
cals.cornell.edu/undergraduate_and_Graduate_Grants.cfm

CALS Undergraduate Minority Research:
cals.cornell.edu/undergraduate_Minority_Research.cfm

CALS Internship Guidelines:
cals.cornell.edu/Internship_Guidelines.cfm

Undergraduate Research @ Cornell:
www.research.cornell.edu/undergrad/

Cornell Undergraduate Research Board:
www.rso.cornell.edu/curb/ (student organization to promote and facilitate undergraduate research)

Biological Sciences:
www.bio.cornell.edu

Research Honors Program

The Research Honors Program provides students with a special opportunity to work with a faculty mentor to experience the research process. Successful completion of this program requires a thesis written in the style of a master's thesis or professional journal article in that area of research. Original honors research may be published in a professional journal. Students are required to send an electronic version of their thesis title, abstract, student's name, and the research adviser's name to Ann Gantner, amg28@cornell.edu, by the end of the spring semester. In addition to copies of the entire thesis requested by the program area, one copy is required by the Office of Academic Programs (140 Roberts Hall). This copy is made available in Mann Library. Students may volunteer to publish their theses in the Internet-First University Press if it does not interfere with other plans, such as patenting or publishing in another journal. During the summer of each year, the *CALS Research Honors Abstracts* is published as a compilation of abstracts of the honors theses.

The bachelor of science degree with "distinction in research" is conferred upon those students who, in addition to having completed the requirements for the B.S. degree, have satisfactorily completed the honors program in their area of major interest and have been recommended for the degree by the honors committee of that area.

Research may be done under the appropriate program area: animal sciences, biological sciences, biology & society, entomology, information science, landscape studies, natural resources, nutritional sciences, physical sciences, plant sciences, and social sciences. Each program area has its own requirements in addition to the college requirements. After reviewing the requirements of each program area (below), students' questions may be directed toward the appropriate program area chair.

Consult "Undergraduate Research Opportunities" on the web (cals.cornell.edu/CALSUndergraduate_Research_Opportunities.cfm) for information about identifying a research topic, conferring with a faculty member, and undergraduate funding opportunities.

Honors Program Requirements

An undergraduate wishing to enroll in the honors program must have completed at least 55 credits, at least 30 of those 55 at Cornell. In addition, the student must have attained a cumulative Cornell GPA of at least 3.0 (unless otherwise noted by a particular program) at the time of entry.

Interested students must make written application to the CALS Registrar's Office no later than the end of the sixth week of the first semester of their senior year, but are encouraged to make arrangements with a faculty member during the second semester of their junior year (or earlier if required by the program area). Earlier application deadlines to program area committees are noted in

the sections below. For most of the program areas, an application form is available from the college registrar in 140 Roberts Hall. The application form also can be printed from the web at www.cals.cornell.edu/CALS_Research_Honors_Program2.cfm. Applications for biological sciences students can be picked up at 200 Stimson Hall, and for biology & society students at 306 Rockefeller Hall.

Before the completed application is returned to the college registrar, signatures of approval are required in the following order: faculty research mentor, academic adviser, and the research honors program area chair. After the college registrar verifies the student's GPA, the student will be officially enrolled in the honors program. Additional requirements for application and completion of the program are described under each particular program area.

Academic credit also may be earned by enrolling in an appropriate independent research course (required by some program areas). When applying for admission to the program, the student may, if appropriate, submit a budget and a modest request for funds (up to $350) to cover some of the costs incurred in doing the research. If approved, the funding will be transferred from an account in the CALS Office of Academic Programs to a departmental account of the student's research adviser to support the student's research. This funding is not to be used as a student salary. Additional funding opportunities are described at cals.cornell.edu/CALSUndergraduate_Research_Opportunities.cfm.

Unless otherwise indicated in the following program area descriptions, the research report in the form of a thesis or journal article should be submitted to the research program committee no later than four weeks before the end of classes of the semester in which the student expects to graduate. Students in the College of Agriculture and Life Sciences wishing to participate in the Research Honors Program must be accepted in one of the program areas approved by the faculty. Students are not eligible for distinction in research by participating in a program offered by another college or administrative unit.

The research honors committee for each program area recommends to the college registrar those students who qualify for honors. Only those who maintain a GPA of at least 3.0 will be graduated with "distinction in research."

At or near the completion of their research, students are required to give an oral presentation or poster session during any event at Cornell. Some departments have seminar series when presentations may be given. The Cornell Undergraduate Research Board (CURB) Forum is another venue for presentations.

For more information, go to www.cals.cornell.edu/CALS_Research_Honors_Program2.cfm.

The following are the honors program areas:

Animal Sciences

Faculty committee: S. M. Quirk, chair; Y. R. Boisclair, J. R. Giles, J. Gavalchin, P. A. Johnson, T. R. Overton

The objective of the animal sciences research honors program is to provide outstanding undergraduates with the opportunity to pursue supervised independent research and to develop an awareness of the scientific process. It is expected that the research will require significant effort and creative input by the student in its design and execution and in the reporting of the results.

Those students with majors in animal sciences who are interested in doing a research project should consult with their faculty advisers by their junior year. All students are expected to meet the college requirements in qualifying for the program and to complete the following:

- Identify a potential research honors project sponsor (i.e., a faculty member working in the animal sciences) and secure that faculty member's commitment to sponsor the student in the research project. This should be accomplished by the second semester of the junior year. Students are encouraged to implement some research during the junior year and/or summer before the senior year.
- Register for AN SC 499 Undergraduate Research.
- Participate in AN SC 402 Seminar in Animal Sciences, during the spring semester and report on and discuss the project and results.
- Submit a written thesis to the Animal Sciences Research Honors Committee by the scheduled deadline. Specific information regarding deadlines, format, and organization for the thesis will be provided.
- Meet with the Animal Sciences Research Honors Committee for a short oral defense of the thesis following a review of the thesis by the student's sponsor and the research committee.

Details pertaining to the specific requirements of the program can be obtained from the administrative office of the Department of Animal Science, 149 Morrison Hall.

Biological Sciences

Students interested in the Research Honors Program in the biological sciences should consult with their faculty advisers and with potential faculty research sponsors early in their junior year. See "Independent Research and Honors Program" in the Biological Sciences section of this catalog for complete details. Information on faculty research, applications, and program requirements may be obtained from the Office of Undergraduate Biology, 216 Stimson Hall.

Biology & Society

Faculty committee: D. Pimentel, chair

The Research Honors Program in Biology & Society is designed to provide independent research opportunities for academically talented undergraduate students in biology & society. Students who enroll in this program are expected, with faculty guidance, to do independent study and research dealing with issues in Biology & Society. Students participating in the program should find the experience intellectually stimulating and rewarding whether or not they intend to pursue a research career.

Biology & Society students are considered for entry into the research honors program at the end of the second semester of the junior year. Application forms for the program are available in the Biology & Society office, 306 Rockefeller Hall. To qualify for the Biology & Society Research Honors Program, a student must have an overall Cornell cumulative GPA of at least 3.3, have formulated a research topic, and have found a project supervisor (with a Cornell academic appointment) and a Biology & Society faculty member willing to serve as his or her adviser. The director of undergraduate studies will appoint a third reader of the completed research thesis. Applications will be reviewed by a committee headed by the director of undergraduate studies, who will notify students directly of the outcome. Students will be permitted to register for the research honors program only by permission of the biology & society program. Students must enroll for two semesters for 8 credits each in B&SOC 499, Honors Project I and II. More information on the honors program is available in the Biology & Society office, 306 Rockefeller Hall (255-6047).

Important Deadlines

Note: If the following dates fall on a weekend, the deadline is the preceding Friday.

- Last week of second semester of the junior year: Application for honors program submitted to 306 Rockefeller Hall.
- April 14: Thesis completed in a form satisfactory for evaluation and submitted to the three readers.
- April 28: Thesis defense accomplished.
- May 12: One bound copy of completed and defended thesis submitted to director of undergraduate studies.

Entomology

Faculty committee: J. Ewer, chair

The Program. A research honors program in entomology may be pursued by any qualified student in the College of Agriculture and Life Sciences. The student need not be specializing in entomology. Insects, because of their variety, small size, and easy availability, are convenient subjects for studying a wide array of problems dealing with living systems. Short life cycles, unique physiologies and developmental patterns, and species with easily managed colony requirements and a wide range of behavioral traits provide the raw material for research honors study. Cornell's diverse faculty interests and extensive collections and library in entomology are also major assets if a student selects entomology as the area for research honors study.

Prerequisites. An undergraduate wishing to enroll in the research honors program must have completed at least 55 credits, at least 30 of the 55 at Cornell. In addition, the student must have attained a cumulative GPA of at least 3.0 at the time of entry and maintain this GPA to graduate with distinction in research. The CALS registrar will verify GPAs of applicants before officially enrolling them in the research honors program. Research honors students have the option of earning academic credit by enrolling in ENTOM 497 Independent Study during any semester while working toward a research honors thesis. Credits and grade option for satisfying requirements of ENTOM 497 should be

discussed with the thesis adviser (following page.)

Note: Enrolling in independent study is not a requirement for graduating with distinction in research honors in entomology.

Sequence of Requirements The Entomology Research Honors Committee requires that an undergraduate who is interested in embarking on a research honors project proceed with the following steps:

1. Discuss the matter with his or her academic adviser, preferably in the junior year. This schedule makes it possible to carefully plan a research project and implement some research during the junior year and/or summer before the senior year.
2. Select an appropriate faculty member in the Department of Entomology who can serve as a supervisor to oversee the honors research. This need not be the student's academic adviser. The academic adviser will be of assistance in determining which faculty entomologist has expertise most compatible with the interests of the student.
3. Prepare a brief, tentative plan for the project for discussion and approval of the honors project supervisor. The plan should include a statement of objectives or hypotheses, proposed methods for testing hypotheses, needs for laboratory space or shared equipment, and a budget outlining financial support needed for travel and supplies.
4. Submit a completed application and proposal (approved by the honors project supervisor and the chair of the Entomology Research Honors Committee) no later than the end of the sixth week of the first semester of the senior year. Earlier submission is encouraged. Applications are available and should be submitted to the CALS registrar, 140 Roberts Hall. These applications include an opportunity to request a modest amount of funding from the CALS honors program. These funds are distributed only one time per year (in late fall).
5. Submit a brief progress report, approved by the project supervisor, to the Entomology Research Honors Committee by midterm of the semester in which the student will complete his or her graduation requirements.
6. Present a formal seminar reporting the significant findings of the research to the Department of Entomology (as a Jugatae seminar) in the last semester of the senior year.
7. Submit two copies of the final honors thesis (as approved by the thesis supervisor) to the chair of the Entomology Research Honors Committee no later than two weeks before the last day of classes in the semester in which the student anticipates graduation. The thesis will be reviewed by the faculty honors project supervisor and one other referee selected by the chair of the honors committee.
8. Referees will return the thesis to the student one week before the last day of classes. If reviewers indicate that changes must be made, the revised thesis should be submitted to the Entomology Research Honors Committee chair no later than the last day of classes. Referees should include a recommendation to the Entomology Research Honors Committee chair regarding acceptability of the honors thesis. The approved honors theses will be bound and housed in the Entomology Library in Comstock Hall.

The complete text of this section can be found at: www.entomology.cornell.edu/Undergrad/EntomHonors.shtml.

Information Science

Students should follow the CALS social sciences guidelines to obtain research honors in information science.

Landscape Studies

Faculty committee: K. Gleason, chair

The research honors program in landscape studies offers outstanding undergraduates in CALS the opportunity to work with a member of the landscape architecture faculty to pursue supervised independent research in design, the cultural landscape, landscape archaeology, environmental design, and community-based planning and design. The student need not be a major in the landscape architecture professional design curriculum. The subject matter and nature of the research experience may be quite varied. Students participating should find the experience intellectually stimulating and rewarding, whether or not they intend to pursue a research career. The guidance and supervision of a faculty member with substantial interest and expertise in the subject is essential to the success of the project. It is expected that the research will require significant effort and creative input by the student in its design and execution and in reporting the results.

Students who consider this option should be aware that honors research is undertaken above and beyond any of the requirements for graduation in the major of landscape architecture. It involves a number of deadlines and a considerable time commitment. Before signing on for research honors, students need to consult with their academic adviser to make sure that honors research projects will not interfere with other academic or professional objectives, such as job applications, preparation of portfolios, or application to graduate school. These may need to be deferred until the thesis is complete. Students are responsible for meeting deadlines and being prepared for presentations and other meetings.

Although honors research credits for spring semester junior year and both semesters senior year are designated a letter grade, individual mentors may choose the R grade for work in progress until the project has been fully completed. Grade is determined by each student's mentor. The designation of "distinction in research" on the diploma is awarded at the recommendation of the faculty adviser and other referees to the honors committee chair. An outline of activities for both years is given below.

The Landscape Studies Research Honors Committee requires that an undergraduate who is interested in embarking on a research honors project proceed with the following steps:

1. Junior year: Identify a potential research honors project sponsor and secure that faculty member's commitment to sponsor the student in the research project. This should be accomplished early in the second semester of the junior year and be finalized by the end of the spring semester. Pre-register during the spring for the research honors program (LA 499).
2. Work with a faculty adviser to identify and formulate a research problem. If the faculty adviser is not in the Department of Landscape Architecture, select a co-adviser from the department to ensure that the research is consistent with the field.
3. Submit a completed application and proposal (approved by the honors project supervisor and the chair of the research honors committee) no later than the end of the fourth week of the first semester of the senior year. Earlier submissions are encouraged. These will be reviewed by ad hoc committee members, and successful thesis proposals will be submitted to the college honors committee by the sixth week.
4. Carry out an independent research effort that is original and separate from the work of others who may be investigating similar subjects.
5. Submit an outline of the thesis to the chair of the committee by the end of January for a May graduation.
6. Submit a draft to the readers by April 15. Describe and summarize the work within the range of formats used in the master's thesis program or professional journals in design or research. This version will be reviewed by the faculty supervisor and two *ad hoc* reviewers, and the student will be able to incorporate the committee's comments and suggestions into the final version, which will be due the last day of classes. Referees prepare a recommendation to the honors committee chair regarding the acceptability of the honors thesis.
7. Give two oral presentations to the group of other honors research students and invited faculty members. Both presentations are during the student's senior year.
8. Send two bound copies of the completed and defended thesis to the honors committee chair by May 13. These copies are in addition to the unbound copy required for Mann Library. A 250-word abstract must be provided electronically to the CALS Office of Academic Programs and must appear at the front of the thesis (see "CALS Requirements for Honors Thesis").

Natural Resources

Faculty director: J. B. Yavitt, chair

The research honors program in natural resources involves original, independent research that generates novel findings in applied ecology and resource policy and management. Students learn how to design and carry out research under the direct supervision and guidance of a faculty member or senior research associate in the department. Most students in the program begin their research before the start of the senior year, often in the summer after their junior year. Students may enroll and receive credit in independent study (NTRES 494) during their honors research. The research findings are

presented in a written thesis that is reviewed by two experts in the field. Many theses have been published in leading journals in the disciplinary area of the research. Although the format is not prescribed, the thesis usually consists of a short introduction, relevant materials and methods, a concise presentation of the meaningful data, a discussion, and the student's interpretation of the conclusions. Students also give an oral presentation of their research findings in a special symposium hosted by the department in early May.

Students should adhere to the following schedule.

Junior Year

1. File an informal application with the program director. The application includes a project description and adviser information.

Senior Year

1. Sixth week of fall semester: Submit formal application.
2. March 30: Thesis should be close to completion.
3. April 13: Submit two copies of the thesis to the program director for *ad hoc* reviews.
4. April 29: Pick up *ad hoc* reviewers' comments from the program director.
5. May 13: Submit two copies of the final thesis: one for the college, one for the program director.
6. Week of May 24: Students are notified.

Nutritional Sciences

Faculty committee: J. T. Brenna, C. Bisogni

The research honors program in the Division of Nutritional Sciences is a structured experience that involves (1) taking a course in research (NS 398), (2) conducting a research project through which the student becomes intellectually engaged in the whole research process, (3) completing a written thesis that reports the research, and (4) giving an oral presentation of the project at the undergraduate honors symposium. Students must maintain a minimum grade point average to graduate with honors in research.

The research honors program is an excellent opportunity for students who are highly interested in research and wish to commit substantial time and intellectual energy to a project that will span at least four semesters of their undergraduate experience. Honors students experience the excitement of designing a project to generate new knowledge on a topic that interests them and reporting the project findings. By working with faculty mentors and other researchers, they develop skills in research methods and data analysis. Students also learn that research projects are labor intensive and that writing research reports, such as the honors thesis, is a vital, but time-consuming, aspect of the research process. This intensive research experience is not suitable for all students, and those who wish a less intensive research experience may conduct research with a faculty member under NS 401.

Students interested in the program should take NS 398 as early in their program as possible. Students may review program requirements at the NS 398 web site or contact the program directors. Acceptance into the research honors program occurs when the student (1) is accepted into a faculty member's research program and (2) submits a research proposal abstract that is approved by the directors of the research honors program.

Students interested in the program typically spend the spring sophomore semester and fall junior semester exploring honors project opportunities with prospective faculty mentors. Students are responsible for contacting faculty members and applying to their research programs, although some guidance in this process will be provided in NS 398. By the fall of the junior year, the student is expected to have identified their faculty member and be working with him/her on a proposal abstract, which is due early in the spring junior semester.

Students receive academic credit for work on their honors project under NS 499. The 6 required credits may be taken over several semesters. How much time is spent on the project each semester will be the decision of the student and the faculty mentor. For each three to four hours of work per week, the faculty mentor usually will assign one hour of academic credit. This applies to the preparation of the research plan and necessary library research (usually completed during the junior year) as well as the carrying out of the research itself and preparation of the thesis.

The research honors project is the major component of the research honors program. It should be well defined and sufficiently circumscribed to give the student the opportunity to develop the research plan, execute the research, and write an acceptable thesis within the limited time available to students carrying full academic loads. Typically, the project is designed early in the junior year and conducted in the spring junior semester and fall senior semester. Students may arrange with their faculty mentor to work on the project during the summer. The spring senior semester is usually devoted to writing the thesis (at least 25 pages). The student works with the faculty mentor to prepare a draft of the thesis, which is submitted before spring break to a second faculty member for evaluation. When comments are received from the reader, the student must revise the thesis to meet the criteria for acceptance. The student presents the thesis at the Honors Student Symposium at the end of the semester.

Physical Sciences

Faculty committee: A. T. DeGaetano, chair; S. J. Mulvaney, C. D. Bustamante

The research honors program in physical sciences provides outstanding students with an opportunity to do independent research under the supervision of a faculty member in the Departments of Biological and Environmental Engineering, Food Science, Earth and Atmospheric Sciences, or Biological Statistics and Computational Biology.

In addition to meeting the requirements of the college, the student is expected to:

1. Identify a thesis adviser and thesis topic before the end of the junior year.
2. Work with the thesis adviser to prepare a budget and application form (due by the sixth week of senior year).
3. Enroll in the program for a minimum of two semesters.
4. Enroll in the appropriate departmental undergraduate research course for a total of at least 6 credits.
5. Submit an outline of the thesis to the chair of the committee by the end of January (for a May graduation).
6. Submit a draft of the thesis to the thesis adviser with sufficient lead-time for a revision to be prepared.
7. Submit three copies of the thesis and names of recommended reviewers to the chair of the honors committee by four weeks before the end of classes in the semester in which graduation is expected.

There is no required format, but the thesis is usually written in the form of a research journal article or a master's thesis.

Further details of the program can be obtained from the chair of the Physical Sciences Research Honors Committee.

Plant Sciences

Faculty committee: R. L. Obendorf, chair; I. A. Merwin, E. B. Nelson, F. S. Rossi, A. DiTommaso, M. E. Smith-Einarson

Students perform independent scientific research under the guidance of faculty members in the fields of horticultural, agronomic, and soil sciences; plant biology; plant genetics and breeding; and plant pathology. For admission to the program, students must meet college requirements and submit to the Plant Sciences Research Honors Committee a project proposal (two to three pages) that includes a title; a brief background of the problem (justification and literature review); a clear statement of objective(s) and hypotheses to be tested; methodology and experimental plan, necessary space, equipment and supplies; and a project budget. The proposal must be accompanied by a letter from the faculty supervisor stating that he or she has approved the project plan and that its completion within the remainder of the student's undergraduate tenure is feasible.

A brief progress report will be made to the committee usually during the third week of the spring semester. Research presentations are recommended (e.g., Cornell Undergraduate Research Board Spring Forum, department seminars, professional meetings).

Successful completion of the research honors program requires acceptance by the honors committee of two copies of a research report. The report should be written in the format of a research publication in the appropriate scientific field. The acceptable report must have been reviewed and corrected according to the recommendations of the research supervisor before the report is submitted to the honors committee. The report must be received by the honors committee at least two weeks before the last day of classes of the semester in which the degree is sought and must be accompanied by a letter from the research supervisor evaluating the research and, if appropriate, recommending graduation with distinction in research.

The research honors committee will review the report within one week and may accept it or return it to the student with specific recommendations for revisions. A suitably revised version must be submitted to the committee before the second day of the

examination period. When the committee accepts an honors report, the chair will recommend to the associate dean and director of academic programs and to the college registrar that the student be graduated with distinction in research. One copy of the accepted report will be returned to the student with review comments from the committee.

Additional guidelines may be found at www.css.cornell.edu/Programs/PlantSciHon/.

Social Sciences

Faculty committee: J. B. Walther, chair; J. D. Francis, N. Chau, S. C. Piliero

Research projects in this program area include applied economics and management, communication, development sociology, education, and information science. Students are accepted into the social sciences research honors program of the College of Agriculture and Life Sciences after meeting all the college criteria described above, after evaluation of the student's written application, and on approval of a detailed thesis proposal. The application and proposal are due to the program area chair no later than the third week of the first semester of the senior year. Each student is encouraged to begin working on this proposal with a prospective faculty thesis adviser during the junior year. The purpose of the proposal is twofold. First, it formalizes a plan of study and establishes a set of expectations between the student and his or her faculty adviser. Second, the honors committee reviews the proposal to determine whether it is consistent with honors thesis requirements and to make suggestions for improvement.

The proposal should be 5 to 10 typed, double-spaced pages and include the following:

1. **Research Topic:** State the problem to be studied or the topic of interest. Review the basic literature and the background of the problem or topic; include a more extensive bibliography to be consulted.
2. **Research Questions/Empirical Hypotheses:** Specify the proposed questions to be answered or hypotheses to be tested empirically via collection of data and a mode of analysis accepted in the social sciences.
3. **Research Methods:** Discuss the models to be constructed (if any), sampling procedures, data collection procedures (including measurement instruments and survey or experimental designs, if appropriate), and proposed methods of analysis.
4. **Expected Significance:** State what new knowledge or information is likely to be forthcoming and why it is important. State any practical applications expected as a result of the research.

Faculty advisers must be members of the graduate faculty. Exceptions may be granted for persons with special expertise who are deemed capable of thesis supervision; exceptions may be granted pending petition to the Social Science Honors Committee. Students should register for honors credit directed by the faculty research honors project adviser.

Distinction in research is awarded upon approval of the research honors thesis by the Social Science Research Honors Committee. The research should deal with a substantive issue in one of the fields in the social sciences. Both the results of the research and the methodology (or the logical argument by which the results were achieved) must be reported. Reviews of the literature, practical conclusions or applications, or broad characterizations of an area of inquiry may constitute part of the research report but are not themselves sufficient to count as research.

Honors theses should be written according to the form of any standard journal within the appropriate field. We recommend the submission of the thesis draft to the student's research adviser by the beginning of the month two months before graduation, for revision suggestions. Two copies of the thesis must be submitted to the chair of the social science committee no later than the middle of the second-to-last month before graduation (i.e., April or November). A supporting letter from the faculty member supervising the work also must be submitted. The thesis will be independently reviewed and further revisions may be required before the thesis is accepted. Final approval of the thesis requires a majority vote of the honors committee.

OFF-CAMPUS OPPORTUNITIES

Study off campus is of two types: (1) credit may be earned at another institution and transferred to Cornell, or (2) credit may be earned in Cornell courses that require off-campus activity.

Students who plan to enroll in courses at another institution in the United States must petition for a leave of absence. Courses should be selected in consultation with the faculty adviser. Please also see transfer credit policies under non-Cornell credit policies. Information about enrolling at another institution outside of the United States can be found under "Study Abroad."

Albany Programs

Study off campus in Albany, the New York State capital, provides a unique opportunity to combine career interests with academic and legislative concerns. Two formalized opportunities are available. The Assembly Intern Program is offered in the spring semester and provides placement with a staff member of the New York State Assembly. The Senate Assistants Program also occurs during the spring semester and has placements with New York State senators and selected staff. Each program has an academic component as well. Check the individual folders in the internship files in the CALS Career Development Office, 177 Roberts Hall.

Applications are collected and processed by the CALS Career Development Office, 177 Roberts Hall, in the semester before assignments. Those accepted should plan a program of study in consultation with their faculty adviser. At least 12 credits must be carried to meet the residency requirement. To receive academic credit for the internship, students enroll in ALS 400 for an S-U grade only.

Information and applications are available in the CALS Career Development Office, 177 Roberts Hall.

Cornell in Washington

The Cornell in Washington program offers students from all colleges in the university an opportunity to earn full academic credit for a semester in Washington, D.C. Students take courses from Cornell faculty members, conduct individual research projects, and work as externs. Students take part in a public policy or humanities seminar, serve as externs in federal agencies, congressional offices, or nongovernmental organizations, and carry out individual research projects under the supervision of Cornell faculty members. The required externships and all course enrollments are arranged through, and approved by, the Cornell in Washington program. Students in the College of Agriculture and Life Sciences must register for ALS 500 and cannot receive credit for the externship experience alone. For further information, see p. 22, inquire at M101 McGraw Hall, 255-4090, or visit ciw.cornell.edu.

SEA Semester

The Sea Education Association is a nonprofit educational institution offering ocean-focused academic programs and the opportunity to live, work, and study at sea. Science, the humanities, and practical seamanship are integrated in small, personal classes. The 17-credit program is 12 weeks in length. Six weeks are spent in Woods Hole, and the following six weeks are spent on either one of SEA's two sailing vessels: the *SSV Robert Seamans* or the *SSV Corwith Cramer.* For more information, contact the Cornell Marine Programs office, G14 Stimson Hall (255-3717) or visit www.sea.edu. CALS students should file an intent to study off campus form with the college registrar as early as possible to ensure proper registration and enrollment in courses.

Shoals Marine Laboratory (SML)

The Shoals Marine Laboratory, run cooperatively by Cornell University and the University of New Hampshire, is a seasonal field station located on 95-acre Appledore Island off the coast of Portsmouth, N.H., in the Gulf of Maine. SML offers undergraduates and other interested adults a unique opportunity to study marine science in a setting noted for its biota, geology, and history. Please refer to "Courses in Marine Science," in the section on the Office of Undergraduate Biology, for a list of courses offered.

For more information, contact the Shoals Marine Laboratory office, G14 Stimson Hall, 255-3717, or visit www.sml.cornell.edu.

Internships

Several departments in the college offer supervised internships for academic credit. Internships may be granted for pay and/or credit with a limit of up to 3 credits per internship and no more than 6 credits total allowed for internships consisting of off-campus work experiences that do not have the continued presence of a Cornell faculty member. The number of credits awarded should reflect the amount of knowledge gained per internship and/or following the CALS guidelines for assigning credits. The 6-credit allotment includes transfer credit and credit from other internships in other colleges at Cornell. The 6-credit limit does

not apply to secondary, post-secondary, and Cooperative Extension teaching internships in the Department of Education. The awarding of credit will not be allowed in cases where a student brings to the college or to a professor a description of a past experience and requests credit. Note that a maximum of 15 (prorated for transfer students) of the 120 credits required for the degree may be taken in internships, independent study courses, and undergraduate teaching or research. For internships not governed by an established internship course, the student must enroll in a 497-level course for the number of credits assigned.

To ensure a fair and manageable system to deal with internships, the College of Agricultural and Life Sciences has set forth guidelines to serve as minimum requirements for a student to receive internship credit.

1. Credit will be assigned or accepted only in cases in which a Cornell faculty member is directly involved in determining both the course content and in evaluating the student's work.
2. The internship should be purposeful, provide opportunities for reflection, present a continual challenge to the student, and incorporate active learning, with the student an active participant in all stages of the experience from planning to evaluation.
3. Before a student begins the internship, a learning contract needs to be written between the Cornell faculty internship adviser on campus, the supervisor at the location, and the student. This contract should state the conditions of the work assignments, supervisor, learning goals, number of credits, and methods of evaluation of the work. A contract form can be obtained from the college Registrar's Office, or departments may have their own.
4. Students should further develop the internship experience based on the college Experiential Learning Criteria, which can be found on the web at cals.cornell.edu/Experimental_Learning_Report.cfm.
5. Students need to keep their faculty internship adviser updated on the progress of the internship while away from campus.

Arrangements should be made with the offering department for assignment of a faculty mentor for planning the program of work, and for evaluating student performance. Individual departments may add more requirements to the internship based on specific needs such as time constraints, faculty workloads, and the relationship of the internship to the goals of the department. The specific terms of the contract should be recorded, using the independent study, research, teaching, and internship form, available in the Registrar's Office in 140 Roberts Hall.

Study Abroad

Each year about 200 CALS undergraduates spend an academic year or semester studying abroad. Whether attending a large university in Australia, a smaller campus in Sweden, or a technical school in Singapore, CALS students have a variety of international study options available to them. They can choose from:

- a CALS exchange program in Austria, Australia, Brazil, Denmark, Mexico, Netherlands, New Zealand, Singapore, Sweden, Switzerland or the United Kingdom;
- a study abroad program through the Cornell Abroad office;
- an international study tour as part of a CALS course, or a summer program designed especially for CALS students.

CALS exchange programs are unique agreements created with other prestigious universities around the world. CALS students participating in an exchange program pay only their Cornell tuition, with no additional administrative fees. To learn more about the exchange programs, please visit: www.cals.cornell.edu/Study_Abroad__Exchange_Index.cfm/ or e-mail exchange coordinator Bonnie Shelley, brs9@cornell.edu.

Study abroad opportunities offered through the Cornell Abroad office are vast, ranging from a traditional university in London to field study in Africa. For information about specific programs, costs and more, visit their office in 300 Caldwell Hall or go to www.cuabroad.cornell.edu/.

Whether on a CALS exchange or going through Cornell Abroad, all CALS students interested in studying abroad must receive approval from their faculty adviser and meet with the college study abroad adviser to review the college policies and to receive college approval. College policies can be viewed at: www.cals.cornell.edu/College_Policies.cfm.

Study abroad advising hours are held in 140 Roberts Hall on Tuesdays and Thursdays, 9:00 A.M. to 12:00 p.m. and Wednesdays 1:00 to 3:00 P.M.

Ithaca College and Wells College Exchange Programs

The Cornell University–Ithaca College Exchange Program is a reciprocal arrangement between Cornell University and Ithaca College that allows matriculated full-time students with prior approval and within stated stipulations, to cross-register at the other institution. No additional tuition is charged except in the case of undergraduate students enrolled during any one semester for a total of more than 18 credits (Cornell and Ithaca College combined). Those students are subject to additional tuition charges on a per-credit basis. This arrangement is available during the fall and spring semesters only, and is contingent upon space availability. A maximum of 12 credits may be taken through this program.

Cornell University also has a reciprocal arrangement with Wells College in Aurora, N.Y. For further information, contact the Cornell School of Continuing Education office, B20 Day Hall, 255-4987, or on the web at www.sce.cornell.edu/exmu/.

GRADUATION REQUIREMENTS FOR THE BACHELOR OF SCIENCE

Graduation Requirements

1. **Credit Hours**

a. Minimum: 120

Exceptions:

- Credit for review or supplemental courses (MATH 109, EDUC 005, and 00 level) **increases** the number of credits required for graduation by the number of credits in the course. The credits **do** count toward the minimum 12 credits for full-time status.
- Credit for repeated courses **increases** the number of credits required for graduation by the number of credits in the course. The credits **do** count toward the minimum 12 credits for full-time status.

b. Minimum at Cornell: **60** academic credits; maximum non-Cornell credits: **60.**

c. Minimum from College of Agriculture and Life Sciences: **55** (includes credit used in the distribution and appropriate transfer and AP credit). CALS credit includes courses from departments within CALS, and Biological Sciences, Earth and Atmospheric Sciences, Information Science, and Nutritional Sciences.

d. Maximum from endowed colleges (Arts and Sciences; Architecture, Art, and Planning; Engineering; and Hotel School) without additional tuition charge: **55** (includes credit used in the distribution *and* failed courses). Summer session courses taken in endowed colleges do not count.

e. Minimum with letter grade: **100** (prorated for transfer students). Freshmen are limited to one optional S-U course per semester.

f. Maximum independent study, research, teaching experience, internships based on 120 credits: **15** (prorated for transfer students).

g. Freshmen may not enroll in more than 18 credits, not including physical education.

h. Credit for physical education *does not* count toward the 120 credits or the minimum 12 credits for full-time status (see #6).

2. **Residence**

a. Students are entitled to enroll eight full-time semesters (prorated for transfer students). A full-time semester requires a minimum of 12 credits per semester (*not* counting physical education.) Review or supplemental courses and repeated courses [see #1a] *are* counted.

b. A minimum of seven semesters is expected; graduation in fewer than seven requires an application. Transfer students are credited with one semester in residence for each 15 credits from another institution.

c. Internal transfer students must be enrolled in CALS for at least two semesters, **not** including residency in Internal Transfer Division.

d. The final semester before graduation **must** be in residence at Cornell as a full-time student in good academic standing.

Exception: Students with 8 or fewer credits remaining for graduation and with circumstances that prevent full-time study may apply to complete remaining credits at another institution or prorated in CALS. An application must be submitted the semester before graduation. Contact the CALS Registrar's Office (140 Roberts Hall) for additional information.

3. **Grade Point Average (GPA)**

A cumulative GPA of 2.00 or above must be maintained. This requirement includes all grades earned at Cornell.

For students who matriculated before 8/01: A cumulative GPA of 1.70 or above must be maintained. This requirement includes all grades earned at Cornell.

4. **Distribution**

The purpose of the distribution requirement is to provide a broad educational background and to ensure a minimum level of competency in particular skills. Through study of the physical and life sciences, students develop their understanding and appreciation of the physical sciences, enhance their quantitative reasoning skills, and gain an appreciation of the variability of living organisms. The social sciences and humanities give students perspective on the structure and values of the society in which we live, and prepare them to make decisions on ethical issues that will affect their work and role in society. Written and oral expression is designed to help students become competent and confident in the use of oral and written communication to express themselves and their ideas.

Credits received for independent study, field, teaching, research, work experience, and internships cannot be used to fulfill the distribution requirement. Courses judged to be review or supplemental in the discipline, such as MATH 109, EDUC 005, and 00 level, will not be counted.

Physical and Life Sciences. 18 credits in at least three disciplines of which 6 credits must be introductory biology and 3 credits in chemistry or physics.

Introductory Biology: BIO G 101–104, 105–106, 107–108, or 109–110

CHEM

PHYS

Other Physical and Life Sciences

AN SC 100, 110, 112, 215, 221, 280, 300, 301

AEM 210

ALS 115

ASTRO

BEE 454, 456, 458, 459

Biological Sciences (except BIO G 200, 299, and 499 [unless permission of the director of undergraduate biology is obtained], BIO G 209, BIO G 498, BIONB 431, and BIOSM 204)

BTRY/Statistics

CSS 190, 260, 311, 312, 315, 317, 366, 414, 415, 455, 473, 483

EAS (except 121, 150, 420)

EDUC 115

ENTOM 201, 210, 212, 215, 241, 260, 277, 315, 325, 344, 369, 370, 455, 463

FD SC 200

HORT 220, 243, 317, 400, 426, 440, 445, 449, 455, 460

IARD 414

ILRST 210, 310

MATH*

NS 115, 222, 262, 320(300), 331, 332, 341, 347, 361, 431, 441, 452

NTRES 210, 310, 313, 314, 322, 323, 326, 413, 420

PL BR 201, 225, 401, 402, 403, 404

PL PA 201, 309

* The college mathematics requirement is described below.

Social Sciences and Humanities. 12 credits (6 in each of the following two categories):

Social Sciences. 100- through 400-level courses in the following departments (*excluding* first-year writing seminars):

AEM 341, 416

AIS 230, 235, 311, 340, 348, 353, 435, 472

ALS 481

ANTHR

ARKEO

BIONB 208

COMM 116, 120, 310, 410, 418, 420, 422

ECON (except 175, 318, 325, 333, 442)

EDUC 271, 317, 370, 378, 411, 451, 471

GOVT

HD 150/250 (cannot receive credit for this course and SOC 151 or 251)

HORT 235

INFO 356

LA/CRP 260, 261, 263

NTRES 331

PSYCH (except 111)

S&TS 324, 350, 390, 391, 400, 401, 402, 406, 407, 412, 425, 427, 431, 442, 467, 483

SOC

Humanities. 100- through 400-level courses in the following departments (*excluding* first-year writing seminars and language courses):

AS&RC (literature and history)

AIS (except 230, 235, 311, 340, 348, 353, 435, 472)

AAS

ASIAN (literature and history)

CLASS (literature and history)

COM L

D SOC 442

EDUC 473

ENGL (literature only)

FGSS 444

FRLIT, GERST, ITALL, RUSSL, and SPANL (literature only)

HIST

ART H

LA 140, 155, 266, 282, 483

MUSIC and THETR (theory, literature, and history only)

NES (literature and history)

NTRES 220, 332, 333, 407, 411, 433

PHIL

RELST

S&TS 205, 206, 233, 250, 281, 282, 286, 292, 360, 381, 384, 389, 433, 444, 447, 472, 481, 490

Written and Oral Expression: 9 credits, of which at least 6 must be in written expression, selected from the following:

Written Expression

First-year writing seminars

AN SC 204

COMM 105, 117, 260, 263, 350, 352

CSS 200

ENGL 280–281, 288–289, 382–385, 388–389

FD SC 230

LA 215

NS 105, 230

Oral Expression

COMM 201, 203

Note: This requirement may be fulfilled by completing (1) 9 credits of written expression or (2) 6 credits of written plus 3 credits of oral expression.

Students scoring 4 or 5 on the English advanced placement exam may be awarded 3 credits, which will be recorded in Written and Oral Expression.

5. **Mathematics Requirement**

Faculty legislation requires minimum competency in mathematics to complete a degree in the College of Agriculture and Life Sciences. As a measure of competency in mathematics, all entering undergraduates, including those with advanced placement or transfer credit in calculus, must take the college math proficiency exam (administered during orientation). The following students are exempt from the CALS Math Placement Exam: (a) internal transfer students who already have passed one mathematics course listed below under Group II, section 1, and (b) entering biological and environmental engineering (BEE) students who take the placement exam in the College of Engineering.

The CALS exam score determines the college math graduation requirement, and provides placement information. Cut-off scores divide students into three groups, each with specific graduation requirements.

Mathematics requirements and placement suggestions:

Group I: Students in this group are considered proficient in math for college graduation requirements. If further math is needed for the major, placement score *suggests* calculus skill level (e.g., MATH 111).

Group II: Placement score *suggests* pre-calculus skill level, and students in this group must satisfy one of the following:

1. Successfully complete an approved mathematics course at Cornell. EDUC 115 is recommended.

Approved Courses:

- Math: EDUC 115, any mathematics course (except MATH 100, 103 and 109).
- Statistics: MATH 171; AEM 210; BTRY 301/NTRES 313; ILRST 211, 310, 311, 312; ENGRD 270; PAM 210. (Also BTRY 100, 101, 102, 201 and 261, and ILRST 210 formerly offered)

2. Successfully complete or have completed an approved calculus course at another college or university with a final grade of B- or better.
3. Receive AP credit for calculus (4 or 5 on Math AB or BC) or statistics.

Group III: Students in Group III on the CALS math placement exam must successfully complete an approved non-statistics mathematics course at Cornell. Prior completion of EDUC 005 may be recommended at the discretion of the student's academic adviser.

Approved Courses:

- EDUC 115, any mathematics course (except MATH 100, 103, 109 and 171).

Transfer and AP math credit (up to 6) will be recorded in Physical and Life Sciences of the college distribution requirements. Additional transfer credit in math will be recorded as general electives. BEE students typically receive fewer AP credits than other CALS students with the same scores. BEE students also may receive AP credits based on the Engineering math placement exam.

6. **Physical Education**

a. Pass a required swim test, administered during orientation. External transfer students who are exempt from PE are exempt from the swim test. See below.

b. Pass two courses with a satisfactory grade (courses do **not** count toward 120 credits for graduation or the minimum 12 credits for full-time study).

c. Students are expected to complete the physical education requirement in their first two semesters at Cornell.

d. External transfer students are credited with one course of physical education for each semester previously enrolled **full-time** (12 or more credits) at another college and are exempt from the swim test.

Non-Cornell Credit Policies

1. Non-Cornell credit includes advanced placement credit (see p. 8 for further details), credit earned at an accredited college or university, credit earned through the Ithaca College and Wells College Exchange Programs, and credit earned through a Cornell Abroad or CALS exchange program.
2. Non-Cornell credit is accepted by CALS when:
   - the credits are earned at an accredited institution;
   - the credits do not duplicate course work already completed at Cornell;
   - the credits are earned before matriculating into CALS or during the summer or winter session (except for an approved exchange program);
   - the credits have not been applied toward high school graduation requirements (except for AP exam credit, see p. XX);
   - the grade earned is "C-" or better; and
   - an official transcript is sent directly to the CALS Registrar's Office from the college/university where the credits were completed.

Please note: *Cornell University does not accept credit for courses sponsored by colleges but taught in high schools to high school students, even if the college provides a transcript for such work. Students who have taken such courses may, however, earn credit by taking an appropriate examination as described on pp. 8–10 of this catalog.*

3. A student may apply a maximum of 60 non-Cornell credits toward his or her graduation requirements.
   - Cornell Abroad (not CALS exchange) credits are limited to 15 credits per semester, 30 per academic year.
   - If more than 60 non-Cornell credits have been completed, the CALS Registrar's Office will work with the student to determine which credits best fulfill CALS graduation requirements.
4. Non-Cornell credits are recorded on the graduation summary and can be applied toward CALS credits, distribution requirements, and major requirements.*
   - Non-Cornell courses that are similar to courses offered in CALS are recorded as CALS credits on the graduation summary and count toward the minimum of 55 CALS credits required for graduation.
   - Non-Cornell courses that are equivalent to Cornell courses which fulfill distribution requirements are recorded under the appropriate distribution area on the graduation summary.
   - Non-Cornell courses that are equivalent to endowed courses can be applied toward distribution requirements or general electives; however, these credits do not count against the maximum of 55 endowed credit hours.
   - If a course has no comparable course at Cornell, the Registrar staff will determine how the credit should be applied.

*Faculty advisers determine how non-Cornell credit will be applied toward major requirements; the CALS Registrar's Office determines how non-Cornell credit will be applied toward CALS graduation requirements.

5. Students who have already matriculated into CALS and are planning to take courses at another institution must complete a transfer credit pre-approval form before completing the course work. Pre-approval forms are available in the CALS Registrar's Office in 140 Roberts Hall.

Graduation Procedures

1. The progress of each student toward meeting the degree requirements is recorded each semester in the CALS Registrar's Office on a graduation summary form. All students receive an updated graduation summary in the fall check-in packet. Students can review their graduation summary online at https://dust.cals.cornell.edu.
2. Students who have been in residence for eight semesters and who have met the graduation requirements will be graduated. Students are entitled to attend for the full eight semesters even if they have completed the graduation requirements in fewer semesters. A student who wishes to either graduate early or delay graduation must complete an additional application with the CALS Registrar's Office.
3. Application to graduate. In the first semester of their senior year, students must complete and submit an application to graduate to the CALS Registrar's Office.

Student Responsibilities: It is the student's responsibility to complete the application to graduate, obtain signatures from faculty adviser(s), and then schedule an appointment to file the application with the CALS Registrar's Office.

Deadlines: January graduates must complete the application to graduate, obtain required signatures, and meet with the CALS Registrar's Office before the end of the third week of classes in their final fall semester.

May graduates must complete the application to graduate, obtain required signatures, and meet with the CALS Registrar's Office before the end of the sixth week of classes in their final fall semester.

Failure to meet these deadlines could result in a student's name being omitted from the commencement program and/or a diploma not being available for pick-up on commencement Sunday.

Faculty Adviser Responsibilities: It is the faculty adviser's responsibility to inform seniors of any courses still needed to fulfill major and/or minor requirements and to list those courses on the application to graduate. Faculty advisers must sign the application to graduate before the student meets with the CALS Registrar's Office. If a student is completing more than one major, the signatures of all faculty advisers are required. If a student is completing a minor, the signature of the minor faculty adviser is also needed.

CALS Registrar's Office Responsibilities: It is the responsibility of the CALS Registrar's Office to inform seniors of any credits needed to fulfill the CALS graduation requirements and to list those credits on the application to graduate. The Registrar's Office will sign the application to graduate and provide both the student and faculty adviser with copies of the signed application. The student should retain a record of the application.

Commencement Information: Commencement information will be provided to all graduating seniors directly from the Commencement Office. Information is also available at www.commencement.cornell.edu/.

ACADEMIC POLICIES AND PROCEDURES

Registration

All students must register with the university *and* check in with this college at the beginning of each fall semester. Check-in materials are available in 140 Roberts Hall.

Course Enrollment

Students will receive course enrollment information from the university registrar. After planning a schedule of courses in consultation with their faculty adviser, students pre-enroll by computer.

To enroll in courses that involve independent study, teaching, or research, a student must file an independent study form, available in the CALS Registrar's Office, 140 Roberts Hall. Students who will be studying off campus should notify the Registrar's Office to ensure that proper registration will occur.

Students may enroll again for a course in which they received a grade of F in a previous semester. Both grades will be recorded and calculated as part of their GPA. If a student retakes a course in which a passing grade was earned, both grades will be recorded and calculated as part of their GPA. However, repeating a course increases the number of credits required for graduation by the number of credits in the course.

Students must *not* enroll again for a course in which they received an incomplete or NGR. Instead, work for that course should be completed without further enrollment. The instructor files a manual grade form with the college registrar when a grade has been assigned. An incomplete not made up by the end of two successive semesters of residence reverts to a failure. In the case of a graduating senior, incompletes revert to failures at the time of graduation.

A student is held responsible for and receives a grade for those courses in which he or she enrolls unless the student officially changes such enrollment. All changes in courses or credit, grading options, or sections must be made by the student using the online add/drop through "Just the Facts" or the official course drop and add form at the Registrar's Office, 140 Roberts Hall. Approval of the faculty adviser is required to change course enrollment. Department or course instructor approval may be required for select courses.

Students may add courses and change grading options or credit hours where applicable during the first three weeks of the semester, and may drop courses until the end of the seventh week.

Academic Integrity Policy

The College of Agriculture and Life Sciences faculty, students, and administration support and abide by the university Code of Academic Integrity. Its principle is that absolute integrity is expected of every student in all academic undertakings: students must in no way misrepresent their work, fraudulently or unfairly advance their academic status, or be a party to another student's failure to maintain academic integrity.

The maintenance of an atmosphere of academic honor and the fulfillment of the provisions of the code are the responsibility of the students and the faculty. Therefore, all students and faculty members shall refrain from any action that would violate the basic principles of this code.

1. Students assume responsibility for the content and integrity of their submitted work, such as papers, examinations, or reports.
2. Students are guilty of violating the code if they
   - knowingly represent the work of others as their own.
   - use or obtain unauthorized assistance in any academic work.
   - give fraudulent assistance to another student.
   - fabricate data in support of laboratory or field work.
   - forge a signature to certify completion or approval.
   - submit the same work for two different courses without advance permission.
   - knowingly deprive other students of library resources, laboratory equipment, computer programs, or similar aids.
   - in any other manner violate the principle of absolute integrity.
3. Faculty members assume responsibility to make clear to students and teaching assistants specific regulations that apply to scholarly work in a discipline.
4. Faculty members fulfill their responsibility to
   - maintain in all class, laboratory, and examination activities an atmosphere conducive to academic integrity and honor.
   - make clear the conditions under which examinations are to be given.
   - make clear the consequences of violating any aspects of the code.
   - provide opportunities for students to discuss the content of courses with each other and help each other to master that content and distinguish those activities from course assignments that are meant to test what students can do independently.
   - state explicitly the procedures for use of materials taken from published sources and the methods appropriate to a discipline by which students must cite the source of such materials.
   - approve in advance, in consultation with other faculty members, which work submitted by a student and used by a faculty member to determine a grade in a course may be submitted by that student in a different course.
   - monitor the work and maintain such records as will support the crucial underpinning of all guidelines: the students' submitted work must be their own and no one else's.

Cornell's Code of Academic Integrity spells out how individuals who have allegedly violated Cornell standards for academic integrity are to be confronted and, if found to be in violation of those standards, sanctioned. The code provides informal resolution of most perceived violations through a primary hearing between the faculty member, the student involved, and an independent witness. If necessary, a hearing before a hearing board follows.

The Academic Integrity Hearing Board for the College of Agriculture and Life Sciences consists of three elected faculty members, three elected student members, a chair appointed by the dean, and the director of counseling and advising, who serves as a nonvoting record keeper. Professor Dale Grossman is the current chair.

Individuals who observe or are aware of an alleged violation of the code should report the incident to the faculty member in charge of a course or to the chair of the hearing board. General information and details on procedures for suspected violations or hearings are available from the Counseling and Advising Office, 140 Roberts Hall.

Academic Honors

The college encourages high academic achievement and recognizes outstanding students in several ways:

1. **Dean's List.** Each semester, students are recognized for academic excellence by inclusion on the Dean's List. Eligibility for the Dean's List in the College of Agriculture and Life Sciences is determined by the following criteria:

a. a minimum course load for the semester of 12 letter-graded credits;

b. completion of at least one CALS course;

c. achievement of a semester GPA of at least 3.50;

d. achievement of an S grade, or a C- or better grade in each course (including physical education), with no Incompletes. Dean's List will be granted retroactively if students meet all the requirements after successful course completion to make up INC grades.

2. **Bachelor of Science with Honors**

a. Students receiving a cumulative GPA of 4.00 or greater (based on the last four full-time residential semesters of Cornell credits, with a minimum of 48 letter-graded credits) will graduate "summa cum laude."

b. Students receiving a cumulative GPA of greater than or equal to 3.75 and less than 4.00 (based on the last four full-time residential semesters of Cornell credits, with a minimum of 48 letter-graded credits) will graduate "magna cum laude."

c. Students receiving a cumulative GPA of greater than or equal to 3.50 and less than 3.75 (based on the last four full-time residential semesters of Cornell credits, with a minimum of 48 letter-graded credits) will graduate "cum laude."

3. **Bachelor of Science with Distinction in Research.** Students will graduate with a bachelor of science degree with distinction in research when, in addition to having completed all the graduation requirements, they have satisfactorily completed the research honors program in their area of interest and have been recommended for the degree by the honors committee of that area. Special requirements are given in the section on the Research Honors Program.

4. **Ho-Nun-De-Kah**, founded in 1929, is the undergraduate honor society of the College of Agriculture and Life Sciences. Members are recruited from the top 20 percent of the senior class and top 15 percent of the junior class. In keeping with the ideals of encouraging scholarship, leadership, and citizenship, members provide free tutoring and a variety of service activities to both the college and the community.
5. **Gamma Sigma Delta** is an honor society of faculty members and students in the Colleges of Agriculture and Life Sciences, Human Ecology, and Veterinary Medicine. The common bond is promotion of excellence in work related to the quality of our environment and life as it relates to agriculture and the related sciences. The Cornell chapter recognizes the academic achievements of students, faculty members, and alumni of those colleges with nominations for membership and with special awards. To be eligible, seniors must be in the upper 15 percent of their major. Five juniors with the highest grade point average in the college are also nominated. Gamma Sigma Delta also promotes academic excellence through sponsorship of special programs in the three colleges.
6. **Golden Key** is an international honor society that recognizes and encourages scholastic achievement and excellence in all undergraduate fields of study. Juniors and seniors in the top 15 percent of their class are invited to membership. Visit Golden Key's web site at www.rso.cornell.edu/gkihs/.

Academic Standing

At the end of each semester, the Committee on Academic Achievement and Petitions reviews the records of those students who in any respect are failing to meet the academic requirements of the college or who persistently fail to attend classes. For students not making satisfactory progress, the committee takes appropriate action, including, but not limited to, issuing warnings, placing students on probation, granting students leaves of absence, advising students to withdraw, or suspending or expelling students.

Specifically, the committee considers as possible cause for action failure to attend and participate in courses on a regular basis or, at the end of any semester, failure to attain one or more of the following:

- semester GPA of at least 2.00*
- cumulative GPA of at least 2.00*
- satisfactory completion of 12 or more credits per semester
- reasonable progress toward completion of distribution requirements
- appropriate completion of college and university requirements

In general terms, regular participation in course work with academic loads at a level sufficient to assure graduation within eight semesters and grades averaging C (2.00) or higher are prima facie evidence of satisfactory progress and good academic standing.

*For those students matriculating 8/01 or later. Requirements are 1.70 for those who matriculated before 8/01.

Petitions Procedures

The Committee on Academic Achievement and Petitions is a college committee of six faculty and two student members. On behalf of the faculty, the committee

- reviews, at the end of each semester and at other times as shall seem appropriate to the committee, the progress of students toward meeting graduation requirements.
- receives and acts on petitions from individual students asking for exceptions from particular academic regulations or requirements of the college, or for reconsideration of action previously taken by the committee.
- acts on readmission requests from persons whose previous enrollment was terminated by the committee.
- notifies the petitioner in writing of the action taken by the committee.

A petition for exemption from a college academic requirement or missed deadline may be filed by any student who has grounds for exemption. A petition is usually prepared with the assistance of a student's faculty adviser, whose signature is required. The adviser's recommendation is helpful to the committee. The committee reviews the written petition and determines whether there is evidence of mitigating and unforeseen circumstances beyond the control of the student that would warrant an exemption or other action.

Students wishing to withdraw from a course after the end of the seventh week must petition. Requests for course changes are approved only when the members of the committee are convinced that unusual circumstances are clearly beyond the control of the student. The committee assumes that students should have been able to make decisions about course content, total workload, and scheduling prior to stated deadlines. A grade of W (for "withdrawal") is recorded on the transcript if a petition to drop a course is approved after the end of the seventh week of classes, and if an approved drop results in fewer than 12 credits.

Forms are available in the Counseling and Advising Office, 140 Roberts Hall. Counselors are available to assist with the process.

Leave of Absence

A student wishing a break from studies in a future semester or who finds it necessary to leave the university before the end of a semester should submit a written petition for a leave of absence. Such action is necessary to clear the record for the semester and if not taken may adversely affect the student's subsequent readmission to the university.

An approved leave is considered a voluntary interruption in study and holds the student's place in the college without requiring reapplication to the university. Voluntary leaves are issued in two ways: unrestricted for students in good academic standing (no restrictions placed on length of leave, or activities pursued, and simple notification by student of intent to return), and restricted (length of leave and activities pursued may be specified, and a petition to return must be approved by the Petitions Committee).

A database is maintained by the Counseling and Advising Office to assist students with questions and the return procedure.

Information and petition forms are available in the Counseling and Advising Office, 140 Roberts Hall.

Withdrawal

A student who wishes to leave the university permanently should file a petition for withdrawal. Such petitions are approved if the student is in good academic standing. Students who have withdrawn and who later decide to return must apply to the CALS Admissions Office.

MAJOR FIELDS OF STUDY

The college curriculum consists of 23 major program areas that reflect the departmental academic effort in the college. Faculty curriculum committees in each area identify a sequence of courses appropriate to all students studying in that field. Courses of study are designed to provide systematic development of basic skills and concepts as well as critical thinking. Opportunity for concentration in an area of particular interest is usually available.

Programs are planned with considerable flexibility, allowing students to prepare for careers, graduate work, professional opportunities, and the responsibilities of educated citizens. Course requirements in each program area are different, but all students must meet the minimum distribution requirements of the college.

Animal Sciences

The animal sciences program area offers a coordinated group of courses dealing with the principles of animal breeding, nutrition, physiology, management, and growth biology. Emphasis in subject matter is directed toward domestic animal species, dairy and beef cattle, horses, poultry, pigs, and sheep, while laboratory, companion, and exotic animal species are also included in research and teaching programs. The Department of Animal Science has extensive facilities for animal production and well-equipped laboratories and classrooms, including a teaching barn, in which students can gain practical experience in the care and management of large animals.

The program focuses on the application of science to the efficient production of animals for food, fiber, and pleasure and easily accommodates a variety of interests and goals. Beyond a core of basic courses (suggested minimum, 15 credits) students select production and advanced courses to fulfill an individually tailored program worked out in consultation with their advisers. In this way it is possible to concentrate by species as well as by subject matter (nutrition, physiology, growth biology, breeding, management). For each subject area, supporting courses in other departments are readily available and strongly encouraged. Many science-oriented students elect a program emphasizing supportive preparation in the physical and biological sciences appropriate to graduate, veterinary, or professional study following graduation.

Dairy management is a popular program among students who may be preparing to manage a dairy farm or enter a related career. Other students may elect a program oriented toward economics and business in preparation for a career in the poultry, dairy, meat-animal, horse, feed, or meats industry. These are examples of the flexibility within these programs that can be developed to meet a student's career interest related to animals.

It is recommended that students obtain appropriate fieldwork or animal experience during summers. Several special training opportunities exist for highly motivated students. Juniors and seniors whose academic records warrant it may, by arrangement with individual faculty members, engage in research (either for credit or honors) or assist with teaching (for credit). The Dairy Management Fellows Program offers an equally challenging but different type of experience for a select group of students.

Students declaring a minor in animal science will arrange for a formal academic adviser in animal science at least three semesters before graduating. It is expected that the minor will be satisfied by completing at least 12 credit hours of animal science courses (at least 6 of which must be taken at Cornell), the makeup of which will be determined in consultation with the adviser. For example, it is recommended that students completing the minor will assemble courses (or demonstrate having the equivalent from elsewhere) including some basic and applied biology of animals (anatomy, physiology, nutrition, genetics) along with a selection of intermediate or advanced offerings from the animal science curriculum. Satisfactory completion of minor requirements will be verified by the minor adviser's signature on the petition to graduate.

For information, contact Deloris Bevins in 149 Morrison Hall, dgb1@cornell.edu.

Applied Economics and Management

The Department of Applied Economics and Management (AEM) offers undergraduate programs of study in three broad areas: business, agribusiness, and applied economics.

AEM is home to Cornell's undergraduate general business degree. Here students can immerse themselves in finance, marketing, management, and business strategy courses, as well as take specialized courses in entrepreneurship, food industry management, and agribusiness. This highly selective program is accredited by AACSB International, the accrediting body for general business degree programs.

AEM also includes undergraduate specializations that focus on the economics of agriculture and the environment. All AEM courses stress the application of analytical skills, critical thinking, and economic theory to real-world business and public policy issues.

The six areas of specialization offered in AEM are:

Business, one of the largest undergraduate majors at Cornell University, offers students a broad array of courses in the fields of finance, marketing, management, accounting, and entrepreneurship.

Food industry management is a specialized business program for students interested in management positions in the retailing, manufacturing, and distribution sectors of the food industry.

Agribusiness management students study general business and take courses tailored to agricultural businesses.

Farm business management and finance is for students interested in working for firms with ties to farming and agriculture, such as cooperatives, banks, horticultural businesses, and family farms.

Agricultural and applied economics is a broad-based specialization that focuses on such important national and international issues as the economics of policy, markets, production, international trade, and international development.

Environmental and resource economics students study the economics of water and air quality, waste management, rural-urban land use, the sustainability of natural resources, energy use, and global climate change.

AEM graduates are actively recruited by elite businesses for positions in finance, marketing, investment banking, and management consulting, as well as by federal and international agencies. Many graduates go on for advanced professional and academic degrees, often after several years in a challenging career position in business or government.

Minors

Through the Department of Applied Economics and Management, CALS students may complete a minor program of study in five different subject areas—agribusiness, business, environmental and resource economics, farm management, or food industry management. These minors consist of between 18 and 20 credits of required courses. Students should contact the Department of Applied Economics and Management for more detailed information and to enroll in one of these minor programs of study. These minors are not open to students outside of CALS.

Atmospheric Science

Atmospheric science is the study of the atmosphere and the processes that shape weather and climate. The curriculum emphasizes the scientific study of the behavior of weather and climate, and applications to the important practical problems of weather forecasting and climate prediction. Students develop a fundamental understanding of atmospheric processes and acquire skill and experience in the analysis, interpretation, and forecasting of meteorological events. All students are required to complete a minimum of three semesters of calculus, two semesters of physics, and a semester each of chemistry, computer science, and statistics.

Atmospheric science courses are offered through the Department of Earth and Atmospheric Sciences (EAS). The requirements for the B.S. in atmospheric science through the College of Agriculture and Life Sciences are as follows:

1. Atmospheric science:
   a. EAS 341, 342, 352, 447, 451
   b. See tracks listed below for additional required courses
2. Mathematics, statistics, and computer science:
   a. MATH 111, 112, 213, or equivalent
   b. AEM 210 or equivalent
   c. MATH 222, or MATH 223, or EAS 435
   d. EAS 121/150 or equivalent
3. Basic physical sciences:
   a. PHYS 207, 208, or equivalent
   b. CHEM 206
4. Tracks

Operational	**Education**	**Broadcasting**
required	*required*	*required*
EAS 250	*EAS 131/133*	*EAS 131/133*
EAS 296	*EAS 250*	*EAS 250*
EAS 456		*EAS 296*
EAS 470		*EAS 470*
		COMM 201
suggested	*suggested*	*suggested*
EAS 131/133	*Courses in*	*EAS 268*
EAS 268	*(ASTRO, EAS)*	*minor in communication*
EAS 331	*minor in education*	
EAS 435		

Business	**Environmental**
required	*required*
EAS 131/133	CHEM 207–208
EAS 268	EAS 334
	EAS 457
suggested	suggested
minor in business	EAS 131/133
	EAS 250
	EAS 268
	EAS 302
	EAS 331
	EAS 435
	EAS 483

It is recommended that students who are interested in graduate study in atmospheric science should take additional courses in mathematics and physics.

A student may minor in atmospheric science by completing any four of the following EAS. courses*: 131, 250, 268, 331, 334, 341, 342, 352, 435, 447, 451, 456, 457, 470, 651, 652 or 666.

*(two of the courses must be taken at Cornell.)

Courses satisfying the requirements for a major or minor in atmospheric science may not be taken S-U.

Biological Sciences

Biology is a popular subject at many universities for a variety of reasons: it is a science that is in an exciting phase of development; it prepares students for careers in challenging and appealing fields such as human and veterinary medicine, environmental sciences, and biotechnology; and it deals with the inherently interesting questions that arise when we try to

understand ourselves and the living world around us. Many of the decisions we face today deal with the opportunities and problems that biology has put before us.

The major in biological sciences is available to students enrolled in either the College of Agriculture and Life Sciences or the College of Arts and Sciences. The Office of Undergraduate Biology in 216 Stimson Hall provides student services that are available to students from either college.

The biology major is designed to enable students to acquire the foundations in physical and life sciences necessary to understand modern biology and to pursue advanced studies in a specific area of biology. Programs of study include either general biology or one of the following concentrations: animal physiology, biochemistry, computational biology, ecology and evolutionary biology, genetics and development, insect biology, molecular and cell biology, microbiology, neurobiology and behavior, nutrition, plant biology, and systematics and biotic diversity. Students interested in the marine sciences should consult the Shoals Marine Laboratory office, G14 Stimson Hall, 255-3717, for academic advising. For more details about the biology curriculum see the section in this catalog on biological sciences or visit www.bio.cornell.edu. For details regarding the minor in biological sciences, please refer to the Biological Sciences section of this catalog.

Biological and Environmental Engineering

The Department of Biological and Environmental Engineering (BEE) addresses three great challenges facing humanity today: ensuring an adequate and safe food supply in an era of expanding world population; protecting and remediating the world's natural resources, including water, soil, air, biodiversity, and energy; and developing engineering systems that monitor, replace, or intervene in the mechanisms of living organisms. The undergraduate engineering major in the Department of Biological and Environmental Engineering has a unique focus on biological systems, including the environment, that is realized through a combination of fundamental engineering sciences, biology, engineering applications and design courses, and liberal studies. The program leads to a bachelor of science degree in biological engineering, which is awarded jointly by the Colleges of Engineering and Agriculture and Life Sciences, and is accredited by the Engineering Accreditation Commission (EAC) of the Accreditation Board for Engineering and Technology, Inc. (ABET). All students in the jointly administered BEE major enroll in the College of Engineering and pay endowed tuition their last two semesters.

Biological engineering students take courses in mathematics, statistics, computing, physics, chemistry, basic and advanced biology, fundamental engineering sciences (mechanics, thermodynamics, fluid mechanics, and transport processes), engineering applications, and design. They may select upper-level engineering courses in subjects that include bioprocessing, soil and water management, biotechnology applications, bioinstrumentation, engineering aspects of animal physiology, environmental systems analysis, and waste treatment and disposal. Students further strengthen their programs by completing minors or a second engineering major. Students planning for medical school take additional lab-based courses in biology, biochemistry, and organic chemistry. Throughout the curriculum, emphasis is placed on communication and teamwork skills, and all biological engineering students complete a capstone design project. Students in the engineering program may major in either biological engineering or environmental engineering and may pursue minors and options in specialized areas as noted in the engineering section of this publication. Biological engineering majors interested in the environment may complete a formal program of courses in the environmental engineering option. **Specific course requirements and other information for the** biological engineering **program and the environmental engineering Option are described in the College of Engineering section of this publication.** Further information is also available at the undergraduate program office in BEE Student Services, 207 Riley-Robb Hall, or at www.bee.cornell.edu/.

The department also offers two technology programs: biological engineering technology and environmental engineering technology. The technology programs emphasize applied and technical aspects of biological, environmental, physical, and life sciences. These programs incorporate courses in basic biological and physical sciences and mathematics as well as engineering and technology, agriculture, business, social sciences, and liberal studies.

Many engineering and technology undergraduate students participate in honors programs, undergraduate teaching and research, internships, independent study, design teams, and study abroad. Students in the engineering program are also eligible to participate in the Engineering Cooperative Education Program. Students pursuing majors offered in the BEE department should have a strong aptitude for the physical and life sciences and mathematics and an interest in the complex social issues that surround technology.

Career opportunities for engineers and technologists cover the spectrum of self-employment, private industry, public agencies, educational institutions, and graduate programs in engineering and science, as well as the professional fields like medicine, business, and law. In recent years graduates have pursued careers in environmental consulting, biotechnology, pharmaceutical industries, biomedical engineering, management, sustainable technologies, consulting, and international development.

The living world is all around us and within us. The biological revolution continues and it has given rise to a growing demand for engineers and technical people who have studied biology and the environment, who have strong math and science skills, who can communicate effectively, who are sensitive to the needs of people, and who are interested in the challenges facing society. The Department of Biological and Environmental Engineering is educating the next generation of engineers to meet these challenges.

Specific course requirements for the accredited engineering programs are found in the College of Engineering section of this book.

Specific course distribution requirements for the academic programs in biological engineering technology and environmental engineering technology include

		Credits
1.	*Basic Subjects*	
	a. Calculus	8
	b. Chemistry	7
	c. Physics	8
	d. Introductory biological sciences	6–8
	e. Computer programming	4
	f. Statistics or probability	3
	g. Written and oral expression	9
	h. Social sciences	6
	i. Humanities	6
2.	*Advanced and Applied Subjects*	
	a. Five courses in the biological, environmental, or life sciences	15
	b. Five engineering or technology courses at the 300 level or above; including at least 9 credits in biological and environmental engineering	15
3.	*Electives*	
	Additional courses to complete College of Agriculture and Life Sciences requirements	
4.	*Total (minimum)*	120

For further details on the biological and environmental engineering and technology programs, see the *BEE Undergraduate Program Handbook*, available at 207 Riley-Robb Hall or at www.bee.cornell.edu. Contact Professor Jim Bartsch at 255-2800, jab35@cornell.edu, or go to www.bee.cornell.edu for more information.

Biology & Society

The Biology & Society program area is designed for students who wish to combine the study of biology with perspectives from the social sciences and humanities. Many of the most critical social issues of our time, from the implications of genetic engineering to the impact of global climate change, have biological processes at their core. At the same time these issues are inherently social, involving complex relationships among people, institutions, laws, and beliefs. The Biology & Society field of study provides the skills and perspectives necessary to confront problems with biological, social, and ethical dimensions. In consultation with a faculty member, students are expected to select their courses in the field to meet their own goals and interests. For a description of the Biology & Society requirements and courses, see "Biology & Society" under the College of Arts and Sciences in this publication or visit www.sts.cornell.edu.

Students who elect Biology & Society as their major field of study graduate from Cornell with well-developed writing and analytical skills and a knowledge base that can lead to employment in a variety of fields. Many graduates have accepted positions as health counselors, writers, or policy analysts and researchers for government organizations, medical institutions, consumer or environmental groups, or scientific research institutes. Students have found that Biology & Society is also excellent preparation for

professional training in medicine, law, and health services administration and for graduate programs in such fields as genetic counseling, nutrition, clinical psychology, public health, environmental studies, anthropology, sociology, and other related fields.

Admissions

Students in CALS may be admitted provisionally into this field of study when they apply to the college. Full admission depends on completing introductory biology and completing an application. Students transferring into this field of study will need to complete introductory biology and to submit an application during their sophomore year.

The application includes

1. a one- to two-page statement explaining the student's intellectual interests in Biology & Society and why it is consistent with his or her academic goals and interests.
2. a selected theme.
3. a tentative plan of courses fulfilling Biology & Society requirements, including courses taken and those planned.
4. a transcript of work taken at Cornell University, current as of the date of application.

The faculty admissions committee reviews applications twice a year, once each during the fall and spring semesters. A faculty adviser is assigned on admittance to the field. Approximately 60 faculty members from four colleges serve as advisers to Biology & Society students. The major program is coordinated for students in all colleges through the Biology & Society Office, 306 Rockefeller Hall, where students can get information, specific course requirements, and application forms. Faculty advisers are available to discuss the Biology & Society requirements.

Requirements for the program are listed below. A full description and listings of courses that satisfy the requirements can be obtained in 306 Rockefeller Hall or at www.sts.cornell.edu. See also "Biology & Society" in the College of Arts and Sciences section of this publication.

Biology & Society requirements:

1. Introductory biology (101–104, 105–106, or 107–108, or a 5 in AP biology)
2. College calculus (one course)
3. Ethics (one course)
4. Two social sciences/humanities foundation courses
5. Three biology foundation courses
6. One biology depth course
7. Statistics (one course)
8. Core course
9. Five theme courses (a coherent group of five courses relevant to the student's special interest in Biology & Society, including a senior seminar that serves as a capstone course for the program).

Students should develop their theme and select their courses in consultation with a member of the Biology & Society faculty. A list of the faculty is available in 306 Rockefeller Hall. Further information may be obtained at www.sts.cornell.edu.

Biometry and Statistics

Quantitative prediction and interpretation are increasingly essential components of biological and social sciences. Complex patterns, structures, and interactions raise fundamental and fascinating questions that can be addressed only using formal mathematical, statistical, and computational methods. The wealth of data that can be acquired using modern methodologies to address these questions, in turn, requires substantive quantitative approaches to make possible appropriate analysis and interpretation. Computational power, meanwhile, has increased exponentially providing the means for sophisticated analysis of complex phenomena.

The biometry and statistics major, in the Department of Biological Statistics and Computational Biology, focuses on the application of mathematical and statistical techniques to the sciences. Biometry applies mathematics and statistics to problems with a biological component, as seen in agricultural, environmental, biological, and medical science. Statistics is concerned with quantitative aspects of scientific investigation: design, measurement, summarization of data, and reaching conclusions based on probability statements. Students with ability in mathematics and an interest in its applications will find this a rewarding and challenging major.

The work of an applied statistician or computational biologist can encompass research, teaching, consulting, and computing in almost any combination and in a wide variety of fields of application. Opportunities for employment are abundant in academics, government, and businesses ranging from large corporations to small consulting firms; salaries are usually excellent. Experience gained through summer employment or work as an undergraduate teaching assistant is highly recommended. For further details on the biometry and statistics major/minor, please contact the director of undergraduate studies, Professor Steven J. Schwager (424WN) at sjs5@cornell.edu or go to www.bscb.cornell.edu.

Requirements for the Major (beyond the college requirements)

Ten (10) core courses:

BTRY 301 Biological Statistics I *or*

BTRY 601 Statistical Methods I

BTRY 302 Biological Statistics I *or*

BTRY 602 Statistical Methods II

BTRY 408 Theory of Probability

BTRY 409 Theory of Statistics

BTRY 495 Statistical Consulting

MATH 111 and 112 Calculus I and II *or*

MATH 121 and 122 Honors Calculus I and II *or*

MATH 191 and 192 Calculus I and II for Engineers

MATH 221 and 222 Linear Algebra and Differential Equations *or*

MATH 223 and 224 Theoretical Linear Algebra and Calculus *or*

MATH 293 and 294 Engineering Mathematics *or*

MATH 213 and 231 Calculus III and Linear Algebra with Applications

COM S 100M Introduction to Computer Programming *or*

BEE 151 Introduction to Computing

Statistics concentration: Students must complete three (3) advanced courses in statistics, computer science, operations research, biology, and/or mathematics courses; below is a sample of such courses (for complete list, go to www.bscb.cornell.edu/ugrads04/):

BTRY 310 Statistical Sampling

BTRY 382 Introduction to Genomics and Bioinformatics

BTRY 604 Applied Experiment Design

ILRST 410 Multivariate Analysis

NTRES 670 Spatial Statistics

COM S 211 Computers and Programming

COM S 426 Computational Biology

OR&IE 361 and 462 Stochastic Processes

OR&IE 473 Empirical Finance

BIOPL 440 Phylogenetic Systematics

AN SC 420 Quantitative Animal Genetics

MATH 311 or 413–414 Introduction to Analysis

MATH 420 Differential Equations and Dynamical Systems

Statistical genomics concentration: Students must complete BTRY 382 Introduction to Genomics and Bioinformatics and BIOGD 281 Genetics; in addition, they must complete two (2) courses from the advanced courses previously listed (for complete list go to www.bscb.cornell.edu/ugrads04/). BTRY 482/682 Statistical Genomics is highly recommended.

Supplementary concentration: Each biometry and statistics major is strongly encouraged to supplement the required courses with a concentration in an area of interest to the student, consisting of a cohesive set of courses chosen by the student. It is the student's responsibility to develop this concentration, with advice from the faculty, particularly the student's faculty adviser. It will be helpful to discuss the selection of courses with the director of undergraduate studies or undergraduate advising coordinator of a department closely linked with the chosen concentration.

The Minor

A minor in biometry and statistics is available to all undergraduate students in CALS. To complete the program, students must submit a minor program of study form, available in 434 Warren Hall. Each student will retain a copy of the form and will be responsible for planning the minor program of study in conjunction with the adviser in the student's major and a BSCB faculty adviser. Students and advisers in other departments should contact the director of undergraduate studies in the Department of Biological Statistics and Computational Biology if they have questions about biometry and statistics courses or the minor. The director of undergraduate studies or another BSCB faculty member will supervise and assist each minor in course selection.

Requirements for the minor

BTRY 301 Biological Statistics I *or* BTRY 601 Statistical Methods I

BTRY 302 Biological Statistics II *or* BTRY 602 Statistical Methods II

BTRY 408 Theory and Probability

BTRY 409 Theory of Statistics

MATH 111 Calculus I

MATH 112 Calculus II

MATH 213 Calculus III *or* MATH 221–222 Linear Algebra and Differential Equations

One (1) additional statistics elective:

BTRY 310 Statistical Sampling

BTRY 382 Introduction to Genomics and Bioinformatics

BTRY 482 Statistical Genomics

BTRY 495 Statistical Consulting

BTRY 603 Statistical Methods III

BTRY 604 Applied Experiment Design

BTRY 652 Computational Statistical Inference

BTRY 672 Environmental Statistics

ILRST 410 Multivariate Analysis

ILRST 411 Categorical Data Analysis

ILRST 614 Structural Equations

NTRES 670 Spatial Statistics

A minimum of 31 credits is needed to complete the minor. Only courses for which the student receives a grade of C or better will count toward the minor in biometry and statistics.

Communication

Communication majors at Cornell study communication in three main areas: science, media, and technology. Students gain a strong core in the theory of communication processes, including attitude, knowledge, and behavior change, public opinion, and information systems. They develop applied oral and written communication skills; they learn how communication systems work in society and in their personal and professional lives; they apply their understanding of communication to solving problems, sustaining the environment, reaching the public with new knowledge, and managing intricate networks of technologies.

Communication majors learn how

- communication influences attitudes, opinions, and behaviors.
- mass media work in our society.
- to use, evaluate, and design communication technologies.
- to apply their understanding of communication to solving problems in science, the environment, government, industry, health, and education.

The communication major is a program with a strong core of contemporary communication knowledge, theory, and practice.

Required freshman courses

Fall semester

COMM 120 Contemporary Mass Communication

Spring semester

COMM 116 Understanding Human Communication

COMM 117 Writing about Communication

This set of courses provides students with a basic understanding of communication and the communication process.

Sophomore courses

Fall semester

COMM 201 Oral Communication

COMM 282 Communication Industry Research

Spring semester

COMM 230 Visual Communication

After completing the courses in the core curriculum, all majors take an additional 18 credits in communication. In consultation with their advisers, students can choose to concentrate in one of four defined focus areas or they may plan an independent focus area appropriate to specific educational and career goals.

1. *Communication in the life sciences (CILS)*—Students focusing in CILS will understand the nature of science, health, and environmental communication; learn specific skills for communicating in the life sciences; and explore conceptual and theoretical issues in science communication.
2. *Communication media studies (CMS)*—Students concentrating in CMS will analyze and understand the social processes that are affected by media in contemporary society.
3. *Communication and information technology (CIT)*—Students focusing in CIT will explore the nature of communication systems and technologies, their social and organizational uses and impacts, and their social design.
4. *Communication planning and evaluation (CPE)*—Students focusing in CPE will develop skills in identifying audiences and in preparing and implementing communication programs to meet the needs of those particular audiences. Courses in this focus area stress the positive, ethical, and effective uses of communication in human affairs.
5. *Independent concentration*—The Undergraduate Program Committee will review proposed independent focus areas and authorize students to proceed with approved independent concentrations.

Detailed information on the distribution of courses is available from the department.

In designing the communication major, the faculty of the department has considered students' need to understand contemporary research-based knowledge about communication as well as their need to be competent communicators in the workplace and in society at large.

Through the Department of Communication, CALS students may complete a **minor program of study in communication** or a **minor program of study in information science** or both.

The **minor in communication** consists of four required courses (COMM 116, 120, 201, 230), one advanced presentation course (chosen from COMM 203, 260, 263, 301, 350, 352), and two elective courses totaling 6 credit hours, at least one of which must be at the 300–400 level, excluding COMM 496 and 498.

The **minor program of study in information science** is a cross-disciplinary program requiring one prerequisite statistics course, two courses from the information systems component area (primarily computer science), two courses from the human-centered systems component area (human–computer interaction and cognitive science), one course from the social systems component area (social, economic, political, and legal issues), and one additional course from any component area. A list of specific courses is available through the Department of Communication.

Students should contact the Department of Communication to enroll in either of these programs of study.

Crop and Soil Sciences

The Department of Crop and Soil Sciences provides instruction in the subject matter areas of crop science, soil science, environmental information science, and agronomy. Agronomy integrates the first three subjects. A specialization in crop science is a part of the plant science major. A focus on soil science is possible in two majors, the science of natural and environmental systems (SNES) or the science of earth systems (SES). The SNES major is a biophysical science–based major that addresses the interface of environmental science and human systems involved in environmental management. Within the SNES major, students can concentrate in agroecosystem science, environmental biology, environmental information science, and sustainable development. The SES major places emphasis on the basic disciplines of chemistry, physics, and mathematics. The agronomy area combines crop production and soil management. Students interested in agronomy can major in crop and soil sciences. This major requires 30 credits with 6–12 credits in each of the categories of applied crop science, plant protection, and soil science.

A minor in crop management is also available for students with any major at Cornell University. In summary, it requires at least two courses and at least 7 credits in each of crop science (CSS 311, 312, 317, or 414) and plant protection (CSS 315, 444, ENTOM 241, or PL PA 301 or 401) plus at least three courses and at least 12 credits in soil science (CSS 260, 372, 412, 421 or 466). Equivalent transferred courses can be substituted. This minor helps prepare students for the Certified Crop Advisor examination, which provides an important credential for jobs in agriculture and environmental management.

A minor in soil science requires 15 credits in soil science, but an additional 12 credits in biological, physical, and earth sciences are recommended to qualify the student for the Civil Service classification as Soil Scientist (GS-0470). In addition to 15 credits in soil science, Civil Service classification as

Soil Conservationist (GS-0457) requires 12 credits in natural resources and agriculture and three credits in applied plant science. The soil science minor is also available to students with any major at Cornell University and transfer credit can be used to meet requirements. Students wishing to pursue either the crop management or soil science minor should contact the Department of Crop and Soil Sciences (255-5459).

Development Sociology

Technological, economic, demographic, and environmental changes are social processes. Each has major impacts on individuals, social groups, societies, and the international order. At Cornell, development sociology students study these and other facets of social change in both domestic and international settings. The development sociology major provides an opportunity for in-depth study of the interactions among development processes, environmental and technological contexts, demographic structures and processes, and the institutionalized and grassroots social movements through which people seek change in these dimensions. Courses offered by the department cover topics such as: the impact of changes in agricultural systems on rural development; community and regional development; environmental sociology; rural industrialization and labor markets; technology and social change; the implications of the genomic revolution for agriculture and communities; the linkages between population dynamics, the environment, and development; the political economy of globalization; women in development; and ethnic competition and stratification. Most courses provide background in both domestic and international aspects of the subject matter. Students can develop a specialization with a domestic, international, or global emphasis by choosing appropriate elective courses. All students learn the theory and methodology of sociology and how to apply both to research and policy in their subject areas.

Majors in development sociology are required to successfully complete seven core courses: introductory sociology (D SOC 101), international development (D SOC 205), population dynamics (D SOC 201), methods (D SOC 213 or 214), theory (D SOC 301), social stratification (D SOC 370), and a course in statistics. Four additional development sociology courses are also required of all majors, at least two of which must be at the 300 level or higher. The elective courses allow students to focus their major on particular themes such as the sociology of development; the social processes linking the environment, population, and development; and more general areas such as ethnic and class stratification, social movements, social policy, and gender and development. In each of these focus areas, students can choose to concentrate on domestic or international situations. Students are encouraged to complement courses in the department with course work in the history and economics of development, area studies, and the policy sciences.

Recognizing that students are concerned with future career opportunities, the development sociology major emphasizes acquisition of skills as well as general knowledge in preparation for jobs or post-graduate study. Accordingly, students are expected to become involved in the application of theory, methodology, and principles and concepts in the analysis of practical problems. Development sociology offers degree programs at both the undergraduate and graduate levels (B.S., M.S., and Ph.D.). The department and graduate field are recognized as top programs in the area. The department is particularly well known for providing instruction in international as well as domestic aspects of community and rural development, environmental sociology, sociology of agriculture, population studies, and the interactions among these dimensions. Development sociology faculty are committed to both quality instruction and cutting-edge research programs.

The department maintains strong ties with technical fields in CALS as well as with programs dealing with a range of issues of importance to international and domestic development. These include: the International Agriculture Program, the Biology and Society Program, the Cornell Institute for Social and Economic Research, the Center for the Environment, the Polson Institute for Global Development, the Community and Rural Development Institute, the Gender and Global Change Program, the Bronfenbrenner Life Course Institute, and the Center for International Studies. Nearly half of the department faculty is associated with one or more area studies programs including the Southeast Asia Program, South Asia Program, Latin American Studies Program, East Asia Program, and the Institute for African Development. Department members also maintain working relations with faculty members in the Department of Sociology and social science units located in other colleges at Cornell. Students are encouraged to supplement their development sociology course work by electing courses in these other departments.

Education

Building on strong academic disciplines and grounding in sociopolitical, psychological, empirical, and theoretical bases of educational practice, the department has two foci to meet societal demands for teachers of mathematics, science, and agriculture, and for leaders in nonformal educational settings: Learning, Teaching, and Social Policy (LTSP), which includes the Cornell Teacher Education Program (CTE); and Adult and Extension Education (AEE). These two programs of study, largely at the graduate level, prepare leaders who will both engage in professional practice and improve educational processes through research, practice, and scholarship. Our undergraduate program leads to provisional certification in agricultural education. For the latest information on program developments, go to http://education.cornell.edu.

Adult and Extension Education (AEE). Creating a livable world requires more than just new knowledge and technology; it also requires sustained and expert practice in learning and education. The AEE program provides opportunities for graduate students to investigate participatory educational and organizing practices that link learning to the challenge of facilitating global sustainability. As public universities focus their research, teaching, and extension on domestic and global environmental, political, and social problems, the AEE program focuses on creating opportunities for critical reflection on adult, extension, and international education by connecting action and research. The goal is to move beyond procedural questions of "how to do it" to critical institutional questions of who does and who should benefit from our adult, extension, and international educational work. The aim is to engage practitioners and graduate students in critical reflection on practice to create practical theory from and for action.

Participation in the AEE program helps scholars and practitioners prepare for adult and extension educational leadership and professional roles in domestic and international community-based, nongovernmental, and governmental organizational settings. Areas of expertise and inquiry include: participatory practices in research, community development, and adult education; public scholarship, university extension/outreach, and community organizing in the United States; international adult and extension education; learning in adulthood; educational planning and program development; continuing professional education; staff development; and health issues related to the education of adults.

Learning, Teaching, and Social Policy (LTSP). This program is designed to foster the development of educational leaders, researchers, and practitioners who approach issues and challenges in education from multiple perspectives, and seek to construct an integrated knowledge base upon which the practice of teaching, learning, and social policy is based. The impacts of implementation and practice are explored for creating new theories, approaches, and policies to improve teaching, learning, and community life.

Drawing on the dynamic nature of teaching and learning, this program challenges students to create and apply research-based, critically reflective analysis of cognitive, intellectual, personal, social, moral, and institutional dimensions of learning, teaching, and educational policy in a variety of contexts and at multiple governance levels. Students engage in critically reflective practice to address pressing problems and issues in formal and nonformal educational contexts across a variety of national and cultural settings.

The program is philosophically grounded in the perspective that learning and teaching is a lifelong process vital to individual development, the development of democratic communities, and the implementation of democratic values in educational policy and practice. Context, gender, social, and economic diversity underlie the design and implementation of curriculum, teaching and learning theory, and social interactions, and are lenses for examining educational practice, theory, and policy.

Faculty members and graduate students in research programs in Learning, Teaching, and Social Policy (LTSP) engage in research that investigate factors that contribute to scientific and quantitative literacy; curriculum design and evaluation in science, mathematics, and agricultural science; effectiveness of teacher professional development; educational policy in rural schools; and sociomoral development, action, and reflective thought in schools and communities. Our mission is to contribute to an educated, global society of leaders and citizens who are prepared to respond to emerging social, technological, and scientific

issues, with ethical and critically reflective judgment.

The Cornell Teacher Education (CTE) program is a unique interdisciplinary cohort-based program that certifies teachers for secondary teaching in agriculture, science, and mathematics. Students in the CTE program develop a solid mastery of their content areas and an understanding of the issues in education, and interact with and learn from each other. Each of the certification areas contributes to the others in important ways. Understanding contemporary agriculture requires knowledge of the scientific bases for the changes in the way agriculture is practiced and is developing. Understanding science fully requires knowledge of how principles are applied in the world. Agriculture provides a salient field in which to apply science notions. Understanding the ways that mathematics is used to develop analytic systems, build arguments, and organize the world is essential to any modern scientific enterprise, whether basic or applied. Agriculture and science topics give mathematics teachers practical examples they can use to help their future pupils develop understanding of abstract mathematical principles. CTE teachers are prepared as scholars of teaching and learning, able to help all their students achieve the scientific and quantitative literacy and ethical decision making skills needed for participation in a democracy.

Effective College Teaching Series. The Center for Learning and Teaching, under the auspices of the Department of Education, offers a series of courses, both credit and noncredit, for the improvement of teaching at Cornell, designed for Cornell faculty members and graduate students who are either currently teaching or intending to teach. For details, contact the Center for Learning and Teaching, 607–255–6130, or www.clt.cornell.edu.

Current offerings include:

EDUC 548(5480) Effective College Teaching
Spring and one-week summer session. 1–3 credits. For faculty and graduate students who intend to pursue an academic career.

EDUC 578(5780) ITADP Cross-Cultural Classroom Dynamics, Language, and Teaching Practicum
Fall and spring. 2 credits. For international graduate students who have, or will have, teaching assistantships.

EDUC 579(5790) ITADP Further Training for International Teaching Assistants
Fall and spring. Noncredit course for international teaching assistants who have completed EDUC 578 but need or desire continued work in classroom instructional and communication skills.

Graduate Teaching Development Workshops

Offered early in each fall and spring semester, this daylong series offers an array of workshops in teaching effectiveness, from teacher-student interactions to developing a teaching portfolio. Noncredit, open to all Cornell faculty members and graduate teaching assistants.

EDUC 620(6200) Internship in Education
Fall and spring. 1 credit. Prerequisite: CALS Graduate Student Professional Development Workshop. For CALS graduate teaching assistants or CALS teaching personnel who wish to extend their workshop experience through reflective practice and consultation with an instructional support specialist.

Entomology

The entomology curriculum provides students with a basic background in biological and natural sciences, with a special emphasis on the study of insects. Majors may pursue graduate studies in entomology or related sciences upon completion of the B.S. degree. Alternatively, students may immediately begin careers in various aspects of basic or applied insect biology, including integrated pest management, insect pathology, environmental assessment, medical or veterinary entomology, insect toxicology, apiculture, insect systematics, or insect ecology. Because of the diversity of career options, the major includes flexibility among the core requirements and electives that can be selected by students in consultation with their advisers.

Requirements

General Requirements for CALS (see Graduation Requirements for Bachelor of Science)

Basic Science and Math Requirements

- One year of college mathematics, may substitute statistics or biometry, but must include one course in calculus
- One semester of physics (may need two depending on future plans)
- CHEM 206-208 or 207-208
- CHEM 257 (organic)
- Introductory biology (101–104 recommended, even if AP credit received)
- BIOGD 281 (genetics) or PL BR 225 (plant genetics)
- BIOEE 278 (Evolutionary Biology)
- Choose one of the following two courses:

  BIOEE 261 (Ecology and the Environment)

  BIOBM 330 or 331 (Principles of Biochemistry)

  (Choice depends on student interest in organismal vs. cellular/molecular aspects of biology)

Entomology Requirements (15–21 credits)

- ENTOM 212 Insect Biology – 4 cr
- Group A (core courses). Choose two of the following six courses:

  ENTOM 322 Insect Morphology – 4 cr

  ENTOM 333 Larval Insect Biology – 3 cr

  ENTOM 331 Insect Systematics—4 cr

  ENTOM 400 Insect Development – 4 cr

  ENTOM 455 Insect Ecology – 3 cr

  ENTOM 483 Insect Physiology – 4 cr
- Two additional entomology courses from Groups A or B (see link to Entomology Course Spreadsheet for a complete list of entomology courses, www.entomology.cornell.edu)

Food Science

The food science program prepares students for careers in the food industry or research organizations and for graduate study in food science or related disciplines. Food scientists enjoy satisfying careers that help ensure the sustainable availability of a safe, nutritious, affordable, and high-quality food supply for people throughout New York State, the nation, and the world.

Students in the food science program can choose from one of four specialization options in the major: (1) food science; (2) food operations and management; (3) food biotechnology; or (4) enology. The first option meets the curriculum standards set by the Institute of Food Technologists (IFT), the premier professional society for food scientists, allowing students to compete for IFT scholarships and awards. Students choose an option based on their individual interests and career goals.

The first two years of the undergraduate food science program are intended to establish a solid background in the physical and biological sciences, math and statistics, and communication skills. Required courses include chemistry (introductory and organic), biology, microbiology, calculus, physics, first-year seminar, introductory food science courses, and nutrition. The last two years emphasize the application of these basic sciences and technology to the manufacturing, sensory evaluation, storage, distribution, and safety of foods and food ingredients. Examples of food science core courses include Food Engineering Principles, Physical Principles of Food Manufacturing, Food Safety Assurance, Food Chemistry, Sensory Evaluation of Foods, and Food Microbiology; many elective courses are offered as well. Students choose electives to satisfy both college distribution requirements and their individual interests within the major and beyond.

Students are also strongly encouraged to participate in undergraduate research supervised by a faculty member and/or complete an internship in a food company during their program of study. Most teaching faculty in the department also have active research programs and welcome participation by undergraduate students. Students may receive academic credit or wages for faculty-directed undergraduate research. Several food companies recruit on campus for their internship programs. These internships provide an excellent opportunity for students to gain hands-on experience in their chosen field of interest and to establish contacts for future employment. A modern food processing and development pilot plant, an operational dairy plant, and well-equipped laboratory facilities are available to support the teaching and research needs of undergraduates.

Enology and Viticulture. Students with primary interest in viticulture and secondary interest in enology (V/E) can enroll in the plant sciences degree program, with a concentration in horticulture and a specialization in Viticulture. For these students, plant sciences will be their "major," and their required courses in enology (offered within the Food Science program) will constitute a "minor" in Food Science with a concentration in enology.

Students with primary interest in enology and secondary interest in viticulture (E/V) can "major" in food science (with a concentration in enology) and a "minor" in plant sciences (with a concentration in Horticulture).

Students in either track will take many of the same courses during their two years and must satisfy the core degree-program requirements of their major and minor program, as well as the general requirements of the college. The curriculum will consist of course work in the basic sciences (e.g., chemistry, biology, microbiology) as well as advanced courses in plant and food sciences. In addition, students will be expected to participate in internships at vineyards and/or with wine makers.

The curriculum is designed to provide students with a strong background in the basic sciences, coupled with a thorough understanding of plant and food sciences as applied to viticulture and wine making. Elective courses can be taken in a variety of areas to support and expand the major.

Prospective students should contact the undergraduate coordinators in either the Department of Horticulture (viticulture option) or Food Science (enology option) for specific course requirements.

Information Science

Information Science (IS) is an interdisciplinary field that studies the design and use of information systems in a social context: the field studies the creation, representation, organization, application, and analysis of information in digital form. The focus of Information Science is on systems and their use, rather than on the computing and communication technologies that underlie and sustain them. Moreover, Information Science examines the social, cultural, economic, historical, legal, and political contexts in which information systems are employed, both to inform the design of such systems and to understand their impact on individuals, social groups, and institutions.

The Information Science major organizes its courses into three area-based tracks:

- *Human-Centered Systems.* This area examines the relationship between humans and information, drawing from human–computer interaction and cognitive science.
- *Information Systems.* This area examines the computer science problems of representing, organizing, storing, manipulating, and accessing digital information.
- *Social Systems.* This area studies the cultural, economic, historical, legal, political, and social contexts in which digital information is a major factor.

Students must complete a set of 11 core courses: one introductory course, four courses in math and statistics, and two courses from each of the three IS areas. Students must also obtain depth in two tracks—a primary and a secondary track—that together best represent their interests. In particular, completion of the major requires four advanced courses from the selected primary track and three advanced courses from the secondary track.

Note: All INFO courses will count as in-college credit.

Requirements

Core (11 courses)

1. Introductory (one course):

   INFO 130 Introductory Design and Programming for the Web

2. Math and Statistics (four courses):
   - MATH 111 Calculus I
   - one course chosen from: MATH 171 Statistical Theory and Application in the Real World; H ADM 201 Hospitality Quantitative Analysis; AEM 210 Introductory Statistics; PAM 210 Introduction to Statistics; ENGRD 270 Basic Engineering Probability and Statistics; BTRY 301 Statistical Methods I; SOC 301 Evaluating Statistical Evidence; CEE 304 Uncertainty Analysis in Engineering; ILRST 312 Applied Regression Methods; ECON 319 Introduction to Statistics and Probability; PSYCH 350 Statistics and Research Design
   - either MATH 231 Linear Algebra or MATH 221 Linear Algebra and Differential Equations
   - INFO 295 Mathematical Methods for Information Science
3. Human-Centered Systems (two courses):

   INFO 214 Cognitive Psychology

   INFO 245 Psychology of Social Computing
4. Information Systems (two courses):

   COM S 211 Computers and Programming

   INFO 230 Intermediate Design and Programming for the Web
5. Social Systems (two courses):
   - either ECON 301 Microeconomics or ECON 313 Intermediate Microeconomic Theory
   - either INFO 292 Inventing an Information Society or INFO 355 Computers: From the 17 C. to the Dot. com Boom or INFO 356 Computing Cultures

Where options in the core courses exist, the choice will depend on the student's interests and planned advanced courses for the selected primary and secondary tracks.

Tracks

Students must complete four advanced courses in their selected primary track and three advanced courses in their selected secondary track. The Human-Centered Systems and Information Systems tracks can be used as primary or secondary tracks. The Social Systems track can be used only as a secondary track.

Courses taken to satisfy the core-course requirements may not be used to fulfill the track requirements.

All courses used toward the major must be taken for a letter grade.

Additional information on Information Science courses can be found below and in the CIS section of *Courses of Study*. Course information for all other courses in the major can be found in the relevant departments (e.g., AEM, COM S, and S&TS).

1. Human-Centered Systems

   PSYCH 342 Human Perception: Applications to Computer Graphics, Art, and Visual Display*

   INFO 345 Human–Computer Interaction Design

   PSYCH 347 Psychology of Visual Communications

   PSYCH 380 Social Cognition*

   PSYCH 413 Information Processing: Conscious and Unconscious

   PSYCH 416 Modeling Perception and Cognition

   INFO 440 Advanced Human–Computer Interaction Design

   INFO 445 Seminar in Computer-Mediated Communication

   INFO 450 Language and Technology

   DEA 470 Applied Ergonomic Methods

   *Students who take PSYCH 342 may also count its prerequisite, PSYCH 205, toward the Human-Centered Systems primary/secondary track requirements. Similarly, students who take PSYCH 380 may also count PSYCH 280 toward the Human-Centered Systems primary/secondary track requirements. At most, one of PSYCH 205 or 280 can be counted toward the primary/secondary track requirements.
2. Information Systems

   INFO 330 Applied Database Systems

   COM S 419 Computer Networks

   LING 424 Computational Linguistics

   INFO 430 Information Retrieval

   INFO 431 Web Information Systems

   COM S 432 Introduction to Database Systems

   COM S 465 Computer Graphics I

   COM S 472 Foundations of Artificial Intelligence

   LING 474 Introduction to Natural Language Processing

   OR&IE 474 Statistical Data Mining

   COM S 478 Machine Learning

   OR&IE 480 Information Technology

   COM S 501 Software Engineering

   INFO 530 Architecture of Large-Scale Information Systems
3. Social Systems

   SOC 304 Social Networks and Social Processes

   AEM 322 Technology, Information, and Business Strategy*

   INFO 349 Media Technologies

   INFO 355 Computers: From the 17 C. to the Dot.com Boom

   INFO 356 Computing Cultures

   ECON 368 Game Theory (formerly ECON 467)*

   INFO 387 The Automatic Lifestyle: Consumer Culture and Technology

   LAW 410 Limits on and Protection of Creative Expression—Copyright Law and Its Close Neighbors

S&TS 411 Knowledge, Technology, and Property

ECON 419 Economic Decisions Under Uncertainty

COMM 428 Communication Law

INFO 435 Seminar on Applications of Information Science

OR&IE 435 Introduction to Game Theory*

S&TS 438 Minds, Machines, and Intelligence

INFO 447 Social and Economic Data

ECON 476/477 Decision Theory I and II

COMM 494 Special Topics in Communication: Copyright in the Digital Age

INFO 515 Culture, Law, and Politics of the Internet

H ADM 574 Strategic Information Systems*

*Only one of OR&IE 435 and ECON 368 may be taken for IS credit. Only one of AEM 322 and H ADM 574 may be taken for INFO credit.

The Minor

A minor in Information Science is also available to students in AAP (Architecture and Planning students only), Arts and Sciences, CALS, Engineering, Hotel, Human Ecology, and ILR. The minor has been designed to ensure that students have substantial grounding in all three of the human-centered systems, information systems, and social systems areas. Detailed information about the minor can be found in the CIS section of *Courses of Study*. Students are also referred to www.infosci.cornell.edu/ugrad/concentrations.html for the most up-to-date description of the concentration and its requirements.

International Agriculture and Rural Development

International agriculture and rural development provides students with an understanding of the special problems of applying basic knowledge to the processes of agricultural development in low-income countries. The student typically specializes in a particular subject and works with an adviser to plan a program oriented toward international agriculture. The courses in international agriculture and rural development are designed to acquaint students with the socioeconomic factors in agricultural development, the physical and biological nature of tropical crops and animals, and the various world areas for which study programs exist.

Requirements

In addition to the college distribution requirements, students in international agriculture and rural development must take a minimum of 36 credits toward the major. A minimum of 7 credits in international agriculture and rural development (IARD) are required. The foreign language requirement for the IARD major is identical to that of the College of Arts and Sciences (see p. 422). Students are expected to complete an overseas field experience of a minimum of six weeks. The other courses recommended are drawn from a wide range of disciplines. The objective is to familiarize students with the many facets of agricultural development in low-income countries. Students are encouraged to take additional specialized courses in one of the other program areas of the college.

International Studies Minor

Preparing for leadership in an increasingly interconnected and dynamic world, CALS undergraduates need knowledge, skills, and attitudes that build "global competencies." The minor for CALS students not majoring in international agriculture and rural development will recognize an international concentration of course work and experiences.

Requirements

1. Four courses with significant international content, as recommended by students' major departments (two should be from CALS).
2. One semester of IARD 480 Global Seminar.
3. The foreign language requirement for the international studies minor is identical to that of the College of Arts and Sciences (see p. 422).
4. An approved overseas experience (exchange, study abroad program, internship, or faculty-led short course).

For more information, contact the academic programs coordinator in the International Programs Office, 255-3037.

Landscape Architecture

Landscape architecture focuses on the art of landscape design as an expression of the cultural values and the natural processes of the ambient environment. The program's unique place within the university promotes interaction among the areas of horticulture, environmental science, architecture, and city and regional planning.

The course of study prepares students for the practice of landscape architecture. The curriculum focuses on graphic communication, basic and advanced design methods, landscape history and theory, plant materials, construction and engineering technology, and professional practice. Design studios deal with the integration of cultural and natural systems requirements as applied to specific sites at varying scales. Projects may include garden design, parks design, housing design, historic preservation, environmental rehabilitation, and urban design.

Landscape architecture offers two professional degree alternatives: a four-year bachelor of science degree administered through the College of Agriculture and Life Sciences and a three-year master of landscape architecture degree administered through the Graduate School for those who have a four-year undergraduate degree in another field. Both of these degrees are accredited by the Landscape Architecture Accreditation Board (LAAB) of the American Society of Landscape Architects. The major in each degree is composed of core courses related to professional education in landscape architecture, a concentration in a subject related to the core courses, and free electives.

The department also offers a two-year master of landscape architecture advanced degree program administered through the Graduate School for those with accredited degrees in landscape architecture or architecture. The program entails core courses in the discipline and the development of a concentration in subject matter areas such as landscape history and theory, landscape ecology and urban horticulture, the cultural landscape, site/landscape and art, or urban design.

In addition, an undergraduate minor in cultural landscape studies is available for nonmajors.

Dual-Degree Options

Graduate students can earn a master of landscape architecture and a master of science (Horticulture) or a master of city and regional planning simultaneously. Students need to be accepted into both fields of study to engage in a dual-degree program and must fulfill requirements of both fields of study. Thesis requirements are generally integrated for dual degrees.

Study Abroad

The faculty encourages study abroad and has two formally structured programs. The *Denmark International Study* (DIS) program is available primarily to senior undergraduates and third-year graduate students in the fall semester and is administered through Cornell Abroad. The *Rome Program* is made available to undergraduates and graduate students through the College of Architecture, Art, and Planning.

Bachelor of Science Landscape Architecture Degree Sequence (Note: Each semester, the studio classes require payment of a supply and field trip fee, and all landscape architecture majors are required to pay an annual technology fee.):

First Year

Fall Semester	*Credits*
*LA 141 Grounding in Landscape Architecture	4
†Biological sciences elective	3
†Physical sciences elective	3
†Social sciences or humanities elective	3
†Written or oral expression elective	3
	16
Spring Semester	
*LA 142 Grounding in Landscape Architecture	4
†Biological sciences elective	3
†Social sciences or humanities elective	3
†Written or oral expression elective	3
‡Physical sciences elective	3
	16

Second Year

Fall Semester	
*LA 491 Creating the Urban Eden: Woody Plant Selection, Design and Landscape Establishment	4
*LA 201 Medium of the Landscape	5
†Biological sciences elective	3
†Social sciences or humanities elective	3
Historical studies	3
	18

Spring Semester

*LA 202 Medium of the Landscape	5
*LA 315 Site Engineering I	3
*LA 492 Creating the Urban Eden: Woody Plant Selection, Design and Landscape Establishment	4
†Written or oral expression elective	3
‡Physical sciences elective	3
	18

Third Year

Fall Semester

*LA 301 Integrating Theory and Practice	5
*LA 316 Site Engineering II (second seven weeks)	2
**Concentration	3
‡Free electives	4
	14

Spring Semester

*LA 302 Integrating Theory and Practice Community Design Studio	5
**Concentration	3
*Historical studies	3
*LA 318 Site Construction	5
	16

Fourth Year

Fall Semester

**Concentration	6
†Social sciences or humanities elective	3
‡Free elective	2
(Optional landscape architecture study abroad semester in Denmark or Rome)	11

Spring Semester

*LA 402 Integrating Theory and Practice II	5
**Concentration	3
*LA 412 Professional Practice	1
‡Free elective	2
	11

Summary of credit requirements

*Specialization requirements	58
†Distribution electives	39
‡Free electives	8
**Concentration	15
	120

Master of Landscape Architecture (M.L.A.) License Qualifying Degree

Requirements of the three-year M.L.A. curriculum include 90 credits, six resident units of satisfactory completion of the core curriculum courses, and a thesis or a capstone studio. (Note: Each semester, the studio classes require payment of a supply and field trip fee, and all landscape architecture majors are required to pay an annual technology fee.)

First Year

Fall Semester — *Credits*

*LA 505 Graphic Communication I	3
*LA 501 Composition and Theory	5
*Historical studies	3
*LA 491 Creating the Urban Eden: Woody Plant Selection, Design and Landscape Establishment	4
	15

Spring Semester

*LA 502 Composition and Theory	5
*LA 492 Creating the Urban Eden: Woody Plant Selection, Design and Landscape Establishment	4
**Concentration	2
*LA 615 Site Engineering I	3
*Historical studies	3
	17

Second Year

Fall Semester

*LA 601 Integrating Theory and Practice	5
*LA 616 Site Engineering II	2
*Electives	2
**Concentration	6
	15

Spring Semester

*LA 602 Integrating Theory and Practice	5
*LA 618 Site Construction	5
*LA 590 Theory Seminar	3
**Concentration	3
	16

Third Year

Fall Semester

*LA 701 Urban Design and Planning	5
‡Free elective	2
**Concentration	4
*Historical studies	3
	14

Spring Semester

*LA 800 Master's Thesis in Landscape Architecture	9
or *LA 702 Advanced Design Studio	5
*LA 412 Professional Practice	1
‡Free elective(s)	2 or 6
Concentration LA 603	1
	13

Summary of credit requirements

*Specialization requirements	64 or 68
**Concentration	16
‡Free electives	6 or 10
	90

Master of Landscape Architecture Advanced Degree Program. The two-year master of landscape architecture (M.L.A./A.D.) program serves to broaden and enrich undergraduate education in design by providing an expanded educational experience to those who are technically skilled. Applicants must hold a bachelor's degree in landscape architecture or architecture from an accredited program. The objective of the two-year (M.L.A./A.D.) program is to develop specializations for individuals who may wish to teach, practice, or conduct applied research in landscape architecture.

Students admitted to the two-year M.L.A./A.D. program are required to complete 60 credits of course work as approved by the members of their graduate committee. For landscape architects, this must include at least two advanced studios, a graduate seminar, a concentration, and a thesis. For architects, the curriculum requires three advanced studios, two courses in plants and planting design, two courses in the history of landscape, two courses in site engineering, a seminar in design theory, a course in professional practice, a concentration, and electives.

Undergraduate Minor for Nonmajors

Students outside the professional program may choose the undergraduate minor (five courses, 15 credits) in cultural landscape studies to complement their major. A variety of courses consider the cultural landscape as an object, something to be studied for its own sake, and as a subject, as means to understand society's relationship to natural systems. The study of cultural landscapes also includes perceptions of landscapes, cultural ideas and values, and visible elements. Direct inquiries to Professor A. Hammer, Department of Landscape Architecture, 440 Kennedy Hall.

Courses: choose five for a total of 15 credits

+LA 140 The Symbols of New York State's Cultural Landscape (3 credits)

+LA 155 American Indian Cultural Landscapes: Changes in Time (3 credits)

+LA 360 Pre-Industrial Cities and Towns of North America (3 credits) offered alternate years

+LA 261 Urban Archaeology (4 credits)

+LA 262 Laboratory in Landscape Archaeology (3 credits)

LA 263 American Indians, Planners, and Public Policy (3 credits), offered alternate years

+LA 282 The American Landscape (3 credits)

+LA 418 New York Landscapes Oral History Project (3 credits)

+LA 483 Seminar in Landscape Studies (3 credits)

LA 497 Independent Study (1–5 credits)

LANAR 524 History of European Landscape Architecture (3 credits)

LANAR 525 History of American Landscape Architecture (3 credits)

LA 545 The Parks and Fora of Imperial Rome (3 credits)

LA 569 Archaeology in Preservation Planning and Design (3 credits)

LA 580 Landscape Preservation: Theory and Practice (3 credits)

+ Distribution elective

Natural Resources

As the number of humans living on the Earth surpassed six billion at the start of the 21st century, knowing how to conserve and manage well the Earth's remaining biological resources and natural environments takes on increasing importance and urgency. The field of natural resources sits squarely at the interface of science and policy, applied to these important conservation and environmental challenges. This is a biologically based major that focuses on the interface of nature (species, populations, communities, and ecosystems) with the human institutions involved in environmental conservation and management. The major's focus on biological resources (e.g., fisheries, wildlife, forests, and wetlands) includes issues of conservation and restoration of scarce species and their habitats, sustainable harvest of species of economic importance, management of invasive species and overabundant species, population dynamics in aquatic and terrestrial environments, ecosystem and watershed management, and mitigating the effects of human-induced changes on the environment.

The mission of the Department of Natural Resources, home of the major, is "to develop knowledge and facilitate learning to improve society's stewardship of natural resources and the environment." A commitment to undergraduate education is a vital component of that mission. For more information see www.dnr.cornell.edu. The curriculum emphasizes the biology and ecology of natural systems, as well as the social science/human aspects of conservation challenges. The major allows students flexibility to pursue a variety of paths to understand the scientific, ethical, and societal basis for management and protection of natural resources and environments through the application of ecological principles and knowledge of societal needs.

The Future for Natural Resources Majors

Most students entering the major have a strong interest in the natural world and in contributing to greater harmony between humans and the environment. An undergraduate degree in natural resources gives students the concepts and tools needed to participate intelligently and effectively in decisions that determine the future of our environment, either as natural resources professionals or as informed citizens.

Career opportunities in natural resources are diverse. The major prepares students for graduate school or entry-level positions in natural resources and environmental management agencies at local, state, federal, and international levels, or for jobs in the private for-profit (e.g., environmental consulting firms) or nonprofit sectors. Many students ultimately pursue graduate studies in environmentally related fields including the biological, physical, and chemical sciences; forest, wetland, stream, wildlife, or fisheries management; and environmental law and public policy. Graduates often assume leadership positions in government, colleges and universities, national and international conservation organizations, environmental consulting firms, environmental divisions of private industry, and organizations involved in environmental education or communication.

Curriculum

Natural resources is a flexible major, and free electives can account for as many as 40 credits out of the total of 120 required for graduation. Students complete a set of courses in biology, ecology, chemistry, mathematics, economics, ethics, and written and oral expression; many of these courses also meet the college's distribution requirements for graduation. *Freshmen and sophomores* complete a series of four foundation courses in the major: Introduction to the Field of Natural Resources, Environmental Conservation, Introductory Field Biology, and People, Values, and Natural Resources. Juniors complete three core courses: Applied Population Ecology, General Ecology, and Natural Resources Management and Planning. These foundation and core courses introduce the critical environmental and natural-resource issues confronting society, and develop the conceptual and methodological tools that students will use in upper-division courses.

Juniors and seniors may specialize in one of three areas of concentration: applied ecology, resource policy and management, or environmental studies. Through course work in these concentrations, students gain an in-depth understanding of key principles, concepts, and practices. All students also have the flexibility to gain exposure to a wide variety of environment-related courses offered by Natural Resources and other departments throughout Cornell. Many students elect to conduct a research honors thesis.

Areas of Concentration within the Major

Applied ecology is designed as a foundation for those who wish to pursue careers or advanced study in science-based conservation or management of fish and wildlife populations and their habitats, conservation biology, control of invasive and overabundant species, watershed and landscape management, quantitative population dynamics, resource inventory and information management, global ecology, or applied ecology and biogeochemistry of forests and wetlands. This concentration also may interest students seeking a biologically-based approach to environmental science or global studies. Students who select this concentration typically focus their course work in the areas of species biology and applied ecosystem ecology, including quantitative analysis of fish, wildlife, and plant populations, ecosystems, and landscapes. They complement their course work within the department with courses in other departments, such as Ecology and Evolutionary Biology, Microbiology, Geology, Crop and Soil Science, Atmospheric and Earth Sciences, Animal Sciences, and Plant Biology.

Resource policy and management provides a foundation for students who wish to pursue careers or advanced study in the human dimensions or policy aspects of natural resource conservation and management, natural resource and environmental law, environmental policy analysis, or environmental communication. Students who select this concentration typically focus on courses related to the development of environmental policy, management strategies for particular species or ecosystems, natural resource planning, resource economics, or programs in environmental communication and education. They complement their course work within the department with courses in other departments such as Government, Ecology and Evolutionary Biology, Development Sociology, Communications, Applied Economics and Management, City and Regional Planning, and Policy Analysis and Management.

Environmental studies is intended for those who wish to pursue a broad and synthetic approach to understanding and participating in (re)structuring the interactions between society and environment. The concentration's emphasis is on developing an ability to think critically about these interactions. Building on a foundation of courses required for the natural resources major, during years 3 and 4, each student will design a cohesive sequence of six upper-division courses with help from their departmental adviser. These six courses should include two courses from each of three categories: (1) natural science; (2) social science and analytic skills, e.g., economics, political economy, logic, computer programming, GIS, statistics; and (3) humanities, e.g., history, philosophy, literature, arts, foreign language. This self-defined environmental theme ensures development of specific competencies linked to personal and professional ambitions of the individual student. Example themes include environmental law, environmental education, "green" business, sustainable agriculture, and environmental communication. Students are expected to take advantage of internship, independent study, and honors thesis opportunities, as appropriate.

Research and Work Opportunities for Undergraduates

The department offers many opportunities for field-oriented studies, independent research, internships, and jobs. These include several field-based courses and access for research at the Arnot Teaching and Research Forest near Ithaca, the Little Moose Field Station in the Adirondacks, the Cornell Biological Field Station on Oneida Lake near Syracuse, and the Hubbard Brook Experimental Forest in New Hampshire, as well as numerous natural areas near campus. Part-time jobs in the research and extension programs of many faculty members offer students opportunities for career-related work experience. A research honors program is available for qualified students.

For a comparison of the natural resources major with other environmental majors, see www.dnr.cornell.edu/teaching/ugrad/faq/cals_env.pdf.

Nutritional Sciences

Nutritional sciences draws upon chemistry, biology, and the social sciences to understand complex relationships among human health and well-being, food and lifestyle patterns, food and agricultural systems, and social and institutional environments.

The program in nutritional sciences provides students with strong training in human nutrition in the context of an understanding and appreciation of the agricultural and life sciences. The program responds to the growing and important interrelationships among human nutrition and the agricultural and life sciences. Growing public interest in health and nutrition has placed new demands upon food producers, processors, and retailers. The problems of hunger and malnutrition in the United States and abroad

require that nutritionists work with specialists in areas such as agricultural economics, food production, and development sociology. Advances in biotechnology provide researchers with new ways to understand human nutritional requirements and the regulation of human metabolism.

Nutritional sciences majors complete a core set of requirements and choose elective courses in the areas of their particular interest. The core curriculum includes introductory chemistry and biology, organic chemistry, biochemistry, physiology, and mathematics. Students complete five courses in nutritional sciences: NS 115 Nutrition, Health and Society; NS 245 Social Science Perspectives on Food and Nutrition; NS 345 Nutritional and Physicochemical Aspects of Foods; NS 331 Physiological and Biochemical Bases of Nutrition; and NS 332 Methods in Nutritional Sciences. In addition, students select a minimum of three advanced courses in nutritional sciences as well as elective courses in the broad areas of food production and processing, food and agricultural policy, the life sciences, environment and natural resources, communication, and education.

All majors have faculty advisers in the Division of Nutritional Sciences with whom they meet regularly. Advisers help students plan course schedules and help find opportunities for special study or experiences outside the classroom.

Many students engage in laboratory or field research with a faculty member for academic credit. The research honors program is designed for academically talented students who are interested in research. Honors students conduct independent research projects under the guidance of a faculty member and prepare an honors thesis. Many students participate in field experiences for credit during the academic year or summer. Placements in laboratories, industries, or community agencies are possible.

The major in nutritional sciences can lead to many different career paths. By supplementing the core requirements with courses in different areas, students can prepare for jobs in industry, government, or community agencies in the United States or abroad. The major is excellent preparation for graduate study in a variety of fields.

The Division of Nutritional Sciences is affiliated with both the College of Agriculture and Life Sciences and the College of Human Ecology. Most of the division faculty members work in Savage Hall, Kinzelberg Hall, and Martha Van Rensselaer (MVR) Hall. In addition to housing offices, classrooms, and seminar rooms, these buildings contain research facilities, specialized laboratories, a human metabolic research unit, and computer facilities.

For additional information about the nutritional sciences program, contact the Division of Nutritional Sciences Academic Affairs Office, 335 MVR Hall, 255-2628, aadns@cornell.edu.

The minor in **nutrition and health** in the College of Agriculture and Life Sciences allows students to choose from courses concerned with economic influences on human nutrition, epidemiology and public health, food quality and food service management, human health and nutrition, nutritional biochemistry, and the psychological and social influences on human nutrition. The minor consists of NS 115 Nutrition, Health, and Society plus 9 credits of 200-level or above didactic NS courses. Enrollment is limited in some courses. Please check www.nutrition.cornell.edu/undergrad/calsminr.html for details.

Plant Sciences

Plant sciences prepares students for careers that meet the challenges of providing a safe, nutritious, and abundant food supply for a growing world population and using plants to enhance the beauty of our landscapes. It is a multidepartmental program administered by faculty in the Departments of Crop and Soil Sciences, Horticulture, Plant Biology, Plant Breeding and Genetics, and Plant Pathology, representing one of the strongest groups of plant scientists in the world. Students in the program share a common interest in learning about topics associated with plant growth and development in the broadest sense, but beyond that common thread, individual career goals vary widely. Some have their sights set on careers in applied agriculture, others plan to contribute to advancements of our knowledge by way of teaching or research, and still others see study in plant science as a stepping-stone to specialized training in business, government, or law. In addition to the college distribution requirements, Plant science majors must take at least one course in each of several areas including botany, plant physiology, ecology, taxonomy/systematics, genetics, statistics, plant-pest interactions, crop production, and soil science, for a total of 40 credits.

Students who begin with well-defined interests or who identify certain areas of interest after several semesters of course work may choose a specialization within one of the five cooperating departments. Each specialization has additional requirements beyond the basic core courses. However, students who are uncertain about the breadth of their interests or who are seeking as much flexibility as possible may choose to design their course of study in plant sciences without declaring a specialization. Those students develop a strong background in plant science but have fewer required courses so that they can explore other areas of interest.

More than 100 courses that deal directly with some area of plant science are offered by the cooperating departments, and other courses relating to plant science are offered elsewhere in the university. There are also ample opportunities for internships, undergraduate teaching, and research experience. Qualified students, especially those expecting to go on for graduate degrees, are encouraged to avail themselves of such opportunities. Students who are planning to enter the work force immediately upon completion of the B.S. degree are encouraged to obtain practical experience. This may involve summer employment in research or in a plant production or maintenance related industry such as a lawn and tree care company, commercial greenhouse, nursery, orchard, vineyard or winery, botanical garden or arboretum, crop production farm, or with Cooperative Extension. Plant sciences faculty members also encourage students to avail themselves of opportunities to work and/or study abroad.

In addition to classrooms and laboratories in five buildings on the Cornell campus proper, research and teaching facilities adjacent to the campus are freely available to students for hands-on practice, technical training, independent research projects, and internships. These facilities include research orchards and vineyards, golf courses and a turf research facility, the Cornell Plantations (including arboretum and natural areas) and vegetable and field crop farms. Demonstration/research facilities in Aurora (Cayuga County), Geneva (Ontario County), Highland (Ulster County), Lake Placid (Essex County), Middletown (Orange County), Odessa (Tioga County), and Riverhead (Suffolk County) are also sites administered by departments in the Plant Sciences consortium and are available for undergraduate and graduate field study.

Crop science is a specialization that focuses on the major food and feed crops of the world, such as wheat, corn, rice, soybeans, and alfalfa. In addition to 15 credits in applied crop science, students in this program also take at least 6 credits in plant protection (weed science, entomology, and plant pathology), and at least 6 credits in soil science. The crop science specialization can be focused on preparation for graduate school or be combined with a crop management minor for those planning to be certified crop advisers.

Enology and viticulture. The College of Agriculture and Life Sciences offers a curriculum in viticulture and enology within existing undergraduate B.S. degree programs in plant sciences and food science.

Students with primary interest in viticulture and secondary interest in enology (V/E) can enroll in the plant sciences degree program, with a concentration in horticulture and a specialization in viticulture. For these students, plant sciences will be their "major," and their required courses in enology (offered within the food science program) will constitute a "minor" in food science with a concentration in enology.

Students with primary interest in enology and secondary interest in viticulture (E/V) will "major" in food science (with a concentration in enology) and "minor" in plant sciences (with a concentration in Horticulture).

Students in either track will take many of the same courses during their two to four years, and must satisfy the core degree-program requirements of their major and minor programs, as well as the general requirements of the college. The curriculum will consist of course work in the basic sciences (e.g., chemistry, biology, microbiology) as well as advanced courses in plant and food sciences. In addition, students will be expected to participate in internships at vineyards and/or with wine makers.

The curriculum is designed to provide students with a strong background in the basic sciences, coupled with a thorough understanding of plant and food sciences as applied to viticulture and wine making. Elective courses can be taken in a variety of areas to support and expand the major.

Prospective students should contact the undergraduate coordinators in either the Department of Horticulture (viticulture option) or Food Science (enology option) for specific course requirements.

Horticulture. Derived from the Latin word "hortus," meaning garden, horticulture is a blend of science and culture involving

knowledge of plants in farms and gardens, parks and landscapes, and athletic and recreational facilities; indoor plants; greenhouse and nursery plant production; and crops used for wines, herbs and spices, medicinal purposes, and coffee and teas. The knowledge and skills essential to grow, maintain, process, and market horticultural plants are in high demand in a world increasingly concerned with environmental quality, recreation, and health.

The 40 faculty members in horticulture specialize in almost every aspect of horticultural science, with active research and outreach programs regionally, nationally and internationally.

Students choosing a concentration in horticulture must complete a minimum of 40 credits of core courses for the plant sciences major, plus the following courses:

HORT 101 Horticultural Science and Systems (4 credits)

HORT 400 Plant Propagation (3 credits)

Two HORT courses in plant production or management at the 400 level (6 credits)

One additional course of integrated pest management (plant pathology, entomology, or weed science) beyond the 3-credit plant sciences core requirement (3 credits)

Students transferring into Cornell from other colleges can petition to waive or adjust these requirements, in consultation with their faculty advisers.

Plant biology stresses a basic, rather than applied, understanding of how plants function, grow, and develop, as well as a study of their genome, evolution, and relationships to man. It provides undergraduates with a thorough preparation for graduate study in plant sciences. In cooperation with an adviser each student plans a curriculum with a concentration in basic sciences, supplemented by more advanced courses in plant biology. Students specializing in plant biology within the plant sciences major should take a minimum of four courses beyond the core of plant sciences courses. Options include plant molecular biology, plant cell biology, biochemistry, ethnobotany, and further courses in the function, growth, genetics, systematics, ecology, and evolution of plants. Individual research under professorial guidance is encouraged. Different options within plant biology afford a flexible curriculum.

Plant genetics and breeding relates information about genetics/genomics of plants to the improvement of cultivated plant species. Agriculturally important genes are identified, characterized, and deployed through combinations of molecular studies and sexual crosses. This area of study integrates genetic information with plant physiology/biochemistry, plant pathology, entomology, conservation biology, international agriculture, and related areas to create crops that meet the needs of modern society. In addition to the core plant sciences courses, students should take PL BR 201, 403, 404, and BIOPL 343. Other courses may be included after consultation with the adviser. Students are encouraged to participate in research projects and take advantage of opportunities for internships in industry.

Plant pathology is the study of plant diseases caused either by microorganisms or by chronic exposure to toxic elements in air and water. At the very least, specialists in the field must learn how to identify plant diseases and to design management strategies that will limit their overall impact. However, by employing contemporary tools from molecular biology, plant pathologists are also well positioned to answer fundamental questions about the nature of host–pathogen interactions and the genes that control them. Use of these new tools has already led to rapid deployment of disease-resistant crop varieties and it promises to offer much more in the future. For most students, a concentration in plant pathology as an undergraduate is preparation for graduate study in the field. However, graduates may also be employed as representatives with agribusiness firms, Cooperative Extension educators, state or federal regulatory agents, and laboratory technicians. Suggested courses beyond the plant sciences core include organic chemistry, biochemistry, calculus, introductory plant pathology, mycology, entomology, and plant breeding.

Plant protection is offered to students who are interested in the management of plant pests. It includes the study of insects, diseases, weeds, vertebrate pests, and other factors that prevent maximum crop production. Although designed as a terminal program for students desiring practical preparation for careers in pest management, the specialization can also provide an adequate background for graduate work in entomology, plant pathology, or weed science.

Science of Earth Systems (SES)

During the past several decades, with the increasing concern about air and water pollution, nuclear waste disposal, the destruction of the ozone layer, and global climate change, the scientific community has gained considerable insight into how the biosphere, hydrosphere, atmosphere, and lithosphere systems interact. It has become evident that we cannot understand and solve environmental problems by studying these individual systems in isolation. The interconnectedness of these systems is a fundamental attribute of the Earth system, and understanding their various interactions is crucial for understanding our environment.

The SES major emphasizes the basic study of the Earth system as one of the outstanding intellectual challenges in modern science and as the necessary foundation for the future management of our home planet. Cornell's strengths across a broad range of earth and environmental sciences have been fused to provide students with the tools to engage in what will be the primary challenge of the 21st century. The SES major has its home in the Department of Earth and Atmospheric Sciences, but relies on the collaboration of several departments across the university.

The SES curriculum includes a strong preparation in mathematics, physics, chemistry, and biology during the freshman and sophomore years. During the junior and senior years, students complete the SES core sequence, studying such topics as climate dynamics, Earth system evolution, and biogeochemistry. These classes emphasize the interconnectedness of the Earth system, and are team-taught by professors from different traditional disciplines. The selection of upper-level "concentration" courses allows the student to develop an area of expertise that complements the breadth of the introductory and SES core courses. Possible areas of concentration include biogeochemistry, ecological systems, environmental geology, ocean sciences, climate dynamics, hydrological systems, and soil science.

The SES major provides a strong preparation for graduate school in any one of the Earth system sciences, such as atmospheric sciences, geology/geophysics, oceanography, hydrology, ecology, and biogeochemistry. Students seeking employment with the B.S. degree will have many options in a wide variety of environmentally oriented careers in both the private sector and government. Students with the strong science background provided by the SES major are also highly valued by graduate programs in environmental law, public affairs, economics, and public policy.

Requirements for the Major

1. Basic Math and Sciences

This part of the SES curriculum builds a strong and diverse knowledge of fundamental science and mathematics, providing the student with the basic tools needed in upper-level science classes.

   a. MATH 190 or 191, and MATH 192 (or MATH 111, 112)
   b. PHYS 207 and 208 (or PHYS 112, 213)
   c. CHEM 207 and 208
   d. BIOGD 101/103–102/104 (or 105–106) or BIOGD 109/110

2. Required Introductory Courses: EAS 220 The Earth System

3. Science of Earth Systems Core Courses

Three 4-credit courses that emphasize the interconnectedness of the Earth system are required. These courses are founded on the most modern views of the planet as an interactive and ever-changing system, and each crosses the traditional boundaries of disciplinary science.

   EAS 302 Evolution of the Earth System

   EAS 331/ASTRO 331 Climate Dynamics

   EAS 321/NTRES 321 Biogeochemistry

4. Concentration Courses

Four intermediate to advanced-level courses (300 level and up) that build on the core courses and have prerequisites in the basic sciences and mathematics courses are required. Note that additional basic math and science courses may be required to complete the concentration courses; the specific courses will depend on the student's choice of a concentration. The concentration courses build depth and provide the student with a specific expertise in some facet of Earth system science. The concentration should be chosen before the junior year in consultation with an SES adviser whose interests match those of the student.

Freshmen are encouraged to enroll in EAS 103, the SES freshman colloquium offered in the fall semester. For more information, contact Professor Stephen Colucci, Department of Earth and Atmospheric Science, sjc25@cornell.edu, or visit www.geo.cornell.edu/ses/.

Science of Natural and Environmental Systems

Environmental stewardship and sustainability are increasingly recognized as human and planetary imperatives. Graduates who understand how people both generate and can resolve environmental problems

will contribute significantly to creating a sustainable environment for their own and future generations. This new major in environmental science provides a broad-based, integrative program in the physical, biological, social, and economic sciences, as well as disciplinary strength in one or more subjects suitable for entry-level professional positions or post-baccalaureate studies.

The curriculum comprises an intensive foundation in the sciences; an environmental core with courses covering earth, biotic, social, and economic systems; and several disciplinary programs of study. This major emphasizes inter- and multidisciplinary work, independent thinking and analysis, and development of competency in writing and speaking throughout the curriculum.

Foundation Courses

The foundation courses, listed here, can be used to fulfill many of the CALS distribution requirements. The purpose of this component of the program is to provide a strong foundation in the basic sciences and an introduction to the relationships between the biophysical and social sciences.

- two semesters of college-level biology
- two semesters of college-level calculus
- four semesters of college-level chemistry and physics (at least one semester of each)
- one semester of college-level statistics
- NTRES 201 Environmental Conservation
- DEA 150 Introduction to Human-Environment Relationships

The freshman and sophomore years are designed to provide foundation courses and meet CALS requirements at the outset. The freshman year provides engagement with environmental study through DEA 150 and NTRES 201. Depending on student interest and available time, other courses in environmental study may be taken as electives early in the schedule.

Advanced placement credit will be accommodated in the program through consultation with the student's faculty adviser.

Environmental Core

The environmental core consists of five courses. Its purpose is to provide a rigorous, integrated understanding of the environment, broadly defined. This core recognizes that knowledge of the environment encompasses physical and biological sciences, social sciences, and human behavior. ALS 115, required in the freshman year, provides a unifying overview of the goals, facts, depth, and breadth of the major.

Core courses are to provide integration (among areas, disciplines, methodologies, topics, and issues); systems emphasis; basic, rigorous presentation of core material; root competencies for understanding the environment; a framework for further advanced courses; and a new way of thinking that enables innovative solutions to difficult problems.

Environmental Science: ALS 115 Environmental Science: Core Principles

Earth Systems: CSS 365 Environmental Chemistry: Soil, Air, and Water

Biotic Systems: BIOEE 261 Ecology and the Environment

Economic Systems: AEM 250 Environmental and Resource Economics

Social Systems: D SOC 324 (S&TS/SOC 324) Environment and Society

Programs of Study

Programs of study that focus in one or more areas of environmental science are being established to provide disciplinary expertise sufficient for entry-level proficiency. Each student in the major will be required to take four courses at the 300 level or above in at least one program of study.

Programs of study will not replace or duplicate current majors. Rather, they will provide the basic core of knowledge essential for an introductory understanding of the area—the concepts, basic science, methodologies, and major applications. Proposed programs of study are

environmental biology

environmental information science

sustainable development

agroecosystem science

environmental economics

If established programs of study do not meet the student's interests and needs, the student may propose a program of study, in collaboration with a faculty mentor and subject to approval by the Faculty Program Committee.

Freshmen are encouraged to enroll in the introductory environmental science course. For more information about this major, see snes.eas.cornell.edu, visit the undergraduate program office in 12 Fernow Hall, or send e-mail to sw38@cornell.edu.

Special Programs in Agriculture and Life Sciences

Interdisciplinary Studies. The opportunity to develop an independent major in interdisciplinary studies is available for students interested in pursuing a general education in agriculture and life sciences. In consultation with a faculty adviser, students may plan a sequence of courses suited to their individual interests, abilities, and objectives in an area not encompassed by the existing programs. In addition to the distribution and other college requirements, this major may include a concentration of courses in one of several academic units of the college or university.

Students completing this major are often planning a career in agriculturally related food and service enterprises. Many of the fast-growing occupations require the broad perspective, the scientific and technical skills, and the attitudes and the analytical ability that a general education fosters.

Interdisciplinary studies includes production agriculture as well as technical work in the agricultural and life sciences. Many biotechnology concerns deal with aspects of agriculture, especially plants, crops, and ecosystems in the natural environment. A strong grounding in biological sciences as well as knowledge of the agricultural sciences is essential in this rapidly growing field. Students should plan basic course work in the major areas of study in the college—animal sciences, plant sciences, environment and technology, agronomic sciences, biological sciences, and social sciences. Advanced courses may be selected in these and other areas of individual interest or career aspiration. A course of study for a special program must be planned with and approved by a college faculty adviser. Information on the options and names of faculty advisers prepared to advise in special programs are available in the Counseling and Advising Office, 140 Roberts Hall.

Agricultural Science Program

Many students wish to pursue a general education in agriculture to prepare for careers that require knowledge of food systems and natural resources, such as production and marketing of foods (animals and plants) and ornamental plants, agricultural education in secondary schools, cooperative extension, food systems, and crop consultants. The agricultural science program is designed to allow students to work with their adviser in developing a curriculum that best fits the needs of each individual student. In this program, students can gain a broad exposure to the agricultural courses across the college. The program is very flexible and allows students to develop a general course of study and to select one or two areas of concentration.

All students are required to take the core courses. Concentrations requiring at least 12 credits are available in animal science, applied economics and management, education and communication, and plant sciences/agronomy.

Students will gain practical experience through special projects, extracurricular activities, and/or internships. Opportunities are available in research and outreach experiences, and in summer employment, which enrich the practical experience. Students will engage in group activities and will participate in discussions with faculty and other experts in various sectors of the agricultural industry.

Approval of this program as a major is anticipated by summer 2005.

DESCRIPTION OF COURSES

Undergraduate and graduate courses in the college are offered through the academic departments and units and also through the biological sciences undergraduate program and the Division of Nutritional Sciences.

Descriptions of undergraduate and graduate courses are arranged by department, in alphabetical order.

Graduate study is organized under graduate fields, which generally coincide with the departments. Graduate degree requirements are described in the *Announcement of the Graduate School.* Courses for graduate students are described in the section on the academic department that offers them.

INTERDEPARTMENTAL/INTERCOLLEGE COURSES

American Indian Studies

The American Indian Program offers a minor in American Indian Studies to undergraduate students. The minor is earned upon the completion of five courses: AIS 100 and AIS

101, plus at least three other courses from the AIS curriculum, for a minimum total of 15 credit hours. The three additional courses must include one course from Group A (arts and humanities) and one course from Group B (social and natural sciences) as listed below. One of the courses offered toward the minor must be at the 300- or 400-level. Only one 3-credit independent study (AIS 497) may be counted toward the minor. Only program-listed courses for which the student has earned a letter grade of C or better will be counted toward the minor. No courses taken for S-U credit will be counted toward the minor. Students seeking to minor in American Indian studies are encouraged to contact Professor Kurt Jordan, associate director of academic development, 255-3109. Application materials for the minor may also be obtained from the AIP office, 4th floor, Caldwell Hall. Students are also advised to consult www.aip.cornell.edu/academic.htm for the most up-to-date listings of course offerings.

Minor in American Indian Studies

Required Courses

AIS 100 Introduction to American Indian Studies I: Indigenous North America to 1890

AIS 101 Introduction to American Indian Studies II: Contemporary Issues in Indigenous North America

Electives

(Group A, Arts and Humanities)

AIS 195 Colonial Latin America

AIS 236 Native Peoples of the Northeast

AIS 239 Seminar in Iroquois History

AIS 260 Introduction to Native American Literature

AIS 266 Introduction to Native American History

AIS 386 Contemporary American Indian Fiction of the United States

AIS 404 Race and Ethnicity in Latin America

AIS 486 American Indian Women's Literature

AIS 490 New World Encounters, 1500–1800

(Group B, Social and Natural Sciences)

AIS 230 Cultures of Native North America

AIS 235 Archaeology of North American Indians

AIS 311 Social Movements

AIS 333 Environmental Issues and Indigenous People

AIS 340 Contested Terrain: Hawaii

AIS 348 Iroquois Archaeology

AIS 353 Anthropology of Colonialism

AIS 435 Indigenous Peoples and Globalization

AIS 472 Historical Archaeology of Indigenous Peoples

(Independent Study)

AIS 497 Independent Study

J. Mt Pleasant, director; E. Cheyfitz, L. Donaldson, C. Geisler, A. Gonzales, K. Jordan, B. Lambert, M. Muskett, J. Parmenter, A. Simpson

AIS 100(1100) Introduction to American Indian Studies I: Indigenous North America to 1890
Fall. 3 credits. T R 1:25–2:40 plus sec. K. Jordan
Provides an interdisciplinary introduction to American Indian cultures and histories from Precolumbian times to 1890, emphasizing the current relevance of traditional values and the ways the deep past continues to affect present-day Indian peoples. Course materials draw on perspectives from the humanities, social sciences and expressive arts.

AIS 101(1110) Introduction to American Indian Studies II: Contemporary Issues in Indigenous North America
Spring. 3 credits. M W 11:15–12:05 plus sec. A. Simpson.
Interdisciplinary exploration of contemporary issues in American Indian Country north of Mexico after 1890. Examines Indian sovereignty, nationhood, agency and engagement through time using the perspective of American Indian Studies. Course materials are drawn from the humanities, social science and expressive arts.

AIS 195(1950) Colonial Latin America (also HIST 195[1950])
Fall. 4 credits. S-U option. M W 11:15–12:05, plus sec. K. Graubart.
Examines the colonial "encounter" of Iberia, Africa and the New World, which began in 1492. Topics include economic and social organization of the colonies; the cultural hybridity that preceded as well as developed within colonialism; the production of ethnicity and race; slavery, forced labor and economic stratification; intellectual currents and daily life; indigenous and slave resistance and rebellion; and independence.

AIS 230(2300) Cultures of Native North America (also ANTHR 230[2730])
Fall. 3 or 4 credits. M W F 1:25–2:15. B. Lambert.
Survey of the principal Inuit and American Indian culture area north of Mexico. Examines selected cultures to bring out the distinctive features of the economy, social organization, religion, and worldview. Although the course concentrates on traditional cultures, some lectures and readings deal with changes in native ways of life that have occurred during the period of European-Indian contact.

AIS 235(2350) Archaeology of North American Indians (also ANTHR 235[2235])
Spring. 3 credits. M W F 10:10–11:00. K. Jordan.
Introductory course surveying archaeology's contributions to the study of North American Indian cultural diversity and change. A principal focus is on major transformations in lifeways such as the adoption of agriculture, the development of political–economic hierarchies, and the disruptions that accompanied the arrival of Europeans to the continent.

[AIS 236(2360) Native Peoples of the Northeast, Pre-Contact to the Present (also HIST/AM ST 236[2360])
Fall. 4 credits. Not offered 2005–2006. J. Parmenter.
After an initial, hostile series of economic and military exchanges with Europeans beginning off the coast of Maine in 1524, the native peoples of northeastern North America have undergone a fascinating and dramatic series of transformations. Adopting an interdisciplinary perspective, this course analyzes the history of Native Americans in the Northeast from a variety of perspectives. Readings and discussions are drawn from a wide range of secondary and primary sources, including historical documents, traditional narratives, archaeological reports, the Internet, and museum exhibits of material culture. The course emphasizes critical reading of texts and discussion.]

AIS 239(2390) Seminar in Iroquois History (also HIST 239[2390])
Fall. 4 credits. M W 2:55–4:10. J. Parmenter.
Interdisciplinary seminar exploring the history and culture of Iroquois people from ancient times, through their initial contacts with European settlers, to their present-day struggles and achievements under colonial circumstances in North America.

[AIS 260(2600) Survey of American Indian Literatures in the United States (also ENGL 260[2600])
Spring. 4 credits. Not offered 2005–2006. E. Cheyfitz.
Introduction to U.S. American Indian literatures, both oral and written. The method of studying these literatures emphasizes historical, legal, and cultural contexts as well as current critical debates over methodological approaches. In addition to examples of the oral tradition transcribed in writing, students study a variety of written genres from their beginnings in the late 18th century, including autobiography, the essay, poetry, and fiction.]

AIS 266(2660) Introduction to Native American History (also HIST/AM ST 266[2660])
Spring. 4 credits. M W 11:15–12:05, plus sec. J. Parmenter.
With the abandonment of earlier perspectives grounded in romantic and evolutionary stereotypes, Native American history represents today one of the most exciting, dynamic, and contentious fields of inquiry into America's past. This course introduces students to the key themes and trends in the history of North America's indigenous peoples by taking an issues-oriented approach. It stresses the ongoing complexity and change in Native American societies and emphasizes the theme of Native peoples' creative adaptations to historical change. Additionally, the course provides numerous opportunities for students to develop their critical thinking and reading skills.

AIS 311(3110) Social Movements (also D SOC/LSP 311[3110])
Fall. 3 credits. Prerequisites: D SOC/SOC 101 or permission of instructor. S-U grades optional. T R 10:10–11:25. A. Gonzales.
Social movements are collective efforts by relatively powerless groups of people to change society. Typically conceptualized as political activity outside the institutional framework, social movements are "politics by other means." This course examines the transnational dimensions of social movements to assess the implications of globalization for political mobilization and the ways that social movement actors engage the global political process to effect social change. Under what

circumstances do movements emerge? How do global processes shape both domestic and transnational political mobilization? How do movements internally organize and choose political tactics and strategies to achieve their goals? How have social movements changed history, identities, society, and politics? This course addresses these and related questions through an examination of indigenous peoples' movements in the United States, Canada, and Latin America.

AIS 333(3330) Environmental Issues and Indigenous People (also NTRES 333[3330])
Spring. 3 credits. TBA. M. Muskett.
For description, see NTRES 333.

AIS 340(3400) Contested Terrain: Hawaii
Spring. 3 credits. Prerequisite: introductory or intermediate-level social sciences or history. F 8–11 A.M.; one S a month 8–11 A.M. M. M. Hamabata.
This course, offered in conjunction with Earth and Atmospheric Sciences' program in Hawaii, draws from the fields of history, political science, and sociology to present an historical understanding of contemporary Hawaiian society. Topics include Western contact, establishment of Western institutions, overthrow of a sovereign government, annexation, integration into the United States. Direct experience with Hawaiian leaders and institutions are incorporated to address contemporary issues: sovereignty, economic development/dependency, social change, and land use as a sociopolitical and cultural struggle. Students should consult www.eas.cornell.edu/hawaii/ regarding the status of this course.

AIS 348/648(3480/6480) Iroquois Archaeology (also ANTHR 348/648[3480/6480])
Spring. 4 credits. S-U grades optional. K. Jordan.
Surveys the long-term development of Iroquois (Haudenosaunee) culture from an archaeological perspective. Issues examined will include the origins of the Iroquois; material culture, settlement, and subsistence; the Iroquois Confederacy; responses to European encroachment; and contemporary Haudenosaunee perspectives on archaeology. Course requirements differ at the 300 and 600 levels.

AIS 353(3530) Anthropology of Colonialism (also ANTHR 353[3453])
Fall. 4 credits. M W F 10:10–11 A.M. A. Simpson.
Examines the relationship between colonialism and anthropology and the ways in which the discipline has engaged this global process locally in North America. One of the aims is to gain an appreciation of colonialism both as a theory of political legitimacy and as a set of governmental practices. As such, North America is re-imagined in light of the colonial project—and its technologies of rule such as education, law, policy—that worked to transform indigenous notions of gender, property, and territory. Students come to appreciate the ways in which these forms of knowledge and practice advanced the settlement of space and place and both settled and unsettled peoples. This course is comparative in scope but is grounded in the literature from Native North America.

[AIS 386(3860) Contemporary American Indian Fiction (also ENGL 367[3670])
Fall. 4 credits. Not offered 2005–2006.
Examines contemporary American Indian fiction as a response to the colonial structure of federal Indian law. Beginning with Mourning Dove's *Cogewea*, a novel of the Allotment Era, students read works by a range of Native fiction writers (from a list that includes McNickle, Welch, Silko, Vizenor, Hogan, Alexie, Walters, Glancy, and Red Corn) that respond critically to U.S. federal Indian policy.]

AIS 404(4040) Race and Ethnicity in Latin America (also HIST 404[6041])
Fall. 4 credits. Recommended: Latin American history course. M 2:30–4:25. K. Graubart.
Seminar examining the historical production of "race" and ethnicity in the Latin American context, beginning with the creation of "Indians" by European colonists and the introduction of African slaves into these already complex societies. The second half of the course addresses contemporary issues that stem from these colonial concerns: nationalism, the romantic invocation of the indigenous past, cultural practices, land rights, political representation, and enduring racism.

[AIS 435/635(4350/6350) Indigenous Peoples and Globalization (also D SOC 435/465[4350/4650])
Fall. 3 credits. Not offered 2005–2006.
Explores ways in which processes of globalization affect indigenous peoples worldwide and the strategies indigenous peoples are using to deal with those pressures. Globalization, whether under the auspices of the World Trade Organization and regional economic agreements such as the NAFTA or the deterritorialization of social and political arrangements cotemporal with modernization or the expansion of communication technology and its impact on traditional knowledge systems, have had profound social, cultural, and economic impacts on indigenous peoples. At issue are the lands, resources, traditional knowledge, intellectual and cultural property, and indigenous struggles for recognition and self-determination.]

[AIS 472/772(4720/7720) Historical Archaeology of Indigenous Peoples
Spring. 4 credits. Not offered 2005–2006. K. A. Jordan.
Seminar examining the responses of indigenous peoples across the world to European expansion and colonialism over the past 500 years. Archaeological case studies from North America, Africa, and the Pacific provide a comparative perspective on Postcolumbian culture contact and illustrate how archaeology can both supplement and challenge document-based histories.]

[AIS 486(4860) American Indian Women's Literature (also ENGL 486[4860])
Spring. 4 credits. Not offered 2005–2006.
Explores the development of women's literature in a number of different American Indian cultures. Attends to native paradigms of cultural production such as women's songmaking, weaving, basketmaking, and storytelling, as well as the appropriation of European literary forms such as the novel. Students read a diverse range of materials including novels, autobiography, poetry, drama, and short stories.]

AIS 490(4900) New World Encounters, 1500 to 1800 (also HIST 490[4990], AM ST 499[4990])
Spring. 4 credits. M 2:30–4:25. J. Parmenter.
The discovery of the Americas, wrote Francisco Lopez de Gomara in 1552, was "the greatest event since the creation of the world, excepting the Incarnation and Death of Him who created it." Five centuries have not diminished either the overwhelming importance or the strangeness of the early encounter between Europeans and the indigenous peoples of the Americas. Taking a comparative approach, this course conceptualizes early American history as the product of reciprocal cultural encounters by assessing the various experiences of Spanish, French, and English newcomers in different regions of the Americas. Critical interpretation of primary source material is emphasized, as is the development of students' ability to reflect critically on these documents, taking into account the perspective of both the colonizers and the colonized.

AIS 497(4970) Independent Study
Fall or spring. 1–4 credits. Staff.
Topic and credit hours TBA between faculty member and student. The American Indian Program office must approve independent study forms.

[AIS 600(6000) American Indian Studies
Fall. 4 credits. Staff.]

AIS 601(6010) American Indian Studies Proseminar
Fall and spring. 1 credit. TBA. Staff.
Graduate-level course that introduces students to ongoing research in the field of American Indian Studies in a proseminar/colloque format. Advanced graduate students are expected to present their work in progress; all are expected to attend each seminar and provide presenters with critical and constructive commentary on papers.

[AIS 671(6710) Law and Literature in the Antebellum United States (also ENGL 671)
Spring. 4 credits. Not offered 2005–2006. E. Cheyfitz.
For description, see ENGL 671.]

AIS 726(7260) Federal Indian Law: The Legal Construction of Indian Country (also LAW 726)
Spring. 3 credits. TBA. Limited enrollment. Students who have taken LAW 608 American Indian Law may also take this seminar. Letter grades only. E. Cheyfitz.
For description, see LAW 726.

Department of Statistical Science

The university-wide Department of Statistical Science coordinates undergraduate and graduate study in statistics and probability. A list of suitable courses can be found at the front of this catalog (see p. 25).

Environmental Toxicology

A. J. Baeumner, S. E. Bloom, K. J. Boor, P. R. Bowser, D. L. Brown, J. W. Casey, R. R. Dietert, R. A. Durst, J. W. Gillett, A. G. Hay, A. Hedge, J. H. Hotchkiss, L. V. Kochian, W. L. Kraus, A. T. Lemley, L. W. Lion, R. H. Liu, E. L. Madsen, M. B. McBride, C. McCormick, A. Nikitin, B. U. Pauli, M. Roberson, E. Rodriguez, J. G. Scott, M. L. Shuler, S. M. Snedeker, D. A. Soderlund, J. R. Stedinger, B. J. Strupp, D. A. Weinstein, R. S. Weiss, D. B. Wilson, A. Yen

There is both breadth and depth in many facets of environmental toxicology and related disciplines. The program offers a combination of research and didactic training that is designed to prepare students for solving the problems of modern toxicology. The graduate student may choose from three degree options: M.S., M.S./Ph.D., or Ph.D. Concentrations include cellular and molecular toxicology; nutritional and food toxicology; ecotoxicology and environmental chemistry; and risk assessment, management, and public policy. Research by the faculty associated with the program focuses on the interactions of drugs, pesticides, and other potentially hazardous environmental agents with a wide variety of living organisms (including humans) as well as the ecosystems with which these organisms are associated. General information is available through the Environmental Toxicology office in 116 Stocking Hall, or at toxicology.cornell.edu.

TOX 323(3230) Principles of Toxicology (Undergraduate) (also NTRES 323[3230])
Spring. 3 credits. Prerequisites: one year each of chemistry and biology with labs; one semester of organic chemistry lecture or permission of instructor. J. W. Gillett.
For description, see NTRES 323.

TOX 370(3700) Pesticides and the Environment (also ENTOM 370[3700])
Fall. 2 credits. Prerequisites: BIO G 101–102 or equivalent. Offered even years. J. G. Scott.
For description, see ENTOM 370.

TOX 406(4060) Ecology Risk Assessment (also NTRES 406[4060])
Fall. 3 credits. Prerequisites: BIOEE 261 or equivalent; advanced student in natural sciences or engineering or permission of instructor. J. W. Gillett.
For description, see NTRES 406.

TOX 437(4370) Eukaryotic Cell Proliferation (also BIOBM 437[4370])
Fall. Variable credit; students may take lec for 2 credits, or lec and disc for 3 credits. Limited to 20 students per disc; priority given to graduate students. Prerequisite: BIO G 101–102 or 105–106 and BIOBM 330 or 331/332. Recommended: BIOGD 281 and BIOBM 432. S. Lee.
For description see BIOBM 437.

TOX 490(4900) Insect Toxicology and Insecticidal Chemistry (also ENTOM 490[4900])
Spring. 3 credits. Prerequisite: general chemistry course. Offered odd years. J. G. Scott.
For description, see ENTOM 490.

TOX 607(6070) Ecotoxicology (also NTRES 607[6070])
Spring. 3 credits. Prerequisites: graduate or senior standing; two 300-level courses in chemistry, biological science, or toxicology. Offered alternate even years. J. W. Gillett.
For description, see NTRES 607.

TOX 610(6100) Introduction to Chemical and Environmental Toxicology (also BIOMI 610[6100])
Fall. 3 credits. Prerequisite: graduate standing in field or permission of instructor. A. G. Hay.
For description, see BIOMI 610.

[TOX 611(6110) Molecular Toxicology (NS 611[6110])
Spring. 3 credits. Prerequisites: TOX 610 or permission of instructors. Lec, T R 10:10. Offered alternate years; next offered 2006–2007. S. Bloom, R. Dietert, D. Muscarella, and B. Strupp.
For description, see NS 611.]

[TOX 625(6250) Nutritional Toxicology (also AN SC 625[6250])
Spring. 2 credits. Prerequisites: biochemistry and nutrition courses. S-U grades optional. Offered alternate years; not offered 2005–2006. Lec, W 1:25–2:15; lab/disc, W 2:30–4:25. D. L. Brown.
For description, see AN SC 625.]

TOX 698(6980) Current Topics in Environmental Toxicology (also NTRES 698[6980] and NS 700[7000])
Fall, spring. 1 to 3 credits. Prerequisites: graduate or senior standing in scientific discipline and permission of instructor.
For description, see NTRES 698.

TOX 699(6990) Environmental Toxicology Journal Club (also BIOMI 699[6990])
Spring only. 1 credit. Requirement for env. tox. students until post–A exam. A. G. Hay.

TOX 701(7010) Mouse Pathology and Transgenesis (also VTBMS 701[7010])
Spring only. 1 credit. Prerequisites: basic course in histology (BIOAP 413 or equivalent) highly recommended, or permission of instructor. Letter grades only. A. Nikitin.
For description, see VTBMS 701.

TOX 702(7020) Seminar in Toxicology (NS 702[7020])
Fall or spring. 1 credit.
For description, see NS 702.

TOX 713(7130) Cell Cycle Analysis (also VTBMS 713[7130])
Spring. 1. credit. S-U grades only. A Yen.
For description, see VTBMS 713.

TOX 890(8900) Master's Thesis and Research
Fall/spring. Credit TBA. Prerequisite: permission of chair of graduate committee and instructor.

TOX 990(9900) Doctoral Thesis and Research
Fall/spring. Credit TBA. Prerequisite: permission of chair of graduate committee and instructor.

Related Courses in Other Departments

CEE 597(5970) Risk Analysis and Management
Spring. 3 credits. Prerequisite: introduction to probability and statistics course (e.g., CEE 304, ENGRD 270, ILSRT 210, BTRY 261 or AEM 210); two semesters of calculus. Prerequisite: senior or graduate standing or permission of instructor. J. R. Stedinger.
For description, see CEE 597.

FD SC 621(6210) Food Lipids

NONDEPARTMENTAL COURSES

ALS 101(1101) Transition to and Success at Cornell
Fall. 1 credit. Prerequisite: entering students in CALS. Letter grades only. B. O. Earle and CALS Career Development Office.
Discussion-oriented course to enable all new CALS students to enjoy their experience at and transition to Cornell. Lecture, discussion, guest speakers, student panels, and assignments that explore Cornell's history, academic opportunities, services, and organizations are used. Emphasizes the role of Agriculture and Life Sciences in the future of all related careers.

ALS 115(1150) Environmental Science: Core Principles
Fall. 3 credits. Letter grades only. Lec, T R 10:10–11; lab, R 1–4. E. L. Madsen.
Environmental science is the multidisciplinary study of how the Earth works, how to contend with environmental change, and how humans influence and manage the Earth's life-support systems. This course highlights facts and principles from the physical, chemical, biological, social, and economic sciences. The readings, case studies, discussions, field/laboratory experiences, and research topics are designed to unify the curriculum for students majoring in the Science of Natural and Environmental Systems (SNES).

ALS 134(1340) Emergency Medical Technician
Fall and spring. 3 credits each semester. Two-semester course; students enroll in fall semester only. Recommended: basic or advanced first aid. S-U grades optional. Lec, M 1:30–4:30; lab, W 1:30–4:30 or W 6:30–9:30. D. A. Grossman, P. Rach, and A. E. Gantert.
Intensive 140-hour course taught throughout the fall and spring semesters. Includes training in C.P.R. for the professional rescuer, oxygen administration, airway management, fracture management, bleeding control, patient assessment, spinal immobilization, the use of medical antishock trousers, and defibrillation. Students qualify for the New York State E.M.T. Certification Exam upon successful completion of the course.

ALS 135(1350) Advanced Emergency Medical Technician, Critical Care
Fall and spring; two-semester course. 4 credits each semester. Prerequisite: current certification as N.Y.S. Basic E.M.T. or have applied for reciprocity. S-U grades optional. Lec, T 1:30–4:30; lab, R 1:30–4:30, Sat 9:00–12:00. D. Grossman, P. Rach, and D. Spaulding.

Includes topics such as emergency pharmacology, patient assessment, advanced cardiac life support, emergency hypoperfusion management, and basic trauma life support. Uses classroom, lab, hospital, and field sessions to teach skills such as intubation, emergency IV access, electro-cardioversion and defibrillation, and patient assessment and pharmacological intervention. Requires extensive out of classroom (exceeds 140 hours) time.

ALS 392(3920) New York State Government Affairs (also PAM 392[3920])

Spring. 15 credits. Prerequisite: junior or senior standing; minimum GPA of 2.3. W. Rosen.

For description see PAM 392.

ALS 400(4000) Internship

Fall, spring, or summer. 6 credits max. Not open to students who have earned internship credits elsewhere or in previous semesters. S-U grades only.

Students may register only for internships in the New York State Assembly Intern Program, the New York State Senate Session Assistant's Program, and the Albany Semester Program. A learning contract is negotiated between the student and the faculty supervisor(s), stating conditions of the work assignment, supervision, and reporting. Requires participation in any structured learning activities associated with the internship.

ALS 402(4020) Agricultural Study Tour to Burgundy, France

Spring. 2 credits. Prerequisite: registered CALS students. S-U grades optional. L. A. Weston and P. Durand.

Two-week study tour held in the month of May in Burgundy, France. Students experience French agriculture, history, and cuisine. Tour includes wine, fruit, vegetable, cheese, dairy, beef, and poultry production, and French university facilities featuring modern agricultural research. Requires 10- to 20-page paper. Students travel throughout Burgundy and eastern France with Pascal Durand, professor at ENESAD in Dijon, France.

ALS 403(4030) Internship Opportunities in Burgundy, France

Spring. Variable to 4 credits. Prerequisite: enrollment in Agricultural Study Tour to Burgundy, France. Recommended: some French language experience. S-U grades optional. L. A. Weston and P. Durand.

Six- to eight-week internship experiences in Burgundy, France, in agriculturally related subject areas including viticulture, agribusiness, agronomy, food science, and biotechnology. Requires final paper documenting internship experience.

ALS 477(4770) Environmental Stewardship in the Cornell Community

Spring. 2–4 credits, variable. T R 11:40–1:10. J. M. Regenstein, plus faculty adviser.

Each student undertakes an original project to improve the environment at Cornell while working with a faculty adviser and the Cornell infrastructure (generally campus life and/or facilities). Through class discussions, students learn how to be more effective at developing environmental programs in the future, both during and after college. Students present the final written project report orally at a public forum. (**Note:** If students prefer to take 1 or 2 credits of independent research in a department in the College of Agriculture and Life Sciences, this can be arranged. Assistance in finding a faculty adviser is provided. May be taken more than once.)

ALS 481(4810) Global Conflict and Terrorism

Spring. 3 credits. Lec, M 7:30–9:30; sec, R 2:30–3:20. J. Shanahan.

Reviews and discusses issues concerning global development and its relationship to conflict and terrorism. Each class session focuses on a specific topic presented by either a faculty member or a guest speaker leading the discussion and actively engaging the students. The weekly discussion section focuses on discussing in greater depth the reading assignments.

ALS 494(4940) Special Topics in Agriculture and Life Sciences

Fall or spring. 4 credits max. S-U grades optional.

The college teaches "trial" or temporary courses under this number. Offerings vary by semester and are advertised by the college before the beginning of the semester. The same course is not offered more than twice under this number.

ALS 499(4991/4992) Honors Project I and II (also B&SOC/S&TS 499[4991/4992])

Fall and spring (yearlong). 8 credits each semester. Prerequisite: biology & society seniors and permission of department; overall GPA of 3.3. Apply in 306 Rockefeller Hall.

Students who are admitted to the honors program are required to complete two semesters of honors project research and to write an honors thesis. The project must include substantial research and the completed work should be of wider scope and greater originality than is normal for an upper-level course.

ALS 500(4998) Politics and Policy: Theory, Research, and Practice [also AM ST 501(4998), PAM 406(4998), GOVT 500(4998)]

Students in CALS must register for ALS 500. S. Jackson and staff.

This course, taught in Washington, D.C., forms the core of the public policy option of the Cornell in Washington program. The central objective is to provide students with the instruction and guidance necessary to analyze and evaluate their own chosen issue in public policy. Toward that end, the course has three components: (1) weekly lectures providing background on the structures and processes of national politics and policy as well as training in research methodology; (2) student externships; and (3) individual research papers or projects. All three components interrelate to provide students with a strategy and framework for integrating classroom-based learning, field experience, and individual research. Students apply through the Cornell in Washington office, M101 McGraw Hall.

ALS 580(5800) International Teaching Assistant Development Program Course 3

Fall or spring. 2 credits. Prerequisite: EDUC 579. ITADP staff.

Specifically designed for international graduate students who plan to assume teaching assistant responsibilities that range from lab introductions to individual tutoring sessions with undergraduate students. Participants address English-language issues relating to phonemes, grammar, and suprasegmentals. Activities in these areas target communicative functions such as presenting concepts, initiating and sustaining conversation, and interpreting information in academic settings.

ALS 581(5810) International Teaching Assistant Development Program Course 4

Fall or spring. 2 credits. Prerequisite: ALS 580. ITADP staff.

Specifically designed for international graduate students who plan to assume teaching assistant responsibilities that range from lab introductions to individual tutoring sessions with undergraduate students. Participants develop skills in self-monitoring, critical listening and language fluency with attention to time frame usage, academic terminology, extended discourse, and compensatory speech strategies.

ALS 661(6610) Environmental Policy [also B&SOC 461(4611), BIOEE 661(6610)]

Fall and spring. 3 credits each semester; students must register for 6 credits each semester since "R" grade is given at end of fall semester. Limited to 12 students. Prerequisite: permission of instructor. Sem, R 2:30–4:30. D. Pimentel.

Focuses on complex environmental issues. Ten to 12 students, representing several disciplines, investigate significant environmental problems. The research team spends two semesters preparing a scientific report for publication in *Science* or *BioScience*. Thus far, every study has been published.

APPLIED ECONOMICS AND MANAGEMENT

W. H. Lesser, chair (154 Warren Hall, 255-4576); C. B. Barrett, N. L. Bills, G. Blalock, V. L. Bogan, R. N. Boisvert, L. D. Chapman, N. H. Chau, R. D. Christy, J. M. Conrad, R. T. Curtis, H. Daouk, H. de Gorter, B. A. Gloy, C. Gomes, D. A. Grossman, J. M. Hagen, D. R. Just, H. M. Kaiser, S. M. Kanbur, W. A. Knoblauch, S. C. Kyle, E. L. LaDue, D. R. Lee, A. E. Leiponen, J. E. Little, E. W. McLaughlin, T. D. Mount, D. T.-C. Ng, A. M. Novakovic, P. D. Perez, D. J. Perosio, G. L. Poe, J. E. Pratt, J. T. Prince, S. P. Raj, C. K. Ranney, W. D. Schulze, D. H. Simon, M. W. Stephenson, D. H. Streeter, L. W. Tauer, W. G. Tomek, C. L. van Es, A. Wang, B. Wansink, G. B. White

Courses by Subject

Farm management, agricultural finance, and production economics: 302, 403, 404, 405, 608, 708

Statistics, quantitative methods, and analytical economics: 210, 410, 411, 412, 415, 417, 419, 711, 712, 713, 714, 717

Management, finance, law, and accounting: 220, 221, 222, 320, 321, 322, 323, 324, 325, 327, 329, 420, 421, 422, 424, 425, 427, 428, 429

Policy and international trade: 230, 335, 430, 431, 432, 433, 434, 630, 632, 633, 634, 730, 735

Marketing and food distribution: 240, 241, 342, 344, 346, 442, 443, 444, 446, 447, 448, 449, 640, 641

Environmental and resource economics: 250, 450, 451, 555, 651, 655, 750

Economics of development: 464, 660, 667, 762, 765

Consumer economics: 670

General, contemporary issues, research, and other: 101, 200, 380, 494, 497, 498, 499, 694, 698, 699, 700, 800, 900, 901

AEM 101(1101) Introduction to Applied Economics and Management
Fall. 1 credit. Prerequisite: required of and limited to freshmen in AEM. S-U grades only. D. A. Grossman and A. M. Novakovic.
Freshman transition course exploring the major courses of study available to AEM students, including a discussion of "hot topics," research, and career paths in each field. Numerous AEM faculty members are guest presenters. Students are introduced to campus resources such as the library system, study abroad opportunities, course planning, career planning, and learning strategies. Short written assignments and active group participation are required.

AEM 120(1200) Foundations of Entrepreneurship and Business
Fall. 2 credits. P. D. Perez.
Introductory course providing a sound base to both the understanding of entrepreneurial activity and possibilities and the study and practice of entrepreneurship at Cornell. Includes lectures, selected guest appearances by successful entrepreneurs, and extensive use of IT–based learning and presentation tools.

AEM 121(1210) Entrepreneurship Speaker Series
Fall. 1 credit. M. P. D. Perez.
Seminars and guest lectures by faculty members engaged in the study and practice of entrepreneurship and by prominent entrepreneurs associated with the Entrepreneurship and Personal Enterprise program at Cornell, with a view to inform and inspire students. Evaluation includes attendance and written feedback on lectures. Intended as a companion to AEM 120 but may be taken independently.

AEM 200(2000) Contemporary Controversies in the Global Economy
Fall. 3 credits. Prerequisite: ECON 101. Recommended: ECON 102. Priority given to sophomores and juniors in AEM. C. Barrett.
Aims to stimulate critical thinking and cogent writing and speaking about contemporary controversies that attract regular attention in the international press and among key private and public sector decision-makers. Students read and discuss competing arguments about current issues such as patenting and pricing of pharmaceuticals worldwide, controls on commercial and humanitarian distribution of genetically modified foods, and immigration restrictions. Students write a series of short briefing papers and give regular oral briefs, which are evaluated for quality of communication and content.

AEM 210(2100) Introductory Statistics
Spring. 4 credits. Prerequisite: EDUC 115 or equivalent level of algebra. Two evening prelims. C. van Es.
Introduces statistical methods. Topics include the descriptive analysis of data, probability concepts and distributions, estimation and hypothesis testing, regression, and correlation analysis. Uses applications from business, economics, and the biological sciences to illustrate the methods covered.

AEM 220(2200) Introduction to Business Management
Spring. 3 credits. Two evening prelims. P. D. Perez.
Provides an overview of management and business. Human resource, marketing, finance, and strategy concerns are addressed with consideration paid to current issues such as technology and its impact on operations, globalization, ethics, quality, and entrepreneurship. Guest speakers are an important part of the course.

AEM 221(2210) Financial Accounting
Fall. 3 credits. Not open to freshmen. Priority given to CALS majors. Two evening prelims. J. Little.
Comprehensive introduction to financial accounting concepts and techniques, intended to provide a basic understanding of the accounting cycle, elements of financial statements, underlying theory of GAAP, and financial statement interpretation. Topics include methods of recording inventory, receivables, depreciation, bonds, and equity. Requires two evening prelims and a comprehensive final; weekly homework assignments.

AEM 222(2220) Business Management Case Analysis
Spring. 1 credit. Requirement for and limited to AEM majors. P. D. Perez.
Offers students teams the opportunity for hands-on application of general business management concepts through discussion and written analysis of a series of cases. Case topics are closely coordinated with both the content and sequencing of material presented in AEM 220.

AEM 230(2300) International Trade and Finance (also ECON 230[2300])
Spring. 3 credits. Prerequisites: ECON 101 or equivalent. Recommended: ECON 102 or equivalent. S-U grades optional. One evening prelim. D. R. Lee.
One-semester introduction to international economic principles and issues. Begins by surveying key topics such as the elements of comparative advantage, tariff and nontariff barriers, and multilateral institutions. The second part of the course treats selected topics in international finance, including exchange rates, balance of payments, and capital markets. Discusses current issues such as the effects of trade liberalization, trade and economic growth, and instability in international capital markets. Designed as a less technical introduction to concepts developed at a more advanced level in AEM 430 and ECON 361–362.

AEM 240(2400) Marketing
Fall. 3 credits. E. W. McLaughlin.
Provides a broad introduction to the fundamentals of marketing. Explores the components of an organization's strategic marketing program, including how to price, promote, and distribute goods and services. Industry guest lectures and current marketing applications from various companies are presented and analyzed.

AEM 241(2410) Marketing Plan Development
Fall. 1 credit. Requirement for and limited to AEM majors. D. J. Perosio.
Offers student teams the opportunity for an intense, hands-on application of basic marketing concepts through research and development of a marketing plan. Guided by a series of assignments, teams develop key components that are integrated into a comprehensive written plan for a local business.

AEM 250(2500) Environmental and Resource Economics
Spring. 3 credits. S-U grades optional. G. L. Poe.
Introduces fundamental economic principles and the "economic approach" to policy issues, and demonstrates how these concepts underpin contemporary environmental and natural resource issues and policy solutions. Subjects include valuation, benefit-cost analysis, policy design, property rights, and ecological economics. Uses these tools to explore major current policy issues such as economic incentives in environmental policy, endangered species protection, air and water pollution, depletion of renewable and nonrenewable resources, and global warming.

AEM 302(3020) Farm Business Management
Fall. 4 credits. Not open to freshmen. Prerequisite for AEM 405 and 427. On days farms are visited, sec is 1:25–6. W. A. Knoblauch.
Intensive study of planning, directing, organizing, and controlling a farm business, with emphasis on the tools of managerial analysis and decision making. Topics include financial statements, business analysis, budgeting, and acquisition, organization, and management of capital, labor, land, buildings, and machinery.

AEM 320(3200) Business Law I (also NBA 560[5600])
Fall and summer. 3 credits. Prerequisite: junior, senior, or graduate standing. One evening prelim. D. A. Grossman.
Examines legal problems of particular interest to persons who expect to engage in business. Emphasizes the law of contracts, sales, agency, and property.

AEM 321(3210) Business Law II (also NBA 561[5610])
Spring. 3 credits. Prerequisite: junior, senior, or graduate standing; business law course or permission of instructor. D. A. Grossman.
The first portion of this course examines legal issues in the formation and operation of business enterprises, particularly partnerships, corporations, and limited liability companies. The second portion reviews selected topics in business law, like employment discrimination, debtor/creditor relations, product liability, unfair competition, e-commerce law, and international business law.

AEM 322(3220) Information Technology Strategy
Spring. 3 credits. Prerequisites: AEM 220 and ECON 101. A. Leiponen.
Explores the impact of new technologies on business processes and industries. Focuses particularly on the effects of information and communication technologies (ICT).

The objective is to understand the nature of information as an economic good, business opportunities and challenges created by ICT, and organizational constraints involved in exploiting these opportunities.

AEM 323 Managerial Accounting
Spring. 3 credits. Priority given to CALS majors. Prerequisite: AEM 221 or equivalent. Two evening prelims. J. Little.
Introduction to cost accounting emphasizing the application of accounting concepts to managerial control and decision making. Major topics include product costing, standard costing, cost behavior, cost allocation, budgeting, variance analysis, and accounting systems in the manufacturing environment. Requires use of electronic spreadsheets. Includes two evening prelims, a third exam, weekly homework.

AEM 324(3240) Finance
Fall. 4 credits. Priority given to CALS majors. Prerequisites: AEM 210, 220, and 221, or equivalents. Three evening prelims. R. Curtis.
Focuses on the mathematics of finance, valuation, and the economics of managerial decisions, corporate financial policy, risk management, and investments. Topics include the time value of money, bond and stock valuation, capital-budgeting decisions, financing alternatives, the cost of capital and the capital-structure decision, distribution policy, mergers and acquisitions and restructuring, options, forward and futures contracts, market efficiency and market anomalies, strategies of successful investors, and personal finance.

AEM 325(3250) Personal Enterprise and Small Business Management
Spring. 4 credits. Prerequisites: junior or senior standing; AEM 220 and 221 or permission of instructor. Absolutely no adds or drops after second class meeting. Cost of term project: approx. $100 per team. D. Streeter.
Focuses on the activities involved in planning a start-up business, including the exploration of strategic dimensions, performance of marketing research, and planning of financial aspects related to the new company. Lectures and hands-on clinics include visits by real world entrepreneurs, who discuss the start-up process and the challenges of managing growth in a small business. Term project is the development of a business plan, completed in teams of no fewer than three students.

AEM 328(3280) Innovation and Dynamic Management (also H ADM 444[4443])
Spring. 3 credits. Prerequisite: junior or senior standing. Staff.
For description, see H ADM 443.

AEM 329(3290) International Agribusiness Study Trip
Fall. 2 credits. Prerequisites: AEM 220 or 302, and 240. Open by application before March 1 of spring semester before course is offered. Approximately 12 students are selected with preference given to sophomores and juniors in CALS. Field study co-payment: $800. B. A. Gloy and L. W. Tauer.
Gives students interested in agribusiness management exposure to the managerial practices essential to the success of agriculture, agribusiness, and food companies competing in the global marketplace. Involves a two-week international field study trip that takes place after the final exam period of the spring semester before the course is offered. The course meets for a few sessions in advance of the field study trip. A paper analyzing an aspect of the field study is required.

AEM 330(3300) Managerial Economics and Decision Making
Spring. 3 credits. Prerequisites: AEM 220 and ECON 101. D. Simon.
Focuses on tools for making various decisions managers encounter in the real world, including decisions of pricing, output, advertising expenditures, and new product introductions. Considers issues such as how to estimate a firm's demand and cost functions as considered in making such decisions. Compares standard microeconomic models with more realistic approaches to making decisions. Emphasizes considering decisions that are less stylized and more similar to those managers face on a regular basis.

AEM 331(3310) Economic of Business Regulation
Spring. 3 credits. Prerequisites: ECON 101, 313, and AEM 220. S-U or letter grades. J. Prince.
Studies the economics and other factors (e.g., politics, lobbying) that determine regulation policy along with firm strategies in regulated or potentially regulated markets. Major topics include: antitrust, economic regulation and environmental regulation. Applications to the current business environment are emphasized.

AEM 334(3340) Women, Leadership, and Entrepreneurship
Fall. 1 credit. D. Streeter.
Seminar that uses lectures, guest panels, and readings to focus on issues facing women (and their partners) in their business careers. Topics include status of women in business leadership, pathways and strategies for leadership development, family/life balance issues, gender issues in the workplace, and resources for emerging leaders.

[AEM 335(3350) International Technology Marketing of Biotechnology
Spring. 3 credits. Prerequisites: ECON 101 and BIOG 109 or equivalents. S-U grades optional. W. H. Lesser.
Explores international technology marketing from an economics perspective using biotechnology as an example. Topics include technology theories, products, risk (health and environmental) regulation, industry structure, labeling uses and regulations, public perceptions, patents, trade, and international conventions. The course is of interest to students of biotechnology, public technology policy, and international technology marketing.]

[AEM 340(3400) Futures and Options Trading
Fall. 3 credits. Prerequisite: junior or senior standing. Priority given to CALS juniors and seniors, then non-CALS seniors; ECON 101, EDUC 115, and AEM 210 or equivalent. S-U grades optional. Staff.
Focuses on the use of futures and options as risk management tools. Covers commodities, exchange rate, and interest rate derivatives from the perspective of the hedger, but those also provides insight for students interested in arbitrage and speculation. Students participate in a simulated trading exercise in which they use price and market information and input from industry experts to manage a hedge position.]

AEM 342(3420) Integrated Marketing Communication
Fall. 3 credits. Prerequisite: introductory marketing course. S. P. Raj.
Focuses on decisions regarding communication and promotion decisions in companies that market consumer products and services. Explores how business-to-business communication differs. Responsibility for many of these decisions typically resides under the brand-management umbrella and calls for an integrated approach to planning, budgeting, and evaluating advertising, sales promotion, and public relations.

AEM 344(3440) Consumer Behavior
Fall. 3 credits. Prerequisites: AEM 240 or equivalent. B. Wansink.
Develops a useful, conceptual understanding of the problems and strategies associated with psychology behind consumer behavior. In doing so, the course provides frameworks that enable students to address these issues responsibly, systematically, and creatively.

AEM 346(3460) Dairy Markets and Policy
Spring. 3 credits. Prerequisites: junior, senior, or graduate standing; ECON 101 or equivalent. S-U grades optional. A. Novakovic.
Survey of topics related to the structure and performance of U.S. dairy markets and federal and state policies that regulate market activities. Emphasizes learning both the origin and characteristics of dairy policies and methods for analyzing their impacts on market performance.

AEM 380(3800) Independent Honors Research In Social Science
Fall or spring. 1–6 credits. Prerequisite: requirements for honors program met (see "Honors Program" under CALS).
Provides qualified students an opportunity to conduct original research under supervision. Information is available in the AEM undergraduate program office in Warren Hall.

AEM 403(4030) Farm Management Study Trip
Spring. 1 credit. Prerequisite: AEM 302. Open by application only. W. A. Knoblauch.
Special program to study production and management systems in diverse agricultural regions of the United States. Includes a trip (usually taken during spring break) to the region being studied. A different region is visited each year. The course meets in advance of the study trip and upon return from trip. Students must write a paper that further explores an aspect of the trip.

AEM 404(4040) Advanced Agricultural Finance Seminar
Spring. 3 credits. Limited to 16 students. Prerequisite: senior standing; extensive course work in farm management and farm finance. Open by application before March 1 of year before course is offered. Staff.
Special program in agricultural finance, conducted with financial support from the Farm Credit System. Includes two days at Northeast Farm Credit offices, one week in Farm Credit Association offices, a one-day program on FSA financing during fall semester, a two- to four-day trip to financial institutions in New York City, and an actual

farm consulting and credit analysis experience in the spring semester.

AEM 405(4050) Agricultural Finance
Spring. 4 credits. Prerequisite: AEM 302 or equivalent. L. Tauer.
Discusses the principles and practices used in financing agricultural businesses, from the perspectives of the business owner and the lender. Topics include sources of capital, financing entry into agriculture, financial analysis of a business, capital management, financial statements, credit instruments, loan analysis, financial risk, and leasing.

AEM 410(4100) Business Statistics
Fall. 3 credits. Prerequisite: AEM 210 or equivalent. C. van Es.
Focuses on techniques used to analyze data from marketing research, business, and economics. Topics include experimental design and ANOVA, contingency-table analysis, quality-control methods, time-series analysis and forecasting. Also includes brief introductions to nonparametric methods and multivariate analysis. Involves a research project designed to give experience in collecting and interpreting data.

AEM 411(4110) Introduction to Econometrics
Fall. 3 credits. Prerequisite: AEM 210 and either ECON 313 or PAM 200 or equivalents. D. Just.
Introduces students to basic econometric principles and the use of statistical procedures in empirical studies of economic models. Introduces assumptions, properties, and problems encountered in the use of multiple regression are discussed and simultaneous equation models, simulation, and forecasting techniques.

AEM 412(4120) Computational Methods for Management and Economics
Spring. 3 credits. Primarily for juniors, seniors, and M.S. degree candidates. Prerequisite: AEM 210 or equivalent. C. Gomes.
Course in applied mathematical programming. Emphasizes formulation of and interpretation of solutions to mathematical models of problems in economics and business. Studies blending, resource allocation, capital budgeting, transportation and financial planning, and inventory management. Introduces integer and nonlinear programming.

AEM 414(4140) Behavioral Economics and Managerial Decisions
Fall. 3 credits. Prerequisites: junior or senior standing; ECON 313 or PAM 200. Lab fee: $40. D. Just.
Behavioral economics integrates psychology and economics by identifying systematic anomalies in decision-making. These are now recognized to be an important source of error in business decisions, and provide the foundation for both behavioral marketing and finance. The course compares rational choice theory with behavior both in lecture and through a series of economics experiments in which students face situations that are likely to lead to anomalies such as "the winner's curse," the status quo bias, hyperbolic discounting, and bias in assessing risks. Students have the opportunity to evaluate their own decision-making.

AEM 415(4150) Price Analysis (also ECON 415)
Fall. 3 credits. Prerequisites: AEM 210 or equivalent, ECON 313 or PAM 200 or equivalent. H. M. Kaiser.
Focuses on the analysis of supply and demand characteristics of commodities with particular attention to agricultural products. Pays special attention to empirical analysis. Includes institutional aspects of pricing, temporal and spatial price relationships, price forecasting, and the economic consequences of pricing decisions.

AEM 416(4160) Consumer Demographics and Market Analysis (also D SOC 331[3310])
Summer. 3 credits. Prerequisite: AEM 210 or equivalent. W. Brown.
For description, see D SOC 331.

AEM 417(4170) Decision Models for Small and Large Businesses
Fall. 3 credits. Prerequisites: junior or senior standing (priority given to AEM majors); AEM 210 or equivalent. No F lec in weeks labs are held. C. L. van Es.
Focuses on economic and statistical models of decision analysis and their applications in large and small business settings. Demonstrates how use of models can improve the decision-making process by helping the decision maker. Emphasizes the importance of sensitivity analysis and the need to combine both quantitative and qualitative considerations in decision making. Draws cases from small business scenarios, the public policy arena, and corporate settings. Lab sessions focus on implementing decision models with computers.

AEM 419(4190) Strategic Thinking
Fall. 3 credits. Prerequisite: PAM 200 or ECON 313. S-U grades optional. N. H. Chau.
The art of thinking strategically puts outdoing one's adversary at the core of the decision-making process, while anticipating that the adversary is doing exactly the same thing. Businesses make investment decisions and innovate products in anticipation of the reaction of their rivals; managers make pay contingent on peer performance, taking into account the reaction of their subordinates and superiors; national trade policies are formulated based on whether trading partners are committed to make credible concessions. This course introduces and explores the use of game theory to understand these interactions; students are expected to work with a balanced dose of both theory and relevant case studies. The objective of the course is to facilitate students' ability to think strategically on firm level issues (e.g., pricing, advertising wars, product differentiation, and entry deterrence) and strategic policy interaction in international economic relations (e.g., trade wars, and the arms race).

AEM 420(4200) Investments
Spring. 3 credits. Prerequisites: AEM 210 or equivalent and AEM 324. Recommended: basic knowledge of statistics and linear algebra. Priority given to AEM students. S-U grades optional. A. Wang.
Introduces the basic conceptual frameworks and analytical tools used in investment analysis. These tools are then applied to a variety of financial applications, both theoretical and empirical. Topics include: forwards and futures, portfolio theory, CAPM, options, financial management, and selected advanced topics. A portion of this course involves the use of a spreadsheet or other computer programs.

AEM 421(4210) Derivatives and Risk Management
Fall. 3 credits. Prerequisites: AEM 210 and 324 or equivalents. Recommended: ECON 313 or equivalent and a calculus course; familiarity with calculus and probability and statistics. Priority given to students in AEM. S-U grades optional. H. Daouk.
Covers the pricing of derivatives and how derivatives can be used for the purpose of risk management and speculation. A portion of this course involves the use of a spreadsheet or other computer programs.

AEM 422(4220) Estate Planning (also NBA 562[5620])
Fall. 1 credit. Prerequisite: junior, senior, or graduate standing. S-U grades only. D. A. Grossman.
Fourteen sessions on the various aspects of estate planning techniques. Covers the law and use of trusts, the law of wills, federal and New York State estate and gift taxes, and substitutes for probate procedures.

AEM 423(4230) Contemporary Topics in Applied Finance
Fall. 3 credits. Prerequisites: ECON 101, MATH 111 or equivalent, AEM 210 or equivalent, AEM 324. Letter grades. V. Bogan.
Stimulates critical thinking about contemporary topics that attract attention in the press and among key finance decision-makers. This analytical course draws on the theory of modern finance to facilitate the understanding of real world issues. Covers traditional topics in financial markets such as security trading, derivatives, fixed income, IPOs, portfolio formation, and market efficiency. Also explores newer issues such as technology and financial markets.

AEM 424(4240) Management Strategy
Fall and spring. 3 credits. Prerequisite: AEM seniors in business. Fall, G. Blalock; spring, D. Simon.
Capstone course designed to integrate what students have learned in other AEM courses with an emphasis on strategic decision making. Approaches issues from the standpoint of the board of directors, chief executive officer, and business unit managers. Focuses on what should be considered and how strategic decisions should be made.

AEM 425(4250) Small Business Management Workshop
Fall. 4 credits. Prerequisite: senior standing, AEM 325 or NBA 300 and permission of instructor. Cost of term project: approx. $100 per team. D. Streeter.
Students serve as counselors to small businesses in the central New York area and confront problems facing small personal enterprises. Encourages the application of business principles to an existing business and the witnessing of the results of firm-level decision making. Student teams meet with the business owners and course staff members at arranged times during the semester.

AEM 427(4270) Agribusiness Strategy
Fall. 3 credits. Prerequisite: AEM 220 or 302. B. A. Gloy.
Intended for students with an interest in agribusiness and designed to integrate previous course work and enhance

problem identification and solving skills. Focuses on the evaluation, formulation, and implementation of strategy designed to create and sustain competitive advantage for agribusiness firms. Covers industry analysis, firm analysis, market analysis and selection, risk analysis, strategy development, organizational design and structure, and leadership for agribusiness firms. Designed as a capstone course for the agribusiness management specialization.

AEM 428(4280) Valuation of Capital Investment

Spring. 3 credits. Prerequisites: AEM 210 and 324 or equivalents. D. T.-C. Ng.

Focuses on the analysis of financial information—particularly firms' financial reports—for making decisions to invest in businesses. The primary focus is on equity (share) valuation, with some attention given to credit analysis. Examines various valuation models in detail and applies them in cases and projects involving listed companies. Topics include models of shareholder value, discounted cash flow approaches to valuation, the analysis of profitability, growth, and valuation generation in a firm, forecasting earnings and cash flows, proforma analysis for strategy and planning, analysis of risk, and the determination of price/earnings and market-to-book ratios.

AEM 429(4290) International Finance

Spring. 3 credits. Prerequisites: AEM 210 and 324. S-U grades optional. D. T.-C. Ng.

Teaches students about issues in international financial management and international investment. The major issues discussed include exchange rate volatility, the benefit of international diversification, and the analysis of international capital budgeting decisions. Specific topics include the determination of the cost of capital for foreign investments, the determination and management of foreign exchange risks and country risks, and the use of innovative financing for the multinational corporation.

AEM 430(4300) International Trade Policy

Spring. 3 credits. Prerequisites: ECON 101–102 or equivalents and intermediate microeconomics course. S-U grades optional. N. H. Chau.

Examines the economic principles underlying international trade and monetary policy, and the policies, practices, and institutions that influence trade and foreign exchange markets. Also emphasizes applications to current topics in international trade policy, to trade in primary commodities, and to both developed and developing countries.

AEM 431(4310) Agricultural and Food Policy

Spring. 3 credits. Prerequisites: junior, senior, or graduate standing; PAM 200, ECON 301, 313, or equivalent. S-U grades optional. A. Novakovic.

Acquaints students with current and historically important U.S. policies related to agriculture and food, including subsidies and regulations related to markets, production, and the environment. Explores methods of policy analysis, and students learn to critique policies and write policy briefs.

AEM 432(4320) Business and Governments in a Global Marketplace

Fall. 3 credits. Prerequisite: intermediate microeconomics course. C. K. Ranney.

The government agency and the individual business enterprise are two of the most powerful institutions in modern society. This course looks at the economic interfaces between government and business. The shifting and complicated relationships between them exert great influence on the changing performance of the economy and on the lives of citizens. These relationships range from cooperative to competitive, from friendly to hostile. It is an uneasy relationship, each side possessing basic powers and yet each having an important need for the other. In the United States, the result is a mixed economy in which the public and the private sectors interact in many ways. Government exercises a variety of important powers in dealing with the individual private enterprise, ranging from taxation to regulation. Business, in turn, relies on constitutional protections as well as on public support of its basic role in creating income, employment, and material standards of living. In a dynamic and increasingly globalized economy, the business-government relationship is constantly changing and the line between public and private sectors frequently shifts. Future managers are constantly confronted with issues that relate to government-business interfaces.

AEM 433(4330) Devolution, Privatization, and the New Public Management (also CRP 412[4120], FGSS 411/611[4110/6110])

Fall. 4 credits. Prerequisite: ECON 101. S-U grades optional. M. E. Warner.

For description, see CRP 412.

AEM 434(4340) Government Policy Workshop (also CRP 418[4180], FGSS 420[4200])

Spring. 4 credits. S-U grades optional. M. E. Warner.

For description, see CRP 418.

AEM 437(4370) Technological Change and Innovation Strategy

Spring. 3 credits. Prerequisites: AEM 220 and ECON 101. A. Leiponen.

Explores innovation and technological change. Studies how technological change affects economies and industries, and how innovation of new products, processes, and services takes place in firms. Focuses on the creation, management, and exchange of knowledge within and across organizational boundaries.

AEM 442(4420) Emerging Markets

Fall. 3 credits. Prerequisites: senior or graduate standing; AEM 240 and PAM 200 or ECON 313. R. D. Christy.

Provides a framework for examining the effectiveness of marketing strategies in economies in transition and identifying the challenges and opportunities for firms in low-income economies to access industrial markets. Appraises the risk of entering markets in low-income economies and assesses the political, legal, cultural, and economic forces. Analyzes and discusses case studies of companies.

AEM 443(4430) Food-Industry Strategy

Fall. 3 credits. Prerequisite: AEM juniors, seniors, or graduate students; AEM 240 or 448; or permission of instructor. J. M. Hagen.

Examines the decisions that businesses must make, such as what to sell, where to invest, when to outsource, and how to market—all in a changing and competitive environment. While the principles are applicable to any competitive environment, the focus is on one industry, the food industry, to allow an in-depth look at how the various players (manufacturers, retailers, and others) both cooperate and compete in the process of supplying food to consumers. Students learn how such issues as globalization, industry consolidation, new technologies, and health concerns add to their challenges and opportunities.

AEM 444(4440) Marketing Strategy and Brand Management

Fall. 3 credits. Prerequisite: AEM 240. S. P. Raj.

A sound marketing strategy is essential for the long-term success of a firm. This requires an understanding of how customer needs evolve, how product-market boundaries shift, and how competitors are likely to react. The strategic roles of existing and new products need to be assessed, appropriate resource allocations made, and strategies developed to ensure sustained growth. The course is designed to provide opportunities to learn about the theoretical and applied perspectives of marketing strategy from readings, case analyses, and guest speakers.

AEM 446(4460) Food Marketing Colloquium

Fall. 1 credit. Prerequisite: junior or senior standing; extensive course work in food industry management and marketing. D. J. Perosio.

AEM 446 and 447 have been developed as a two-semester special seminar that provides the weekly focus for the Food Marketing Fellows Program. The seminar covers advanced topics in food marketing, many of which have an important international dimension and are presented by industry members. Several field trips are taken. Students participate in research topics on various aspects of the food industry.

AEM 447(4470) Food Marketing Colloquium

Spring. 1 credit. Prerequisite: food marketing fellows. D. J. Perosio.

For description, see AEM 446.

AEM 448(4480) Food Merchandising

Spring. 3 credits. Prerequisite: junior or senior standing; AEM 240. D. J. Perosio.

Covers merchandising principles and practices as they apply to food industry situations. Examines the various elements of merchandising such as buying, pricing, advertising, promotion, display, store layout, profit planning and control, and merchandising strategy. Considers the consequences of food industry trends and initiatives for other industry members, public policymakers, and consumers.

AEM 449(4490) Global Marketing Strategy

Spring. 3 credits. Prerequisite: junior, senior, or graduate standing; marketing course. J. M. Hagen.

Examines opportunities and challenges in the rapidly changing global marketplace. Topics

include the decision to serve a foreign market, alternative strategies for entry into foreign markets (such as exporting or establishing a local subsidiary), and issues in implementing those strategies. Includes case analysis and discussion.

AEM 450(4500) Resource Economics (also ECON 450[4500])
Fall. 3 credits. Prerequisites: MATH 111, ECON 313, and familiarity with Excel. J. M. Conrad.
Constructs dynamic models of renewable, nonrenewable, and environmental resources to examine market allocation and optimal resource management.

AEM 451(4510) Environmental Economics (also ECON 409[4090])
Spring. 3 credits. Prerequisites: undergraduate standing; intermediate microeconomics course, and calculus. S-U grades optional. G. L. Poe.
Explores the economic foundations for public decision making about environmental commodities and natural resources, using tools from intermediate microeconomics. Emphasizes the welfare economic approach for allocating public goods, with specific emphasis on market failure, externalities, benefit-cost analysis, nonmarket valuation techniques, and cost-effective policy instruments. Also examines property rights/institutional perspectives and ecological economic concepts.

AEM 460(4600) Security Trading and Market Making
Spring. 3 credits. Prerequisite: AEM 324. S-U grades optional. A. Wang.
Theory and practice of securities trading at exchanges around the world. How trading and the design of markets affects liquidity, informativeness, transparency, volatility, and fairness. Analyzes alternative trading strategies and the cost of trading. Examines innovations in security exchanges and regulatory policy. Provides hands-on trading experience using realistic trading simulations.

AEM 464(4640) Economics of Agricultural Development (also ECON 464[4640])
Fall. 3 credits. Prerequisites: ECON 101–102 or permission of instructor. R. D. Christy.
Provides an understanding of the economics of the agricultural sector in low-income countries. Also covers more general issues of economic development beyond the agricultural sector to provide the necessary context for an understanding of rural problems. Topics include the nature of development and technical change, welfare and income distribution, land reform, food and nutrition policy, food security and food aid, competition with more developed countries and international markets, the effect of U.S. policy on agricultural development, and the role of international institutions. Uses examples from a wide variety of developing countries to illustrate the basis for economic analysis.

AEM 494(4940) Undergraduate Special Topics in Applied Economics and Management
Fall or spring. 4 credits max. S-U grades optional. Staff.
The department teaches "trial" courses under this number. Offerings vary by semester and are advertised by the department before the beginning of the semester.

AEM 497(4970) Individual Study in Applied Economics and Management
Fall or spring. Variable credit. S-U grades optional. Students must register using independent study form (available in undergraduate program office in Warren Hall). Staff.
Used for special projects designed by faculty members.

AEM 498(4980) Supervised Teaching Experience
Fall or spring. 1–4 credits. Students must register using independent study form (available in undergraduate program office in Warren Hall). Staff.
Designed to give qualified undergraduates experience through actual involvement in planning and teaching courses under the supervision of department faculty. Students cannot receive both pay and credit for the same hours of preparation and teaching.

AEM 499(4990) Undergraduate Research
Fall, spring, or summer. 1–4 credits. Prerequisite: GPA of at least 2.7. Students must register using independent study form (available in undergraduate program office in Warren Hall). S-U grades optional. Staff.
Permits outstanding undergraduates to carry out independent study of suitable problems under appropriate supervision. Students cannot receive both pay and credit for the same hours of work.

AEM 555(5550) Environmental Management and Policy
Fall. 3 credits. Prerequisites: ECON 101 and 102 or equivalent and calculus course. L. D. Chapman.
Seminar giving an inside perspective on implementation and evaluation of environmental policy in a business or organization. Examines the effectiveness of the new market-based green policies; analyze the operational significance of sustainability in a business context; and come to understand the economic basis for government's role in environmental protection. Uses HBS case studies; each seminar participant prepares a case study of environmental management in a business or organization. Makes extensive use of guest speakers from finance, electricity, forest products, construction, and manufacturing.

[AEM 605(6050) Agricultural Finance
Fall. 3 credits. Prerequisite: AEM 324 or 405 or equivalent. Not offered 2005–2006. B. A. Gloy.
Covers advanced topics in agricultural finance, including investment analysis, capital budgeting under uncertainty, decision analysis, risk management, capital structure, and financial intermediaries.]

AEM 608(6080) Production Economics (also ECON 408[4080])
Fall. 3 credits. Prerequisite: ECON 313 and MATH 111 or equivalents. L. W. Tauer.
Studies the theory of production economics with emphasis on applications to agriculture and natural resources. Topics include the derivation, estimation, and use of production, cost, profit, revenue, demand, and supply functions. Discusses the concepts of efficiency and productivity. Introduces production response over time and under risk.

AEM 611(6110) Global Modeling
Spring. 3 credits. Prerequisite: graduate micro theory course. T. D. Mount and R. N. Boisvert. Taught over Internet by Tom Hertel at Purdue University.
Teaches how to use a global general equilibrium model (GTAP) for research on trade and environment policies. Weekly assignments start with the components of a single-country model and end with a full global model. A final project and the assignments are the primary course requirements.

AEM 612(6120) Applied Econometrics
Fall. 1 credit. Co-requisite: AEM 411. D. Just.
Designed for M.S. and Ph.D. students who do not meet the prerequisites for other graduate-level econometrics courses. Complements AEM 411, providing greater depth of understanding of econometric methods and exposure to applied econometric literature. Focuses on preparing students to conduct their own applied economic research.

AEM 630(6300) Policy Analysis: Welfare Theory, Agriculture, and Trade (also ECON 430[4300])
Spring. 4 credits. Prerequisites: AEM 608 or PAM 603, ECON 313, or equivalent intermediate micro theory course incorporating calculus. H. de Gorter.
The first half of the course surveys the theory of welfare economics as a foundation for public policy analysis. Major issues addressed include the problem of social welfare measurement, the choice of welfare criteria, and the choice of market or nonmarket allocation. Basic concepts covered include measurement of welfare change, including the compensation principle, consumer and producer surplus, willingness-to-pay measures, externalities, and the general theory of second-best optima. The second half focuses on public policy analysis as applied to domestic agricultural policy and international trade. The domestic policy component examines major U.S. farm commodity programs and related food and macroeconomic policies and analyzes their effects on producers, consumers, and other groups. The international trade component examines the structure of world agricultural trade, analytical concepts of trade policy analysis, and the principal trade policies employed by countries in international markets.

AEM 632(6320) Open Economy Analysis: Theory and Applications
Spring. 3 credits. Prerequisites: ECON 313/314 or permission of instructor. S-U grades optional. N. Chau and S. Kyle.
Explores both recent theoretical and methodological advances as well as practical applications in analyzing current topics and issues in open economies. Brings together research methods pertinent to open economy macroeconomics and international trade policies to give students a basic understanding of how different aspects of contemporary debates are analyzed in practice.

AEM 633(6330) Devolution, Privatization, and the New Public Management (also CRP 612[6120], FGSS 611[6110])
Fall. 4 credits. S-U grades optional. M. E. Warner.
For description, see CRP 612.

AEM 634(6340) Government Policy Workshop (also CRP 618[6180], FGSS 620)
Spring. 4 credits. S-U grades optional. M. E. Warner.
For description, see CRP 618.

[AEM 640(6400) Analysis of Agricultural Markets (also ECON 440[4400])
Fall. 3 credits. Prerequisites: AEM 411 and 415 or equivalents. Offered even years; not offered 2005–2006. H. M. Kaiser.
Focuses on the unique features of agricultural commodity markets. Emphasizes government and private institutions that affect these markets, as well as on models of price behavior including marketing margins and imperfect competition. Also covers empirical tools to evaluate market characteristics.]

AEM 641(6410) Commodity Futures Markets
Spring, weeks 8–14. 2 credits. Prerequisites: AEM 411 and 415 or equivalents. Recommended: AEM 640. W. G. Tomek.
Focuses on markets for agricultural futures contracts. Emphasizes models of price behavior on futures markets including relationships among cash and futures prices. These principles provide a foundation for a discussion of hedging, speculation, and public policy issues.

AEM 642(6420) Globalization, Food Security and Nutrition (also NS 642[6420])
Fall. 2 credits. Prerequisites: permission of instructor, enrollment in a graduate program, and basic understanding of economics and nutrition. Letter grades. P. Pinstrup-Andersen.
For description, see NS 642.

AEM 651(6510) Environmental and Resource Economics
Spring. 4 credits. Core course for environmental management concentration/option. Prerequisite: graduate standing. Open to graduate students outside economics. W. D. Schulze.
Review of welfare economics, environmental externalities, and common property resources, and a survey of current environmental and natural resource policy. Covers techniques for measuring benefits and costs—including property value and wage hedonic approaches, travel cost models, and contingent evaluation. Describes survey/data collection methods in detail. Explores innovative market mechanisms for resolving public good, common property, and externality problems. Students are required to complete a paper describing their own formal economic analysis of a natural resource or environmental problem.

[AEM 652(6520) Land Economics Problems
Fall or spring. 1 or more credits. Prerequisite: graduate standing and permission of instructor. S-U grades optional. Staff.
Special work on any subject in the field of land and resource economics.]

AEM 655(6550) Electric Systems Engineering and Economics (also ECE 551[5510])
Fall. 2 credits. Prerequisites: basic calculus and microeconomics courses. T. D. Mount and R. Thomas.
For description, see ECE 551.

AEM 660(6600) Agroecosystems, Economic Development, and the Environment
Spring. 3–4 credits. Prerequisite: graduate standing. Open to graduate students outside economics; additional sec TBA for economics majors. S-U grades optional. D. R. Lee.
Examines selected topics in agricultural and economic development, technology assessment, ecosystem management and the environment, with a focus on developing countries. Topics include production, poverty, and environmental tradeoffs; sustainable technology development; trade and environment linkages; economics of conservation and development; and alternative methodologies for analyzing these interactions. Readings emphasize the economic literature, but also draw from the biophysical sciences, ecosystem management, and the broader social sciences.

AEM 667(6670) Topics in Economic Development (also ECON 770[7770])
Fall. 3 credits. Targeted to second-year graduate students. Prerequisite: basic first-year courses in ECON or AEM or permission of instructor. S-U grades optional. R. Kanbur.
Topics vary from year to year but may include poverty, inequality, intra-household allocation, structural adjustment, and debt. Examination is by term paper.

AEM 670(6700) Economics of Consumer Demand (also PAM 608[6080])
Fall. 3 credits. Prerequisites: ECON 311 or 313 and two semesters of calculus. S-U grades optional. C. K. Ranney.
Graduate-level introduction to theory and empirical research on household demand, consumption, and saving. Emphasizes the use of the theory in empirical research. Topics include neoclassical theory of demand, duality, complete demand systems, conditional demand, demographic scaling and translating, consumption, and savings. As time allows, Becker and Lancaster models of demand may be introduced.

AEM 694(6940) Graduate Special Topics in Applied Economics and Management
Fall or spring. 4 credits max. S-U grades optional. Staff.
The department teaches "trial" courses under this number. Offerings vary by semester, and are advertised by the department before the beginning of the semester.

AEM 698(6980) Supervised Graduate Teaching Experience
Fall or spring. 1–4 credits; max. 4 credits during graduate program. Prerequisite: graduate standing; permission of instructor. Undergraduates should enroll in AEM 498. Students must register using independent study form (available in undergraduate program office in Warren Hall). S-U grades optional. Staff.
Designed to give graduate students teaching experience through involvement in planning and teaching courses under the supervision of departmental faculty members. The experience may include leading discussion sections, preparing, assisting in, or teaching lectures and laboratories, and tutoring. Students are expected to actually teach at least one hour per week for each credit awarded. Students may not receive both pay and credit for the same hours of preparation and teaching.

AEM 699(6990) M.P.S. Research
1–6 credits. Prerequisite: M.P.S. students. Credit granted for M.P.S. project report. Staff.

AEM 700(7000) Individual Study in Applied Economics and Management
Fall or spring. Prerequisite: graduate standing. S-U grades optional. Credit, class hours, and other details TBA with faculty member. Staff.
Used for special projects designed by faculty members. More than one topic may be given each semester in different sections. Student must register in section appropriate to topic being covered; section number is provided by instructor.

[AEM 708(7080) Advanced Production Economics
Fall. 3 credits. Prerequisite: AEM 608, 710, or equivalents. Highly recommended: ECON 609. Offered alternate years; not offered 2005–2006. R. N. Boisvert.
Covers theoretical and mathematical developments in production economics, with emphasis on estimating production relationships, scale economies, technical change, and factor substitution. Emphasizes developments in flexible functional forms, duality, and dynamic adjustment models. Gives considerable emphasis to empirical specification and estimation. Discusses other topics (risk, supply response, and household production functions) based on student interest.]

AEM 710(7100) Econometrics I
Spring. 3 credits. Prerequisites: matrix algebra and statistical methods courses at level of ILRST 311 or ECON 619. H. Daouk.
Provides (together with AEM 711) a graduate sequence in applied econometrics that is suitable for M.S. and Ph.D. students. Covers linear-regression models and the associated estimation and testing procedures.

AEM 711(7110) Econometrics II
Fall. 3 credits. Prerequisite: AEM 610 or equivalent. T. D. Mount.
Coverage beyond AEM 610 of dynamic models, including single equation ARIMA, vector ARIMA, Kalman filtering, structural dynamic models, and regime switching. Topics include endogeneity, stability, causality, and cointegration.

AEM 712(7120) Quantitative Methods I
Fall. 4 credits. Prerequisite: some formal training in matrix algebra. Highly recommended: course at level of BTRY 417. R. N. Boisvert.
Comprehensive treatment of linear programming and its extensions, including postoptimality analysis. Topics include nonlinear programming, including separable, spatial equilibrium, and risk programming models. Discusses input-output models and their role in social accounting matrices and computable general equilibrium models. Makes applications to agricultural, resource, and regional economic problems.

AEM 713(7130) Dynamic Optimization
Spring. 3 credits. Prerequisite: ECON 609. S-U grades only. J. M. Conrad.
Concerned with the solution of dynamic allocation problems. Objectives are to (1) pose prototype optimization problems in discrete and continuous time, (2) introduce the common methods for solving prototype problems, (3) present a set of numerical

problems, and thereby (4) equip students with basic theory and methods to perform applied research on dynamic allocation problems.

AEM 714(7140) Experimental Economics
Fall. 4 credits. Prerequisite: ECON 609. Offered alternate years. W. D. Schulze.
Surveys both experimental economics methods and research as an approach to test economic theory. Students participate as subjects in a series of illustrative computerized experiments ranging from double auctions to public goods provision. Topics include experimental methods; decisions and games; markets (testing auction institutions); market power (monopoly, oligopoly); bargaining, compensation, and performance; public goods; externalities and voting; information and uncertainty; and economic anomalies. Students must design and write a paper describing their own experiment.

AEM 717(7170) Research Methods in Agricultural Economics
Spring. 2 credits. Prerequisite: graduate standing. R. N. Boisvert.
Discusses the research process and scientific method as applied in agricultural economics. Topics include problem identification, hypotheses, sources of data, sampling concepts and designs, methods of collecting data, questionnaire design and testing, field organization, and analysis of data. During the semester, each student develops a research proposal that may be associated with his or her thesis.

[AEM 730(7300) Seminar on International Trade Policy: Agriculture, Resources and Development
Spring. 3 credits. Prerequisite: graduate standing; AEM 630 or equivalent. Not offered 2005–2006. D. R. Lee.
Examines selected topics in the professional literature on international trade policy, focusing on agricultural trade and related topics, including trade liberalization, trade and environmental linkages, technological change and trade policy, and agricultural trade and development.]

AEM 735(7350) Public Finance: Resource Allocation and Fiscal Policy (also ECON 735[7350])
Fall. 4 credits. R. Kanbur.
For description, see ECON 735.

[AEM 740(7400) Agricultural Markets and Public Policy
Spring, weeks 1–7. 2 credits. Prerequisite: graduate standing; familiarity with multiple regression techniques at AEM 411 level or higher. Recommended: AEM 640. W. H. Lesser.
Develops the concepts and methodology for applying and analyzing the effects of public-policy directives to the improvement of performance in the U.S. food marketing system. Prospective topics include a survey of industrial organization principles, antitrust and other legal controls, and coordination systems in agriculture. Topics may be adjusted to students' interests.]

AEM 744(7440) Advanced Consumer Research
Fall. 3 credits. Prerequisite: graduate standing; priority given to CALS Ph.D. students, especially in AEM, nutritional science, or food technology. B. Wansink.
Workshop providing students with a unique opportunity to develop an advanced theory-based understanding of consumers by using innovative methods and new research techniques. Class sessions alternate theory with implementation.

AEM 750(7500) Resource Economics
Fall. 3 credits. Prerequisites: ECON 609 and 618, or AEM 713. J. M. Conrad.
Uses optimal control and other methods of dynamic optimization to study the allocation and management of natural resources.

AEM 751(7510) Environmental Economics
Spring. 4 credits. Prerequisites: ECON 609 and 618, or AEM 713. S-U grades optional. R. N. Boisvert.
Studies the basic theory and applications of environmental economics and policy. Extensions include comparisons of taxes, subsidies, and other policy instruments; an examination of the effects on policy of market imperfections; multiple positive and negative externalities; and other government regulations such as those in agriculture. Also examines the effects of uncertainty, and special problems associated with nonpoint externalities and asymmetric information. There is an extensive treatment and evaluation of contingent valuation and other methods for valuing nonmarket goods. Throughout, the theoretical results are highlighted through discussions of important empirical policy applications.

AEM 752(7520) Applied Welfare Economics: Nonmarket Valuation of Public Goods
Fall, first seven weeks of semester. 2 credits. Prerequisites: ECON 609 and graduate-level econometrics course or permission of instructor. G. L. Poe.
Estimates of nonmarket values associated with improvements (or decrements) in public goods, such as environmental resources and public health and safety, are now widely required in public decision-making. This course develops the policy context and the economic–theoretic foundations of nonmarket valuation and benefit-cost analysis. Uses these foundations to develop empirical models of leading valuation methods, including both stated (e.g., contingent valuation and stated-choice methods) and revealed (e.g., hedonic analysis, travel-cost method and defensive expenditures) preference methods.

AEM 762(7620) Microeconomics of International Development
Fall. 3 credits. Prerequisite: completion of first-year Ph.D. course sequence in AEM or ECON or permission of instructor. S-U grades optional. C. B. Barrett.
Focuses on models of individual, household, firm/farm, and market behavior in low- and middle-income developing economies. Topics include agricultural land, labor, and financial institutions; technology adoption; food security and nutrition; risk management; intra-household analysis; reciprocity networks; and product/factor markets analysis. Emphasizes empirical research.

AEM 765(7650) Development Microeconomics Graduate Research Seminar
Fall/spring. 1–3 credits. Prerequisite: graduate standing and permission of instructor. C. B. Barrett.
Graduate students and the instructor present draft research proposals, papers, and preliminary thesis results for group review and discussion. Students who actively participate by offering written and oral comments on others' work receive 1 credit. Students who also present their own proposal or paper receive 2 credits. Presentations last 75 minutes and thus represent a substantial investment of time. Students who present a second proposal or paper receive 3 credits.

AEM 800(8900) Master's-Level Thesis Research
Fall or spring. 1–9 credits. Prerequisite: permission of graduate committee chair. S-U grades only. Graduate faculty.
For students admitted specifically to a master's program.

AEM 900(9900) Graduate-Level Thesis Research
Fall or spring. 1–9 credits. Prerequisite: permission of graduate committee chair. S-U grades only. Graduate faculty.
For Ph.D. students **only before** "A" exam has been passed.

AEM 901(9910) Doctoral-Level Thesis Research
Fall or spring. 1–9 credits. Prerequisite: permission of graduate committee chair. S-U grades only. Graduate faculty.
For Ph.D. candidates **after** 'A" exam has been passed.

ANIMAL SCIENCE

A. W. Bell, chair (149 Morrison Hall, 255-2862); R. E. Austic, D. E. Bauman, R. W. Blake, Y. R. Boisclair, D. L. Brown, W. R. Butler, L. E. Chase, W. B. Currie, H. N. Erb, R. W. Everett, D. M. Galton, J. Gavalchin, P. A. Johnson, X. G. Lei, P. A. Oltenacu, T. R. Overton, J. E. Parks, A. N. Pell, E. J. Pollak, R. L. Quaas, S. M. Quirk, R. D. Smith, M. L. Thonney, M. E. Van Amburgh

AN SC 100(1000) Domestic Animal Biology I
Fall. 4 credits. S-U grades optional. Lec, M W F 9:05; sec, T W or R 2:00–4:25. W. B. Currie.
Introduction to the biology of economically important species (morphology, anatomy, and physiology) and its application to the management of animals in major livestock industries. Topics include domestication and origins of animal science, anatomy, quantitative cell biology, regulatory mechanisms, public domain genetic databases, major life support systems, and digestion. Students undertake the care and management of several species of farm animals and Japanese quail. Laboratory exercises include animal handling and examining aspects of growth and development. Living farm animals are used noninvasively, and fresh organs from dead animals are examined.

AN SC 105(1050) Contemporary Perspectives of Animal Science
Spring. 1 credit. Prerequisite: freshmen, sophomores, and first-year transfers. T 1:25 or W 12:20. D. J. R. Cherney and D. E. Bauman.
A forum to discuss the students' career planning and the contemporary and future role of animals in relation to human needs.

AN SC 110(1100) The Animals That Sustain Us: Lecture
Spring. 2 credits. S-U grades optional. Lec, T R 11:15. D. L. Brown.
Teaches the importance of the symbiosis between humans and domestic animals and how animal enterprises can be ethically, environmentally, and economically sound.

AN SC 111(1110) The Animals That Sustain Us: Lab
Spring. 1 credit. S-U grades optional. Lab, R 1:25–4:25. D. L. Brown.
Teaches students to restrain and care for several species of domestic animals, including cats, dogs, sheep, cattle, goats, fish, and horses. Other species may be added according to student interest. Associated with AN SC 110 but may be taken separately.

AN SC 150(1500) Domestic Animal Biology II
Spring. 4 credits. S-U grades optional. Lec, M W F 9:05; lab/disc, T W or R 2:00–4:25. W. R. Butler and staff.
Second of a two-semester sequence (100/150) applying the basic biology and physiology of growth, defense mechanisms, reproduction, and lactation to aspects of the production and care of domestic animals. Uses fresh tissues and organs from dead animals along with preserved specimens in laboratories, exercises, and demonstrations. Uses a colony of Japanese quail for growth exercises, behavior, and data collection.

AN SC 204 Sophomore Seminar: Domestic Animal Issues
Fall. 3 credits. S–U grades optional. Lec, T R 1:25–2:40. D. Brown.
Expression of discoveries, opinions, and solutions to problems in the area of domestic animal science and industry take on an extremely wide variety of forms. These expressions may include: the peer-reviewed journal article, summaries of scientific work for the public, grant writing for science, film, music, cowboy poetry, investigative journalism, web pages, online discussion groups, computer models and the conference. This course challenges students from any major with the criticism and practice of these arts. Topics used as points of reference for exposition of biological principles and for practicing those means of expression will vary as the years go on, but for 2005–2006 include: roles animals play in society; BSE; vegetarianism; gender stereotypes and livestock; impact of animals on air and water quality; using hormones and antibiotics in food production; feral horses of the West.

AN SC 212(2120) Animal Nutrition
Fall. 4 credits. Prerequisite: CHEM 208 or equivalent. Recommended: AN SC 100 and 150. Lec, M W F 10:10; lab, M T W R or F 1:25–4:25. A. W. Bell and D. J. R. Cherney.
Introduction to animal nutrition, including digestive physiology and metabolism of domestic animals and other species; nutrient properties and requirements for different aspects of animal production and performance; principles of feed evaluation and ration formulation. Laboratory classes include gastrointestinal tract dissections and nutritional experiments performed on laboratory or farm animal species.

[AN SC 213(2130) Nutrition of the Dog
Spring, weeks 1–7. 1 credit. Prerequisite: AN SC 212 or equivalent. Offered alternate years; next offered 2007. Lec, W 7:30–9:25 P.M. A. W. Bell.
Covers digestive physiology, nutrient requirements, feeding practices, and interactions of nutrition and disease.]

AN SC 214(2140) Nutrition of Exotic Animals
Fall, weeks 1–7. 1 credit. Prerequisite: AN SC 212 or equivalent. Lec, W 7:30–9:25 P.M. H. F. Hintz.
Discusses nutrient requirements, sources of nutrients, feeding management systems, and ration formulation. Describes signs of nutrient deficiencies and excesses.

AN SC 215(2150) Exotic Avian Husbandry and Propagation
Fall. 2 credits. Limited to 100 students. Prerequisite: AN SC 100, 150, or one year introductory biology. Lec, M 2:30–4:25. J. Parks and D. Muscarella.
Natural history, care, management, health, and breeding of exotic avian species with emphasis on psittacines (parrots and related species) and raptors (birds of prey). Includes lectures, demonstrations, and local field trips.

[AN SC 216(2160) Nutrition of the Cat
Fall, weeks 1–7. 1 credit. Prerequisite: AN SC 212 or equivalent. Offered alternate years; next offered 2006. Lec, W 7:30–9:25 P.M. H. F. Hintz.
Covers digestive physiology, nutrient requirements, feeding practices, and interactions of nutrition and disease.]

AN SC 221(2210) Introductory Animal Genetics
Spring. 3 credits. Prerequisite: one year of college biology. Lec, T R 9:05; sec, T W R or F 2:00–4:25. E. J. Pollak.
Examination of basic genetic principles and their application to the improvement of domestic animals, with emphasis on the effects of selection on animal populations.

AN SC 222(2220) Introduction to Canine Genetics
Winter or summer. 1 credit. Prerequisite: introductory biology or permission of instructor. (May not be taken for credit by students who have successfully completed AN SC 221.) S-U grades only. To receive credit, students must register through School of Continuing Education, www.sce.cornell.edu/DL/html/caninegenetics.html. E. J. Pollak.
Introduction to basic Mendelian genetics and simply inherited characteristics in the dog. This distance-education course delivered by CD and web interaction for residents and nonresidents consists of lectures on basic genetic principles, probabilities, linkage and genetic testing, and seminars on genome mapping, inherited sexual disorders, bleeding disorders, and eye defects.

AN SC 250(2500) Dairy Cattle Principles
Fall. 3 credits. Prerequisite for AN SC 251, 351, 354, and 355. S-U grades optional. Lec, T R 10:10; lab, T or R 1:25–4:25. D. M. Galton and T. Batchelder.
Introduction to the background and scientific principles relating to dairy cattle production. Laboratories are designed to provide an understanding of production techniques.

AN SC 251(2510) Dairy Cattle Selection
Fall. 2 credits. Prerequisite: senior standing or permission of instructor. S-U grades optional. Lec, W 11:15–12:05; disc, W 12:20–1:10. D. M. Galton.
Application of scientific principles of genetic programs in herds with different breeding programs. Emphasizes economical traits to be used to improve genetic progress and herd profitability.

AN SC 265(2650) Horses
Fall. 3 credits. Prerequisites: AN SC 100 and 150 or permission of instructor. S-U grades optional. Lec, T R 9:05; lab, R 1:25–4:25.
C. Collyer.
Selection, management, feeding, breeding, and training of light horses.

AN SC 280(2800) Molecular Biology in Agriculture and Medicine
Fall. 3 credits. Prerequisite: one year introductory biology. Lec, T R 10:10–11:25. S. M. Quirk.
Discusses the applications of molecular biology to animal research, animal agriculture, industry, and medicine. Introduction of basic recombinant DNA techniques followed by topics such as genome projects, comparative and functional genomics, genetic screening, gene therapy, transgenic animal production, and mammalian cloning. Class discussions explore ethical issues raised by the use of these technologies.

AN SC 290(2900) Meat Science (also FD SC 290[2900])
Fall. 2 or 3 credits. Lec, T R 11:15; lab, M or R 12:20–3:20. Lec only, 2 credits; lec plus lab, 3 credits; lab cannot be taken without lec. D. Shaw.
Introduction to meat science through a study of the structure, composition, and function of muscle and its conversion to meat. Also study properties of fresh and processed meat, microbiology, preservation, nutritive value, inspection, and sanitation. Laboratory exercises include anatomy, meat-animal slaughter, meat cutting, wholesale and retail cut identification, inspection, grading, curing, sausage manufacture, and quality control. An all-day field trip to a commercial meat plant may be taken.

AN SC 300(3000) Animal Reproduction and Development
Spring. 3 credits. Prerequisite: AN SC 100–150 or equivalent and one year introductory biology. Lec, M W F 10:10. J. E. Parks.
Comparative anatomy and physiology of mammalian and avian reproduction, with emphasis on domestic and laboratory animals; fertilization through embryonic development, pregnancy, and growth to sexual maturity; emphasizes on physiological mechanisms and application to fertility regulation. Separate laboratory is offered to demonstrate fundamental aspects of reproduction and reproductive technology.

AN SC 301(3010) Animal Reproduction and Development Lab
Spring. 1 credit. Limited to 30 students per lab. Prerequisite: AN SC 100–150 or equivalent; concurrent enrollment in or completion of AN SC 300. Lab, M W or F 1:25–4:25. J. E. Parks.
Demonstrates fundamental principles and applied aspects of mammalian and avian reproduction. A limited number of live

animals are used in some demonstrations. Dissection and examination of tissues from vertebrate animals are included in selected laboratories.

AN SC 305(3050) Farm Animal Behavior (also BIOAP 312[3120])
Spring. 2 credits. Prerequisites: one year introductory biology and introductory animal physiology (AN SC 100 and 150 or equivalent or BIOAP 311). Recommended: at least one animal production course or equivalent experience. S-U grades optional. Lec, T R 11:15. Staff.
The behavior of production species (avian and mammalian) influences the success of any management program. Students study behaviors relating to communication, learning, social interactions, reproduction, and feeding of domestic animals and their physiological basis. Management systems for commercial livestock production and their implications for animal behavior and welfare are stressed.

AN SC 323(3230) Equine Genetics Seminar
Fall. 2 credits. Prerequisite: AN SC 221 or equivalent. S-U or letter grades. Disc, T 1:25–2:15. P. A. Oltenacu.
Presents and discusses topics of equine genetics. Students are also required to view one seminar each week. Seminars are animated PowerPoint presentations available in computer lab and can be viewed at flexible times during the week.

[AN SC 341(3410) Biology of Lactation
Spring. 2 credits. Prerequisite: AN SC 100–150 or animal physiology course. Offered alternate years; next offered 2007. Lec, T R 9:05. Y. R. Boisclair and staff.
Comprehensive survey of the biology of the mammary gland. Lectures cover (1) basic aspects such as anatomy and development of the mammary gland, biochemistry and hormone regulation of milk synthesis and regulation of gene expression in the mammary cells; (2) practical aspects such as the impact of lactation on nutrition, reproduction, and diseases. Lactation in the dairy cow provides the primary context, but examples from other mammals, including humans, are used.]

AN SC 351(3510) Dairy Herd Management
Spring. 4 credits. Prerequisite: AN SC 250 or permission of instructor. Recommended: AEM 302. Lec, M W F 11:15; lab, W 1:25–4:25 and F (alternate weeks) 1:25–4:25. D. M. Galton.
Application of scientific principles to practical herd management with components of reproduction, milking, housing, records, and production economics. Laboratories emphasize practical applications, analyses of alternatives, decision making, field trips, and discussion.

AN SC 354(3540) Dairy Cattle Herd Health
Fall. 3 credits. Prerequisite: AN SC 250 or permission of instructor. Lec, T R 9:05–9:55; lab, R 1:25–4:25. D. M. Galton and W. Stone.
Application of scientific principles to practical herd management with emphasis on herd health and animal well-being. Laboratory emphasizes practical applications of herd health management including on-farm herd health analysis.

AN SC 355(3550) Dairy Cattle Nutrition
Spring. 3 credits. Prerequisite: AN SC 250 or permission of instructor. Letter grades only. Lec, W F 10:10; lab, R 1:25–4:25. T. L. Batchelder and L. E. Chase.
Application of scientific principles to practical herd nutrition relating to herd production and feeding management. Laboratory emphasizes practical applications and field trips.

AN SC 360(3600) Beef Cattle
Spring. 3 credits. Lec, T R 10:10; sec, W 2:00–4:25. Offered alternate years; next offered 2006. M. L. Thonney.
Emphasizes the management of reproduction, nutrition, and selection in beef cattle enterprises. A cattle growth model is studied. Laboratories acquaint students with management skills through computerized simulations and working directly with cattle. Students spend several days during the semester feeding and caring for cows and their newborn calves.

[AN SC 365(3650) Equine Nutrition
Fall. 3 credits. Prerequisites: AN SC 100, 212, and 265 or equivalent. S-U grades optional. Lec, M W F 9:05–9:55. Not offered 2005. Staff.
Presents the principles of nutrition for horses. Discusses digestive physiology, sources of nutrients, feeding programs for various classes of horses, and interactions of nutrition and diseases.]

[AN SC 370(3700) Swine Nutrition and Management
Fall. 3 credits. Recommended: AN SC 212. Lec, T R 11:15; lab, T 2–4:25. Offered alternate years; next offered 2006. X. G. Lei and K. Roneker.
Focuses on swine nutrition, feeding, and management. Lectures are integrated basic nutrition and swine system, including pig biology, digestive and metabolic development, nutritional biochemistry and physiology, impact of swine nutrition on environment, use of pig model in medicine, and current swine nutrition and biotechnology. Offers laboratory practice, animal projects, and problem troubleshooting.]

[AN SC 380(3800) Sheep
Spring. 3 credits. Lec, T R 10:10; sec, W 2–4:25. Offered alternate years; next offered 2007. M. L. Thonney.
Emphasizes the breeding, feeding, management, and selection of sheep from a production-system approach. Lectures and laboratories are designed to give students a practical knowledge of sheep production as well as the scientific background for improved management practices. Students work directly with sheep during laboratories and spend several days during the semester feeding and caring for ewes and their newborn lambs.]

AN SC 400(4000) Livestock in Tropical Farming Systems
Spring. 3 credits. Prerequisite: upperclass standing. Cost of optional field trip (includes airfare, local transport, and lodging; some merit and need-based financial aid may be available): approx. $2,000. Lec, T R 9:05; disc, W 1:25–3:20. R. W. Blake.
Comprises analyses of constraints on livestock production in developing countries of the tropics, economic objectives and risk, and methods of management. The 2006–2007 editions focus on livestock systems in the Yucatán Peninsula. Emphasis is on strategic use of animal and plant resources, animal performance with inputs restricted, and decision making. Principles, field study, independent study projects and classroom interactions aided by videoconferencing with Mexican partners facilitate problem-solving to improve welfare of rural households. Interactions with Mexican farmers and other professionals during a 10-day field-study trip provide context and opportunities for developing study projects aligned with needs of Yucatecan farmers.

AN SC 401(4010) Dairy Production Seminar
Spring. 1 credit. Prerequisite: junior or senior standing. Disc, M 7:30 P.M. T. R. Overton.
Capstone course in which students, with the help of faculty members, complete a study of the research literature on topics of current interest in the dairy industry. Students then make an oral and a written report on their topic with emphasis on integrating theory and practice.

AN SC 402(4020) Seminar in Animal Sciences
Spring. 1 credit. Prerequisite: students engaged in undergraduate honors research projects. S-U grades optional. Disc, R 4:30. S. Quirk.
Reports of undergraduate research and honors projects. Students present oral reports of their work for class discussion.

AN SC 403(4030) Tropical Forages
Spring. 2 credits. Prerequisites: knowledge of crop production and livestock nutrition. Offered alternate years. Next offered 2006. Lec, T R 10:10. A. N. Pell.
Overview of tropical grasslands, seeded pastures, and crop residues as feed resources; grass and legume characteristics; establishment and management of pastures; determination of feeding value of forages and crop residues; physiology of digestion of ruminants that affects feeding behavior; problems of chemical inhibitors in plants; and preservation of tropical forages as hay or silage.

AN SC 410(4100) Nutritional Physiology and Metabolism
Fall. 3 credits. Prerequisites: biochemistry and physiology courses. M W F 11:15. R. E. Austic and D. E. Bauman.
Fundamental approach to nutrition focusing on the metabolic fate of nutrients and the interrelationships among nutrients, nutritional state, and metabolic processes. The overall goal is to increase understanding of metabolism and metabolic regulation through an integration of nutrition, biochemistry, and physiology.

AN SC 411(4110) Applied Cattle Nutrition
Fall. 4 credits. Designed for juniors, seniors, and entering graduate students. Prerequisites: AN SC 100 and 212 (or equivalent). Highly recommended: AN SC 355. Lec, M W F 10:10; lab, M 1:25–4:25. M. E. Van Amburgh.
Applied approach to predicting nutrient requirements and feed use to meet requirements with wide variations in cattle type, feed composition, and environmental conditions. Emphasizes dairy cattle. Discusses nutrient management to minimize cost of production and environmental effects. Computer models (Cornell Net Carbohydrate and Protein System) are used in the laboratory to apply the information presented in lectures,

including evaluation of feeding programs on case study farms.

AN SC 412(4120) Whole-Farm Nutrient Management (also CSS 412[4120])
Spring. 2- or 4-credit option. Prerequisite: junior, senior, or graduate standing; AN SC 411. Offered as two modules. Enrollment in Module 1 for first half of semester required (2 credits). Consists of crop and manure nutrient management planning; no prerequisites for CALS students. Enrollment in Module 2 for second half of semester is optional (additional 2 credits); builds on crop and manure nutrient management planning module by integrating agronomic nutrient management planning with herd nutrient management planning. Lec, T R 11:15; lab, T 1:25–4:25 for both modules, with work on case studies outside lab. M. E. Van Amburgh and Q. M. Ketterings.
Provides students with an understanding of the concepts underlying whole farm nutrient management planning to improve profitability while protecting water and air quality. Students learn and apply concepts in the development of a Comprehensive Nutrient Management Plan (CNMP) that is required for a Concentrated Animal Feeding Operation plan to meet environmental regulations. Students develop components of a CNMP for a case study farm, using the Cornell University Nutrient Management Planning System (*cu*NMPS) and other tools. All students enrolled learn the concepts and processes of developing the crop and manure nutrient management plan component of a CNMP during the first half of the semester in Module 1. Students opting to continue through the end of the semester in Module 2 (4-credit option) build upon knowledge gained in the first half of the semester by learning the knowledge and skills necessary to integrate crop production and herd feeding management for reducing nutrient imports on farms.

AN SC 414(4140) Ethics and Animal Science
Fall. 2 credits. Prerequisite: junior or senior standing. Lec, M 12:20; disc, W 12:20–1:10. D. J. R. Cherney.
Explores the place of humans in the biological world, origins of ethics and morality, speciesism, the use of animals for research and agricultural purposes, transgenic animals. A book review, participation in discussion in class and online, and a project of the student's choice are used to evaluate the performance of each student.

AN SC 420(4200) Quantitative Animal Genetics
Spring. 2 credits. Limited to 30 students. Prerequisite: AN SC 221 or equivalent. S-U grades only. Lec, M 12:20; sec, M 2:00–4:25. E. J. Pollak.
Consideration of problems involved in improvement of animals through application of the theory of quantitative genetics, with emphasis on genetic evaluation and analysis of data for genetic parameters. Computer labs use interactive matrix algebra programs for problem solving.

AN SC 425(4250) Gamete Physiology and Fertilization (also BIOAP 425[4250])
Fall. 2 credits. Limited to 50 students. Prerequisite: AN SC 300 or equivalent. Offered alternate years. Next offered 2005. Lec, R 2:30–4:25. J. E. Parks.
Study of the formation, growth, differentiation, and maturation of mammalian sperm and oocytes; gamete transport and interaction with male and female reproductive tracts; and cytological, physiological, and molecular changes required for fertilization. Lecture, discussion, and aspects of gamete physiology and in vitro technologies such as cryopreservation, oocyte maturation, and fertilization are covered.

AN SC 427(4270) Fundamentals of Endocrinology (also BIOAP 427[4270])
Fall. 3 credits. Prerequisite: animal or human physiology course or permission of instructor. Lec, M W F 9:05. P. A. Johnson.
Physiology and regulation of endocrine secretions. Emphasizes neuroendocrine, reproductive, growth, and metabolic aspects of endocrinology. Examples are selected from many animals, including humans.

AN SC 451(4510) Dairy Herd Business Management
Fall. 3 credits. Co-requisite: AN SC 456. Lec, W 1:25–2:15; disc, W 2:30–4:25; lab, F 1:25–4:25. D. M. Galton and J. Karszes.
Emphasizes dairy herd business management with application to herd management analysis. Laboratory includes farm tours and analysis.

AN SC 456(4560) Dairy Management Fellowship
Spring. 2 credits. Prerequisites: senior standing; AN SC 351; permission of instructor. S-U grades only. Times TBA. D. M. Galton.
Designed for undergraduates who have a sincere interest in dairy farm management. Objective is to gain further understanding of the integration and application of dairy farm management principles and programs with respect to progressive dairying and related industries.

AN SC 457(4570) Communicating to Hispanic Staff
Fall. 2 credits. Pre- or co-requisite: AN SC 250 or permission of instructor. Lec, T 2:30–4:25. Staff.
Students with a focus on dairy management learn to communicate with the increasingly Spanish-speaking workforce to assure that the knowledge of cutting-edge dairy management and observations from the field are exchanged accurately. This is the first of a sequence of two courses developed to meet these goals. Students are expected to be able to converse and explain, through the use of live animals, technical processes involved in the care of livestock and to listen and understand observations and concerns of Spanish-speaking staff.

AN SC 458(4580) Communicating to Hispanic Staff
Spring. 2 credits. Pre- or co-requisite: AN SC 250 or permission of instructor. Lec, W 2:30–4:25. Staff. .
Students with a focus on dairy management need to be able to communicate with the Hispanic workforce and upward mobility of that workforce depends on knowledge of cutting-edge dairy management. This is the second course of a two-sequence program that will further develop the students' skills to be able to communicate in Spanish higher-level dairy production tasks and principles to Hispanic dairy workers. Students are expected to be able to converse and explain through the use of live animals technical processes involved in the care of livestock and to listen and understand observations and concerns of Spanish-speaking staff.

AN SC 494(4940) Special Topics in Animal Science
Fall or spring. 4 credits max. Prerequisite: undergraduate standing. S-U grades optional. Staff.
The department teaches "trial" courses under this number. Offerings vary by semester and are advertised by the department before the semester begins. Courses offered under the number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

AN SC 496(4960) Internship in Animal Science
Fall or spring. 1–3 credits; 6 credits max, during undergraduate career. Students must register using independent study form (available in 140 Roberts Hall). S-U grades only. Staff.
Structured, on-the-job learning experience under supervision of qualified professionals in a cooperating organization (e.g., farm, agribusiness, pharmaceutical company, zoo, educational institution). Internships are arranged by the student and must be approved in advance by the student's academic adviser. The internship should provide a professionally supervised experience with at least 60 hours on the job per credit required.

AN SC 497(4970) Individual Study in Animal Science
Fall or spring. 1–3 credits; may be repeated for credit. Intended for students in animal sciences. Prerequisite: permission of instructor. Students must register using independent study form (available in 140 Roberts Hall). S-U grades optional. Staff.
May include individual tutorial study or a lecture topic selected by a professor. Because topics may change, the course may be repeated for credit.

AN SC 498(4980) Undergraduate Teaching
Fall or spring. 1–3 credits; limited to two experiences during undergraduate career. Prerequisite: GPA of at least 2.7. Students must register using independent study form (available in 140 Roberts Hall).
Designed to consolidate the student's knowledge. A participating student assists in teaching a course allied with his or her education and experience. The student is expected to meet regularly with a discussion or laboratory section, to gain teaching experience, and regularly to discuss teaching objectives, techniques, and subject matter with the professor in charge.

AN SC 499(4990) Undergraduate Research
Fall or spring. 6 credits max. during undergraduate career. Prerequisite: junior or senior standing; GPA of at least 2.7. Not open to students who have earned 6 or more undergraduate research credits elsewhere in the college. Students must register using independent study form (available in 140 Roberts Hall).
Affords opportunities for students to carry out independent research under appropriate supervision. Each student is expected to review pertinent literature, prepare a project outline, conduct the research, and prepare a report.

[AN SC 603(6030) Mineral Nutrition: Metabolic, Health, and Environmental Aspects [also NS 603(6030)]

Fall. 2 credits. Prerequisites: biochemistry, physiology, and nutrition courses. Letter grades only. Lec, T 2–4. Offered alternate years; next offered 2006. X. G. Lei and C. C. McCormick.

Emphasizes metabolism, gene regulation, antioxidation, and genetic defects related to mineral nutrition. Team-taught lectures cover topics ranging from single gene mutation to social and environmental aspects of mineral nutrition and mineral-related disorders. Discusses effective approaches to improve global mineral nutrition by agriculture and food systems.]

[AN SC 606(6060) Ruminant Nutrition: Microbial Ecology and Forage Chemistry

Spring. 4 credits. Prerequisites: AN SC 212, biochemistry course; senior or graduate standing or permission of instructor. S-U grades optional. Lec, M W F 9:05; disc, W 8:00. Offered alternate years; next offered 2007. A. N. Pell.

Provides an overview of ruminant nutrition with an emphasis on microbial ecology, forage chemistry, and rumen function.]

AN SC 610(6100) Animal Science Seminar

Fall and spring. 1 credit. Prerequisite: graduate standing. S-U grades only. Lec, T 12:20–1:10. A. W. Bell.

Weekly seminar on topics related to animal science. The requirement for an S grade is regular attendance at seminars during the semester.

AN SC 619(6190) Field of Nutrition Seminar (also NS 619[6190])

Fall and spring. 0 credits. No grades given. For description, see NS 619.

AN SC 620(6200) Seminar in Animal Breeding

Fall and spring. 1 credit. Prerequisite: graduate standing and major or minor in animal breeding. S-U grades only. Times TBA. E. J. Pollak.

Current topics in animal breeding and statistics as applied to genetic evaluation and selection of domestic animals.

AN SC 621(6210) Reproductive Physiology/Endocrinology Seminar

Fall and spring. 1 credit. Prerequisite: graduate standing or permission of instructor. S-U grades only. Lec, W 4:00. W. R. Butler and staff.

Current research in reproductive physiology is presented by staff members, graduate students, and visitors.

AN SC 622(6220) Seminar in Animal Metabolism

Fall and spring. 1 credit. Prerequisite: permission of instructor. S-U grades only. Lec, R 4:00. Y. R. Boisclair and D. E. Bauman.

Current issues in metabolism are discussed as they relate to productivity, well-being, and diseases of animals. Students present research proposals for new initiatives, progress reports on ongoing projects and recent peer-reviewed publications of high significance.

[AN SC 625(6250) Nutritional Toxicology (also TOX 625[6250])

Spring. 2 credits. Prerequisites: biochemistry and nutrition courses. S-U grades optional. Offered alternate years; next offered 2007. Lec, W 1:25–2:15; lab/disc, W 2:30–4:25. D. L. Brown.

Explores toxicological principles and a selective survey of natural food and feed toxicants. At the end of this course, students understand relationships between nutrition and toxicology; are prepared to conduct research concerning the effects of naturally occurring toxicants; and are able to use multimedia to present their understanding of a class of toxicants. Occasional on-campus field trips. In addition, students read printed and electronic communications and create STELLA simulation models and a system of web pages related to a specific family of toxicants.]

AN SC 640(6400) Individual Study in Animal Science: TIES Seminar, Decision Support of Ruminant Livestock Systems in the Gulf Region of Mexico [U.S.–Mexico Training, Internships, Exchanges, and Scholarships (TIES) Partnership Initiative]

Fall and spring. 1 credit. S-U grades only. Times TBA. R. W. Blake.

Study of topics in animal science more advanced than, or different from, other courses. Subject matter involves research and training collaborations between Cornell University and Mexican institutions in the Gulf Region of Mexico.

AN SC 650(6500) Molecular Techniques for Animal Biologists

Spring. 4 credits. Limited to 15 students. Prerequisites: BIOBM 330 or 332 or 333 or equivalents and permission of instructors. Lec, T 11:15; lab, T and R 1:25–4:25. Offered alternate years; next offered 2006. Y. Boisclair and staff.

Lab course designed for students who have little or no experience with techniques in molecular biology. Emphasizes modern techniques used in conducting research in animal-related sciences such as nutrition, physiology, pharmacology, and immunology (e.g., subcloning, mutagenesis of DNA, RT-PCR, analysis of gene and protein expression, overexpression of proteins, and study of protein-DNA interactions). Lectures introduce laboratory exercises and supplement laboratory topics. Students perform an independent project requiring time outside scheduled laboratories and give a scientific presentation.

AN SC 694(6940) Special Topics in Animal Science

Fall or spring. 4 credits max. Prerequisite: graduate standing. S-U grades optional.

The department teaches "trial" courses under this number. Offerings vary by semester and are advertised by the department before the semester begins. Courses offered under the number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

AN SC 720(7200) Advanced Quantitative Genetics

Spring. 3 credits. Prerequisites: matrix algebra, linear models, and mathematical statistics courses. S-U grades optional. Times TBA. Offered alternate years; next offered 2006. R. L. Quaas.

Covers statistical methods used in a variety of problems in the quantitative genetics of animal populations. The initial focus is the estimation of breeding values for purposes of ranking animals for selection. The core of the course is the mixed linear model; linear estimators and predictors are treated extensively. Emphasizes the importance of appropriate modeling; makes generalizations to nonlinear models, via Bayesian principles, i.e., inferences from posterior distributions.

AN SC 800(8900) Master's-Level Thesis Research

Fall or spring. Credit TBA, max. 12 per semester. Prerequisite: permission of adviser. S-U grades only. Graduate faculty.

For students admitted specifically to a master's program.

AN SC 900(9900) Graduate-Level Thesis Research

Fall or spring. Credit TBA, max. 12 per semester. Prerequisite: permission of adviser. S-U grades only. Graduate faculty.

For students in a Ph.D. program **only before** "A" exam has been passed.

AN SC 901(9910) Doctoral-Level Thesis Research

Fall or spring. Credit TBA, max. 12 credits per semester. Prerequisite: permission of adviser. S-U grades only. Graduate faculty.

For students admitted to candidacy **after** "A" exam has been passed.

Related Courses in Other Departments

Introductory Animal Physiology (BIOAP 311)

Introductory Animal Physiology Laboratory (BIOAP 319)

Milk Quality (FD SC 351)

Agriculture in the Developing Nations (IARD 602)

Lipids (NS 602)

Basic Immunology Lectures (BIO G 305)

BIOLOGICAL AND ENVIRONMENTAL ENGINEERING

M. F. Walter, chair (104 Riley-Robb Hall; 255-2270, -2465); B. A. Ahner, L. D. Albright, D. J. Aneshansley, A. J. Baeumner, J. A. Bartsch, J. R. Cooke, A. K. Datta, K. G. Gebremedhin, D. A. Haith, J. B. Hunter, L. H. Irwin, W. J. Jewell, D. Luo, J.-Y. Parlange, N. R. Scott, R. M. Spanswick, T. S. Steenhuis, M. B. Timmons, L. P. Walker. Lecturers: T. J. Cook, L. D. Geohring, P. E. Hillman

Note: Class meeting times are accurate at the time of publication. If changes occur, the department will provide new information as soon as possible.

BEE 102(1102) Introduction to Microcomputer Applications

Fall or spring. 3 credits. All students, including graduating seniors and pre-enrolled students, must attend first lec to guarantee admittance and select a lab sec. Letter grades only. Lec, fall: T R 12:20–1:10, spring: M W 12:20–1:10; lab, M 1:25–4:25 or 7:30–10:30 P.M. or T 1:25–4:25 or W 1:25–4:25 or 7:30–10:30 P.M. or R 1:25–4:25. Fee: $25. P. E. Hillman.

Introduction to application packages on microcomputers. Laboratories provide experience with word processing, object-oriented and bit-mapped graphics, spreadsheets, visual basic macros, database management, presentation graphics, and web page authoring. An independent project using spreadsheets, presentation graphics, and word processing is required. These packages and others such as anti-virus software and those used for searching the Internet for information are discussed and demonstrated in the lectures, along with an overview of computer hardware and health hazards and social issues of computing.

BEE 110(1030) Introduction to Metal Fabrication Techniques

Spring. 3 credits. Limited to 18 students per lab. Lec, T R 9:05–9:55; lab, M T or R 1:25–4:25, M or T 7:30–10:30 P.M. T. J. Cook.

Emphasizes selection of proper materials and techniques to accomplish a variety of metal fabrication and maintenance projects. Covers hand and machine tools, fasteners, strengths of materials, classification and identification of metals, soldering, brazing, forging, pipe fitting, sheet metal work, controlling distortion, oxyacetylene cutting, and arc welding.

BEE 132(1040) Introduction to Wood Construction

Fall. 3 credits. Limited to 16 students per lab. Lec, T R 9:05–9:55; lab, T W or R 1:25–4:25, T or W 7:30–10:30 P.M. T. J. Cook.

Principles and practice of wood construction. Covers site selection and preparation, drainage, water and septic development, footers and foundations, material properties, framing and roofing, comparison of alternatives to wood construction, use of hand and power tools, wood joining methods, fasteners, concrete work, and block construction. Each student plans and constructs an approved carpentry project.

BEE 151(1510) Introduction to Computer Programming

Fall. 4 credits. Limited to 22 students per lab and rec. No previous programming experience assumed. Pre- or co-requisite: MATH 191 or equivalent. Lec, M W F 11:15–12:05; lab, W R 12:20–2:15, 2:30–4:25, F 1:25–3:20. L. D. Albright.

Introduction to computer programming and concepts of problem analysis, algorithm development, and data structure in an engineering context. The programming language MATLAB with Simulink is implemented on personal computers and applied to problems of interest in biological and environmental engineering.

BEE 200(1200) The BEE Experience

Spring. 1 credit. Requirement for BEE freshmen. Not required for students who have completed ENGRG 150. Prerequisite: BEE majors or permission of instructor. Letter grades only. Lec, T 1:25–2:15. J. A. Bartsch.

Forum covering the career opportunities for engineering students and the activities and curricula that lead to these opportunities. A series of seminars are given by practicing engineers, Cornell faculty members, alumni, staff from Cornell career services offices, and students. Students develop their undergraduate course plans, complete a web search assignment to locate jobs and internships, and select future courses to meet their academic objectives and career goals.

BEE 222(2220) Bioengineering Thermodynamics and Kinetics

Spring. 3 credits. Prerequisites: MATH 192, one semester of introductory biology, or equivalent; PHYS 213 and chemistry course completed or concurrent. Lec, M W F 9:05–9:55. J. B. Hunter.

Living systems rely on chemical and phase equilibria, precise coordination of biochemical pathways, and the release of chemical energy as heat, all of which are governed by the laws of thermodynamics and the rates of chemical reactions. The course covers concepts and laws of thermodynamics as applied to phase transformations, work, heat, and chemical reactions; and reaction kinetics applied to industrial processes and living systems, all with a focus on biological examples.

BEE 251(2510) Engineering for a Sustainable Society (also ENGRD 251[2510])

Fall. 3 credits. Pre- or co-requisite: MATH 293. Lec, T R 10:10–11:25. B. A. Ahner.

Case studies of contemporary environmental issues including pollutant distribution in natural systems, air quality, hazardous waste management, and sustainable development. Emphasis is on the application of math, physics, and engineering sciences to solve energy and mass balances in environmental sciences. Introduces students to the basic chemistry, ecology, biology, ethics, and environmental legislation relevant to the particular environmental problem. BEE students must complete either BEE 251 or 260 according to their academic plan. BEE students who complete both BEE 251 and 260 receive engineering credit for only one of these courses.

BEE 260(2600) Principles of Biological Engineering (also ENGRD 260[2600])

Spring. 3 credits. Pre- or co-requisite: MATH 293. Lec, T R 8:40–9:55. Offered spring 2006 and fall 2006 and every fall thereafter. A. J. Baeumner.

Focuses on the integration of biological principles with engineering, math, and physical principles. Students learn how to formulate equations for biological systems in class and practice in homework sets. Topics range from molecular principles of reaction kinetics and molecular binding events to macroscopic applications such as energy and mass balances of bioprocessing and engineering design of implantable sensors. BEE students must complete either BEE 251 or 260 according to their academic plan. BEE students who complete both BEE 251 and 260 receive engineering credit for only one of these courses.

BEE 299(3299) Sustainable Development: A Web-Based Course

Spring. 3 credits. Prerequisite: at least sophomore standing. S-U grades optional. N. R. Scott.

Sustainable development is the dominant economic, environmental, and social issue of the 21st century. This course develops the concepts of sustainable development as an evolutionary process, demanding the integration of the physical sciences and engineering with the biological and social sciences for design of systems. Topics include the nature of ecosystems, global processes, sustainable communities, and industrial ecology and life cycle analysis.

BEE 305(3050) Principles of Navigation (also NAV S 301[3050])

Fall. 4 credits. 4 classes each week (lec-rec-project work). Lec, T R 8–9:15; lab, F 8–8:50 or 9:05–9:50. Lt. Leisner.

Introduction to the fundamentals of marine navigation emphasizing piloting and celestial navigation procedures. Covers coordinate systems, chart projections, navigational aids, instruments, compass observations, time, star identification, use of the nautical almanac, tides, and currents. Also *briefly* discusses electronic navigation systems.

BEE 310(1050) Advanced Metal Fabrication Techniques

Spring. 1 credit; 2-credit option available. Prerequisite: BEE 110 or permission of instructor. Lab, F 1:25–4:30. T. J. Cook.

Principles and practices beyond the scope of BEE 110. Includes out-of-position, high-carbon steel and cast iron welding. Topics such as soldering and brazing of aluminum, hard surfacing, both tungsten (TIG) and metallic (MIG) inert gas welding, and plasma-arc and oxy cutting of metals. Planning, development, and fabrication of a metal construction project is required for the 2-credit option.

BEE 325(3250) Environmental Management

Fall. 3 credits. Lec, T R 2:55–4:10. W. J. Jewell.

Explores the decline in environmental quality caused by human activities and the limits of science and technology solutions. Emphasizes understanding complex issues such as global warming and deriving sustainable solutions, which are illustrated with case studies. Includes field trips to water supply and waste treatment facilities. Emphasizes water, using energy, air quality, and soil evaluations to illustrate environmental quality problems. Meets concurrently with BEE 625. BEE 625 students complete a semester-long design-oriented project.

BEE 350(3500) Biological and Environmental Transport Processes

Fall. 3 credits. Pre- or co-requisites: MATH 293 and fluid mechanics course. Lec, M W F 11:15–12:05; disc, W 2:30–3:20; two evening prelims. A. K. Datta.

Focuses on understanding the principles of heat and mass transfer in the context of biological, biomedical, and environmental systems. Emphasizes physical understanding of transport processes and simple reaction rates with application examples from plant, animal, and human biology, the environment (soil/water/air), and industrial processing of food and biomaterials.

BEE 360(3600) Molecular and Cellular Bioengineering (also BME 360[3600])

Spring. 3 credits. Prerequisite: biochemistry couse or AEP 252 or permission of instructor. Lec, T R 2:55–4:10. D. Luo.

Biological engineering at the molecular and cellular level, focusing on different organisms (viruses, bacteria, cells, animals, and plants) and different scales (nano, molecular, cellular, tissue, and environment) with two underlying themes: DNA and cancer. Introduction of quantitative analysis and measurement as well as ethics in molecular and cellular bioengineering with emphasis on integration of molecular and cell biology with engineering.

BEE 365(3650) Properties of Biological Materials
Spring. 3 credits. Pre- or co-requisite: ENGRD 202. Lec, T R 12:20–1:10; lab, W, R, or F 2:30–4:25. J. A. Bartsch.
Mechanics and structural properties of biological materials; mechanical testing of animal, plant, and food products. Laboratory exercises involve quasistatic and dynamic testing of materials and interpretation of test results. Uses experimental techniques to determine engineering properties of these materials. Satisfies BEE laboratory experience requirement.

BEE 368(3680) Biotechnology Applications: Animal Bioreactors
Fall. 3 credits. Prerequisite: biochemistry course or permission of instructor. Lec, M W F 10:10–11:00. R. C. Gorewit.
Introduces students to the biotechnological applications of animals; their organs, tissues, and cells as bioreactors for the production of substances such as pharmaceuticals; growth factors, anti-tumor proteins, antibodies, and vaccines. Exposes students to various design issues, technical constraints, societal concerns, and ethical considerations of this biotechnology.

BEE 371(3710) Physical Hydrology for Ecosystems
Spring. 3 credits. Prerequisite: MATH 192 or permission of instructor. Lec, T R 9:05–9:55; lab, R 2:30–4:25. T. S. Steenhuis and M. T. Walter.
Physical hydrological processes and their interaction with ecological systems and human activities; surface and near-surface processes and introduction to deep groundwater hydrology. Topics include hydrologic cycles, watershed hydrology, ecosystem–watershed interactions, runoff generation, physical and biophysical vadose-zone processes, soil erosion, ecohydrology, biogeochemical-watershed budgets. Assignments and lab activities provide opportunities to manipulate, and analyze hydrological data in various contexts.

BEE 401(4010) Renewable Energy Systems
Spring. 3 credits. Prerequisite: college physics. Lec, T R 10:10–11:25. L. D. Albright.
Introduces energy systems with emphasis on quantifying costs and designing renewable energy systems to convert environmental inputs into useful forms of energy. Covers solar energy, small-scale hydropower, wind, bio-conversion processes, house energy balances. Focuses on the technologies and small-scale system design, not policy issues. Use of spreadsheets is extensive.

BEE 427(4270) Water Sampling and Measurement
Fall. 3 credits. Satisfies BEE laboratory experience requirement. Prerequisites: fluids or hydrology course and MATH 191. Lec, T 9:05–9:55; lab, T 1:25–4:25. L. D. Geohring and T. S. Steenhuis.
Get your feet wet with this field-based lab course on water sampling methods where science and engineering technologies are integrated to quantify, characterize, and analyze environmental engineering problems. Focuses on quantification of surface and subsurface flow and quality, and includes sampling techniques of soils and sediment. Addresses standard environmental site characterization and monitoring methods, quality assurance and control protocols, and interpretation of watershed loading of contaminants.

BEE 435(4350) Principles of Aquaculture
Spring. 3 credits. BEE students who wish to take this course to satisfy BEE capstone design requirement must co-register in BEE 496 for 1 credit hour. Prerequisite: at least junior standing. Lec, W 1:25–4:25. M. B. Timmons.
In-depth treatment of the principles of aquacultural engineering: mass balances, waste-treatment system design, gas conditioning, production economics, and fish processing. Presents nutrition and fish health in the context of global and local demand. Builds upon previous biology and engineering course work and emphasizes fish-production system design. Includes "hands-on" experiences and field trips.

BEE 450(4500) Bioinstrumentation
Spring. 4 credits. Satisfies both BEE laboratory experience and BEE capstone design requirement. Satisfies College of Engineering technical writing requirement when co-registered in BEE 493. Prerequisites: MATH 294, BEE 151, PHYS 213, or permission of instructor. Lec, T R 8:40–9:55; lab, M, T, or W 2:30–4:25. D. J. Aneshansley.
Lab-based course emphasizing biological and biomedical applications. Considers the electronic instrument from sensor to computer. Static and dynamic characteristics of components and systems are determined theoretically and empirically. General analog and digital signal condition circuits are designed, constructed, and tested.

BEE 453(4530) Computer-Aided Engineering: Applications to Biomedical Processes (also M&AE 453[4530])
Spring. 3 credits. Satisfies BEE capstone design requirement. Prerequisite: heat and mass transfer (BEE 350 or equivalent). Lec, M W 10:10–11; computation disc/lab, F 10:10–11. A. K. Datta.
Introduction to simulation-based design as an alternative to prototype-based design; analysis and optimization of complex real-life processes using industry-standard physics-based computational software on a supercomputer or on high-end personal computers. Covers biomedical heat and mass transfer processes, including cryosurgery, hyperthermia treatment, laser eye surgery, detection of breast cancer, and drug delivery. Computational topics introduce the finite-element method, pre- and post-processing, and pitfalls of using computational software. Students choose their own term project, which is the major component of the course (no final exam).

BEE 454(4540) Physiological Engineering
Fall. 3 credits. Satisfies BEE laboratory experience requirement. Co-requisite: fluid mechanics course. Lec, T R 12:20–1:10; lab, T R 1:25–4:25. D. J. Aneshansley.
Engineering analysis and design in the physiology of animals and humans. Covers the use of engineering principles to study how animals work in nature and to intervene in physiological functions. The two major engineering themes are: signal processing as related to neural conduction, sound processing, vision, and image processing; and systematics as applied to cardiovascular and respiratory systems, bioenergetics, and bird flight. Laboratories involve experiments, computing applications, field trips, and live animal demonstrations.

[BEE 456(4560) Biomechanics of Plants (also BIOPL 456[4560])
Fall. 3 credits. Prerequisites: upper-division undergraduate or graduate standing, completion of introductory sequence in biology and one year of calculus, or permission of instructor. S-U or letter grades optional. Not offered 2005–2006. Lec, T R 11:15–12:05; disc, W 2:30–3:20. J. R. Cooke and K. J. Niklas.
Takes an engineering approach to plant form and function following the text *Plant Biomechanics*. Topics include mechanical behavior of materials, effect of geometry on mechanical behavior, plant-water relations, plant cell walls, mechanical behavior of tissues, mechanical attributes of organs, the plant body, fluid mechanics and biomechanics, and plant evolution.]

[BEE 459(4590) Biosensors and Bioanalytical Techniques
Spring. 4 credits. Satisfies BEE capstone design requirement and BEE laboratory experience requirement for engineering students. Prerequisites: biochemistry course and permission of instructor. Lec, T R 11:40–12:55; lab, M 1:25–4:25 and 7:30–10:30 P.M. Not offered 2005–2006. A. J. Baeumner.
Provides students with an understanding of the scientific and engineering principles of biosensors and bioanalytical techniques. Addresses selected topics from simple biosensors to micro/nanofabricated Micro Total Analysis Systems (MicroTAS). Biosensor and Micro TAS applications in environmental analysis, food safety, and medical diagnostics are explored. Students give oral presentations in lecture, prepare a biosensor of their choice in the laboratory, and present a poster in a biosensor workshop at the end of the semester. Undergraduate students work together in teams of two to four.]

BEE 464(4640) Bioseparation Processes
Fall. 3 credits. Prerequisites: introductory biochemistry, physics, MATH 192, BEE 260 or equivalent, or permission of instructor. Lec, M W F 12:20–1:10. J. B. Hunter.
Bioseparation is the science and engineering of fractionating and purifying biological materials: DNA, proteins, living cells, antibiotics, biofuels, and even foods. This course covers separation methods used in the biotechnology industry, principles governing these methods, approaches to improving bioseparation performance, and the special challenges of scale-up. Key topics (centrifugation, filtration, extraction, membrane methods, ion exchange, chromatography, electrophoresis) are supplemented with student presentations. Intended for seniors and graduate students in engineering, chemistry, biology, and food science.

BEE 471(4710) Introduction to Groundwater (also EAS 445[4710])
Spring. 3 credits. Prerequisites: MATH 293, fluid mechanics or hydrology course. Lec, T R 10:10–11:25; field trip. L. M. Cathles and T. S. Steenhuis.
Intermediate-level study of aquifer geology, groundwater flow, and contamination of aquifers and cleanup methods. Describes transport of pesticides, nutrients and toxics through the unsaturated zone and aquifers. Discusses theoretical and practical applications. Includes short field trips.

BEE 473(4730) Watershed Engineering
Fall. 3 credits. BEE students who wish to take this course to satisfy BEE capstone design requirement must co-register in BEE 496 for 1 credit. Satisfies College of Engineering technical writing requirement when co-registered in BEE 493. Prerequisite: fluid mechanics or hydrology course. Lec, T R 10:10–11:00; disc, R 1:25–4:25. M. F. Walter.
Applies engineering principles to the design of management strategies aimed at solving natural resource problems in the context of watersheds. Emphasizes rural systems and small-scale design for water conveyance, soil erosion control, flood damage control, earthen dams, ponds, moisture conservation, drainage, and water supply.

BEE 474(4740) Water and Landscape Engineering Applications
Spring. 3 credits. Satisfies BEE capstone design requirement. Prerequisite: fluid mechanics or hydrology course or permission of instructor. Lec, M W F 12:20–1:10. T. S. Steenhuis and L. D. Geohring.
Addresses water–soil plant relationships and methods to solve water-management problems in humid and arid ecosystems. The main focus is on drainage and irrigation systems. Emphasizes the practical application of hydrology and hydraulics for solving problems in agriculture and nonagricultural settings. A major design project is required and actual situations are evaluated.

BEE 475(4750) Environmental Systems Analysis
Fall. 3 credits. Prerequisites: computer programming and one year of calculus. Lec, T R 11:40–12:55. D. A. Haith.
Applications mathematical modeling, simulation, and optimization to environmental-quality management. Fate and transport models for contaminants in air, water, and soil. Optimization methods (search techniques, linear programming) to evaluate alternatives for solid-waste management and water and air pollution control. Introduction to hydrologic simulation (runoff and streamflow).

BEE 476(4760) Solid Waste Engineering
Spring. 3 credits. Prerequisites: one semester of physics and chemistry. Lec, T R 11:40–12:55. D. A. Haith.
Planning and design of processes and facilities for management of municipal solid wastes. Source characterization and reduction; collection and transport systems; waste-to-energy combustion; sanitary landfills; composting; recycling, and materials recovery facilities; and hazardous waste management. Emphasizes quantitative analyses.

BEE 478(4780) Ecological Engineering
Spring. 3 credits. BEE students who wish to take this course to satisfy BEE capstone design requirement must co-register in BEE 496 for 1 credit. Prerequisite: junior-level environmental quality engineering course or equivalent. Lec, T R 2:55–4:10. W. J. Jewell.
Ecological engineering is the language of sustainable living. Waste management with natural systems, the most advanced form of this new engineering direction, includes constructed wetlands, hydroponic applications of plants in resource-recovery waste management systems, soil restoration, phytoremediation, and bioremediation of toxics. Biomass refineries to create energy-independent communities, sustainable drinking water systems, carbon sequestration, and zero polluting farms are future sustainable living topics that also solve some of society's larger problems.

BEE 481(4791) LRFD–Based Engineering of Wood Structures (also CEE 481[4791])
Spring. 3 credits. BEE students who wish to take course to satisfy BEE capstone design requirement must co-register in BEE 496 for 1 credit. Prerequisite: ENGRD 202. Lec, M W F 12:20–1:10 (Hollister Hall); two evening prelims. K. G. Gebremedhin.
Computer-aided and manual computation procedures of Load and Resistance Factor Design (LRFD)–based engineering of wood structures. Topics include national design codes and standards; estimation of design loads (dead, live, wind, snow, and seismic loads); determination of factored resistance and stiffness values; mechanical properties of wood and wood products; designs of beams, columns, trusses, frames, arches, bridges, and diaphragms; and connections and special wood structural members and systems. Also discusses engineering design judgment as an integral component of the quantitative design procedure.

BEE 482(4820) Biothermal Engineering for Humans
Fall. 3 credits. Satisfies BEE capstone design requirement. Prerequisites: BEE 350 or equivalent and introductory biology. Letter grades only. Lec, M W F 11:15–12:05. P. E. Hillman.
Engineering design to help humans survive outdoor extremes of heat and cold as well as achieving comfort indoors. Three major topics are discussed: principles of heat and mass transfer applied to humans interacting with their environment, physiological responses to stressful environments, and designing outerwear for environmental extremes.

BEE 484(4840) Metabolic Engineering
Spring. 3 credits. Prerequisite: biochemistry course or permission of instructor. S-U grades optional. Lec, T R 10:10–11:25. R. M. Spanswick.
The principles of metabolic engineering as they relate to the regulation of metabolic pathways, including membrane transport, are considered in terms of enzyme kinetics and metabolic control analysis. Case studies, reflecting the interests of the instructor, include examples involving higher plants. Each student is expected to investigate one topic in depth and make a short class presentation.

BEE 487(4870) Sustainable Energy Systems
Spring. 3 credits. Satisfies BEE capstone design requirement. Intended for upper-level undergraduates and graduate students. Prerequisite: BEE 350 and thermodynamics course. Lec, T R 9:05–9:55; lab, W 1:25–4:25. N. R. Scott and L. D. Albright.
Offers a systems approach to understanding renewable energy systems (solar, wind, and biomass) and their conversion processes, from various aspects of biology, physics, engineering, environmental impacts, economics, and sustainable development.

BEE 489(4890) Engineering Entrepreneurship, Management, and Ethics
Spring. 4 credits. Satisfies College of Engineering technical writing requirement. Prerequisites: junior standing; ENGRD 270 or CEE 304 or equivalent. Lec, T R 1:25–2:40; disc, M 1:25–2:15, or 7:30–8:20 P.M. M. B. Timmons.
Focuses on engineering entrepreneurship, economics, management, and professional ethics. Covers prediction/probability of net returns; financial calculations (internal rate of return, time value of money, pro forma statements); legal structures of businesses; project management; developing an awareness of issues related to professional ethics; and technical writing and communication. Group project required to produce a business plan for a technology-driven concept suitable for a venture fair audience.

BEE 493(4930) Technical Writing for Engineers
Fall or spring. 1 credit. Meets College of Engineering technical writing requirement when taken concurrently with BEE 473 in fall or BEE 450 in spring. Co-requisite: BEE 473 (fall), BEE 450 (spring). Lec, M 7:30–9:25 P.M. (five evenings in first half of semester). Staff.
Covers writing skills necessary for technical project reports. Also considers outlines, style, audience, and general writing mechanics.

BEE 494(4940) Fundamentals of Tissue Engineering
Spring. 3 credits. Limited to 20 students; priority given to graduating seniors. Prerequisites: biochemistry, BEE 350. Letter grades only. Lec, M W F 12:20–1:10. R. C. Gorewit.
Fundamentals and applications of tissue engineering. Cell technology, cell function in constructs and sources of cells for tissue engineering. Biomaterials, including functional requirements, biomimetics and substrates, and bioartifical construct technology. Diffusion and transport processes in engineered tissue, manufacture and scale-up of production processes, regulation and FDA approval of engineered products. Examples include cartilage, bone, skin, cardiovascular and neural tissues.

BEE 495(4950) BEE Honors Research
Fall or spring. 1–6 credits, variable. Prerequisite: enrollment in BEE research honors program. Students must complete honors program application by third week of fall semester, senior year. Letter grades only. Staff.
Intended for students pursuing the research honors program in BEE.

BEE 496(4960) Capstone Design in Biological and Environmental Engineering
Fall and spring. 1 credit. Co-requisite: one approved upper-level course (BEE 435, 473, 478, 481). Students must register using independent study form (available in 140 Roberts Hall). Staff.
Involves capstone design experience, including a team project incorporating analysis, design, evaluation, synthesis, and a written and oral report of the end product.

BEE 497(4970) Individual Study in Biological and Environmental Engineering

Fall and spring. 1–4 credits. S-U grades optional. Prerequisite: written permission of instructor and adequate ability and training for work proposed; normally reserved for seniors in upper two-fifths of their class. Students must register using independent study form (available in 140 Roberts Hall). Staff.

Special work in any area of biological and environmental engineering on problems under investigation by the department or of special interest to the student, provided, in the latter case, that adequate facilities can be obtained.

BEE 498(4980) Undergraduate Teaching

Fall and spring. 1–4 credits. Prerequisite: written permission of instructor. Students must register using independent study form (available in 140 Roberts Hall). Staff.

The student assists in teaching a biological and environmental engineering course appropriate to his or her previous training. The student meets with a discussion or laboratory section, prepares course materials, grades assignments, and regularly discusses objectives and techniques with the faculty member in charge of the course.

BEE 499(4990) Undergraduate Research

Fall and spring. 1–4 credits. Prerequisites: normally reserved for seniors in upper two-fifths of their class; adequate training for work proposed; written permission of instructor. Students must register using independent study form (available in 140 Roberts Hall). Staff.

Research in any area of biological or environmental engineering on problems under investigation by the department or of special interest to the student, provided that adequate facilities can be obtained. The student must review pertinent literature, prepare a project outline, carry out an approved plan, and submit a formal final report.

BEE 501(5010) Bioengineering Seminar (also BME 501[5010])

Fall, spring. 1 credit. Prerequisite: junior, senior, or graduate standing. S–U grades only. Fall, R 3:35–4:25; spring, W 3:35–4:25. D. Putnam.

Broad survey of all aspects of bioengineering, including biomedical, bioprocess, biological, and bioenvironmental engineering and aspects of biotechnology. Sessions may be technical presentations for discussions. Sessions may occasionally be held outside of scheduled times.

BEE 520(5900) M.P.S. Project

Fall and spring. 1–6 credits. Requirement for each M.P.S. candidate in field. ABEN graduate faculty.

Comprehensive project emphasizing the application of agricultural technology to the solution of a real problem.

BEE 551(5950) Master of Engineering Design Project

Fall and spring. 3–6 credits. Prerequisite: admission to M.Eng. degree program. ABEN graduate faculty.

Comprehensive design projects dealing with existing engineering problems in the field. Emphasizes the formulation of alternative design proposals that include consideration of economics, nontechnical factors, engineering analysis, and complete design for the best design solution. Projects are supervised by faculty members on an individual basis. There is, however, a formal orientation during the first four weeks of the semester. A formal report and public presentation of the results of the design project are required for completion of the course(s). A minimum of 3 to a maximum of 12 credits of 551 is required for the M.Eng. degree.

BEE 625(6250) Environmental Management

Fall. 3 credits. Lec, T R 2:55–4:10. W. J. Jewell.

For description, see BEE 325.

BEE 647(6470) Water Transport in Plants (also BIOPL 651[6510])

Fall. 2 credits. Lec, T R 10:10–11:00. Offered alternate years. R. M. Spanswick.

Topics include water relations of plant cells and tissues using water potential terminology; permeability of plant cells to water and the role of aquaporins; transport of water through whole plants, including transpiration, stomatal physiology, and the modifications due to plant communities; water status and plant growth in relation to water stress.

[BEE 649(6490) Solute Transport in Plants (also BIOPL 649[6490])

Fall. 3 credits. Lec, T R 10:10–11:25. Offered alternate years; not offered 2005–2006. R. M. Spanswick.

Fundamental treatment of the transport of ions and small organic molecules in plants. Topics include electrophysiology of cell membranes, including ion channels and electrogenic ion pumps; transport mechanisms for the major ions; intercellular and long-distance ion transport; cotransport systems for sugars and amino acids; phloem transport; ABC-type transporters.]

BEE 651(6510) Bioremediation: Engineering Organisms to Clean Up the Environment

Spring. 3 credits. Prerequisites: BIOMI 290 or 398 or BIOBM 331 or permission of instructor. Lec, T R 10:10–11. B. A. Ahner.

Examines ways in which organisms may be used to remove or metabolize pollutants in the environment, including bacterial degradation of organics and phytoremediation of heavy metals. Through lectures and current literature, students evaluate the benefits as well as the current obstacles. Examines the current efforts to genetically engineer organisms for bioremediation and the potential risks of releasing them into the environment.

BEE 655(6550) Thermodynamics and Its Applications

Fall. 3 credits. Prerequisite: MATH 293 or equivalent. Lec, R 2:30–4:30. Offered alternate years. J.-Y. Parlange.

Thermodynamics and its applications to problems in engineering and agriculture. Topics include basic concepts (equilibrium, entropy, processes, systems, potentials, stability, phase transitions) and applications (soil and water processes, dilute solutions, electromagnetism, surface phenomena, heat and mass transport, and structure of organizations).

[BEE 659(6590) Biosensors and Bioanalytical Techniques

Spring. 4 credits. Prerequisites: biochemistry course and permission of instructor. Lec, T R 11:40–12:55; lab, M 1:25–4:25 and 7:30–10:30 P.M. Not offered 2005–2006. A. J. Baeumner.

Provides students with an understanding of the scientific and engineering principles of biosensors and bioanalytical techniques. Addresses selected topics from simple biosensors to micro/nanofabricated Micro Total Analysis Systems (MicroTAS). Biosensor and Micro TAS applications in environmental analysis, food safety, and medical diagnostics are explored. Students give oral presentations in lecture, prepare a biosensor of their choice in the laboratory, and present a poster in a biosensor workshop at the end of the semester. Graduate students work independently on individual biosensor projects.]

[BEE 671(6710) Analysis of the Flow of Water and Chemicals in Soils

Fall. 3 credits. Prerequisites: four calculus courses and fluid mechanics course. Lec, M 2:30–4:25 (first meeting TBA). Offered alternate years; not offered 2005–2006. J.-Y. Parlange.

Encompasses a full range from simple to complex methods to describe the chemical and water flows on the surface, in the vadose zone, and through the aquifer. Discusses current analytical, semi-analytical, and computer-based techniques. Analyzes both homogeneous and heterogeneous soils are analyzed. Offered alternately with CEE 633—a complementary, but not identical, course.]

BEE 672(6720) Drainage

Spring. 4 credits. Satisfies BEE capstone design experience requirement. Prerequisites: BEE 471 or BEE 473. S-U grades optional. Lec, M W F 12:20–1:10; lab, T 1:25–4:25. T. S. Steenhuis and L. D. Geohring.

Discusses the theory of water and solute flow in aquifers, hill slopes, and the vadose zone as it relates to natural and artificial drainage. Critically reviews drainage design as it relates to agricultural land, landfills, and land application sites. Examines the importance of preferential flow and matrix flow on water quality of drainage waters. Laboratories provide hands-on experience with measuring soil parameters and for actual drainage design.

BEE 673(6730) Sustainable Development Seminar (also NBA 573[5730])

Spring. 1–3 credits. Prerequisites: upper-division undergraduate or graduate standing or permission of instructor. Lec, F 1:30–3:00. N. R. Scott.

Sustainable development is the most beneficial concept to come out of the environmental movement in years. The concept of a sustainable world, however, is not a constant. There are many aspects of sustainability involving economics, environment, and political, social, scientific, and technological developments. This seminar explores topics such as energy, agricultural and food systems, green buildings and ecological design, corporate sustainability, and other contemporary issues.

BEE 685(6850) Biological Engineering Analysis

Spring. 4 credits. Prerequisite: TAM 310 or permission of instructor. Lec, M W F 11:15–12:05. J. R. Cooke.

Explores engineering problem-solving strategies and techniques. Students solve several representative engineering problems that inherently involve biological properties. Emphasizes formulation and solution of mathematical models and the interpretation

of results. Makes extensive use of students' knowledge of fundamental principles.

BEE 687(6870) The Science and Engineering Challenges to the Development of Sustainable Bio-Based Industries
Fall. 1 credit. Prerequisite: graduate standing. Lec, R 12:20–1:10; disc, R 1:25–2:15. B. A. Ahner.
Environmentally sustainable alternatives for our energy and chemical needs are critical. This seminar series explores challenges facing the development of industries that use biologically derived materials to produce useful chemicals and energy for society. Topics include natural products from biological systems, conversion of biomass to fuel and other commodities, and the use of biological systems for environmental bioremediation.

BEE 694(6940) Graduate Special Topics in Agricultural and Biological Engineering
Fall or spring. 4 credits max. S-U grades optional. ABEN graduate faculty.
The department teaches "trial" courses under this number. Offerings vary by semester, and are advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

BEE 697(6970) Graduate Individual Study in Agricultural and Biological Engineering
Fall or spring. 1–6 credits. Prerequisite: permission of instructor. S-U grades optional. ABEN graduate faculty.
Topics are arranged by the staff at the beginning of the semester.

BEE 700(7010) General Seminar
Fall. 1 credit. S-U grades only. Staff.
Presentation and discussion of research and special developments in agricultural and biological engineering and related fields.

BEE 740(6430) Veterinary Perspectives on Pathogen Control in Animal Manure (also VTMED/BIOMI 740[6430])
Spring, March 24–May 16. 2 credits. Prerequisite: graduate standing or permission of instructor. Lec, M T W R 3:00–4:00. D. D. Bowman.
In-depth look at the management of pathogens in animal manures. Reviews the pathogens involved, the role of governing agencies, the survival of pathogens in the field, and methods of pathogen destruction. Discusses commercial methods of manure processing for the control of these pathogens for the protection of other animals and the human population. Concludes with class discussions with major stakeholders representing the dairy, beef, pork, and poultry industries and their understanding of the problem as it relates to veterinary students.

BEE 750(7000) Orientation to Graduate Study
Fall, first seven weeks. 1 credit. Prerequisite: new graduate students. S-U grades only. Lec, M 3:35–4:25. D. J. Aneshansley.
Introduction to BEE research policy, programs, methodology, resources, and degree candidates' responsibilities and opportunities.

BEE 754(7540) Watershed Management
Spring. 2–3 credits. Prerequisite: graduate standing or permission of instructors. Lec, W 2:30–4:25. T. S. Steenhuis and M. J. Pfeffer.
Traditional top-down approaches to watershed management have been challenged by advocates of public participation. These challenges have raised questions about how to effectively integrate science, policy, and public participation. This course reviews different management approaches and evaluates their usefulness in dealing with different watershed management problems. Considers case examples from watersheds in the United States and overseas.

BEE 760(7600) Nucleic Acid Engineering (also BME 760[7600])
Spring. 2 credits. Prerequisite: BEE 360 or permission of instructor. Lec, T R 12:20–1:10. D. Luo.
Nucleic acid engineering focuses on manipulating nucleic acid molecules in a true engineering sense as well as in the "genetic engineering" sense by treating nucleic acids (including DNA, RNA, PNA, and TNA) as both genetic and generic materials. Both biomedical and nonbiomedical applications of nucleic acid engineering, including tool kits for nucleic acid engineering and current examples of DNA-based engineering, DNA nanotechnology, and DNA-based medicine. A design project and formal project presentation are required.

BEE 771(7710) Soil and Water Engineering Seminar
Fall and spring. 1–3 credits. Prerequisite: graduate standing or permission of instructor. S-U grades optional. T. S. Steenhuis, J.-Y. Parlange, and M. F. Walter.
Study and discussion of research or design procedures related to selected topics in irrigation, drainage, erosion control, hydrology, and water quality.

BEE 781(7810) Structures and Related Topics Seminar
Spring. 1 credit. Prerequisite: graduate standing or permission of instructor. S-U grades only. Times TBA. Staff.
Advanced analysis and design of production systems with emphasis on structural and environmental requirements, biological responses, and economic considerations.

BEE 785(7850) Biological Engineering Seminar
Spring. 1 credit. Prerequisite: graduate standing or permission of instructor. S-U grades only. Staff TBA.
Examines the interactions of engineering and biology, especially the environmental aspects of plant, animal, and human physiology to improve communication between engineers and biologists.

BEE 787(7870) Industrial Ecology of Agriculturally Based Bioindustries
Spring. 3 credits. Prerequisites: graduate standing; one year of calculus, some knowledge of MATLAB, BEE 687. Lec, M W F 3:35–4:25. L. P. Walker.
Uses input/output modeling methods to explore the use of the industrial ecology perspective for the design and analysis of sustainable bio-based industries.

BEE 788(7880) Biomass Conversion of Energy and Chemicals
Fall. 3 credits. Prerequisite: one year of college calculus and chemistry; minimum of one course in thermodynamics and computer programming. Lec, M W F 1:25–2:15. L. P. Walker.
Biological and physical conversion of biomass to bioenergy and bioproducts. Biological and engineering concepts associated with microbial and enzymatic conversion of biomass to useful products, physical and chemical concepts associated with the pretreatment of biomass and the separation of key biomolecules. Uses mass and energy balances and mathematical models (with MATLAB) to simulate process behavior.

BEE 800(8900) Master's-Level Thesis Research
Fall and spring. 1–15 credits. Prerequisite: permission of adviser. S-U grades. ABEN graduate faculty.

BEE 900(9900) Doctoral-Level Thesis Research
Fall and spring. 1–15 credits. Prerequisite: permission of adviser. S-U grades. ABEN graduate faculty. Variable credit for Ph.D. research.

BIOLOGICAL SCIENCES

The program of study in biology is coordinated by the Office of Undergraduate Biology. For course descriptions, see the separate section "Biological Sciences."

BIOLOGY & SOCIETY

The undergraduate major field of study in biology & society is offered through the Department of Science and Technology Studies. For a full description of courses that fulfill field requirements, see "Biology & Society" under the College of Arts and Sciences.

BIOMETRY AND STATISTICS

M. Wells, chair (301 Malott Hall, 255-4388, -8801), J. Booth, C. Bustamante, R. Nielsen, S. J. Schwager, A. C. Siepel, R. Strawderman

The Department of Biological Statistics and Computational Biology in Statistical Science offers the following courses in Biometry and Statistics. Students must register under Course Listings: College of Agriculture and Life Sciences—Biometry and Statistics.

BTRY 301(3010) Biological Statistics I (also NTRES 313[3130], STBTRY 301[3010])
Fall and summer. 4 credits.
Develops and applies statistical methods to problems encountered in the biological and environmental sciences. Methods include data visualization, population parameter estimation, sampling, bootstrap resampling, hypothesis testing, the Normal and other probability distributions, and an introduction to modeling. Carries out applied analysis in the S-Plus statistical computing environment.

BTRY 302(3020) Biological Statistics II (also NTRES 413[4130], STBTRY 302[3020])
Spring. 4 credits. Prerequisite: BTRY 301 or 601.
Applies linear statistical methods to quantitative problems addressed in biological and environmental research. Methods include linear regression, inference, model assumption evaluation, the likelihood approach, matrix formulation, generalized linear models, single factor and multifactor analysis of variance (ANOVA), and a brief foray into nonlinear modeling. Carries out applied analysis in the S-Plus statistical computing environment.

BTRY 310(3100) Statistical Sampling (also ILRST 310[3100] and STBTRY 310[3100])
Fall. 3 credits. Lec, T R 1:25–2:40.
Prerequisites: two semesters of statistics.
Applied methodology and theory of statistical sampling, with particular emphasis on sampling methods, sample design, cost, estimation of population quantities, and error estimation. Assessment of nonsampling errors. Discussion of application to social and biological sciences and business. Includes an applied project.

[BTRY 382(3820) Introduction to Statistical Genomics and Bioinformatics (also STBTRY 382[3820])
Fall. 4 credits. Intended for undergraduates and beginning graduate students in mathematical and biological sciences. Prerequisite: BTRY 301, MATH 111, BIOG 102, or equivalent.
Survey course focusing on the statistical analysis of genomic data. Includes an introduction to probability and statistics and application to DNA sequence analysis, phylogenetic inference, population genetics, genetic mapping, molecular evolution, and macromolecular structure prediction. Evaluation is based on weekly problem sets and computer assignments as well as a midterm and final examination.]

BTRY 408(4080) Theory and Probability (also STBTRY 408[4080])
Fall. 4 credits. Prerequisites: MATH 111, 112, at least concurrent enrollment in 213 or 222 or equivalents. Recommended: at least one introductory course in statistical methods.
Introduction to probability theory: axiomatic foundations; combinatorics and equally likely events; conditional probability and independence; discrete and continuous random variables, their distributions and moments; generating functions; transformations; extensions to problems involving two or more random variables; random samples. Can serve as either one-semester introduction or a foundation for a course in statistical theory.

BTRY 409(4090) Theory of Statistics (also STBTRY 409[4090])
Spring. 4 credits. Prerequisites: BTRY 408 or equivalent and at least one introductory statistics course.
Introduction to classical theory of parametric statistical inference that builds on the material covered in BTRY 408. Topics include sampling distributions, principles of data reduction, likelihood, parameter estimation, hypothesis testing, interval estimation, and basic asymptotic theory.

[BTRY 421(4210) Matrix Computation
Fall. 4 credits. Prerequisite: calculus course. Not offered 2005–2006.
Introductory course in matrix computations that reviews linear algebra (vector spaces, linear independence) and emphasizes a matrix approach to solving systems (LU-factorization, QR-decomposition, SVD, Schur complements) and the role of the condition number of a matrix. Discusses positive definite matrices, eigenvalues, and their applications in mathematical modeling and statistics.]

BTRY 482(4820) Statistical Genomics (also STBTRY 482[4820])
Fall. 4 credits. Prerequisite: BTRY 382 or equivalent. S-U grades optional.
Covers topics in the statistical analysis of genetic, molecular, and genomic data, including the statistics of DNA database searches and alignment, statistical methods in molecular evolution, population genetics, phylogenetics, molecular ecology, forensic genetics, the analysis of comparative molecular data, QTL mapping, and association mapping. Topics may vary from year to year. Meets concurrently with BTRY 682; undergraduate students are evaluated on the basis of a final exam and a term paper instead of a research project.

BTRY 494(4940) Undergraduate Special Topics in Biometry and Statistics (also STBTRY 494[4940])
Fall or spring. 1–3 credits. S-U grades optional.
Course of lectures selected by the faculty. Because topics usually change from year to year, this course may be repeated for credit.

BTRY 495(4950) Statistical Consulting (also STBTRY 495[4950])
Fall and spring. 2–3 credits. Pre- or co-requisites: BTRY 302 or 602 and 409 and permission of instructor. S-U grades optional.
Participation in the Department of Biological Statistics and Computational Biology consulting service: faculty-supervised statistical consulting with researchers from other disciplines. Discussion sessions are held for joint consideration of literature and selected consultations encountered during previous weeks.

BTRY 497(4970) Undergraduate Individual Study in Biometry and Statistics (also STBTRY 497[4970])
Fall and spring. 1–3 credits. S-U grades optional. Students must register using independent study form (available in 140 Roberts Hall).
Consists of individual tutorial study selected by the faculty. Because topics usually change from year to year, this course may be repeated for credit.

BTRY 498(4980) Undergraduate Supervised Teaching (also STBTRY 498[4980])
Fall and spring. 2 credits. S-U grades optional. Students must register using independent study form (available in 140 Roberts Hall).
Students assist in teaching a course appropriate to their previous training. Students meet with a discussion or laboratory section and regularly discuss objectives with the course instructor.

BTRY 499(4990) Undergraduate Research (also STBTRY 499[4990])
Fall or spring. 1–3 credits. Prerequisite: statistics and biometry undergraduates; permission of faculty member directing research. S-U grades optional. Students must register using independent study form (available in 140 Roberts Hall).

BTRY 601(6010) Statistical Methods I (also STBTRY 601[6010])
Fall and summer. 4 credits. Prerequisite: graduate standing or permission of instructor.
Develops and uses statistical methods to analyze data arising from a wide variety of applications. Topics include descriptive statistics, point and interval estimation, hypothesis testing, inference for a single population, comparisons between two populations, one- and two-way analysis of variance, comparisons among population means, analysis of categorical data, and correlation and regression analysis. Introduces interactive computing through MINITAB statistical software. Emphasizes basic principles and criteria for selection of statistical techniques.

BTRY 602(6020) Statistical Methods II (also STBTRY 602[6020])
Spring. 4 credits. Prerequisite: graduate standing or permission of instructor; BTRY 601 or equivalent.
Continuation of BTRY 601. Emphasizes the use of multiple regression analysis, analysis of variance, and related techniques to analyze data in a variety of situations. Topics include an introduction to data collection techniques; least squares estimation; multiple regression; model selection techniques; detection of influential points, goodness-of-fit criteria; principles of experimental design; analysis of variance for a number of designs, including multi-way factorial, nested, and split plot designs; comparing two or more regression lines; and analysis of covariance. Emphasizes appropriate design of studies before data collection, and the appropriate application and interpretation of statistical techniques. Practical applications are implemented using a modern, widely available statistical package.

[BTRY 603(6030) Statistical Methods III (also STBTRY 603[6030])
Spring. 3 credits. Prerequisite: BTRY 601 and 602 or permission of instructor. Offered alternate years.
Categorical data analysis, including logistic regression, log-linear models, stratified tables, matched pairs analysis, polytomous response and ordinal data. Applications in biomedical and social sciences.]

BTRY 604(6040) Statistical Methods IV: Applied Design (also STBTRY 604[6040])
Spring. 4 credits. Prerequisites: BTRY 601 and 602 or permission of instructor. Offered alternate years.
Applications of experimental design including such advanced designs as split plots, incomplete blocks, fractional factorials. Stresses use of the computer for both design and analysis, with emphasis on solutions of real data problems.

[BTRY 652(6520) Computationally Intensive Statistical Inference (also STBTRY 652[6520])
Spring. 4 credits. Prerequisite: BTRY 421 and 409 or equivalent. S-U grades optional. Offered alternate years.
Modern applications in statistics often require intensive computation not handled by "off-the-shelf" software. This course covers topics in statistical computing, including numerical optimization and finding zeros (likelihood and related techniques including generalized estimating equations and robust estimation), kernel density estimation, resampling methods (randomization and bootstrap tests and confidence intervals), and statistical simulation (random number generation, heuristic search methods, Bayesian estimation, and Monte Carlo Markov Chain methods for tests and interval estimation). Programming is done in MATLAB. Focuses on the use of numerical analysis methods for solving problems in statistical inference and estimation.]

[BTRY 672(6720) Topics in Environmental Statistics (also STBTRY 672[6720])
Fall and spring. 2 credits. S-U grades optional. Prerequisite: BTRY 601 or permission of instructor. Not offered 2005–2006.
Discussion group focusing on statistical problems arising in the environmental sciences. Explores these issues in a number of different ways, such as student presentations of research papers, directed readings, and outside speakers.]

BTRY 682(6820) Statistical Genomics (also STBTRY 682[6820])
Fall. 4 credits. Prerequisite: BTRY 382 or equivalent. S-U grades optional.
Covers topics in the statistical analysis of genetic, molecular, and genomic data, including the statistics of DNA database searches and alignment, statistical methods in molecular evolution, population genetics, phylogenetics, molecular ecology, forensic genetics, the analysis of comparative molecular data, QTL mapping, and association mapping. Topics may vary from year to year. All students are expected to participate in small research projects.

BTRY 694(6940) Graduate Special Topics in Biometry and Statistics (also STBTRY 694[6920])
Fall or spring. 1–3 credits. S-U grades optional.
Course of lectures selected by the faculty. Because topics usually change from year to year, this course may be repeated for credit.

BTRY 697(6970) Individual Graduate Study in Biometry and Statistics (also STBTRY 697[6970])
Fall, spring, or summer. 1–3 credits. S-U grades optional.
Individual tutorial study selected by the faculty. Because topics usually change from year to year, this course may be repeated for credit.

[BTRY 717(7170) Linear and Generalized Linear Models (also STBTRY 717[7170])
Fall. 3 credits. Prerequisites: BTRY 409, 421, and 602 or equivalents. S-U grades optional. Offered alternate years.
Statistical modeling and inference using linear models and generalized linear models. Includes estimation by least squares, maximum likelihood, quasi-likelihood, and generalized estimating equations. Covers the use of link functions and generalized linear models to accommodate nonlinear models and non-normally distributed data. Also covers the use of random effects to accommodate correlation structures in both linear mixed models and generalized linear mixed models and to model longitudinal data. Some use of software packages and illustrative examples.]

BTRY 726(7260) Problems and Perspectives in Computational Molecular Biology (also PL BR 726[7260], COM S 726[7590])
Fall and spring. 1 credit. Prerequisite: permission of instructor. S-U grades only.
Weekly seminar series discussing timely topics of computational molecular biology. Addresses methodological approaches to sequence annotation, protein structure and function relationships, and evolutionary relationships across species. Discusses statistical and deterministic computational approaches are covered and specific and detailed biological examples. Discusses topics of interest discussed in relation to papers prepared by teams of students and/or faculty members. Students/faculty members from biology backgrounds are paired with students from math, computer science, and statistics for paper preparation. Students summarize the salient questions addressed by the paper, the research methods used, and the results obtained. At the end of the presentation, questions should be listed on an overhead slide to initiate discussion in the group.

BTRY 795(7950) Statistical Consulting (also STBTRY 795[7950])
Fall and spring. 2–3 credits. Pre- or co-requisites: BTRY 602 and 409 and permission of instructor. S-U grades optional.
Participation in the Department of Biological Statistics and Computational Biology consulting service: faculty-supervised statistical consulting with researchers from other disciplines. Discussion sessions are held for joint consideration of literature and selected consultations encountered during previous weeks.

BTRY 798(7980) Graduate Supervised Teaching (also STBTRY 798[7980])
Fall and spring. 2–4 credits. Prerequisites: permission of instructor and chair of special committee plus at least two advanced courses in statistics and biometry. S-U grades only.
Students assist in teaching a course appropriate to their previous training. Students meet with a discussion section, prepare course materials, and assist in grading. Credit hours are determined in consultation with the instructor, depending on the level of teaching and the quality of work expected.

BTRY 800(8900) Master's-Level Thesis Research
Fall or spring. Credit TBA. Prerequisite: M.S. candidates; permission of graduate field member concerned. S-U grades only.
Research at the M.S. level.

BTRY 900(9900) Graduate-Level Dissertation Research
Fall or spring. Credit TBA. Prerequisite: Ph.D. candidates; permission of graduate field member concerned. S-U grades only.
Research at the Ph.D. level.

BTRY 901(9910) Doctoral-Level Dissertation Research
Fall or spring. Credit TBA. S-U grades only.

COMMUNICATION

G. K. Gay, chair (303 Kennedy Hall, 255-7737, -5530); K. L. Berggren, S. A. Conroe, R. D. Colle, B. O. Earle, T. L. Gillespie, D. A. Grossman, J. T. Hancock, B. V. Lewenstein, K. A. McComas, P. L. McLeod, R. E. Ostman, T. M. Russo, C. W. Scherer, J. E. Shanahan, M. A. Shapiro, L. P. Van Buskirk, J. B. Walther, Y. C. Yuan

Note: Class meeting times are accurate at the time of publication. If changes occur, the department will provide new information as soon as possible.

COMM 116(1160) Understanding Human Communication
Spring. 3 credits. Lec, M W F 11:15–12:05. K. McComas.
Introduces students to communication theory and its applications to social relations. Students gain an understanding of theory development and evaluation and learn about the major paradigms of communication research. Covers a wide range of communication theories in a variety of settings, including interpersonal, group, and organizational.

COMM 117(1170) Writing about Communication
Spring. 3 credits. Co-requisite: COMM 116. T R 10:10–11:25, 11:40–12:55, 1:25–2:40, 2:55–4:10. L. Van Buskirk and staff.
Students develop skill in various writing styles and genres. This course explores communication practices and theories as they are observed and studied in personal and professional contexts. Assignments polish students' ability to gather information, analyze information, integrate ideas about communication, and express those ideas clearly and cogently.

COMM 120(1200) Contemporary Mass Communication
Fall or summer. Fall: lec, M W F 12:20–1:10. J. Shanahan.
The processes and effects of mass communication systems. Topics include the evolution of communication media, current knowledge about mediated communication, and the role of communication in contemporary social issues.

COMM 201(2010) Oral Communication
Fall, spring, or summer. 3 credits. Limited to 20 students per sec (fall and spring) or 15 students per sec (summer). Priority given to sophomores, juniors, and seniors. Fluency in spoken English assumed. Class secs meet first day of class before mass lec. Students absent twice during first week of class are dropped from course roster. K. Berggren, T. Russo, and staff.
Through theory and practice, students develop self-confidence and competence in researching, organizing, and presenting material to audiences. Students give four graded speeches, write short papers, perform speaker evaluations, and engage in other speech-related activities.

COMM 203(2030) Argumentation and Debate
Fall, spring, and summer. 3 credits. Fall: T R 11:40–12:55; spring: T R 11:40–12:55. Staff.
Students learn the principles of argumentation and debate. Topics emphasize Internet database research, synthesis of collected data, analysis of evidentiary quality, refutation of counter claims, identification of logical fallacies, risk evaluation, framing of issues, and coherent storytelling. Prepares students to work with a great range of opinion and evidence. Emphasizes different viewpoints, including those of different cultures. Assumptions are interrogated.

COMM 220(2200) Mass Media and Society
Spring. 3 credits. Lec, T R 11:40–12:55. T. Gillespie.
Considers the role of the mass media in a democratic society. Explores recent theories of communication, media, and society by considering: the industries and institutions that structure media production and distribution; the representational complexity of media texts and genres; the role of news media in the political life of the nation; the interpretive work of audiences; and the relationship between media texts and cultural identity.

COMM 230(2300) Visual Communication
Spring. 3 credits. Lec 01, T R 9:05–9:55; lab, T 2:30–4:25; W 10:10–12:05; 12:20–2:15, 2:30–4:25. C. Scherer.
Introduction to visual communication theory. Examines how visuals influence our attention, perspectives, and understanding. Uses examples of visuals drawn from advertising, TV news, documentaries, entertainment movies, print, and interactive media develop a theoretical framework for becoming more visually aware and for thinking more critically about how visuals influence us.

COMM 245(2450) Psychology and Social Computing (also INFO 245[2450])
Fall. 3 credits. T R 10:10–11:25. J. Hancock.
In-depth examination of several social aspects of computing, drawing upon recent and classical social psychology and social-cognition research. Closely examines a small number of topics that may include impression formation/management, group behavior, deception and trust, disinhibition, and online relationships.

COMM 260(2600) Science Writing for Public Information
Fall, spring, or summer. 3 credits. Limited to 25 students per sec. Prerequisite: sophomore, junior, senior, or graduate-student standing; college-level writing course. Fall: Lec 01, M W F 9:05–9:55, lec 02, M W F 10:10–11:00; spring: Lec 01, M W F 9:05–9:55 or lec 02, M W F 1:25–2:15. S. Conroe.
Intensive course in simplifying scientific and technical material for specific audiences within the general public. Weekly assignments include instructions, descriptions, explanations, and summaries in such formats as the newsletter, brochure, and report. Emphasizes audience analysis. Not oriented to the mass media.

COMM 263(2630) Organizational Writing
Fall, spring, or summer. 3 credits. Limited to 25 students per sec. Prerequisite: junior, senior, or graduate standing; college-level writing course. Fall: Lec 01, M W F 9:05–9:55; lec 02, M W F 10:10–11:00; lec 03, M W F 11:15–12:05. Spring: Lec 01, M W F 10:10–11:00, lec 02, M W F 11:15–12:05. L. Van Buskirk and staff.
Students write from the point of view of various organizations, including businesses, government agencies, and nonprofit organizations. This course emphasizes appropriate representation of the writer's organization, audience analysis, and clear and effective written presentation of detailed content. Assignments include text for web sites, reports, proposals, memoranda, letters, and e-mail.

COMM 272(2720) Principles of Public Relations and Advertising
Summer. 3 credits. Not open to freshmen. Staff.
Survey of the fields of public relations and advertising. Describes organizations, jobs, and functions in the industry. Covers the roles of public relations and advertising in society, the economic system, and organizations; psychological and sociological principles as bases for appeals; strategies for media selection and message execution. Introduction to research and regulation.

COMM 282(2820) Communication Industry Research
Fall. 3 credits. Pre- or co-requisite: COMM 116, 120. Lec, M W F 11:15–12:05. R. Ostman and staff.
Public opinion polls, readership/viewership studies, audience segmentation techniques, and media and message effect evaluation are all widely used in communication industries. This course covers the use of basic research design, measurement, sampling, and simple descriptive and influential statistics in conducting these studies.

COMM 284(2840) Sex, Gender, and Communication
Fall. 3 credits. Not open to freshmen. T R 2:55–4:10. L. Van Buskirk.
Explores the personal, career, social, and economic implications of male and female gender categories. Topics include theories of male and female gender construction, social structures, personal relationships, and gender concerns in the workplace.

COMM 285(2850) Communication in Life Sciences (also S&TS 285[2851])
Spring. 3 credits. M W F 10:10–11. B. Lewenstein.
Environmental problems, public health issues, scientific research—in each of these areas, communication plays a fundamental role. From the mass media to individual conversations, from technical journals to textbooks, from lab notes to the web, communication helps define social issues and research findings. This course examines the institutional and intellectual contexts, processes, and practical constraints on communication in the life sciences.

COMM 301(3010) Business and Professional Presentation
Fall and spring. 3 credits. Prerequisite: COMM 201; second-semester sophomore, junior, or senior standing. Lec, M W 11:15–12:05; sec, T 12:20–2:15 and 2:30–4:25; W 1:25–3:20; R 10:10–12:05. B. Earle.
The study and practice of written and oral communication skills used in formal and informal organizations. These skills include interviews; informative, persuasive, and special-occasion speeches; reports; discussions; and Powerpoint presentations. Students study and practice the organizational, analytical, and presentational skills needed in contexts suited to their own business and professional career goals.

COMM 303(3030) Speech and Debate Practicum
Fall and spring. 2 credits. Prerequisite: Program in Speech and Debate members; permission of instructor; completion of one year in program. Staff.
Students learn how to prepare for CEDA (Cross Examination Debate Association) debate, Lincoln-Douglas debate, or individual speaking events. The class is divided into four groups according to level of experience; therefore, it may be repeated to a maximum of 8 credits.

COMM 345(3450) Human-Computer Interaction Design (also INFO 345[3450])
Spring. 3 credits. T R 10:10–11:25. G. Gay.
Gives students insight into the design of computer interfaces and software from the user's point of view. Students come to understand how hardware and software design influence the interaction between people and computers. Using assigned readings, demonstrations, and projects, students examine issues and trade-offs in interaction design and invent and evaluate alternative solutions.

[COMM 349(3490) Media Technologies (also S&TS 349[3491])
Spring. 3 credits. Not offered 2005–2006. T R 1:25–2:40. T. Gillespie.
Our efforts to communicate, share culture, and drive social agendas depend on the tools we've developed. However, our commonplace notions of communication and media regularly overlook the role of the material technologies that are so crucial to them. This course considers the technologies of media (including printing, photography, film, telegraph, telephone, radio, television, and computer networks) as an opportunity to think about the intersection of technology, communication, and its social context.]

COMM 350(3500) Writing for Magazines
Fall. 3 credits. Limited to 25 students. Prerequisite: junior, senior, or graduate standing or permission of instructor; college-level writing course. No drops after third week. M 1:25–4:25; lab, R 1:25–2:15. S. Conroe.
Course in nonfiction freelance writing for magazines. Intensive fact writing to help students communicate more effectively through the medium of the printed word in magazines. Art and techniques of good writing are studied; magazines in many fields of interest are reviewed. All articles are analyzed and returned to the student to rewrite and submit to a magazine. Extensive out-of-class writing assignments.

COMM 352(3520) Science Writing for the Mass Media (also S&TS 352[3521])
Fall and spring. 3 credits. Limited to 24 students. Not open to freshmen. Prerequisite: college-level writing course. Lec, M W 10:10–11; lab, W 12:20–2:15. B. Lewenstein and staff.
How to write about science, technology, and medicine for the mass media. Discussion topics include accuracy, simplicity, comprehensiveness, risk communication, and the history and social structure of science.

Writing assignments focus on writing news and feature stories for newspapers and magazines, with excursions into newsletters, radio, TV, and other media.

COMM 353(3530) Science Writing Practicum

Spring. 1 credit. Prerequisite: COMM 260, COMM/S&TS 352, ENGRC 350, or permission of instructor. B. Lewenstein.

Students cover the annual meeting of the American Association for the Advancement of Science, held in February each year. Before the meeting, students review science writing techniques and issues. At the meeting, students meet with science writers and attend press conferences and scientific sessions. Students write at least two stories. Students are responsible for all costs of travel, lodging, and meals.

[COMM 376(3760) Planning Communication Campaigns

Fall. 3 credits. Pre- or co-requisites: COMM 282 or equivalent social research course. Not offered 2005–2006. T R 11:40–12:55. K. McComas.

Provides a theoretical and practical overview of the audiences, messages, and evaluation of communication campaigns. Includes principles of planning and evaluation relevant to several kinds of campaigns. Topics include discussion of campaign goals, objectives, strategies, and tactics; research design and implementation; audience segmentation; message construction; and techniques of evaluation. Considers common methods of data collection (e.g., focus groups, experiments, surveys) and analysis of campaign-related data sources.]

COMM 382(4932) Advanced Communication Research

Fall. 3 credits. Prerequisite: COMM 282 or equivalent social research course. C. Yuan.

Advanced approaches to methods of data collection and analysis in communication research for students who intend to complete advanced research projects such as honors research or other independent studies and who have preliminary research under way. Every week the class examines one or two research situations in detail, analyzes specific problems connected to the method used, and discusses strategies for data analysis and presentation. This format provides all students—independent of their specific thesis topic—with an in-depth understanding of the methods used in communication research and how they are applied to specific projects.

COMM 398(3980) Issues in Teaching Communication

Fall and spring. 1 credit. Pre- or co-requisite: junior or senior standing; present or past undergraduate teaching assistant for COMM course. Alternate M 7:30–9:10 P.M. K. Berggren.

Seminar bringing together novice educators to discuss ideas, experiences, and practice. Integration of theory into actual education efforts is challenging for professional educators. Novice teachers are not aware of their common experiences, much less of a theoretical component to education. In discussions of actual teaching experiences, literature reviews, research reports, textbook chapters, curriculum, and evaluation tools, students examine new ideas and practices. The primary goal of the seminar is to enrich and deepen the novice teaching experience.

COMM 405(4050) Community Service Practicum

Fall and spring. 1 credit; may be repeated once for credit. Meets 1 hour weekly, time TBA. Staff.

Students share their communication talents in structured experiences in which they design and implement a speech or debate project in local schools or the community.

[COMM 410(4100) Organizational Communication: Theory and Practice

Fall. 3 credits. Limited to 15 students per lab. Prerequisite: junior, senior, or graduate standing; COMM 116 or permission of instructor. Not offered 2005–2006. Lec, M W 11:15–12:05; lab 01, W 12:20–2:15; lab 02, W 2:30–4:15; lab 03, R 12:20–2:15; lab 04, R 2:30–4:15. C. Yuan.

Study of management communication processes in formal organizations. Applies relevant organizational behavior and communication principles in today's business environment; examines formal and informal communication networks, and explores the craft of consulting. Case studies analyzed in lab.]

COMM 420(4200) Public Opinion and Social Process

Spring. 3 credits. Prerequisite: COMM 282. M W 2:55–4:10. R. Ostman and staff.

Provides a scientific and applied overview of the concept of "public opinion" and its implications for macrosocial processes. Reviews the historical development of this concept in fields such as political science, social psychology, and communication science, followed by a closer look at what is meant by "measuring" public opinion. For example, is public opinion measured by summing across individual opinions, or are there macro-level dynamics of public opinion that go beyond what individuals in a society think? Based on theory, students conduct survey research on the importance of public opinion and public opinion perception for democratic societies, examining such areas as communication media, policymaking, risk perceptions, mass and popular culture, or political participation.

[COMM 421(4210) Communication and the Environment

Spring. 3 credits. Lec, M W 2:55–4:10. Offered odd-numbered years. K. McComas.

Students investigate how values, attitudes, social structure, and communication affect public perceptions of environmental risk and public opinion about the environment. A primary focus is mass media's impact on public perceptions of the environment, how the media portray the environment, and discussion of the implications of public consumption of environmental content.]

COMM 422(4220) Psychology of Television (and Beyond)

Fall. 3 credits. Prerequisites: introductory psychology or HD 120 or COMM 120 or 116. Lec, M W F 12:20–1:10. M. Shapiro.

Survey of knowledge about how people mentally process television and other audiovisual communication technologies—including movies, video games, virtual reality, and the Internet. Topics include why people watch, what happens mentally when they watch, how people understand and mentally process media, and how media psychologically influence beliefs, attitudes, thinking, and emotion.

[COMM 424(4240) Communication in the Developing Nations

Fall. 3 credits. Prerequisite: junior or senior standing. Not offered 2005–2006. Lec, T 1:25–2:35; lab, T 2:35–4:25. R. Colle.

The role of communication in development programs, particularly in the Third World. Emphasizes communication interventions in agriculture, health, nutrition, family planning, and community development and especially on methods for designing communication strategies for reaching low-income, rural people. Considers extension, social marketing, and development support communication.]

COMM 428(4280) Communication Law

Spring. 3 credits. Prerequisite: junior, senior, or graduate standing or permission of instructor. Lec, M W F 11:15–12:20. D. Grossman.

Deals with the law governing communication media. Topics include First Amendment concepts, restraints on newsgathering and dissemination, libel, invasion of privacy, copyright protection, regulation of broadcast and nonbroadcast electronic media, advertising law, and current legal issues unique to online communication.

COMM 440(4400) Advanced Human-Computer Interaction Design (also INFO 440[4400])

Fall. 3 credits. Prerequisite: COMM 245 or permission of instructor. T R 10:10–11:25. G. Gay.

Focuses on the design of computer interfaces and software from the user's point of view. The goal is to teach user interface designs that "serve human needs" while building feelings of competence, confidence, and satisfaction. Topics include formal models of people and interactions, collaborative design issues, psychological and philosophical design considerations, and cultural and social issues.

COMM 445(4450) Seminar in Computer-Mediated Communication (also INFO 445[4450])

Fall. 3 credits. Prerequisite: COMM 245. T R 11:40–12:55. J. Walther.

Focuses on reading and evaluating the theories and research methodologies used to investigate communication via computer systems. Assignments include student collaborations using electronic conferencing and other advanced communication technologies, as well as reflections on and evaluations of these collaborations in light of current theories and research findings. Topics include virtual teams, videoconferencing, and others as they emerge.

COMM 450(4500) Language and Technology (also INFO 450[4500])

Spring. 3 credits. T R 11:40–12:55. J. Hancock.

Examines how new communication technologies affect the way we produce and understand language and modify interaction with one another. Focuses on the collaborative nature of language use and how Internet technologies affect the joint activities of speakers and listeners during the construction of meaning in conversation.

COMM 466(4660) Public Communication of Science and Technology (also S&TS 466[4660])

Fall. 3 credits. Prerequisite: COMM 260 or 352, ENGRC 350, or permission of instructor. Offered odd-numbered years. M W 2:55–4:10. B. Lewenstein.

Explores the structure, meanings, and implications of "public communication of science and technology" (PCST). Examines the contexts in which PCST occurs, looks at motivations and constraints of those involved in producing information about science for nonprofessional audiences, and analyzes the functions of PCST. Ties existing ideas about PCST to general communication research, and leads to developing new knowledge about PCST. Format is primarily seminar/discussion.

COMM 476(4760) Communication Fellows Program

Spring. 2 credits. Prerequisites: communication seniors selected based on goals and academic preparation; permission of instructor. Fee for three-day trip: $150. M 2:55–4:10. B. O. Earle.

Series of lectures, seminars, and guest speakers exploring the planning, evaluation, and policy-making process. Includes a three-day trip to a metropolitan area to visit corporate leaders, administrative agencies, and policymakers.

COMM 480(4800) Independent Honors Research in Social Science

Fall or spring. 1–6 credits. Prerequisite: undergraduate standing; requirements met for honors program. Times TBA. Staff.

Students who have successfully completed COMM 382 register for no more than 3 credits. Students who have not completed an advanced research methods course may register for up to 6 credit hours.

COMM 486(4860) Risk Communication

Spring. 3 credits. T R 1:25–2:15; lab, R 2:30–4:25. C. Scherer.

Examination of theory and research related to the communication of scientific information about environmental, agricultural, food, health, and nutritional risks. Concentrates on social theories related to risk perception and behavior. Examines case studies involving pesticide residues waste management, water quality, environmental hazards, and personal health behaviors. Emphasizes understanding, applying, and developing theories.

COMM 494(4940) Special Topics in Communication

Fall, spring, or summer. 1–3 credits, variable. Prerequisite: permission of instructor. S-U grades optional.

Study of topics in communication not otherwise provided by a department course and determined by the interest of the faculty and students.

COMM 496(4960) Communication Internship

Fall or spring. Work component and variable. 1 credit; may be repeated once for a total of 2 credits. Prerequisite: COMM major or minor (first-, second-, third-, or fourth-year) for 1 credit (minimum 60 hours). K. Berggren.

Students receive a structured, on-the-job learning experience under the supervision of communication professionals in cooperating organization. A minimum of 60 hours of on-the-job work is required; the number of work hours beyond 60 is left to the discretion of the intern and the supervising company. A final paper linking communication theory to practical work experience is required. All internships must be approved before the work experience segment by the internship coordinator.

COMM 497(4970) Individual Study in Communication

Fall or spring. 1–3 credits; may be repeated to 6 credits with different supervising faculty member. Prerequisite: 3.0 GPA. Students must register using independent study form (available in 140 Roberts Hall).

Individual study under faculty supervision. Work should concentrate on locating, assimilating, synthesizing, and reporting existing knowledge on a selected topic. Attempts to implement this knowledge in a practical application are desirable.

COMM 498(4980) Communication Teaching Experience

Fall or spring. 1–3 credits; may be repeated to 6 credits with different courses. Intended for undergraduates desiring classroom teaching experience. Prerequisite: junior or senior standing; 3.0 GPA (2.7 if teaching assistant for skills development course); permission of faculty member who supervises work and assigns grade. Students must register using independent study form (available in 140 Roberts Hall).

Periodic meetings with the instructor cover realization of course objectives, evaluation of teaching methods, and student feedback. In addition to aiding with the actual instruction, each student prepares a paper on some aspect of the course.

COMM 499(4990) Independent Research

Fall or spring. 1–3 credits; may be repeated to 6 credits. Prerequisites: senior standing; 3.0 GPA. Students must register using independent study form (available in 140 Roberts Hall).

Permits outstanding students to conduct laboratory or field research in communication under appropriate faculty supervision. The research should be scientific: systematic, controlled, empirical. Research goals should include description, prediction, explanation, or policy orientation and should generate new knowledge.

[COMM 610(6100) Seminar in Communication and Social Networks

Not offered 2005–2006.]

[COMM 618(6180) Communication and Persuasion

Spring. 3 credits. Prerequisite: introductory research methods course and introductory psychology or social psychology course. Not offered 2005–2006. T R 10:10–11:25. Staff.

Focuses on theories of communication's influence on persuasion and attitude change. Familiarizes students with a variety of social-psychological theories of attitude change and persuasion. Also applies those theories to a variety of communication situations including mass communication, advertising, public relations/public information, and interpersonal communication. Lectures concurrent with COMM 418; graduate students should enroll in COMM 618.]

[COMM 621(6210) Advanced Communication and the Environment

Spring. 3 credits. M W 2:55–4:10. Offered odd-numbered years. K. McComas.

Students investigate how values, attitudes, social structure, and communication affect public perceptions of environmental risk and public opinion about the environment. A primary focus is mass media's impact on public perceptions of the environment, how the media portray the environment, and discussion of the implications of public consumption of environmental content. Lectures concurrent with COMM 421; graduate students should enroll in COMM 621.]

COMM 622(6220) Advanced Psychology of Television (and Beyond)

Fall. 3 credits. Prerequisites: graduate standing and permission of instructor. Times TBA. M. Shapiro.

Survey of knowledge about how people mentally process television and other audiovisual communication technologies—including movies, video games, virtual reality, and the Internet. Topics include why people watch, what happens mentally when they watch, how people understand and mentally process media, and how media psychologically influence beliefs, attitudes, thinking, and emotion.

COMM 624(6240) Communication in the Developing Nations

Fall. 3 credits. Prerequisite: junior, senior, or graduate standing. Lec, M 2:30–4:25; lab, 1 hour TBA. R. D. Colle.

The role of communication in development programs, particularly in Third World nations. Emphasizes communication interventions in agriculture, health, nutrition, family planning, and community development, and especially methods for designing communication strategies for reaching low-income, rural people. Among the approaches considered are extension, social marketing, and development support communication. Lectures concurrent with COMM 424; graduate students should enroll in COMM 624.

COMM 640(6400) Human-Computer Interaction Design (also INFO 640[6400])

Fall. 3 credits. Prerequisite: graduate standing or permission of instructor. T R 10:10–11:25. G. Gay.

Graduate-level readings and research supplementing COMM 440. Focuses on the design of computer interfaces and software from the user's point of view. The goal is to teach user interface designs that "serve human needs" while building feelings of competence, confidence, and satisfaction. Topics include formal models of people and interactions, collaborative design issues, psychological and philosophical design considerations, and cultural and social issues.

COMM 645(6450) CMC Graduate Seminar (also INFO 645[6450])

Spring. 3 credits. Prerequisite: graduate standing or permission of instructor. T R 11:40–1:25. J. Walther and J. Hancock.

Graduate-level readings and research supplementing COMM 445. Through close reading and research in communication and technology, and participation in projects using these technologies, students enhance experiential, theoretical, and critical understanding of contemporary computer-mediated communication systems and uses. Topics include virtual teams, videoconferencing, and others.

COMM 650(6500) Language and Technology (also INFO 650[6500])

Spring. 3 credits. T R 11:40–12:55. J. Hancock.

Graduate-level readings and research supplementing COMM 450. Examines how new communication technologies affect the

way we produce and understand language and modify interaction with one another. Focuses on the collaborative nature of language use and how Internet technologies affect the joint activities of speakers and listeners during the construction of meaning in conversation.

[COMM 676(6760) Communication Planning for Social and Behavioral Change
Spring. 3 credits. T R 10:10–11:25. Not offered 2005–2006. Staff.]

COMM 680(6800) Studies in Communication
Fall. 3 credits. Prerequisite: communication graduate students or permission of instructor. M W 8:40–9:55. J. Shanahan.
Reviews classical and contemporary readings in communication, including key concepts and areas of investigation. Explores the scope of the field, the interrelationships of its various branches, and examines the role of theory in the research process.

COMM 681(6810) Advanced Communication Theory
Spring. 3 credits. Prerequisite: COMM 680 or graduate standing and permission of instructor. M W 2:55–4:10 with additional meetings TBA. M. Shapiro.
Development of, and contemporary issues in, communication theory. Discusses the interaction between communication and society, social groupings, and mental processing.

COMM 682(6820) Methods of Communication Research
Spring. 3 credits. Recommended: familiarity with basic statistical concepts. M W F 12:20. R. Ostman.
Analyzes the methods used in communication research. Emphasizes understanding the rationale for survey, textual, experimental, and ethnographic research methods. Development of class research project from research question to final report. (Uses Statistical Package for the Social Sciences [SPSS] to assist in data analysis.)

[COMM 683(6830) Qualitative Research Methods in Communication
Not offered 2005–2006.]

COMM 686(6860) Risk Communication
Spring. 3 credits. M W 10:10–11:25; lab, R 2:30–4:25. C. Scherer.
Examination of theory and research related to the communication of scientific information about environmental, agricultural, food, health, and nutritional risks. Concentrates on social theories related to risk perception and behavior. Examines case studies involving pesticide residues, waste management, water quality, environmental hazards, and personal health behaviors. Emphasizes understanding, applying, and developing theories of risk communication.

COMM 691(6910) Seminar: Topics in Communication
Fall and spring. 0 credits. S-U grades only. Staff.
Some weeks scholars from a wide variety of fields present varied topics in theory or research as it relates to communication; other weeks graduate students present thesis (project) proposals to faculty members and peers.

COMM 694(6940) Special Topics in Communication
Fall, spring, or summer. 1–3 credits, variable. Prerequisite: permission of instructor. S-U grades optional.
Study of topics in communication not otherwise provided by a department course and determined by the interest of faculty members and students.

[COMM 781(7810) Seminar in Psychology of Communication
Spring. 3 credits. Prerequisite: COMM 680 and 681 or equivalent graduate-level theory in psychology or social psychology. Letter grades. Offered odd-numbered years. M. Shapiro.
Discusses and analyzes selected current issues in the psychology of communication. Students discuss and synthesize current research and theory in the mental processing of communication.]

COMM 794(7940) Seminar in Communication Issues
Fall, spring, or summer. 1–3 credits.. Prerequisite: permission of instructor. Letter grades only.
Small group study of topical issue(s) in communication not otherwise examined in a graduate field course.

COMM 797(7970) Graduate Independent Study
Fall, spring, or summer. 1–3 credits. Prerequisite: permission of instructor. Letter grades only.
Individual study concentrating on locating, assimilating, synthesizing, and reporting existing knowledge on a selected topic.

COMM 798(7980) Communication Teaching Laboratory
Fall and spring. 1–3 credits each semester; may be repeated once. Prerequisite: graduate standing and permission of faculty member who will supervise work and assign grade. (Students must use faculty member's section number to register.) Letter grades only. Graduate faculty.
Designed primarily for graduate students who want experience in teaching communication courses. Students work with an instructor in developing course objectives and philosophy, planning, and teaching.

COMM 799(7990) Graduate Research
Fall, spring, or summer. 1–3 credits. Prerequisite: appropriate communication graduate course work or permission of instructor. Letter grades only.
Small-group or individual research based on original, empirical, data-based designs regarding topical issues in communication not otherwise examined in a graduate field course.

COMM 800(8900) Master's-Level Thesis Research
Fall or spring. 1–6 credits; may be repeated for max. of 6 credits. Prerequisite: permission of committee chair. S-U grades only.
Thesis research for M.S. (communication) students.

COMM 901(9900) Doctoral-Level Dissertation Research
Fall or spring. 1–9 credits; may be repeated for max. of 9 credits. Prerequisites: completion of "A" exam; permission of committee chair. S-U grades only.
Dissertation research for Ph.D. candidates.

CROP AND SOIL SCIENCES

S. D. DeGloria, chair (232 Emerson Hall, 255-5459); P. C. Baveye, D. R. Bouldin, D. Buckley, J. H. Cherney, W. J. Cox, A. DiTommaso, J. M. Duxbury, E. C. Fernandes, G. W. Fick, R. R. Hahn, P. Hobbs, Q. Ketterings, L. V. Kochian, J. Lehmann, A. Lembo, M. B. McBride, R. L. Obendorf, S. J. Riha, J. M. Russel-Anelli, T. W. Scott, T. L. Setter, J. E. Thies, H. M. van Es, A. Van Wambeke, R. M. Welch

Note: Class meeting times are accurate at the time of publication. If changes occur, the department will provide new information as soon as possible.

Courses by Subject

Crop Science: 311, 312, 315, 317, 414, 415, 444, 455, 608, 610, 612, 613, 614, 642, 691, 820, 920, 921

Environmental Information Science: 398, 410, 411, 420, 465, 485, 486, 620, 660, 675, 694, 860, 960, 961

Soil Science: 200, 260, 362, 363, 365, 372, 373, 412, 421, 466, 471, 472, 473, 483, 621, 663, 666, 667, 669, 671, 672, 693, 880, 980, 981

General Courses

CSS 190(1900) Sustainable Agriculture
Fall. 3 or 4 credits, variable. Limited to 60 students. S-U grades optional. Lec, T R 10:10; labs, M T 2:00–4:25. G. W. Fick.
Concerns food, farming, and the future. Designed to introduce basic food production resources in the context of the human aspects of farming. The information is of general value for nonmajors and students new to the field. Several field trips enhance appreciation for the diversity of agriculture. Students can earn 1 extra credit by participating in team preparation and delivery of a lesson in sustainable agriculture.

CSS 494(4940) Special Topics in Crop and Soil Sciences (undergraduate level)
Fall or spring. 4 credits max. S-U grades optional.
The department teaches "trial" courses under this number. Offerings vary by semester, and are advertised by the department before the semester begins. Courses offered under this number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

CSS 497(4970) Individual Study in Crop and Soil Sciences
Fall or spring. 1–6 credits. S-U grades optional. Students must register using independent study form (available in 140 Roberts Hall).
Topics in soil science, crop science, or environmental information science are

arranged at the beginning of the semester for individual study or for group discussions.

CSS 498(4980) Teaching Experience in Crop and Soil Sciences
Fall or spring. 1–5 credits. S-U grades optional. Students must register using independent study form (available in 140 Roberts Hall).
Teaching experience in soil science, crop science, or environmental information science is obtained by assisting in the instruction of a departmental course.

CSS 499(4990) Undergraduate Research
Fall or spring. Credit TBA. S-U grades optional. Students must register using independent study form (available in 140 Roberts Hall).
Independent research on current problems selected from any phase of crop science, soil science, or environmental information science.

CSS 696(6960) Seminar in Crop and Soil Sciences
Fall and spring. 1 credit. S-U grades only. Lec, R 12:20–1:10. Staff.
Covers current research and selected topics in the crop and soil sciences and related fields.

Crop Science

CSS 311(3110) Grains and Nutraceuticals
Fall. 4 credits. Prerequisite: CSS 260 or BIOPL 241. Lec, M W F 10:10; lab, M 1:25–4:25. One or two field trips during lab periods (until 5 P.M. or on weekends). R. L. Obendorf.
Globally, six seed crops provide 75 percent of the caloric and protein needs of mankind by direct consumption or indirectly through animal and microbial products. Seed crops for starch, protein, oil, fiber, sugar, nutraceutical, pharmaceutical, and industrial uses are emphasized, including adaptation, growth and development, environmental stress, optimization of yield and quality, and genetic improvement in the context of food systems for improved health. Laboratory uses living plants, an extensive crop garden, and computer simulation.

CSS 312(3120) Forage Crops
Spring. 4 credits. Prerequisite: introductory crop and/or soil science course. Recommended: animal nutrition course. Lec, M W F 9:05; lab, M 1:25–4:25. G. W. Fick.
Considers the production and management of crops used for livestock feed in terms of establishment, growth, maintenance, harvesting, and preservation. Emphasizes forage grasses, forage legumes, and corn and considers their value as livestock feed in terms of energy, protein, and other nutritional components.

CSS 315(3150) Weed Science
Fall. 4 credits. Prerequisite: introductory course in biology or botany. Lec, T R 10:10–11:25; lab, T or W 2:00–4:25. A. DiTommaso.
Examines principles of weed science. Emphasizes (1) weed biology and ecology; (2) weed-management strategies used in agricultural and natural ecosystems; and (3) chemistry of herbicides in relation to effects on plant growth and the environment. Hands-on laboratory sessions cover weed identification and ecology, herbicide application, selectivity, and symptomology.

[CSS 317(3170) Seed Science and Technology (also HORT 317[3170])
Fall. 3 credits. Prerequisite: BIOPL 241 or equivalent. Lec, T R 11:15–12:05; lab, R. Two all-day field trips are scheduled during semester. Offered alternate years; not offered 2005–2006. A. G. Taylor, Geneva Experiment Station. (Ithaca contact, R. L. Obendorf.)
The principles and practices involved in the production, harvesting, processing, storage, testing, quality management, certification, and use of high-quality seed from improved cultivars. Information is applicable to various kinds of agricultural seeds. Hands-on laboratory experience.]

CSS 403(4030) Traditional Agriculture in Developing Nations (also IARD 403[4030])
Fall. 1 credit. S-U grades only. P. Hobbs.
Half the world's arable land is farmed by traditional farmers who have produced food and fiber for millennia with few outside inputs. Many of these practices are forgotten but some are still used by farmers in developing countries. This course examines the pros and cons of some of these traditional systems.

CSS 414(4140) Tropical Cropping Systems: Biodiversity, Social, and Environmental Impacts (also IARD 314[3140])
Fall. 3 credits. Prerequisite: introductory crop science or soil science or biology course or permission of instructor. Lec, T R 8:40–9:55; labs, one per month, TBA. P. Hobbs.
Characterizes and discusses traditional shifting cultivation; lowland rice-based systems; upland cereal-based systems; smallholder mixed farming including root crops and livestock; plantation fruit and oil crop systems; and agroforestry. In addition to species diversity and domestication, factors such as climate, land quality, soil management, land tenure, labor, and markets are considered. Evaluates the impact of tropical cropping systems on the environment.

CSS 426(4260) Practicum in Forest Farming as an Agroforestry System (also HORT/NTRES 426[4260])
Fall. 2 credits. Lab, W 1:25–4:25. K. W. Mudge, L. E. Buck, and P. Hobbs.
Students actively take part in the development and management of a 70-year-old nut grove originally planted at Cornell in the 1930s. The MacDaniel's Nut Grove is being developed as a multipurpose forest-farming teaching, research, and extension site. Hands-on activities include all or most of the following: temperate-nut harvest and variety evaluation, mushroom culture, small-fruit and fruit-tree culture, medicinal-herb culture, site evaluation and planning, and field trips to other agroforestry-related sites. Outdoor activities are integrated with selected readings via an online discussion board.

CSS 444(4440) Integrated Pest Management (also ENTOM 444[4440])
Fall. 4 credits. Prerequisites: biology course or permission of instructor. Lec, M W F 9:05; lab, M 1:25–4:25. J. E. Losey and A. DiTommaso.
Lectures integrate the principles of pest control, ecology, and economics in the management of pests across multiple systems. Laboratory exercises reinforce concepts presented in lecture and demonstrate pest monitoring techniques and the application of computer technology to management problems.

[CSS 455(4550) Mineral Nutrition of Crops and Landscape Plants (also HORT 455[4550])
Spring. 3–5 credits. Prerequisite: CSS 260 and BIOPL 242, or equivalent. Lec, M W F 9:05; lab, R 1:30–4. Offered alternate years; next offered 2006–2007. H. C. Wien and staff.
Modular course on principles of plant mineral nutrition and nutrient management. A mandatory module on principles is followed by others on agronomic crops, vegetables, floriculture, and fruit crops. Each module carries 1 credit; a minimum of 3 credits must be taken in one semester. By the end of the course, students understand the principles of mineral nutrient function in crop plants, and are able to diagnose deficiencies by symptoms and tissue tests and devise organic and conventional nutrient management schemes that maximize productivity and mineral nutrient quality.]

[CSS 608(6080) Water Status in Plants and Soils
Fall. 1 credit. Prerequisite: permission of instructor. S-U grades only. Lec, lab, R 1:25–4:25, first class meeting R. Offered alternate years; not offered 2005–2006. T. L. Setter.
Covers techniques for field appraisal of the status of water in plants and soil, including methods used in physiological studies, such as the psychrometer, pressure chamber, gas exchange analyzer, and abscisic acid analysis with ELISA.]

[CSS 610(6010) Physiology of Environmental Stresses
Fall. 3 credits. Prerequisite: plant physiology course (BIOPL 242 or 342) or permission of instructor. Offered alternate years; not offered 2005–2006. Lec, M W F 1:25. T. L. Setter.
Study of the responses of plants to environmental stresses, including chilling, drought, freezing, high temperature, salinity, hypoxia, and toxic elements. Emphasizes the physiological and biochemical basis of injury and plant resistance mechanisms at the whole-plant, cellular, and molecular levels.]

CSS 612(6120) Seed Biology
Fall. 3 credits. Prerequisite: plant physiology course. T R 8:30–9:55. R. L. Obendorf.
Describes the molecular, biochemical, physiological, environmental, and genetic regulation of seed development, maturation, and germination events, including the deposition and mobilization of seed reserves with illustrations from the world's major food and feed seeds. Illustrations extend the principles to practical situations, industrial uses, and food systems for improved health.

CSS 613(6130) Physiology and Ecology of Yield
Spring. 3 credits. Prerequisite: plant physiology course (BIOPL 242 or 342) or permission of instructor. M W F 12:20–1. T. L. Setter.
Study of environmental constraints on crop-plant productivity from the perspective of key biological processes. Examines acclimation responses and genetic adaptation for temperature, light, water, compacted

soil, and mineral nutrient environments. Topics include photosynthesis and nitrogen assimilation, translocation, and partitioning; canopy-scale influences on solar radiation use efficiency; regulation of growth processes in leaf, root, and floral sinks in response to environment; seed set; water transport and stomatal regulation; root growth in flooded and compacted soils; and drought responses. Emphasizes growth processes of vegetative plant organs.

[CSS 614(6140) Weed Ecology and Management

Spring. 3 credits. Prerequisite: CSS 315 or equivalent. Lec, T R 10:10–11:25. Offered alternate years; not offered 2005–2006. A. DiTommaso.

Examination of plant ecological principles governing weed population dynamics and weed-crop competitive interactions in different crop and noncrop ecosystems. Explores the application of these fundamentals for the development and implementation of environmentally sound and sustainable integrated weed management strategies. Topics include seed biology and seedbank dynamics, weed demography and spatial variation, weed-crop interference, invasive weed biology, biological weed control, and site-specific weed management.]

[CSS 642(6420) Plant Mineral Nutrition (also BIOPL 642[6420])

Spring. 3 credits. Prerequisite: BIOPL 341 or equivalent. Lec, M W F 10:10–11. Not offered 2005–2006. L. V. Kochian, R. M. Welch.

Detailed study of the processes by which plants acquire and use mineral nutrients from the soil. Topics include the uptake, translocation, and compartmentation of mineral elements; root-soil interactions; metabolism of mineral elements; the involvement of mineral nutrients in various physiological processes; and nutrition of plants adapted to extreme environmental stresses (e.g., acidic soils). Emphasizes specific mineral elements to illustrate the above topics.]

CSS 691(6910) Special Topics in Crop Science

Fall or spring. 1–6 credits. S-U grades optional. Staff.

Study of topics in crop science that are more specialized or different from other courses. Special topics to be offered depend on staff and student interests.

CSS 820(8200) Master's-Level Thesis Research in Crop Science

Fall or spring. Credit TBA. S-U grades only. Times TBA. Graduate faculty.

Thesis research for M.S. candidates.

CSS 920(9200) Graduate-Level Thesis Research in Crop Science

Fall or spring. Credit TBA. S-U grades only. Times TBA. Graduate faculty.

Thesis research for Ph.D. students before "A" exam has been passed.

CSS 921(9210) Doctoral-Level Dissertation Research in Crop Science

Fall or spring. Credit TBA. S-U grades only. Times TBA. Graduate faculty.

Dissertation research for Ph.D. candidates **after** "A" exam has been passed.

Environmental Information Science

[CSS 397(3970) Environmental Microbiology [also BIOMI 397(3970)]

Spring. 3 credits. Prerequisite: BIOEE 261 or BIOMI 290 or CSS 260 or permission of instructor. Offered alternate years; not offered 2005–2006. Lec, M W F 10:10–11:00. E. L. Madsen.

Discusses the biology, behavior, and function of microorganisms in natural environments in relation to past and present environmental conditions on Earth. Also considers the role of microorganisms in ecologically and environmentally significant processes through discussion of specific topics such as elemental cycles, nutrient cycling, transformation of pollutant chemicals, wastewater treatment, and environmental biotechnology.]

CSS 410(4100) The GMO Debate: Environmental Impacts

Spring. 3 credits. Prerequisite: BIO G 109 or equivalent. Lec, M W F 9:05–9:55. D. Buckley and P. Hobbs.

This course covers issues pertaining to the agricultural use of genetically modified organisms with emphasis on evaluating their environmental impact. Students will learn to critically evaluate the risks of benefits associated with the use of GMOs. We will examine the types of GMOs in use and in development, how they are made, and their potential impacts on the environment including: gene flow, non-target effects, horizontal gene transfer, biodiversity effects and the implications of changes in farming practices and chemical inputs.

CSS 411(4110) Resource Inventory Methods [also CEE 411(4110)]

Spring. 3 credits. Prerequisite: permission of instructor. Lec, M W 9:05–9:55; lab, M R 1:25–4:25. A. Lembo.

Survey of resource inventory methods applied to field-based studies of environmental systems. Laboratory emphasizes using maps, spatial databases, global positioning systems, and aerospace imagery to discriminate, measure, inventory, and monitor environmental resources.

CSS 420(4200) Geographic Information Systems

Fall. 4 credits. Prerequisite: CSS 411 or permission of instructor. Lec, T R 9:05–9:55; lab, T 10:10–1:10; M W R 1:25–4:25; F lab added only if enrollment numbers dictate. A. Lembo.

Principles and applications of geographic information systems for the characterization and assessment of agronomic and environmental resources. Emphasizes methods for accessing, updating, analyzing, and mapping spatial data and information. Considers needs assessment, coordinate systems, database design and maintenance, data transformations, and map accuracy assessment.

CSS 465(4650) Global Positioning System

Fall, first five weeks of semester. 1 credit. Prerequisite: CSS 411 or 420, or equivalent, or permission of instructor. Lec, F 9:05–12:00. Spring, last five weeks of semester. 1 credit. Prerequisite: CSS 411 or 420, or equivalent, or permission of instructor. Lec, F 1:25–4:25. A. Lembo.

Introduction to navigation-grade GPS instruments used in agricultural and environmental science. Topics include instrument familiarization; field-data collection and processing; real-time and post-differential correction; and GPS-GIS integration.

CSS 485(4850) Problem Solving in Environmental and Agroecosystem Science I

Fall. 4 credits. Prerequisite: senior standing, CSS 260 or equivalent. Lec, first meeting F 1:25; lab, at least one four-hour afternoon per week plus additional time as needed. P. Baveye.

Capstone experience for seniors, centering on the pluridisciplinary analysis of a specific problem (e.g., a brownfield in Ithaca in fall 2004), with a number of faculty members serving as technical resources and lecturing as needed. Involves field trips, in-depth discussions of data assembled before the course, gathering of relevant scientific information (in groups), and report writing. Students are expected to work approximately 15 hours per week on a range of assignments. The course is conceived as the first of a sequence of two complementary courses, but it can be taken alone.

CSS 486(4860) Problem Solving in Environmental and Agroecosystem Science II

Spring. 4 credits. Prerequisite: senior standing, CSS 485. Lec, TBA; lab, at least one four-hour afternoon per week plus additional time as needed. P. Baveye.

Capstone experience for seniors, in continuation of CSS 485. Students work in groups to carry out the laboratory measurements identified in the fall, with faculty members serving as technical support and lecturing as needed. Students are expected to work approximately 15 hours per week on a range of laboratory measurements. The results of these measurements are discussed as they become available and are combined with the rest of the assembled information to come up with recommendations about the management of the targeted problem (e.g., in spring 2005, a brownfield in Ithaca).

CSS 620(6200) Spatial Modeling and Analysis

Spring. 3 credits. Prerequisites: CSS 420, 461, or permission of instructor. Lec, T R 9:05–9:55; lab, T W 1:25–4:25. A. Lembo.

Theory and practice in the development, integration, and visualization of spatial data for resource inventory, environmental process modeling, land classification, and evaluation. Emphasizes application and evaluation of advanced spatial analytical methods applied to environmental systems and databases of interest to the student.

CSS 621(6210) Applications of Space-Time Statistics

Spring. 2 credits. Prerequisite: STBTRY 601 or equivalent. S-U grades only. Offered alternate years; offered after spring break 2006. W F 2:30–4:25. H. Van Es.

Introduction to space-time statistics with applications in agriculture and environmental management. Topics include geostatistics (including use of ArcView's Geostatistical_ Analyst), temporal statistics, sampling, experimental design, state-space analysis, data mining, and fuzzy logic. Focuses on landscape-scale processes and a user's perspective.

[CSS 660(6600) Remote Sensing Fundamentals [also CEE 610(6100)]
Fall. 3 credits. Prerequisite: permission of instructor. Lec, M W 12:20–1:10; lab, F 12:20–1:10, 1:25–2:15. Not offered 2005–2006. W. D. Philpot.
Introduces equipment and methods used in obtaining information about earth resources and the environment from aircraft or satellite. Covers sensors, sensor and ground-data acquisition, data analysis and interpretation, and project design.]

CSS 675(6750) Modeling the Soil-Plant-Atmosphere System (also EAS 675[6750])
Spring. 3 credits. Prerequisite: CSS 483 or equivalent. Offered alternate years. Lec, T R 8:40–9:55. S. J. Riha.
Introduction to the structure and use of soil-plant-atmosphere models. Topics include modeling plant physiology, morphology, and development; potential crop production and crop production limited by moisture and nutrient availability; plant-plant competition; and land surface processes as well as model data requirements, validation, and scale. Discusses use of soil-plant-atmosphere models for teaching, research, extension, and policy formation.

CSS 694(6940) Special Topics in Environmental Information Science
Fall or spring. 1–6 credits. S-U grades optional. Staff.
Study of topics in environmental science that are more specialized or different from other courses. Special topics covered depend on staff and student interests.

CSS 860(8600) Master's-Level Thesis Research in Environmental Information Science
Fall or spring. Credit TBA. S-U grades only. Graduate faculty.
Thesis research for master's students.

CSS 960(9600) Graduate-Level Dissertation Research in Environmental Information Science
Fall or spring. TBA. S-U grades only. Times TBA. Graduate faculty.
Dissertation research for Ph.D. students **before** "A" exam has been passed.

CSS 961(9610) Doctoral-Level Dissertation Research in Environmental Information Science
Fall or spring. Credit TBA. S-U grades only. Times TBA. Graduate faculty.
Dissertation research for Ph.D. candidates **after** "A" exam has been passed.

Soil Science

CSS 200(2000) Sophomore Writing Seminar: Civilizations and Sustainable Land Use
Fall. 4 credits. Limited to 15 students. S-U grades optional. Lec, M W F 11:15–12:05. P. Baveye.
This course provides an extensive, guided writing opportunity on the historical connection between the rise and fall of civilizations in various parts of the world and the efficient use or abuse of available soil and water resources. Based on selected readings, students will reflect on worldwide soil and water contamination. In addition, this semester, students will have the opportunity to create a virtual field trip to the New York City watershed. After touring, filming, and photographing the area, and interviewing experts, students will discuss their experiences and how best to relate their observations in a thorough but engaging manner to a future audience. Students will receive extensive feedback at every step of the way, from outlining and selecting illustrations, to the final formatting and submission of their work.

This is a special seminar sponsored by the John S. Knight Institute's Sophomore Seminars Program. Seminars offer discipline-intensive study within an interdisciplinary context. While not restricted to sophomores, the seminars aim at initiating students into the discipline's outlook, discourse community, modes of knowledge, and ways of articulating that knowledge. Special emphasis is given to strong thinking and writing and to personalized instructions with top university professors.

CSS 260(2600) Soil Science
Fall. 4 credits. S-U grades optional. Lec, M W F 9:05; lab, M T W or R 1:25–4:25. J. Russell-Anelli.
Designed for students interested in a comprehensive introduction to soil science from both an environmental and plant management perspective. Divided into three units: (1) soil information unit introduces students to soil characterization, testing, mapping, classification, GIS, and land evaluation. (2) soil management unit addresses fertility, pest management, water, and microclimate, as well as erosion, conservation, pollution, and soil health: (3) unit on the role of soils in ecosystems considers topics such as biodiversity, soils as sinks and sources of greenhouse gases, and the impact of soils on land use. Labs are initially field-oriented with an emphasis on learning practical skills needed to evaluate and manage soils. Subsequent labs focus on accessing, interpreting, and applying soil information.

[CSS 362(3620) Soil Morphology
Fall. 1 credit. Prerequisite: undergraduate standing. Recommended for sophomores and juniors. One all-day field trip required. R 1:25–4:25. Not offered 2005–2006. J. Russell-Anelli.
Presents the principles for field identification of soil properties, profiles, and landscapes. A series of soil pits are examined, described, classified, and interpreted in the field.]

CSS 363(3630) Soil Genesis, Classification, and Survey
Fall. 4 credits. Prerequisite: CSS 260. Lec, M W F 11:15; lab, W 1:25–4:25. One all-day field trip required. J. Russell-Anelli.
Discusses factors and processes of soil formation on which soil survey is based. Practices principles of field identification, classification, survey, and interpretation in a field setting. Provides an overview of soil databases, their content, development, and use for site evaluation and land classification.

CSS 365(3650) Environmental Chemistry: Soil, Air, and Water
Spring. 3 credits. Prerequisites: CHEM 207–208. Lec, M W F 10:10–11. M. B. McBride.
Overview of the chemical processes that control the fluxes, concentrations, and bioavailability of nutrients and pollutants in soil, air, and water. Gives particular attention to soil's function as a filter for contaminants. Describes the history of environmental contamination by xenobiotics and heavy metals and their impact on agricultural soils and ecosystems.

CSS 372(3720) Nutrient Management in Agroecosystems
Spring. 4 credits. Prerequisite: CSS 260 or permission of instructor. Graduate students should enroll in CSS 472. Lec, T R 8:40–9:55; lab, R 1:25–4:25. J. Lehmann.
Familiarizes students with the basic concepts of soil fertility and biogeochemistry and how soil and environmental properties affect nutrient availability and cycling. Discussion focuses on the way organic farming and soil conservation affect the fate of nutrients in agroecosystems. Emphasizes how nutrient management can be improved without creating environmental hazards. Students have hands-on training in analytical procedures and expand knowledge in discussion groups and through oral as well as poster presentations.

CSS 412(4120) Whole-Farm Nutrient Management [also AN SC 412(4120)]
Spring. 2- or 4-credit option. Prerequisite: AN SC 411; junior, senior, or graduate standing. Offered as two modules. Enrollment in Module 1 for first half of semester required (2 credits); consists of crop and manure nutrient management planning; no prerequisites for CALS students. Enrollment in Module 2 for second half of semester optional (additional 2 credits). Lec, T R 11:15 and lab T 1:25–4:25 for both modules, with work on case studies outside of lab. M. E. VanAmburgh, Q. M. Ketterings, and G. L. Albrecht.
Provides students with an understanding of the concepts underlying whole-farm nutrient management planning to improve profitability while protecting water and air quality. Students learn and apply concepts in the development of a Comprehensive Nutrient Management Plan (CNMP) that is required for a Concentrated Animal Feeding Operation plan to meet environmental regulations. Students develop components of a CNMP for a case study farm, using the Cornell University Nutrient Management Planning System (*cu*NMPS) and other tools. All students enrolled learn the concepts and processes of developing the crop and manure nutrient management plan component of a CNMP (Module 1). Students opting to continue through the end of the semester in Module 2 (4-credit option) build on knowledge gained in the first half of the semester by learning the knowledge and skills necessary to integrate crop production and herd feeding management for reducing nutrient imports on farms.

CSS 421(4210) Soil and Water Management
Fall. 4 credits. Prerequisite: CSS 260. S-U grades optional. Lec, T R 11:40–12:55; lab, R 2:30–4:30. H. M. van Es.
Introduces students to the principles of soil and water interaction and to the effects of human intervention on these processes. Examines aspects of soil and water management, including hydrology, soil erosion and conservation, water management, contaminant movement, tillage, soil compaction, and water quality. Discusses case studies and policy approaches from both the United States and abroad.

CSS 466(4660) Soil Ecology (also HORT 466[4660])
Spring. 4 credits, with lab. Prerequisite: one year of biology or ecology and CSS 260 or permission of instructor. Lec, T R 10:10–11:25; lab, W 1:25-4:25. J. E. Thies.
Discover the wonder of life underground. This course studies the amazing diversity of soil organisms along with their multifaceted functions in terrestrial ecosystems. It highlights the fundamental principles and features of biologically mediated processes in the soil and the functions of soil biology in the context of both managed and unmanaged ecosystems. Special topics are selected from: beneficial symbioses, biological control of plant pathogens, biogeochemistry of unique habitats, bioremediation and composting of organic wastes, among others. Labs focus on molecular and traditional methods for assessing soil biological–community composition, abundance, and activity in soil.

[CSS 471(4710) Properties and Appraisal of Soils of the Tropics
Spring. 3 credits. Prerequisite: CSS 260 or equivalent. S-U grades optional. No auditors. Lec, T R 12:20; disc, W 1:25–3:25. Not offered 2005–2006. A. VanWambeke.
Examines the conditions in which soils form, and considers ecological, geological, and vegetational factors that produce the diversity that exists among them. The major kinds of soils are recognized, their management properties described, and methods to alleviate the constraints to crop production and preservation of the environment are examined. Topics include the identification of soils, and their functions in sustaining traditional farming systems and advanced technological packages. The course pursues these themes reviewing the most recent sources of information generated in tropical countries and published in Latin-American, French, and English journals. The last part of the course gives special attention to salt-affected soils, paddy rice cultivation, and the characteristics of acid-sulfate soils. Lectures include slides of soils, landscapes, and cropping systems. The course is available on a compact disk in Mann Library.]

CSS 472(4720) Nutrient Management and Research in Agroecosystems
Spring. 4 credits. Prerequisite: CSS 260 or permission of instructor. Lec, T R 8:40–9:55; lab, R 1:25–4:25. J. Lehmann.
Familiarizes students with the basic concepts of soil fertility and biogeochemistry and how soil and environmental properties affect nutrient availability and cycling. Discussion focuses on the way organic farming and soil conservation affect the fate of nutrients in agroecosystems. Emphasizes the way nutrient management can be improved without creating environmental hazards. Gives students hands-on training in analytical procedures and expand knowledge in discussion groups and through oral as well as poster presentations. The laboratory experiments conclude with a final paper.

[CSS 473(4730) Ecology of Agricultural Systems (also BIOEE 473[4730])
Fall. 3 credits. Limited to 45 students. Prerequisite: BIOEE 261 or permission of instructor. S-U grades optional. Lec and disc, T R. During first six weeks of class, R meetings may run to 5:30 because of field trips. T R 2:30–3:45. Not offered 2005–2006. A. G. Power and E. C. Fernandes.
Analysis the ecological processes operating in agricultural systems, with an emphasis on the interactions between organisms. Topics include nutrient dynamics in agroecosystems, plant competition and facilitation, intercropping, the ecology of species invasions, mutualism in agroecosystems, plant–herbivore relations, plant-pathogen interactions, biological pest control, and evolutionary processes in agriculture. Uses case studies from both the tropics and the temperate zone to illustrate important concepts.]

[CSS 483(4830) Environmental Biophysics (also EAS 483[4830])
Spring. 3 credits. Prerequisite: CSS 260 or equivalent or permission of instructor. Offered alternate years; next offered 2006–2007. Lec, T R 8:40–9:55. S. J. Riha.
Introduction to basic principles of energy and mass transfer and storage in soil-plant systems. Covers energy budgets; soil heat flow; water movement in saturated and unsaturated soils; evapotranspiration; and water, gas, and nutrient dynamics in the soil-plant-atmosphere continuum. Considers applications to agronomic and environmental problems and instrument design and use through discussion and problems sets.]

[CSS 663(6630) Pedology
Spring. 3 credits. Prerequisite: CSS 361 or permission of instructor. M W F 11:15–12:05. Offered alternate years; not offered 2005–2006. J. Russell-Anelli.
Weathering, reactions, and processes of soil genesis; principles of soil classification and the rationale and use of soil taxonomy; development and significance of major groups of soils of the world.]

CSS 666(6660) Applied Plant–Microbe Interactions
Fall. 4 credits. Prerequisite: CSS 466 or equivalent or permission of instructor. Lec, T R 10:10–11:25; lab, F 1:25–4:25. Offered alternate years. Next offered fall 2005. J. E. Thies.
Discussion and laboratory-based course focusing on the nature of microbial interactions with plants, concentrating largely on bacterial and fungal associations. Investigates symbiotic, associative, and pathogenic interactions. A main aim of this subject is improving professional practice, within the content area. Students learn to examine the primary literature, present research reports, write and review proposals, conduct a small independent-research project, and report on the outcomes in conference and journal formats. Class discussions explore the nature of the rhizosphere environment as a habitat for microorganisms and the ecology of the organisms residing there through readings in the primary literature. In laboratory, all students conduct an independent research project, aligned with their interests, in which they develop testable hypotheses and conduct experiments using relevant, modern methods.

[CSS 667(6670) Advanced Soil Physics
Spring. 3 credits. Prerequisites: one year of college physics and CSS 483 or permission of instructor. S-U grades optional. Offered alternate years; not offered 2005–2006. M W F 11:15–12:05. P. C. Baveye.
Acquaints students with advanced topics in soil physics in a number of areas, including the statics and thermodynamics of soil water, the physics of swelling-shrinking soils, the transport of water and solutes in heterogeneous soils, the measurement of soil physical parameters, and the effect of spatial/temporal heterogeneity of soils on their physical characteristics. The format of the course, based in most years on weekly, individual tutorials, allows different topics to be covered, depending on the interest(s) of the students. If a group of students expresses interest, the course also can involve reflection on the detailed design of one or more laboratory or field experiments related to soil physics.]

CSS 669(6690) Organic Matter—Soils, Sediments, and Waters
Spring. 3 credits. Prerequisites: CSS 260 and CHEM 357–358 or equivalent. M W F 10:10–11:00. J. M. Duxbury.
Discussion of current concepts on the chemical nature, dynamics, and properties of natural organics and organo-mineral associations in terrestrial and aquatic environments. Includes a modeling project of soil carbon dynamics in natural or agricultural ecosystems.

CSS 671(6710) Soil Chemistry
Fall. 3 credits. Prerequisite: one year of physical chemistry or permission of instructor. Lec, M W F 10:10. Offered alternate years. M. B. McBride.
Detailed examination of the structure and surface chemistry of colloidal particles important to the function of soils. Emphasizes ion exchange; mineral-solution equilibria; and adsorption reactions of silicate clays, oxides, and organic matter. Describes the sorption behavior of environmental contaminants in soils, particularly metals and xenobiotics.

[CSS 672(6720) Nutrient Cycling in Natural and Managed Ecosystems
Fall. 3 credits. Prerequisite: CSS 372 or NTRES 321 or BIOEE 478, or permission of instructor. Offered alternate years; offered 2006–2007. Lec, T R 10:10–11; lab, F 1:25–4:25. J. Lehmann.
Covers nutrient cycling in soil and the interface between the soil and the biosphere, atmosphere, and hydrosphere. Examines the biogeochemistry of nutrient elements in natural ecosystems, disturbed or degraded ecosystems, and agricultural systems, including pollution in watersheds. Students develop independent projects, present a research proposal, and conduct field research that culminates in a presentation and a paper in publishable format.]

CSS 693(6930) Special Topics in Soil Science
Fall, spring, or summer. 1–6 credits. S-U grades optional.
Study of topics in soil science that are more specialized or different from other courses. Special topics covered depend on staff and student interests.

CSS 696(6960) Seminar: Organic Inputs in Tropical Soils and Agroforestry (also NTRES/IARD 696[6960])
Fall, spring. 1 credit sec 2. S-U grades only. Lec, F 12:20–1:10. E. Fernandes and L. Fisher.
A variety of speakers present seminars on organic inputs in the tropics and agroforestry. Students are required to prepare a synopsis of each seminar.

CSS 880(8880) Master's-Level Thesis Research in Soil Science
Fall or spring. Credit TBA. S-U grades only. Times TBA. Graduate faculty.
Thesis research for master's students.

CSS 980(9800) Graduate-Level Dissertation Research in Soil Science
Fall or spring. Credit TBA. S-U grades only. Times TBA. Graduate faculty.
Dissertation research for Ph.D. students **before** "A" exam has been passed.

CSS 981(9810) Doctoral-Level Dissertation Research in Soil Science
Fall or spring. Credit TBA. S-U grades only. Times TBA. Graduate faculty.
Dissertation research for Ph.D. candidates **after** "A" exam has been passed.

DEVELOPMENT SOCIOLOGY

P. D. McMichael, chair (133A Warren Hall, 255-5495); D. L. Brown, P. R. Eberts, P. Eloundou-Enyegue, S. Feldman, J. D. Francis, C. C. Geisler, A. Gonzales, D. T. Gurak, T. A. Hirschl, T. A. Lyson, R. L. Mize, M. J. Pfeffer, L. B. Williams

Note: The prefixes for courses in this department were listed as RSOC in previous years.

Note: Class meeting times are accurate at the time of publication. If changes occur, the department will provide new information as soon as possible.

D SOC 101(1101) Introduction to Sociology
Fall or spring. 3 credits. Lec, T R 10:10–11:00; sec, various times. Fall, T. Hirschl; spring, A. Gonzales and R. Mize.
Introduction to theory and research in sociology. Demonstrates how the insights, theories, and methods of sociological analysis can be brought to bear on major issues of social life. A primary goal is to convey a sense of the manner in which sociologists formulate theories and how the collection and analysis of data are used to evaluate those theories. Provides "hands-on" experience in analyzing sociological issues. Students undertake guided research exercises that involve using computers to analyze actual data. No prior background is presumed; necessary skills are covered in class and section meetings.

[D SOC 103(1103) Self and Society (also SOC 103)]

D SOC 111(1201) Development Sociology First-Year Writing Seminar
Fall, spring. 3 credits. Lec, T R 10:10–11:25. Staff.
The department offers first-year writing seminars on a wide range of development sociology topics. Consult John S. Knight Writing Seminar Program brochures for instructors and descriptions.

D SOC 112(1200) Development Sociology First-Year Writing Seminar
Fall, spring. 3 credits. Lec, M W 2:55-4:10. Staff.
The department offers first-year writing seminars on a wide range of development sociology topics. Consult John S. Knight Writing Seminar Program brochures for instructors and descriptions.

[D SOC 200(2000) Social Problems (also SOC 200)]

D SOC 201(2010) Population Dynamics (also SOC 202[2202])
Spring. 3 credits. Limited to 35 students. ALS students must enroll in D SOC 201. S-U grades optional. T R 2:55–4:10. P. Eloundou–Enyegue.
Introduction to population studies. First reviews basic concepts and demographic principles and techniques, then focuses on how demographic processes (fertility, mortality, and migration) affect social and economic outcomes. Discussions cover special topics related to population growth and distribution, including mass education, marriage and family formation, labor force participation, inequality and poverty, women's status, resource allocation, and the environment.

D SOC 205(2050) International Development (also SOC 206[2206])
Spring. 3 credits. Limited to 74 students. M W F 10:10–11:00. P. McMichael.
Examines new questions concerning development models in the post–Cold War era from a comparative and global perspective on North-South relations. While the focus is the "Third World," the issues confronting it are often global, even when they concern the most basic issue of food security. Using films and various theoretical perspectives, the course examines Southern societies (economies, ecologies, class/gender relations) and the impact of global forces on Southern resources. Such forces include global food systems, new forms of export production, development agencies, multilateral institutions, local bureaucracies, transnational corporations, the debt crisis, and new technologies. Also examines the new global justice movements, such as environmentalism, feminism, and landless workers, peasant, and grassroots activism.

[D SOC 206(2060) Gender and Society (also FGSS 206[2060])
Spring. 3 credits. Limited to 100 students. Lec, T R 10:10–11:25; sec, various times. Not offered 2005–2006. Staff.
Familiarizes students with origin of gender hierarchies, social and behavioral similarities/differences between females and males, and the degree that biological, psychoanalytic, psychological and sociological perspectives help to understand the differences. United States and cross-cultural comparisons of the consequences of gender inequality are a major focus of the course. Objectives are met through lectures, readings, films, participant observation, and personal experiences.]

[D SOC 208(2080) Technology and Society]

D SOC 209(2090) Social Inequality (also SOC 208[2208])
Spring. 4 credits. T R 10:10–11:25. K. Weeden.
For description, see SOC 208.

[D SOC 210(2100) Race in America and at Cornell (also GOVT 210[2101])]

D SOC 213(2130) Social Indicators, Data Management, and Analysis
Fall. 3 credits. Offered alternate years (complement of D SOC 214). T R 11:40–12:55. P. Eloundou-Enyegue.
Survey of definitions of social indicators and general principles of social indicators research is illustrated from data on both developed and less-developed countries. Data management and analysis of measures of poverty, level of living, inequality, and quality of life based on census data, household surveys, and key-informant and other low-cost techniques, are examined using personal computers.

[D SOC 214(2140) Research Methods for the Social Sciences]

[D SOC 215(2150) Introduction to Organizations (also SOC 215[2150])]

D SOC 220(2200) Sociology of Health of Ethnic Minorities (also LSP 220[2200])
Fall. 3 credits. Limited to 15 students. S-U grades optional. T R 10:10–11:25. P. A. Parra.
Discusses the health status of minorities in the United States. Explores intragroup diversity such as migration, economic status, and the influence of culture and the environment on health status and access to health care. Although special attention is given to Latino populations, discussion encompasses other minorities who face similar problems.

D SOC 230(2300) Latino Communities (also AM ST/LSP 230[2300])
Fall. 3 credits. T R 1:25–2:40. R. Mize.
From community sociology perspectives, an analysis of Latino community formation in U.S. urban and rural contexts. A major focus is the predominance of Puerto Ricans and Dominicans in New York, Cubans in South Florida, and Mexicans in the Southwest. The last portion of the course addresses the increasing "Latinization" of new receiving areas and the formation of transnational communities that transcend spatially defined communities.

[D SOC 261(2610) Sociology of Sustainable Development]

D SOC 275(2750) Immigration and a Changing America
Fall. 3 credits. S-U grades optional. T R 2:55–4:10. M. M. Kritz.
Immigration helped America become the nation that it is today. While many experts thought that immigration's contribution to American history ended in the early 1900s, immigration surged to historic highs in the second half of the 20th century and shows no signs of diminishing in the 21st century. This course examines the economic, social, and policy forces that underlie contemporary U.S. immigration and the impacts that immigrants are having on the American economy and society today. It looks in detail at who the new immigrants are, why they come to America, where they live, and what roles they fill in America.

D SOC 301(3010) Theories of Society (also SOC 375[3750])
Spring. 3 credits. Limited to 30 students. Prerequisites: development sociology or sociology course. S-U grades optional. T R 11:40–12:55. P. Eberts.
Introduction to the "classical" sociological theorists (Marx, Weber, Durkheim) of the late 19th and early 20th century. Also addresses the dramatic social upheavals of the industrialization, capitalism, and rise of bureaucracy to which these thinkers reacted and the inspiring (and conflicting) visions for the future which they offered. Emphasizes the intellectual history, the influence of the theorists on subsequent sociology, and the potential for relevance to contemporary society.

D SOC 305(3050) Education, Inequality and Development
Spring. 3 credits. Prerequisite: introductory social science course or permission of instructor. Letter grades. T R 10:10–11:25. P. Eloundou-Enyegue.
Improvements in formal schooling are often advocated as solutions for a variety of socioeconomic problems in nonindustrial and industrial nations alike. This course critically assesses human capital approaches to development. Topics include (1) the variety and functions of school systems, (2) the individual and macro-level determinants of education, (3) education and socioeconomic stratification, (4) the effects of education on development, and (5) tools for evaluating education projects.

D SOC 311(3110) Social Movements (also AIS/LSP 311[3110])
Fall. 3 credits. Prerequisites: D SOC 101/SOC 101 or permission of instructor. S-U grades optional. T R 2:55–4:10. A. Gonzales.
Introduces students to the causes and characteristics of social movements and related ideologies central to the sociological study and interpretation of major trends involving both social and cultural change in society. Drawing upon a diverse range of empirical examples, students examine key theories that explain the origins, tactics, and success of social movements and the ways in which people have mobilized to bring about political and social change.

D SOC 324(3240) Environment and Society (also S&TS 324[3241], SOC 324[3240])
Spring. 3 credits. Limited to 100 students. T R 2:55–4:10. C. Geisler.
The main objective is to develop a critical understanding of the dominant trends in modern U.S. environmental thought, such as preservationism, conservationism, deep ecology, social ecology, NIMBYism, risk assessment, ecological modernization, and environmental equity. A second objective is to familiarize students with some major contemporary substantive environmental problems and policies. These topics include air and water quality, public lands management, biodiversity, deforestation, climate change, and ozone depletion. A sociological framework is applied to evaluate interrelationships of substantive and philosophical/theoretical issues.

[D SOC 333(3330) Genomics and Society]

[D SOC 336(3360) Rural Areas in Metropolitan Society
Spring. 3 credits. Prerequisite: social science course. T R 11:40–12:55. Not offered 2005–2006. D. Brown.
Analyzes the changing structure and role of small towns and rural areas in developed nations. Focuses on adaptation of rural communities and populations to major trends, including increased societal differentiation and complexity; increased societal interdependence; and rapid social, economic, technological, and ecological change. Considers alternative policies to ameliorate rural problems and/or enhance rural contributions to national development. Students participate in group research projects in rural communities.]

[D SOC 340(3400) Sociology of Food Systems
Spring. 3 credits. T R 1:25–2:40. Not offered 2005–2006. G. W. Gillespie.
Examines our changing food and agricultural systems sociologically, with attention to how these reflect the social organization of an increasingly global society. Addresses such questions as: What are the major trends? What drives them? What do these trends imply for people, communities, and the environment? What are the social, human-health, and environmental issues? What might be better alternatives and what strategies of development might achieve them?]

[D SOC 354(3540) Sociology of Contemporary Culture (also S&TS 354[3541], SOC 352[3520])
Fall. 4 credits. M W F 11:15–12:05. Not offered 2005–2006. C. Leuenberger.
Introduces students to the rapidly expanding body of work at the intersection of sociology, cultural studies, and science and technology studies. Provides an introduction to theoretical debates in cultural studies and to sociological studies of culture. Discusses the emergence of the tourist industry; the significance of consumption and advertisements in modern life; the cultures of music, art, and television; the use of rhetoric in politics and science; cultural and feminist analyses of knowledge, science, and technology; as well as the social construction of self, bodies, and identities.]

[D SOC 355(3550) Latinos, Law, and Identity (also LSP 355[3550], AM ST 357[3570])
Spring. 3 credits. Prerequisite: D SOC 101 or permission of instructor. Letter grades only. M W F 11:15–12:05. Not offered 2005–2006. R. L. Mize.
Critical exploration of the critical-justice movement and Latina/o identities. Highlights legal cases, federal and state laws, and constitutional issues that affect Latina/os residing in the United States. Theoretical contributions of law and society, critical race theory, LatCrit, and outsider-jurisprudence perspectives applied to historical precedent and current attempts at marginalizing/empowering Latina/o communities.]

D SOC 370(3700) Comparative Issues in Social Stratification (also SOC 371[3710])
Fall. 3 credits. Prerequisite: introductory social science course. T R 1:25–2:40. T. Lyson.
Reviews both classical and contemporary issues in the comparative social stratification literature. Gives particular attention to the changing configurations of different labor markets, debates on the meaning of new economic constituencies, and the role of gender, race, ethnicity, and sexuality in assessing the patterns, meaning, and experiences of inequality. Throughout the course special attention is given to the importance of understanding how questions of measurement are constructed and employed in understanding social inequality.

D SOC 375(3750) Comparative U.S. Racial and Ethnic Relations (also AM ST/LSP 375[3750])
Spring. 3 credits. Prerequisite: D SOC 101 or permission of instructor. Letter grades only. T R 1:25–2:40. R. L. Mize.
Comparative historical study of the social construction of race. Examines structures of racism as they influence Latina/o, African American, Native American, and Asian American experiences. Does a critical interrogation of whiteness and ethnic identities. Focuses on historical legacy of institutional and interpersonal racism and its contemporary relevance in terms of political economic, residential, legal, educational, cultural, health, and social-psychological inequalities.

D SOC 380(4900) Independent Honors Research in Social Science
Fall and spring. 1–6 credits; 6 credits max. may be earned in honors program. Prerequisite: requirements for honors program met. J. Francis.
Students should select a faculty adviser and begin proposal development during the junior year. Students must submit written proposals by the third week of the semester of their senior year to the departmental honors committee representative.

D SOC 410(4100) Health and Survival Inequalities (also SOC 410[4100])
Fall. 4 credits. S-U grades optional. T R 2:55–4:10. A. Basu.
Historical inequalities in health and survival continue to exist today. This course covers some of the markers of such inequalities, including region, class, race, gender, and age, and examines some of the biological, socioeconomic, and political determinants of these differences. Examines macro as well as individual and family-level determinants. Evaluates policy prescriptions and proposes new innovative approaches.

D SOC 421(4210) Theories of Reproduction (also SOC 421[4210])
Spring. 4 credits. S-U grades optional. T R 2:55–4:10. A. Basu.
Examines the contentious debate on what makes women have any, few, and many children. Covers theories of population growth and changing fertility in both historical and contemporary populations. Discusses demographic concepts like "the demographic transition" and "natural fertility." Gives primary attention to "sociocultural" and "gender-based" explanations of reproductive behavior. Also looks at theories about the place of the state in women's lives.

D SOC 430/629(4300/6300) Human Migration: Internal and International
Fall. 3 credits. Prerequisite: demography course or permission from instructor. M 10:10–1:10. D. Brown.
Analyzes the determinants and consequences of internal and international migration in developed and developing nations. Emphasizes multilevel and multidisciplinary approaches. Examines public policy implications of the volume and composition of migration for origin and destination communities. Discusses techniques and measurement issues. (For 629, graduate students also meet with instructor every other week to discuss graduate readings and topics relevant to term project.)

D SOC 431/631(4310/6310) Comparative Ethnic Stratification: Demographic Perspectives
Spring. 3 credits. Prerequisite: introduction to sociology or permission of instructor. S-U grades optional. T R 11:40–12:55. D. Gurak.
Comparative examination of ethnic stratification and mobility that focuses principally on dimensions of social groups

that can be empirically measured using readily available demographic sources. These include residential segregation, occupational status and mobility, marriage and family formation patterns, health and mortality, family structure, fertility, and intermarriage. Also examines the role of migration in shaping ethnic stratification systems. About half of the course examines the U.S. situation. Other societies receiving significant attention include India, Brazil, Nigeria, and several European societies. For D SOC 631, graduate students also meet with the instructor every other week to discuss graduate readings and topics relevant to their papers.

[D SOC 437(4370) Aging and Aging Social Policy in the 1990s]

D SOC 438/638(4380/6380) Population and Development

Fall. 3 credits. Prerequisite: permission of instructor. S-U grades optional. T R 11:40–12:55. D. Gurak.

Examines major historical and recent demographic transitions in mortality, fertility, age structure, and composition, and explores the relationships between these transitions and the social, or economic, and cultural changes being experienced by diverse societies before, during, and following the onset and conclusions of the demographic shifts. Uses case studies from diverse historical periods and geographic locations. Graduate students meet with the instructor every other week to discuss graduate readings and topics relevant to their papers.

D SOC 494(4800) Special Topics in Development Sociology

Fall or spring. 4 credits max. S-U grades optional.

The department teaches "trial" courses under this number. Offerings vary by semester, and are advertised by the department before the semester starts. Courses offered under the number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

[D SOC 495/695(4650/6650) Population and Development in Sub-Saharan Africa]

D SOC 497(4901) Independent Study in Development Sociology

Fall or spring. 3 credits, variable; may be repeated for credit. Students must register using independent study form (available in 140 Roberts Hall). S-U grades optional.

Informal study may include a reading course, research experience, or public service experience.

D SOC 560(5600) Managing Local Environmental Systems: Social Perspectives and Research Bases

Fall. 3 credits. W 1:25–4:25. J. Francis.

For students with diverse backgrounds: undergrads, grads, people in professional careers, others with interesting environmental-issue identification, resolution, and management. Discussions include ecological, social, economic, and local government perspectives. Via lab exercises throughout the semester, students have opportunities to apply the concepts and principles of these perspectives to analysis of specific local environmental-management problems. Readings, lectures, and a course project are mandatory.

D SOC 601(6010) Theoretical and Methodological Approaches to Community and Rural Development

Fall. 3 credits. Prerequisite: graduate standing. Letter grades only. Lec, W 7:30–10 P.M. P. Eberts.

Survey of three general approaches for conducting analysis and practice in community and rural development. These approaches include examinations of (1) community structural changes and policymaking; (2) participatory processes for generating community development; and (3) planning strategies as mechanisms for creating community development opportunities.

D SOC 602(6020) Community Development Seminar

Spring. 1 credit. Prerequisite: D SOC 601. Letter grades only. W 7:30–10:00 P.M. P. Eberts.

A participatory seminar for feedback, collective learning, and guidance as M.P.S. students apply community and rural development theory and methods in thesis project work with local and regional communities.

D SOC 603(6030) Classical Sociological Theory

Spring. 4 credits. Prerequisite: graduate standing. T 2:30–5:30. M. J. Pfeffer.

Reviews the main streams of classical sociological thought, focusing on the work of Weber, Durkheim, Marx, and Simmel. Course materials include original texts and secondary literature used to examine the concepts, methods, and explanation in classical sociological thought. Important objectives are to identify the philosophical and conceptual core of the discipline and to critically evaluate the relevance of the classical theories to contemporary social change and development.

D SOC 606(6060) Sociological Theories of Development

Fall. 3 credits. R 1:25–4:25. Staff.

Critical examination of a historical range of theories and research in the sociology of development from the postwar period through the present. Major topics include modernization theory, dependency theory, world-system theory, the developmental state, global commodity chains, and globalization. Throughout the course, the concept of development itself is questioned and critiqued both theoretically and in terms of practical challenges from environmental, indigenous, and other social movements.

[D SOC 607(6070) Sociology of Natural Resources and Development (also ASIAN 603[6603])]

D SOC 608(6080) Demographic Techniques (also PAM 606[6060])

Fall. 3 credits. Prerequisite: multivariate statistics or permission of instructor. S-U grades optional. W 4:30–7:30 P.M. K. Joyner.

Introduction to the methods, measures, and data used in the analysis of human populations. Topics include demographic rates, life-table analysis, cohort vs. period analysis, sources and quality of demographic data, population estimation and projection, and stable population models.

[D SOC 611(6110) Globalization and Social Movements]

[D SOC 612(6120) Population and Development in Asia (also FGSS 612[6120])]

D SOC 615(6150) Qualitative Research Methods

Fall. 3 credits. Letter grades only. Lec, T 1:25–4:25. L. Williams.

Seminar introducing students to a number of qualitative methods of field research in the social sciences. Discusses field observation, archival research, in-depth individual interviews, and focus group interviews. Assesses the strengths and weaknesses of various strategies of field research and consider a range of practical matters such as choice of research site (and sample where appropriate), choice of questions, and issues of validity and reliability. Highlights ethical considerations.

D SOC 617(6170) Foundations in Social Research: Comparative Epistemologies

Fall. 3 credits. Letter grades only. W 1:25–4:25. S. Feldman.

Seminar designed to introduce graduate students in the social sciences to the variety of epistemological approaches used by social scientists to analyze social change and development. Examines both positivist and nonpositivist approaches. Relates the relationship of quantitative and qualitative methodologies to different epistemologies.

[D SOC 618(6180) Research Design I]

D SOC 619(6190) Quantitative Research Methods

Spring. 4 credits. Prerequisite: statistics course. Letter grades only. T R 12:20–2:15. J. Francis.

Graduate-level course in measurement and analysis of survey, demographic, and observational data. Topics include linear regression, analysis of variance, and analysis of covariance with both continuous and categorically coded variables. Introduces logistic regression and some nonlinear models. Gives special attention to handling ordered and unordered categorical data as these are prevalent in social/demographic data sets. Analyzes data from real surveys like the American National Election Studies and the General Social Surveys using programs like SAS and SPSS. Includes labs and writing programs to analyze these data. Students familiarize themselves with data cleaning, missing data estimation, transformations, subsetting, and other data handling procedures.

D SOC 620(6200) Sociology of the Community

Fall. 3 credits. W 1:25–4:25. D. Brown.

Graduate seminar that critically analyzes the intellectual core of community sociology and its theoretical development over time. "Community" as a concept is often reified and rarely critically examined, hence the course begins by clarifying the various ways in which "community" has been conceptualized and operationalized by sociologists. The course provides students with both a grounded conceptual foundation and an overview of multiple strategies for conducting research on community structure and change in the United States and internationally. Includes a critical examination of the forms and shapes sociological research on the community

assumes. Uses a case study approach to examine the assumptions driving the methods and analysis of both contemporary and historical research.

[D SOC 621(6210) Foundations of Environmental Sociology]

[D SOC 625(6250) State, Economy, and Society
Fall. 3 credits. T 1:25–4:25. P. D. McMichael.
Reviews major issues concerning the relations between political and economic institutions and the role of states, markets, firms, social movements, and cultural institutions in the process of social change. Draws theoretical perspectives from classical and modern social theory, including the application of comparative and world/historical methodologies.]

[D SOC 630(6500) Field Research Methods and Strategies]

[D SOC 635(6350) Indigenous Peoples and Globalization (also AIS 635[6350])
Fall. 3 credits. Limited to 25 students. Prerequisite: graduate standing. S-U grades optional. W 10:10–1:10. Not offered 2005–2006. A. Gonzales.
Explores ways in which processes of globalization affect indigenous peoples worldwide and the strategies indigenous peoples are using to deal with those pressures. Globalization, whether under the auspices of the World Trade Organization and regional economic agreements such as the NAFTA or the de-territorialization of social and political arrangements cotemporal with modernization or the expansion of communication technology and its impact on traditional knowledge systems, has had profound social, cultural, and economic impacts on indigenous peoples. At issue are the lands, resources, traditional knowledge, intellectual and cultural property, and indigenous struggles for recognition and self-determination.]

D SOC 640(6400) Community and Changing Property Institutions
Fall. 3 credits. R 1:25–4:25. C. C. Geisler.
The "ownership society" assumes multiple forms. The seminar focuses on property in land and acquaints students with the origin and evolution of property rights. It traces major property debates (aboriginal ownership vs. terra nullius; private versus public (and mixed) ownerships; the tragedy (versus the opportunity) of the commons; takings vs. givings) as well as abiding property topics with which social scientists should be familiar (the "new" property; property rights as human rights; and new currents in and reform).

[D SOC 641(6410) Politics and Economics of Rural and Regional Development
Fall. 3 credits. Prerequisite: upper-level or graduate standing. M 12:20–2:50. Not offered 2005–2006. A. Lyson.
Survey of social, political, and economic factors in local and regional development. Explores theories of community and regional development and underdevelopment. Examines Neoclassical, Marxist, and civil society theories within local and global contexts.]

[D SOC 645(6450) Rural Economy and Society]

[D SOC 655(6550) Advanced Techniques of Demographic Analysis]

D SOC 661(6610) Sustainable Agriculture and Development
Fall. 3 credits. M 12:20–2:50. T. A. Lyson.
Examines the relationship between local agriculture and development as these are embedded in a globalizing economy.

[D SOC 666(6660) Genomics, Agriculture, Food Systems, and Development]

[D SOC 671(6710) Epistemological Challenges to Social Science Paradigms: A Feminist Inquiry (also FGSS 671[6710])]

[D SOC 675(6750) Global Patterns of International Migration]

D SOC 694(6800) Special Topics in Development Sociology
Fall or spring. 4 credits max. S-U grades optional.
The department teaches "trial" courses under this number. Offerings vary by semester, and are advertised by the department before the semester starts. Courses offered under the number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

[D SOC 715(7150) Comparative Research Methods]

[D SOC 718(7180) Multidimensional Measurement and Classification]

[D SOC 719(7190) Logistic and Log Linear Models]

[D SOC 725(7250) Theories of State, States of Theory
Spring. 3 credits. W 1:25–4:25. Not offered 2005–2006. S. Feldman.
Examines how processes of political, economic, and social restructuring reshape state capacities and processes of state formation. The animating question: How have new patterns of "globalization"—transnational corporatist alliances, social movements, and new hegemonic relations—altered how we understand the meanings, activities, and power of rule? Critical to these discussions are the contours of nationalisms, and fundamentalisms as these emerge and reconfigure national, regional, and global alliances and practices, as well as shape interpretations of current processes of resistance, change, and terms of intervention and exchange. The course engages historical, poststructural, postcolonial, and comparative theories particularly as these have emerged and been refined by current debates in South Asia, Latin America, and Africa.]

[D SOC 730(7300) Sociology of Global Change
Fall. 3 credits. R 1:25–4:25. Not offered 2005–2006. P. D. McMichael.
Analyses of social change and development are increasingly sensitive to global context. They include the sociology of the world economy as a multilayered entity anchored in an evolving international division of labor and the system of nation states, and the sociology of transnational political, economic, and cultural processes (e.g., food regimes, commodity chains, diasporas and transnational identities, the new regionalism, and transnational social movements). This seminar examines the substantive and methodological questions generated by research on these global processes, including questions of relevant units of analysis, situating global process in local events and subjectivities and vice versa, and examining the ways in which national structures and cultures interact with global structures and cultures.]

D SOC 791(7910) Teaching Experience
Fall or spring. 1–3 credits. Prerequisite: graduate standing. S-U grades only. Graduate faculty.
Participation in the ongoing teaching program of the department.

D SOC 800(8900) Master's-Level Thesis Research
Fall or spring. Credit TBA. Prerequisite: permission of instructor. S-U grades optional. Graduate faculty.
Thesis research for master's students.

D SOC 872(8720) Development Sociology
Prerequisite: master's and doctoral degree candidates, permission of graduate field member concerned. S-U grades optional. Graduate faculty.

D SOC 900(7900) Graduate-Level Thesis Research
Fall or spring. Credit TBA. Prerequisite: permission of instructor. S-U grades optional. Graduate faculty.
Thesis research for Ph.D. students **only before** "A" exam has been passed.

D SOC 901(9900) Doctoral-Level Thesis Research
Fall or spring. Credit TBA. Prerequisite: permission of instructor. S-U grades optional. Graduate faculty.
Thesis research for Ph.D. candidates **after** "A" exam has been passed.

Related Courses in Other Departments

(Others may be added)

Population Dynamics (SOC 205)

Gender Relations, Gender Ideologies, and Social Change (FGSS 524)

EARTH AND ATMOSPHERIC SCIENCES

T. E. Jordan, chair (4108 Snee Hall, 255-3596; 254-8737); S. J. Colucci, co-chair; director of undergraduate studies: B. L. Isacks (Geological Sciences and Science of Earth Systems); M. W. Wysocki (Atmospheric Science), R. W. Allmendinger, W. D. Allmon, M. Barazangi, W. Bassett, J. M. Bird, A. L. Bloom, L. D. Brown, L. M. Cathles, J. L. Cisne, K. H. Cook, A. T. DeGaetano, L. A. Derry, P. J. Gierasch, C. H. Greene, D. L. Hysell, B. L. Isacks, R. W. Kay, S. Mahlburg Kay, M. C. Kelley, D. E. Karig, W. W. Knapp, B. Monger, J. E. Oliver, A. J. Pershing, J. Phipps-Morgan, M. Pritchard, F. H. T. Rhodes, S. J. Riha, D. L. Turcotte, W. M. White, D. S. Wilks

Field Study in Hawaii

Field study is a fundamental aspect of earth system science. Students wishing to increase their field experience may fulfill some of the requirements for the SES major by off-campus study through the Cornell Earth and Environmental Semester program

(EES). The EES program is offered during the spring semester and emphasizes field-based education and research. It is based on the island of Hawaii, an outstanding natural laboratory for earth and environmental sciences. Courses that may be applied to the SES major include EAS 240, 322, and 351. EAS 322 and 351 may also be used to fulfill requirements of the Geological Sciences major. The EES program also offers opportunities for internships with various academic, nonprofit, and government organizations. Typically students participate in the EES program during their junior year, although exceptions are possible. The EES program is administered by Cornell Abroad. For further information on the EES program see www.geo.cornell.edu/geology/classes/hawaii/course.html.

EAS 240(2400) Field Study of the Earth System
Spring. 5 credits. Prerequisites: one semester of calculus (MATH 190/191/192 or 111/112) and two semesters of any of the following: PHYS 207/208 or 112/213; CHEM 207/208; BIO G 101/103–102/104 or 105/106 or 109/110 or equivalent course work. A. Moore.
Interdisciplinary field course covering fundamental concepts of the Earth system. Topics include global circulation patterns in the solid Earth, atmosphere and ocean; energy and mass transfer; change and variability of Earth atmosphere and ocean systems; the temporal record of change preserved in the geologic record; Earth/ocean/atmospheric controls on ecosystem processes. The course is project-based with students engaged in hands-on, active learning that takes advantage of local resources.

EAS 322(3220) Biogeochemistry of the Hawaiian Islands
Spring. 4 credits. Prerequisites: EAS 240. Recommended: college-level chemistry. L. Derry.
Field-oriented study of biogeochemical processes and ecosystem interactions across the Hawaiian Islands. Field, class, and laboratory work focus on how landscape age and climate strongly control biogeochemical cycling and ecosystem development in Hawaii. Other topics include succession of ecosystems, evolution of nutrient cycles, and impacts of invasive species. The course is structured around field projects, carried out both as groups and individually.

EAS 350(3500) Dynamics of Marine Ecosystems (also BIOEE 350[3500])
Fall. 3 credits. Prerequisites: one year of calculus (MATH 191/192/193 or 111/112), semester of oceanography (EAS/BIOEE 154) permission of instructor. Offered alternate years. C. Greene and R. Howarth.
Lecture course covering the interactions of physical and biological processes in marine ecosystems. Begins by looking at these processes on a global scale and works down to the scales relevant to individual organisms. Topics include the following: global patterns of ocean circulation; global patterns of ocean production; climate variability and the role of the ocean in global climate change; the El Niño/Southern Oscillation; ecosystem dynamics of the open ocean and coastal environments.

EAS 351(3510) Marine Ecosystems Field Course (also BIOEE 351[3510])
Spring. 4 credits. Prerequisite: EAS 240. Recommended: oceanography course C. Greene, B. Monger, and C. D. Harvell.
Covers the interactions of physical and biological processes in marine ecosystems. Begins by looking at these processes on ocean-basin to regional scales and work down to the smaller scales relevant to individual organisms. Introduces students to modern techniques of marine-ecosystems research, including remote sensing, oceanographic-survey methods, and experimental marine ecology. This course is field and laboratory intensive with students engaged in hands-on, active learning that takes advantage of local resources.

EAS 496(4960) Internship Experience
2 credits. Prerequisite: EAS 240. A. Moore.
During the last 3.5 weeks of the semester students carry out a service-learning project with a local NGO, environmental business, government agency, research lab, or educational facility. Projects are carefully designed with the student, sponsoring agency, and faculty member. A final report is required.

General Courses

EAS 121(1210) Introduction to Computer Programming
Fall. 2 credits. Prerequisites: MATH 111. Co-requisite: MATH 191. D. Schwartz.

EAS 150(1500) FORTRAN Applications in Earth Science
Spring, seven-week course. 2 credits. Prerequisite: CIS/EAS 121 or equivalent. Letter grades only. Lec, T R 9:05–9:55; lab, T 1:25–3:25. A. J. Pershing.
Emphasizes the application of scientific computing in the Earth sciences, including data processing and modeling of the Earth, its atmosphere, and oceans. Extends the procedural programming concepts developed in CIS 121/EAS 121 and considers their implementation in high-performance, compiled languages. Topics include the structure and syntax of a FORTRAN program, data input/output, compilation, and debugging.

EAS 496(4960) Internship Experience
Fall or spring. 1–2 credits. S-U grades only. Staff. See individual units for requirements.

EAS 498(4980) Teaching Experience in Earth and Atmospheric Sciences
Fall, spring. 1–4 credits. S-U grades only. Students must register using independent study form. Staff.
The student assists in teaching an EAS course appropriate to his or her previous training. The student meets with a discussion or laboratory section, prepares course materials, grades assignments, and regularly discusses course objectives and teaching techniques with the faculty member in charge of the course.

Atmospheric Science

EAS 131(1310) Basic Principles of Meteorology
Fall. 3 credits. Lec, M W F 9:05. M. W. Wysocki.
Simplified treatment of the structure of the atmosphere: heat balance of the Earth; general and secondary circulations; air masses, fronts, and cyclones; and hurricanes, thunderstorms, tornadoes, and atmospheric condensation. The optional 1-credit laboratory for the course is offered as EAS 133.

EAS 133(1330) Basic Meteorology Lab
Fall. 1 credit. Co-requisite: EAS 131. T W or R 1:25–4:25 or M 7–9:30 P.M.; M 7–9:30 P.M. (majors only). M. W. Wysocki.
This course is required for atmospheric science majors, but is optional for other students taking EAS 131.

EAS 250(2500) Meteorological Observations and Instruments
Fall. 4 credits. Prerequisite: EAS 131. Lec, M W F 12:20; lab, R 1:25. M. W. Wysocki and B. Monger.
Covers methods and principles of meteorological measurements and observations including surface, free-air, and remote systems. Also covers instrument siting, mounting, and protection; instrument response characteristics, calibration, and standardization; and recorders and data logging systems. Laboratory exercises are in observation and data analysis. The course is intended to serve as preparation for Observers Examination.

EAS 268(2680) Climate and Global Warming
Spring. 3 credits. Prerequisite: basic college math. S-U grades optional. Lec, M W F 10:10–11:00. A. T. DeGaetano.
Familiarizes students from a range of disciplines with such contemporary issues in climatology as global warming and El Niño. Introduces the natural greenhouse effect, past climates, and observed and projected climate changes and impacts. Also covers natural climate variations (e.g. El Niño) and their consequences and predictability. Weekly student-led discussions of issues appearing in journals such as *Nature*.

EAS 296(2960) Forecast Competition
Fall and spring. 1 credit; students enroll for two consecutive semesters; credit awarded after second semester; may be repeated for credit. Prerequisite: sophomore standing in atmospheric science or permission of instructor. S-U grades only. D. S. Wilks.
Two-semester course providing daily exercise in probabilistic weather forecasting, in which students compete to forecast local weather most skillfully.

EAS 331(3310) Climate Dynamics (also ASTRO 331[3331])
Fall. 3 credits. Prerequisites: two semesters of calculus and one semester of physics. Lec, M W F 12:20–1:10; disc, F 1:25–2:15. K. H. Cook and P. J. Gierasch.
Discusses processes that determine climate and contribute to its change, including atmospheric radiation, ocean circulation, and atmospheric dynamics. Investigates contemporary climate change issues and discusses them in the context of natural variability of the system.

[EAS 334(3340) Microclimatology
Spring. 3 credits. Prerequisite: physics course. T R 10:10–11:25. Not offered 2005–2006. D. S. Wilks.
The relationships of radiant energy, temperature, wind, and moisture in the atmosphere near the ground. Examines the interplay between physical processes of the atmosphere, plant canopies, and soil with emphasis on the energy balance.]

EAS 341(3410) Atmospheric Thermodynamics and Hydrostatics
Fall. 3 credits. Prerequisites: one year of calculus and one semester of physics. M W F 10:10–11:00. M. W. Wysocki.
Introduction to the thermodynamics and hydrostatics of the atmosphere and to the methods of description and quantitative analysis used in meteorology. Topics include thermodynamic processes of dry air, water vapor, and moist air, and concepts of hydrostatics and stability.

EAS 342(3420) Atmospheric Dynamics (also ASTRO 342[3342])
Spring. 3 credits. Prerequisites: one year each of calculus and physics. Lec, M W F 11:15–12:05. K. H. Cook and P. J. Gierasch.
Introduction to the basic equations and techniques used to understand motion in the atmosphere, with an emphasis on the space and time scales typical of storm systems (the synoptic scale). Derives the governing equations of atmospheric flow from first principles and applies them to middle latitude and tropical meteorology. Topics include balanced flow, atmospheric waves, circulation, and vorticity.

EAS 352(3520) Synoptic Meteorology I
Spring. 3 credits. Prerequisite: EAS 341. Co-requisite: EAS 342. Lec, T R 9:05; lab, M 1:25. M. W. Wysocki.
Study of weather map analysis and forecasting techniques by applying the principles of fluid and heat flow. Strengthens previously introduced meteorological concepts that are applied to forecasting midlatitude synoptic scale weather systems, such as cyclones, anticyclones, jet streams, fronts, and waves.

EAS 435(4350) Statistical Methods in Meteorology and Climatology
Fall. 3 credits. Prerequisites: one introductory course each in statistics (e.g., AEM 210) and calculus. T R 10:10–11:25. D. S. Wilks.
Statistical methods used in climatology, operational weather forecasting, and selected meteorological research applications. Includes statistical characteristics of meteorological data including probability distributions and correlation structures. Covers operational forecasts derived from multiple regression models, including the MOS system and forecast evaluation techniques.

EAS 447(4470) Physical Meteorology
Fall. 3 credits. Prerequisites: one year each of calculus and physics. M W F 9:05–9:55. Offered alternate years. A. T. DeGaetano.
Primarily a survey of natural phenomena of the atmosphere, with emphasis on their underlying physical principles. Topics include atmospheric electricity; atmospheric optics and radiation; microphysical cloud processes; and principles of radar probing of the atmosphere.

EAS 451(4510) Synoptic Meteorology II
Fall. 3 credits. Prerequisites: EAS 341 and 342. Lec, T R 9:05; lab, M 1:25–4:25. S. J. Colucci.
Structure and dynamics of large-scale midlatitude weather systems, such as cyclones, anticyclones, and waves, with consideration of processes that contribute to temperature changes and precipitation. Lab sessions involve real-time weather forecasting and the computer application of a numerical model of the atmosphere to study selected large-scale midlatitude weather events.

EAS 456(4560) Mesoscale Meteorology
Spring. 3 credits. Prerequisites: EAS 341 and 342 or permission of instructor. T R 11:40–12:55. S. J. Colucci.
Covers structure and dynamics of midlatitude mesoscale weather systems such as fronts, jets, squall lines, convective complexes, precipitation bands, downslope windstorms, mountain breezes, sea breeze circulations, and lake effect snowstorms. Also considers tropical weather systems and mesoscale modeling.

[EAS 457(4570) Atmospheric Air Pollution
Fall. 3 credits. Prerequisites: EAS 341 or one course in thermodynamics, and one semester of chemistry, or permission of instructor. M W F 10:10–11. Offered alternate years; next offered 2006–2007. M. W. Wysocki.
Examines sources, effects, transport, measurement, and controls of air pollution. Discusses the basic principles in each area with an emphasis on their local, regional, and global impacts.]

EAS 470(4700) Weather Forecasting and Analysis
Spring. 3 credits. Prerequisites: EAS 352 and 451. Times TBA. M. W. Wysocki.
Applied course focusing on weather forecasting and analysis techniques for various regions around the world. Lectures emphasize the application of student's knowledge of atmospheric dynamics, thermodynamics, and computer data analysis, to forecast the development and movement of multiscale weather systems. Students participate in weekly forecast discussions; write daily forecasts that include a synoptic discussion, quantitative precipitation forecasts, and severe weather outlook for the forecast region; and lead class discussion on assigned readings.

[EAS 483(4830) Environmental Biophysics (also CSS 483[4830])
Spring. 3 credits. T R 8:40–9:55. Offered alternate years; next offered 2006–2007. S. J. Riha.
Introduces basic principles of energy and mass transfer and storage in soil-plant systems. Covers energy budgets, soil heat flow; water movement in saturated and unsaturated soils; evapotranspiration; and water, gas, and nutrient dynamics in the soil-plant-atmosphere continuum. Considers applications to agronomic and environmental problems and instrument design and use through discussions and problem sets.]

EAS 487(4870) Introduction to Radar Remote Sensing (also ECE 487[4870])
Fall. 3 credits. Prerequisite: PHYS 208 or 213 or equivalent, or permission of instructor. Lec, M W F 9:05–9:55. D. L. Hysell.
Fundamentals of radar, antennas, and remote sensing. Exposes students to the principles underlying the analysis and design of antennas used for communication and for radar-related applications. Students also encounter both a mathematical and a practical description of how radars function, how their performance can be optimized for different applications, and how signals acquired by them can be processed. The objective is to familiarize students with a wide variety of radars rather than to turn them into practicing radar engineers. Each topic is developed from basic principles so students with a wide variety of backgrounds are able to take the course. Emphasizes radar applications in geophysics, meteorology and atmospheric sciences, and astronomy and space sciences. Gives special attention to radar remote sensing of the Earth from spacecraft.

EAS 494(4940) Special Topics in Atmospheric Science (undergraduate level)
Fall or spring. 8 credits max. S-U grades optional. Staff.
The department teaches "trial" courses under this number. Offerings vary by semester and are advertised by the department before the semester starts. The same course is not offered more than twice.

EAS 497(4970) Individual Study in Atmospheric Science
Fall or spring. 1–6 credits. S-U grades optional. Students must register using independent study form. Staff.
Topics are arranged at the beginning of the semester for individual study or for group discussions.

EAS 499(4990) Undergraduate Research in Atmospheric Science
Fall or spring. Credit TBA. S-U grades only. Students must register using independent study form. Staff.
Independent research on current problems in atmospheric science.

[EAS 651(6510) Atmospheric Physics (also ASTRO 651[7651])
Fall. 3 credits. Prerequisite: good background in undergraduate calculus and physics. Offered alternate years; next offered 2006–2007. T R 11:40–12:55. K. H. Cook, P. J. Gierasch, and S. J. Colucci.
Survey of the fundamental physical processes in atmospheres. Topics include thermodynamics of atmospheric gases, moist effects, hydrostatics, convective instability, atmospheric radiation and radiative heating, radiative-convective equilibrium, clouds, cloud microphysics, and precipitation processes. Discusses thermal structure and greenhouse effects on the Earth and other planets. Taught at the level of *Thermodynamics of Atmospheres and Oceans* by Curry and Webster.]

[EAS 652(6520) Advanced Atmospheric Dynamics (also ASTRO 652[7652])
Spring. 3 credits. Prerequisites: EAS 341 and 342 or equivalents. T R 11:40–12:55. Offered alternate years; next offered 2006–2007. S. J. Colucci and P. J. Gierasch.
Covers quasigeostrophic theory, atmospheric waves, hydrodynamic instability, the general circulation of the atmosphere, and other topics selected from among numerical weather prediction and tropical, mesoscale, and middle atmosphere processes according to student interest.]

[EAS 666(6660) Applied Multivariate Statistics
Spring. 3 credits. Prerequisites: multivariable calculus, matrix algebra, two statistics courses. Offered alternate years; not offered 2005–2006. T R 10:10–11:25. D. S. Wilks.
Statistical techniques for multivariable data. Topics include multivariate exploratory data analysis, the multivariate normal distribution, parametric and nonparametric inference about multivariate means, principal component analysis, canonical correlation analysis, discriminant analysis, and cluster analysis. Emphasizes geophysical applications, using

primarily atmospheric and oceanographic data as examples, but the development is general enough to be of broader interest.]

EAS 675(6750) Modeling the Soil–Plant–Atmosphere System (also CSS 675[6750])
Spring. 3 credits. Prerequisite: EAS/CSS 483 or equivalent. T R 8:40–9:55. S. J. Riha.
Introduction to the structure and use of soil-plant-atmosphere models. Topics include modeling plant physiology, morphology, and development; potential crop production and crop production limited by moisture and nutrient availability; plant-plant competition; and land surface processes as well as model data requirements, validation, and scale. Discusses use of soil-plant-atmosphere models for teaching, research, extension, and policy formation.

EAS 692(6920) Special Topics in Atmospheric Science
Fall or spring. 1–6 credits. S-U grades optional. Staff.
Study of topics in atmospheric science that are more specialized or different from other courses. Special topics covered depend on staff and student interests.

EAS 711(7110) Upper Atmospheric and Space Physics
Fall or spring. 1–6 credits. Seminar course TBA. D. L. Hysell.

EAS 850(8500) Master's-Level Thesis Research in Atmospheric Science
Fall or spring. Credit TBA. S-U grades only. Times TBA. Graduate faculty.
Thesis research for atmospheric science master's students.

EAS 950(9500) Graduate-Level Dissertation Research in Atmospheric Science
Fall or spring. Credit TBA. S-U grades optional. Times TBA. Graduate faculty.
Dissertation research for atmospheric science Ph.D. students only **before** "A" exam has been passed.

EAS 951(9510) Doctoral-Level Dissertation Research in Atmospheric Science
Fall or spring. Credit TBA. S-U grades optional. Times TBA. Graduate faculty.
Dissertation research for atmospheric science Ph.D. candidates **after** "A" exam has been passed.

Geological Science

EAS 101(1101) Introductory Geological Sciences
Fall. 3 credits. Staff.
Designed to enhance an appreciation of the physical world. Emphasizes natural environments, surface temperatures, dynamic processes such as mountain belts, volcanoes, earthquakes, glaciers, and river systems. Covers interactions of the atmosphere, hydrosphere, biosphere, and lithosphere (Earth system science). Examines water, mineral, and fuel resources and environmental concerns. Includes field trips in the Ithaca region.

EAS 102(1102) Evolution of the Earth and Life (also BIO G 170[1700])
Spring. 3 credits. J. L. Cisne.
Earth systems and their evolution; Earth history's astronomical context; plate tectonics, continental drift, and their implications for climate and life; coevolution of life and the atmosphere; precedents for ongoing global change; dinosaurs, mass extinctions, and human ancestry. Includes laboratories on reconstructing geological history and mapping ancient geography. Fossil-collecting on field trips.

EAS 108(1108) Earth in the News
Summer. 3 credits. S. L. Losh.
Introduction to physical geology and Earth system science and explores the scientific basis for informed decision making regarding many timely environmental issues including global warming; water pollution and use; geologic hazards such as floods, earthquakes, and volcanoes; fossil fuel distribution and use; and land use. A field trip is taken in the Ithaca area.

EAS 109(1109) Dinosaurs
Fall. 1 credit. J. L. Cisne.
Introductory survey course for anyone interested in dinosaurs. Lectures examine the fossil evidence and illustrate how various geological and biological disciplines contribute to understanding dinosaurs and their world.

[EAS 111(1110) To Know the Earth
Fall. 3 credits. Staff.
Acquaints the nonscientist with Earth, its major features, how the Earth has evolved, Earth system science, and building a habitable planet. Covers the effects of human activity on geologic environments, mitigating environment damage, and living with natural hazards. Also covers mineral resource use in the 21st century and an environmentally sound fuel-minerals cycle.]

EAS 122(1220) Earthquake! (also ENGRI 122[1220])
Spring. 3 credits. L. D. Brown.
Explores the science of natural hazards and strategic resource. Covers techniques for locating and characterizing earthquakes and assessing the damage they cause; methods of using sound waves to image the Earth's interior to search for strategic minerals; and the historical importance of such resources. Includes seismic experiments on campus to probe for groundwater, the new critical environmental resource.

EAS 154(1540) The Sea: An Introduction to Oceanography—Lecture (also BIOEE 154[1540])
Fall, summer. 3 credits; optional 1-credit lab offered as EAS/BIOEE 155. S-U grades optional. Spring: C. H. Greene, B. C. Monger; summer: B. C. Monger.
Intended for both science and nonscience majors. Cover the basic workings of the ocean including its physics, chemistry, and biology. Following this basic description, the course examines threats to the health of the ocean and the important role the ocean plays in global climate change. Nonscience majors should pay particular attention to this course to fulfill a science requirement, because they learn broadly how the Earth works (physically, chemically, and biologically) in a single nonquantitative class.

EAS 155(1550) The Sea: An Introduction to Oceanography—Laboratory (also BIOEE 155[1550])
Fall. 1 credit. Co-requisite: EAS/BIOEE 154. S-U grades optional. C. H. Greene and B. C. Monger.
Laboratory course covering topics presented in EAS/BIOEE 154.

EAS 201(2010) Introduction to the Physics and Chemistry of the Earth (also ENGRD 201[2010])
Fall. 3 credits. Prerequisite: PHYS 112 or 207. J. Phipps Morgan.
Covers formation of the solar system: accretion and evolution of the Earth; the rock cycle: radioactive isotopes and the geological time scale, plate tectonics, rocks and minerals, earth dynamics, mantle plumes; the hydrologic cycle: runoff, floods and sedimentation, groundwater flow, and contaminant transport; and the weathering cycle: chemical cycles, CO_2 (weathering), controls on global temperature (CO_2 or ocean currents), and oil and mineral resources.

EAS 210(2100) Introduction to Field Methods in Geological Sciences
Fall. 1 lec, S field trips. 3 credits. Prerequisite: EAS 101 or EAS 201 or permission of instructor. Staff.
Considers the methods by which rocks are used as a geological database. Covers field methods used in the construction of geologic maps and cross sections; systematic description of stratigraphic sections. Field and lab sessions meet on Saturdays until Thanksgiving. There is also one additional lecture during most of these weeks. There is one weekend field trip to eastern New York.

EAS 213(2130) Marine and Coastal Geology
Summer. 4 credits. Prerequisite: introductory geology or ecology course or permission of instructor. Staff.
Special two-week course offered at Cornell's Shoals Marine Laboratory (SML), located on an island near Portsmouth, N.H. For more details, including estimated cost and an application, contact SML office, G14 Stimson Hall, or visit www.sml.cornell.edu.

EAS 302(3020) Evolution of the Earth System
Spring. 4 credits. Prerequisites: MATH 112 or 192 and CHEM 207 or equivalent. W. White and staff.
Coevolution of life and the Earth system: Earth's early history; plate tectonics, continental drift, and climate changes during the past billion years; mountain building, ice ages, and humans' own emergence during the past 10 million years. Introduces methods of interpreting information preserved in the rock record.

EAS 315(3150) Geomorphology
Fall. 4 credits. Prerequisite: geology, hydrology, or soil science course. Two S field trips. B. L. Isacks.
Study of the processes that sculpt the Earth's landscapes (above and below sea level) and the nature of those landforms. The point of departure is landforms constructed by Earth's internal processes, as the course examines their modification by physical interaction with the atmosphere and oceans. Also treats depositional landforms that are generated by accumulations of grains or sediment. Laboratory exercises include both field examination of landforms of the Finger Lakes area and computer analysis of satellite images and Digital Elevation Models of examples from around the globe.

EAS 321(3210) Introduction to Biogeochemistry (also NTRES 321[3210])
Fall. 4 credits. Prerequisites: CHEM 207, MATH 112, and biology and/or geology course. L. A. Derry and J. Yavitt.
Control and function of the Earth's global biogeochemical cycles. Begins with a review of the basic inorganic and organic chemistry of biologically significant elements, and then considers the biogeochemical cycling of carbon, nutrients, and metals that take place in soil, sediments, rivers, and the oceans. Topics include weathering, acid-base chemistry, biological redox processes, nutrient cycling, trace gas fluxes, bio-active metals, the use of isotopic tracers, controls on atmospheric carbon dioxide, and mathematical models. Interactions between global biogeochemical cycles and other components of the Earth system are discussed.

EAS 326(3260) Structural Geology
Spring. 4 credits. Prerequisite: one semester of calculus plus introductory geology course, or permission of instructor. One weekend field trip. R. W. Allmendinger.
Nature and origin of deformed rocks at microscopic to macroscopic scales, with emphasis on structural geometry and kinematics. Topics include stress, strain, rheology, deformation mechanisms, minor structures, faulting, folding, and structural families.

EAS 350(3500) Dynamics of Marine Ecosystems (also BIOEE 350[3500])
Fall. 3 credits. Prerequisites: one year of calculus and one semester of oceanography (i.e., BIOEE/EAS 154), or permission of instructor. C. H. Greene and R. W. Howarth.
Lecture course covering the interactions of physical and biological processes in marine ecosystems. Begins by looking at these processes on a global scale and works down to the scales relevant to individual organisms. Topics include global patterns of ocean circulation; global patterns of ocean production; climate variability and the role of the ocean in global climate change; the El Niño/Southern Oscillation; ecosystem dynamics of the open ocean and coastal environments.

EAS 355(3550) Mineralogy
Fall. 4 credits. Prerequisite: EAS 101 or 201 and CHEM 207/211 or permission of instructor. S. Mahlburg Kay.
Examination of minerals by hand-specimen properties and optical microscopy. Covers geological setting, classification, crystal structures, phase relations, chemical properties, and physical properties of minerals. Introduces X-ray diffraction. Includes an independent research project.

EAS 356(3560) Petrology and Geochemistry
Spring. 4 credits. Prerequisite: EAS 355. R. W. Kay.
Principles of phase equilibrium as applied to igneous and metamorphic systems. Includes description, classification, chemistry, origin, regional distribution, and dating of igneous and metamorphic rocks; geochemical distribution of trace elements and isotopes in igneous and metamorphic systems. Also covers the petrological evolution of the planets.

EAS 375(3750) Sedimentology and Stratigraphy
Fall. 4 credits. Prerequisite: EAS 101, 102, or 201. J. L. Cisne.
Sediments, sedimentary rocks, and the rock cycle; sedimentary systems and stratigraphic sequences; fossil organisms and their paleoecology; correlation of strata in relation to age and environment; construction of the geological time scale; stratigraphic study of plate-tectonic processes and global change.

EAS 388(3880) Geophysics and Geotectonics
Spring. 4 credits. Prerequisites: MATH 192 (or 112) and PHYS 208 or 213. B. L. Isacks.
Covers global tectonics and the deep structure of the solid Earth as revealed by investigations of earthquakes, earthquake waves, the Earth's gravitational and magnetic fields, and heat flow.

EAS 401(4010) Fundamentals of Energy and Mineral Resources
Spring. 3 credits. Prerequisites: math through differential equations, physics through electricity and magnetism, CHEM 207, or equivalent. Recommended: introduction to geology. L. M. Cathles.
Fossil fuels will continue to be the prime source of energy for the foreseeable future, and society depends upon mineral resources. This course describes and quantitatively analyzes energy and mineral resources on the earth. Describes the distribution and nature of earth resources, focusing on U.S. examples. Develops quantitative tools and uses them to understand the processes that accumulate resources to economic levels.

EAS 404(4040) Geodynamics
Spring. 3 credits. Prerequisite: calculus and calculus-based physics courses or permission of instructor. J. Phipps Morgan.
Quantitative study of the deformation, heat transport, and melting processes that have shaped the evolution of the solid Earth. Familiar physical and chemical principles and concepts are applied to the study of plate tectonics, fluid dynamics, mantle convection, melting, and mountain building.

EAS 405(4050) Active Tectonics
Spring. 3 credits. Recommended: mechanical background equivalent to EAS 326/388. M. Pritchard.
Develops the ideas and methods necessary to understand how the Earth deforms—from individual earthquakes to the construction of mountain ranges. Discusses the driving forces of deformation, and how these forces interact with different geologic materials to cause deformation.

EAS 417(4170) Field Mapping in Argentina
Summer. 3 credits. Prerequisites: EAS 210 and 326; Recommended: knowledge of Spanish. S. Mahlburg Kay.
Modern techniques of geological mapping applied in the region of San Juan, Argentina, including folded and faulted sedimentary rock units of the Andean Precordillera (San Juan River section), intensely deformed Precambrian metamorphic rocks of the Pampean Ranges (Pie de Palo), and shallow-level silicic intrusives (Cerro Blanco-Ullun).

[EAS 434(4340) Reflection Seismology
Fall. 3 credits. Prerequisites: MATH 192 and PHYS 208, 213, or equivalent. Not offered 2005–2006. L. D. Brown.
Fundamentals of subsurface imaging by multichannel seismic reflection techniques as used in oil exploration and geohydrological investigations. Covers survey design, acquisition, analysis, processing, and interpretation in both 2-D and 3-D. Includes discussion of related techniques such as seismic refraction analysis, tomographic inversion, vertical seismic profiling, shear wave exploration, and ground-penetrating radar. Lab is keyed to state-of-the-art seismic processing, modeling, and interpretation software from LandMark.]

EAS 437(4370) Geophysical Field Methods (also ARKEO 437[4370])
Fall. 3 credits. Prerequisites: PHYS 213 or 208, or permission of instructor. Offered alternate years. L. D. Brown.
Introduction to field methods of geophysical exploration, especially as applied to environmental issues. Emphasizes seismic, ground penetrating radar, gravity, and magnetic techniques. Analyzes and interprets field surveys carried out at the beginning of the semester.

EAS 453(4530) Advanced Petrology
Fall. 3 credits. Prerequisite: EAS 356. Offered alternate years. R. W. Kay.
Magmas and metamorphism in the context of plate tectonics; major and trace element chemistry and phase petrology as monitors of the creation and modification of igneous rocks; temperature and stress in the crust and mantle and their influence on reaction rates and textures of metamorphic rocks; application of experimental studies to natural systems.

[EAS 454(4540) Advanced Mineralogy
Spring. 3 credits. Prerequisite: EAS 355 or permission of instructor. Offered alternate years. S. M. Kay.
Covers crystallography and crystal chemistry of minerals and the methods of their study. Includes X-ray diffraction, optical methods, and computer simulation of crystal structures. Emphasizes effects of high pressures and temperatures with implications for understanding the Earth's interior.]

EAS 455(4550) Geochemistry
Fall. 4 credits. Prerequisites: CHEM 207 and MATH 192 or equivalent. Recommended: EAS 356. Offered alternate years. W. M. White.
The Earth from a chemical perspective. Covers the formation of the elements; cosmochemistry; chemical evidence regarding the formation of the Earth and solar system; trace-element geochemistry; isotope geochemistry; geochemical thermodynamics and kinetics; chemical evolution of the crust, mantle, and core; weathering and the chemistry of natural waters; chemistry of rivers and the oceans; hydrothermal systems; and ore deposition.

[EAS 458(4580) Volcanology
Fall. 3 credits. Prerequisite: EAS 356 or equivalent. Next offered 2006–2007. R. W. Kay and W. M. White.
Causes of volcanism, melting in the Earth, and the origin of magmas. Physical volcanology, nature and types of volcanic eruptions and associated deposits, and eruption mechanisms. Volcanic plumbing systems, magma chamber

processes, evolution of magma. Volcanism and impact phenomena in the solar system. Volcanic hazard assessment and volcano monitoring. Ore deposits associated with volcanism.]

[EAS 460(4600) Late Quaternary Paleoecology
Fall. 4 credits. Not offered 2005–2006. M. Goman.
Explores topics in Late Quaternary paleoecology. Broadly divided into two sections: (1) lectures that cover a variety of topics, such as philosophy of paleoecology, radiometric dating methods, and paleoenvironmental proxies; (2) field- and laboratory-based research. The field research provides students with hands-on experience in sediment core collection, while in the laboratory studentslearn the basics of core description, pollen, and macrofossil analysis.]

[EAS 462(4620) Marine Ecology (also BIOEE 462[4620])
Fall. 3 credits. Limited to 75 students. Prerequisite: BIOEE 261. Offered alternate years. C. D. Harvell and C. H. Greene.
Lectures and discussion focus on current research in broad areas of marine ecology with an emphasis on processes unique to marine systems. A synthetic treatment of multiple levels of organization in marine systems including organismal, population, community, ecosystems, and evolutionary biology. Draws examples from all types of marine habitats, including polar seas, temperate coastal waters, and tropical coral reefs.]

EAS 471(4710) Introduction to Groundwater (also BEE 471[4710])
Spring. 3 credits. Prerequisite: MATH 293, fluid mechanics or hydrology course. T. S. Steenhuis and L. M. Cathles.
Intermediate-level study of aquifer geology, groundwater flow, and contamination of aquifers and cleanup methods. Includes description of transport of pesticides, nutrients and toxics through the unsaturated zone and aquifers. Discusses theoretical and practical applications. Includes short field trips.

EAS 475(4750) Special Topics in Oceanography
Fall, spring, summer. 2–6 credits, variable. Prerequisites: one semester of oceanography and permission of instructor. Fall, spring: C. H. Greene; summer: B. C. Monger.
Undergraduate instruction and participation in advanced areas of oceanographic research. Topics change from semester to semester. Contact instructor for further information.

[EAS 476(4760) Sedimentary Basins: Tectonics and Mechanics
Fall. 3 credits. Prerequisite: EAS 375 or permission of instructor. Offered alternate years. T. E. Jordan.
Subsidence of sedimentary basins from the point of view of plate tectonics and geomechanics. Covers interactions of subsidence, sediment supply, and environmental characteristics in development of stratigraphic sequences. Also covers stratigraphic characteristics of active-margin, passive-margin, and cratonic basins. Geophysical and stratigraphic modeling; sequence stratigraphy. Uses modern and ancient examples.]

[EAS 478(4780) Advanced Stratigraphy
Fall. 3 credits. Prerequisite: EAS 375 or permission of instructor. Offered alternate years; next offered 2005–2006. T. E. Jordan.
Covers modern improvements on traditional methods of study of ages and of genetic relations among sedimentary rocks, emphasizing 3-D relationships. Introduces techniques and applications of sequence stratigraphy at scales ranging from beds to entire basins. Considers physical correlation, dating techniques, and time resolution in sedimentary rocks as well as physical controls on the stratigraphic record and numerical modeling.]

[EAS 479(4790) Paleobiology (also BIOEE 479[4790])
Fall. 4 credits. Prerequisites: one year of introductory biology and BIOEE 274 or 373 or EAS 375, or permission of instructor. Offered alternate years; not offered 2005–2006. W. D. Allmon.
Surveys the major groups of organisms and their evolutionary histories. Intended to fill out the biological backgrounds of Earth and atmospheric science students concerning the nature and significance of the fossil record for their respective studies.]

EAS 491–492(4910–4920) Undergraduate Research
Fall, spring. 1 to 4 credits. Staff.
Introduction to the techniques and philosophy of research in geological sciences and an opportunity for undergraduates to participate in current faculty research projects. Topics chosen in consultation with, and guided by, a faculty member. A short written report is required, and outstanding projects are prepared for publication. Fill out form at 2124 Snee Hall.

EAS 498(4980) Teaching Experience in Earth and Atmospheric Sciences
Fall, spring. 1–4 credits. S-U grades only. Students must register using independent study form. Staff.

EAS 500(5000) Design Project in Geohydrology
Fall, spring. 3–12 credits. Alternative to industrial project for M.Eng. students choosing geohydrology option. May continue over two or more semesters. L. M. Cathles.
The project may address one of the many aspects of groundwater flow and contamination, and must involve a significant geological component and lead to concrete recommendations or conclusions of an engineering nature. Results are presented orally and in a professional report.

EAS 502(5020) Case Histories in Groundwater Analysis
Spring. 4 credits. L. M. Cathles.
Analyzes in depth groundwater flow in a specific area, such as a proposed nuclear-waste disposal site. Geological and resource data on the area are presented early in the course. Students working as an engineering analysis team analyze the material. Each student makes a weekly progress report and writes part of a final report. Results are presented in a half-day seminar at the end of semester.

[EAS 622(6220) Advanced Structural Geology I
Spring. 3 credits. Prerequisites: EAS 326 and permission of instructor. Offered alternate years. R. W. Allmendinger.
Stress-strain theory and application: advanced techniques of structural analysis. Topics include finite and incremental strain measurement; microstructure, preferred orientation, and TEM analysis; and pressure solution and cleavage development; and experimental deformation. Applications to deformation of unconsolidated sediments, brittle and brittle-ductile deformation of supracrustal strata, and ductile deformation of high-grade metamorphic rocks. Kinematic analysis of shear zones and folds in these regimes.]

EAS 624(6240) Advanced Structural Geology II
Spring. 3 credits. Prerequisites: EAS 326 and permission of instructor. Offered alternate years. R. W. Allmendinger.
Geometry, kinematics, and mechanics of structural provinces. Concentrates on thrust belts, rift provinces, or strike-slip provinces. Covers techniques of balanced cross sections.

[EAS 628(6280) Geology of Orogenic Belts
Spring. 3 credits. Prerequisite: permission of instructor. Not offered 2005–2006. Staff.
Seminar course in which students study specific geologic topics of an orogenic belt selected for study during the semester.]

[EAS 641(6410) Analysis of Biogeochemical Systems
Spring. 3 credits. Prerequisite: MATH 293 or permission of instructor. Offered alternate years. TBA. L. A. Derry.
Covers dynamics of biogeochemical systems; kinetic treatment of biogeochemical cycles; box models, residence time, response time; analytical and numerical solutions of model systems; Eigen-analysis of linear systems; feedback and nonlinear cases, problems of uncertainties in natural systems; modeling software such as MATLAB; and applications to current research of participants or from recent literature.]

[EAS 656(6560) Isotope Geochemistry
Spring. 3 credits. Open to undergraduates. Prerequisite: EAS 455 or permission of instructor. Offered alternate years. W. M. White.
Nucleosynthetic processes and the isotopic abundance of the elements; geochronology and cosmochronology using radioactive decay schemes, including U-Pb, Rb-Sr, Sm-Nd, K-Ar, U-series isotopes, and cosmogenic isotopes such as ^{14}C and ^{36}Cl. Use of radiogenic and stable isotopes in petrology and their application to study of the evolution of the crust and mantle. Isotopic evidence regarding the formation of the Earth and the solar system. Stable isotopes and their use in geothermometry, ore petrogenesis, paleontology, and the global climate system.]

EAS 693(6930) Special Topics in Geological Sciences
1–3 var. credits. Fall or spring. S–U grades optional. Staff.
Study of specialized advanced topics in the Earth Sciences through readings from the scientific literature, seminars, and discussions.

EAS 700–799(7000–7990) Seminars and Special Work
Fall, spring. 1–3 credits. Prerequisite: permission of instructor. Staff.
Advanced work on original investigations in earth and atmospheric sciences. Topics change from semester to semester. Contact appropriate professor for more information.

EAS 722(7220) Advanced Topics in Structural Geology
R. W. Allmendinger.

EAS 731(7310) Planetary Geodynamics, Active Tectonics, Volcanology, Earthquakes, and Geodesy
M. Pritchard.

EAS 733(7330) Advanced Topics in Geodynamics
Spring. J. Phipps Morgan.

EAS 751(7510) Petrology and Geochemistry
R. W. Kay.

EAS 755(7550) Advanced Topics in Tectonics and Geochemistry
J. Phipps Morgan.

EAS 757(7570) Current Research in Petrology and Geochemistry
S. Mahlburg Kay.

EAS 762(7620) Advanced Topics in Paleobiology
W. D. Allmon.

EAS 771(7710) Advanced Topics in Sedimentology and Stratigraphy
T. E. Jordan.

EAS 773(7730) Paleobiology
J. L. Cisne.

EAS 775(7750) Advanced Topics in Oceanography
C. H. Greene.

EAS 780(7800) Earthquake Record Reading
Fall. M. Barazangi.

EAS 781(7810) Geophysics, Exploration Seismology, Ground-Penetrating Radar
L. D. Brown.

EAS 783(7830) Advanced Topics in Geophysics
B. L. Isacks.

EAS 789(7890) Lithospheric Seismology Seminar
L. D. Brown.

EAS 793(7930) Andes-Himalaya Seminar
S. Mahlburg Kay, R. W. Allmendinger, B. L. Isacks, and T. E. Jordan.

EAS 795(7950) Low Temperature Geochemistry
L. A. Derry.

EAS 796(7960) Geochemistry of the Solid Earth
W. M. White.

EAS 797(7970) Fluid-Rock Interactions
L. M. Cathles.

EAS 799(7990) Soil, Water, and Geology Seminar
Spring. L. M. Cathles and T. S. Steenhuis.

EDUCATION

R. S. Caffarella, chair (435 Kennedy Hall, 255-2207); G. J. Applebee, W. G. Camp, M. Constas, B. A. Crawford, B. Heath-Camp, M. M. Kroma, S. K. Kroma, S. J. Peters, S. C. Piliero, R. Ripple, V. N. Rockcastle, D. E. Schrader, J. W. Sipple, D. J. Trumbull, T. Tucker, D. G. Way, A. L. Wilson

EDUC 005(1005) Basic Review Mathematics
Spring. 3 credits; not counted toward 120 credits required for degree. S-U grades. Lec, T R 2:55–4:10. S. Piliero.
Reviews concepts necessary for success in basic mathematics and statistics courses. Topics include problem solving, graphing, basic algebra skills, linear and quadratic functions, polynomial equations, exponents and logarithms, and trigonometry. Places considerable emphasis on learning mathematics for understanding and solving word problems.

EDUC 100(1100) Multiculturalism in Education
Fall. 3 credits. M W F 10:10–11:25. S. Kroma.
Should schools provide mandatory bilingual education programs to non–English-speaking students? Should the United States adopt an "English only" official language policy? Should Kwanza be celebrated as a public holiday? These are some of the many questions that challenge the notion of "cultural unity" once expressed as the "melting pot." In this course, students develop writing skills as they explore discourse on the forces responsible for our cultural diversity and the changing perspectives on our "cultural unity." Through writing activities, students learn to critically examine the historical, political, and legal contexts of this diversity and define their own views on the competing public positions that multicultural education issues arouse.

EDUC 100.2 Writing through Action: Scholarly Discourse in the University
Fall, spring. 3 credits. Disc, T R 10:10–11:25. C. Shafer.
The challenge for this highly interactive course is to create a model community of inquiry within which to explore the links between research, writing, and thinking in the university. Readings introduce fearless explorers and careful scholars of digital discourse and action research whose work alike challenges the status quo of academic culture. Their respective views of educational transformation and its associated issues of validity, property, space, reality, community, power, and identity inform our own writing about the future of knowledge making. For more information, see cu-ed100.com.

EDUC 100.3 Re-creating the World: Education and Social Change
Spring. 3 credits. T R 1:25–2:40. M. Hittleman.
How do we build respectful, just, democratic communities in which all can participate and flourish? How do we help others participate in such change processes? Through a cooperative inquiry process, this course explores the work of educators and community organizers, including Dewey, Freire, Hooks, Horton, Shor, and Baker; students critically examine their own experiences as members of a powerful social and institutional community: the American university.

EDUC 115(1150) Introductory College Mathematics
Fall. 4 credits. Does **not** count toward graduation credit in College of Arts and Sciences. M W F 11:15–12:05; lab, TBA. S. Piliero.
Designed for students wishing to fulfill distribution requirements and/or prepare for study in calculus. Offers a multi-representational approach to topics in precalculus and calculus, stressing conceptual understanding, problem solving, and applications in a technology-enhanced environment. Considerable emphasis is placed on numerical, graphical, and symbolic representations of functions and their transformations. Students use graphing calculators in a collaborative lab setting.

[EDUC 120(1200) Education for Empowerment
Spring. 3 credits. W 1:25–4:25. Not offered 2005–2006. Staff.
Common themes running through the modules include human learning, teaching strategies, and political/social/economic factors affecting education. Provides an opportunity to sample different areas of study and to gain knowledge and awareness of one's own educational processes.]

EDUC 151(1510) Engaging Diversity: Multicultural Issues in Education and Society
Fall or spring. 3 credits. S-U grades optional. Lec, T R 1:25–2:40. S. K. Kroma.
Explores diversity issues that affect students e.g., example, race, culture, gender, and class in the context of modern American society. Through selected readings and course activities, students recognize the strengths of a diverse community and acquire the knowledge and skills necessary for living and working in it. The focus is on critical thinking about the differences in our society, and the strategies we need for cross-cultural interactions.

EDUC 220(2200) Community Learning and Service Partnership (CLASP)
Fall only. 2 credits. Prerequisite: permission of instructor. Students must commit to taking EDUC 221 the following spring. S–U grades optional. T 2:30–4:25. A. Wilson.
In this service-learning course, students partner with Cornell service staff to accomplish a variety of learning goals selected by the employees. Students are introduced to the field of adult basic education and the principles of the Community Learning and Service Partnership (CLASP). Seminars examine the issues of learning through service and reflection, adult teaching philosophy and practice, and empowerment through education. Students must commit to continuing their service by taking EDUC 221 the following spring semester.

EDUC 221(2210) Community Learning and Service Partnership (CLASP)
Spring only. 2 credits. Prerequisites: EDUC 220 and permission of instructor. S–U grades optional. T 2:30–4:25. A. Wilson.
Continues the field experience and curriculum begun in EDUC 220. Students work with Cornell service staff to accomplish a variety of learning goals selected by the employees. Students receive in-service training and support. Seminars examine the impact of gender, race, and social class on learning and educational opportunity.

EDUC 240(2400) The Art of Teaching
Fall and spring. 3 credits. Fall: M 12:20–2:15, or T 2:30–4:25, or W 12:20–2:15, or R 2:30–4:25; spring: M 12:20–2:15, or T 2:30–4:25, or W 12:20–2:15, or R 2:30–4:25. B. Heath-Camp.
Exploratory course designed for students of all backgrounds and interests who have a desire to learn more about teaching. Teaching takes place in a variety of contexts from the family to the workplace and this course endeavors to examine the elements of teaching that transcend the typical school-teaching environment. Designed to guide students in reflecting upon their experiences to help them better understand the decisions they make as teachers. Students have the opportunity to pursue their own interests through a teaching fieldwork assignment. Possible field experiences range from large group to tutorial situations, from preschool to adult education, from traditional school subject matters to recreational and career and technical areas, and from school-based to nonformal situations. The course work and readings are designed to build on these experiences throughout the semester and provide concepts and skills to apply in the field.

EDUC 271(2710) Social and Political Context of American Education
Fall. 3 credits. Disc, T R 1:25–2:40. J. W. Sipple.
Examines the goals, roles, inputs, and outcomes of schooling in American society and the policy environment in which schools operate. Analyzes controversies and tensions (e.g., equity, market forces, state control) surrounding public education at local, state, and federal levels. Includes current and historical, urban and rural issues and problems.

EDUC 331(3310) Careers in Agriculture, Extension, and Adult Education
Fall. 1–3 credits. Letter grades only. F 1:25–4:20; 2:00–4:25. G. J. Applebee.
Offers modules in three areas of teaching: adult education, cooperative extension, and agricultural education. Each module offers 1 hour of credit, and students may take one or more of the modules. The course provides an historical perspective and an introduction to the organization and scope of programs for each module. Students examine career opportunities and characteristics of the professions addressed by each module. Course activities include field observations and experiences during arranged times.

EDUC 335(3350) Youth Organizations
Spring. 3 credits. R 2:55–4:25; lab, TBA. W. Camp.
Visionary, creative, and competent leaders are essential for youth organizations. Class participants learn how to facilitate both youth and adult volunteer leadership development. They examine factors affecting membership, purposes, design, operation, and administration of youth organizations. The course provides students with in-depth learning-by-doing experience of how youth organizations function. Requires field experience with a recognized youth organization.

EDUC 380(3800) Independent Honors Research in Social Science
Fall or spring. 1–6 credits; max. 6 credits may be earned in honors program. Prerequisite: requirements for honors program met. S-U grades optional. Staff.

EDUC 401(4010) Our Physical Environment
Fall. 3 credits. Prerequisite: permission of instructor. Lab fee: approx. $7. T 1:25–4:25. V. N. Rockcastle.
Practical, relatively nonmathematical study of some basic relationships and physical interactions in the environment, with emphasis on physics and earth science. Pays attention to analysis for understanding and techniques for teaching. Includes an individual research project. Useful for teachers, environmental educators, and those for whom physical science seems difficult or uninviting.

EDUC 404(4040) Learning and Teaching I
Fall. 4 credits. Prerequisite: admission to Cornell Teacher Education program or permission of instructor. Letter grades. Lec, T R 8:40–9:55 P.M.; fieldwork, TBA. D. Trumbull.
Designed to foster development of pedagogical and reflective understanding crucial to good teaching. Students explore what it means to understand and teach through examining key disciplinary topics, which requires rethinking disciplinary knowledge, assessment of learning, and motivation. Required fieldwork (4 hours weekly) focuses on learners' understandings and classroom structures.

EDUC 405(4050) Learning and Teaching II
Spring. 4 credits. Prerequisite: EDUC 404 or permission of instructor. Letter grades. Lec, T R 8:40–9:55; fieldwork, TBA. W. Camp, B. A. Crawford, and S. Piliero.
Important part of a sequence of courses and experiences intended to lead to excellence in science, agricultural science, and mathematics teaching. Prospective teachers develop understanding and skills in effective planning, instruction, and assessment of students studying agricultural science, mathematics, and science in middle and high school. The course is intended to integrate theory and practice associated with learning and teaching in school classroom settings and includes a minimum of 40 hours of fieldwork in area classrooms.

EDUC 411(4110) Educational Psychology
Fall. 3 credits. Prerequisite: PSYCH 101 or permission of instructor. S-U grades optional. Lec, T R 11:15–12:05; F sec TBA. D. E. Schrader.
Educational psychology is the application of psychological concepts to educational settings. This course examines the dynamic interaction between people as teachers and learners, schools as social and learning environments, and the sociocultural contexts that influence learning. The focus is on those interactions in cognitive, epistemic, social, moral, and personal domains in educational contexts.

EDUC 420(4200) Field Experience
Fall or spring. 1–4 credits. Undergraduates must attach to their course enrollment material written permission from faculty member who will supervise work and assign grade. S-U grades optional. Staff.
Students may engage in planned, semiprofessional, or professional practice in an educational enterprise. Each student prepares a plan of action including rationale, purposes, and procedures and arranges with a faculty member to supervise and evaluate their field experience.

EDUC 441(4410) Language, Literacy, and Schooling
Spring. 3 or 4 credits. M W 2:55–4:10; lab, TBA. S. Kroma.
Foundation for literacy activities in secondary education. Examines current research, policy, and practice relating to the acquisition of first and second languages, the dynamics of literacy in school contexts, and the development of academic language proficiency. The fourth credit hour requires a practical project based on fieldwork.

[EDUC 445(4450) Curriculum Design Workshop
Spring. 3 credits. Not offered 2005–2006. Staff.
General practical approach to course planning. Includes readings, group discussions, and individual conferences centering on students' projects. Consists of designing course materials in a subject area for an age level and an institutional setting of the student's choosing and, when possible, testing materials.]

[EDUC 448(4480) Instruction for Students with Disabilities
Summer. 3 credits. Prerequisite: educational psychology or introductory psychology course, or permission of instructor. S-U grades optional. Lec, TBA: 3 hours weekly. Not offered 2005–2006. Staff.
Provides preservice middle and secondary school teachers a comprehensive overview of disability law, functional limitations caused by disabling conditions, and classroom strategies to provide academic accommodations/adjustments to meet the needs of students with disabilities. Focuses on specific classroom and curriculum strategies for adapting instruction to meet the needs of students with disabilities.]

[EDUC 450(4500) Education Technology
Fall. 3 credits. Letter grades. M W 10:10–11:25. W. Camp.
Gives future educators the skills necessary to use current technology in educational settings. Focuses on examining how applying technology in the classroom can be used to enhance students' understanding of course content. Course participants compile an electronic portfolio demonstrating skills developed throughout the semester. A quarter of the class time is lecture and discussion focused on the current use of technology in the classroom. The remainder of the time is spent in lab completing hands-on projects.]

EDUC 451(4510) Multicultural Issues in Education
Fall. 3 credits. Letter grades. Lec, M W 2:55–4:10. S. K. Kroma.
Explores issues pertaining to teaching and learning in multicultural classrooms in American schools. Examines events that have shaped contemporary American society, the educational policies and practices that affect the cultural diversity that has emerged, and the teacher's role in dealing with cross-cultural issues in the classroom.

EDUC 452(4520) Multicultural Issues in Secondary Education
Fall. 1 credit. Prerequisites: EDUC 451 and permission of instructor. Letter grades. S. K. Kroma.
Students spend two out-of-class hours a week in a classroom setting in the Ithaca school community and write a project on

culturally responsive teaching based on their experience.

EDUC 459(4590) Educational Innovations in Africa and the Diaspora (also AS&RC 459[4601])

Fall. 3 credits; 4 in College of Arts and Sciences. T 10:10–12:35. N. Assié-Lumumba.

Deals with educational innovations geared to promoting equal opportunity based on gender, race and class, in Africa and the African Diaspora. After introducing the concepts and theories of education and innovations and the stages of innovation as planned change, the course focus on concrete cases and different types of educational innovations. Selected case studies, in the United States, include the creation and expansion of historically black institutions with a focus on Tuskegee Institute (now Tuskegee University), Lincoln University, Spelman College, and the Westside Preparatory School in Chicago. The African cases studied include African languages for instruction in Nigeria, science education also in Nigeria, Ujamaa and education for self-reliance in Tanzania, classroom action research in Lesotho, Information Communication Technologies (ICTs) in African higher education with a focus on African Virtual Universities (AVU), the application of the Global Development Learning Network (GDLN) in Côte d'Ivoire, and OnLine learning in South Africa.

EDUC 463(4630) Policies, Practices, and Critical Issues of Distance Learning in Developing Countries

Spring. 3 credits. S-U grades optional. T 2:00–4:25. N. Assié-Lumumba.

Distance learning is increasingly being adopted to respond to the high demand for education in developing countries. This course critically analyzes distance education for the general population as well as specific social and professional categories. A typology of the ICTs (information and communication technologies) used and the different forms of virtual leaning institutions are examine. Case studies include single-mode and dual-mode institutions in Africa, Asia, and Latin American countries and also eLearning programs designed in industrial countries for developing countries.

EDUC 494(4940) Special Topics in Education

Fall or spring. 4 credits max. S-U grades optional. Staff.

The department teaches "trial" courses under this number. Offerings vary by semester, and will be advertised by the department before the semester starts. Courses offered under this number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

EDUC 497(4970) Individual Study in Education

Fall or spring. 1–3 credits. S-U grades optional. Students must register using independent study form (available in 140 Roberts Hall). Staff.

A student may, with approval of a faculty adviser, study a problem or topic not covered in a regular course or may undertake tutorial study of an independent nature in an area of educational interest.

EDUC 498(4980) Undergraduate Teaching

Fall or spring. 1 or 2 credits; 4 credits max. during undergraduate career. Prerequisite: GPA of at least 2.7. S-U grades optional. Students must register using independent study form (available in 140 Roberts Hall). Staff.

Participating students assist in teaching a course allied with their education and experience. Students are expected to meet regularly with a discussion or laboratory section, to gain teaching experience, and regularly to discuss teaching objectives, techniques, and subject matter with the professor in charge.

EDUC 499(4990) Undergraduate Research

Fall or spring. 6 credits max. during undergraduate career. Not open to students who have earned 6 or more undergraduate research credits elsewhere in the college. Prerequisite: junior or senior standing; GPA at least 2.7. Students must register using independent study form (available in 140 Roberts Hall). Staff.

Affords opportunities for students to carry out independent research under appropriate supervision. Each student is expected to review pertinent literature, prepare a project outline, conduct the research, and prepare a report.

EDUC 502(5020) Education and Development in Africa (also AS&RC 502[5020])

Spring. 3 credits; 4 in College of Arts and Sciences. S-U grades optional. T 2:00–4:25. N. Assié-Lumumba.

Examines the relationship between education and individual and national development. Besides human capital theory, different paradigms of development, including modernization and dependency theories, and Third World Forum, are examined. Issues discussed include schooling and nonformal education; the role of primary, secondary, and higher education in development; nd the issues related to employment, national migration and international brain drain, language, equity in access, output, and outcome based on social class, ethnicity, race, gender, and nationality. Finally, the information and communication technologies (ICTs), indigenous knowledge systems, and the role of higher education in the national, regional, and international contexts and cooperation are discussed.

EDUC 503(5030) Diversity in the Classroom

Fall, spring, or summer. 1 credit for each seminar. Prerequisite: admission to CTE program. S-U grades optional. Disc, TBA. S. Kroma.

Builds on knowledge of literacy and diversity gained from course work and field activities in the CTE program. Students review literacy development, cultural diversity, learning style preferences, fieldwork experiences, and strategies for accommodating difference in teaching.

EDUC 504(5040) Research Experience for Teachers (also PL BR/BIO G 504[5040])

Spring. 3 credits. Prerequisites: appropriate science major, 6 credits education or educational psychology course work, and permission of instructor. Intended for, but not restricted to, students in M.A.T. degree program, practicing teachers, and students considering becoming teachers. S-U or letter grades. T. Fulton.

Students work in a laboratory with a research team for the semester. Research experiences are accompanied by weekly discussions and readings. Students explore how research is conducted, how formal scientific discourse and informal communication occur and differ, and how these topics can be conveyed during classroom teaching.

EDUC 523(5230) Food and Fiber Across the Curriculum

Summer, July 19–23, M–F (four overnights, on the road). 1–3 credits; offered at graduate level for 1–3 credits; 1 credit granted for satisfactorily completing course. Additional credits require completion of special project agreed on by instructor. Expenses for food and incidentals are responsibility of participants; lodging, course materials, and transportation provided. W. Camp.

Intensive five-day course focusing on agriculture and food systems as a classroom on wheels. Designed to help teachers, administrators, graduate students, extension agents, and other educators understand the complexity of the agriculture and food system. Students travel throughout upstate New York visiting farms of all types, forests, food processors, food retailers, and agriculture research and education centers. Participants explore agriculture, global and local food systems, issues of sustainability, environment and natural resources, and careers in agriculture. Students visit all aspects of the food and fiber system and explore a variety of marketing and distribution models. The integration of agriculture and food systems into the core disciplines of math, science, English, language arts, social studies, the arts, family and consumer sciences, health, physical education, technology, and career exploration—while meeting all the State Learning Standards at the local level—is a course priority.

EDUC 532(5320) Educational Programs in Agricultural Science

Fall. 3 credits. R 3–5:25. W. Camp.

Overview of the organization and planning processes necessary to operate a successful agricultural science education program in the public schools. Topics include local needs assessments, agricultural advisery boards, community-partnering strategies, program planning, course development, sequencing instruction, professional development. Fieldwork provides experience with New York agricultural education students, teachers, and programs.

EDUC 548(5480) Effective College Teaching

Spring. 1–3 credits. S-U grades optional. T 5–7. D. Way.

Designed to help participants become more effective college teachers. Examines the basic principle of learning, identifies different learning styles, and explores a variety of teaching techniques, methods, and technologies. Participants also learn how to design a course and improve their effectiveness as teachers.

EDUC 571(5710) Social and Political Context of American Education
Fall. 3 credits. Prerequisites: admission to Cornell Teacher Education Program or permission of instructor. T R 1:25–2:40. J. W. Sipple.
Examines the goals, roles, inputs, and outcomes of schooling in American society, and the policy environment in which schools operate. Analyzes controversies and tensions (e.g., equity, market forces, state control) surrounding public education at local, state, and federal levels. Includes current and historical, urban and rural issues and problems.

EDUC 578(5780) International Teaching Assistant Development Program (ITADP) Training Course: Cross-Cultural Classroom Dynamics, Pronunciation, and Language, Video Teaching Practicum
Fall and spring. 2 credits. S-U grades only. TBA. ITADP staff.
Designed for first-time international teaching assistants from countries in which English is not the primary language. Focuses on three areas: cross-cultural classroom dynamics, video teaching practicum, and language—enhancing communicative competence in English. Through small-group seminars and individual conferences, the ITADP helps international teaching assistants develop their linguistic and pedagogical skills as they gain sensitivity to the dynamics of U.S. classrooms.

EDUC 579(5790) Further Training for International Teaching Assistants
Fall, spring, summer. 2 credits. Prerequisite: EDUC 578. S-U grades optional. Lec, TBA: 3 contact hours per week. ITADP staff.
Designed for international teaching assistants from countries in which English is not the primary language and who have completed EDUC 578, the ITADP follow-up course provides further instruction and practice in oral English and pedagogical skills.

EDUC 601(6010) Secondary Agriculture, Science, and Mathematics Teaching Practicum
Fall or spring. 6 credits. Prerequisite: graduate students enrolled in Teacher Education in Science and Mathematics Program; permission of instructor. S-U grades only. M T W R F 8:00–3:00. S. C. Piliero, D. J. Trumbull, B. A. Crawford, and W. Camp.
Supervised student teaching in agriculture, mathematics or science at the secondary level. Program includes teaching in a local school for 14 weeks.

EDUC 602(6020) Practicum Seminar
Fall or spring. 9 credits. Co-requisite: EDUC 601 or permission of instructor. M T W R F 9:00–3:00. W. Camp, B. A. Crawford, D. J. Trumbull, and S. C. Piliero.
Begins with full-day sessions of intensive consideration of theoretical frameworks relevant to all aspects of student teaching. Assignments and an online seminar during the semester require students to use those theories to develop and evaluate teaching materials and practices. Students complete an extensive portfolio documenting their work.

EDUC 603(6030) Inquiry Science Outreach in Secondary Schools (also NTRES 603[6030])
Fall or spring. 1 credit. Prerequisite: recipients of fellowship from Cornell Science Inquiry Partnerships (CSIP) program. S-U grades. N. Trautmann, L. Tompkins, and M. Krasny.
Prepares graduate students who receive Cornell Science Inquiry Partnerships fellowships for outreach work in high school and middle school science classes. Participants explore effective strategies for inquiry-based learning and review core educational issues such as learning standards, working with students of various ability levels, and assessing student learning.

EDUC 614(6140) Gender, Context, and Epistemological Development (also FGSS 624[6240])
Fall. 3 credits. S-U grades optional. T 12:20–2:15. D. E. Schrader.
Insight into how individuals make sense of knowledge is essential to teaching and learning. This course examines theories of personal epistemology and their implications for educating students across the life span. Places particular emphasis on the role of gender and contextual influences on the development of thought and on metacognitive development.

EDUC 620(6200) Internship in Education
Fall or spring. 1–6 credits. S-U grades optional. Each student, before course enrollment, must obtain approval of faculty member who will assume responsibility for supervising work. Staff.
Opportunity for practical experience in educational professions development.

EDUC 621(6210) Work-Experience Coordinator Certification Course I
Summer. 3 credits. Prerequisite for EDUC 622. S-U grades optional. Staff.
First of a two-course sequence designed to develop the competencies needed for certification as a coordinator of diversified cooperative work experience programs. Focuses on the history and philosophy, types, operation, and evaluation of work-experience programs including articulation with JPTA and VESID. Requires field interviews.

EDUC 622(6220) Work-Experience Coordinator Certification Course II
Summer. 3 credits. Prerequisite: EDUC 621. Staff.
Second course for certification as a diversified cooperative work experience coordinator combines course work and directed field experience leading to the planning, development, and approval of a work-experience program in a local educational agency. Development of a philosophy and policy statement, budget, curriculum for related instruction, annual work plan by function, promotional materials, and all program forms for Board of Education approval required.

EDUC 630[6300] Special Problems in Agricultural, Extension, and Adult Education
Fall or spring; may also be offered in summer. 1–3 credits. S-U grades optional. Staff.
Provides an opportunity for graduate-level study of individually selected problems and issues in agricultural, extension, and adult education.

[EDUC 632[6320] Teaching Agricultural, Extension, and Adult Education
Summer. 3 credits. Prerequisite: introductory teaching methods course or permission of instructor. Staff.
Focuses on the selection, use, and evaluation of methods and materials for teaching. Covers methods for group and informal instruction. Provides an opportunity for students to develop teaching competence based on their individual needs and interests. Develops self-evaluation skills. Class project on the development of instructional materials required.]

EDUC 633(6330) Program Planning in Adult and Extension Education
Spring. 3 credits. S-U grades optional. Lec, R 4–6:30. Offered alternate years beginning spring 2006. A. Wilson.
Examines current social and economic conditions affecting agricultural, extension, and adult education. Applies principles, objectives, strategies, and sources of information to program planning. Participants have an opportunity to observe ongoing programs in agricultural, extension, and adult education and to pursue individual interests in program development and improvement.

[EDUC 635(6350) Experiential Learning
Fall. 2 credits. Prerequisite: for undergraduates, permission of instructor. S-U grades optional. T 12:20–2:15. Not offered 2004–2005. Staff.
Participants explore various dimensions of scholar and practitioner thinking about the understanding and practice of experiential learning. Theoretical perspectives on experiential education, reflective practice, and a critical learning systems perspective are explored through readings and applied assignments. The instructor introduces methods of facilitation designed to encourage inquiry and dialogue for improvement of both nonformal and formal educational activities. The course process is intended to engage participants in reflective dialogue—nurturing emergence of learning community elements.]

[EDUC 645(6450) Curriculum for a Diverse and Technological Society
Spring. 3 credits. Letter grades only. Disc, TBA. Staff.
Examines basic curriculum concepts, principles, and theories. Gives special emphasis to the ways diversity and technology drive changes in the development of curriculum. Each student chooses a particular curriculum for analysis as a project. Within that context, theoretical perspectives on curriculum and the basic elements of any curriculum are discussed.]

EDUC 661(6610) Administration Leadership and Organizational Change
Fall. 3 credits. T 3:35–6:00. J. W. Sipple.
Perspectives on the administration of educational organizations. Considers social science, legal and ethical theories, and their application to both public schools and higher education. Intended for students who are considering careers as educational administrators, as well as for those who want to further their understanding of educational organizations.

EDUC 671(6710) American School Reform: Organizational and Sociological Perspectives
Spring. 3 credits. S-U grades optional. Lec, M 1:55–4:25. J. W. Sipple.
For individuals interested in the role of schools in society and in organizational behavior and public policy. This seminar investigates the sociological functions of schooling, including the stability of school organization given the long history of policy initiatives designed to reform schools. The focus is American K–12 public education, though issues of pre-K, private, and post-secondary education are covered.

EDUC 680(6800) Foundations of Adult and Extension Education
Fall. 3 credits. Limited to 20 students. S-U grades optional. R 4–6:30. Offered alternate years beginning fall 2005. A Wilson.
Analysis of alternative purposes, nature, and scope of extension, adult, and continuing education programs in the United States and abroad, with emphasis on the relationship of programs to historical, cultural, political, and social settings. Examines definitions, conceptual controversies, philosophical issues, and current research directions through a seminar approach.

EDUC 682(6820) Community Education and Development
Fall. 3 credits. Limited to 25 students. Letter grades only. W 1:25–4:25. S. Peters.
Critical study of the democratic purposes and practices of educators in community and economic development, with a special focus on the role of education in community organizing. Key philosophies and traditions of community education and development are analyzed in their historical, cultural, social, and political context, with an eye toward implications for contemporary practice.

EDUC 683(6830) Adult Education and Globalization: Comparative Perspectives
Spring. 3 credits. S-U grades optional. T 1:25–3:55. M. Kroma.
Examines the interconnections between particular economic and political systems as key to understanding the relationships of adult education to society. Employing a critical framework, the course explores emerging local, regional and national responses in adult education that are planting seeds of change and creativity in ways that are nurturing new forms of educational life in the context of globalization. Particular attention is paid to modes of social analyses that explore the relationship between adult education and social structural factors, including gender, race and class, to inform a sense of place and social location.

EDUC 685(6850) Training and Development: Theory and Practice (also IARD 685[6850])
Spring. 4 credits. S-U grades optional. F 9:05–12:05. M. Kroma.
Prepares professionals to design, administer and facilitate training programs responsive to the challenges of sustainability in our world system. Focuses on the theory and practice of training for the development of human resources in small farm agriculture, rural health and nutrition and literacy. Through in-depth discursive critiques of selected readings, students develop insights into the range of methods and strategies employed in situation analysis, the analysis of socioeconomic, sociocultural, and sociopolitical contexts of training programs; facilitation of participatory training programs for the development of human resources in small holder agriculture, rural health and nutrition, and community building. The specific role of training/education in larger change-promoting systems is also explored. The course is appropriate for persons likely to be playing professional roles as educator-trainers, scientists, administrators, and social organizers in rural and agricultural development programs in international as well as domestic contexts.

EDUC 694(6940) Special Topics in Education
Fall, spring, or summer. 1–3 credits. Prerequisite: permission of instructor. S-U grades optional. Staff.
Topics TBA.

EDUC 700(7000) Directed Readings
Fall or spring. 6 credits, variable. Prerequisite: graduate standing; permission of instructor. S-U grades optional. Staff.
For study that predominantly involves library research and independent study.

EDUC 701(7010) Empirical Research
Fall or spring. 6 credits, variable. Prerequisite: graduate standing; permission of instructor. S-U grades optional. Staff.
For study that primarily involves collection and analysis of research data.

EDUC 702(7020) Practicum
Fall or spring. 6 credits, variable. Prerequisite: graduate standing; permission of instructor. S-U grades optional. Staff.
For study that predominantly involves field experience in community settings.

EDUC 703(7030) Teaching Assistantship
Fall or spring. 6 credits, variable. Prerequisite: graduate standing; permission of instructor. S-U grades optional. Staff.
For students assisting faculty with instruction. Does not apply to work for which students receive financial compensation.

EDUC 704(7040) Research Assistantship
Fall or spring. 6 credits, variable. Prerequisite: graduate standing; permission of instructor. S-U grades optional. Staff.
For students assisting faculty with research. Does not apply to work for which students receive financial compensation.

EDUC 705(7050) Extension Assistantship
Fall or spring. 6 credits, variable. Prerequisite: graduate standing; permission of instructor. S-U grades optional. Staff.
For students assisting faculty with extension activities. Does not apply to work for which students receive financial compensation.

[EDUC 714(7140) Moral Development and Education
Spring. 3 credits. S-U grades optional. T 12:20–2:15. D. E. Schrader.
Seminar exploring moral psychology from cognitive developmental, social contextual, normative, and feminist perspectives. Topics vary by semester, yet all semesters discuss theoretical and empirical studies of the development of moral reasoning, gender differences, cultural context, the relationship between moral judgment and moral action, the development of the self in relation to others and to society, and moral education. Emphasis is on development in adolescence through adulthood.]

EDUC 718(7180) Adult Learning and Development
Spring. 3 credits. Prerequisite: permission of instructor. S-U grades optional. W 2–4:25. Staff.
Deals with adult development and learning from points of view of educational psychology, sociology, and adult education. Draws inferences from theory and research to the practice of adult and extension education. Appropriate for graduate students in adult and extension education and community service education, and for others interested in adult learning and development.

[EDUC 730(7300) Seminar in Agricultural, Extension, and Adult Education
Spring. 3 credits. S-U grades optional. R 8–9:55. S. Peters.
Emphasizes current problems and research in agricultural, extension, and adult education. Includes discussion and analysis of student and staff research.]

EDUC 762(7620) Comparative and International Education
Fall. 3 credits. S-U grades optional. M 2–4:25. N. Assie-Lumumba.
Seminar that critically analyzes education conceived both as a universal social institution and a reflection of cultural, economic, and political dynamics of the local and global contexts. The analysis focuses on policies, organization, and the functioning of education in industrial, new/emerging economies, and developing countries. Specific case studies are drawn from different countries.

EDUC 783(7830) Farmer-Centered Research and Extension (also IARD 783[7830])
Fall. 3 credits. S-U grades optional. M. Kroma.
Forum for discussion and critical analyses of participatory research and extension approaches in agriculture and natural resource management in the complex and diverse environments characteristic of many developing countries. Theoretical and philosophical arguments that underpin participatory research and extension, as well as current tools and techniques for facilitating participation and social learning are examined. Case studies and individual projects related to farmer-centered research and extension provide a focus for analyses. The course also explores and pays special attention to the challenges and opportunities related to institutionalization of participatory research and extension for sustainable agriculture and natural resource management.

EDUC 800(8900) Master's-Level Thesis Research
Fall or spring. Credit TBA. Each student, before course enrollment, must obtain approval of faculty member who will assume responsibility for guiding work. S-U grades optional. Times TBA. Staff.

EDUC 900(9900) Doctoral-Level Thesis Research
Fall or spring. Credit TBA. Each student, before course enrollment, must obtain approval of faculty member who will assume responsibility for guiding work. S-U grades optional. Times TBA. Staff.
Doctoral or other research and development projects for Ph.D. students.

ENTOMOLOGY

J. P. Nyrop, chair (2130 Comstock Hall, 255-7723); A. M. Agnello, A. Agrawal, N. W. Calderone, B. N. Danforth, A. DiTommaso, T. Eisner, G. M. English-Loeb, J. Ewer, P. P. Feeny, C. Gilbert, A. E. Hajek, L. C. Harrington, G. W. Hudler, B. P. Lazzaro, J. K. Liebherr, C. Linn, J. E. Losey, M. Luckow, D. Pimentel, L. S. Rayor, J. P. Sanderson, J. G. Scott, E. J. Shields, J. S. Thaler, W. M. Tingey, P. A. Weston

Courses by Subject

Apiculture: 260, 264
Behavior: 215, 315, 325, 394, 471, 662
Conservation: 344
Ecology: 369, 452, 455, 470, 672
Introductory courses: 201, 210, 212, 215, 241
Medical and veterinary entomology: 210, 352, 652
Morphology: 322
Pathology: 463, 670
Pest management: 241, 277, 441, 443, 444, 477, 644, 670
Physiology, development, and toxicology: 370, 394, 400, 483, 490, 685
Systematics: 331, 333, 453, 634, 635

Note: Class meeting times are accurate at the time of publication. If changes occur, the department will provide new information as soon as possible. Check the web site for updates.

ENTOM 201(2010) Alien Empire: Bizarre Biology of Bugs
Spring. 2 credits. Limited to 100 students. S-U grades optional. Lec, T R 9:05; optional field trips, required lab demonstrations. B. N. Danforth.
Insects are the most abundant and diverse animals on earth. This course explores the bizarre biology of insects by examining their evolutionary history, anatomy, development, feeding habits, life-history strategies, behavior, and their interactions with humans (both positive and negative) through history. Optional field trips and one open lab provide hands-on opportunities for examining these amazing animals.

ENTOM 210(2100) Plagues and People
Fall. 2 or 3 credits. Prerequisites: introductory biology or permission of instructor. Lec, M W F 2:30–3:20. Offered alternate years; not offered 2006–2007. L. C. Harrington.
Human diseases transmitted by insects and related forms (arthropods) have affected human lives and society through history. This course focuses on the pathogens, parasites, and arthropods causing human plagues. Those plagues that have had the greatest impact on human culture and expression are emphasized. Lectures are supplemented with readings and films. Also addresses emerging diseases, bioterrorism, and future plagues. Students taking the course for 3 credits participate in readings, presentations/discussions each week (on Fridays), weekly readings quizzes, and have a comprehensive final project.

ENTOM 212(2120) Insect Biology
Fall. 4 credits. Pre- or co-requisites: BIO G 101–102 or equivalent. Lec, T R 11:15–12:05; lab, T W or R 1:25–4:25. Lab fee: $38. J. P. Sanderson.
Introduces the science of entomology by focusing on basic principles of systematics, morphology, physiology, behavior, and ecology of insects. The laboratory in early fall includes field trips to collect and study insects in the natural environment. Requires a collection emphasizing ecological, behavioral, and taxonomic categories.

ENTOM 215(2150) Spider Biology: Life on a Silken Thread
Fall. 2 credits. Prerequisite: introductory biology or permission of instructor. S-U grades optional. Lec, W F 1:25–2:15. L. S. Rayor.
Introduction to the fascinating world of spiders. Explores evolution, ecology, behavior, and physiology of spiders and their close kin from a modern perspective. Topics include identification of major spider families, spiders' unique use of silk, risky courtship, predatory behavior, diverse life styles, social spiders, and potential use in IPM.

ENTOM 241(2410) Insect Pest Management for Practitioners
Spring. 3 credits. Limited to 18 students. Prerequisites: BIO G 101–102 or equivalent. Lec, T R 10:10–11; lab/disc, T 12:20–3:15. W. M. Tingey.
Introduction to insect pest management in plant or animal protection for those preparing for careers in extension, service, and production. Emphasizes pest monitoring, sight identification, diagnosis, decision-making, and management tactics for the major groups of insect and arthropod pests affecting field, forage, and vegetable crops; floriculture, woody ornamentals, and turf; urban environments and public health; veterinary, dairy, livestock, and poultry. Five off-campus laboratory field trips with demonstrations of pest management decision-making, pest-monitoring tools, and pesticide-application equipment.

[ENTOM 260(2600) Introductory Beekeeping
Fall. 2 credits. Lec, T R 11:15–12:05. Offered alternate years; not offered 2006–2007. N. W. Calderone.
Introduces students to the life history, physiology, and behavior of honey bees, as well as to the fundamentals of practical beekeeping. Reviews classical and contemporary research on the dance language, chemical communication, behavioral genetics, division of labor, and evolution of social behavior. Also includes lectures on pollination of agricultural crops, honey and beeswax, bees in ancient and modern rituals, Africanized honey bees, and insect politics.]

[ENTOM 264(2640) Practical Beekeeping
Fall. 1 credit. Limited to 20 students. Pre- or co-requisite: ENTOM 260. Lab, R 2–4:25. Offered alternate years; not offered 2006–2007. N. W. Calderone.
Consists of 14 laboratory sessions that acquaint students with practical methods of colony management. Laboratories involve hands-on work with honey bee colonies and equipment. Topics include management of bees for apple pollination, honey harvesting and processing, and disease identification/control. The class makes a number of field trips to commercial beekeeping operations. Students conduct simple experiments to demonstrate color perception by bees, as well as the chemical basis for swarming, nest guarding, and mating.]

ENTOM 277(2770) Natural Enemies: An Introduction to Biological Control
Spring. 2–3 credits. S-U grades optional. Lec, T R 1:25–2:15; lab, demonstration; optional field trip. Optional disc session for 1 credit. A. E. Hajek and J. P. Nyrop.
Introduces students to the dynamic field of biological control: What it is, when should it be used, and how to use it safely. This course covers a diversity of types of biological control, including use of parasitoids, predators, pathogens and antagonists to control pests form microbes to weeds to invertebrates and vertebrates. This course is intended for students curious about the biology and ecology of these organisms and their practical use. Students are not allowed to take both ENTOM 277 and ENTOM 377 for credit.

ENTOM 315(3150) Spider Biology
Fall. 3 credits. Prerequisite: introductory biology or permission of instructor. Letter grades only. Lec, M W F 1:25–2:15. L. S. Rayor.
In-depth introduction to the fascinating world of spiders and their relatives. Meets concurrently with ENTOM 215 (2 credits). Students in ENTOM 315 meet for another hour with additional coverage of current topics in arachnology and developing spider identification skills. Entomology majors and biology majors in the Insect Biology Program of Study should take ENTOM 315 rather than 215. Students may not take both ENTOM 215 and 315 for credit.

[ENTOM 322(3220) Comparative Insect Morphology
Spring. 4 credits. Prerequisite: ENTOM 212 or 241. Lec, T R 9:05–9:55; lab, T R 1:25–4:25. Offered alternate years; not offered 2005–2006; next offered 2006–2007. B. N. Danforth.
Provides a detailed introduction to the external and internal anatomy of insects. Lectures introduce basic concepts in insect morphology, such as the organization of the insect body plan and organ systems, functional morphology, homology, phylogeny, modularity, and development. The lab introduces students to the basic methods of insect microdissection, specimen preparation, and scientific illustration. High-quality, publishable illustrations are produced based on student artwork.]

[ENTOM 325(3250) Insect Behavior
Spring. 3 credits. Prerequisite: introductory biology and either ENTOM 212 or BIONB 221. Lec, T R 10:10–11:25. Offered alternate years; not offered 2005–2006; next offered 2006–2007. L. S. Rayor.
Insects are the most diverse organisms on earth, with equally diverse behavior. This course explores the behavior of insects, ranging from the individual sensory and physiological mechanisms that are the basis of insect behavior, to the behavioral dynamics of foraging, courtship, parental care, and social behavior. Topics include insect learning, perceptual abilities, host finding strategies, predation, pollination, and examination of current issues in insect behavior.]

[ENTOM 331(3310) Introductory Insect Systematics
Spring. 4 credits. Prerequisite: ENTOM 212. Lec, T R 12:20–1:10; lab, T R 1:25–4:25. Lab fee: $50. Offered alternate years; not offered 2005–2006; next offered 2007–2008. Staff.
Introduction to the classification, evolutionary history, and distribution of insects. Includes

lab practice in the identification of orders, families, and representative genera of insects; methods of collection, preservation, and study. Lectures cover theory and practice of insect systematics and major features of insect evolution. Insect collections required.]

ENTOM 333(3330) Maggots, Grubs, and Cutworms: Larval Insect Biology
Spring. 3 credits. Prerequisites: ENTOM 212 or permission of instructor. S-U grades optional. Lec, T R 11:15–12:05; lab, T 1:25–4:25. Offered alternate years; not offered 2006–2007. J. K. Liebherr.
The evolutionary history of the Holometabola has been greatly informed by attributes of their larvae. This course introduces students to the biology, anatomy, and natural history of holometabolous insect larvae. The lab includes field sampling, curation of field-collected specimens, and identification of unknowns. Development of a small larval collection required.

ENTOM 335(3350) Naturalist Outreach in Biology

ENTOM 344(3440) Insect Conservation Biology
Spring. 3 credits. Prerequisite: entomology or conservation biology course or permission of instructor. S-U grades optional. Lec, T R 10:10–11:25. Offered alternate years; not offered 2006–2007. J. E. Losey.
In-depth look at the concepts and issues surrounding the conservation of insects and other invertebrates. Topics include sampling rare populations; insect conservation genetics; the role of phylogeny in determining conservation priorities; refuge design; saving individual species; plus the unique political, social, and ethical aspects of insect conservation and preservation of their ecological services (i.e., pollination, decomposition, pest suppression, and insectivore food sources).

[ENTOM 352(3520) Medical and Veterinary Entomology
Fall. 4 credits. Prerequisites: BIO G 101–102 or permission of instructor. S-U grades optional. Lec, T R 10:10–11; lab, R 1:25–4:25. Offered alternate years; not offered 2005–2006; next offered 2006–2007. L. C. Harrington.
Diseases resulting from arthropod-borne pathogens (such as malaria, dengue, and yellow fever) cause considerable human and animal suffering and death worldwide. This course explores the impact of vector-borne disease and provides a comprehensive overview of the fields of medical and veterinary entomology. The goal is to encourage an understanding of evolutionary and ecological issues associated with disease transmission. The laboratory includes field trips, collection and identification of arthropods of medical/veterinary importance, and hands-on experience with modern laboratory research methods. Undergraduate and graduate students from entomology as well as other disciplines including pre-medical and veterinary students are encouraged to enroll.]

ENTOM 369(3690) Chemical Ecology (also BIOEE/BIONB 369[3690])
Spring. 3 credits. Prerequisites: one semester of introductory biology for majors or nonmajors and one semester of introductory chemistry for majors or nonmajors or equivalents, or permission of instructor. S-U grades optional. Lecs, M W F 11:15–12:05. A. Agrawal, G. Jander, A. Kessler, and J. Thaler.
Why are chilies so spicy? This course examines the chemical basis of interactions between species and is intended for students with a basic knowledge of chemistry and biology. Focuses on the ecology and chemistry of plants, animals, and microbes. Stresses chemical signals used in diverse ecosystems, using Darwinian natural selection as a framework. Topics include: plant defenses, microbial warfare, communication in marine organisms, and human pheromones.

[ENTOM 370(3700) Pesticides, the Environment, and Human Health (also TOX 370[3700])
Fall. 2 credits. Prerequisites: BIO G 101–102 or equivalent. Lec, T R 9:05. Offered alternate years; not offered 2005–2006; next offered 2006–2007. J. G. Scott.
Survey of the different types of pesticides, their uses, properties, and effects on the environment. Discusses the risks, benefits, regulation, politics, and current controversies associated with pesticide use and genetically modified crops.]

ENTOM 394(3940) Circadian Rhythms (also BIOGD/BIONB/PL PA 394[3940])
Fall. 2 credits. Prerequisite: 200-level biology course. S-U grades optional. Lec, T 10:10–11:50. K. Lee (fall, even years) and J. Ewer (fall, odd years).
Explores a fundamental feature of living organisms from all kingdoms: how the cellular 24-hour biological clock operates and influences biological activities. Covers fundamental properties of biological rhythms and cellular and molecular structure of circadian oscillators in many organisms, including cyanobacteria, fungi, insects, plants, reptiles, birds, and mammals (including humans).

ENTOM 400(4000) Insect Development (also BIOGD 402[4020])
Spring. 4 credits. Prerequisite: ENTOM 212 or BIOGD 281 or permission of instructor. S-U grades optional. Lec, M W 11:15–12:05; lab, M 12:20–3:20; disc, F 11:15–12:05. Offered alternate years; not offered 2006–2007. J. Ewer.
Emphasizes the mechanisms that underlie embryonic and post-embryonic developmental processes of insects. The portion of the course on embryonic development leans heavily on knowledge obtained from *Drosophila* but also covers more classical studies as well as recent advances exploring the molecular basis for the evolution of body plan. The post-embryonic development portion covers the control of growth, molting, and metamorphosis. The lab uses modern techniques to illustrate developmental events at the organismal and cellular level. The discussion section involves the analysis and presentation of primary research papers.

[ENTOM 443(4430) Entomology and Pathology of Trees and Shrubs (also PL PA 443[4430])
Fall. 4 credits. Prerequisites: ENTOM 212 or equivalent and PL PA 241 or equivalent. S-U grades optional. Lec, M W F 11:15–12:05; lab, F 1:25–4:25; evening prelims. Offered alternate years; not offered 2005–2006; next offered 2006–2007. P. A. Weston and G. W. Hudler.
For students preparing for careers in horticulture, urban forestry, pest management, and natural history/science education. Deals with the nature, diagnosis, assessment, and management of insect and disease pests on trees and shrubs in forests, urban landscapes, Christmas tree plantations, and other sites where intensive pest management is practiced.]

ENTOM 444(4440) Integrated Pest Management (also CSS 444[4440])
Fall. 4 credits. Prerequisite: introductory biology or permission of instructor. Lec, M W F 9:05–9:55; lab, M 1:25–4:25. J. E. Losey and A. DiTommaso.
Lectures integrate the principles of pest control, ecology, and economics in the management of pests across multiple systems. Labs consist of exercises to reinforce concepts presented in lecture and demonstrate pest monitoring techniques and the application of computer technology to management problems.

[ENTOM 452(4520) Herbivores and Plants: Chemical Ecology and Coevolution (also BIOEE 452[4520])
Spring. 3 credits. Prerequisites: one year introductory biology; BIOEE 261; CHEM 257 or 357/358 and 251 or 301; or permission of instructor. Lec, M W F 11:15–12:05. Offered alternate years; not offered 2005–2006; next offered 2006–2007. P. P. Feeny.
Significance of plant chemistry in mediating interactions between plants and herbivorous animals; mechanisms and strategies of plant finding and exploitation by animals, especially insects, and of defense and escape by plants; evolutionary hypotheses for ecological patterns of resistance and attack; implications for human food and agriculture.]

ENTOM 453(4530) Principles and Practice of Historical Biogeography (also BIOPL 453[4530])
Fall. 3 credits. Prerequisite: systematics course or permission of instructor. S-U grades optional. Lec, T R 10:10–11; lab, T 1:25–4:25. Offered alternate years, not offered 2006–2007. J. K. Liebherr and M. Luckow.
Survey of techniques in historical biogeography, and the development of modern biogeographic theory in the context of classical, ecological, and phylogenetic analytical methods. Presents geological and paleontological aspects of biogeography and discusses large-scale biogeographic patterns. Labs focus on computer applications and discussion of controversial issues.

ENTOM 455(4550) Insect Ecology (also BIOEE 455[4550])
Fall. 3 credits. Recommended: ENTOM 212 or BIOEE 261 or permission of instructor. S-U grades optional. Lec, T R 9:05–9:55; lab, T 1:25–4:25. Offered alternate years; not offered 2006–2007. J. S. Thaler.
Focuses on individual and population aspects of insect ecology as well as some topics in community and ecosystem ecology. Sresses the importance of interactions with the biotic and abiotic environment stressed. Laboratory includes indoor and outdoor field trips illustrating the major concepts in insect ecology as well as experimental techniques.

ENTOM 463(4630) Invertebrate Pathology
Spring. 4 credits. Prerequisites: one year introductory biology. S-U grades optional. Lec, M W F 9:05–9:55; lab, W 1:25–4:25. Offered alternate years; not offered 2006–2007. A. E. Hajek.

Lecture presents principles of pathology as applied to invertebrates. Topics include noninfectious and infectious diseases caused by viruses, bacteria, fungi, protozoa, and nematodes, epizootiology of insect diseases, and use of pathogens for control. Lab involves a diversity of pathogens and hosts using techniques such as microinjection, electrophoresis, immunoassay, density gradient centrifugation, soil extraction, and computer simulation.

[ENTOM 470(4700) Ecological Genetics
Spring. 3 credits. Prerequisites: BIOEE 278 or permission of instructor. S-U grades optional. Offered alternate years; next offered 2006–2007. Lec, T R 11:40–12:55. B. P. Lazzaro.
Focuses on the application of population genetic concepts in ecological or applied contexts. Emphasizes measuring adaptation in natural populations, detecting the effects of population demography, and determining the genetic basis of quantitative traits. Draws examples from primary research on animals and plants to illustrate experimental techniques and methods of data analysis on single-gene, multi-locus and genome-wide scales.]

[ENTOM 477(4770) Biological Control
Spring. 3 credits. Prerequisites: ENTOM 212, BIOEE 261, and permission of instructor. Lec, T R 9:05–9:50; lab, T 1:25–4:15. Offered alternate years; not offered 2005–2006; next offered 2006–2007. J. Nyrop and A. Hajek.
Lectures present case studies exploring classical biological control, augmentation and conservation, and applications of strategies to control arthropods and weeds. Labs focus on selected concepts in more depth using live organisms.]

ENTOM 483(4830) Insect Physiology
Fall. 4 credits. Prerequisite: ENTOM 212 or permission of instructor. Lec, M W F 11:15–12:05; lab, W 1:25–4:25 disc, TBA. Offered alternate years; not offered 2006–2007. C. Gilbert.
Introduction to the often unique ways in which insects have met their basic needs. Examines each organ system with emphasis on basic principles and specific examples. Also introduces students to some common methods used in physiological research and to the critical reading of scientific literature.

[ENTOM 490(4900) Toxicology of Insecticides (also TOX 490[4900])
Spring. 3 credits. Prerequisite: general chemistry course. S-U grades optional. Lec, M W F 9:05–9:55. Offered alternate years; not offered 2005–2006; next offered 2006–2007. J. G. Scott.
History, metabolism, and mechanism of action of genetically modified, synthetic, and naturally occurring insecticides. Discusses insecticide resistance, resistance management, and new approaches to insect control with genetically modified organisms.]

ENTOM 494(4940) Special Topics in Entomology
Fall or spring. 4 credits max. S-U grades optional. Staff.
The department teaches "trial" courses under this number. Offerings vary by semester, and are advertised by the department before the semester starts. Courses offered under the number will be approved by the department curriculum committee, and the same course is not to be offered more than twice under this number.

ENTOM 497(4970) Individual Study in Entomology
Fall or spring. Credit TBA. Prerequisite: permission of instructor. Students must register using independent study form (available in 140 Roberts Hall). Staff.

ENTOM 498(4980) Undergraduate Teaching
Fall or spring. Credit TBA. Prerequisite: permission of instructor. Students must register using independent study form (available in 140 Roberts Hall). Staff.
Undergraduate teaching assistance in an entomology course by agreement with the instructor. Participating students assist in teaching a course allied with their education and experience. Students are expected to meet regularly with a discussion or laboratory section, to gain teaching experience, and regularly to discuss teaching objectives, techniques, and subject matter with the professor in charge.

ENTOM 634(6340) Special Topics in Systematic Entomology
Fall or spring; on demand. 2–4 credits. Prerequisite: permission of instructor. Staff.
Lectures on the classification, evolution, and bionomics of selected taxa, with accompanying laboratory studies on identification and comparative morphology. Collections sometimes required.

ENTOM 635(6350) Insect Molecular Systematics
Spring. 2 credits. Prerequisite: permission of instructor. Times TBA. Offered alternate years; not offered 2006–2007. B. N. Danforth.
Analysis of DNA sequence variation can provide a powerful tool for resolving problems in insect systematics, from species-level taxonomic decisions to higher-level (ordinal) relationships. This course introduces students, through readings of the primary literature, to the basic methods of insect molecular systematics, including DNA extraction, gel electrophoresis, PCR, DNA purification, and DNA sequencing (manual and automated). Results are analyzed using available computer programs. Students are encouraged to collect preliminary data for thesis or post-doctoral research.

ENTOM 644(6440) Advanced IPM: Theory and Implementation
Spring. 1–4 credits. Prerequisites: upper-level undergraduate or graduate standing; intermediate backgrounds in IPM. (In special cases, students with little or no background in IPM seeking intensive instruction on a specialized topic may enroll with permission of instructor.) S-U grades optional. Lec, M W F 10:10. Coordinator: J. E. Losey.
Rotating series of four-week intensive modules on specialized topics. Topics range from basic ecology and genetics of pests and their natural enemies to specific strategies for pest management implementation. Each module is a unique unit and students may take any or all modules each time the course is offered. Prerequisites and grading procedures are determined by the instructor(s) of each module. Potential modules include: Insecticide Resistance and Resistance Management—J. Scott: Entomology (Ithaca); Crop Protection Decision Making—J. Nyrop: Entomology (Geneva); Greenhouse and Floriculture IPM—J. Sanderson: Entomology (Ithaca); Agricultural Acarology—J. Sanderson: Entomology (Ithaca); Fruit Arthropod IPM Methods in New York—A. Agnello, G. English-Loeb: Entomology (Geneva); Plant Resistance—W. Tingey: Entomology (Ithaca); Aerial Sampling in Pest Management—E. Shields: Entomology (Ithaca); Conservation Biological Control—J. Nyrop and G. English-Loeb: Entomology (Geneva); Insect Population Ecology—J. Losey: Entomology (Ithaca); Veterinary Entomology—IPM Methods for New York—D. Rutz: Entomology (Ithaca); Chemical Conversations and Integrated Pest Management—C. Linn: Entomology (Geneva).

ENTOM 652(6520) Seminar in Medical Entomology
Fall. 1 credit. Prerequisite: permission of instructor or ENTOM 352. Disc, TBA. L. C. Harrington.
Addresses a variety of topics in the field of medical entomology. Weekly discussions of key papers on topics chosen by participating students and faculty.

[ENTOM 662(6620) Insect Behavior Seminar
Spring. 2 credits. Prerequisites: permission of instructor or ENTOM 212 and BIONB 221 or equivalents. S-U grades optional. Offered alternate years; not offered 2005–2006; next offered 2006–2007. Times TBA. C. Gilbert.]

[ENTOM 670(6700) Seminar on Biological Control
Fall. 1 credit. Prerequisite: ENTOM 463 or 644 or permission of instructor. S-U grades optional. Times TBA. Offered alternate years; not offered 2005–2006; next offered 2006–2007. A. E. Hajek.
Upper-level seminar series in biological control covering topics chosen by participating students and faculty. Weekly discussion groups with each participant presenting at least one oral report based on independent reading or research focusing on a central theme for the semester.]

[ENTOM 685(6850) Seminar in Insect Physiology
Spring. 1 credit. Prerequisite: permission of instructor. S-U grades optional. Times TBA. Offered alternate years; next offered 2006–2007. C. Gilbert.]

ENTOM 707(7070) Individual Study for Graduate Students
Fall or spring. Credit TBA. Prerequisite: permission of instructor. Not for thesis research. Staff.

ENTOM 709(7090) Teaching Entomology
Credit TBA. Staff.
Teaching entomology or for extension training.

ENTOM 767(7670) Current Topics in Entomology
Fall and spring. 1 credit. Requirement for first- and second-year entomology graduate students. S-U grades only. Staff.
After the Jugatae seminar, the students taking the course discuss the seminar and additional papers with the speakers from 4:30 to 5:30 in 2123 Comstock Hall.

ENTOM 800(8000) Master's-Level Thesis Research
Credit TBA. Prerequisite: permission of instructor. S-U grades optional. Staff.
Research at the master's level.

ENTOM 900(9000) Doctoral-Level Thesis Research
Credit TBA. Prerequisite: permission of instructor. S-U grades optional. Staff.
Research at the doctoral level.

Jugatae Seminar
Fall and spring.
Seminar conducted by Jugatae, the entomology club of Cornell University, to discuss topics of interest to its members and guests. All interested undergraduate and graduate students are encouraged to attend.

FOOD SCIENCE

J. H. Hotchkiss, chair (119 Stocking Hall, 255-7912); T. E. Acree, D. M. Barbano, C. A. Batt, K. J. Boor, J. W. Brady, D. P. Brown, J. M. Brown, R. B. Gravani, T. Henick-Kling, H. T. Lawless, C. Y. Lee, R. H. Liu, D. D. Miller, C. I. Moraru, S. J. Mulvaney, J. M. Regenstein, S. S. H. Rizvi, J. S. Roberts, K. J. Siebert, M. Wiedmann

Note: Class meeting times are accurate at the time of publication. If changes occur, the department will provide new information as soon as possible.

FD SC 101(1010) Science and Technology of Foods
Fall. 1 credit. S-U grades only. M 1:25–2:15. J. H. Hotchkiss and staff.
Explores the application of science and technology to foods. Lectures elucidate the role of engineering, biotechnology, chemistry, biochemistry, nutrition, toxicology, and microbiology in supplying the world with safe and nutritious food. An overview of food science as a discipline and career choice is given.

FD SC 102(1020) Exploring Food Processing
Spring. 1 credit. S-U grades only. F 12:20, five field trips; one F 12:30–4:00, four F 12:30–5:30. D. P. Brown.
Series of seminars on current technological and regulatory developments in food science. Field trips to five commercial food manufacturing/processing plants are used to illustrate the application of current technologies. A course project, using the Food Science Alumni Network, is required.

FD SC 150(1500) Food Choices and Issues
Spring. 2 credits. S-U grades optional. T R 12:20–1:10. R. B. Gravani and D. D. Miller.
Provides Cornell students with the knowledge needed to make healthy food choices. Topics include the U.S. food system; relationships between diet and health; food processing; food safety; and discussions of contemporary issues relating to food quality, safety, and nutrition. Students assess the nutritional quality of their personal diets and learn how to make changes to improve their eating habits.

FD SC 151(1510) Food and Health: Current Issues and Controversies
Spring. 1 credit. Limited to 25 students. Pre- or co-requisites: FD SC 150 or permission of instructors. S-U grades only. Disc, M 2:30–3:25. R. B. Gravani and D. D. Miller.
Discussion-based course designed to explore current issues and controversies that involve relationships between food and health. A required reading from the popular press or the scientific literature is assigned each week. S-U grades are based on attendance, overall participation, and the oral presentation. Topics may include the obesity epidemic, food irradiation, food safety, plant sterols, heart disease, eating disorders, functional foods, dietary supplements, food regulations, genetically modified foods, and other current issues. Several class discussions are held at a Cornell dining facility on selected Wednesday evenings during the semester.

FD SC 200(2000) Introductory Food Science
Fall. 3 credits. Prerequisite: college-level courses in chemistry and biology. Letter grades only. M W F 11:15–12:05. J. H. Hotchkiss.
Comprehensive introduction to the principles and practice of food science and technology. Topics include chemistry of foods; nutritional significance; food formulation, preservation, and processing; microbiology and fermentations; composition and processing of food commodities; and contemporary issues including food safety, regulation, and world food needs. Stresses interrelationships between the chemical, physical, nutritional, and quality properties of foods as affected by formulation, processing, and packaging.

FD SC 210(2100) Food Analysis
Spring. 3 credits. Limited to 24 students. Prerequisite: CHEM 208 or equivalent. Lec, W F 1:25–2:15; lab, M 12:20–3:20. R. H. Liu and J. M. Brown.
Introduces basic analytical techniques for food analysis and other biological analysis. Emphasizes fundamental principles of analytical chemistry, basic laboratory techniques, and modern instrumental methods. Discusses gravimetric, volumetric, and spectrophotometric methods, gas chromatography (GC), high-performance liquid chromatography (HPLC), infrared spectra (IR), and atomic absorption spectrometry.

FD SC 230(2300) Sophomore Seminar: Functional Foods; Where Food Science and Nutrition Meet (also NS 230[2300])
Spring. 2 credits. Limited to 15 students; priority given to sophomores who have completed two first-year writing seminars and introductory course in either food science or nutritional sciences. Lec, W 2:30–4:25. S. J. Mulvaney and R. Parker.
Functional foods are foods whose nutrient composition has been modified to achieve targeted health outcomes. This course explores the interface where nutritional science and food science can work together to design and produce foods to meet certain health goals using a case study approach. Each case study involves interdisciplinary discussion, and a writing assignment that includes both technical (e.g., scientific basis for diet-health claims) and nontechnical (e.g., personal experience and opinions related to functional foods) content.

This is a special seminar sponsored by the John S. Knight Institute's Sophomore Seminars Program. Seminars offer discipline-intensive study within an interdisciplinary context. While not restricted to sophomores, the seminars aim at initiating students into the discipline's outlook, discourse community, modes of knowledge, and ways of articulating that knowledge. Special emphasis is given to strong thinking and writing and to personalized instruction with top university professors.

FD SC 250(2500) Kosher and Halal Food Regulations
Spring. 2 credits. Prerequisite: at least sophomore standing. S-U grades optional. Lec, M 7:30–9:25 P.M. J. M. Regenstein.
Comprehensive introduction to kosher and halal foods in the American food industry with some coverage of home practices. Examines the kosher food laws, their origin, and their application in modern food processing. Describes the nature of the kosher supervision industry in America. Also examines Halal laws and explores the interactions between the two communities. Reviews current food-related issues in both communities, including recent court decisions. May also consider some aspects of ethnic foods.

FD SC 290(2900) Meat Science (also AN SC 290[2900])
Fall. 2 or 3 credits; lec only—2 credits; lec plus lab—3 credits; lab cannot be taken without lec. Letter grades only. Lec, T R 11:15; lab, M or R 12:20–3:20. D. E. Shaw.
Introduction to meat science through a study of the structure, composition, and function of muscle and its conversion to meat. Also studies properties of fresh and processed meat, microbiology, preservations, nutritive value, inspection, and sanitation. Lab exercises include anatomy, meat-animal slaughter, meat cutting, wholesale and retail cut identification, processing, inspection, grading, quality control, and meat merchandising. An all-day field trip to commercial meat plants may be taken.

FD SC 321(3210) Food Engineering Principles
Fall. 3 credits. Prerequisites: FD SC 200 and introductory physics. Letter grades only. M W F 11:15–12:05; disc, W 3:35–4:20.
S. S. H. Rizvi.
Introduces the engineering principles underlying food processes and equipment. Topics include thermodynamics, mass and energy balance, fluid mechanics, heat and mass transport, and refrigeration and psychrometrics.

FD SC 351(3510) Milk Quality
Fall. 1 credit. Prerequisite: AN SC 250 or equivalent or permission of instructor. Letter grades only. F 12:20. M. Wiedmann.
Focuses on the effects of on-farm and animal husbandry practices on milk and dairy food quality and safety. Significant parts of class focus on discussion and critical analysis of the assigned reading materials, questions, and hot topics.

FD SC 394(3940) Applied and Food Microbiology (also BIOMI 394[3940])
Fall. 3 credits. Prerequisites: BIOMI 290–291. M W F 12:20–1:10. C. A. Batt.
Microorganisms play a central role in a variety of food, agricultural, and environmental processes. This course presents a comprehensive survey of the roles that microorganisms play in industrial/biotechnological processes as well as their importance in the safety and production of foods. Reviews issues related to the biochemistry, genetics, and physiology of microorganisms important in these processes. A 2-credit core section on food microbiology is complemented by a 1-credit section on industrial/biotechnological applications.

FD SC 395(3950) Food Microbiology Laboratory
Fall. 2 credits. Prerequisite: BIOMI 291 or equivalent. Letter grades only. M W 2:00–4:25. J. M. Brown.
Work includes study of the physiological characteristics of representative food microorganisms, practice in using general and rapid methods for microbiological testing and control of food products, and practice in the application of a systematic approach to controlling the safety of foods, or addressing a food safety issue.

[FD SC 396(3960) Food Safety Assurance
Spring. 2 credits. Prerequisite: BIOMI 290 or permission of instructor. T R 9:05–9:55. Offered alternate years; not offered 2005–2006; next offered 2006–2007. R. B. Gravani.
Provides information on procedures to control biological, chemical, and physical hazards and assure the safety of foods. Topics include discussions on the Hazard Analysis Critical Control Point (HACCP) concept, good manufacturing practices, prerequisite programs, and the application of current technologies in reducing the risk of foodborne illnesses. Uses case studies and class projects to demonstrate and apply the key principles discussed.]

FD SC 400(4000) Current Topics in Food Science and Technology
Spring. 1 credit. S-U grades optional. R 3:35–4:25. Staff.
Discussion of current topics in food science. Topics vary and are chosen from scientific literature and popular press.

[FD SC 401(4010) Concepts of Product Development
Spring. 2 credits. Prerequisite: FD SC 200 or equivalent. Letter grades only. M W 11:15–12:05. Offered alternate years; not offered 2005–2006; next offered 2006–2007. J. H. Hotchkiss.
Discussion of the sequence of events in developing and marketing new food products. Topics include food formulation, packaging and labeling, food additive and ingredient regulations, taste panels, market testing, market research, and patents.]

FD SC 402(4020) Agriculture in Developing Nations I (also IARD 402[4020])
Fall. 2 credits. F 1:25–3:20. T. W. Tucker and R. W. Blake (Mexico sec); K. V. Raman and W. R. Coffman (India sec).
Acquaints students with the major issues and problems in international agriculture and rural development and demonstrates how problems in development are being addressed in the Gulf Region of Mexico and India. The lectures/discussions establish the global and regional contexts for sustainable agricultural development and focus on development challenges in Latin America and Asia through cases in southern Mexico and India. This course may be taken as a stand-alone survey course in international agriculture and rural development. However, it is primarily a preparatory course for participants selected to participate in the spring semester course Agriculture in the Developing Nations II (IARD 602), which includes concurrent field trips to the Gulf Region of Mexico and India during the January intersession.

[FD SC 405(4050) Managing Food Waste Without Trashing the Environment
Spring. 2 credits. Prerequisite: FD SC 200 or equivalent. Letter grades only. Lec, M 12:30–2:15; lab, M 2:30–4:25. Offered alternate years; not offered 2005–2006; next offered 2006–2007. J. M. Regenstein.
Examines the various waste streams generated by food plants, institutional feeders, supermarkets, and restaurants. What is the role of waste minimization? What technologies can control or remediate the problems? What are the disposal, composting, and recycling options? What are the legal requirements locally, state-wide, and nationally that affect various food waste processes? This course serves as a general introduction to available waste management technologies and to policy issues faced by a wide range of businesses and production plants.]

FD SC 406(4060) Dairy and Food Fermentations
Fall. 2 credits. Prerequisite: BIOMI 290. Letter grades only. R 12:20–2:15. M. Wiedmann.
Lecture course covering the basic principles of fermentation, the microbiology of food fermentations (including the physiology and genetics of fermentative microorganisms), starter cultures and their preparations and applications, as well as specific examples of food fermentations. Selected textbook readings are supplemented with papers from peer-reviewed journals. Significant parts of class focus on discussion and critical analysis of the assigned reading materials.

FD SC 410(4100) Sensory Evaluation of Food
Fall. 2–3 credits; 1 lab credit. Lec and lab required for undergraduate food science majors. Prerequisite: statistics course. Letter grades only. Lec, T R 9:05–9:55; lab, F 1:25–4:25. H. T. Lawless.
Topics include the sensory evaluation methods used to test the flavor, appearance, and texture of foods by quantitative description and simple difference testing; consumer testing for product acceptability; sensory tests in quality control; strategic product research; and product development. Presents the psychological principles in sensory testing and statistical methods for sensory data analysis. The lab provides first-hand experience in organizing and conducting sensory tests and an introduction to online date collection and analysis.

FD SC 415(4150) Principles of Food Packaging
Spring. 3 credits. Letter grades only. M W F 10:10–11:00. Offered alternate years; offered 2005–2006. J. H. Hotchkiss.
Discusses the chemical and physical properties and manufacture of the basic materials used to construct packaging. Presents the influence of packaging on shelf life. Emphasizes newer packaging technologies and materials. Briefly presents economics, design, and regulation of food packaging.

FD SC 417–418(4170–4180) Food Chemistry I and II
417, spring (3 credits); 418, fall (2 credits). Prerequisites: CHEM 257 or BIOBM 330 or 331. S-U or letter grades. 417, M W F 9:05–9:55; 418, M W 9:05–9:55. J. W. Brady.
Covers the chemistry of foods and food ingredients. Discusses the chemical and physical properties of water, proteins, lipids, carbohydrates, and other food components and additives in the context of their interactions and functional roles in foods. Describes the effects of chemical changes during processing and storage on the quality and nutritional aspects of several food commodity groups (dairy, meat, fruits and vegetables, cereals, and legumes).

FD SC 419(4190) Food Chemistry Laboratory
Spring. 2 credits. Prerequisites: BIOBM 330 or 331 or CHEM 257 or equivalent. Co-requisite: FD SC 417. W 12:20–4:25. D. D. Miller.
Deals with the chemical properties of food components and changes they undergo in processing and storage. Stresses relationships between the chemical composition of foods and functional, nutritional, and organoleptic properties. Introduces lab techniques commonly used in food research. Requires a lab research project that involves writing a research proposal for the project, conducting laboratory research to test hypotheses described in the proposal, analyzing the data, and writing a paper following the format used by the *Journal of Food Science*.

FD SC 423(4230) Physical Principles of Food Preservation and Manufacturing
Fall. 3 credits. Prerequisite: FD SC 321. Letter grades only. Lec, T R 11:15–12:05; disc, T 12:20–2:15. S. J. Mulvaney and J. S. Roberts.
Emphasizes the fundamental principles that underlie much of food preservation and manufacturing. Uses a systems analysis approach to make connections between the chemical and physical changes that occur in food processing and their impact on food quality. Topics include materials properties of foods, heat processing, freezing, concentration, and drying. Selected products serve as case studies for more complex manufactured foods.

FD SC 425(4250) Dairy Foods Processing
Spring. 3 credits. Prerequisites: FD SC 321, 394, 417, 418, and 423. Letter grades only. Lec, M 12:20–1:10, W 9:05–9:55; lab, M 1:25–4:25. C. I. Moraru.
Combined lecture-laboratory course focusing on principles and practices fundamental to modern dairy foods processing. Structured in two parts. The first part deals with the main unit operations used in dairy processing (i.e., pasteurization, sterilization, centrifugal separation, homogenization, membrane separation, concentration, and drying) and the second part focuses on the science and technology that underpins the manufacture of main classes of dairy products (i.e., fluid milk, milk powder, ice cream, butter, and cheese). Laboratories are conducted in a food processing pilot plant facility, which allows students to gain hands-on experience

in operating pilot plant equipment and the manufacture of safe, high quality dairy products. One field trip to operating dairy plants in the area is scheduled during the semester.

FD SC 430(4300) Understanding Wine and Beer

Spring. 3 credits. Prerequisites: introductory biology and chemistry or permission of instructor; age 21 by first day of class (Jan. 23, 2006). S-U grades optional. T R 1:25–3:20. T. E. Acree, T. Henick-Kling, and K. J. Siebert.

Introduction to wine and beer appreciation through the study of fermentation biology, product composition, and sensory perception. Uses samples of wines and beers to illustrate the sensory properties, microbiological processes, and chemical components that determine quality. Students learn to recognize the major features of wine and beer that determine sensory quality and know the processes that produced them. Topics include the psychology and chemistry of bouquet, taste, and aroma; the microbiology of fermentation and spoilage; the sensory properties of wines from different grape varieties, viticultural practices, and wine-making techniques; and the effects of brewing raw materials and processing procedures on beer quality.

FD SC 450(4500) Fundamentals of Food Law

Spring. 2 credits. Letter grades only. Lec, M 1:25–3:20. Offered alternate years; not offered 2006–2007. J. M. Regenstein.

Introduction to the complex array of federal and state statutes and regulations that control the processing, packaging, labeling, and distribution of food, including aspects of safety and nutritive value. Emphasizes the Food and Drug Administration and U.S. Department of Agriculture regulations but also refers to other regulatory agencies. Emphasizes how a food or agricultural professional interacts with the U.S. legal system during legislative action, regulatory rule making, and with respect to compliance.

[FD SC 456(4560) Advanced Concepts in Sensory Evaluation

Spring. 2 credits. Prerequisite: FD SC 410. S-U grades optional. Offered alternate years; not offered 2005–2006; next offered 2006–2007. F 1:25–3:20. H. T. Lawless.

Readings and discussions of primary source materials in sensory evaluation, including recent advances in sensory methods, historical perspectives, psychophysics, perceptual biases, and multivariate statistical approaches to sensory data. Students conduct a major independent research project on a current issue in sensory evaluation.]

FD SC 480(4800) Global Seminar: Building Sustainable Environments and Secure Food Systems for a Modern World (also NTRES/IARD 480[4800])

Spring. 3 credits. Prerequisite: junior, senior, or graduate standing. J. Lassoie and D. Miller.

Modernization has led to development pressures that have increasingly disrupted natural systems, leading to widespread concerns about the long-term viability of important environmental services, including those critical to food security worldwide. This multidisciplinary course uses case studies to explore interrelationships among social, economic, and environmental factors basic to sustainable development. Cases include population growth, genetically modified foods, biodiversity, sustainable tourism, global warming, and global responsibility. Cornell faculty members lead discussions in each of the major topic areas. In addition, students participate in discussions and debates with students from Sweden, Costa Rica, Honduras, South Africa, and Australia through live interactive videoconferences and electronic discussion boards.

FD SC 494(4940) Special Topics in Food Science

Fall or spring. 4 credits max. S-U grades optional. Staff.

The department teaches "trial" courses under this number. Offerings vary by semester, and are advertised by the department before the semester starts. Courses offered under the number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

FD SC 497(4970) Individual Study in Food Science

Fall or spring. 3 credits max. Prerequisite: permission of instructor. Students must register using independent study form (available in 140 Roberts Hall). S-U grades optional. Staff.

May include individual tutorial study, a special topic selected by a professor or a group of students, or selected lectures of a course already offered. Since topics vary, the course may be repeated for credit.

FD SC 498(4980) Undergraduate Teaching Experience

Fall or spring. 3 credits max. Prerequisite: permission of instructor. Students must register using independent study form (available in 140 Roberts Hall). S-U grades only. Staff.

Students assist in teaching a course appropriate to their previous training and experience. Students meet with a discussion or laboratory section and regularly discuss objectives with the course instructor.

FD SC 499(4990) Undergraduate Research in Food Science

Fall or spring. 4 credits max; may be repeated for credit. S-U grades optional. Students must register using independent study form (available in 140 Roberts Hall). Staff.

Students conduct original research directed by a food science faculty member.

FD SC 599(5990) Research for Lausanne Exchange Students

Fall/spring. 10 credits max. Prerequisite: permission of instructor. S-U grades optional. Staff.

Undergraduate senior thesis research for Lausanne exchange students only. Students conduct original research directed by a food science faculty member, then write and present a final report to the faculties of both Cornell University and the University of Lausanne.

FD SC 600(6000) Seminar in Food Science

Fall and spring. 1 credit. S-U grades only. Requirement for all graduate students in field of food science and technology; highly recommended for graduate students minoring in food science and technology. T 4:00–5:00. Staff.

Weekly seminar series on contemporary topics and issues in the field of food science and technology. Representatives from academia, industry, and government provide presentations on a wide variety of topics. Graduate students in the field of food science and technology may use the forum to present their required thesis research seminar.

FD SC 602(6020) Agriculture in Developing Nations II (also IARD 602[6020])

Spring, field trips to Gulf Region of Mexico (sec 1) and India (sec 2) during Jan. intersession. 3 credits. Prerequisites: IARD 402 and (or) permission of instructors. Cost of field study trip (including airfare, local transportation, and lodging; some merit and need based financial aid may be available): approx. $2,500. T R 2:30–4:25 until midterm only. R. W. Blake, T. W. Tucker, and C. F. Nicholson (Mexico); K. V. Raman and W. R. Coffman (India).

Designed to provide students with an opportunity to observe agricultural development in tropical Mexico or India and to promote interdisciplinary exchange among faculty, staff, students and their Mexican and Indian counterparts. A two-week field-study trip in January is followed by discussions, written projects and oral presentations dealing with problems in food, agriculture and livestock production in the context of social and economic conditions.

[FD SC 604(6040) Chemistry of Dairy Products

Fall. 2 credits. Limited to 16 students. Prerequisites: introductory organic and biochemistry, food chemistry, and dairy foods processing courses or permission of instructor. Letter grades only. Offered alternate years; not offered 2005–2006; next offered 2006–2007. F 1:25–3:20. D. M. Barbano.

Detailed study of milk constituents and their properties. Covers the chemical and physical changes that occur in dairy products before, during, and after processing. Emphasizes current research in dairy chemistry.]

FD SC 607(6070) Advanced Food Microbiology

Spring. 2 credits. Prerequisites: BIOMI 290, FD SC 394. Letter grades only. Offered alternate years; not offered 2006–2007. M W 11:15. M. Wiedmann.

Explores advanced topics in food microbiology. Places major emphasis on critical evaluation of current literature and on microbiological concepts that affect food microbiology. Specific areas covered include microbial ecology of foods, rapid detection and typing methods for foodborne pathogens, microbial modeling, pathogenesis of foodborne diseases, and food applications of genetic engineering. Some guest lectures may be arranged to provide an introduction to other advanced food microbiology topics (e.g., risk assessment).

[FD SC 608(6080) Chemometric Methods in Food Science

Fall. 2 credits. Prerequisites: basic statistics and chemistry course or permission of instructor. S-U grades optional. W 1:25–3:20. Offered alternate years; not offered 2005–2006; next offered 2006–2007. K. J. Siebert.

Food science applications using multivariate statistical methods (chemometrics) include extracting information from large data sets,

modeling molecular and product properties, optimizing analytical methods and processing operations, discerning relationships between product composition and sensory properties, identifying cultivars or species, and detecting adulteration. The techniques covered are also applicable to many other problems in biology and chemistry.]

FD SC 616(6160) Flavors—Analysis and Applications
Spring. 2 credits. S-U grades optional. Lec, F 1:25; disc, F 2:30. Offered alternate years; not offered 2006–2007. H. T. Lawless and T. E. Acree.
Advanced course in sensory and instrumental analysis of flavors, flavor chemistry, and flavor applications in foods for food scientists and those in related fields concerned with human food perception and consumption. Surveys taste, aroma and volatile flavors, and trigeminal stimuli from the perspectives of chemical structures, methods of analysis, uses and interactions in food systems. Also discusses recent advances in the physiology of taste and smell.

FD SC 620(6200) Food Carbohydrates (also NS 620[6200])
Spring. 2 credits. Prerequisite: qualified seniors and graduate students, BIOBM 330 or equivalent. T R 10:10–11. Offered alternate years; not offered 2006–2007. B. A. Lewis and J. W. Brady.
Considers the chemistry of carbohydrates, including sugars, starches, pectins, hemicelluloses, gums, and other complex carbohydrates. Emphasizes the intrinsic chemistry and functionality in food systems and the changes occurring during food processing and storage.

[FD SC 621(6210) Food Lipids
Fall. 2 credits. Prerequisite: basic biochemistry course. Letter grades only. Offered alternate years; not offered 2005–2006; next offered 2006–2007. T R 2:30–3:20. R. H. Liu.
Describes the physical, chemical, biochemical, and functional properties of lipids. Emphasizes lipid oxidation, emulsions, and functional foods associated with lipids.]

FD SC 622(6220) Nutraceuticals and Functional Foods
Fall. 2 credits. Prerequisites: biochemistry course equivalent to BIOBM 330 and one year college biology or permission of instructor. Letter grades only. Offered alternate years; not offered 2006–2007. Lec, T R 2:30–3:20. R. H. Liu.
Covers nutraceuticals and functional foods, natural bioactive compounds, antioxidants, and dietary supplements, botanicals and herbs in disease prevention and health promotion. Emphasizes the mechanisms of action and scientific evidence of efficacy of nutraceuticals and functional foods. Also discusses biomarkers, safety and efficacy testing, and regulations for nutraceuticals and functional foods.

FD SC 664(6640) Food Polymer Science: Principles and Applications
Spring. 2 credits. Prerequisites: introductory chemistry and physics. T R 12:20–1:10. Offered alternate years; not offered 2006–2007. S. J. Mulvaney.
Integrates polymer science, chemistry, and materials science principles as the basis for characterization of the physical properties of biopolymer materials of interest to the food industry. Emphasizes unique aspects of food materials, e.g., plasticization by water, physical gelation, transient networks, and effects of thermal treatments on material properties. Problems and case studies based on proteins, starches, gelatin, and other hydrocolloids relevant to food systems.

[FD SC 665(6650) Food and Bioprocessing Systems
Spring. 3 credits. Prerequisite: FD SC 423. Letter grades only. Offered alternate years; not offered 2005–2006; next offered 2006–2007. Lec, T R 12:20; disc, T 1:25–2:15. S. S. H. Rizvi and S. J. Mulvaney.
Fundamental and quantitative analyses of processes for manufacture of foods and related biological products. Topics include centrifugation, membranes, supercritical fluids, extrusion, high pressure, pulsed electric field, thermal processing, drying, and crystallization.]

FD SC 694(6940) Special Topics in Food Science
Fall or spring. 4 credits max. S-U grades optional. Staff.
The department teaches "trial" courses under this number. Offerings vary by semester, and are advertised by the department before the semester starts. Courses offered under the number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

FD SC 695(6950) Current Readings in Food Science
Fall and spring. 1 credit; may be taken multiple times. Graduate students in food science strongly encouraged to enroll. Prerequisite: 300- to 400-level course relevant to chosen topic. S-U grades only. Lec, TBA/one hour per week. Staff.
Seminar series on current topics chosen by participating faculty members and students on a rotating basis. Format consists of weekly discussion groups with each participant presenting at least one oral report based on independent reading. Multiple sections focusing on different topics may be taught in any given semester. Topics include food microbiology and food safety; food chemistry; packaging; food engineering. Interested students should contact the designated instructor(s) for each semester.

FD SC 698(6980) Graduate Teaching Experience
Fall and spring. 1 to 3 credits. S-U grades only. Staff.
Designed to give graduate students teaching experience through involvement in planning and teaching courses under the supervision of field faculty members. The experience may include leading discussion sections; preparing, assisting in, or teaching lectures and laboratories; and tutoring.

FD SC 800(8000) Master's-Level Thesis Research
Fall or spring. Credit TBA; max. 12. Prerequisite: master's candidates; permission of Special Committee chair. S-U grades only. Graduate faculty.

FD SC 900(9000) Graduate-Level Thesis Research
Fall or spring. Credit TBA; max. 12. Prerequisite: doctoral students who have not passed "A" exam; permission of Special Committee chair. S-U grades only. Graduate faculty.

FD SC 901(9010) Doctoral-Level Thesis Research
Fall or spring. Credit TBA. Maximum of 12 credits. Prerequisite: doctoral students who have passed "A" exam; permission of Special Committee chair. S-U grades only. Graduate faculty.

HORTICULTURE

M. P. Pritts, chair (134A Plant Science Bldg., 255-1778); N. L. Bassuk, R. R. Bellinder, M. P. Bridgen, L. Cheng, L. E. Drinkwater, M. Eames-Sheavly, S. Gan, G. L. Good, D. E. Halseth, C. P. Mazza, I. A. Merwin, W. B. Miller, J. Mt. Pleasant, K. W. Mudge, A. M. Petrovic, D. A. Rakow, A. Rangarajan, F. S. Rossi, C. B. Watkins, L. A. Weston, T. H. Whitlow, H. C. Wien, D. W. Wolfe

HORT 101(1110) Horticultural Science and Systems
Fall. 4 credits. Lec, M W F 9:05; lab, W 1:25–4:25. I. A. Merwin.
Science and technology of horticultural plants grown for foods and beverages and ornamental, landscape, or recreational purposes. Lectures, labs, and field trips involve natural history and evolution of horticultural plants, botany and physiology, sustainable management of soil, water and plant nutrition, breeding and propagation, ecological and landscape functions, and integrated design and management of horticultural plantings and production systems.

HORT 102(1120) Hands-On Horticulture
Spring. 2 credits. Nominal materials fee. Lec, F 12:20; lab F 1:25–4:25. M. P. Pritts.
The objective is to instill in students a lifelong appreciation for how gardening can enhance individual well-being through aesthetics, culinary experiences, and mastery of techniques. Emphasizes hands-on learning and practice of key gardening skills and techniques in the greenhouse and the field, such as landscape management, garden design, propagation, pruning, grafting, pest management, and flower arrangement. There is one Saturday field trip at the end of the semester to visit gardens in the local area.

HORT 201(2010) The Art of Horticulture I: Plants and Gardens as a Subject of Art
Fall. 2–3 credits. Studio, T 1:25–4:25. Fee for materials: $35. M. Eames-Sheavly.
Part of a HORT 201 and 203 sequence, this experiential course considers plants and gardens as a subject of art. Students explore basic drawing techniques, botanical-illustration methods, watercolor, and photography. The course addresses the natural history and symbolic use of plants in fine art. Students critically reflect on course content in journals and explore the work of garden writers.

HORT 203(2030) The Art of Horticulture II: Plants Used in Art or as Artforms
Spring. 2 credits. Studio, T 1:25–4:25. Fee for materials: $35. M. Eames-Sheavly.
Part of a HORT 201 and 203 sequence, this experiential course focuses on plant materials used to create art or manipulated as artforms. Acquaints students with a range of topics such as the use of plants in fibers and dyes; floral design; and living-sculpture practices such as topiary, bonsai, turfworks, and tree sculpture. Students create a final project focused on these or related methods.

HORT 215(2150) Sophomore Seminar: Nonfiction Adventure Writing: Reclaiming the Scientist's Voice

Spring. 4 credits. Limited to 15 students. Letter grades only. Lec, TBA. T. H. Whitlow.

Using juxtaposed readings drawn from the published chronicles of scientific and nonscientific adventures, this course discovers strategies for conveying excitement in their own writing. In addition to classroom discussion, group adventures in the field and lab provide raw material for writing individual narratives. Each student has opportunities to cultivate individual awareness of natural processes and recount their discoveries in writing.

This is a special seminar sponsored by the John S. Knight Institute's Sophomore Seminars Program. Seminars offer discipline-intensive study within an interdisciplinary context. While not restricted to sophomores, the seminars aim at initiating students into the discipline's outlook, discourse community, modes of knowledge, and ways of articulating that knowledge. Special emphasis is given to strong thinking and writing and to personalized instruction with top university professors.

HORT 220(2200) Practicing Sustainable Land Care

Fall. 2–3 credits; 1 additional credit for student projects by permission of instructor. Lec, R 12:20; lab, R 1:25–4:25. Offered odd years. L. E. Drinkwater.

Experiential course emphasizing interdisciplinary, ecosystem-based approaches to land management and food production. Covers concepts from biological and environmental sciences (i.e. ecology, soil science, horticulture) and includes hands-on activities in organic agriculture, agroforestry, and ecosystem restoration. Classes are held at Dilmun Hill Organic Farm and the MacDaniels Nut Grove.

[HORT 225(2250) Vegetable Production

Fall. 4 credits. Lec, M W F 11:15; lab, W 2:00–4:25; four field trips (Sept.). W 11:15–6. Not offered 2005–2006. Staff.

Intended for those interested in the production, processing, and marketing of vegetables. Topics include techniques, problems, and trends in the culture, harvesting, and storage of the major vegetable crops. Includes field trips to conventional and organic farms and hands-on experience in growing vegetables in the greenhouse.]

HORT 235(2350) Plants and Human Well-Being

Spring. 3 credits. Lec, T R 9:05; lab, W 1:25–4:25. J. Mt. Pleasant and S. M. Skelly.

Examines the beneficial effects of plants on human cultures, communities and individuals. Areas of focus include: impacts of community gardens, green space, and farmer's markets; use of plants for pollution control, economic development, conflict resolution, and tourism; how plants benefit individuals, in terms of adult cognition, K–12 education, mental health, and personal empowerment. Laboratories include field trips and exercises to allow students to analyze and evaluate plant-based initiatives in many phases of contemporary life.

[HORT 243(2430) Taxonomy of Cultivated Plants (also BIOPL 243[2430])

Fall. 4 credits. Prerequisite: one year introductory biology or written permission of instructor. May not be taken for credit after BIOPL 248. Lec, M W F 10:10–11; lab, M or W 2–4:25. Offered even years. M. A. Luckow.

Study of ferns and seed plants, their relationships, and their classification into families and genera, emphasizing cultivated plants. Places particular emphasis on gaining proficiency in identifying and distinguishing families and in preparing and using analytic keys. Also gives attention to the economic importance of taxa, the basic taxonomic literature, and the elements of nomenclature.]

HORT 300(3000) Herbaceous Plant Materials

Fall. 3 credits. Lec, T R 10:10; lab, T 2–4:25. Cost of field trip: $75. W. B. Miller.

Identification, use, characteristics, and garden cultural requirements of annual and herbaceous perennial plants, especially those used in northern climates. Practical gardening experiences at selected campus locations. Field trips to nearby specialty nurseries.

[HORT 310(3100) Production and Marketing of Greenhouse Crops

Spring. 4 credits. Letter grades only. Lec, T R 10:10; lab, R 1:25–4:25. Cost of required three-day field trip: approx. $130. Offered odd years. Staff.

Covers basics of establishing a greenhouse operation, growing crops in optimized environments, and serving niche or mass markets. Discusses technology basics including structures and equipment, systems for heating and cooling, lighting, irrigating and fertilizing, materials handling; environmental stewardship and integrated pest management; and production management. Also covers world centers of greenhouse crop production; culture of cut, pot, bedding, vegetable, and fruit crops in greenhouses, emphasizing predictive harvesting through environmental, physical, and chemical management of growth and development. Each student grows one or more crops.]

[HORT 317(3170) Seed Science and Technology (also CSS 317[3170])

Fall. 3 credits. Prerequisite: BIOPL 241 or equivalent course approved by instructor. Letter grades only. Lec, T R 11:40–12:30; lab, R 1:25–4:25. Not offered 2005–2006; next offered 2006–2007. A. G. Taylor, Geneva Experiment Station.

Study of the principles and practices involved in seed production, conditioning, storage, quality management, seed enhancements, and stand establishment. Information is applicable to various kinds of agricultural and horticultural seeds. Hands-on laboratory experience.]

HORT 330(3300) Turfgrass-ing the Landscape

Spring. 3 credits. Prerequisite: CSS 260 or permission of instructor. Letter grades only. Lec, M W F 8 A.M. F. S. Rossi and A. M. Petrovic.

Proposal, siting, specification, installation, establishment, and management of turfgrass areas. Emphasizes commercial locations including lawns, sports fields, and golf courses. Case study projects are a major aspect of the course.

HORT 391(3910) Woody Plant Identification and Use I

Fall. 2 credits. Limited enrollment. Prerequisite: permission of instructor. Letter grades only. Lec, R 12:20–1:10; lab, R 1:25–4:25. N. L. Bassuk.

Module of HORT/LA 491 covering the identification of approximately 200 woody trees, shrubs, and vines in leaf and their use in the landscape. Students desiring a more comprehensive course that covers site assessment, soil modification, design, plant specifications and landscape establishment principles and techniques should take HORT/LA 491 or the 491–492 sequence.

HORT 392(3920) Woody Plant Identification and Use II

Spring. 2 credits. Limited enrollment. Prerequisite: permission of instructor. Letter grades only. Lec, T 12:20–1:10; lab, T 1:25–4:25. N. L. Bassuk.

Module of HORT/LA 492 covering the identification of approximately 160 evergreen trees and shrubs and deciduous plants using winter identification. HORT 391 (fall module) need not be taken before taking HORT 392 (spring module). Students also assist in the establishment of a new landscape on campus.

HORT 400(4000) Principles of Plant Propagation

Fall. 3 credits. Prerequisites: BIOPL 242 and 244 or another plant physiology course or permission of instructor. Lec, T R 9:05; lab, R 1:25–4:25. K. W. Mudge.

Sexual (seed) propagation and asexual (vegetative) propagation including cuttage, graftage, tissue culture, layering, and specialized vegetative reproductive structures. Stresses physiological, environmental, and anatomical principles and industry applications in lecture, and hands-on skills in laboratories. Examples include both temperate and tropical horticultural, agronomic, and forestry crops.

HORT 401(4010) The How, When, and Why of Grafting—A Distance Learning Approach

Spring, 10 weeks. 2 credits. Lec, autotutorial (web); lab, greenhouse/autotutorial (web/CD); disc, web; one introductory face-to-face meeting, TBA. K. W. Mudge.

Web/CD–based autotutorial approach to the principles and practices of grafting and budding as applied to plant propagation. Emphasizes the role of grafting in modern horticultural practice and on student development of hands-on grafting skills. Instruction involves web-based asynchronous presentation of lecture and lab materials (web, CD-ROM), asynchronous discussion, and autotutorial hands-on grafting lab exercises.

HORT 420(4200) Principles of Nursery-Crop Production

Fall. 4 credits. Prerequisite: HORT 400. Lec, M W F 9:05; lab, M 2–4:25. Field trips. Offered odd years. G. L. Good.

Principles of commercial production of nursery crops to marketable stage, including postharvest handling and storage. Term project required. Includes field trips to commercial nurseries.

HORT 425(4250) Postharvest Biology of Horticultural Crops

Fall. 3 credits. Lec, M W 9:05–9:55; lab, W 1:25–4:25. Offered odd years. S. Gan.

Study of the the biological processes controlling physical and chemical changes

in harvested yet living horticultural crops or their parts. Discusses the theoretical principles and fundamental processes underlying these changes. Also covers strategies and practical handling requirements/conditions for storage, transportation, and quality monitoring of harvested horticultural crops.

HORT 426(4260) Practicum in Forest Farming as an Agroforestry System (also NTRES/CSS 426[4260])

Fall. 2 credits. Prerequisite: junior, senior, or graduate standing or permission of instructor. Lab, W 1:25–4:25. K. W. Mudge and L. E. Buck.

Students actively take part in the restoration of a 70-year-old nut grove. The MacDaniel's Nut Grove is being developed as a multipurpose forest-farming teaching, research, and extension site. Hands-on activities include: temperate-nut harvest and variety evaluation, mushroom culture, small-fruit and fruit-tree culture, medicinal-herb culture, site evaluation and planning, and field trips to other agroforestry-related sites. Outdoor activities are integrated with selected readings via an online discussion board.

[HORT 435(4350) The Care of Woody and Herbaceous Plants in the Landscape

Fall. 4 credits. Prerequisites: HORT 301 and 491 or permission of instructor. Lec, M W F 9:05; lab, M 2–4:25. Field trips. Offered even years. Staff.

Study of the practices involved in the maintenance of ornamental plants in the landscape. The major emphasis is on post-planting techniques, including water and fertilization management, weed management, pruning, and general tree care. Labs have a hands-on focus.]

HORT 440(4400) Restoration Ecology

Fall. 5 credits. Prerequisite: upper division or graduate standing and permission of instructor. Letter grades only. Lec, T R 8:40–9:55; lab, F 12:30–4:45, plus several weekends. T. H. Whitlow.

Draws concepts from ecology, hydrology, soil science, and conservation biology and applies these in both principle and practice to the rapidly evolving field of restoration ecology. Through lectures, reading, and discussion, site visits to active restoration sites, and a real world class project, students learn and practice skills needed to develop restoration plans for a variety of situations.

[HORT 442(4420) Berry Crops: Culture and Management

Fall. 3 credits. Lec, M W 9:05; lab, M 1:25–4:25. Offered even years. M. P. Pritts.

Study of the evolution, breeding history, and physiology of strawberries, raspberries, blackberries, blueberries, and other minor small fruit crops, and of cultural practices that influence productivity, fruit quality, and pest damage. Considers marketing and economics and discusses alternate production practices for both commercial and home gardeners. Frequent field trips enhance classroom activities.]

HORT 443(4430) Viticulture and Vineyard Management—I

Fall. 3 credits. Prerequisites: BIO G 101/103, 102/104, BIOPL 241, CSS 260, BIOPL 242/244 or equivalents. Letter grades only. Lec, T R 9:05; lab, R 1:25–4:25. R. M. Pool, A. N. Lakso, and M. C. Goffinet.

First-semester course in commercial grape production with an emphasis on the problems of production in cold climates. Students examine environmental factors favoring production and quality, soils, and the anatomical and physiological basis for vineyard management decision-making. Laboratory exercises and field trips offer hands-on experience.

HORT 444(4440) Viticulture and Vineyard Management—II

Spring. 3 credits. Pre- or co-requisites: HORT 443 and PL BR 225 or equivalent. Letter grades only. Lec, T R 9:05; lab, R 1:25–4:25. R. M. Pool, B. I. Reisch, P. Cousins, and C. Owens.

Second-semester course in commercial grape production with an emphasis on the problems of production in cold climates. Students examine the genetics of the vine, and learn principles of vineyard establishment, propagation, pruning and training, and conservation. Laboratory exercises and field trips offer hands-on experience.

HORT 445(4450) Ecological Orchard Management

Spring. 3 credits. Prerequisite: introductory biology. S-U grades optional. Recommended: previous horticulture/plant science courses. Lec, T R 10:10; lab, T 1:25–4:25. Offered even years. I. A. Merwin.

The ecology and technology of deciduous tree-fruit production. Topics include basic tree and fruit physiology; orchard renovation and design systems; nutrition, irrigation, and freeze protection practices; tree pruning and training; post-harvest fruit storage; marketing and economic spreadsheet models; monitoring and decision-making systems for integrated pest management; and efficient use of orchard equipment. Emphasizes the agroecology of perennial crop systems, with labs providing hands-on experience in orchard management.

HORT 449(4490) Green Signals and Triggers—The Plant Hormones (also BIOPL 449[4490])

Fall. 1 or 2 credits. Prerequisites: introductory biology and BIOPL 242 or 342 or permission of instructor. S-U grades optional. Lec, F 1:25–2:15. Offered odd years. P. J. Davies.

Study of the plant hormones and how they regulate plant growth and development. Topics include the discovery, role in growth and development, mode of action, and practical uses of the plant hormones auxin, gibberellins, cytokinins, abscisic acid, ethylene, and brassinosteroids. An optional additional 1-credit writing component is offered for construction of a book on plant hormones appropriate for the course.

HORT 455(4550) Mineral Nutrition of Crops and Landscape Plants (also CSS 455[4550])

Spring. 3–5 credits. Prerequisite: CSS 260 and BIOPL 242(2420), or equivalent. Lec, M W F 9:05; lab, R 2–4:25. Offered even years. H. C. Wien and staff.

Modular course on principles of plant mineral nutrition and nutrient management. A mandatory module on principles is followed by others on agronomic crops, vegetables, floriculture, and fruit crops. Each module carries 1 credit; a minimum of 3 credits must be taken in one semester. By the end of the course, students understand the principles of mineral nutrient function in crop plants, are able to diagnose deficiencies by symptoms and tissue tests, and can devise organic and conventional nutrient management schemes that maximize productivity and mineral nutrient quality.

HORT 460(4600) Plant-Plant Interactions

Spring. 3 credits. Prerequisite: any crop production or plant ecology course or permission of instructor. Lec, T R 9:05; lab/disc, M 2–4:25. Offered even years. D. W. Wolfe.

Uses our basic understanding of plant ecology and physiology to evaluate the mechanisms by which plants perceive "neighbors" and compete or positively interact with each other in natural and managed ecosystems. Emphasizes agricultural systems, from tropical home garden polyculture, to pastures, to intensive row-crop monoculture. In laboratory exercises, the effects of plant density and environmental factors such as light and fertility on plant interactions are quantified, and students gain first-hand experience in techniques such as isolation of allelochemicals and determination of weed thresholds.

[HORT 462(4620) Physiology of Vegetables and Flowers

Spring. 4 credits. Prerequisite: BIOPL 242 or equivalent. Lec, M W F 9:05; lab/disc, M 2–4:25. Offered odd years. H. C. Wien.

Study of the physiological principles that govern growth, development, and production of reproductive structures of vegetable crops and herbaceous ornamental plants. Emphasizes processes of flower induction, fruit and seed set, and the balance of vegetative and reproductive growth, especially in perennials. Practical hands-on greenhouse experiments and small group discussions illustrate the lecture material.]

HORT 466(4660) Soil Ecology (also CSS 466[4660])

Spring. 4 credits, with lab. Prerequisite: one year of biology or ecology and CSS 260 or permission of instructor. Lec, T R 10:10–11:25; lab, W 1:25–4:25. J. E. Thies.

For description, see CSS 466.

HORT 480(4800) Plantations Lecture Series

Fall, 12 weeks. 1 credit. S-U grades only. W 7:30–8:45. D. A. Rakow.

Introductory class, 10 lectures, and a final evaluation session. Each week, lectures feature prominent speakers on a broad range of popular horticultural, natural-science, and human-cultural themes.

[HORT 485(4850) Public Garden Management

Spring. 3 credits. Prerequisites: HORT 300 or 301; HORT 230 or 335. Lec, T R 10:10–11, lab, T R 11:15–12:05. Two-and-a-half-day field trip to other botanical gardens and arboreta. Offered odd years. D. A. Rakow and S. M. Skelly.

Explores the history of public gardens, types of contemporary public gardens, and the operation of botanical gardens and arboreta. Includes separate units on collections curation, design of collections, management of landscapes and natural areas, educational programming, interpretive programs, research, financial management, and staffing.]

HORT 491(4910) Creating the Urban Eden: Woody Plant Selection, Design, and Landscape Establishment (also LA 491[4910])

Fall. 4 credits. Limited to 48 students. Prerequisite: horticulture or landscape architecture majors or permission of instructor. Preregistration required. Lec, T R 12:20–1:10; Lab, T R 1:25–4:25. N. L. Bassuk and P. J. Trowbridge.

Focuses on the identification, uses, and establishment of woody plants in urban and garden settings. By understanding the environmental limitations to plant growth, students can critically assess potential planting sites, select appropriate trees, shrubs, vines, and ground covers for a given site, and learn about the principles and practices of site amelioration and plant establishment. Design followed by written specifications and graphic details is produced to implement these practices. A project where students implement what they have learned by creating a new landscape serves to integrate theory, principles, and practices. No prior design experience necessary.

HORT 492(4920) Creating the Urban Eden: Woody Plant Selection, Design, and Landscape Establishment (also LA 492[4920])

Spring. 4 credits. Limited to 48 students. Prerequisite: passing grade in HORT/LA 491; horticulture or landscape architecture majors or permission of instructors. Preregistration required. Lec, T R 12:20–1:10, lab, T R 1:25–4:25. N. L. Bassuk and P. J. Trowbridge.

Second half of course focusing on the winter identification, uses, and establishment of woody plants in urban and garden settings. Issues of site assessment and soil remediation are emphasized in addition to soil volume calculations, drainage and surface detailing, and planting techniques. Students critically assess potential planting sites, and select appropriate trees, shrubs, vines, and ground covers for a given site. Design for specific sites followed by written specifications and graphic details are produced to implement these proposals. Students implement, in a hands-on manner, site remediation and planting techniques they have learned by creating new landscapes that serve to integrate theory, principles, and practices. Together, HORT/LA 491 and 492 constitute an integrated course.

HORT 494(4940) Special Topics in Horticulture

Fall or spring. 4 credits max. S-U grades optional. Staff.

The department teaches "trial" courses under this number. Offerings may vary by semester, and will be advertised before the semester begins. Courses offered under the number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

HORT 495(4950) Undergraduate Seminar—Current Topics in Horticulture

Fall and spring. 1 credit; may be taken four times for 1 credit per semester. Graduate students should enroll in HORT 600. S-U grades only. M 11:15–12:05. L. Cheng.

Undergraduate participation in weekly departmental seminar series.

HORT 496(4960) Internship in Horticulture

Fall or spring. Variable credit. Prerequisite: permission of student's adviser **in advance of participation** in internship programs. S-U grades optional. Students must register using independent study form (available in 140 Roberts Hall) signed by faculty member who will supervise study and assign grade. Staff.

HORT 497(4970) Independent Study in Horticulture

Fall or spring. Variable credit. Prerequisite: permission of instructor(s). S-U grades optional. Students must register using independent study form (available in 140 Roberts Hall).

Independent study in horticultural sciences under the direction of one or more faculty members. Staff.

HORT 498(4980) Undergraduate Teaching Experience

Fall or spring. Variable credit. Prerequisites: previous enrollment in course to be taught or equivalent, and written permission of instructor. S-U grades optional. Students must register using independent study form (available in 140 Roberts Hall). Staff.

Designed to give qualified undergraduate students teaching experience through actual involvement in planning and teaching horticultural sciences courses under the supervision of departmental faculty members. May include leading discussion sections; preparing, assisting in, or teaching laboratories; and tutoring.

HORT 499(4990) Undergraduate Research

Fall or spring. Variable credit. Prerequisite: permission of instructor. S-U grades optional. Students must register using independent study form (available in 140 Roberts Hall.) Staff.

Undergraduate research projects in horticultural sciences.

HORT 500(5000) Master of Professional Studies (Agriculture) Project

Fall or spring. 1–6 credits; 6 credits max. toward M.P.S. (agriculture) degree. Requirement for M.P.S. (agriculture) candidates in respective graduate fields of horticulture. S-U grades optional. Staff.

Comprehensive project emphasizing the application of principles and practices to professional horticultural teaching, extension, and research programs and situations.

HORT 600(6000) Seminar in Horticulture

Fall and spring. 1 credit. Requirement for graduate students majoring or minoring in horticulture. Undergraduate students enroll in HORT 495. S-U grades only. M 11:15–12:05. L. Cheng.

Weekly seminars consisting of graduate student research project reports, faculty research topics, as well as guest speakers from other universities and/or industry.

HORT 615(6150) Quantitative Methods in Horticultural Research

Spring, weeks 1–7. 2 credits. Prerequisite: BTRY 601, 602, or permission of instructor. S-U grades only. W F 2:30–4:25. Offered even years. D. W. Wolfe.

Provides experience in applying statistics principles to real-world agricultural research problems. Uses examples of lab, greenhouse, and field studies from the published literature. Explores other quantitative methods. Topics include approaches to controlling and analysis of variation; common block and incomplete block designs; selecting an appropriate significance level; designing on-farm experiments and demonstration plots; regression methods in relation to mechanistic models and path and principal components analysis; and plant growth analysis techniques.

HORT 617(6170) Advanced Analytical Methods for Plant Systems

Spring. 3 credits. Prerequisite: one year of general chemistry, one semester of organic chemistry, plant physiology. Letter grades only. Lec, T 12:20; lab, T 1:25–4:25. Offered even years. Staff.

Principles and practical applications of selected laboratory methods in the plant and environmental sciences. Emphasizes enhancement of laboratory technique and problem-solving skills. Discusses suitability of various procedures for measuring important plant and soil components. Analytical techniques are chosen from: ICP spectroscopy, elemental analysis by combustion or flow analysis, gas chromatography, HPLC, electrophoresis, electrochemical assays, enzyme assays, bioassays, and mass spectrometry.

[HORT 618(6180) Breeding for Pest Resistance (also PL BR 618[6180])

Fall. 2 credits. Prerequisites: BIOGD 281 and PL BR 403 or equivalents. Highly recommended: introductory plant pathology and/or entomology course. Letter grades only. Lec, M 2:30–4:25. Offered even years. P. D. Griffiths.

For description, see PL BR 618.]

[HORT 625(6250) Advanced Postharvest Biology

Fall. 1–3 credits, variable. Times TBA. Offered even years. Coordinators: S. Gan and C. B. Watkins.

Sec 01 Advanced Postharvest Physiology. 1 credit. (12 lec). S. Gan.

Emphasizes the physiological and biochemical aspects of growth and maturation, ripening, and senescence of harvested horticultural plant parts.

Sec 02 Plant Senescence (also BIOPL 653.06). 1 credit. (12 lec). S. Gan.

Introduces molecular, genetics, and genomics approaches in plant senescence and postharvest research. Topics include gene expression, regulation, and function associated with physiological and biochemical changes in senescing, maturing, and/or ripening plants or parts. Also discusses genetic manipulation of senescence/ripening processes.

Sec 03 Advanced Postharvest Technology. 1 credit. (12 lec). C. B. Watkins.

Emphasizes advanced existing and emerging technology and practice for handling, monitoring, and storage of horticultural crops after harvest.]

HORT 635(6350) Tools for Thought

Fall. 1 credit. Prerequisite: graduate standing. S-U grades only. Disc, TBA. T. H. Whitlow.

Discusses readings from Kuhn, Waddington, Wilson, Lewontin, and others emphasizing application of the philosophy of science to the real-world practices of scientists.

HORT 636(6360) Current Topics in Horticulture
Fall or spring. 1 credit. S-U grades only. One hour per week, TBA. Staff.
Seminar series on current topics chosen by participating students and faculty members, on a rotating basis. Format consists of weekly discussion groups, with each participant presenting at least one oral report based on independent reading and/or experimentation relating to the chosen topic. Interested students should contact the designated instructor(s) for each semester.

HORT 6400(6400) New Directions in Public Horticulture
Spring. 1 credit. Disc TBA. Offered even years. D. A. Rakow and S. M. Skelly.
Designed to introduce students to a range of current issues facing public gardens through a set of required readings. Each class period is devoted to a discussion of the topic between the instructors and students based on both the readings and personal experiences.

HORT 694(6940) Special Topics in Horticulture
Fall or spring. 4 credits max. S-U grades optional. Staff.
The department teaches "trial" courses under this number. Offerings vary by semester and are advertised by the department before the semester starts. Courses offered under the number will be approved by the department curriculum committees, and the same course is not offered more than twice under this number.

HORT 700(7000) Graduate Teaching Experience
Fall or spring. Variable credit. Prerequisite: permission of instructor; graduate standing. Undergraduates should enroll in HORT 498. S-U grades optional. Times TBA. Staff.
Designed to give graduate students teaching experience through involvement in planning and teaching courses under the supervision of departmental faculty members. May include leading discussion sections; preparing, assisting in, or teaching lectures and laboratories; and tutoring.

HORT 800(8000) Thesis Research, Master of Science
Fall or spring. Credit TBA. S-U grades only.

HORT 900(9000) Thesis Research, Doctor of Philosophy
Fall or spring. Credit TBA. S-U grades only.

INTERNATIONAL AGRICULTURE AND RURAL DEVELOPMENT

IARD 300(3000) Perspectives in International Agriculture and Rural Development
Fall. 2 credits. R. Everett and R. Nelson.
Forum to discuss both contemporary and future world food issues and the need for an integrated, multidisciplinary team approach in helping farmers and rural development planners adjust to the ever-changing food needs of the world.

IARD 314(3140) Tropical Cropping Systems: Biodiversity, Social, and Environmental Impacts [also CSS 314(3140)]
Fall. 3 credits. Prerequisite: introductory crop science, soil science, or biology course or permission of instructor. P. Hobbs.
Characterization and discussion of traditional shifting cultivation, lowland rice-based systems, upland cereal-based systems, smallholder mixed farming including root crops and livestock, plantation fruit and oil crop systems, and agroforestry. In addition to species diversity and domestication, factors such as climate, land quality, soil management, land tenure, labor, and markets are considered. Evaluates the effect of tropical cropping systems on the environment.

IARD 402(4020) Agriculture in Developing Nations I (also FD SC 402[4020])
Fall. 2 credits. F 1:25–3:20. T. W. Tucker and R. W. Blake (Mexico sec); K. V. Raman and W. R. Coffman (India sec).
Acquaint students with the major issues and problems in international agriculture and rural development and to demonstrate how problems in development are being addressed in the Gulf Region of Mexico and India. The lectures/discussions establish the global and regional contexts for sustainable agricultural development and focus on development challenges in Latin America and Asia through cases in southern Mexico and India. This course may be taken as a stand-alone survey course in international agriculture and rural development. However, it is primarily a preparatory course for participants selected to participate in the spring semester course Agriculture in the Developing Nations II (IARD 602), which includes concurrent field trips to the Gulf Region of Mexico and India during the January intersession.

IARD 403(4030) Traditional Agriculture in Developing Countries [also CSS 403(4030)]
Fall. 1 credit. S-U grades only. P. Hobbs.
Today, perhaps more than half of the world's arable land is farmed by traditional farmers. They developed sustainable agriculture practices that allowed them to produce food and fiber for millennia with few outside inputs. Many of these practices have been forgotten in developed countries but are still used by many traditional, subsistence, or partially subsistence farmers in developing countries. This course examines traditional systems from several disciplinary points of view.

IARD 404(4040) Crop Evolution, Domestication, and Diversity [also PL BR/BIOPL 404(4040)]
Spring. 2 credits. Prerequisite: BIOGD 281 or PL BR 225 or permission of instructor. S-U grades optional. S. Kresovich.
Evolution, domestication, and breeding of crop plants have molded the current diversity we conserve and use. Based on advances in systematics and molecular genetics, this course presents an integrated approach to understanding and describing diversity of agricultural and horticultural species. Underlying ethical, legal, and social issues affecting conservation and use also are addressed.

IARD 480(4800) Global Seminar: Building Sustainable Environments and Secure Food Systems for a Modern World [also NTRES/FD SC 480(4800)]
Spring. 1–3 credits. Prerequisite: junior, senior, or graduate standing. Letter grades. J. Lassoie and D. Miller.
For description, see NTRES 480.

IARD 494(4940) Special Topics in International Agriculture [also IARD 694(6940)]
Fall, spring, summer. 1–3 credits. S-U grades optional. Staff.
The department teaches "trial" courses, and special topics not covered in other courses, at the undergraduate level, under this number. Offerings vary by semester, and will be advertised by the department. Courses offered under the number are approved by the department curriculum committee, and the same course is not offered more than twice under this number.

IARD 496(4960) International Internship
Fall, spring. 1–6 credits. Prerequisite: submission of approved internship form (see CALS internship policy guidelines). S-U grades optional. Staff.
International internship, supervised by a faculty member who is directly involved in determining both the course content and in evaluating a student's work. The student researches and initiates an appropriate international internship and negotiates a learning contract with the faculty supervisor, stating the conditions of the work assignment, supervision, and reporting.

IARD 497(4970) Independent Study in IARD
Fall and spring. 1–3 credits. S-U or letter grades. Prerequisite: permission of instructor. Students must register using independent study form (available in 140 Roberts Hall). Staff.
Allows students the opportunity to investigate special interests that are not treated in regularly scheduled courses. The student develops a plan of study to pursue under the direction of a faculty member.

IARD 598(5980) International Development M.P.S. Project Paper
Fall and spring. 1–6 credits; max. 6 credits may be applied toward M.P.S. degree. Prerequisite: M.P.S. candidates in field of international development (ID). S-U grades only. N. Uphoff.
Problem-solving project entailing either fieldwork and/or library work. The aim of the project is to give students supervised experience in dealing intellectually and analytically with a professional problem related to a substantive area of international development.

IARD 599(5990) International Agriculture and Rural Development M.P.S. Project Paper
Fall and spring. 1–6 credits; maximum of 6 credits may be applied toward M.P.S. degree requirements. Prerequisite: M.P.S. candidates in field of international agriculture and rural development (IARD). S-U grades only. S. Kyle.
Problem-solving project entailing either fieldwork and/or library work. The aim of the project is to give students supervised experience in dealing intellectually and analytically with a professional problem

related to a substantive area of international agriculture and rural development.

IARD 602(6020) Agriculture in Developing Nations II (also FD SC 602[6020])
Spring, field trips to Gulf Region of Mexico (sec 1) and India (sec 2) during Jan. intersession. 3 credits. Prerequisites: IARD 402 and (or) permission of instructors. Cost of field-study trip (including airfare, local transportation, and lodging; some merit and need-based financial aid may be available): approx. $2,500. T R 2:30–4:25 until midterm only. R. W. Blake, T. W. Tucker and C. F. Nicholson (Mexico); K. V. Raman and W. R. Coffman (India).
Designed to provide students with an opportunity to observe agricultural development in tropical Mexico or India and to promote interdisciplinary exchange among faculty, staff, students and their Mexican and Indian counterparts. A two-week field-study trip in January is followed by discussions, written projects and oral presentations dealing with problems in food, agriculture and livestock production in the context of social and economic conditions of the Gulf Region of Mexico and India.

IARD 603[6030] Administration of Agricultural and Rural Development (also GOVT 692)
Spring. 4 credits. N. T. Uphoff and T. W. Tucker.
Intercollege course designed to provide graduate students with a multidisciplinary perspective on the administration of agricultural and rural development activities in developing countries. The course is oriented to students in agricultural or social sciences who may have administrative responsibilities during their professional careers.

IARD 612(6120) Patents, Plants, and Profits: Intellectual Property Management for Scientists and Entrepreneurs (also PL BR 612[6120])
Spring. 2 credits. Prerequisite: senior or graduate standing. S-U grades optional. A. F. Krattiger, R. Potter, and R. D. Kryder.
For description, see PL BR 612.

IARD 620(6200) Rural Livelihoods and Biological Resources: Technologies and Institutions
Fall, spring. 1–2 credits. S-U grades only. Biweekly, TBA. C. Barrett, A. Pell, and E. Fernandes.
Seminar exploring issues that straddle the boundaries of the biological and social sciences as they relate to rural livelihoods, food security, and the management of biological resources. Students taking the 1-credit option participate in seminars and panels. Students taking the 2-credit option must also participate in a group project.

IARD 685(6850) Training and Development: Theory and Practice [also EDUC 685(6850)]
Spring. 4 credits. S-U grades optional. M. Kroma.
Analysis, design, and administration of training programs for the development of human resources in small-farm agriculture, rural health and nutrition, literacy as nonformal education, and general community development. Designed for scientists, administrators, educator-trainers, and social organizers in rural and agricultural development programs in the United States and abroad.

IARD 694(6940) Graduate Special Topics in IARD
Fall or spring. 1–4 credits. S-U or letter grades. Staff.
The department teaches "trial" courses under this number. Offerings vary by semester and are advertised by the department before the semester starts. Courses offered under the number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

IARD 696 Agroecological Perspectives for Sustainable Development (also NTRES/CSS 696[6960])
Fall, spring. 1 credit. S-U grades only. L. Fisher and L. Buck.
A variety of speakers present seminars on agroecological topics relating to sustainable development throughout the world. Students are required to prepare a synopsis of each seminar.

IARD 697–698(6970–6980) International Development M.P.S. Seminar
Fall, spring. 1 credit. S-U grades only. N. Uphoff.
For M.P.S. students to discuss important issues in international development and to prepare them to write their project papers. Specific content varies.

IARD 699(6990) International Agriculture and Rural Development M.P.S. Project Seminar
Fall, spring. 1 credit. S-U grades only. Prerequisite: required for, and limited to, M.P.S. IARD students or permission of instructor. S. C. Kyle.
Provides students with the opportunity to develop and present their special projects. Also serves as a forum for discussion of current issues in low-income agricultural and rural development, with particular attention to interdisciplinary complexities.

IARD 783(7830) Farmer-Centered Research and Extension [also EDUC 783(7830)]
Fall. 3 credits. S-U or letter grades. M. Kroma and T. Tucker.
Introduction to participatory traditions in farming systems research, extension, evaluation of rural development, technology generation, gender analysis, participatory rural appraisal, and documentation of local and indigenous knowledge of community-based development. Case studies of farmer-centered research and extension provide a focus for analysis. Appropriate roles of researchers and extensionists as partners with farmers are examined. A major contribution of farmer-centered research and extensions is its potential to legitimize people's knowledge by enhancing their capacity to critically analyze their own problems, to conduct their own research, and to empower them to take direct action to solve those problems.

Related Courses in Other Departments

In addition to international agriculture and rural development (IARD) courses, many other courses have an international focus. The following are suggested relevant courses:

Applied Economics and Management

International Trade and Monetary Economics (AEM 230)

*International Agribusiness Study Trip (AEM 329)

International Trade Policy (AEM 430)

*Food Marketing Colloquium (AEM 446/447)

Global Marketing Strategy (AEM 449)

Seminar on Agricultural Trade Policy (AEM 730)

Agriculture and Life Sciences

*Agriculture Study Tour to Burgundy, France (ALS 402)

*Internship Opportunities in Burgundy, France (ALS 403)

Global Seminar (NTRES 480/FD SC 480/IARD 480)

Animal Science

Tropical Livestock Production (AN SC 400)

Tropical Forages (AN SC 403)

Asian Studies

Southeast Asia Seminar: Country Seminar (ASIAN 601)

Biology

Biology of the Neotropics (BIOEE 405)

Food, Agriculture, and Society (BIOEE 469)

The Healing Forest (BIOPL 348)

Communication

Communication in the Developing Nations (COMM 424)

City and Regional Planning

Seminar in International Planning (CRP 671)

Seminar in Project Planning in Developing Countries (CRP 675)

Crop and Soil Science

Properties and Appraisal of Soils of the Tropics (CSS 471)

Ecology of Agricultural Systems (CSS 473)

Tropical Cropping Systems (CSS/IARD 314)

Development Sociology

Comparative Issues in Social Stratification (D SOC 370)

Education, Inequality, and Development (D SOC 305)

International Development (D SOC 205)

Population Dynamics (D SOC 201)

Population, Environment, and Development in Sub-Saharan Africa (D SOC 495)

Population Policy (D SOC 418)

Migration and Population Redistribution (D SOC 430)

Social Indicators, Data Management, and Analysis (D SOC 213)

Sociological Theories of Development (D SOC 606)

Sustainable Development (D SOC 261)

The Sociology of "Third World" States (D SOC 725)

Education

Farmer-Centered Research and Extension (EDUC/IARD 783)

Natural Resources

Global Ecology and Management (NTRES 322)

Environmental Governance (NTRES 331)

International Conservation: Communities and the Management of the World's Natural Resources (NTRES 434)

Seminar in Ecoagriculture (NTRES 694)

Nutritional Science

Nutritional Problems in Developing Nations (NS 306)

Integrating Food Systems and Human Needs (NS 380)

National and International Food Economics (NS 457)

International Nutrition Problems, Policy, and Programs (NS 680)

Plant Breeding

Plants, Genes, and Global Food Production (PL BR 201)

Crop Evolution, Domestication, and Diversity (PL BR 404)

*Includes overseas travel

INFORMATION SCIENCE

W. Y. Arms, C. Cardie, codirectors; J. Abowd, G. Bailey, M. Barazangi, L. Blume, R. Caruana, R. Constable, D. Easley, S. Edelman, E. Friedman, G. Gay, J. Gehrke, T. Gillespie, P. Ginsparg, C. P. Gomes, J. Halpern, J. Hancock, A. Hedge, D. P. Huttenlocher, R. Jarrow, T. Joachims, J. Kleinberg, L. Lee, A. E. Leiponen, B. Lust, M. Macy, P. Martin, A. Moore, L. O'Neill, R. Prentice, M. Rooth, D. Seber, B. Selman, P. Sengers, J. Shanmugasundaram, D. Shmoys, M. Spivey, D. Strang, E. Tardos, E. Wagner, J. Walther, S. Wicker, D. Williamson, C. Yuan

INFO 130(1300) Introductory Design and Programming for the Web (also COM S 130[1300])
Fall. 3 credits.
For description, see COM S 130 in CIS section.

INFO 172(1700) Computation, Information, and Intelligence (also COGST 172, COM S 172[1700], and ENGRI 172[1700])
Fall. 3 credits. Prerequisites: some knowledge of differentiation; permission of instructor for students who have completed equivalent of COM S 100.
For description, see COM S 172 in CIS section.

[INFO 214(2140) Cognitive Psychology (also COGST/PSYCH 214[2140])
Fall. 3 credits. Limited to 175 students. Prerequisite: sophomore standing. Graduate students: see INFO 614, PSYCH 614, or COGST 501. Not offered 2005–2006.
For description, see PSYCH 214.]

INFO 230(2300) Intermediate Design and Programming for the Web (also COM S 230[2300])
Spring. 3 credits. Prerequisite: COM S/INFO 130 or equivalent.
For description, see COM S 230 in CIS section.

INFO 245(2450) Psychology of Social Computing (also COMM 245[2450])
Fall. 3 credits.
For description, see COMM 245.

INFO 292(2921) Inventing an Information Society (also AM ST 292[2980], ECE/ENGRG 298[2980], HIST 292[2920], S&TS 292[2921])
Spring. 3 credits; may not be taken for credit after ECE/ENGRG 198.
For description, see ENGRG 298.

INFO 295(2950) Mathematical Methods for Information Science
Fall. 4 credits. Corequisite: MATH 231 or equivalent.
For description, see INFO 295 in CIS section.

INFO 330(3300) Applied Database Systems (also COM S 330[3300])
Fall. 3 credits. Prerequisites: COM S/ENGRD 211. COM S majors may use only one of the following toward their degree: COM S/INFO 330 or COM S 433.
For description, see COM S 330 in CIS section.

INFO 345(3450) Human–Computer Interaction Design (also COMM 345[3450])
Spring. 3 credits.
For description, see COMM 345.

INFO 349(3491) Media Technologies (also COMM 349[3490], S&TS 349[3491])
Spring. 3 credits.
For description, see S&TS 349.

INFO 355(3551) Computers: From the 17 C. to the Dot.com Boom (also S&TS 355[3551])
Fall. 4 credits.
For description, see S&TS 355.

INFO 356(3561) Computing Cultures (also S&TS 356[3561])
Spring. 4 credits. Prerequisites: none.
For description, see S&TS 356.

[INFO 387(3871) The Automatic Lifestyle: Consumer Culture and Technology (also S&TS 387[3871])
Spring. 4 credits. Not offered 2005–2006.
For description, see S&TS 387.

INFO 430(4300) Information Retrieval (also COM S 430[4300])
Fall. 3 credits. Prerequisite: COM S/ENGRD 211 or equivalent.
For description, see COM S 430 in CIS section.

INFO 431(4302) Web Information Systems (also COM S 431[4310])
Spring. 3 credits. Prerequisites: COM S 211 and some familiarity with web site technology.
For description, see COM S 431 in CIS section.

INFO 435(4350) Seminar on Applications of Information Science (also INFO 635[6350])
Spring. 3 credits. Prerequisites: background in computing, data structures, and programming at level of COM S 211 or equivalent; experience in using information systems.
For description, see INFO 435 in CIS section.

INFO 440(4400) Advanced Human–Computer Interaction Design (also COMM 440[4400])
Fall. 3 credits. Prerequisites: COMM/INFO 345 or permission of instructor.
For description, see COMM 440.

INFO 445(4450) Seminar in Computer-Mediated Communication (also COMM 445[4450])
Fall. 3 credits. Prerequisite: COMM/INFO 245.
For description, see COMM 445.

INFO 447(4470) Social and Economic Data (also ILRLE 447[4470])
Spring. 4 credits. Prerequisites: one semester of calculus, IS statistics requirement, at least one upper-level social science course, or permission of instructor.
For description, see INFO 447 in CIS section.

INFO 450(4500) Language and Technology (also COMM 450[4500])
Spring. 3 credits.
For description, see COMM 450.

INFO 490(4900) Independent Reading and Research
Fall, spring. 1–4 credits.
Independent reading and research for undergraduates.

INFO 491(4910) Teaching in Information Science, Systems, and Technology
Fall, spring. Variable credit.
Involves working as a TA in a course in the information science, systems, and technology major.

INFO 515(5150) Culture, Law, and Politics of the Internet
Fall. 4 credits.
For description, see INFO 515 in CIS section.

INFO 530(5300) The Architecture of Large-Scale Information Systems (also COM S 530[5300])
Spring. 4 credits. Prerequisite: COM S/INFO 330 or COM S 432.
For description, see COM S 530 in CIS section.

[INFO 614(6140) Cognitive Psychology (also COGST 614, PSYCH 614[6140])
Fall. 5 credits. Two components: PSYCH 214 (3 credits) and COGST 501 (2 credits). Intended for graduate students; undergraduates opting for 5 credits should enroll simultaneously in PSYCH 214 and COGST 501. Not offered 2005–2006.
For description, see PSYCH 614.]

INFO 630(6300) Representing and Accessing Digital Information (also COM S 630[6300])
Spring. 4 credits. Prerequisite: basic knowledge of linear algebra and probability theory; basic programming skills.
For description, see COM S 630 in CIS section.

[INFO 634(6341) Information Technology in Sociocultural Context (also S&TS 634[6341])
Fall. 4 credits. Prerequisite: permission of instructor. Not offered 2005–2006.
For description, see S&TS 634.

INFO 635(6390) Seminar on Applications of Information Science (also INFO 435[4350])
Spring. 3 credits. Prerequisites: background in computing, data structures, and programming at level of COM S 211 or equivalent, and experience in using information systems. Undergraduates and master's students should enroll in INFO 435; Ph.D. students should enroll in INFO 635.
For description, see INFO 635 in CIS section.

INFO 640(6400) Human–Computer Interaction Design (also COMM 640[6400])
Fall. 3 credits. Prerequisite: graduate standing or permission of instructor.
For description, see COMM 640.

INFO 645(6450) Seminar in Computer-Mediated Communication (also COMM 645[6450])
Spring. 3 credits. Prerequisite: COMM/INFO 245.
For description, see COMM 645.

[INFO 648(6648) Speech Synthesis by Rule (also LING 648[6648])
Spring. 4 credits. Prerequisite: LING 401, 419, or permission of instructor. Offered alternate years; not offered 2005–2006.
For description, see LING 648.]

INFO 685(6850) The Structure of Information Networks (also COM S 685[6850])
Fall or spring. 4 credits. Prerequisite: COM S 482.
For description, see COM S 685 in CIS section.

[INFO 694(6940) The Internet as a Social Phenomenon (COMM 694[6940])
Fall. 3 credits. Prerequisite: graduate standing; seniors by permission of instructor. Not offered 2005–2006.
For description, see COMM 694.]

INFO 747(7400) Social and Economic Data (GR-RDC) (ILRLE 740[7400])
Spring. 4 credits. Limited to Ph.D. and research master's students.
For description, see INFO 747 in CIS section.

[INFO 751(7002) Media Research and Critical Design
Fall or spring. 4 credits. Prerequisites: graduate-level training in science and technology studies, philosophy, critical theory, communication, artificial intelligence, human–computer interaction, or equivalent, or permission of instructor. Not offered every year.]

INFO 790(7900) Independent Research
Fall, spring. Variable credit. Prerequisite: permission of an information science faculty member.
Independent research for M.Eng. students and pre–A exam Ph.D. students.

INFO 990(9900) Thesis Research
Fall, spring. Variable credit. Prerequisite: permission of an information science faculty member.
Thesis research for post–A exam Ph.D. students.

LANDSCAPE ARCHITECTURE

K. L. Gleason, chair (446 Kennedy Hall, 255-1649); M. I. Adleman, S. Baugher, H. W. Gottfried, A. Hammer, P. H. Horrigan, R. Jaenson, D. W. Krall, L. J. Mirin, A. Okigbo, R. T. Trancik, P. J. Trowbridge, R. W. Venables

LA 140(1400) The Symbols of New York State's Cultural Landscape
Spring. 3 credits.
Lectures with slides and other media illustrate how successive waves of New Yorkers continually defined and redefined their sense of place and "the power of place" by references to natural symbols such as Niagara Falls and to human constructions such as towns of Iroquois long houses and cities of skyscrapers.

LA 141(1410) Grounding in Landscape Architecture
Fall. 4 credits. Limited to 15 students. Letter grades only. Fee for required drafting equipment plus materials for projects: approx. $250.
Introduction to the representation and design of landscapes and to working in a studio setting. Uses freehand drawing, measured drawing, and model making to understand design principles of the changing landscape.

LA 142(1420) Grounding in Landscape Architecture
Spring. 4 credits. Limited to approx. 20 students. Prerequisite: freshman landscape architecture majors or permission of instructor. Required drafting equipment plus project supplies: approx. $250.
Applies fundamentals of landscape design to small-scale site-planning projects. Work in the studio introduces students to the design process, design principles, construction materials, planting design, and graphics.

LA 155(1550) American Indian Cultural Landscapes: Changes in Time
Fall. 3 credits.
Lectures with slides and other media illustrate American Indian cultures and philosophies both before and after 1492. A major focus is on how all Indian societies, from hunting societies to agricultural communities, continually transformed their cultural landscapes. Lectures also include how European expansion forcefully transformed American Indian cultural landscapes.

LA 201(2010) Medium of the Landscape
Fall. 5 credits. Prerequisite: landscape architecture majors. Required drafting equipment, supplies, and fees: approx. $200; field trip: approx. $250.
Studio course emphasizing the design process and principles involved in organizing and giving form to outdoor space through the use of structures, vehicular and pedestrian circulation systems, earthforms, water, and vegetation.

LA 202(2020) Medium of the Landscape
Spring. 5 credits. Prerequisite: LA 201 with grade of C or better. Supplies and fees: approx. $250; field trip: approx. $250.
Focuses on the role of materials in design, design theory, and design vocabulary associated with landscape architecture projects.

LA 215(2150) Sophomore Seminar: Engaging Places
Fall. 4 credits. Lec, M W 2:55–4:10.
A. Hammer.
Explores how places come to be what they are, how they shape—and are shaped by—the people who live in them, how they become coordinates for plotting both a culture's biography and the meaning of a life. While the course serves as an introduction to cultural landscape studies, or the interaction of people and place, its focus is on writing: how do we represent the complexity of a place and our relation to it?

LA 261(2610) Fieldwork in Urban Archaeology [also CRP/ARKEO 261[2610]]
Fall. 4 credits.
Urban archaeologists study American Indian, colonial, and 19th-century sites that now lie within the boundaries of modern cities. This course explores how urban centers evolve; what lies beneath today's cities; and how various cultures have altered the urban landscape. Students participate in a local archaeological excavation. Three 8-hour Saturday field labs are required; students choose three labs from seven that are offered.

LA 262(2620) Laboratory in Landscape Archaeology (also ARKEO 262[2620])
Spring. 3 credits. Prerequisites: LA 261 or ARKEO 261 or permission of instructor.
Various American Indian civilizations and European cultures have altered the landscape to meet the needs of their cultures. Students learn how to interpret the American Indian and Euro-American landscapes of specific archaeological sites by identifying and dating artifacts, studying soil samples, and creating site maps.

[LA 263/547(2630/5470) American Indians, Planners, and Public Policy (also CRP 363/547[3630/5470])
Spring. 3 credits. Offered alternate years; not offered 2005–2006.
Decisions made by public agencies and private enterprise too often lead to the flooding, polluting, strip-mining, or other destruction of American Indian reservations, archaeological sites, and burial grounds. The central focus of this course is how to address urban and regional problems without imperiling the cultural survival of minorities.]

LA 266(2660) Jerusalem through the Ages [also NES 266(2660), JWST/ARKEO/RELST 266(2660)]
Fall. 3 credits.
Explores the history, archaeology, and natural topography of Jerusalem throughout its long life, from its earliest remains in the Chalcolithic period (ca. 4000 B.C.E.) to the 19th century, including Jebusite Jerusalem, Jerusalem as the capital of the Davidic dynasty, the Roman era city of Herod and Jesus, the Crusaders and medieval Jerusalem, and Ottoman Jerusalem as the city entered the modern era. Students examine the original historical sources (e.g., Bible, Josephus, and the Madeba map) that pertain to Jerusalem. Uses slides and videos to illustrate the natural features, human-built monuments, and artifacts that flesh out the textual material, providing a fuller image of the world's most prominent spiritual and secular capital.

LA 282(2820) The American Landscape
Fall. 3 credits.
Interdisciplinary study of the environmental and cultural history of the American landscape. Topics include the relation of landscape to culture, landscape use and ecological change, regional and national landscapes, and perceptions of landscape expressed in paintings, photographs, and literature.

LA 301(3010) Integrating Theory and Practice I
Fall. 5 credits. Prerequisite: LA 202 with grade of C or better. Supplies and fees: approx. $250; field trip: approx. $250.
Engages participants in the art and science of design. The studio focuses on site-scaled projects that consider significant cultural and natural landscapes. Explores theories of landscape restoration, sustainable design, and landscape representation through projects that derive form from site and place.

LA 302(3020) Community Design Studio
Spring. 5 credits. Prerequisite: LA 301 with grade of C or better. Supplies and fees: approx. $250; field trip: approx. $250.
Engages the theory and practice of participatory community design through a real community service project. Participants gain an understanding of how to integrate meaningful public service with design invention and creativity, engage rigorous design research methods, and understand how institutional and community contexts influence design problem-solving. Students are expected to work independently and collaboratively on team projects in a community. One class period per week is designated for community fieldwork. Studio theme to be announced.

LA 315(3150) Site Engineering I
Spring. 3 credits. Prerequisite: permission of instructor.
Lectures and studio projects focusing on the professional skills and knowledge required to competently and creatively develop grading plans for project-scale site design.

LA 316(3160) Site Engineering II
Fall. 2 credits. Prerequisite: LA 315 or permission of instructor.
Lectures and studio projects dealing with earthwork estimating; storm water management, site surveys, site layout, and horizontal and vertical road alignment.

LA 318(3180) Site Construction
Spring. 5 credits. Prerequisite: permission of instructor.
Emphasizes detail design and use of landscape materials in project implementation. Explores construction materials, including specifications, cost estimates, and methods used by landscape architects in project implementation are the foci for this course. Includes lectures, studio problems, and development of drawings leading to construction documentation for a comprehensive project. Participants also fabricate material prototypes in wood and metal.

[LA 360(3600) Pre-Industrial Cities and Towns of North America (also ARKEO 360[3600], CRP 360/666[3600/6660], LA 666[6660])
Fall. 3 credits. Not offered 2005–2006.
Various American Indian civilizations as well as diverse European cultures have all exerted their influences on the organization of town and city living. This course considers how each culture has altered the landscape in its own unique way as it created its own built environments.]

LA 402(4020) Integrating Theory and Practice II
Spring. 5 credits. Supplies and fees: approx. $250; field trip: approx. $250.
Studio focusing on the expression of design solutions that grow from and affirm an explicit sense of site and place. Social, cultural, physical, and historic factors and their relationships to site design and planning are critically explored through theory and practice in this studio.

LA 403(4030) Directed Study: The Concentration
Fall, spring. 1 credit. Prerequisite: landscape architecture undergraduates in final year of study.
Working with their adviser, students create a written and visual paper that documents the concentration intent.

LA 410(4100) Computer Applications in Landscape Architecture
Fall or spring. 3 credits. Limited to 15 students. Prerequisite: landscape architecture students.
Designed to develop a working knowledge of various computer software applications with emphasis on Autocad. Explores other applications relative to land-use planning and the profession of landscape architecture.

LA 412(4120) Professional Practice
Spring. 1 credit.
Presents the student with a comprehensive understanding of the role of the professional landscape architect and the problems and opportunities one may encounter in an office or in other professional situations. Topics include practice diversity, marketing professional services, office and project management, construction management, computers in the profession, and ethics.

LA 418(4180) New York Landscapes Oral History Project
Fall/spring. 3 credits. Limited to 15 students. Letter grades only.
Long-term project documenting the changing face of New York agriculture. Gives students hands-on experience in audio documentary, in creating aural portraits of rural landscapes and communities undergoing critical change. Students talk to people about their lives and work, explore local soundscapes—what Donald Ihde calls "the noise and voice of the environment, of the surrounding lifeworld"—make field recordings, write and prepare pieces for the ear, and use the Pro Tools digital editing system to create compelling pieces for listening. The course encourages students to listen more deeply to the changing world around them, while it offers New Yorkers an occasion to speak meaningfully about the decisions they face.

LA 483(4830) Seminar in Landscape Studies
Spring. 3 credits. Prerequisite: senior or graduate standing in any major or field.
Topical seminar with a different subject and method each time it is offered. Subject and schedule include "Landscape and Visual Culture," spring 2006—an inquiry into the visual construction of landscape and landscape representation in visual (painting, photography, film, graphic design) and written texts.

LA 486(4860) Placemaking by Design
Fall. 3 credits. Limited to 20 students. Priority given to juniors, seniors, and graduate students. S-U grades optional.
Seminar providing an understanding of contemporary planning and landscape architecture design strategies that reaffirm and reclaim a sense of place. Readings and discussions focus on the theory and practice of placemaking as represented in the literature and in built works. Addresses the following questions: What constitutes a place-based design approach and what distinguishes it from other more conventional design approaches? Who are the key players shaping the theory and practice of placemaking?

LA 491(4910) Creating the Urban Eden: Woody Plant Selection, Design, and Landscape Establishment (also HORT 491[4910])
Fall. 4 credits. Limited to 48 students. Prerequisite: horticulture or landscape architecture majors or permission of instructors. Preregistration required. Supplies: approx. $50; field trips: approx. $50.
Focuses on the identification, uses, and establishment of woody plants in urban and garden settings. By understanding the environmental limitations to plant growth, students are able to critically assess potential planting sites; select appropriate trees, shrubs, vines, and ground covers for a given site; and learn about the principles and practices of site amelioration and plant establishment. Design followed by written specifications and graphic details is produced to implement these practices.

LA 492(4920) Creating the Urban Eden: Woody Plant Selection, Design, and Landscape Establishment (also HORT 492[4920])
Spring. 4 credits. Limited to 48 students. Prerequisite: horticulture or landscape architecture majors or permission of instructors; passing grade in HORT/LA 491. Preregistration required. Supplies: approx. $50; field trips: approx. $50.
Second half of course focusing on winter identification, uses, and establishment of woody plants in urban and garden settings. Issues of site assessment and soil remediation are emphasized in addition to soil volume calculations, drainage and surface detailing, and planting techniques. Students critically assess potential planting sites; and select appropriate trees, shrubs, vines and ground covers for a given site. Designs for specific sites are followed by written specifications, and graphic details are produced to implement these proposals. Students implement, in a hands-on manner, site remediation and planting techniques they have learned by creating new landscapes that serve to integrate theory, principles, and practices. Together, HORT/LA 491 and 492 constitute an integrated course.

LA 494(4940) Special Topics in Landscape Architecture
Fall or spring. 1–3 credits; may be repeated for credit. S-U grades optional.
Topical subjects in landscape architectural design, theory, history, or technology. Group study of topics not considered in other courses.

LA 495(4950) Green Cities: The Future of Urban Ecology (also CRP 384/584[3840/5840])
Fall. 4 credits.
Explores the history and future of the ecology of cities and their role in solving the present global ecological crisis. Examines the politics, design, and economics of "green cities" in terms of transportation, renewable energy, solid waste and recycling, land use, and the built environment.

LA 497(4970) Individual Study in Landscape Architecture
Fall or spring. 1–5 credits; may be repeated for credit. Students must register using independent study form (available in 140 Roberts Hall). S-U grades optional.
Work on special topics by individuals or small groups.

LA 498(4980) Undergraduate Teaching
Fall or spring. 1–2 credits. Prerequisites: previous enrollment in course to be taught and permission of instructor. Students must register using independent study form (available in 140 Roberts Hall).
Designed to give qualified undergraduates experience through actual involvement in planning and teaching courses under the supervision of department faculty members.

LA 499(4990) Undergraduate Research
Fall or spring. 1–5 credits. Students must register using independent study form (available in 140 Roberts Hall).
Permits outstanding undergraduates to carry out independent research in landscape architecture under appropriate faculty supervision. Research goals should include description, prediction, and explanation, and should generate new knowledge in the field of landscape architecture.

LA 501(5010) Composition and Theory
Fall. 5 credits. Prerequisite: graduate standing. Drafting supplies and fees: approx. $250; field trip: approx. $250.
Basic principles of natural and cultural processes that form "places" in the landscape. Projects focus on design applied to the practice of landscape architecture: particularly the relationship between measurement, process, experience, and form at multiple scales of intervention.

LA 502(5020) Composition and Theory
Spring. 5 credits. Prerequisite: graduate standing. Drafting supplies and fees: approx. $250; field trip: approx. $250.
Studio focusing on the spatial design of project-scale site development. Students develop their expertise in applying the design theory, vocabulary, and graphic expression introduced in LA 501.

LA 505(5050) Landscape Representation I
Fall. 3 credits. Co-requisite: LA 501 or permission of instructor.
Introduces students to both conventional and unconventional modes of landscape architectural design representation. Teaches drafting, orthographic drawing, axonometric project, lettering, analysis, and concept drawing alongside more expressive modes of direct site study and representation.

LA 506(5060) Graphic Communication II
Spring. 3 credits. Prerequisite: LA 505. Co-requisite: LA 502 or permission of instructor.
Intermediate-level course focusing on modes of landscape representation from ideation to presentation. Representation modes may include freehand, process drawing, analysis and orthographic drawing; concept modeling; composite drawings; and visual books.

LA 524(5240) History of European Landscape Architecture*
Fall. 3 credits.
*Offered through College of Architecture, Art, and Planning.

LA 525(5250) History of American Landscape Architecture*
Spring. 3 credits.
*Offered through College of Architecture, Art, and Planning.

[LA 545(5450) The Parks and Fora of Imperial Rome
Spring. 3 credits. Prerequisites: advanced standing in a design field, classics, or history of art, other disciplines, or permission of instructor.
Advanced seminar seeking an interdisciplinary group of students in classics, art history, archaeology, landscape architecture, horticulture, and architecture to bring their knowledge of Latin, Greek, Italian, archaeology, drawing, design, or computer modeling to a collaborative study of the ancient fora and public parks depicted on the Severan Marble plan of Rome. Opportunity for a spring break trip to Rome.]

[LA 569(5690) Archaeology in Preservation Planning and Site Design (also CRP 569[5690])
Spring. 3 credits. Offered alternate years; not offered 2005–2006.
In response to federal, state, and local legislation, historical archaeology now plays an important role in design, planning, and land-use decisions. Students develop the research skills needed to complete environmental review projects and historic landscape plans.]

LA 580(5800) Landscape Preservation: Theory and Practice
Fall. 3 credits. Prerequisite: junior, senior, or graduate standing.
Examines the evolving practice of landscape preservation in the United States. Topics include the recent history of the discipline, methodology in documentation of historic landscapes, and important practitioners and notable projects. Format is assigned readings and discussion, invited speakers, lectures, and a project documenting a local site.

LA 582(5820) The American Landscape
Fall. 3 credits.
Interdisciplinary study of the environmental and cultural history of the American landscape. Topics include the relation of landscape to culture, landscape use and ecological change, regional and national landscapes, and perceptions of landscape expressed in paintings, photographs, and literature. Graduate students complete additional outside work and attend an additional class session.

LA 590(5900) Theory Seminar
Spring. 3 credits. Prerequisite: senior or graduate standing.
Seminar in landscape design theory.

LA 598(5980) Graduate Teaching
Fall or spring. 1–3 credits. Prerequisite: permission of instructor. Students must register using independent study form (available in 140 Roberts Hall). Staff.
Designed to give qualified students experience through involvement in planning and teaching courses under the supervision of faculty members. The experience may include leading discussion sections, preparing, assisting in desk critiques, and presenting lectures. There are assigned readings and discussion sessions on education theory and practice throughout the semester. (Credit hours are determined by the formula: 2 hours per week = 1 credit hour).

LA 601(6010) Integrating Theory and Practice I
Fall. 5 credits. Prerequisite: graduate standing or permission of instructor. Supplies and fees: approx. $250.
Studio focusing on site-scaled projects that consider significant cultural and natural landscapes. Explores theories of landscape restoration, sustainable design, and landscape representation are explored through projects that derive form from site and place. The integration of site history, ecology, and site construction supports an understanding and relationship between design and site.

LA 602(6020) Integrating Theory and Practice II
Spring. 5 credits. Prerequisite: graduate standing. Drafting supplies and fees: approx. $250; field trip: approx. $250.
Studio building on prior course work with an expectation that participants can creatively manipulate the program and conditions of a site, with increased emphasis on contemporary construction technology. Focuses on the expression of design solutions that grow from and affirm an explicit sense of site and place. Social, cultural, physical, and historic factors and their relationship to site design and planning are critically explored through theory and practice.

LA 603(6030) Directed Study: The Concentration
Fall, spring. 1 credit. Prerequisite: landscape architecture graduate students in final year of study.
Working with their adviser, students create a written and visual paper that documents the concentration intent.

LA 615(6150) Site Engineering I
Spring. 3 credits. Prerequisite: permission of instructor.
Lectures and studio projects focusing on the professional skills and knowledge required to competently and creatively develop grading plans for project-scale site design.

LA 616(6160) Site Engineering II
Fall. 2 credits. Prerequisite: LA 615 or permission of instructor.
Lectures and studio projects dealing with earthwork estimating, storm water management, site surveys, site layout, and horizontal and vertical road alignment.

LA 618(6180) Site Construction
Spring. 5 credits. Prerequisite: permission of instructor.
Emphasizes detail design and use of landscape materials in project implementation. Explores materials, including specifications, cost estimates, and methods used by landscape architects in project implementation. Includes lectures, short studio problems, and the development of drawings leading to construction documentation for a comprehensive project. Participants also fabricate material prototypes in wood and metal.

[LA 666(6660) Pre-Industrial Cities and Towns of North America (also CRP 666[6660])
Fall. 3 credits. Offered alternate years.
Various American Indian civilizations as well as diverse European cultures have all exerted their influences on the organization of town and city living. This course considers how each culture has altered the landscape in its own unique way as it created its own built environments.]

LA 680(6800) Graduate Seminar in Landscape Architecture
Fall or spring. 1–3 credits; may be repeated for credit. Prerequisite: graduate standing. S-U grades optional.
Topical subjects in landscape architectural design, theory, history, or technology. Includes seminar topics and group study not considered in other courses.

LA 694(6940) Special Topics in Landscape Architecture
Fall or spring. 1–3 credits; may be repeated for credit. S-U grades optional.
Topical subjects in landscape architectural design, theory, history, or technology. Includes group study of topics not considered in other courses.

LA 701(7010) Urban Design and Planning: Designing Cities in the Electronic Age (also CRP 555[5550])
Fall. 5 credits. Prerequisite: graduate standing. Supplies and fees: approx. $250; required field trip: approx. $250.
Application of urban-design and town-planning techniques to specific contemporary problems of city environments. Investigates issues of urbanism and applies them to physical design interventions and spatial typologies involving the street, square, block, garden, and park systems. Introduces three-dimensional computer modeling and digital design media as tools for urban design. This is a specially arranged collaborative studio with the Department of City and Regional Planning.

LA 702(7020) Advanced Design Studio
Spring. 5 credits.
Capstone studio providing the opportunity to explore issues in contemporary landscape architecture and to integrate related fields. Topics include the influences of culture, history, and criticism, as well as reinterpretations of engineering and representation.

LA 800(8000) Master's Thesis in Landscape Architecture
Fall or spring. 9 credits.
Independent research, under faculty guidance leading to the development of a comprehensive and defensible design or study related to the field of landscape architecture. Work is expected to be completed in final semester of residency.

NATURAL RESOURCES

B. A. Knuth, chair (117 Fernow Hall, 255-2822); M. B. Bain, B. L. Bedford, B. Blossey, T. Brown, L. E. Buck, E. Cooch, P. Curtis, D. J. Decker, J. Enck, T. J. Fahey, T. A. Gavin, J. W. Gillett, G. Goff, J. R. Jackson, C. Kraft, M. E. Krasny, J. P. Lassoie, B. Lauber, R. A. Malecki, E. Mills, S. Morreale, M. Muskett, M. E. Richmond, L. Rudstam, R. Schneider, R. Sherman, P. J. Smallidge, C. R. Smith, K. Sullivan, P. Sullivan, J. Tantillo, N. Trautmann, S. Wolf, J. B. Yavitt

Note: Class meeting times are accurate at the time of publication. If changes occur, the department will provide new information as soon as possible.

NTRES 100(1001) Introduction to Environmental Studies
Summer. 3 credits. S-U grades optional. R. J. McNeil.
Discussion-centered course examining the interrelationships between the sciences, arts, and humanities as they relate to our environment. Students explore how we manage nature and negotiate with each other to meet our needs. Emphasis is on principles of ecology, economics, aesthetics, ethics, and law.

NTRES 101(1010) Introduction to the Field of Natural Resources
Fall. 3 credits. Prerequisite: first-year students in Department of Natural Resources. J. Lassoie.
Overview of the modern field of renewable natural resources. Focuses on identifying the components of knowledge required to understand the Earth's natural resources and ecological systems, and to participate intelligently in their conservation and management. Uses case studies introduce students to the scientific, ethical, and societal basis for protection and management of natural resources and their related environments. Students become actively engaged in data collection and analysis, use quantitative models to analyze and interpret data, explore the human dimensions of natural resource issues, and come to understand the complexities of the policy process and management strategies.

NTRES 201(2010) Environmental Conservation
Spring. 3 credits. T. Fahey.
At the beginning of the 21st century, our lives increasingly are touched by questions about environmental degradation at local, regional, and global scales. Business as usual is being challenged. This course stimulates students to go beyond the often simplistic portraits of the environmental dilemma offered by the mass media to gain a firmer basis for responsible citizenship and action on environmental issues.

NTRES 210(2100) Introductory Field Biology
Fall. 4 credits. Limited to 90 students. Prerequisite: sophomore or junior standing with adviser in natural resources or permission of instructor; BIOG 101 and 102 or equivalent. Cost of two required overnight weekend field trips: approx. $12. T. Gavin and C. Smith.
Introduction to methods of inventorying, identifying, and studying plants and animals. Students are required to learn taxonomy, natural history, and how to identify approximately 170 species of vertebrates and 80 species of woody plants. Stresses selected aspects of current ecological thinking. Emphasizes the interaction of students with biological events in the field and accurate recording of those events.

NTRES 220(2200) People, Values, and Natural Resources
Spring. 3 credits. J. Tantillo.
Cultural and political context for natural resources conservation and management in North America. Explores historical basis through analysis of North American environmental history, examining shifts in attitudes and conceptions of human relationships to natural resources and the environment. Reviews key laws guiding policy, conservation, and management of natural resources. Introduces concepts underlying the study of human attitudes, behaviors, institutions, and decision-making processes related to natural resource conservation and management.

NTRES 306(3060) Coastal and Oceanic Law and Policy
Summer. 2 credits. Special one-week course offered at Cornell's Shoals Marine Laboratory (SML), located on an island off Portsmouth, N.H. For more details and an application, contact SML office, G14 Stimson Hall. Staff.
Intended for students interested in careers in management of marine or coastal resources or in the natural sciences. Subjects include law and policy related to ocean dumping, marine sanctuaries, environmental impact statements, water and air pollution, fisheries management, offshore gas and oil production, and territorial jurisdiction. Lectures on the status and history of law are accompanied by discussion of relevant policy and efficacy of various legal techniques. A case study that requires extensive use of the laboratory's library and personnel is assigned. The week concludes with a mock hearing.

NTRES 310(3100) Applied Population Ecology
Fall. 3 credits. Letter grades only. Prerequisite: completion of CALS math requirement or equivalent. Highly recommended: background in biology or ecology. E. Cooch.
In-depth analysis of the ecological factors influencing the natural fluctuation and regulation of animal population numbers. Examines models of single- and multi-species population dynamics, with emphasis on understanding the relationship between ecological processes operating at the individual level and subsequent dynamics at the population level. Significant emphasis is placed on principles as applied to conservation and management.

NTRES 311(3110) Fish Ecology, Conservation, and Management
Spring. 3 credits. Prerequisites: NTRES 210 or permission of instructor. Recommended: NTRES 310 or a general ecology course. E. Mills, L. Rudstam, and R. Jackson
Covers basic principles of fish ecology at the individual, population, and community level, particularly as they relate to interactions between fish and the aquatic environment. Emphasizes the application of these principles to the conservation and management of fisheries resources and aquatic habitats. Provides illustrative examples from current literature and case studies.

NTRES 312(3111) Fish Ecology Laboratory
Spring, two weekend field trips. 1 credit. Pre- or co-requisite: NTRES 311. E. Mills, L. Rudstam, and R. Jackson.
Two overnight weekend field trips to the Cornell Biological Field Station and the Adirondack Field Station. Activities include experiences with various fish sampling gear and analysis of collected samples. Discussions about sampling considerations and inferences we can make by contrasting the ecology of fish in lakes of different productivity. Includes visit to a state of the art fish hatchery and evening discussion session during the field trips. Written reports required.

NTRES 313(3130) Biological Statistics I (also BTRY 301[3010])
Fall. 4 credits. Prerequisite: one semester of calculus. P. J. Sullivan.
Develops statistical methods and applies them to problems encountered in the biological and environmental sciences. Methods include data visualization, population parameter estimation, sampling, bootstrap resampling, hypothesis testing, the Normal and other probability distributions, and an introduction to modeling. Applied analysis is carried out in the Splus statistical computing environment.

[NTRES 314(3140) Conservation of Birds
Spring or summer. 2 credits. Prerequisite: NTRES 210 or permission of instructor. Offered alternate odd years; next offered 2007. C. R. Smith.]

[NTRES 315(3141) Conservation of Birds Laboratory
Spring or summer. 1 credit. Co-requisite: NTRES 314. Saturday mornings, TBA. Offered alternate odd years; next offered 2007. C. R. Smith.]

NTRES 321(3210) Introduction to Biogeochemistry (also EAS 321[3210])
Fall. 4 credits. Prerequisites: college-level chemistry and a biology and/or geology course. J. B. Yavitt and L. A. Derry.
For description, see EAS 321.

NTRES 322(3220) Global Ecology and Management
Spring. 3 credits. Prerequisites: college-level biology and general ecology course. J. B. Yavitt.
The subjects of biogeography, ecology, and biodiversity have patterns and processes that emerge only at the global scale. Recognizing the global importance of these patterns and processes is even more imperative in light of the tremendous increase in the human population size and the effects of humans on the Earth. This course is an introduction to the field of global ecology. Topics include comparative ecology and biogeography, community ecology, island biogeography, and ramifications of global climatic change.

NTRES 323(3230) Principles of Toxicology (also TOX 323[3230])
Spring. 3 credits. Prerequisites: one year each of chemistry and biology with labs; one semester of organic chemistry lecture or permission of instructor. J. W. Gillett.
Introductory lecture course in human and environmental toxicology emphasizing basic principles (exposure, dose-response, effects) involved with pesticides, hazardous wastes, and natural products. Science-based assessments for risk analysis and policy are integrated with other considerations. Guest speakers and extensive case studies augment lectures and student team exercises applied to management.

NTRES 324(3240) Ecological Management of Water Resources
Spring. 3 credits. Prerequisites: introductory ecology and introductory chemistry or permission of instructor. R. Schneider.
In-depth analysis of those ecological and biological principles relevant to the management of fresh and marine water resources, with emphasis on the effects of water management on community ecology. Lectures and discussion integrate scientific literature with current management issues. Topics include linkages between hydrologic variability and communities; groundwater-surface connections, flow paths for dispersal, patchily distributed water resources, and water quality controls on organisms.

NTRES 325(3250) Forest Management and Maple Syrup Production
Spring. 3 credits. Letter grades only. Offered alternate even years. P. J. Smallidge.
Practical, field-oriented course emphasizing principles and practices of stewardship and multiple purpose management of small, nonindustrial, private forest land in the northeastern United States, including the production of maple syrup.

NTRES 326(3260) Applied Ecosystem Analysis Laboratory
Spring. 2 credits. Prerequisite: introductory biology; BIOEE 261 or permission of instructor. S. Morreale.
Field and lab course designed to provide experience with techniques for examining and measuring ecosystem structure and function, especially within the context of contemporary applied ecology. Tools and methods to study ecosystems include field sampling schemes and methods, measures of biodiversity and biomass, resource mapping, spatial referencing, and techniques to quantify soil and stream biota, decomposition, and physical and chemical factors controlling ecosystem structure and function.

NTRES 330(3300) Natural Resources Planning and Management
Fall. 3 credits. Prerequisite: junior standing. T. B. Lauber.
Focuses on terrestrial and aquatic resources. Emphasizes the comprehensive planning process and human dimensions of resource management. Students integrate biological, social, and institutional dimensions of management through case studies. Grades are based on individual and group performance.

NTRES 331(3310) Environmental Governance (also S&TS/B&SOC 331[3311])
Spring. 3 credits. S. Wolf.
Considers the question of environmental governance, defined as the assembly of social institutions that regulate natural resource use and shape environmental outcomes. Participants explore the roles of public policy, market exchange, and collective action in resource (mis)management. Introduces theoretical concepts from a variety of social science perspectives to support case studies and student-led discussions. Comparative analysis of how governance is pursued in different countries, historical periods, and ecological contexts (forestry, endangered species, water quality) highlight scope for institutional innovation. Students who wish to take the course for graduate credit should see NTRES 631.

NTRES 332(3320) Introduction to Ethics and Environment
Fall. 4 credits. J. Tantillo.
Introduction to ethics, aesthetics, and epistemology as related to the environment. Asks the question "How should I live?" and explores the implications of different answers to that question for our treatment of nature. Also examines the various approaches to ethics theory; the relations between art, literature, religion, and mortality; the objective nature of value judgments; and the subjective nature of nature.

NTRES 333(3330) Environmental Issues and Indigenous People (also AIS 330[3330])
Spring. 3 credits. M. Muskett.
Explores environmental perceptions and relationships held by indigenous people. Interpretations of the relationships between Indians and nature are examined through the concepts of connective and holistic interrelationship, community, identify, and the sacredness of nature. These concepts are illustrated with specific legal cases, stories, individual perceptions, and current environmental case studies.

NTRES 406(4060) Ecology Risk Assessment (also TOX 406[4060])
Fall. 3 credits. Prerequisites: BIOEE 261 or equivalent; an advanced students in natural sciences or engineering or permission of instructor. J. W. Gillett.
Strives to develop understanding of and competence in the different types of ecological (nonhuman health) risk assessments based on USEPA principles and methods. Focuses on cases for chemical, physical, and biological stressors in a variety of circumstances.

NTRES 410(4100) Conservation Biology: Concepts and Techniques
Fall. 4 credits. Limited to first 30 seniors, plus graduate students. Prerequisite: NTRES 210. Highly recommended: completion of, or concurrent enrollment in, NTRES 310. E. G. Cooch and T. A. Gavin.
Thorough analysis the ecological and quantitative dimensions for decision making in modern conservation biology and management. Emphasizes analysis of variation and maintenance of biological diversity, and focuses on principles and techniques, including demographic viability analysis of populations, genetic analysis, as well as aspects of the human dimensions of conservation biology.

NTRES 411(4110) Quantitative Ecology and Management of Fisheries Resources
Spring. 4 credits. S-U grades optional. Prerequisites: NTRES 313 recommended or permission of instructor. Offered alternate even years. P. J. Sullivan.
Examines the dynamics of marine and freshwater fisheries resources with a view toward observation, analysis, and decision making within a quantitative framework. Growing pressure on fisheries' resources, habitat modification, and increased uncertainty about the nature of biological systems are at the center of many fisheries' issues. Quantitative models are useful for integrating information needed by decision makers in addressing these issues. The course develops analytical methods to assess the dynamics and status of fisheries' resources and then demonstrates how the information may be transformed into useful information for decision makers.

[NTRES 412(4120) Wildlife Population Analysis: Techniques and Models
Spring. 3 credits. Prerequisites: NTRES 310 (or equivalent or permission of instructor), a college-level math or statistics course. Not offered 2005–2006; next offered 2007–2008. E. Cooch.]

NTRES 413(4130) Biological Statistics II (also BTRY 302[3020])
Spring. 4 credits. Prerequisite: NTRES 313 or BTRY 301. P. J. Sullivan.
Applies linear statistical methods to quantitative problems addressed in biological and environmental research. Methods include linear regression, inference, model assumption evaluation, the likelihood approach, matrix formulation, generalized linear models, single factor and multifactor analysis of variance (ANOVA), and a brief foray into nonlinear modeling. Applied analysis is carried out in the Splus statistical computing environment.

NTRES 414(4140) A Darwinian Perspective on Human Behavior and Natural Resources
Spring. 2 credits. Offered alternate even years. Pre-requisite: BIONB 221 or permission of instructor. T. Gavin.
Seeks to understand why human behavior, a product of natural selection and cultural factors, seems to result in environmental degradation. Once students understand the probable underlying basis for this human behavior, the course explores possible methods for altering this behavior.

NTRES 420(4200) Forest Ecology
Fall. 3 credits. Prerequisite: introductory biology. T. J. Fahey.
Comprehensive analysis of the distribution, structure, and dynamics of forest ecosystems. Topics include paleoecology of forests; ecophysiology of forest trees; disturbance, succession and community analysis; primary productivity; and nutrient cycling.

NTRES 421(4201) Forest Ecology Laboratory
Fall. 1 credit. Co-requisite: NTRES 420. Weekend trip: approx. $30. T. J. Fahey.
Field trips designed to familiarize students with the nature of regional forests and to provide experience with approaches to quantifying forest composition and its relation to environmental factors. Optional weekend field trips to Adirondacks and to the White Mountains, New Hampshire. Includes group research projects in local forests.

NTRES 422(4220) Wetland Ecology and Management—Lecture
Fall. 3 credits. Prerequisite: BIOEE 261. B. L. Bedford.
Examination of the structure, function, and dynamics of wetland ecosystems with an emphasis on principles required to understand how human activities affect wetlands. Topics include geomorphology, hydrology, biogeochemistry, plant and animal adaptations to wetland environments, and vegetation dynamics of freshwater and saline wetlands. Considers current regulations, protection programs, and management strategies.

NTRES 423(4221) Wetland Ecology and Management—Laboratory
Fall. 1 credit. Optional. Co-requisite: NTRES 422. One weekend field trip required. B. L. Bedford.
Integrated set of field and laboratory exercises designed to expose students to the diversity of wetland ecosystems; the vegetation, soils, water chemistry, and hydrology of wetlands in the region; methods of sampling wetlands vegetation, soils, and water; and methods of wetland identification and delineation.

NTRES 424(4240) Landscape Impact Analysis
Spring. 3 credits. Prerequisites: junior standing; one introductory and one advanced course in ecology or equivalents. B. L. Bedford.
Presents ecological concepts and analytical tools needed to evaluate environmental impacts to natural resources and ecosystems within an integrated context that incorporates the landscapes in which these resources occur. Explores diverse conceptual frameworks for landscape impact analysis and exposes students to modern tools for evaluating landscapes.

NTRES 426(4260) Practicum in Forest Farming as an Agroforestry System (also HORT/CSS 426[4260])
Fall. 2 credits. Lab, W 1:25–4:25. K. W. Mudge, L. E. Buck, and P. Hobbs.
Students actively take part in the development and management of a 70-year-old nut grove originally planted at Cornell in the 1930s. The MacDaniel's Nut Grove is being developed as a multipurpose forest-farming teaching, research, and extension site. Hands-on activities include all or most of the following: temperate-nut harvest and variety evaluation, mushroom culture, small-fruit and fruit-tree culture, medicinal-herb culture, site evaluation and planning, and field trips to other agroforestry-related sites. Outdoor activities are integrated with selected readings via an online discussion board.

[NTRES 427(4270) Ecoregions: Ecology and Conservation
Spring. 2 credits. Prerequisites: NTRES 210, 310; junior standing or above. Recommended: statistics course. Lec/lab. Letter grades only. Offered alternate even years; not offered 2005–2006. C. R. Smith.]

NTRES 430(4300) Environmental and Natural Resources Policy Processes
Spring. 3 credits. Prerequisites: junior standing; special application process. Lec, Wash., D.C., during Jan. 11-day winter session; three two-hour orientation sessions in fall semester and four two-hour sessions in Feb. and March. Fee: approx. $400. Completed applications due by October 13. Applications available by contacting map10@cornell.edu or at www.dnr.cornell.edu/teaching/ugrad/courses/. B. A. Knuth.
Intensive exploration of the environmental policy process and its conceptual framework. Recognizing and defining natural resource or environmental problems and issues; aggregating interests; agenda-setting; formulating and selecting alternative solutions; implementation and evaluation stages; roles of lobbyists, legislature, executive branch, and other actors. Case studies; presentations by and discussions with about 20 prominent Washington policymakers who appear as guest lecturers. Required interviews, term paper, and oral reports.

NTRES 431(4310) Environmental Strategies
Spring. 3 credits. S. Wolf.
How is conservation of natural resources pursued in today's institutional environment? This course focuses on opportunities to mobilize market mechanisms and competitive strategies of firms to harmonize social and ecological demands on environmental systems. Through production of a portfolio of analyses of real-world integrated environmental management schemes, students explore the mechanics of this general class of policy tools and develop a critique as to why the market does not represent a comprehensive approach to sustainability.

NTRES 432(4320) Human Dimensions of Natural Resource Management
Spring. 3 credits. Prerequisite: junior or senior standing. S-U grades optional. J. Enck.
Focuses on how a social science–based understanding of human attitudes, values, and behaviors can be incorporated in natural resource management decisions and actions. Uses examples from federal, state, and nongovernmental fish, wildlife, and forest management programs to illustrate the importance of socioeconomic considerations in problem solving and decision making.

NTRES 433(4330) Applied Environmental Philosophy
Spring. 3 credits. Recommended: NTRES 332. J. Tantillo.
Focuses on environmental philosophy and environmental ethics considered as an academic field. Major themes include anthropocentrism versus non-anthropocentrism, intrinsic value, monism versus pluralism, animal rights versus environmental ethics, and various approaches to environmental ethics, including deep ecology, ecofeminism, and pragmatism.

NTRES 434(4340) International Conservation: Communities and the Management of the World's Natural Resources
Spring. 3 credits. Letter grades only. J. Lassoie.
Lectures, readings, and multimedia information, including the Internet, build a multidisciplinary understanding of the principles underpinning conservation and natural-resource management. Specific attention is given to the role of local communities in developing sustainable land-use strategies. Case studies from Africa, Latin America, China, and the United States examine particular conservation and management issues from widely different geopolitical perspectives. Stakeholder analyses are used to base discussions of each case, followed by a synthesis and discussion of key contrasts and comparisons centered on common themes identified during the course.

NTRES 444(4440) Resource Management and Environmental Law (also CRP 444[4440])
Spring. 3 credits. Prerequisite: junior, senior, or graduate standing. S-U grades optional. R. Booth.
For description, see CRP 444.

NTRES 456(4560) Stream Ecology (also BIOEE 456[4560])
Fall. 4 credits. Limited to 40 students. Prerequisite: BIOEE 261 or permission of instructor. S-U grades optional. One S field trip. Offered alternate odd years. C. Kraft and A. Flecker.
Lecture examines patterns and processes in stream ecosystems, including geomorphology and hydrology, watershed–stream interactions, trophic dynamics, biogeochemistry, disturbance, and conservation and management. Field and laboratory exercises focus on experimental and analytical techniques used to study stream ecosystems, including techniques to measure stream

discharge, physical habitat, water chemistry, and stream biota. Field project with lab papers.

NTRES 480(4800) Global Seminar: Building Sustainable Environments and Secure Food Systems for a Modern World (also FD SC/IARD 480[4800])

Spring. 3 credits. Prerequisite: junior, senior, or graduate standing. J. Lassoie and D. Miller.

Modernization has led to development pressures that have increasingly disrupted natural systems leading to widespread concerns about the long-term viability of important environmental services, including those critical to food security worldwide. This multidisciplinary course uses case studies to explore interrelationships among social, economic, and environmental factors basic to sustainable development. Cases include population growth, genetically modified foods, biodiversity, sustainable tourism, global warming, and global responsibility. Cornell faculty members lead discussions in each of the major topic areas. In addition, students participate in discussions and debates with students from Sweden, Costa Rica, Honduras, South Africa, and Australia through live interactive videoconferences and electronic discussion boards.

NTRES 493(4930) Individual Study in Resource Policy, Management, and Human Dimensions

Fall, spring, or winter. Credit TBA. Prerequisite: permission of instructor. S-U grades optional. Students must register using independent study form (available in 140 Roberts Hall). R. A. Baer, T. Brown, L. E. Buck, D. J. Decker, J. Enck, J. Gillett, B. Knuth, T. B. Lauber, M. Muskett, J. Tantillo, and S. Wolf.

Topics in environmental and natural resource policy, management, and human dimensions are arranged depending on the interests of students and availability of staff.

NTRES 494(4940) Special Topics in Natural Resources

Fall or spring. 4 credits max. S-U grades optional.

The department teaches "trial" courses under this number. Offerings vary by semester, and are advertised by the department before the semester starts. Courses offered under the number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

NTRES 495(4850) Individual Study in Fish and Wildlife Biology and Management

Fall or spring. Credit TBA. Prerequisite: permission of instructor. S-U grades optional. Students must register using independent study form (available in 140 Roberts Hall). M. Bain, E. Cooch, P. Curtis, T. Gavin, J. R. Jackson, C. Kraft, R. Malecki, E. Mills, S. Morreale, M. Richmond, L. Rudstam, C. Smith, and P. Sullivan.

Topics in fish and wildlife biology and management are arranged depending on the interests of students and availability of staff.

NTRES 496(4960) Individual Study in Ecology and Management of Landscapes

Fall or spring. Credit TBA. Prerequisite: permission of instructor. S-U grades optional. Students must register using independent study form (available in 140 Roberts Hall). B. Bedford, B. Blossey, T. Fahey, M. Krasny, J. Lassoie, R. Schneider, R. Sherman, P. Smallidge, and J. Yavitt.

Topics in ecology and management of landscapes are arranged depending on the interests of students and availability of staff.

NTRES 497(4970) Honors Research in Natural Resources

Fall or spring. 1–6 credits, variable; may be repeated for credit. Prerequisite: enrollment in NTRES honors research program; students must register using independent study form (available in 140 Roberts Hall). NTRES Staff.

Intended for students pursuing the research honors program in natural resources. Students must complete the CALS Honors program application by the third week of the fall semester of their senior year. The research supervisor should be a faculty member or senior research associate within NTRES.

NTRES 498(4980) Teaching in Natural Resources

Fall and spring. 1–4 credits. Prerequisite: permission of instructor. Students must register using independent study form (available in 140 Roberts Hall). S-U grades optional.

Designed to give students an opportunity to obtain teaching experience by assisting in labs, field trips for designated sections, discussions, and grading. Students gain insight into the organization, preparation, and execution of course plans through application and discussions with instructor.

NTRES 500(5900) Professional Projects—M.P.S.

Fall and spring. Credit TBA. Prerequisite: M.P.S. graduate students working on professional master's projects. S-U grades only.

NTRES 600(6000) Introduction to Graduate Study in Natural Resources

Fall. 2 credits. Prerequisite: beginning graduate students whose faculty advisers are in Natural Resources. S-U grades. Lec TBA.

Includes faculty-led discussions of key natural resource issues, student discussions of research ideas, and skill building sessions on proposal writing and giving research presentations. Students are required to complete a research proposal.

NTRES 601(6010) Seminar on Selected Topics in Natural Resources

Fall or spring. 1 credit. S-U grades only. Times TBA. Check with department for availability. Staff.

Selected readings and discussions of research and/or current problems in natural resources. Offering varies by semester and is subject to availability of staff.

NTRES 603(6030) Inquiry Science Outreach in Secondary Schools (also EDUC 603[6030])

Fall or spring. 1 credit. Prerequisite: recipients of fellowships from Cornell Science Inquiry Partnerships (CSIP) program. S-U grades. N. Trautmann, L. Tompkins, and M. Krasny.

Prepares graduate students who receive Cornell Science Inquiry Partnerships fellowships for outreach work in high school and middle school science classes. Participants explore effective strategies for inquiry-based learning and review core educational issues such as learning standards, working with students of various ability levels, and assessing student learning.

NTRES 604(6040) Seminar on Selected Topics in Resource Policy and Management

Fall. 2 credits. S-U grades only. Times TBA. Check with department for availability.

Special topics seminar on subjects related to resource policy and management. Offering varies by semester and is subject to availability of staff.

NTRES 605(6050) Issues in Risk Analysis Seminar (also CEE 605[6050])

Fall. 1 credit. Prerequisite: calculus course, advanced course in statistics and basic natural sciences (chemistry, biology, earth systems). S-U grades only. Lec, TBA. J. Gillett and J. Stedinger.

Discussion of current issues and ongoing research on risk analysis issues from many perspectives with an emphasis on environmental risk analysis. Speakers address problem formulation, quantitative/qualitative methods in assessment of risks, communication issues, and challenges to risk assessment methodologies. Some sessions held jointly with other seminar series. Requires short reports and participation in two required discussion meetings for class members designed to integrate the issues raised during the semester.

NTRES 607(6070) Ecotoxicology (also TOX 607[6070])

Spring. 3 credits. Prerequisites: graduate or senior standing and two 300-level courses in chemistry, biological science, or toxicology. Offered alternate even years. J. W. Gillett.

Lectures, readings, and special guests focus on the principles of effects of toxic chemicals on natural ecosystems, their components, and processes. Major topics include fate and transport of chemicals (chemodynamics), comparative biochemical toxicology, ecosystem process analysis, simulation through mathematical and physical (microcosm) models, and relationships to regulation and environmental management.

NTRES 611(6110) Quantitative Ecology and Management of Fisheries Resources

Spring. 4 credits. S-U grades optional. Prerequisite: NTRES 313 or permission of instructor. Offered even years. P. J. Sullivan.

Taught in conjunction with NTRES 411 (see description above). Students taking the course for graduate credit are asked, in addition to the 400-level projects and homework, to construct and document a model of population or community dynamics that reflects and extends the concepts covered in the course.

[NTRES 612(6120) Wildlife Population Analysis: Techniques and Models
Spring. 3 credits. Prerequisites: NTRES 310 (or equivalent or permission of instructor), college-level math and statistics course. Not offered 2005–2006; next offered 2007–2008. E. Cooch.]

NTRES 614(6140) Fish and Wildlife Ecology Seminar
Fall and spring. 1 credit. Prerequisite: permission of instructor. Check with department for availability. Staff.
Discussion of individual research, current problems, and current literature in fish and in wildlife ecology. Offering varies by semester and subject to availability.

NTRES 615(6150) Case Studies and Special Topics in Agroforestry
Fall. 2 credits. S-U grades only. Prerequisites: graduate standing or permission of instructor. Offered alternate odd years. J. P. Lassoie.
Multidisciplinary examination of the principles and practices of agroforestry in developed and developing countries through discussions of specific case studies and key research and development literature. Students, working individually or in teams, prepare written reviews and analyses of original cases or contemporary topics in agroforestry for presentation to the class.

NTRES 616(6160) Forest Science and Management Seminar
Fall. 1 credit. Prerequisite: upper-level undergraduate or graduate standing. J. B. Yavitt.
Reviews current literature, student research, and selected topics of interest. Topics include biogeography, ecology, and human use of forests located in boreal, temperate, and/or tropical environments.

NTRES 631(6310) Environmental Governance
Spring. 4 credits. S. Wolf.
For description, see NTRES 331. Students taking the course for graduate credit are required to read supplemental materials, undertake more complex research assignments, and participate in seminar discussion section.

[NTRES 670(6700) Spatial Statistics
Spring. 3 credits. Prerequisites: BTRY 601 and 602. Highly recommended: introductory GIS course. S-U grades optional. Offered alternate odd years; next offered 2006–2007. P. J. Sullivan.
Develops and applies spatial statistical concepts and techniques to ecological and natural resource issues. Topics include visualizing spatial data and analysis and modeling of geostatistical, lattice, and spatial point processes. Students should consider taking this course simultaneously with CSS 620.]

NTRES 694(6940) Special Topics in Natural Resources
Fall or spring. 4 credits max. S-U grades optional.
The department teaches "trial" courses under this number. Offerings vary by semester, and are advertised by the department before the semester starts. Courses offered under the number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

NTRES 696(6960) Agroecological Perspectives for Sustainable Development (also IARD/CSS 696[6960])
Fall and spring. 1 credit. S-U grades only. F 12:20–1:10. L. Buck, L. Fisher, and S. DeGloria.
For description, see IARD 696.

NTRES 698(6980) Current Topics: Environmental Toxicology (also TOX 698[6980])
Fall, spring. 1–3 credits. Prerequisites: senior or graduate standing in scientific discipline and permission of instructor.
Student-faculty colloquium on subjects of current interest, usually focusing on multidisciplinary aspects of topical problems (e.g., Superfund, oil spills).

NTRES 699(6990) Graduate Individual Study in Natural Resources
Fall or spring. Credit TBA. Prerequisite: permission of instructor. S-U grades optional. NTRES graduate faculty.
Study of topics in natural resources more advanced than, or different from, other courses. Subject matter depends on interests of students and availability of staff.

NTRES 800(8900) Master's Thesis Research
Fall and spring. Credit TBA. Prerequisite: graduate students working on master's thesis research. S-U grades only.

NTRES 900(9900) Graduate-Level Thesis Research
Fall and spring. Credit TBA. Prerequisite: Ph.D. students **before** "A" exam has been passed. S-U grades only.

NTRES 901(9910) Doctoral-Level Thesis Research
Fall and spring. Credit TBA. Prerequisite: Ph.D. candidates after "A" exam has been passed. S-U grades only.

Related Courses in Other Departments

Courses in many other departments are relevant to students majoring in natural resources. The following list includes some of the most closely related courses but is not exhaustive.

Environment and Society (D SOC 208, 324, 340, 410, 438, 495)

Ecology and Biology (ENTOM 370, 470, 471; BIOEE 261, 263, 274, 278, 452, 457, 459, 461, 462, 463, 465, 466, 468, 471, 472, 475, 476, 478; BIOMI 290–292, 397, 418)

Environmental Law, Ethics, and Philosophy (S&TS 206; CRP 380, 443, 444, 451, 453; PHIL 241, 246, 247, 381)

Human Systems and Communication (COMM 260, 285, 352, 421)

Physical Sciences (BEE 151, 301, 371, 427, 435, 471, 473, 475, 478; CSS 260, 365, 372, 398, 483; EAS 102, 104, 321; CEE 432)

Public Policy and Politics (GOVT 427, 428; B&SOC 461)

Resource Economics (AEM 250, 450, 451)

Spatial Data Interpretation (CSS 411, 420, 620, 660)

PLANT BREEDING

T. Brutnell, E. S. Buckler, W. R. Coffman, W. De Jong, J. J. Doyle, E. D. Earle, V. Gracen, P. Gregory, A. F. Krattiger, S. Kresovich, M. M. Jahn, L. Li, S. R. McCouch, M. A. Mutschler, R. J. Nelson, K. V. Raman, T. L. Setter, M. E. Smith, M. E. Sorrells, S. D. Tanksley, D. R. Viands, W. Pawlowski. Emeritus: R. E. Anderson, H. M. Munger, R. P. Murphy, W. D. Pardee, R. L. Plaisted

Note: Class meeting times are accurate at the time of publication. If changes occur, the department will provide new information as soon as possible.

PL BR 201(2010) Plants, Genes, and Global Food Production
Fall. 2 credits. May be used for partial fulfillment of CALS distribution requirement GROUP B—Biological Sciences. Prerequisite: one year introductory biology or permission of instructor. Lec, T R 11:15. S. R. McCouch.
Introduces plant breeding; offers a sense of the historical and social importance of the field, tracing its evolution from the pre-scientific days of crop domestication to modern applications of biotechnology. Offers specific examples of how breeding objectives are realized and raises questions about the environmental, social, and economic consequences of intensive food production systems.

PL BR 225(2250) Plant Genetics
Spring. 3 or 4 credits; 2 credits if taken after BIOGD 281. Prerequisites: one year of introductory biology or equivalent; permission of instructor for students who have taken BIOGD 281. Lec, M W F 11:15–12:05; lab, R or F 1:25–4:25. M. Mutschler.
Surveys the fundamentals of plant genetics and shows how this information is used in plant biology and allied agricultural sciences and provides a basis for understanding the complex issues related to modern crop genetics. Topics include simple inheritance; linkage analysis; polyploidy; analysis of nuclear, chloroplast and mitochondrial genomes; pollination controls; and methods for analysis and manipulation of genes, chromosomes, and whole genomes. Examples and materials are drawn from diverse crops and plant species.

PL BR 299(2990) Introduction to Research Methods in Plant Breeding and Genetics
Fall, spring, or summer. 1–3 credits, variable. S-U grades only. Staff.
Intended for students who are new to undergraduate research. Students may be reading scientific literature, learning research techniques, or assisting with ongoing research. Students must identify a faculty supervisor who determines the work goals and the form of the final report.

PL BR 401(4010) Plant Cell and Tissue Culture
Fall. 3 credits. Prerequisite: plant biology or genetics course or permission of instructor. Recommended: concurrent enrollment in PL BR 402. Lec, T R 10:10. E. D. Earle.
Provides broad coverage of techniques of plant tissue, cell, protoplast, embryo, and anther culture and the applications of those techniques to biological and agricultural studies. Examples include horticultural, agronomic, and endangered species. Genetic

modification of plants via gene transfer and other manipulations of cultured cells is a major topic.

PL BR 402(4020) Plant Tissue Culture Laboratory
Fall. 1 credit. Limited enrollment. Pre- or co-requisite: PL BR 401 or permission of instructor. W or R 1:25–4:25 (alternate weeks) plus 1 hour TBA. E. D. Earle.
Provides hands-on experience in plant tissue culture and complements PL BR 401. Lab work includes cell, tissue and organ culture techniques related to plant propagation, germplasm storage, and genetic manipulations. Experiments use a broad range of plant materials and include protoplast culture and *Agrobacterium*-mediated gene transfer.

PL BR 403(4030) Genetic Improvement of Crop Plants
Fall. 3 credits. Prerequisites: BIOGD 281, PL BR 225, or other standard genetics course and course in crops or horticulture. M W F 9:05–9:55. V. Gracen.
Genetic enhancement of crop value to humans began with domestication and continues with farmers' variety development and scientifically trained plant breeders' applications of Mendelian, quantitative, and molecular genetics. This course examines crop genetic improvement methods by discussing the history and current practice of plant breeding, tools available to breeders, choices and modifications of those tools to meet specific objectives, and challenges plant breeders face in developing varieties for the future.

PL BR 404(4040) Crop Evolution, Domestication and Diversity (also BIOPL/IARD 404[4040])
Fall. 2 credits. Prerequisite: BIOGD 281 or PL BR 225 or permission of instructor. S-U or letter grades. Lec, T R 9:05.
S. Kresovich.
Evolution, domestication, and breeding of crop plants have molded the current diversity we conserve and use. Based on advances in systematics and molecular genetics, this course presents an integrated approach to understanding and describing diversity of agricultural and horticultural species. Also addresses underlying ethical, legal, and social issues affecting conservation and use.

[PL BR 446(4460) Plant Cytogenetics Laboratory
Spring,two-week module. 1 credit. S-U grades only. Prerequisite: genetics course or permission of instructor. Times TBA. Check with department for further information. K. N. Watanabe.
Aims to provide fundamental knowledge and techniques in plant cytogenetics. Emphasizes applications to research on plant genetics and plant breeding. Plant materials involve a wide range of crop species. Covers basic techniques for examination of plant chromosomes.]

PL BR 494(4940) Special Topics in Plant Breeding
Fall or spring. 4 credits max. S-U grades optional.
The department teaches "trial" courses under this number. Offerings vary by semester, and are advertised by the department before the semester starts. Courses offered under the number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

PL BR 496(4960) Internship in Plant Breeding
Fall or spring. Variable credit; may be repeated to max. of 6; minimum 60 on-the-job hours per credit granted. Prerequisites: junior or senior in plant breeding; minimum GPA of 3.0 in plant breeding courses; permission of adviser and enrollment during pre-enrollment period of semester before internship. S-U grades only. Students must attach to their course enrollment materials a CALS independent study, research, teaching, or internship form signed by faculty member who will supervise study and assign credits and grade. Staff.
On-the-job learning experience under the supervision of professionals in a cooperating organization. A learning contract is written between the faculty supervisor and student, stating the conditions of the work assignment, supervision, and reporting.

PL BR 497(4970) Individual Study in Plant Breeding
Fall or spring. Variable credit; may be repeated to max. of 6. Prerequisite: permission of instructor. S-U grades optional. Students must register using independent study form (available in 140 Roberts Hall). Staff.

PL BR 498(4980) Undergraduate Teaching
Fall or spring. Variable credit; may be repeated to max. of 6. S-U grades optional. Prerequisites: permission of instructor and previous enrollment in course to be taught or equivalent. Students must register using independent study form (available in 140 Roberts Hall). Staff.
Undergraduate teaching assistance in a plant breeding course. Teaching experience may include leading a discussion section, preparing and teaching laboratories, and tutoring.

PL BR 499(4990) Undergraduate Research
Fall or spring. Variable credit. Prerequisite: permission of instructor. S-U grades optional. Students must register using independent study form (available in 140 Roberts Hall). Staff.
Undergraduate research projects in plant breeding.

PL BR 504(5040) Research Experience for Teachers (also EDUC 504[5040], BIO G 504[5040])
Spring. 3 credits. Intended for, but not restricted to, students in M.A.T. degree program, practicing teachers, and students considering becoming teachers. Prerequisites: appropriate science major, 6 credits education or educational psychology course work, and permission of instructor. S-U or letter grades.
T. Fulton.
Students work in a laboratory with a research team for the semester. Research experiences are accompanied by weekly discussions and readings. Students explore how research is conducted, how formal scientific discourse and informal communication occur and differ, and how these concepts can be conveyed during classroom teaching.

PL BR 604(6040) Methods of Plant Breeding Laboratory
Fall. 2 credits. Pre- or co-requisite: PL BR 403 or equivalent. S-U grades optional. T R 1:25–4:15. M. E. Sorrells.
Field trips to plant breeding programs involve discussion of breeding methods used, overall goals, selection and screening techniques, and variety and germplasm release. Additional labs include selection techniques for various traits, intellectual property issues, genetically modified crops, and international agriculture. For a term project, each student designs a comprehensive breeding program on a chosen crop.

PL BR 606(6060) Advanced Plant Genetics
Spring. 3 credits. S-U grades optional. Prerequisites: BIOGD 281 or equivalent and permission of instructor. Lec, T R 1:25–2:40. W. Pawlowski.
Advanced survey of genetics in higher plants including selected topics in Mendelian genetics, plant reproductive biology, chromosome biology, cytogenetics, and epigenetics. The development of critical analytical skills is stressed through case studies, in-class exercises, and the course project.

PL BR 612(6120) Patents, Plants, and Profits: Intellectual Property Management for Scientists and Entrepreneurs (also IARD 612[6120])
Spring, weeks 1–8. 2 credits. Prerequisite: senior or graduate standing. S-U or letter grades. Lec, M 12:20–4:25. A. F. Krattiger, R. Kryden, and R. Potter.
Covers statutory protection (copyright, trademarks, patents, plant variety protection), contracts (from material transfer to licensing), management of IP (e.g., freedom-to-operate, valuation, genetic resources, trade, and marketing), and negotiation. Emphasizes technology transfer and international aspects. The course is particularly relevant to students interested in science management, technology transfer, international agriculture, and business.

[PL BR 618(6180) Breeding for Pest Resistance (also HORT 618[6180])
Fall. 2 credits. Prerequisites: BIOGD 281 and PL BR 403 or equivalents. Highly recommended: introductory course in plant pathology and/or entomology. Lec, M 2:30–4:25. Offered alternate even years.
P. Griffiths.
Multidisciplinary examination of the challenge of incorporating disease and insect resistance into crop plants. Topics include national and international germplasm collections, germplasm evaluation and enhancement, resistance mechanisms in plants, monogenic and polygenic control of resistance, approaches to breeding for resistance, stability of genetic resistance mechanisms, and the use of biochemical, physiological, and molecular tools in breeding for pest resistance.]

PL BR 622(6220) Seminar
Fall or spring. 1 credit. S-U grades only. T 12:20–1:10. Staff, graduate students, and visitors.

PL BR 624(6240) Quantitative Trait Loci Analysis (also BIOGD/PL PA 624[6240])
Fall. 1 credit. S-U or letter option. Prerequisites: introductory statistics and BIOGD 281 or permission of instructor. T 10:10–12:05. Offered alternate years.
K. Lee.
For description, see BIOGD 624.

PL BR 650(6500) Special Problems in Research and Teaching
Fall or spring. 1 or more credits. Prerequisite: permission of instructor supervising research or teaching. Staff.

PL BR 652) Plant Biotechnology (also PL PA 662.2, BIOPL 652.6)
Spring. 1 credit. Prerequisite: BIOPL 653.1 or permission of instructor. S-U grades optional. Lec, M W F 1:25–2:15 (12 lecs). E. D. Earle and M. Zaitlin.
Deals with current and proposed use of transgenic plants for agricultural and industrial purposes. Topics include procedures for gene introduction and control of gene expression, as well as strategies for obtaining transgenic plants that are resistant to insects, diseases, and herbicides, or have improved nutritional or processing characteristics. Other topics are use of transgenic plants for production of valuable products and for environmental remediation. Biosafety, social, legal, and international issues relating to plant biotechnology are discussed.

PL BR 653.1 Concepts and Techniques in Plant Molecular Biology (also BIOPL 653.1, PL PA 663.01)
Fall, eight weeks. 2 credits. Prerequisites: see BIOPL 653. S-U grades optional. Two lec and one day of disc per week. Lec, M W F 10:10 (24 lecs), Aug. 26–Oct. 21. S. McCouch, J. Giovannoni, and J. Rose.
Introductory module providing a broad overview of molecular biology concepts relevant to the plant sciences. Serves as a prerequisite to other modules in the BIOPL 653 (fall) and BIOPL 652 (spring) series. The course is divided into three sections: (1) gene discovery: genetic, molecular, and genomics approaches to the isolation of plant genes; (2) gene characterization: DNA sequence analysis, assessment of gene expression, functional genomics approaches, and production of transgenic plants; (3) analysis and characterization of proteins and metabolites: metabolomic techniques. Course material is coordinated with BIOPL 641 (lab). Emphasis is on understanding concepts, techniques, and strategies that are appropriate for different experiments and objectives.

PL BR 653.3 Plant Genome Organization (also BIOPL 653.3)
Fall. 1 credit. Prerequisite: BIOPL 653.1. M W F 10:10–11:00 (12 lec), September 23–October 19. S-U or letter grades. Offered alternate years. S. D. Tanksley.
Structure and variation of plant nuclear genomes, including changes in genome size, centromere/telomere structure, DNA packaging, transposable elements, genetic and physical mapping, positional gene cloning, genomic sequencing, and comparative genomics.

[PL BR 653.6 Molecular Breeding (also BIOPL 653.5)
Fall. 1 credit. S-U or letter grades. Lec, M W F 10:10–11 (12 lec). Offered alternate years. S. Tanksley.
Application of DNA markers to the identification, manipulation, and isolation of genes important to plant and animal productivity using molecular genetic techniques. Students learn how to design and execute experiments to identify quantitative trait loci (QTLs), as well as how to apply molecular markers to plant and animal breeding programs.]

PL BR 694(6940) Special Topics in Plant Breeding
Fall or spring. 4 credits max. S-U grades optional.
The department teaches "trial" courses under this number. Offerings vary by semester, and are advertised by the department before the semester starts. Courses offered under the number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

[PL BR 716(7160) Perspectives in Plant Breeding Strategies
Spring. 3 credits. Prerequisite: PL BR 403. S-U grades optional. Offered alternate odd years. W 3:35–5:15, F 3:35–4:25. M. E. Sorrells.
Emphasizes critical discussion and evaluation of selected benchmark papers and current literature. Reviews and discusses conventional and molecular selection techniques and breeding objectives, methods, and strategies for both self- and cross-pollinated crops. Requires extensive outside reading. Grades are based on four papers demonstrating creative thinking and analysis of plant breeding concepts.]

PL BR 717(7170) Quantitative Genetics in Plant Breeding
Spring. 3 credits. Prerequisites: PL BR 403 and BTRY 601 or equivalent. S-U grades optional. W F 2:55–4:10. Offered even years. D. R. Viands.
Discussion of quantitative genetics and quantitative trait loci (QTLs) for more efficient plant breeding. Specific topics include population genetics, linkage, components of variance (estimated from various mating designs); theory and computer analysis for QTL, population structure, multiple locus regressions, and interval analysis; heritability; theoretical gain from selection; and genotypic and phenotypic correlation coefficients. During one period, plants in the greenhouse are evaluated to provide data for computing quantitative genetic parameters.

PL BR 726(7260) Problems and Perspectives in Computational Molecular Biology (also COM S/BTRY 726[7260])
Fall and spring. 1 credit. Prerequisite: permission of instructor. S-U grades only. Lec, M 1:25–2:15.
Weekly seminar series discussing timely topics of computational molecular biology. The course addresses methodological approaches to sequence annotation, protein structure and function relationships, and evolutionary relationships across species. Statistical and deterministic computational approaches are covered and specific and detailed biological examples are discussed. Topics of interest are discussed in relation to papers prepared by teams of students and/or faculty members. Students/faculty members from biology backgrounds are paired with students from math, computer science, and statistics for paper preparation. Students summarize the salient questions addressed by the paper, the research methods used, and the results obtained. At the end of the presentation, questions are listed on an overhead slide to initiate discussion in the group.

PL BR 800(8900) Master's-Level Thesis Research
Fall or spring. Variable credit. Prerequisite: Ph.D. students **only before** "A" exam has been passed; permission of instructor. S-U grades optional. Graduate faculty.
For students working on a master's thesis.

PL BR 900(9900) Graduate-Level Dissertation
Fall or spring. Variable credit. Prerequisite: permission of instructor. S-U grades optional. Graduate faculty.

PL BR 901(9910) Doctoral-Level Dissertation Research
Fall or spring. Variable credit. Prerequisite: permission of instructor. S-U grades optional. Graduate faculty.
For students admitted to candidacy **after** "A" exam has been passed.

PLANT PATHOLOGY

G. W. Hudler, chair (318 Plant Science Bldg.,255-7848); S. V. Beer, G. C. Bergstrom, S. Cartinour, A. R. Collmer, W. E. Fry, S. M. Gray, K. T. Hodge, S. G. Lazarowitz, K. Lee, J. W. Lorbeer, R. Loria, G. B. Martin, M. T. McGrath, M. G. Milgroom, E. B. Nelson, R. J. Nelson, T. Pawlowska, K. L. Perry, B. G. Turgeon, X. Wang, M. Zaitlin, T. A. Zitter

Note: Class meeting times are accurate at the time of publication. If changes occur, the department will provide new information as soon as possible.

PL PA 201(2010) Magical Mushrooms, Mischievous Molds
Spring. 2 credits. S-U grades optional. Lec, T R 11:15. G. W. Hudler.
Presentation of the fungi and their roles in nature and in shaping past and present civilizations. Emphasizes the historical and practical significance of fungi as decayers of organic matter, as pathogens of plants and animals, as food, and as sources of mind-altering chemicals.

PL PA 301(3010) Plant Diseases and Disease Management
Fall. 4 credits. Prerequisite: one year of biology. Lecs, M W F 11:15; lab, T or W 1:25. M. G. Milgroom.
Introduction to plant diseases, their diagnosis, and their management. Topics include fungi, bacteria, viruses, nematodes, and other plant pathogens; disease cycles, plant disease epidemiology, disease forecasting, and the principles and practices of plant disease management. Intended for students who want a practical knowledge of plant diseases and their control.

PL PA 309(3090) Introductory Mycology
Fall. 3 credits. Prerequisite: one year of biology. Recommended: concurrent enrollment in PL PA 319. Lec, T R 9:05–9:55; lab, R 1:25–4:25. K. T. Hodge.
Survey of the astounding kingdom of fungi, including mushrooms, molds, yeasts, athlete's foot, fairy rings, and the blue stuff in blue cheese. Covers fungal biodiversity and systematics, how fungi work, and their roles in the environment and in human affairs. Students work with preserved and living fungi and learn basic identification skills. Grades are based on two prelims, a final exam, and a culture collection project.

PL PA 319(3190) Field Mycology
Fall, weeks 1–8. 1 credit. Letter grades only. Lab, W 1:25–4:25 and W 7:30–9:25 P.M. K. T. Hodge.
Students learn to identify mushrooms and other macrofungi on a series of eight afternoon field trips followed by evening lab sessions. Fungi are collected during afternoon trips to sites around Ithaca. In the evenings, students use technical keys and microscopes to identify the fungi and learn about their ecology. Grades are based on a collection project and a final laboratory examination.

PL PA 394(3940) Circadian Rhythms (also ENTOM 394[3940], BIOGD/BIONB 394[3940])
Fall. 2 credits. Prerequisite: 200-level biology. S-U grades optional. Lec, T 10:10–11:50. K. Lee (even years) or Lec, 7:30–9:25 P.M. J. Ewer (odd years).
Explores a fundamental feature of living organisms from all kingdoms: how the cellular 24-hour biological clock operates and influences biological activities. Covers fundamental properties of biological rhythms and cellular and molecular structure of circadian oscillators in many organisms including cyanobacteria, fungi, insects, plants, reptiles, birds, and mammals (including humans).

PL PA 409(4090) Principles of Virology (also VETMI/BIOMI 409[4090])
Fall. 3 credits. Prerequisites: BIOMI 290, 291 or permission of instructor. Recommended: BIOBM 330–332, 432. Letter grades only. Lec, T R 1:25–2:40. G. R. Whittaker and S. G. Lazarowitz.
For description, see VETMI 409.

[PL PA 411(4110) Plant Disease Diagnosis
Fall. 3 credits. Limited to 18 students. Prerequisites: PL PA 301 or equivalent and permission of instructor. Lec, T R 10:10; lab, T R 1:25–4:25. Next offered 2007. Staff.
Teaches a method of diagnosing plant diseases caused by infectious and noninfectious agents with emphasis on application of contemporary laboratory techniques and effective use of the literature. After seven weeks of formal lecture and laboratory sessions, students spend the rest of the semester working on their own to determine the causes of plant diseases on samples that have either been received by the Plant Disease Diagnostic Lab or that have been prepared by instructors.]

PL PA 419(4190) Agricultural Application of Plant Disease Concepts
Fall. 2 credits. Seven sessions. Prerequisite: PL PA 301 **and** permission of instructor. S-U or letter grades. Lec, M 8:30–10:30; lab, M 10:30–4:30. H. Aldwinckle.
Addresses real-world problems in plant pathology through the application of research. Students tour production fields of a diversity of major fruit and vegetable crops that have been affected by diseases. Strategies for managing diseases based on research findings as well as the interface between Research and Extension are emphasized. **This course is taught at Geneva. Free transportation available.**

[PL PA 443(4430) Pathology and Entomology of Trees and Shrubs (also ENTOM 443[4430])
Fall. 4 credits. Limited to 30 students. Prerequisites: PL PA 301 or equivalent, ENTOM 212 or equivalent. Lec, M W F 11:15; lab, F 1:25–4:25. Offered even years; not offered 2005–2006; next offered 2006–2007. G. W. Hudler and P. A. Weston.
For students preparing for careers in horticulture, urban forestry, natural resources, and pest management. Deals with identification, impact, assessment, biology, and management of insects and diseases that damage trees and shrubs. Emphasizes pests of northeastern flora but examples from other parts of the country and the world are also used. Considers forest, shade, and ornamental plants.]

PL PA 470(4700) Professional Skills in Plant Science
Fall. 2 credits. S-U grades only. Lec, R 1:25–4:25. E. B. Nelson.
Provides students who are aspiring to careers as research plant scientists with an overview of the art and science of the profession. Topics include (1) what it means to be a scientist and plant pathologist; (2) preparation required of graduate students in plant pathology programs; (3) ethical considerations important to plant pathologists; (4) how to seek funding to support research activities; (5) managing the scientific literature; (6) funneling curiosity into scientific inquiry; and (7) how to read a scientific paper. Students in related disciplines (e.g., horticulture, plant breeding, plant biology) also benefit from concepts presented in this course.

PL PA 494(4940) Special Topics in Plant Pathology
Fall or spring. 4 credits maximum. S-U grades optional. Staff.
The department teaches "trial" courses under this number. Offerings vary by semester, and are advertised by the department before the semester starts. Courses offered under the number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

PL PA 497(4970) Independent Study
Fall or spring. 1–5 credits. S-U grades optional.
Students must register using independent study form (available in 140 Roberts Hall).
An opportunity for independent study of a special topic in mycology or plant pathology under the direction of a faculty member.

PL PA 498(4980) Teaching Experience
Fall or spring. 1–5 credits. S-U grades optional. Students must register using independent study form (available in 140 Roberts Hall).
Undergraduate teaching assistance in a mycology or plant pathology course by mutual agreement with the instructor.

PL PA 499(4990) Undergraduate Research
Fall or spring. 3–5 credits. Students must register using an Independent Study form (available in 140 Roberts Hall). S-U grades optional.
Opportunity for research experience under the direction of a faculty member.

PL PA 601(6010) Concepts of Plant Pathology
Spring. 3 credits. Prerequisites: PL PA 301 or equivalent. S-U grades optional. Lec, T R 8:40–9:55; lab, R 2:00–4:25. A. R. Collmer.
Concepts in plant-pathogen relationships uniting molecular and population biology approaches, with emphases on molecular/cellular investigations of model pathosystems and population biology studies integrating host-pathogen evolution, genetics, and ecology. The discussion section is used for examining current research literature and other exercises complementary to lecture topics; emphasis is on critical thinking in science. Students prepare and review mock grant proposals.

PL PA 602(6020) Biology of Plant Pathogens
Spring. 3 credits. Prerequisite: PL PA 301. Recommended: PL PA 601 as co-requisite. Lec, T R 10:10–11; lab, R 12:20–2:15. Staff.
Biology and ecology of four major groups of plant pathogens: fungi, bacteria, viruses, and oomycetes. Model plant pathogens are used to illustrate concepts of pathogen diversity, evolution, reproduction, life cycles, movement, diagnosis, and control. Lecture and laboratory topics are coordinated with PL PA 601 to provide students with a comprehensive treatment of pathogen–host interactions at all levels from molecular to ecological. Laboratory periods are used for hands-on demonstration of pathogen diagnosis and manipulation or to discuss current literature relevant to lecture topics.

[PL PA 606[6060] Molecular Plant Virology (also BIOMI 650[6500])
Spring, 7 weeks, first half of semester. 1 credit. Prerequisites: BIOMI 409, cell biology course, or permission of instructor. S-U grades optional. Lec, M W 11:15. Offered odd years; not offered 2005–2006; next offered 2006–2007. S. G. Lazarowitz.
Introduces students to the molecular biology of plant virus replication and interactions with the host to produce disease. Topics include virus replication strategies, cell-to-cell and systemic movement, host defense responses and virus counterstrategies, and engineered resistance.]

[PL PA 608(6080) Genomics of Bacterium-Host Interactions (also BIOMI 608[6080])
Fall, second half of semester. 1 credit. Prerequisits: BIOMI 290 or equivalent or permission of instructor. S-U grades optional. Lec, M W 9:05. Offered even years; not offered 2005–2006; next offered 2006–2007. A. Collmer and S. Winans.
Introduction to genomic approaches, tools, and discoveries involving the study of bacterial interactions with plant and animal hosts. Topics include the TIGRE Comprehensive Microbial Resource and Artemis tools, the pathogens *Yersinia pestis, V. enterocolitica, Pseudomonas syringae, Ralstonia solanacearum,* and *Agrobacterium tumefaciens,* and the symbiont *Sinorhizobium meliloti*.]

[PL PA 620(6200) Ecology of Plant Pathogens
Spring, seven weeks, first half of semester. 1 credit. S-U grades optional. Prerequisite: PL PA 301 or permission of instructor. Lec, M W 9:05–9:55. Offered even years. E. B. Nelson.

Covers the basic ecological concepts, principles, methods, and literature important to the understanding of the interactions of plant pathogens with their physical, biochemical, and microbial environments. Emphasizes ecological processes that regulate the pre-infection behavior of plant pathogens in both aboveground and belowground habitats. Topics include the nature and behavior of pathogen inoculum, population and community biology, pathogen interactions with plant-associated microbial populations and communities, and rhizosphere and phyllosphere dynamics.]

[PL PA 621(6210) Chemical and Biological Disease Control

Spring, seven weeks, second half of semester. 1 credit. S-U grades optional. Prerequisite: PL PA 301 or permission of instructor. Lec, M W 9:05–9:55. Offered even years. E. B. Nelson and W. Koeller.

Discussion of the principles and methods used for the control of plant diseases. Emphasizes chemical and biological strategies for disease control. Topics include historical aspects of disease management in plant pathology; the discovery, use, and mode of action of major fungicide groups; pathogen resistance to fungicides; microbial strategies for biological control, regulation, and commercialization of microorganisms; transgenic microorganisms; and strategies for integrating biological and chemical control strategies.]

PL PA 624(6240) Quantitative Trait Loci Analysis (also BIOGD/PL BR 624[6240])

Fall. 1 credit. Limited to 20 students. Prerequisite: introductory statistics and genetics or permission of instructor. S-U grades optional. Lec, T 10:10–11 (4 computer labs until 12:05). K. Lee.

The combination of genomic sequences, new molecular marker technologies and sophisticated mapping algorithms has made it possible to use natural variation in combination with quantitative genetic techniques to dissect complex traits down to single loci. In this modular QTL analysis course, students learn basic principles of statistical inference and quantitative genetics for QTL analysis. Students also learn how to use the statistical and QTL analysis programs so that they can perform QTL analysis independently.

[PL PA 638(6380) Filamentous Fungal Genomics and Development (also BIOGD 638[6380])

Spring, last four weeks of semester. 1 credit. Prerequisite: BIOGD 281 or equivalent. S-U grades optional. Lec, M W F 10:10. Offered odd years; not offered 2005–2006; next offered 2006–2007. B. G. Turgeon.

Molecular genetic and genomic approaches to the study of fungal biology. Applications of contemporary methodology to genetic dissection of developmental processes, such as pathogenesis and reproduction, are described and experimental data are evaluated. Examples are chosen from investigations of model plant pathogenic fungi such as *Cochliobolus heterostrophus, Fusarium graminearum, Magnaporthe grisea,* and *Ustilago maydis* and from well known genetic models such as *Aspergillus nidulans* and *Neurospora crassa*.]

PL PA 642/652(6420/6520) Special Topics Series

Unless otherwise indicated, the following description applies to PL PA 642–652. Fall or spring. 1 credit. Prerequisite: permission of instructor. S-U grades only.

Weekly discussions of current topics in special areas of plant pathology and mycology. Students are required to do extensive reading of current literature and to present oral and written reports.

PL PA 642(6420) Pathogen Population Biology

Fall. TBA. M. G. Milgroom.

PL PA 644(6440) Current Topics in Oomycete Biology

Fall. R 12:20. E. B. Nelson.

PL PA 645(6450) Plant Virology

Fall. F 12:20. S. M. Gray.

PL PA 647(6470) Phytobacteriology Research Updates

Fall and spring. Alternate M 12:20. S. V. Beer.

Emphasizes current research in phytobacteriology undertaken in laboratories at Cornell.

PL PA 649(6490) Fungal Biology

Spring. 1 credit. Recommended: some background in mycology or plant pathology. Weekly, TBA. K. T. Hodge and B. G. Turgeon.

Weekly meeting to discuss current scientific articles on the biology of fungi. Primarily directed at graduate students, but undergraduates, postdocs, staff, and guests who have an interest in fungi are welcome.

PL PA 650(6500) Diseases of Vegetable Crops

Fall. T 12:20. S-U grades only. J. W. Lorbeer and T. A. Zitter.

PL PA 652(6520) Field Crop Pathology

Spring. 1 credit. TBA. W. G. C. Bergstom.

PL PA 660(6600) Special Topics in Plant Disease Management

Fall and spring. 1 credit. S-U grades only. Lec, F 12:20–1:10. C. D. Smart.

Weekly discussions of current topics in plant disease management. These include not only management practices, but also factors that influence management strategies. Students are required to read current literature and present oral reports on a topic. **Offered only at the Geneva campus. Students provide their own transportation.**

PL PA 661(6610) Diagnostic Lab Experience

Summer and fall. 1 or 2 credits. Priority given to graduate students in plant pathology and plant protection. Recommended: course work or experience in diagnostic techniques. S-U grades only. Requires 3 hours per week per credit hour. T. A. Zitter.

For graduate students and advanced undergraduates with a special interest in diagnosing plant diseases. Students work in the Diagnostic Laboratory (plant pathology department) under supervision of the diagnostician.

PL PA 662.1 Molecular Plant-Pathogen Interactions I and II (also BIOPL 652.1)

Spring, Jan. 23–Feb. 17 (12 lec). 1 credit. Prerequisites: BIOGD 281, BIOBM 330 or 331, and BIOPL 653.1. Lec, M W F. A. Collmer, S. G. Lazarowitz, G. Martin, and B. Turgeon.

Examines the molecular and cellular factors that control pathogen-plant interactions from the perspectives of pathogen biology and plant responses to pathogen infection. Beginning spring 2004, alternate years will focus on (1) plant perception of microbial pathogens and the interplay of plant defenses and pathogen counterstrategies that result in resistance or susceptibility to disease production, with topics including the genetic nature of dominant and recessive resistance, induction of pathogen defense genes, apoptotic responses that limit infection, and RNA interference; and (2) the genetic and molecular mechanisms of microbial pathogenesis, with an emphasis on fungal and bacterial virulence proteins, toxins, and their deployment systems.

PL PA 662.2 Plant Biotechnology (BIOPL 652.6 and PL BR 652)

Spring. 1 credit. Lec, M W F 1:25 (12 lec) Mar. 27–Apr. 21. M. Zaitlin and E. D. Earle.

Deals with production and uses of transgenic plants for agricultural and industrial purposes. Topics include procedures for gene introduction and control of gene expression, as well as strategies for obtaining transgenic plants that are resistant to insects, diseases, and herbicides; produce useful products; or have improved nutritional and food processing characteristics. Discusses regulatory and social issues relating to plant biotechnology.

PL PA 663 Plant Molecular Biology 1

Fall. 1–5 credit. Prerequisite: BIOGD 281, BIOBM 330 or 331.

Sec 01 Concepts and Techniques in Plant Molecular Biology (also BIO PL/PL BR 653.1)

Fall. Aug. 26–Oct. 22, 12 lec. 2 credits. Lec, M W F 10:10. J. J. Giovannoni, S. R. McCouch, and J. Rose.

Introductory module that provides a broad overview of molecular biology concepts relevant to the plant sciences, and serves as a prerequisite to other modules in the BIOPL 653 (fall) and BIOPL 652 (spring) series. The course is divided into two sections: (1) gene discovery, which covers genetic, molecular, and genomics approaches to the isolation of plant genes; and (2) gene characterization, which covers DNA sequencing, DNA and RNA blotting, use of gene databases, and various approaches to producing transgenic plants. Emphasis is on understanding the appropriate approach that is needed for different experiments.

[PL PA 664 Molecular Plant-Microbe Interactions (also BIOPL/BIOMI 652.2)

Spring, first four weeks: Jan. 23–Feb. 17(12 lec). 1 credit. Prerequisites: BIOGD 281, BIOBM 330 or 331 or 333, and BIOPL 653 (sec 1) or equivalents. S-U grades optional. Lec, M W F 12:20. Offered even years. S. C. Winans.

For description, see BIOPL 652, sec 2.]

PL PA 681(6810) Plant Pathology Seminar
Fall and spring. 1 credit. Requirement for all plant pathology majors. S-U grades only. W 12:20–1:10. B. G. Turgeon.

PL PA 694(6940) Special Topics in Plant Pathology
Fall or spring. 4 credits max. S-U grades optional. Staff.
The department teaches "trial" courses under this number. Offerings vary by semester, and are advertised by the department before the semester starts. Courses offered under the number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

PL PA 788(7880) Research in Molecular Plant Pathology
Fall and spring. 2, 4, or 6 credits. Prerequisite: permission of instructor before beginning research. S-U grades only. S. V. Beer.
Guided research experiences in laboratories addressing questions concerning the interaction of pathogens (bacteria, fungi, viruses) and plants at the molecular level. Intended for beginning graduate students with a concentration in molecular plant pathology and sufficient theoretical background and practical laboratory experience. Students submit plans and reports on each research experience.

PL PA 797(7970) Special Topics
Fall or spring. 1–5 credits. S-U grades optional. Staff.
Opportunity for independent study of a special topic.

PL PA 798(7980) Graduate Teaching Experience
Fall or spring. 1–5 credits. S-U grades. Staff.
Graduate teaching assistance in a mycology or plant pathology course by mutual agreement with the instructor. This experience may include, but is not limited to, preparing, assisting in, and teaching laboratories, preparing and delivering lectures, leading discussion sessions, and tutoring.

PL PA 800(8900) Master's-Level Thesis Research
Fall or spring. Credit TBA. S-U grades optional. Prerequisite: permission of adviser. Graduate faculty.
For students working on a master's degree.

PL PA 900(9900) Graduate-Level Thesis Research
Fall or spring. Credit TBA. S-U grades optional. Prerequisite: permission of adviser. Graduate faculty.
For Ph.D. students who have not passed "A" exam.

PL PA 901(9910) Doctoral-Level Thesis Research
Fall or spring. Credit TBA. S-U grades optional. Prerequisite: permission of adviser. Graduate faculty.
For Ph.D. candidates who have passed "A" exam.

FACULTY ROSTER

Abawi, George S., Ph.D., Cornell U. Prof., Plant Pathology (Geneva)
Acree, Terry E., Ph.D., Cornell U. Prof., Food Science, and Technology (Geneva)
Adleman, Marvin I., M. L. A., Harvard U. Prof., Landscape Architecture
Agnello, Arthur M., Ph.D., North Carolina State U. Prof., Entomology (Geneva)
Ahner, Beth A., Ph.D., Massachusetts Inst. of Technology. Assoc. Prof., Biological and Environmental Engineering
Albright, Louis D., Ph.D., Cornell U. Prof., Biological and Environmental Engineering
Aldwinckle, Herbert S., Ph.D., U. of London (England). Prof., Plant Pathology (Geneva)
Aneshansley, Daniel J., Ph.D., Cornell U. Prof., Biological and Environmental Engineering
Austic, Richard E., Ph.D., U. of California, Davis. Prof., Animal Science
Baeumner, Antje J., Ph.D., U. of Stuttgart (Germany). Assoc. Prof., Biological and Environmental Engineering
Bain, Mark B., Ph.D., U. of Massachusetts. Assoc. Prof., Natural Resources
Barbano, David M., Ph.D., Cornell U. Prof., Food Science
Barrett, Christopher B., Ph.D., U. of Wisconsin. Prof., Applied Economics and Management
Bartsch, James A., Ph.D., Purdue U. Assoc. Prof., Biological and Environmental Engineering
Bassuk, Nina L. Ph.D., U. of London (England). Prof., Horticulture
Batt, Carl A., Ph.D., Rutgers U. Prof., Food Science
Baugher, Sherene, Ph.D., SUNY, Stonybrook. Assoc. Prof., Landscape Architecture
Bauman, Dale E., Ph.D., U. of Illinois. Prof., Animal Science
Baveye, Philippe C., Ph.D., U. of California, Riverside. Assoc. Prof., Crop and Soil Sciences
Beer, Steven V., Ph.D., U. of California, Davis. Prof., Plant Pathology
Bell, Alan W., Ph.D., U. of Glasgow (UK). Prof., Animal Science
Bellinder, Robin R., Ph.D., Virginia Polytechnic Inst. and State U. Prof., Horticulture
Bergstrom, Gary C., Ph.D., U. of Kentucky. Prof., Plant Pathology
Bills, Nelson L., Ph.D., Washington State U. Prof., Applied Economics and Management
Bjorkman, Thomas N., Ph.D., Cornell U. Assoc. Prof., Horticultural Sciences (Geneva)
Blake, Robert W., Ph.D., North Carolina State U. Prof., Animal Science
Blalock, Garrick, Ph.D., U. of California, Berkeley. Asst. Prof., Applied Economics and Management
Blossey, Bernd, Ph.D., Christian-Albrechts U. (Germany). Asst. Prof., Natural Resources
Bogan, Vicki L., Ph.D., Brown U. Asst. Prof., Applied Economics and Management
Boisclair, Yves R., Ph.D., Cornell U. Assoc. Prof., Animal Science
Boisvert, Richard N., Ph.D., U. of Minnesota. Prof., Applied Economics and Management
Boor, Kathryn J., Ph.D., U. of California, Davis. Assoc. Prof., Food Science
Booth, James, Ph.D., U. of Kentucky. Prof., Biological Statistics and Computational Biology
Brady, John W., Jr., Ph.D., SUNY, Stonybrook. Prof., Food Science
Brown, Dan L., Ph.D., Cornell U. Assoc. Prof., Animal Science
Brown, David L., Ph.D., U. of Wisconsin. Professor, Development Sociology
Brown, Susan K., Ph.D., U. of California, Davis. Prof., Horticultural Sciences (Geneva)
Buckley, Daniel H., Ph.D., Michigan State U. Asst. Prof., Crop and Soil Sciences
Burr, Thomas J., Ph.D., U. of California, Berkeley. Prof., Plant Pathology (Geneva)
Bustamante, Carlos D., Ph.D., Harvard U. Asst. Prof., Biological Statistics and Computational Biology
Butler, Walter R., Ph.D., Purdue U. Prof., Animal Science
Caffarella, Rosemary S., Ph.D., Michigan State U. Prof., Education
Calderone, Nicholas W., Ph.D., Ohio State U. Assoc. Prof., Entomology
Camp, William G., Ph.D., Georgia State U. Prof., Education
Carlsen, William S., Ph.D., Stanford U. Assoc. Prof., Education
Chapman, Lewis D., Ph.D., U. of California, Berkeley. Prof., Applied Economics and Management
Chase, Larry E., Ph.D., Pennsylvania State U. Prof., Animal Science
Chau, Ho Yan, Ph.D., Johns Hopkins U. Assoc. Prof., Applied Economics and Management
Cheng, Lailiang, Ph.D., Oregon State U. Asst. Prof., Horticulture
Cherney, Jerome H., Ph.D., U. of Minnesota. Prof., Crop and Soil Sciences
Christy, Ralph D., Ph.D., Michigan State U. Prof., Applied Economics and Management
Coffman, W. Ronnie, Ph.D., Cornell U. Prof., Plant Breeding
Collmer, Alan R., Ph.D., Cornell U. Prof., Plant Pathology
Colucci, Stephen J., Ph.D., SUNY, Albany. Prof., Earth and Atmospheric Sciences
Conrad, Jon M., Ph.D., U. of Wisconsin. Prof., Applied Economics and Management
Constas, Mark A., Ph.D., Cornell U. Assoc. Prof., Education
Cooch, Evan G., Ph.D., Queen's U. (Canada). Asst. Prof., Natural Resources
Cook, Kerry H., Ph.D., North Carolina State U. Assoc. Prof., Earth and Atmospheric Sciences
Cooke, J. Robert, Ph.D., North Carolina State U. Prof., Biological and Environmental Engineering
Cox, William J., Ph.D., Oregon State U. Prof., Crop and Soil Sciences
Crawford, Barbara A., Ph.D., U. of Michigan. Assoc. Prof., Education
Currie, W. Bruce, Ph.D., Macquarie U. (Australia) Prof., Animal Science
Curtis, Paul D., Ph.D., North Carolina State U. Assoc. Prof., Natural Resources
Danforth, Bryan N., Ph.D., U. of Kansas. Assoc. Prof., Entomology
Daouk, Hazem, Ph.D., Indiana U. Asst. Prof., Applied Economics and Management
Datta, Ashim K., Ph.D., U. of Florida. Prof., Biological and Environmental Engineering
Decker, Daniel J., Ph.D., Cornell U. Prof., Natural Resources
Degaetano, Arthur, Ph.D., Rutgers U. Assoc. Prof., Earth and Atmospheric Sciences
DeGloria, Stephen D., Ph.D., U. of California, Berkeley. Prof., Crop and Soil Sciences
de Gorter, Harry, Ph.D., U. of California, Berkeley. Assoc. Prof., Applied Economics and Management
DeJong, Walter S., Ph.D., U. of Wisconsin. Asst. Prof., Plant Pathology
Dillard, Helene R., Ph.D., U. of California, Davis. Prof., Plant Pathology (Geneva)