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

Barbara A. Knuth, senior associate dean

Jan P. Nyrop, senior associate dean

Margaret H. Ferguson, associate dean for finance and administrative services

Michael P. Riley, associate 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

Michael P. Hoffmann, associate dean and director of the Cornell University Agricultural Experiment Station

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

Christopher B. Watkins, associate director of cooperative extension

Glenn J. Applebee, associate director of cooperative extension

W. Ronnie Coffman, director of international programs

James E. Haldeman, senior associate director of international programs

Terry W. Tucker, associate director of international programs

Alice Pell, director of Cornell International Institute for Food, Agriculture, and Development

Department Chairs

Animal science: W. Ronald Butler, 149 Morrison Hall

Applied economics and management: Loren W. Tauer, 154 Warren Hall

Biological and environmental engineering: Daniel J. Aneshansley, 104 Riley-Robb Hall; Beth A. Ahner, associate chair, 202 Riley-Robb Hall

Biological statistics and computational biology: James Booth, 1178 Comstock Hall

Communication: Geri K. Gay, 339 Kennedy Hall

Crop and soil sciences: Harold van Es, 235 Emerson Hall

Development sociology: Max Pfeffer, 133A Warren Hall

Earth and atmospheric sciences: Larry D. Brown, 3120 Snee Hall; Arthur T. DeGaetano, associate chair, 1119 Bradfield Hall

Ecology and evolutionary biology: Nelson G. Hairston, Jr., E345 Corson Hall

Education: Arthur L. Wilson, 435 Kennedy Hall

Entomology: Jeffrey G. Scott, 2130 Comstock Hall

Food science: Kathryn J. Boor, 114 Stocking Hall

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

Landscape architecture: Peter J. Trowbridge, 443 Kennedy Hall

Microbiology: William C. Ghiorse, B76C Wing Hall

Molecular biology and genetics: Kenneth J. Kemphues, 107A Biotechnology Bldg.

Natural resources: Marianne E. Krasny, 118 Fernow Hall

Neurobiology and behavior: Kraig Adler, W363A S. G. Mudd Hall

Plant biology: William L. Crepet, 412 Mann Library

Plant breeding and genetics: Mark E. Sorrells, 241 Emerson Hall

Plant pathology and plant-microbe biology: George W. Hudler, 334 Plant Science Bldg.

Statistical sciences: Martin T. Wells, 1190 Comstock 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, services also are located across the college in the Office of Undergraduate Biology and in various departments. 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 advisor 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 Counseling and Advising Office coordinates the faculty advising program, serves as the college's central undergraduate advising office, coordinates the college international exchange programs, and offers consultation and support for personal issues. Two counselors with expertise in college policies and guidelines provide confidential consultation and support appropriate to each student's academic circumstances. Students seek advising, consultation, and support on a variety of issues including academic problems, course problems and college procedures, graduation requirements, personal and family problems, stress management, and time management.

Academic advising is available for students who are interested in international study, need to file petitions, wish to waive college academic regulations, have disability concerns, are experiencing academic difficulties, take or return from leave of absence, 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.

The staff is available on a walk-in basis as well as by appointment in 140 Roberts Hall. Visit www.cals.cornell.edu/advising. Counseling and Advising staff: Lisa Ryan, Bonnie Shelley, Pamela Torelli, and Christine Potter.

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). EOP is a state-supported program 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 advisors 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 that serve the college's entire population. At present, that includes general college diversity activities, serving as the college prehealth advisor, 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, 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 college graduation requirements, and schedules all CALS courses. Specific information can be found at www.cals.cornell.edu/current/registrar.

The CALS Registrar's Office holds walk-in hours to assist students with any registrar-related issue. Walk-in hours are Tuesdays from 9:00 to 11:00 A.M. and Wednesdays from 2:00 to 4:00 P.M. in 140 Roberts Hall. No appointment is necessary during these times. Registrar's Office staff: Torrey Jacobs, Shawna Lockwood, and Adrienne Wilson.

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 web sites, career information books, extensive internship files, employer directories, and job listings. Alumni Career Link is a database of more than 500 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 DVD. 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, Jennifer DeRosa, Jo-Lynn Buchanan, or Derek Trulson in 177 Roberts Hall.

The CALS Admissions Office is responsible for admitting and enrolling a talented and diverse class of students each year. 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- and off-campus information sessions for prospective students, evaluates and makes decisions on more than 5,000 applications each year, and coordinates events for admitted students. 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, Jeri Nyrop, Erica Walters, Victoria Watts, and Victoria Parker.

Students

Undergraduate enrollment is approximately 3,200, with about 57 percent in the upper division. Each year about 850 students graduate, while 648 freshmen and 275 new transfer students enroll. College faculty members serve as chairs of the Special Committees of roughly 1,000 graduate students.

Admission

A significant factor taken into consideration by the CALS admissions committee is how well a student's academic interests relate to the mission of the college. If you decide to apply for admission to the College of Agriculture and Life Sciences, we'll ask you to choose from more than 20 major fields of study. As a part of the application process, you'll be asked to write about your academic interests and to articulate how you see your interests blending into our programs that contribute to the mission of the college. Majors fall within these broad areas: life sciences, environment, social sciences, and agriculture and food. Appropriateness for the college must also align with high academic achievement. While approximately 60 percent of CALS students come from New York State, about 40 percent come from other parts of the United States or abroad. Slightly more than half of the undergraduates are women. Approximately 26 percent are self-identified as members of ethnic groups.

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

Transfer Students

All accepted transfer credit must be from an accredited college or university. Transfer credit is awarded based on review of official transcripts. Additional course information may be required. Contact the CALS Registrar's Office for information. A maximum of 60 non-Cornell credits may be transferred.

Approximately 30 percent of CALS undergraduate students are transfers who have completed part of their collegiate work at community colleges, two- and four-year institutions. Detailed information on transfer admission is available on the CALS Admissions web site.

Intra-University Transfer

A Cornell student in good standing may apply for an intra-university transfer to pursue an academic program unavailable in his or her current college. Guidelines are available on the CALS Admissions web site. The procedure involves attending an information session, meeting with a faculty member in the proposed area of study, and submitting an application and essay.

Consideration is given to students who have demonstrated an interest in their proposed new field of study by taking appropriate prerequisite courses. Academic achievement is also considered. Students need to spend two semesters in their home college before applying. In certain cases, a student may be referred to the Internal Transfer Division (ITD) to study for one semester before entering the college. During this trial semester, the student must achieve a predetermined grade point average 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 complete the Cornell transfer application process. 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, Semester in Environmental Science with the Marine Biology Laboratory, field study in Human Ecology or Industrial and Labor Relations, Capital Semester, Cornell in Washington, and IPM internship.

Facilities

The College of Agriculture and Life Sciences is located on the upper campus 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 Cornell 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 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, master of landscape architecture, and 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 24 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 advisor 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 sciences: Antonio DiTommaso, 903 Bradfield Hall, ad97@cornell.edu

Agricultural science education: William Camp, 416 Kennedy Hall, wgc4@cornell.edu

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

Applied economics and management: Dale Grossman, 114 Warren Hall, dag14@cornell.edu

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

Biological engineering: Michael Walter, 207 Riley-Robb Hall, mfw2@cornell.edu

Biological sciences: Jeffrey Doyle, 404 Mann Library, jjd5@cornell.edu; Bonnie Comella, 216 Stimson Hall, bec3@cornell.edu

Biology and society: Brian Chabot, 102 Little Rice, bfc1@cornell.edu

Biometry and statistics: Steven Schwager, 1194 Comstock Hall, sjs5@cornell.edu

Communication: Danielle Dean, 334 Kennedy Hall, dyd1@cornell.edu

Crop and soil sciences: Antonio DiTommaso, 903 Bradfield Hall, ad97@cornell.edu

Development sociology: Tom Hirschl, 333 Warren Hall, tah4@cornell.edu

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

Environmental engineering: Michael Walter, 207 Riley–Robb Hall, mfw2@cornell.edu

Food science: Alicia Orta-Ramirez, 107 Stocking Hall, ao98@cornell.edu

Information science: Christine Stenglein, 303 Upson Hall, cms242@cornell.edu

Interdisciplinary studies: Lisa Ryan, 140 Roberts Hall, lar4@cornell.edu

International agriculture and rural development: Terry Tucker, 16 Warren Hall, twt2@cornell.edu

Landscape architecture: Peter Trowbridge, 443 Kennedy Hall, pjt4@cornell.edu

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

Nutritional sciences: Charles McCormick, 223 Savage Hall, ccm3@cornell.edu

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

Science of earth systems: John Cisne, 2102 Snee Hall, john.cisne@cornell.edu

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

Viticulture and enology: Ian Merwin, 118 Plant Sciences Bldg., im13@cornell.edu

Minors

Students in the College of Agriculture and Life Sciences may pursue one or more minor fields of study in any department in any college that offers them, subject to limitations placed by the department offering the minor or by the student's major. Minor fields of study do not require an academic advisor, 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 can be found on the CALS counseling and advising web site (cals.cornell.edu/cals/current/advising/options/doubmaj.cfm). For minors outside of CALS, please consult with the specific department.

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 file an application for dual-enrollment and 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 advisor as part of their undergraduate program. 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 economics: David Just, 254 Warren Hall, drj3@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: Daniel Wilks, 1113 Bradfield Hall, dsw5@cornell.edu

Biochemistry, molecular, and cell biology: Volker Vogt, 358 Biotechnology Bldg., vmv1@cornell.edu

Biological and environmental engineering: Antje Baeumner, 306 Riley-Robb Hall, ajb23@cornell.edu

Biometry: Robert Strawderman, 1172 Comstock Hall, rls54@cornell.edu

Biophysics: Gerald W. Feigenson, 201 Biotechnology Bldg., gwf3@cornell.edu

Communication: Jeff Hancock, 320 Kennedy Hall, jth34@cornell.edu

Development sociology: acting DGS, Charles Geisler, 237 Warren Hall, ccg2@cornell.edu

Ecology and evolutionary biology: Monica Geber, E413 Corson Hall, mag9@cornell.edu

Education [also M.A.T.]: John Sipple, 421 Kennedy Hall, jws28@cornell.edu

Entomology: Cole Gilbert, 6136 Comstock Hall, cg23@cornell.edu

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

Food science and technology: Martin Wiedmann, 412 Stocking Hall, mw16@cornell.edu

Genetics and development: Bik Tye, 325 Biotechnology Bldg., bt16@cornell.edu

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

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

International development: Norman Uphoff, 33A 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): Jim Haldeman, 36 Warren Hall, or see director of graduate studies for chosen field, jeh5@cornell.edu

Microbiology: James Shapleigh, 257A Wing Hall, jps2@cornell.edu

Natural resources: Clifford Kraft, 206H Fernow Hall, cek7@cornell.edu

Neurobiology and behavior: Joseph Fetcho, W103 Mudd Hall, jrf49@cornell.edu

Nutritional sciences: Charles McCormick, 223 Savage Hall, ccm3@cornell.edu

Physiology: Robin Davisson, T9-014C Vet Research Tower, rld44@cornell.edu

Plant biology: Klaas van Wijk, 332 Emerson Hall, kv35@cornell.edu

Plant breeding: Walter DeJong, 309 Bradfield Hall, wsd2@cornell.edu

Plant pathology: Michael Milgroom, 357 Plant Science Bldg., mgm5@cornell.edu

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

Soil and crop sciences: Dan Buckley, 705 Bradfield Hall, dhb28@cornell.edu

Statistics: Robert Strawderman, 1172 Comstock Hall, rls54@cornell.edu

Zoology: Susan Suarez, T5002B Vet Research Tower, sss7@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 4990-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:
www.cals.cornell.edu/cals/current/career

CALS Undergraduate Research Opportunities:
www.cals.cornell.edu/cals/current/student-research/undergrad (information on how to explore research opportunities)

CALS Research Honors Program:
www.cals.cornell.edu/cals/current/student-research/honors

CALS Undergraduate and Graduate Student Grants Proposal Development:
www.cals.cornell.edu/cals/current/student-research/grants

CALS Undergraduate Minority Research:
www.cals.cornell.edu/cals/current/student-research/minority

CALS Internship Guidelines:

www.cals.cornell.edu/cals/current/student-research/internship

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

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

Biological Sciences:
www.biology.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 requires a thesis written in the style of a master's thesis or scholarly journal article. Original honors research may be suitable for publication in a professional journal. 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 each summer the *CALS Research Honors Abstracts* is published (on the web beginning 2009) as a compilation of honors theses abstracts.

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 and have been recommended for the degree by the honors committee.

Research may be done in these program areas: 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/cals/current/student-research/undergrad) 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 submit a written application and thesis proposal early in the first semester of their senior year; however, they are encouraged to make arrangements with a faculty member during the second semester of their junior year. Several program areas require students to submit their applications and thesis proposal to the program area honors committee chair by the end of the third week, while other program areas have students submit the application and proposal to the CALS Registrar's office by the end of the sixth week. *It is the student's responsibility to know the deadlines and submission procedures for the particular program area of interest.* Application forms are available from the CALS Registrar in 140 Roberts Hall or from the web at www.cals.cornell.edu/cals/current/student-research/honors. 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 submitted, signatures of approval are required in the following order: faculty research mentor, academic advisor, and 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 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 research funds (up to $350). If approved, the funding will be transferred to a departmental account of the student's research advisor 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/cals/current/student-research/undergrad.

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 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 an

appropriate event. 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/current/student-research/honors.

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 advisors 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 ANSC 4991 Undergraduate Research.
- Participate in ANSC 4020 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.
- Students may volunteer to submit electronically to the honors committee chair a copy of their final approved thesis (in pdf or Word format) for Mann Library. Mann Library has given CALS the opportunity to have theses available to the public electronically if this does not interfere with other plans, such as patenting or publishing in another journal. A permission form to allow a thesis to be made available online at Mann Library can be obtained from the honors committee chair.
- In addition, students are required to submit electronically to the honors committee chair their thesis title, research advisor's name, and abstract (in Word format). During each summer, the CALS Research Honors Abstracts publication is published (on the web beginning 2009) as a compilation of research honors thesis abstracts.

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 advisors 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, or at www.biology.cornell.edu/research/honors.html.

Biology & Society

Faculty committee: B. Chabot, 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 and 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 advisor. 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 4 credits each in BSOC, ALS, or HE 4991–4992, 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 11: Thesis completed in a form satisfactory for evaluation and submitted to the three readers.
- April 25: Thesis defense accomplished.
- May 9: Two bound copies of completed and defended thesis submitted to director of undergraduate studies.

Students may volunteer to submit electronically to the honors committee chair a copy of their final approved thesis (in pdf or Word format) for Mann Library. Mann Library has given CALS the opportunity to have theses available to the public electronically if this does not interfere with other plans, such as patenting or publishing in another journal. A permission form to allow the thesis to be made available online at Mann Library can be obtained from the honors committee chair.

In addition, students are required to submit electronically to the honors committee chair their thesis title, research advisor's name, and abstract (in Word format). During each summer, the CALS Research Honors Abstracts publication is published (on the web beginning 2009) as a compilation of research honors thesis abstracts.

Entomology

Faculty committee: C. Gilbert, 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 majoring 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.

Research honors students have the option of earning academic credit by enrolling in ENTOM 4991 Honors Research in Entomology during any semester while working toward a research honors thesis. Credits and grade option for satisfying requirements of ENTOM 4991 should be discussed with the thesis advisor (following page.)

Note: Enrolling in independent study course, either ENTOM 4970, 4990, or 4991, 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 advisor, 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 advisor. The academic advisor 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 to the chair of the Entomology Research Honors Committee no later than the end of the fifth week of the first semester of the senior year. Earlier submission is encouraged. Applications are available from 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.
9. Students may volunteer to submit electronically to the honors committee chair a copy of their final approved thesis (in pdf or Word format) for Mann Library. Mann Library has given CALS the opportunity to have theses available to the public electronically if this does not interfere with other plans, such as patenting or publishing in another journal. A permission form to allow the thesis to be made available online at Mann Library can be obtained from the honors committee chair.
10. In addition, students are required to submit electronically to the honors committee chair their thesis title, research advisor's name, and abstract (in Word format). During each summer, the CALS Research Honors Abstracts publication is published (on the web beginning 2009) as a compilation of research honors thesis abstracts.

The complete text of this section can be found at www.entomology.cornell.edu/public/IthacaCampus/EduTraining/Undergrad/EntomHonors.html.

Information Science

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

Landscape Studies

Faculty committee: P. J. Trowbridge, 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 advisor 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 advisor 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 4991).
2. Work with a faculty advisor to identify and formulate a research problem. If the faculty advisor is not in the Department of Landscape Architecture, select a co-advisor 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.
9. Students may volunteer to submit electronically to the honors committee chair a copy of their final approved thesis (in pdf or Word format) for Mann Library. Mann Library has given CALS the opportunity to have theses available to the public electronically if this does not interfere with other plans, such as patenting or publishing in another journal. A permission form to allow the thesis to be made available online at Mann Library can be obtained from the honors committee chair.
10. In addition, students are required to submit electronically to the honors committee chair their thesis title, research advisor's name, and abstract (in Word format). During each summer, the CALS Research Honors Abstracts publication is published (on the web beginning 2009) as a compilation of research honors thesis abstracts.

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 4991 Honors Research in Natural Resources) 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 faculty director. The application includes a project description and advisor information.

Senior Year

1. Register for NTRES 4991 before the add deadline (fall and spring).
2. Sixth week of fall semester: Submit formal application to faculty director (16 Fernow Hall).
3. March 31: Thesis should be close to completion.
4. April 15: Submit two copies of the thesis to the faculty director for *ad hoc* reviews.
5. May 4: Pick up *ad hoc* reviewers' comments from the faculty director.
6. May 15: Submit two copies of the final thesis: one for the college, one for the program director.
7. Week of May 25: Students will be notified of the decision, and the faculty director will recommend that each approved student graduate with "Distinction in Research."
8. Students may volunteer to submit electronically to the honors committee chair a copy of their final approved thesis (in pdf or Word format) for Mann Library. Mann Library has given CALS the opportunity to have theses available to the public electronically if this does not interfere with other plans, such as patenting or publishing in another journal. A permission form to allow the thesis to be made available online at Mann Library can be obtained from the honors committee chair.
9. In addition, students are required to submit electronically to the honors committee chair their thesis title, research advisor's name, and abstract (in Word format). During each summer, the CALS Research Honors Abstracts publication is published (on the web beginning 2009) as a compilation of research honors thesis abstracts.

Nutritional Sciences

Faculty committee: J. T. Brenna

The research honors program in the Division of Nutritional Sciences is a structured experience that requires (1) successful completion of NS 3980, (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 about four semesters of their undergraduate experience. Honors students experience the excitement of participating in 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 4010.

Students interested in the program should take NS 3980 as early in their program as possible. Students may review program requirements at the DNS Honors Research Program web site (www.nutrition.cornell.edu/dns7_undergradhonres.html) or contact Professor Brenna. 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 director 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 3980. By the fall of the junior year, the student is expected to have identified their faculty member and be working with him or 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 4990. 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.

Students may volunteer to submit electronically to the honors committee chair a copy of their final approved thesis (in pdf or Word format) for Mann Library. Mann Library has given CALS the opportunity to have theses available to the public electronically if this does not interfere with other plans, such as patenting or publishing in another journal. A permission form to allow the thesis to be made available online at Mann Library can be obtained from the honors committee chair.

In addition, students are required to submit electronically to the honors committee chair their thesis title, research advisor's name, and abstract (in Word format). During each summer, the CALS Research Honors Abstracts publication is published (on the web beginning 2009) as a compilation of research honors thesis abstracts.

Physical Sciences

Faculty committee: S. J. Mulvaney, chair; 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 advisor and thesis topic before the end of the junior year.
2. Work with the thesis advisor to prepare a budget, short research proposal (2–3 pages), and application form. These materials must be received by the Physical Sciences committee chair by the end of the third 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 advisor 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.
8. Students may volunteer to submit electronically to the honors committee chair a copy of their final approved thesis (in pdf or Word format) for Mann Library. Mann Library has given CALS the opportunity to have theses available to the public electronically if this does not interfere with other plans, such as patenting or publishing in another journal. A permission form to allow the thesis to be made available online at Mann Library can be obtained from the honors committee chair.
9. In addition, students are required to submit electronically to the honors committee chair their thesis title, research advisor's name, and abstract (in Word format). During each summer, the CALS Research Honors Abstracts publication is published (on the web beginning 2009) as a compilation of research honors thesis abstracts.

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.

Students may volunteer to submit electronically to the honors committee chair a copy of their final approved thesis (in pdf or Word format) for Mann Library. Mann Library has given CALS the opportunity to have theses available to the public electronically if this does not interfere with other plans, such as patenting or publishing in another journal. A permission form to allow the thesis to be made available online at Mann Library can be obtained from the honors committee chair.

In addition, students are required to submit electronically to the honors committee chair their thesis title, research advisor's name, and abstract (in Word format). During each summer, the CALS Research Honors Abstracts publication is published (on the web beginning 2009) as a compilation of research honors thesis abstracts.

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

Social Sciences

Social Sciences Program Area Faculty Committee: N. Chau, chair (NetID: hyc3); A. A. Gonzales, T. D. Park, and C. W. Scherer

Overview

Research projects in the social sciences 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 program provides an excellent opportunity for students to pursue independent study and research under the guidance/mentorship of a faculty member. Previously approved theses covered a wide range of topics and methodologies. A complete list can be found at http://ecommons.library.cornell.edu/handle/1813/2937.

Guidelines and Due Dates

A. Application and Proposal:

Students must submit one hard copy of the completed application and proposal to the social science program area faculty committee chair two semesters before their prospective graduation date (see deadlines below). Late applications will not be considered.

Graduation Date	Proposal Due Date
December 2009	February 16, 2009
May 2010	September 15, 2009
December 2010	February, 15, 2010
May 2011	September 15, 2010
December 2011	February 15, 2011

Students are strongly encouraged to meet with faculty during their junior year in order to identify someone to serve as their honors thesis advisor. Honors thesis faculty advisors must be members of the graduate faculty. Exceptions may be granted for persons with special expertise pending petition to the committee.

Working with their honors thesis advisor, students should begin developing their thesis proposal during the second semester of their 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 the faculty advisor. 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.

Students accepted into the honors program should register for credit directed by the honors thesis faculty advisor (e.g., AEM 4991, COMM 4991, DSOC 4991, EDUC 4991).

B. Final Submission for Review and Approval Requirements:

Honors theses should be written according to the form of any standard journal within the appropriate field. Distinction in research is awarded upon approval of the research honors thesis by the committee. 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 as research.

The committee recommends the submission of the thesis draft to the research advisor two months before graduation to permit sufficient time for revision.

Completed theses are due approximately one month before graduation:

Graduation Date	Thesis Due Date
December 2009	November 16, 2009
May 2010	April 15, 2010
December 2010	November 15, 2010
May 2011	April 15, 2011
December 2011	November 15, 2011

One electronic copy of the final thesis (in pdf or Word format) should be sent by email to the Social Sciences program area faculty committee chair no later than the due date. A supporting letter from the faculty member supervising the work also must be submitted either electronically or as a hard copy.

The thesis will be independently reviewed typically by two faculty committee members within about two weeks. If further revisions are required, students will be informed and a revised draft will be requested. Students will be notified of the committee's decision by the week of May 25.

Students may volunteer to submit electronically to the honors committee chair a copy of their final approved thesis (in pdf or Word format) for Mann Library. Mann Library has given CALS the opportunity to have theses available to the public electronically if this does not interfere with other plans, such as patenting or publishing in another journal. A permission form to allow the thesis to be made available online at Mann Library can be obtained from the honors committee chair.

In addition, students are required to submit electronically to the honors committee chair their thesis title, research advisor's name, and abstract (in Word format). During each summer, the CALS Research Honors Abstracts publication is published (on the web beginning 2009) as a compilation of research honors thesis abstracts.

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 should refer to the non-Cornell credit policies on p. 37. 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 advisor. At least 12 credits must be carried to meet the full-time residency requirement. To receive academic credit for the Assembly Intern Program, students enroll in ALS 3920. To receive academic credit for the Senate Assistants Program, students enroll in ALS 4960. Information and applications are available in the CALS Career Development Office, 177 Roberts Hall.

Cornell in Washington

The Cornell in Washington program offers students in all majors an opportunity to earn full academic credit for a semester in Washington, D.C. Students take part in a public policy or humanities seminar, serve as externs in federal agencies, congressional offices, or nongovernmental organizations, carry out individual research projects, and take one or two electives. 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 4998 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.

Marine Biological Laboratory's (MBL) Semester in Environmental Science

The Marine Biological Laboratory's (MBL) Semester in Environmental Science is a semester-long program held each fall in Woods Hole, Mass. This is a multi-university and college program run by the staff of the Ecosystems Center of the MBL. Approximately 15–20 students interact intensively with the world-class research staff of the Ecosystems Center in a mixture of classroom, laboratory, and field-research activities. The major foci of the program are on biogeochemistry, ecosystem science, and the impacts of land use and global change on the environment. Students spend about 20 hours each week conducting intensive, hands-on field and lab work in coastal forests, freshwater ponds, and estuaries, and complete an independent research project as part of the curriculum. The MBL is one of the oldest (founded in 1888) and most distinguished biological field stations in North America. Cornell credit for up to 16 credits is offered. More information on the program can be obtained from the Cornell faculty liaison (Prof. Bob Howarth, E309 Corson Hall, 255-6175) or from the director of the program (Dr. Ken Foreman, MBL Ecosystems Center, 508-289-7777; courses.mbl.edu/SES).

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. Courses are directly transferrable and listed in *Courses of Study* under BIOSM. Six weeks are spent in Woods Hole, Mass., and the following six weeks are spent on either one of SEA's two sailing research vessels: the *SSV Robert Seamans* or the *SSV Corwith Cramer*. SEA offers four unique programs. SEA Semester: Ocean Exploration, SEA Semester: Oceans and Climate, SEA Semester: Documenting Change in the Caribbean, and SEA Semester: Sustainability in Polynesian Island Cultures and Ecosystems. SEA Semester: Ocean Exploration is also offered as a 12-credit, eight-week summer program. For more information, contact Sea Education Association, P.O. Box 6, Woods Hole, MA 02543 (1-800-552-3633 x 770) 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 provides 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 Shoals Marine Laboratory (BIOSM), 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 4970-level course for the number of credits assigned.

To ensure a fair and manageable system to deal with internships, the College of Agriculture 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 advisor 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 at cals.cornell.edu/cals/teaching/elr.
5. Students need to keep their faculty internship advisor 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 140 Roberts Hall.

Pay and Credit for Undergraduate Research, Teaching, and Internships

Research: students can receive pay or credit or they can partition it so that they receive pay for part of the research and credit for the other as long as the work does not overlap.

Undergraduate Teaching Assistant: students can receive either pay or credit, but they cannot partition it.

Internships: students may receive both pay and credit for the same internship experience.

Study Abroad

Each year almost 200 CALS undergraduates spend a semester or year studying abroad. Students enroll directly in universities in Australia, participate in fieldwork in Africa, or explore the wonders of a foreign city while participating in an internship. CALS recognizes that students study abroad for a variety of reasons and, as a result, offers a great deal of choice for its students. Students may want to study abroad to broaden their worldview, boost employment prospects, learn a new language, gain independence, discover a new educational system, or all of the above! A variety of options is available. Students can choose from:

- a CALS exchange program in a variety of universities around the world that have been created especially for CALS students. For a list of the programs available, visit www.cals/current/abroad-exchange/index.cfm;
- a study abroad program through the Cornell Abroad office;
- an international study tour as part of a CALS course, or a summer program.

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.

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 participating in a CALS exchange or a program through Cornell Abroad, all CALS students interested in studying abroad must receive approval from their faculty advisor and meet with the college study abroad advisor to review the college policies and to receive college approval. College policies can be viewed at www.cals.cornell.edu/cals/current/abroad-exchange/index.cfm.

Study abroad advising hours are held in the Counseling and Advising Office, 140 Roberts Hall.

Ithaca College and Wells College Exchange Programs

The Cornell University–Ithaca College Exchange Program is a reciprocal arrangement 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 Requirements

A. Minimum total credits: 120 academic credits are required for graduation.

Important Exceptions:

- Repeated courses increase the number of credits required for graduation by the number of credits in the course. These credits *do* count toward the minimum 12 credits required for full-time status.
- Review or supplemental courses (e.g., 1000- to 1099-level) increase the number of credits required for graduation by the number of credits in the course. These credits *do not* count toward the minimum 12 credits required for full-time status.
- Physical education courses *do not* count toward 120 credits for graduation. They *do not* count toward the minimum 12 credits required for full-time status.

B. Minimum credits at Cornell: 60 academic credits must be completed at Cornell.

C. Maximum non-Cornell credits: 60 non-Cornell credits (AP, CASE, transfer, Cornell Abroad, and exchange credits) can be applied toward degree requirements.

D. Minimum credits from College of Agriculture and Life Sciences: 55 CALS credits are required for graduation. CALS credits include all courses from departments within CALS and courses offered in the Biological Sciences, Earth and Atmospheric Sciences, Information Science, and Nutritional Sciences Departments. Specifically, courses offered under the following subject prefixes count as CALS credits: AGSCI, AIS, ALS, AEM, ANSC, BEE, BIOG, BIOAP, BIOBM, BIOEE, BIOGD, BIOMI, BIOMS, BIONB, BIOPL, BIOSM, BTRY, COMM, CSS, DSOC, EAS, EDUC, ENTOM, FDSC, HORT, IARD, INFO, LA, NS, NTRES, PLBR, PLPA, SNES, VIEN.

E. Maximum 55 endowed credits: CALS students are limited to 55 credits from the endowed colleges. If an academic program requires additional credit, permission may be requested by contacting the CALS Registrar's Office (607-255-2017, 140 Roberts Hall, cals_registrar@cornell.edu).

F. Minimum letter-graded credits: 100 (prorated based on non-Cornell credits).*

G. Maximum credits earned through independent study, research, teaching assistantships, and/or internships: 15 credits of "unstructured" course work can be applied toward graduation requirements (prorated based on non-Cornell credits) (i.e., a minimum of 100 "structured" credits are required for graduation).

*The prorated formula is available at www.cals.cornell.edu/current/registrar.

2. Physical Education Requirement

A. Pass two PE courses with a satisfactory grade.

Exception: 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 before matriculation.

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

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

3. Residency Requirements

A. Eight semesters of full-time study are expected. Transfer students are credited with one semester in residence for each 15 credits earned at another institution.

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

C. The final semester before graduation must be completed in a Cornell program as a full-time student in continued good academic standing.

D. Students in the ninth and final semester may apply for prorated tuition. The eligibility criteria are listed below. The student will be charged the full administrative fee and student service charge, plus one-fifteenth of the remaining full tuition per credit hour.

All of the following conditions must be met in order for a student to be considered for prorated tuition:

1. The prorated semester is the ninth and final semester of study.
2. The student is in good academic standing with the college and the major.
3. Maximum of 11 credit hours of course work are allowed under prorated tuition. Students cannot exceed the number of credits approved or full tuition will be charged, and no refund will be allowed if fewer credits than applied for are completed.
4. Approval of the student's faculty advisor, the college registrar, and the university registrar is required for all requests. Note that approval is conditional until grades are finalized at the end of the semester immediately preceding the prorated semester. Should those grades indicate that more than the requested number of prorated tuition credits are required for graduation, prorated tuition will be adjusted accordingly.
5. Students applying to be prorated in the fall semester are encouraged to submit the application by May 1. The final deadline is June 1. Students applying to be prorated in the spring semester are encouraged to submit the application by December 15. The final deadline is January 15.

   Please be advised that prorated tuition may impact the student's financial aid, student loans, scholarships, non-Cornell health insurance programs, athletic eligibility, or other considerations. It is the responsibility of the student to resolve and rectify these situations prior to submitting this petition.

4. Grade-Point Average (GPA) Requirements

Minimum cumulative GPA: 2.00 or above must be maintained. The cumulative GPA includes all grades earned at Cornell.

5. Schedule Requirements

A. Students are expected to enroll in at least one CALS course each semester until 55 CALS credits have been earned.

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

C. Freshmen are limited to one S–U course per semester.

D. PE and supplemental course work do not count toward the 12-credit minimum required for full-time status.

E. To add more than 18 academic credits to a student's schedule, advisor permission must be obtained through an add/drop slip to add more course work.

6. Distribution Requirements

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.

Please note: 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 1000- to 1099-level courses, will not be counted in the distribution areas.

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: BIOG 1101–1104, 1105–1106, 1107–1108, 1109–1110, BIOSM 1110 (summer)

Beginning fall 2008, students majoring in Applied Economics and Management, Communication, Development Sociology, Information Science, and Landscape Architecture have the option of fulfilling 6 credits of introductory biology by either taking courses listed above or newly developed courses. See www.cals.cornell.edu/cals/current/registrar/current-students/cals-graduation/biology.cfm for the most up-to-date list of courses. Students should consult with their advisors to clarify major requirements.

CHEM

PHYS

Other Physical/Life Sciences

AEM 2100

ANSC 1100, 1120, 1160, 2120, 2150, 2210, 2400, 2410, 3200, 3700, 3920, 3980

ASTRO

BEE 4540, 4590

Biological Sciences (any course EXCEPT BIOG 2000, 2990, 4980, 4990, and BIONB 4310, BIOSM 2040, and BIOAP 4980, BIOBM 4980, BIOEE 4980, BIOGD 4980, BIONB 4980, BIOPL 4980)

BTRY/Statistics

CHEM

CSS 1900, 2110, 2600, 3150, 3170, 4050, 4140, 4440, 4551–4555, 4660, 4830

EAS (EXCEPT 2900)

ENTOM 2010, 2100, 2120, 2150, 2410, 2600, 3070, 3150, 3250, 3310, 3311, 3690, 4440, 4550, 4630

FDSC 2000

HADM 2010

HORT 2200, 2430, 3170, 4000, 4260, 4400, 4450, 4490, 4551–4555, 4600

IARD 4050, 4140

ILRST 2100, 2120, 3100

Mathematics—See CALS requirements for graduation.

NS 1150, 1220, 2220, 3200, 3310, 3320, 3410, 3470, 3610, 4310, 4410, 4520

NTRES 1101, 2010, 2100, 2830, 3100, 3130, 3140, 3141, 3220, 3260, 4130, 4200, 4201, 4220

PAM 2100

PHYS

PLBR 2010, 2250, 4010, 4011, 4030, 4040, 4050

PLPA 2010, 3010, 3090, 3190, 3290, 4330, 4430, 4480

SNES 1101

Social Sciences and Humanities. Students must complete four courses of 3 or more credits each from the following seven categories of courses in the humanities and social sciences.

- At least one course must be completed from three different categories.
- No more than two courses in the same department will be counted toward the distribution requirement.
- For freshmen entering in fall 2008 or later, one course MUST be in the human diversity (D) category.

Categories:

- Cultural Analysis (CA)
- Human Diversity (D)
- Historical Analysis (HA)
- Knowledge, Cognition, and Moral Reasoning (KCM)
- Literature and the Arts (LA)
- Social and Behavioral Analysis (SBA)
- Foreign Language (FL)

Detailed descriptions follow.

Social Sciences and Humanities: Category Descriptions

Cultural Analysis (CA)

These courses study human life in particular cultural contexts through interpretive analysis of individual behavior, discourse, and social practice. Topics include belief systems (science, medicine, religion), expressive arts and symbolic behavior (visual arts, performance, poetry, myth, narrative, ritual),

identity (nationality, race, ethnicity, gender, sexuality), social groups and institutions (family, market, community), power and politics (states, colonialism, inequality).

Historical Analysis (HA)

These courses interpret continuities and changes—political, social, economic, diplomatic, religious, intellectual, artistic, scientific—through time. The focus may be on groups of people, dominant or subordinate, a specific country or region, an event, a process, or a time period.

Knowledge, Cognition, and Moral Reasoning (KCM)

These courses investigate the bases of human knowledge in its broadest sense, ranging from cognitive faculties shared by humans and animals such as perception, to abstract reasoning, to the ability to form and justify moral judgments. Courses investigating the sources, structure, and limits of cognition may use the methodologies of science, cognitive psychology, linguistics, or philosophy. Courses focusing on moral reasoning explore ways of reflecting on ethical questions that concern the nature of justice, the good life, or human values in general.

Literature and the Arts (LA)

These courses explore literature and the arts in two different but related ways. Some courses focus on the critical study of artworks and on their history, aesthetics, and theory. These courses develop skills of reading, observing, and hearing and encourage reflection on such experiences; many investigate the interplay among individual achievement, artistic tradition, and historical context. Other courses are devoted to the production and performance of artworks (in creative writing, performing arts, and media such as film and video). These courses emphasize the interaction among technical mastery, cognitive knowledge, and creative imagination.

Social and Behavioral Analysis (SBA)

These courses examine human life in its social context through the use of social scientific methods, often including hypothesis testing, scientific sampling techniques, and statistical analysis. Topics studied range from the thoughts, feelings, beliefs, and attitudes of individuals to interpersonal relations between individuals (e.g., in friendship, love, conflict) to larger social organizations (e.g., the family, society, religious or educational or civic institutions, the economy, government) to the relationships and conflicts among groups or individuals (e.g., discrimination, inequality, prejudice, stigmas, conflict resolution).

Foreign Language (FL)

These courses are taught by the following departments: Africana Studies and Research Center (ASRC—language only), Asian Studies (BENGL, BURM, CHIN, HINDI, INDO, JAPAN, KHMER, KOREA, SANSK, TAG, THAI, and VIET), Classics (CLASS—language only), German Studies (GERST—language only, DUTCH, and SWED), Linguistics (LING—languages only), Near Eastern Studies (NES—languages only), Romance Studies (CATAL, FREN, ITAL, PORT, QUECH, and SPAN), and Russian Studies (RUSSA, HUNGR, POLSH, SEBCR, and UKRAN).

Human Diversity (D)

These courses address several of the college's stated goals for undergraduate education, specifically, the expectation that in the course of earning a degree, students will enhance their abilities to communicate with people of different cultural perspectives; to listen carefully and respectfully to the views of others, especially views with which they disagree; and to employ ethical reasoning in judging ideas, actions, and their implications. These courses explore the challenges of building a diverse society, and/or examine the various processes that marginalize people and produce unequal power relations in terms of race, nationality, ethnicity, sexuality, religion, gender, age, or economic status.

Written and Oral Expression. 9 credits total, of which at least 6 must be in written expression. Oral expression is not required by the college (it may be for some majors); all 9 credits may be in written expression. Courses in written and oral expression may be selected from the following:

Oral Expression

COMM 2010, 2030

ENTOM 3350

Written Expression

First-Year Writing Seminars

AEM 2000

COMM 1310, 2630, 3520, 3600

ENGL 2800, 2810, 2880, 2890, 3820–3850, 3880, 3890

LA 2150

7. Quantitative Literacy Requirement

Faculty legislation requires minimum competency in quantitative literacy to complete a degree in the College of Agriculture and Life Sciences. This requirement can be satisfied in one of three ways:

- Earning a score of 4 or 5 on the AP Calculus exam; or
- Transferring an approved calculus or statistics course with a grade of "C" or better; or
- Taking an approved math or statistics course at Cornell.

A complete listing of approved math and statistics courses is available online at www.cals.cornell.edu/current/registrar. Pre-approval forms are available in CALS Registrar's Office.

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;
   - 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 or through Cornell Abroad or an approved exchange program;
   - the credits have not been applied toward high school graduation requirements (except for AP exam credit, see p. 8);
   - 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. 9–12 of this catalog. For CALS-specific policies, see College Credit Earned While in High School.

3. A student may apply a maximum of 60 non-Cornell credits toward his or her graduation requirements.
   - 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.
   - Advanced placement credits are limited to 30 credits.
   - Cornell Abroad (not CALS exchange) credits are limited to 15 credits per semester, 30 per academic year.
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 that 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, staff in the CALS Registrar's Office determine how the credit should be applied.
   - Faculty advisors 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 should

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.

6. During the regular academic year, students can be enrolled in courses at both Cornell and another institution only if the student is taking a course not offered at Cornell. (Schedule conflicts or unavailability of courses in a given semester do not constitute valid rationales for concurrent enrollment at another institution.)

College Credit Earned While in High School

If a student is enrolled in a college or university course during his or her high school years, transfer credit will be given only if all the following criteria are met:

1. Course cannot be used to fulfill high school graduation requirements.
2. Course/section must be a standard course available to all students registered in the college.
3. If taught in a high school, the high school must be a satellite location, one of several options available to all students taking the course.
4. Instructor must be a faculty member (includes adjunct) at the offering college.
5. An official transcript must be sent to the CALS Registrar's Office by the offering institution. It is the student's responsibility to request an official transcript.
6. Both the college form and high school form must be provided to confirm that all credit earned in high school meets these criteria. It is the student's responsibility to request that the college and high school complete these forms. Forms are available in the CALS Registrar's Office, 140 Roberts Hall.

Each condition must be met for credit to be accepted.

Appropriate AP exams identifying a students understanding of the material indicated by achieving the scores outlined in *Courses of Study*, may be used to gain credit for course work that does not meet the criteria outlined above. In addition, students who have taken such courses may earn credit by taking an appropriate examination as described on page 8.

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. Students can review their graduation summary online at https://dust.cals.cornell.edu under degree progress.
2. Students who have been in residence for eight semesters and who have met the graduation requirements will be graduated. Students are expected 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 file an application to graduate with the CALS Registrar's Office.

Deadlines to File the Application to Graduate:

January graduates: October 16

May graduates: December 18

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 pickup on commencement Sunday.

Student Responsibilities: It is the student's responsibility to complete Part I of the Application to Graduate available online at https://dust.cals.cornell.edu; schedule a meeting with your faculty advisor(s) to complete Part II of the application; submit Part II of the application to the CALS Registrar's Office, 140 Roberts Hall; seek clarification from your advisor and/or CALS Registrar's Office staff if graduation requirements are unclear; and retain a copy of the Application to Graduate for your records.

Note: If a student is completing more than one major and/or a minor, the student must meet with and complete Part II of the Application to Graduate with **all** advisors.

Faculty Advisor Responsibilities: It is the faculty advisor's responsibility to complete Part II of the Application to Graduate with the student, listing any outstanding requirements on the application (including courses in which the student is currently enrolled); and answer any student questions regarding major requirements.

CALS Registrar's Office Responsibilities: It is the responsibility of the CALS Registrar's Office to update the graduation summary of seniors before each student's final fall semester. The CALS Registrar's Office staff is available to review degree requirements during walk-in hours and by appointment.

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

ACADEMIC POLICIES AND PROCEDURES

Registration

All students must register with the university at the beginning of each semester. In order to be considered a registered student by the university, a student must:

- complete course enrollment according to individual college requirements;
- settle all financial accounts, including current semester tuition;
- clear any holds, whether these are from the Bursar's Office, Gannett Health Center, the judicial administrator, or the dean of your college; and
- satisfy New York State health requirements.

Students can check their registration status using *Student Center*. The first screen in *Student Center* will indicate whether you are registered and will list any holds that need to be cleared, including the correct office to visit to have the holds removed. Students are expected to register by the fifth week of the semester. Failure to register may result in termination of your Cornell services such as, but not limited to, library access, meal plans, door access, Blackboard, and bus service. You may be considered withdrawn by the college. Only registered students are entitled to attend classes and have access to services.

Course Enrollment

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

To enroll in courses that involve independent study, teaching, internships, or research, a student must file an independent study form, available in the CALS Registrar's Office, 140 Roberts Hall.

Repeated Courses

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 cumulative 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 cumulative GPA. However, repeating a course increases the number of credits required for graduation by the number of credits in the course.

Incompletes

Students must *not* enroll again for a course in which they received an incomplete. 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.

Enrollment Changes

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 *Student Center* or the official course drop and add form at the CALS Registrar's Office, 140 Roberts Hall. Approval of the faculty advisor may be 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 full code may be found at http://cuinfo.cornell.edu/Academic/AIC.html.

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; and
   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 cumulative Cornell GPA) 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 cumulative Cornell GPA) 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 cumulative Cornell GPA) 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. Visit Ho-Nun-De-Kah's web site at www.rso.cornell.edu/hndk.
5. **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 major and distribution 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.

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 advisor, whose signature is required. The advisor'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 taking 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 serves as appropriate notification to university offices and corrects the student's transcript.

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 up to five years, 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 Committee on Academic Achievement and Petitions). A leave exceeding five years will require additional paperwork.

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 24 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.

Agricultural Sciences

Agriculture is an exciting and dynamic field involving a wide range of disciplines. The Agricultural Sciences major trains students to be broad thinkers who are scientifically skilled and knowledgeable about socioeconomic issues related to agriculture and the environment. This interdisciplinary program is for students wishing to pursue a general education in agriculture to prepare for careers that require knowledge of food systems and natural resources. Such careers may include the production and marketing of plant/animal foods, agricultural education in secondary schools, organic farming, cooperative extension, and crop consultation. By providing students with focused categories of courses from which to choose, the Agricultural Sciences program is designed to allow students to work with their advisor in developing a curriculum that best fits the needs of each individual. The program allows students to focus on one or two areas of concentration while gaining a broad exposure to the agricultural courses across the college.

All students are required to take the core courses in sustainable agriculture, soil science, and integrated pest management, as well as gain practical experience by completing an internship and a "hands-on" experiential learning capstone course addressing real problems in agricultural science. Concentrations requiring at least 12 credits are available in Animal Science, Applied Economics and Management, Education and Communication, Crop Production and Management, and Sustainable Agriculture.

Students graduating with an Agricultural Sciences major will be trained to address complex global agricultural issues of today and will have a knowledge base that leads to employment in a variety of fields. The required emphasis on one or two concentration areas also allows students to become experts in the area of agriculture that is most exciting to them.

Since students in the Agricultural Sciences program come from across the college, we create a family of students who take courses, study, learn, and discuss together as a group. We do this by organizing activities that facilitate learning in an interdisciplinary setting, such as inviting guest speakers from various sectors of the agricultural industry to lead discussions, offering professional development workshops to train students for the workforce, and hosting social events for students in the major. Opportunities are also available in research and outreach experiences, and in summer employment, which serve to enrich the students' practical experience.

Animal Sciences

The Animal Sciences program area offers a coordinated group of courses dealing with the principles of animal genetics, 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 advisor. 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 business 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 advisor 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 advisor. 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 advisor'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 programs in general business, agribusiness, and applied economics. Its undergraduate degree is accredited by AACSB International—The Association to Advance Collegiate Schools of Business. Ten areas of specialization are offered in AEM: Accounting, Agribusiness Management, Applied Economics, Entrepreneurship, Environmental and Resource Economics, Finance, Food Industry Management, International Trade, and Development Marketing and Strategy.

Minors

Through the Department of Applied Economics and Management, CALS students may complete a minor program of study in one of eight different subject areas: Agribusiness Management, Business, Environmental and Resource Economics, Finance, Marketing, Food Industry Management, Applied Economics, and International Trade and Development. The minors consist of at least 18 credits of required course. 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 CALS. For those lacking time to incorporate all the minor requirements during the regular school year, up to three of the required courses can be taken during summer session.

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 four 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 3410, 3420, 3520, 4470, 4510
   b. See tracks listed below for additional required courses
2. **Mathematics, statistics, and computer science:**
   a. MATH 1110, 1120, (1920 or 2130), 2930
   b. AEM 2100 or equivalent
   c. EAS 2900 or equivalent
3. **Basic physical sciences**:
   a. PHYS 2207, 2208, or equivalent
   b. CHEM 1560
4. **Tracks**

Operational required	Education required	Broadcasting required
EAS 2500	EAS 1310	EAS 1310
EAS 2960	EAS 1330	EAS 1330
EAS 4560	EAS 2500	EAS 2500
EAS 4700		EAS 2960
		EAS 4700
		COMM 2010
suggested	**suggested**	**suggested**
EAS 1310	EAS 1340	EAS 2680
EAS 1330	Courses in	EAS 1340
EAS 1340	(ASTRO, EAS)	
EAS 2680		minor in communication
EAS 3050	minor in	
EAS 4350	education	

Business required	Environmental required
EAS 1310	CHEM 2070
EAS 1330	CHEM 2080
EAS 2680	EAS 3340
	EAS 4570
suggested	**suggested**
minor in business	EAS 1310
	EAS 1330
	EAS 1340
	EAS 2500
	EAS 2680
	EAS 3050
	EAS 4350
	EAS 4830

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*: 1310, 2500, 2680, 3050, 3340, 3410, 3420, 3520, 4350, 4470, 4510, 4560, 4570, 4700, 6510, 6520, or 6660.

*(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.biology.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) offers majors in biological engineering and environmental engineering. BEE faculty and students address 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 majors in the Department of Biological and Environmental Engineering have a unique focus on biological systems and 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 or environmental engineering, which is awarded jointly by the Colleges of Engineering and Agriculture and Life Sciences.

Engineering students take courses in mathematics, statistics, computing, physics, chemistry, basic and advanced biology, fundamental engineering sciences (solid mechanics, thermodynamics, fluid mechanics, and transport processes), engineering applications, and engineering 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 may further strengthen their programs by completing an engineering minor. Students preparing 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 collaborative problem-solving. **Specific course requirements and other information for the biological engineering major and the environmental engineering major 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 technology concentrations in biological engineering technology and environmental engineering technology within the Interdisciplinary Studies Major in CALS. The technology concentrations emphasize technical applications of biological, environmental, physical, and life sciences. Students take courses in basic biological and physical sciences and mathematics, and choose electives in engineering and technology, agriculture, business, social sciences, and liberal studies.

Many engineering and technology students participate in undergraduate teaching and research, internships, independent study, project teams, and study abroad. Students 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 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.

The living world is all around us and within us. The biological revolution continues and it has given rise to a growing demand for technical people 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 preparing the next generation to meet these challenges.

Specific course distribution requirements for the concentrations in biological engineering technology and environmental engineering technology include the following:

		Credits
1.	*Basic Subjects*	
	a. Calculus	8
	b. Chemistry	7
	c. Physics	8
	d. Computer applications	4
	e. Statistics or probability	3
	f. Introductory biological sciences*	6–8
	g. Written and oral expression*	9
	h. Social sciences and humanities*	12
	*Required of CALS majors.	
2.	*Advanced and Applied Subjects*	
	a. Five courses (15 credits) in the biological, environmental, or agricultural sciences	15
	b. Five courses (15 credits) in technology. Three courses from the list of approved technology courses.**	
	One course must be chosen from the list of approved laboratory courses.**	
	The lab course cannot double count as one of the three required technology courses	15
	**Contact department for a list of approved courses.	
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 technology concentrations, contact the BEE department undergraduate programs office at 207 Riley-Robb Hall, 607-255-2173 or at www.bee.cornell.edu.

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 and/or elsewhere, 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 advisor is assigned on admittance to the field. Approximately 60 faculty members from three colleges serve as advisors 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 advisors 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 (1101–1104, 1105–1106, or 1107–1108)
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, physical, and social sciences. Complex patterns, structures, and interactions raise fundamental and fascinating questions that can be addressed only using 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, continues to increase 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 statistical and mathematical techniques to the sciences. Biometry applies statistics and mathematics 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 firms; salaries are usually excellent. Experience gained through summer employment, undergraduate research, 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 (1194 Comstock Hall). at sjs5@cornell.edu or go to www.bscb.cornell.edu.

Requirements for the Major (beyond the college requirements)

Nine core courses, plus either the Statistics or the Statistical Genomics concentration. Only courses for which the student receives a grade of C- or better will count toward the major in biometry and statistics.

Core Courses:

BTRY 3010 Biological Statistics I or

BTRY 6010 Statistical Methods I

BTRY 3020 Biological Statistics II or

BTRY 6020 Statistical Methods II

BTRY 4080 Theory of Probability

BTRY 4090 Theory of Statistics

MATH 1110 Calculus I

MATH 1120 or 1220 or 1910 Calculus II

MATH 2210 or 2230 or 2310 or 2940 Linear Algebra

MATH 1920 or 2130 or 2220 or 2240 Multivariable Calculus

CS 1112 Introduction to Computer Programming or

BEE 1510 Introduction to Computing

Statistics concentration: Students must complete three advanced courses in statistics, computer science, operations research, or computational biology, including at least two from the list below (for complete list, go to www.bscb.cornell.edu/majReq.php):

BTRY/ILRST 3100 Statistical Sampling

BTRY/ILRST 4100 Multivariate Analysis

BTRY 4790/CS 4782 Probabilistic Graphical Models

BTRY 4820 Statistical Genomics

BTRY 4830 Quantitative Genomics and Genetics

BTRY 4840 Computational Genomics

BTRY 4940 Special Topics (as appropriate)

BTRY 6030/ILRST 4110 Statistical Methods III: Categorical Data Analysis

BTRY 6040/ILRST 4140 Statistical Methods IV: Applied Design

BTRY 6150 Applied Functional Data Analysis

ILRST 6140 Structural Equations

ILRST 6190 Hierarchical Linear Models

NTRES 4110 Quantitative Ecology and Management of Fisheries Resources

NTRES 4120 Wildlife Population Analysis

NTRES 6700 Spatial Statistics

ORIE 3510 and 4520 Stochastic Processes

ORIE 4740 Statistical Data Mining

ORIE 5550 Applied Time-Series Analysis

Statistical genomics concentration: Students must complete two courses from BTRY 4820 Statistical Genomics, BTRY 4830 Quantitative Genomics and Genetics, and BTRY 4840 Computational Genomics; BIOGD 2810 Genetics; and in addition, they must complete one course from the advanced courses previously listed (for complete list go to www.bscb.cornell.edu/majReq.php).

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 advisor. 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 1198 Comstock 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 advisor in the student's major and a BSCB faculty advisor. Students and advisors in other departments should contact the director of undergraduate studies in the Department of Biological Statistics and Computational Biology if they have general questions about Biometry and Statistics courses or the minor. A BSCB faculty member will supervise and assist each minor in course selection.

Requirements for the minor

BTRY 3010 Biological Statistics I or BTRY 6010 Statistical Methods I

BTRY 3020 Biological Statistics II or BTRY 6020 Statistical Methods II

BTRY 4080 Theory of Probability

BTRY 4090 Theory of Statistics

MATH 1110 Calculus I

MATH 1120 or 1220 or 1910 Calculus II

MATH 1920 or 2130 Multivariable Calculus or

MATH 2210–2220 or 2230-2240 Linear Algebra and Multivariable Calculus

One additional statistics elective from the advanced statistics course list given above.

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 1101 Cases in Communication

Spring semester

COMM 1300 Visual Communication

COMM 1310 Writing about Communication

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

Required sophomore courses

COMM 2010 Oral Communication

COMM 2820 Research Methods in Communication Studies

Two of the four Focus Area introductory courses:

COMM 2200 Media Communication

COMM 2450 Communication and Technology

COMM 2760 Persuasion and Social Influence

COMM 2850 Communication, Environment, Science, and Health

After completing the courses in the core curriculum, all majors take an additional 18 credits in communication distributed among advanced writing and presentation courses, electives, and focus area requirements. Students must also complete 3 credits of college-level statistics. In consultation with their advisers, students concentrate in one of four defined focus areas appropriate to specific educational and career goals.

1. *Communication, environment, science, and health (CESH)*: Students focusing in CESH will investigate how communication influences public understanding of science, health, environmental, and risk-related issues. While exploring conceptual and theoretical issues, students will learn specific skills for communicating science, health, environmental, and risk information to a variety of audiences. Possible career paths include public information officer, science writer, environmental educator/outreach specialist, environmental or health-risk communicator, and business, legal, and other graduate study.
2. *Communication media studies (CMS)*: Students focusing in CMS will investigate the forces that shape media in contemporary society, investigating how what we see and hear comes to be. They will also analyze and understand the psychological, social, and cultural processes that are in turn affected by media, from politics to entertainment to news to the very question of what we understand as real about ourselves and true about the world around us. Students may pursue careers in the media industries, in designing the laws and policies regarding media, in business, legal, or other graduate study, or in the service of making media better; most of all, they will be more informed and astute citizens in a highly mediated world.
3. *Communication and information technologies (CIT)*: Students focusing in CIT will explore the social and psychological dimensions of the design, use, and evaluation of communication and information technologies, how people form and manage impressions and relate to each other in cyberspace, the uses of language in online interaction, and how people coordinate work in virtual teams, as well as people's interface and information needs. Possible career paths include information systems designer, research analyst, user interface designer, software designer, usability specialist, technology writer, and business, legal, and other graduate study.
4. *Communication and social influence (CSI):* Students focusing in CSI will use communication principles to analyze issues and situations involving groups, organizations, and selected audiences to design, implement, and evaluate appropriate communication programs. Courses stress the positive, ethical, and effective uses of communication in human affairs. This focus area would be appropriate for students interested in using communication to bring about change at the individual and societal level. Possible career paths include public relations, marketing communications, polling, human resources, governmental affairs, and business, legal, and other graduate study.

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 1101, 1300, 2010 and either 2200, 2450, 2760, or 2850; Students also complete three elective courses totaling 9 credit hours, at least two of which must be at the 3000–4000 level, excluding the advanced writing and presentation courses and COMM 3030, 3530, 4050, 4960, and 4980.

The minor 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 and is a part of the Agricultural Sciences major (crop production and management concentration). 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 Agricultural Sciences major is an interdisciplinary program for students wishing to pursue a general education in agriculture to prepare for careers that require a scientific and integrative understanding of agriculture and food systems. Students can concentrate in one or more areas, including Animal Science, Agriculture Economics and Management, Education and Communication, Crop Production and Management, and Sustainable Agriculture. 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 environmental agriculture, environmental biology, environmental economics, environmental information science, and sustainable development. The SES major places emphasis on the basic disciplines of chemistry, physics, and mathematics.

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 2110 or 4050, 3170, or 4140) and plant protection (CSS 3150, 4440, ENTOM 2410, or PLPA 3010) plus at least three courses and at least 12 credits in soil science (CSS 2600, 3210, 3650, 3720, 4120, or 4660). 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 3 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 and rural labor markets; community and regional development; environmental sociology; technology; the political economy of globalization; women in development; and ethnic stratification and integration. 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 (DSOC 1101), international development (DSOC 2050), population dynamics (DSOC 2010), methods (DSOC 3130 or 3140), theory (DSOC 3010), social stratification (DSOC 3700), 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 3000 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 offers a general DSOC minor and a minor in Globalization, Ethnicity, and Development. For a complete list of requirements for either minor, please go to our web site: http://devsoc.cals.cornell.edu or visit 133 Warren Hall.

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 and ethnic studies programs including the American Indian Program, Latino Studies Program, Asian American Studies Program, 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

The Department of Education builds on strong academic disciplines such as sociology psychology, anthropology, biological and political sciences, political thought, and philosophy and is grounded in empirical and theoretical studies of educational practice in order to address education in diverse contexts and across the life span. The department has two foci to meet societal demands for teachers, researchers, and learners. The Learning, Teaching, and Social Policy (LTSP) concentration, which includes the Cornell Teacher Education Program (CTE), concentrates on teacher education in science, mathematics and agricultural science education, diversity, critical pedagogy, the study of school-age children and their families, and policy related to formal education. The Adult and Extension Education (AEE) concentration prepares scholars and practitioners for adult and extension education leadership and professional development roles in domestic and international community-based, nonformal, and formal organizations and focuses on community development and organizing, adult education, public scholarship, university extension/outreach, learning in adulthood, educational planning and program development, and international adult and extension education. These two programs of study, largely at the graduate level, prepare leaders who will both engage in professional practice and improve educational processes through their scholarship and practice. Our undergraduate program leads to initial certification in agricultural science education. An undergraduate minor in education is also available for students across all colleges at Cornell. For the latest information on program developments, go to 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. We seek 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, and 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 investigates 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 agricultural science,

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. Undergraduates accepted into the CTE program major in a mathematics, agriculture, or science field in any Cornell college and complete a minor in education. With a CTE minor and a bachelor's degree, students can complete the Master of Arts in Teaching (MAT) in one year. 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.

Agricultural Science Education is taught at the middle and high school levels in New York State and nationally. Building on strong academic disciplines in the agricultural sciences, and with a solid grounding in the psychological, social, empirical, and theoretical bases of educational practice, the department offers two programs that lead to professional certification in Agricultural Science Education. The undergraduate degree in Agricultural Science Education and the agriculture option in the Master of Arts in Teaching are both offered under the Cornell Teacher Education umbrella. In addition, the undergraduate degree offers a non-certification option for persons with interests in instruction in nonschool settings such as extension, 4-H, arboretums, and state and national parks. All three of these programs prepare educators for leadership and professional roles in the broad fields of agriculture and natural resources.

Minor in Education

The minor in education gives students a planned core of courses to provide them with an overview of education as a field. One option prepares students to move into the graduate segment of the Cornell Teacher Education (CTE) program. Other options provide preparation for admission into other graduate teacher certification programs or a background for professional venues such as extension, business, and industry. Any undergraduate student in the university may enroll subject to availability in courses required for the minor. Students who wish to pursue a minor in Education must complete and submit an application. Applications are available in 426 Kennedy Hall, the CALS Office of Academic Programs, or by e-mailing cu_teacher_ed@cornell.edu.

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, 255–6130, or www.clt.cornell.edu.

Current offerings include:

EDUC 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 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 5790 ITADP Further Training for International Teaching Assistants
Fall and spring. Noncredit course for international teaching assistants who have completed EDUC 5780 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 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 advisors.

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
- One semester of physics (may need two depending on future plans)
- CHEM 1570 Introduction to Organic and Biological Chemistry or CHEM 3570 and 3580 Organic Chemistry for the Life Sciences (for students planning on medical school)
- Introductory biology (1101–1104 recommended, even if AP credit received)
- BIOGD 2810 (genetics)
- BIOEE 2780 (Evolutionary Biology)
- Choose one of the following two courses:

  BIOEE 2610 (Ecology and the Environment)

  BIOBM 3300, 3310, or 3320 (Principles of Biochemistry)

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

Entomology Requirements (15–21 credits)

- ENTOM 2120 Insect Biology—4 cr
- Group A (core courses). Choose two of the following six courses:

  ENTOM 3310/3311 Insect Systematics—4 cr

  ENTOM 3330 Larval Insect Biology—3 cr

  ENTOM 3520/3521 Medical and Veterinary Entomology—4 cr

  ENTOM 4440 Integrated Pest Management—4 cr

  ENTOM 4550 Insect Ecology—4 cr

  ENTOM 4630 Invertebrate Pathology—4 cr

  ENTOM 4830 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 three specialization options in the major: (1) food science; (2) food operations and management; or (3) food biotechnology. 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.

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 1300 Introductory Design and Programming for the Web

   Note: INFO 1301 and 1302 (no longer offered) may count together in place of 1300.

2. Math and Statistics (four courses):
   - MATH 1110 Calculus I
   - one course chosen from: MATH 1710 Statistical Theory and Application in the Real World; HADM 2201 Hospitality Quantitative Analysis; AEM 2100 Introductory Statistics; PAM 2100 Introduction to Statistics; ENGRD 2700 Basic Engineering Probability and Statistics; BTRY 3010 Statistical Methods I; SOC 3010 Evaluating Statistical Evidence; CEE 3040 Uncertainty Analysis in Engineering; ILRST 3120 Applied Regression Methods; ECON 3190 Introduction to Statistics and Probability; PSYCH 3500 Statistics and Research Design
   - either MATH 2310 Linear Algebra with Applications or MATH 2210 Linear Algebra
   - INFO 2950 Mathematical Methods for Information Science or CS 2800 Discrete Structures

3. Human-Centered Systems (two courses):

   INFO 2140 Cognitive Psychology

   INFO 2450 Communication and Technology

4. Information Systems (two courses):

   CS 2110 Object-Oriented Programming and Data Structures*

   INFO 2300 Intermediate Design and Programming for the Web

*CS 2110 is an intermediate programming course that requires prior knowledge of Java. Students who have not learned Java can take CS 1130 after completing INFO 1300 and 2300, or they can take CS 1110.

5. Social Systems (two courses):
   - either ECON 3010 Microeconomics or ECON 3130 Intermediate Microeconomic Theory
   - one course chosen from: INFO 2921 Inventing an Information Society; INFO 3551 Computers: From the 17th Century to the Dotcom Boom; or INFO 3561 Computing Cultures; or INFO 3200 New Media and Society

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.

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. Students must earn a C- or better in all courses used for the major.

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, CS, and STS).

1. Human-Centered Systems

   INFO 3400 Psychology of Social Computing

   PSYCH 3420 Human Perception: Applications to Computer Graphics, Art, and Visual Display*

   INFO 3450 Human–Computer Interaction Design

   PSYCH 3470 Psychology of Visual Communications

   INFO 3650 Technology and Collaboration

   PSYCH 3800 Social Cognition*

   PSYCH 4160 Modeling Perception and Cognition

   INFO 4400 Advanced Human–Computer Interaction Design

   INFO 4450 Seminar in Computer-Mediated Communication

   INFO 4500 Language and Technology

   DEA 4700 Applied Ergonomic Methods

   *Students who take PSYCH 3420 may also count its prerequisite, PSYCH 2050, toward the Human-Centered Systems primary/secondary track requirements. Similarly, students who take PSYCH 3800 may also count PSYCH 2800 toward the Human-Centered Systems primary/secondary track requirements. At most, one of PSYCH 2050 or 2800 can be counted toward the primary/secondary track requirements.

2. Information Systems

   INFO 3300 Data-Driven Web Applications

   CS 4450 Computer Networks

   LING 4424 Computational Linguistics

   INFO 4300 Information Retrieval

   INFO 4302 Web Information Systems

   CS 4320 Introduction to Database Systems

   LING 4474 Introduction to Natural Language Processing

   CS 4620 Introduction to Computer Graphics

   CS 4700 Foundations of Artificial Intelligence

   ORIE 4740 Statistical Data Mining I

   CS 4780 Machine Learning

   ORIE 4800 Information Technology

   CS 5150 Software Engineering

   INFO 5300 Architecture of Large-Scale Information Systems

   CS 5430 System Security

   CS 5780 Empirical Methods in Machine Learning and Data Mining

3. Social Systems

   INFO 2040 Networks

   SOC 3040 Social Networks and Social Processes

   INFO 3200 New Media and Society*

   AEM 3220 Internet Strategy

   INFO 3490 Media Technologies

INFO 3551 Computers: From the 17th Century to the Dotcom Boom

INFO 3561 Computing Cultures

INFO 3660 History and Theory of Digital Art

ECON 3680 Game Theory*

INFO 3871 The Automatic Lifestyle: Consumer Culture and Technology

STS 4111 Knowledge, Technology, and Property

ECON 4190 Economic Decisions Under Uncertainty

INFO 4290 Copyright in the Digital Age

INFO 4350 Seminar on Applications of Information Science

ORIE 4350 Introduction to Game Theory*

INFO 4144 Responsive Environments

SOC 4150 Internet and Society*

INFO 4470 Social and Economic Data

ECON 4760 Decision Theory I

ECON 4770 Decision Theory II

HADM 4489 The Law of the Internet and E-Commerce

INFO 4850 Computational Methods for Complex Networks

INFO 5150 Culture, Law, and Politics of the Internet

*Only one of ORIE 4350 and ECON 3680 may be taken for IS credit. Only one of INFO 3200 and SOC 4150 may be taken for IS 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 should visit www.infosci.cornell.edu/ugrad 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 and rural development in low-income countries. The student chooses an area of concentration within the major and works with an advisor to plan an individualized program of study. Areas of concentration include (1) social development and livelihoods, (2) food systems, and (3) environment and ecosystems. The core curriculum and areas of concentration are designed to acquaint students with relevant socioeconomic factors, the physical and biological aspects of tropical crops and animal production, and issues of resource management and sustainability in low-income countries.

Requirements

In addition to the college distribution requirements, students in international agriculture and rural development must take a minimum of 50 credits toward the major. A minimum of 18 credits from a core curriculum (in addition to foreign language) are required, 8 of which should be in international agriculture and rural development (IARD). The foreign language requirement for the IARD major is identical to that of the College of Arts and Sciences (see p. 445). Other course work is drawn from a wide range of disciplines, consistent with the student's chosen concentration. Students are expected to complete an overseas field study experience of a minimum of six weeks. The objective is to familiarize students with the many facets of agricultural and rural development in low-income countries.

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. Five courses with significant international content, as recommended by students' major departments (three should be from CALS).

Highly recommended

1. Foreign language course work.
2. An approved overseas experience (exchange, study abroad program, internship, or faculty-led short course).

For more information, contact the academic programs coordinator in the CALS International Programs Office, 255-3811.

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 1410 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 1420 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 4910 Creating the Urban Eden: Woody Plant Selection, Design, and Landscape Establishment	4
*LA 2010 Medium of the Landscape	5
†Biological sciences elective	3
†Social sciences or humanities elective	3
Historical studies	3
	18

Spring Semester

*LA 2020 Medium of the Landscape	5
*LA 4910 Creating the Urban Eden: Woody Plant Selection, Design, and Landscape Establishment	4
†Written or oral expression elective	3
†Physical sciences elective	3
Concentration	3
	18

Third Year

Fall Semester

*LA 3010 Integrating Theory and Practice	5
*LA 3150 Site Engineering	5
‡Free electives	4
	14

Spring Semester

**Concentration	6
*Historical studies	3
*LA 3180 Site Construction	5
Electives	2
	16

Fourth Year

Fall Semester

*LA 4010 Advanced Synthesis: Project Design	5
**Concentration	2
LA 4120 Professional Practice 1	
†Social sciences or humanities elective	3
(Optional landscape architecture study abroad semester in Denmark or Rome)	
	11

Spring Semester

*LA 4020 Integrating Theory and Practice II	5
**Concentration	4
‡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 5050 Graphic Communication I	3
*LA 5010 Composition and Theory	5
*Historical studies	3
*LA 4910 Creating the Urban Eden: Woody Plant Selection, Design and Landscape Establishment	4
	15

Spring Semester

*LA 5020 Composition and Theory	5
*LA 4920 Creating the Urban Eden: Woody Plant Selection, Design and Landscape Establishment	4
LA 5900 Theoretical Foundations	2
Concentration	3
	14

Second Year

Fall Semester

*LA 6010 Integrating Theory and Practice	5
*LA 6160 Site Engineering	5
**Concentration	3
Historical studies	3
	16

Spring Semester

*LA 6020 Integrating Theory and Practice	5
*LA 6180 Site Construction	5
*LA 6900 Methods of Landscape Architectural Inquiry	3
**Historical studies	3
	16

Third Year

Fall Semester

*LA 7010 Urban Design and Planning	5
‡Free elective	3
**Concentration	3
Theory	3
LA 4120 Professional Practice 1	
	15

Spring Semester

*LA 8000 Master's Thesis in Landscape Architecture	9
or *LA 7020 Advanced Design Studio	5
‡Free elective(s)	2 or 6
Concentration LA 6030	1
	14

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 a 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 3600 Pre-Industrial Cities and Towns of North America (3 credits) offered alternate years

+LA 2610 Fieldwork in Urban Archaeology (4 credits)

+LA 2620 Laboratory in Landscape Archaeology (3 credits)

+LA 2820 Photography and the American Landscape (3 credits)

+LA 4180 Audio Documentary: Stories from the Land (3 credits)

+LA 4830 Seminar in Landscape Studies (3 credits)

LA 4970 Independent Study (1–5 credits)

LANAR 5240 History of European Landscape Architecture (3 credits)

LANAR 5250 History of American Landscape Architecture (3 credits)

LA 5450 The Parks and Fora of Imperial Rome (3 credits)

LA 7920 Landscape Preservation: Theory and Practice (3 credits)

+ Distribution elective

Natural Resources

Natural Resources is an interdisciplinary major focusing on the fundamental knowledge and analytical tools required to conserve, restore, and manage the Earth's biodiversity and ecosystem services in sustainable ways. The curriculum draws on relevant knowledge from biology, ecology, chemistry, mathematics, sociology, economics, law, and ethics. A large number of field courses provide direct experience working in forests, wetlands, streams, lakes, and policy-making arenas. Courses address pressing environmental issues such as global climate change, landscape transformation, endangered and invasive species, human alteration of biogeochemical cycles, "green" markets and other environmental strategies, environmental justice, bio-cultural and biological diversity, and international conservation. Concentrations include applied ecology, resource policy and management, and environmental studies.

The major allows students flexibility to pursue a variety of paths to understand the biological, ecological, ethical, and societal basis for biodiversity conservation, sound resource management, and sustainable development.

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 society 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 professionals within a diverse array of environmental careers, or as informed citizens working in other professions.

Graduates with a major in natural resources have the flexibility to pursue a number of different careers because of the interdisciplinary nature of the curriculum. The major prepares students for graduate school in numerous fields, and for 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 (e.g., conservation organizations) 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 Society 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, and Plant Biology.

Resource policy and management provides a foundation for students who wish to pursue careers or advanced study in the social science or policy aspects of natural resource conservation and management, environmental sociology, international conservation, 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, Communication, 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 advisor. 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 1150 Nutrition, Health, and Society; NS 2450 Social Science Perspectives on Food and Nutrition; NS 3450 Introduction to Physicochemical and Biological Aspects of Foods; NS 3310 Physiological and Biochemical Bases of Nutrition; and NS 3320 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 advisors in the Division of Nutritional Sciences with whom they meet regularly. Advisors 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, B21 Savage Hall, 255-4410, 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 1150 Nutrition, Health, and Society plus 9 credits of 2000-level or above didactic NS courses. Several NS courses are excluded from use toward the minor. Please check www.nutrition.cornell.edu/undergrad/calsminr.html for details. Enrollment is limited in some courses.

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 and Plant-Microbe Biology, 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 140 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 workforce 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.

For more information about this major, see www.cals.cornell.edu/cals/hort/teaching/plant-sci-undergrad/index.cfm

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 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 advisors.

Horticulture. Derived from the Latin word "hortus," meaning garden, horticulture is a blend of science and culture involving knowledge of plants grown 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 1101 Horticultural Science and Systems (4 credits)

HORT 4000 Plant Propagation (3 credits)

Two HORT courses in plant production or management at the 4000 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 advisors.

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 humans. It provides undergraduates with a thorough preparation for graduate study in plant sciences. In cooperation with an advisor 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 breeding and genetics 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 PLBR 2010, 4030, 4040, and BIOPL 3430. Other courses may be included after consultation with the advisor. Students are encouraged to participate in research projects and take advantage of opportunities for internships in industry.

Plant pathology and plant-microbe biology faculty study interactions of plants with pathogenic and beneficial microorganisms and with toxic elements in air and water. Some specialists in the field choose to focus their attention on the cause and management of plant diseases and others employ contemporary tools of molecular biology to answer fundamental questions about the nature of host-pathogen interactions. Working together, they advance the frontiers of science to ensure rapid deployment of new strategies for growing healthy crops with maximum yields and minimal impacts on the surrounding environment. For most students, a concentration in Plant Pathology and Plant-Microbe Biology is preparation for graduate study in the field. However, graduates may also be employed as sales or technical representatives with agribusiness firms, Cooperative Extension educators, state or federal regulatory officials, and laboratory technicians. Suggested courses beyond the Plant Science 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)

The EARTH SCIENCES have never been more critical to society than they are today. Global warming, dwindling energy resources, inadequate water supplies, political strife over strategic minerals, and megadisasters threatened by volcanic eruptions, earthquakes, tsunami, and hurricanes: these are but a few of the headlines that appear with increasing frequency. The Department of Earth and Atmospheric Sciences at Cornell is a global leader in research directed toward understanding the fundamental processes that have shaped our planet, and is committed to providing Cornell students with the earth literacy needed to serve as informed citizens and wise stewards of the Earth. EAS faculty members and graduate students carry out frontier research on both basic and applied aspects of subjects as diverse as satellite monitoring of volcanic activity, the deep structure of the Andes and Tibetan Plateau, the nature of the earth's ionosphere, and the impact of aerosols on global climate.

The Science of Earth Systems (SES) major is the undergraduate program offered by EAS to Cornell students in the Colleges of Engineering, Arts and Sciences, and Agriculture and Life Sciences. Students in this program can pursue education and research that prepares them to compete for careers or graduate study at leading institutions in this country and abroad. Students may choose to focus on one of a number of disciplinary specialties, such as geophysics or tectonics, or develop the broad expertise needed to understand the interactions between the diverse elements of Earth and life in the past, present, and future. By analyzing the complex relations among the ocean, solid earth, atmosphere, and biosphere, students can help meet society's growing demand for energy, minerals, and clean water as well as contribute to mitigating the negative impacts related to global warming, rising sea level, natural hazards, and decreasing biodiversity.

The SES program is intrinsically interdisciplinary, involving many branches of science and engineering. Examples include archaeology, astronomy, biological and environmental engineering, civil and environmental engineering, and ecology and evolutionary biology. The SES program is unique in that it incorporates the fundamentals of earth science with the emergence of a new and more complete approach that encompasses all components of the earth system—air, life, rock, and water—to gain a new and more comprehensive understanding of the world as we know it.

To achieve a complete understanding of these important issues, students must have a desire to take a very hands-on approach. An abundance of opportunities exist for geological, oceanographic, and meteorological research in the field and for nationwide and international travel as well as paid research experience. Students have worked with faculty members in the Andes, the Aleutians, the Rockies, the Atacama Desert, the Caribbean, Tibet, and Hawaii, and have spent a semester at sea in the Woods Hole Ocean Studies Program. Students are also able to probe the ionosphere of Earth and the surface of Mars by utilizing techniques in remote sensing.

The SES major provides a strong preparation for graduate school in any one of the earth sciences, such as atmospheric sciences, geological sciences, geophysics, geochemistry, oceanography, hydrology, and biogeochemistry. Students seeking employment with the B.S. degree will have many options in a wide variety of careers related to energy, the environment, and critical resources in both the private sector and government. Students with 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 1910–1920 (or MATH 1110–1120)

b. PHYS 2207–2208 (or PHYS 1112–2213)

c. CHEM 2070–2080 or 2070–1570 or 2090–2080

d. BIOLOGY—there are three options (CALS students must choose within option 1):

1. one year of biology, choosing from the introductory biology sequences of courses: BIOG 1101/1103-1102/1104, or 1105/1106, or BIOG 1109/1110

2. one semester from the introductory biology sequences of courses (listed in option 1) and EAS/BIOEE 1540 or EAS 1700

3. students may substitute (with written permission of their advisor) one semester of biology with an additional semester of chemistry, math, or physics.

2. Required Introductory Course: EAS 2200 The Earth System

3. Science of Earth Systems Core Courses

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. Three courses selected from the following four core courses are required for the major.

EAS 3010 Evolution of the Earth System

EAS/NTRES 3030 Biogeochemistry

EAS 3040 Interior of the Earth

EAS 3050 Climate Dynamics

4. Concentration Courses

Four intermediate to advanced-level courses (3000 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 as prerequisites for courses chosen for the 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 during the junior year or before in consultation with an SES advisor whose interests match those of the student. Four concentrations are defined for the major: atmospheric sciences, biogeochemistry, geological sciences, and ocean sciences (see EAS web site for details). Other concentrations can be tailored to a student's interests in concert with the student's

advisor and upon approval of the SES curriculum committee. Examples include sustainable Earth and environmental systems, earth system science and policy, hydrology, planetary science, and soil science.

5. Field/Observational/Laboratory Experience

Exposure to the basic observations of earth science, whether directly in the field, or indirectly by various techniques of remote sensing, or in the laboratory, is necessary to understand fully the chosen area of concentration in the major. A minimum of 3 credits of course work of an observational nature is required. Possibilities include

Courses in the Hawaii Environmental Semester program;

Courses given by the Shoals Marine Laboratory;

EAS 2500 (Meteorological Observations and Instruments);

EAS 3520 (Synoptic Meteorology I);

EAS 4170 (Field Mapping in Argentina);

EAS 4370 (Geophysical Field Methods);

EAS 4910 and/or 4920 (Undergraduate Research, total 3 credits) with appropriate choice of project

Field courses taught by another college or university (3-credit minimum), if approved by advisor.

For more information, contact Professor John Cisne, Department of Earth and Atmospheric Sciences, john.cisne@cornell.edu, or visit www.eas.cornell.edu.

Students may minor in Science of Earth Systems as well. See the EAS web site for more information.

Science of Natural and Environmental Systems

Environmental stewardship and sustainability are increasingly recognized as human and planetary imperatives. This environmental science major will provide you with a strong foundation in the basic sciences, and an introduction to the relationships between the biophysical and social sciences. Concentrations include environmental agriculture, environmental biology, environmental economics, environmental information science, and sustainable development.

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.

The SNES major is an excellent preparation for careers in governmental or non-governmental organizations responsible for environmental evaluation and policy; professional programs in law, business, journalism; and graduate programs in a variety of environmental science fields (earth science, ecology, environmental engineering, marine biology, soil science).

Foundation Courses

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. Many of these courses (listed below) will also contribute to completion of CALS distribution requirements.

- 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
- DEA 1500 Introduction to Human-Environment Relationships
- NTRES 2010 Environmental Conservation

The freshman and sophomore years are designed to provide a strong scientific basis for future advanced study and to become engaged in environmental studies through DEA 1500 and NTRES 2010. 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 advisor.

Environmental Core

The environmental core consists of six 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. SNES 1101, required in the freshman year, provides a unifying overview of the goals, 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.

Biotic Systems: BIOEE 2610 Ecology and the Environment

Colloquium Series: SNES 2000 Environmental Sciences Colloquium

Earth Systems: CSS 3650 Environmental Chemistry: Soil, Air, and Water

Economic Systems: AEM 2500 Environmental and Resource Economics

Environmental Science: SNES 1101 Intro to the Science and Management of Environmental and Natural Resources

Social Systems: DSOC 3240 (STS 3241/SOC 3240) Environment and Society

Programs of Study

Programs of study that focus in one or more areas of environmental science have been established to provide disciplinary expertise sufficient for entry-level professional proficiency. Each student in the major will be required to take four courses at the 3000 level or above in at least one program of study.

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

Environmental Agriculture

Environmental Biology

Environmental Economics

Environmental Information Science

Sustainable Development

For more information about this major or minor, see http://snes.eas.cornell.edu, visit the undergraduate program office in 12 Fernow Hall, or send e-mail to sw38@cornell.edu.

Viticulture and Enology

The juice and wine grape industry is expanding rapidly in New York State, creating opportunities for experts in grape-growing (viticulture), wine-making (enology), wine marketing, and other related scientific fields. In recent years there has been a shortage of qualified personnel to manage vineyards and wineries.

Cornell's new Viticulture and Enology major is creating the next generation of leaders for the wine-grape industry in New York, nationally, and internationally. Its primary focus is on cool climate grapes and wines, addressing the unique challenges of climates, soils, new and traditional grape varieties, and marketing estate-grown wines. The major offers two concentrations: (1) the Viticulture concentration is for those primarily interested in grape growing, and (2) the Enology concentration emphasizes wine production. The curriculum for both concentrations includes many courses in common, and the major provides a strong foundation in the physical and biological sciences. College distribution requirements ensure a broad educational background for all students.

The Viticulture and Enology Program maintains extensive research/teaching vineyards near the Ithaca campus, providing students with hands-on experience producing grapes for juice or fermentation in the enology courses. A new teaching winery is located at the Cornell Orchards next to the Ithaca campus, and at the New York State Agricultural Experiment Station in Geneva, enabling students to learn grape processing, wine-making, and chemical analysis of grapes and wines. Our vineyards include more than 30 wine and table grape varieties, including native American grapes, French-American hybrid grapes, and most of the major European vinifera-type grapes.

The major is closely linked with the New York wineries throughout the state, and student internships at these vineyards and wineries are an integral part of the curriculum. Most of our classes have fewer than 20 students, providing ample opportunities for student/faculty interactions and involvement of undergraduate students in faculty research and outreach programs. In addition, students have access to extension and research activities in viticulture and enology at several research stations, academic departments, and facilities at Cornell University.

Special highlights of this major include:

- Regional focus on the special challenges and opportunities of viticulture and enology in New York and cool-climate areas worldwide

- Hands-on teaching vineyards and student winery near the Ithaca campus
- Flexibility to add electives from the Department of Applied Economics and Management, the School of Hotel Administration, and other Cornell units
- The program draws on the resources of Cornell's Geneva Campus at the New York State Agriculture Experiment Station. The Station includes the USDA-ARS germplasm repository for cool-climate grapes and Cornell's state-of-the-art vinification and brewing technology laboratory

For more information, please see www.grapesandwine.cals.cornell.edu/undergraduate.

Foundation Courses

The purpose of this component of the major is to provide a strong foundation in the basic sciences. Many of these courses (listed below) will also contribute to completion of CALS distribution requirements.

- Two semesters of biology with lab
- Microbiology
- Introductory botany
- Plant function and growth
- Food analysis
- General inorganic and organic chemistry with lab
- Statistics

Core Viticulture and Enology Courses

Several VIEN or Viticulture and Enology major courses including:

- VIEN 1104 Introduction to Wines and Vines
- VIEN 2400 Grape Composition and Analysis
- VIEN 3400 Winemaking Technology
- VIEN 4400 Wine and Grape Flavor Development
- VIEN 4430 and 4440: Viticulture and Vineyard Management I and II
- VIEN 4444 Grapevine Biology

All students are encouraged to complete internships in the wine or grape industry during the summers and to participate in undergraduate research programs on campus. In New York State alone, more than 220 wineries and 600 vineyards are enthusiastic about working with students and hosting interns.

The Minor

Through a minor in Viticulture and Enology, students will learn the essential natural history and biology of wine grapes, systems, and technologies of grape and wine production, as well as the basic chemistry of grape and wine analysis. Those interested in pursuing a minor in Viticulture and Enology need to complete at least 13 credits.

Required Introductory Core Course (4 cr)

VIEN 1104 Wines and Vines (3 cr)

VIEN 1105 Wines and Vines, Lab (1 cr)

Required Upper Level Core Courses (7 cr)

VIEN 3400 Winemaking Practices and Principles (3 cr)

VIEN 3410 Winemaking Lab (1 cr)

VIEN 4430 Viticulture and Vineyard Management I (3 cr)

A minimum of one additional class and 2 additional credits in any course(s) with a "VIEN" designation except 1104, 3400, 3410, 4300, 4430, 4960 must also be taken.

Recommended courses include:

VIEN 2400 Wine and Grape Analysis and Composition (2 cr)

VIEN 4200 Grape Pest Management (3 cr)

VIEN 4400 Wine and Grape Flavor Development (3 cr)

VIEN 4440 Viticulture and Vineyard Management II (3 cr)

VIEN 4444 Grapevine Biology (3 cr)

Any undergraduate student in the college may enroll, subject to availability, in courses required for the minor. Several courses in VIEN have suggested prerequisites, but these requirements may be waived at the discretion of the instructor. Only courses for which a grade of "C" or better is received will count toward the minor in Viticulture and Enology (courses taken with an S–U option will not count).

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 advisor, students plan a sequence of courses suited to their individual interests, abilities, and objectives. 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. A course of study for interdisciplinary studies must be planned with and approved by a college faculty advisor. Information on the options and names of faculty advisors prepared to advise in special programs are available in the Counseling and Advising Office, 140 Roberts Hall.

DESCRIPTIONS 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.

NONDEPARTMENTAL COURSES

ALS 1140 Explorations in Biology Research and Health Professions
Summer. 1 credit. Not for Biological Sciences majors. K. Gellman.
We will explore biology as it pertains to research, health-care professions, and the world at large. This seminar is designed for students with a strong interest in medicine and biological research. Discussions and laboratory exercises will allow students to interact with faculty and guest speakers. We will also learn to read and evaluate scientific publications on current biological topics. Course grade will be based upon a final paper.

ALS 1340/1341 N.Y.S. Emergency Medical Technician—Basic
Fall and spring. 6 credits awarded at completion of course. Full academic-year course requiring fall and spring enrollment. Recommended: basic or advanced first aid. S–U or letter grades. D. A. Grossman, R. Kniffen, and A. E. Gantert.
Intensive 170-hour course taught throughout the fall and spring semesters. Includes training in C.P.R. and defibrillation for the professional rescuer, oxygen administration, airway management, fracture management, bleeding control, spinal immobilization, patient assessment, emergency pharmacology, and the use of medical antishock trousers. Students qualify for the New York State E.M.T.—Basic certification process. Examinations upon successful completion of the course.

ALS 1350 Advanced N.Y.S. Emergency Medical Technician—Intermediate
Fall. 4 credits. Prerequisite: current certification as N.Y.S. Basic E.M.T. or have applied for reciprocity. S–U or letter grades. D. Grossman and staff.
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 time.

ALS 3920 New York State Government Affairs (also HE 3920)
Spring. 15 credits. Prerequisite: junior or senior standing; minimum GPA of 2.3. R. Canfield.
For description see HE 3920.

ALS 4000 Community Service Learning Project
Fall and spring. 3 credits. Prerequisite: none. Letter grades only. B. Chabot.
Students will develop an independent community-based project that will achieve both service and learning objectives. Learning objectives include skills in research, critical thinking, and leadership. Students will gain knowledge in community needs assessment, project planning, design, implementation, and evaluation. Faculty members will mentor students in developing community partnerships, research, and project planning.

ALS 4770 Environmental Stewardship in the Cornell Community
Spring. 2–4 credits, variable; may be taken more than once. J. M. Regenstein.
Each student or team of students undertakes an original project to improve the environment at Cornell or in Tompkins County. Often the projects will involve working with 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 a final oral report at a public forum to which senior Cornell administrators are invited. The final written report will be made public.

ALS 4940 Special Topics in Agriculture and Life Sciences
Fall or spring. 4 credits max. S–U or letter grades.
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 4960 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 4991/4992 Honors Project I and II (also BSOC/STS/HE 4991/4992)
Fall and spring (yearlong). 8 credits (register for 4 credits each semester; total credits awarded is 8). 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 4998 Politics and Policy: Theory, Research, and Practice (also AMST/PAM/GOVT 4998)
Students in CALS must register for ALS 4998. 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, or online at ciw.cornell.edu.

ALS 5100 Leadership Development for Life Scientists
Spring. 3 credits. Prerequisite: invitation or permission of instructor. S–U grades only. M. Pritts, C. Warzynski, and L. Gasser.
Formal training and practice of skills required for leading people in an academic or business environment. Skills include coaching, feedback, managing conflict, fostering teamwork, creating vision, and developing diversity. A significant portion is devoted to understanding one's own strengths and weaknesses and how to recognize and use strengths in others.

ALS 5800 International Teaching Assistant Development Program Course 3
Fall or spring. 2 credits. Prerequisite: EDUC 5790. ITADP staff.
Specifically designed for international graduate students who plan to assume teaching assistant responsibilities that range from lab introductions to individual tutoring sessions. 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 5810 International Teaching Assistant Development Program Course 4
Fall or spring. 2 credits. Prerequisite: ALS 5800. ITADP staff.
Specifically designed for international graduate students who have completed ALS 5800 and who plan to assume teaching assistant responsibilities that range from lab introductions to individual tutoring sessions. 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 6610–6611 Environmental Policy (also BSOC 4611–4612, BIOEE 6610–6611)
6610, fall; 6611, 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. D. Pimentel.
For description, see BIOEE 6610.

AGRICULTURAL SCIENCES

D. Brown, D. Buckley, W. Camp, D. Cherney, P. Dewey, A. DiTommaso, L. Drinkwater, G. Fick, B. Gloy, R. Gravani, P. Hobbs, Q. Ketterings, W. Knoblauch, J. Losey, R. Nelson, T. Park, T. Setter, M. Smith, M. Van Amburgh, D. Viands, C. Wien

The Agricultural Sciences major is an interdisciplinary program for students wishing to pursue a general education in agriculture to prepare for careers that require a scientific and integrative understanding of agriculture and food systems. Students can concentrate in one or more areas including: Animal Science, Agriculture Economics and Management, Education and Communication, Crop Production and Management, and Sustainable Agriculture.

AGSCI 2940 Introduction to Agricultural Machinery (also CSS/HORT 2940)
Fall. 2 credits. B. Flannigan and A. DiTommaso.
For description, see CSS 2940.

AGSCI 3800 Organic Food and Agriculture (also CSS/HORT 3800)
Fall. 3 or 4 credits. Prerequisites: CSS 1900, CSS 2600, HORT 1101 recommended, or permission of instructor. Staff.
For description, see CSS 3800.

AGSCI 4010 Seminar in Agricultural Sciences
Fall or spring. 1 credit. S–U grades only. A. DiTommaso.
Students in this weekly seminar series will learn about current debates and hot issues in the agricultural sciences today from both local and global perspectives. It will include both Agricultural Sciences majors presenting on internship and capstone experiences, and invited guest speakers. The target audience is Agricultural Sciences majors. Students are required to prepare a weekly reflection on each presentation. This course creates a weekly forum in which majors in our interdepartmental program can gather to learn and discuss important issues in agricultural sciences, while at the same time building community within our Agricultural Sciences major program.

AGSCI 4940 Special Topics in Agricultural Sciences
Fall or spring. 4 credits max. A. DiTommaso.
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.

AGSCI 4960 Internship in Agricultural Sciences
Fall, spring, or summer. 1–3 credits variable, 6 credits maximum. Prerequisite: permission of student's advisor in advance of participation in internship programs. S–U or letter grades. Staff.
In this experiential learning opportunity, students will participate in structured, on-the-job learning under supervision of qualified professionals in a cooperating external organization. Internships and learning goals are arranged by the student in conjunction with an internship advisor and the internship host. Course may be taken multiple times for up to 6 credits. All 4960 internship courses must adhere to the CALS guidelines at www.cals.cornell.edu/cals/current/student-research/internship/index.cfm.

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 1100 and AIS 1110, 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 3000 or 4000 level. Only one 3-credit independent study (AIS 4970) 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. A number of older courses no longer offered by AIP do count toward the minor, as do courses with the same title that were numbered using the old three-digit system. Students seeking to minor in American Indian studies or determining the eligibility of a course are encouraged to contact Professor Kurt Jordan, associate director for academic development, at kj21@cornell.edu. 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 1100 Introduction to American Indian Studies I: Indigenous North America to 1890

AIS 1110 Introduction to American Indian Studies II: Contemporary Issues in Indigenous North America

Electives

(Group A, Arts and Humanities)

AIS 2360 Native Peoples of the Northeast

AIS 2390 Seminar in Iroquois History

AIS 2600 Survey of Native American Literatures in the United States

AIS 2660 Introduction to Native American History

AIS 3860 Contemporary American Indian Fiction of the United States

AIS 4300 Native American Philosophies

AIS 4860 American Indian Women's Literature

AIS 4900 New World Encounters, 1500–1800

(Group B, Social and Natural Sciences)

AIS 2200 Field Course in Iroquois Archaeology

AIS 2350 Archaeology of North American Indians

AIS 3110 Social Movements

AIS 3330 Ways of Knowing

AIS 3400 Contested Terrain: Hawaii

AIS 3480 Iroquois Archaeology

AIS 4000 Critical Approaches to American Indian Studies

AIS 4600 Field and Analytical Methods in American Indian Archaeology

AIS 4720 Historical Archaeology of Indigenous Peoples

(Independent Study)

AIS 4970 Independent Study

AIS 6970 Individual Study in American Indian Studies

E. Cheyfitz, director; K. Kassam, C. Andronicos, L. Donaldson, C. Geisler, A. Gonzales, K. Jordan, J. Mt. Pleasant, J. Parmenter, T. Richardson, J. Rickard

AIS 1100 Introduction to American Indian Studies I: Indigenous North America to 1890 (CA) (HA)
Fall. 3 credits. P. Nadasdy.
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 1110 Introduction to American Indian Studies II: Contemporary Issues in Indigenous North America (CA) (HA)
Spring. 3 credits. K. Kassam.
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 2200 Field Course in Iroquois Archaeology (also ANTHR/ARKEO 2200) (HA) (SBA)
Summer. 3 credits. Letter grades only. K. Jordan.
This course provides hands-on-training in archaeological field methods through survey and excavation at historic-period Iroquois (Haudenosaunee) sites in the Finger Lakes region. Most class time will consist of supervised excavation of past residential and domestic areas, supplemented by lectures on archaeological methods and Iroquois history and material culture.

[AIS 2350 Archaeology of North American Indians (also ANTHR 2235) (CA) (HA)
Next offered 2010–2011.]

[AIS 2360 Native Peoples of the Northeast, Pre-Contact to the Present (also HIST/AMST 2360) (CA) (HA)
Spring. 4 credits. Next offered 2011–2012. J. Parmenter.
For description, see HIST 2360.]

[AIS 2390 Seminar in Iroquois History (also HIST 2390) (CA) (HA)
Fall. 4 credits. Next offered 2011–2012. J. Parmenter.
For description, see HIST 2390.]

[AIS 2600 Survey of American Indian Literatures in the United States (also ENGL 2600) (LA) (CA)
Spring. 4 credits. Next offered 2011–2012. E. Cheyfitz.
For description, see ENGL 2600.]

[AIS 2660 Introduction to Native American History (also HIST/AMST 2660) (CA) (HA) (D)
Spring. 4 credits. Next offered 2010–2011. J. Parmenter.
For description, see HIST 2660.]

[AIS 3110 Social Movements (also DSOC/LSP 3110)
Fall. 3 credits. Prerequisites: DSOC/SOC 1101 or permission of instructor. S–U or letter grades. Next offered 2010–2011. A. Gonzales.
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.]

AIS 3330 Ways of Knowing: Indigenous and Local Ecological Knowledge (also NTRES 3330) (CA, SBA) (D)
Fall. 3 credits. Prerequisite: junior, senior, or graduate standing. Letter grades only. K. Kassam.
For description, see NTRES 3330.

AIS 3400 Contested Terrain: Hawaii (also SOC 3420) (CA) (SBA)
Spring. 3 credits. Prerequisite: introductory or intermediate-level social sciences or history. M. M. Hamabata.
This course, offered through 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/cals/eas/academics regarding the status of this course.

AIS 3422/6422 Culture, Politics, and Environment in the Circumpolar North (also ANTHR 3422/6422) (CA)
Spring. 4 credits. Prerequisite: none. Letter grades only. P. Nadasdy.
For description, ANTHR 3422/6422.

[AIS 3480/6480 Iroquois Archaeology (also ANTHR 3480/6480) (CA) (HA)
Fall. 4 credits. S–U or letter grades. Next offered 2011–2012. K. Jordan.
For description, see ANTHR 3248/6248.]

[AIS 3860 Contemporary American Indian Fiction (also ENGL 3670) (LA) (CA)
Fall. 4 credits. Next offered 2011–2012.
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 4000 Critical Approaches to American Indian Studies (also AIS 6000) (CA) (HA)
Fall. 4 credits. Prerequisite: advanced undergraduates or graduate students; permission of instructor. Course requirements differ at 4000 and 6000 levels. S–U or letter grades. Staff.
An interdisciplinary survey of the literature in Native American Studies. Readings engage themes of indigeneity, coloniality, power, and "resistance." The syllabus is formed from

some "classic" and canonical works in Native American Studies but also requires an engagement with marginal writings and theoretical and historical contributions from scholars in other disciplines.

AIS 4300 Native American Philosophies (also ENGL/AMST 4300) (KCM) (LA)
Fall. 4 credits. Prerequisite: permission of instructor. E. Cheyfitz.
This course will focus on American Indian, Native Alaskan, and Native Hawaiian social, spiritual, legal, political, aesthetic, scientific, environmental, and historical thought from the pre-invasion period (before 1492) to the present as it is contained in both oral narratives and written texts (nonfiction, fiction, and poetry).

[AIS 4600 Field and Analytical Methods in American Indian Archaeology (also ANTHR/ARKEO 4260) (SBA) (HA)
Next offered 2011–2012.]

AIS 4720/7720 Historical Archaeology of Indigenous Peoples (also ANTHR/ARKEO 4272/7272) (CA) (HA)
Fall. 4 credits. K. 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 4860 American Indian Women's Literature (also ENGL 4860) (LA) (CA)
Spring. 4 credits. Next offered 2010–2011.
For description, see ENGL 4860.]

[AIS 4900 New World Encounters, 1500 to 1800 (also HIST/AMST 4990) (CA) (HA)
Next offered 2011–2012.]

AIS 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 6000 Critical Approaches to American Indian Studies (also AIS 4000)
Fall. 4 credits. Staff.
For description, see AIS 4000.

AIS 6010 American Indian Studies Proseminar
Fall and spring. 1 credit. Staff.
graduate-level course that introduces students to ongoing research in the field of American Indian Studies in a proseminar/colloquium 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 6350 Indigenous Peoples and Globalization (also DSOC/LATA 6350)
Fall. 3 credits. Next offered 2010–2011. 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. At issue are the lands, resources, traditional knowledge, and indigenous struggles for recognition and self-determination.]

[AIS 6610 Colonial American Literatures (also ENGL/AMST 6610)
Spring. 4 credits. Next offered 2010–2011. E. Cheyfitz.
For description, see ENGL 6610.]

[AIS 6710 Law and Literature in the Antebellum United States (also ENGL 6710)
Spring. 4 credits. Next offered 2010–2011. E. Cheyfitz.
For description, see ENGL 6710.]

AIS 6970 Individual Study in American Indian Studies
Fall, spring, or summer. 1–3 credits. S–U or letter grades. 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 interest in American Indian Studies.

APPLIED ECONOMICS AND MANAGEMENT

L. W. Tauer, chair (154 Warren Hall, 255 4576); C. B. Barrett, J. Bennett, A. Bento, N. L. Bills, G. Blalock, V. L. Bogan, R. N. Boisvert, N. H. Chau, R. D. Christy, J. M. Conrad, R. T. Curtis, H. Daouk, H. deGorter, B. O. Earle, B. A. Gloy, C. Gomes, M. Gomez, D. A Grossman, D. R. Just, H. M. Kaiser, S. M. Kanbur, W. A. Knoblauch, S. C. Kyle, D. R. Lee, A. E. Leiponen, W. H. Lesser, E. E. Lewis, J. W. Lippitt, J. E. Little, E. W. McLaughlin, T. D. Mount, D. T. Ng, C. F. Nicholson, A. M. Novakovic, P. D. Perez, D. J. Perosio, G. L. Poe, E. Prasad, J. T. Prince, C. K. Ranney, T. M. Schmit, W. D. Schulze, D. H. Simon, M. W. Stephenson, D. H. Streeter, W. G. Tomek, C. G. Turvey, C. L. vanEs, B. Wansink, A. Wessels, G. B. White

AEM 1101 Introduction to Applied Economics and Management
Fall. 1 credit. Required of and limited to freshmen in AEM. S–U grades only. D. A. Grossman and A. M. Novakovic.
The purpose of this course is to acquaint first-year students in AEM with their new department and better enable them to make academic and early-career decisions. A cross-section of faculty will lead discussions that introduce most of the major academic subjects taught in AEM. In addition, there are presentations on student organizations and course planning and an assignment on the use of library resources.

AEM 1102 Personal Evaluation and Development
Spring. 1 credit. Required of and limited to first-year majors in AEM. S–U grades only. A. M. Novakovic.
This course is designed to help students better understand their personal and professional skills and attributes and enhance their abilities in areas such as teamwork, leadership, trust, ethics, and diversity and what this means for interpersonal relationships. The weekly meeting will either be one plenary lecture or a smaller lab. Students will learn by experience and have guest lecturers from the business community.

AEM 1200 Introduction to Business Management
Fall, spring, summer. 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 technological innovation and its impact on operations, globalization, ethics, teamwork, leadership, and entrepreneurship. Opportunity to deliver an integrative group project.

AEM 1210 Entrepreneurship Speaker Series
Fall. 1 credit. P. D. Perez.
Course consists of guest lectures by faculty members engaged in the study and practice of entrepreneurship and by prominent entrepreneurs associated with the entrepreneurship@Cornell program, with a view to inform and inspire students. Evaluation includes attendance, book reports, and written feedback on lectures.

AEM 1220 Entrepreneurship in the Life Sciences
Spring. 1 credit. W. Lesser.
Seminars and guest lectures by faculty members and entrepreneurs engaged in the study and practice of entrepreneurship in the life sciences. Emphasis on the process of turning scientific discovery into business opportunity and success. Evaluation includes attendance and written feedback on lectures. Intended as a follow-up to AEM 1200 and AEM 1210 but may be taken independently.

AEM 1230 Foundations of Entrepreneurship and Business
Fall and spring. 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. Emphasis on the identification and elaboration of business opportunities (i.e., business ideas). Extensive use of IT–based learning and presentation tools.

[AEM 2000 Contemporary Controversies in the Global Economy]

AEM 2100 Introductory Statistics
Spring. 4 credits. Prerequisite: college 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. Includes an introduction to Minitab, a statistical software package.

AEM 2190 Introduction to Applied Portfolio Management
Summer. 4 credits. Special program. D. Dase.
Based in New York City's Financial District. Topics include capital markets; the impact of the economy and the Federal Reserve System; recent stock market history; regulation; investment banking and management principles of both institutional and individual portfolios. Industry guest speakers provide unique perspectives. An individualized internship is required of all students.

AEM 2210 Financial Accounting
Fall, summer. 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 2240 Principles of Finance
Summer. 3 credits. R. Curtis.
This course focuses on the mathematics of finance, the economics of managerial decisions, corporate financial policy, risk management, and investments. Topics include time value, bonds, stock valuation, capital budgeting, financing alternatives, costs of capital, the capital structure decision, distribution policy, mergers and acquisitions, options, forward and futures contracts, market efficiency and market anomalies, strategies of successful investors, and personal finance.

AEM 2250 AEM Certificate in Business Management Consulting Project
Summer 1 credit. R. Curtis and P. Perez.
Student teams consult with local organizations in central New York and suggest solutions to problems those organizations are currently facing. Students will apply business principles they have learned during their AEM Certificate in Management summer immersion program. Each team will prepare a written report and will give a presentation to AEM Certificate faculty and representatives of the organization the team is working with.

AEM 2260 AEM Certificate Activities
Summer. 1 credit. Staff.
Students participate in special activities as part of the AEM Certificate in Business Management summer immersion program. While activities may vary from year to year, in the past these activities have included a field trip to corporate sites in New York City, Cornell Outdoor Education team building and leadership exercises, a career services résumé/job search presentation, and a talk on the evolution of a local small business by its founder. Student participation in all activities is mandatory and a paper focusing on "take-aways" from each activity is required.

AEM 2270 Introduction to International Business
Summer. 4 credits. D. Ng.
Based in the global finance center of Hong Kong, students will gain a fundamental understanding of how some of the most powerful multinational firms in the world make and implement financial decisions, how they manage risk and gain competitive advantage, how they interact with governments, and what the risks and returns are in conducting such international business. Students will be assigned to internships in order to experience firsthand how such corporations function.

AEM 2300 International Trade and Finance (also ECON 2300) (SBA)
Spring. 3 credits. Prerequisites: ECON 1110 or equivalent. Recommended: ECON 1120 or equivalent. S–U or letter grades. 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 4300 and ECON 3610–3620.

AEM 2400 Marketing
Fall, summer. 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 2410 Marketing Plan Development
Fall, spring. 2 credits. Requirement for and limited to AEM majors. Prerequisite: AEM 2400. 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 2500 Environmental and Resource Economics (SBA)
Fall. 3 credits. S–U or letter grades. G. 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 3020 Farm Business Management
Fall. 4 credits. Not open to freshmen. Prerequisite for AEM 4050 and 4270. 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 3200 Business Law I (also NBA 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 3210 Business Law II (also NBA 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 3220 Internet Strategy]

AEM 3230 Managerial Accounting
Spring. 3 credits. Priority given to CALS majors. Prerequisite: AEM 2210 or equivalent. One evening prelim. 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 an evening prelim, a second exam, weekly homework.

AEM 3240 Finance (also PAM 5620)
Fall and spring. 4 credits. Priority given to CALS majors. Prerequisites: AEM 2100, 1200, and 2210, 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 3250 Personal Enterprise and Small Business Management
Spring. 4 credits. Prerequisites: junior or senior standing; AEM 1200 and 2210 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 3280 Innovation and Dynamic Management (also HADM 4443)
Spring. 3 credits. Prerequisite: junior or senior standing. Staff.
For description, see HADM 4443.

[AEM 3290/3291 International Agribusiness Study Trip
3291, fall; 3290, spring. 2 credits. Prerequisites: AEM 1200 or 3020, and 2400. 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. Gloy and T. Schmit.
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 3300 Managerial Economics and Decision Making
Spring. 3 credits. Prerequisite: ECON 1110. 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 3310 Economics of Business Regulation
Spring. 3 credits. Prerequisites: ECON 1110, 3130, and AEM 1200. 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 3330 European Business Institutions]

AEM 3340 Women, Leadership, and Entrepreneurship
Fall. 1 credit. Prerequisite: junior or senior standing. 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 3350 International Technology Marketing of Biotechnology
Spring. 3 credits. Prerequisites: ECON 1110 and BIOG 1109 or equivalents. S–U or letter grades. 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 3360 Intermediate Accounting I
Fall. 3 credits. Prerequisites: AEM 2210 and 3230. Staff.
Includes an overview of Generally Accepted Accounting Principles, balance sheet valuation, and income measurement and recognition. Other topics include accounting for pensions, earnings per share, and special financial reporting issues.

AEM 3370 Intermediate Accounting II
Spring. 3 credits. Prerequisite: AEM 3360 Intermediate Accounting I. Staff.
Continuation of the in-depth study of accounting theory, generally accepted accounting principles, and the techniques involved in measuring, recording, summarizing, and reporting financial data for business organizations. Learn the GAAP accounting for equities, revenue, investments, accounting changes, and statement of cash flows. Understand accounting alternatives within GAAP and accounting alternatives to GAAP for the topics covered so that students are prepared to understand and use future changes in GAAP.

AEM 3380 Social Entrepreneurs, Innovators, and Problem Solvers
Fall. 4 credits. A. Wessels.
This course introduces students to the social entrepreneurs, innovators, and visionaries who are creating new strategies for solving society's problems. The course highlights innovative case studies of success in restoring the environment, resolving conflicts, curing diseases, overcoming poverty, and addressing other problems of social injustice. At the end of the course, each student develops an original blueprint for social innovation: a creative proposal for solving a societal problem.

[AEM 3420 Integrated Marketing Communication]

AEM 3440 Consumer Behavior
Fall. 3 credits. Prerequisites: AEM 2400 or equivalent. Preference given to AEM majors. 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 3460 Dairy Markets and Policy
Spring. 3 credits. Prerequisites: junior, senior, or graduate standing. ECON 1110 or equivalent. S–U or letter grades. 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.

AEM 4020/4021 Food and Brand Lab Workshop
Fall and spring. 6 credits total. Prerequisite: permission of instructor. B. Wansink.
The purpose of the Food and Brand Lab Workshop is to provide students with an advanced opportunity to develop an advanced understanding of consumers by involving them in collaborative, theory-based research related to food. This course is focused on asking and answering the "why" questions behind consumer behavior. Fall-semester students will receive an "R" grade and then receive their grade for course in the spring semester.

AEM 4030 Farm Management Study Trip
Spring. 1 credit. Prerequisite: AEM 3020. Open by application only. W. A. Knoblauch and B. Gloy.
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 the trip. Students must write a paper that further explores an aspect of the trip.

AEM 4040 Financial Management for Agriculture and Agribusiness
Spring. 3 credits. Prerequisites: AEM 4050 or equivalent; permission of instructor. C. Turvey.
To expand students' knowledge base of finance as it relates to agriculture and agricultural business. The course will follow three main themes: Capital Budgeting and Project Valuation; Cost of Capital; Risk Management.

AEM 4050 Agricultural Finance
Spring. 3 credits. Prerequisite: AEM 3020 or equivalent. Recommended: calculus and statistics. C. Turvey.
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 4100 Business Statistics
Fall. 3 credits. Prerequisite: AEM 2100 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 4110 Introduction to Econometrics
Fall. 3 credits. Prerequisite: AEM 2100 and either ECON 3130 or PAM 2000 or equivalents. D. Just.
Introduces students to basic econometric principles and the use of statistical procedures in empirical studies of economic models. Assumptions, properties, and problems encountered in the use of multiple regression are discussed as are simultaneous equation models, simulation, and forecasting techniques.

AEM 4120 Computational Methods for Management and Economics
Fall. 3 credits. Primarily for juniors, seniors, and M.S. degree candidates. Prerequisite: AEM 2100 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 4130 Business Strategy Research
Fall. 3 credits. Prerequisite: AEM 2100 or equivalent statistics course; permission of instructor. G. Blalock.
AEM 4130 introduces empirical microeconomic research methods applied primarily to questions of business strategy. The course objective is to familiarize students with the potential problems of business strategy research and the methods employed to overcome those problems. Students will read and discuss peer-reviewed academic journal articles in business and economics.

AEM 4140 Behavioral Economics and Managerial Decisions
Fall. 3 credits. Prerequisites: junior or senior standing; ECON 3130 or PAM 2000. Lab fee: $40. D. Just and W. Schulze.
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 they 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 4150 Price Analysis
Fall. 3 credits. Prerequisites: AEM 2100 or equivalent, ECON 3130 or PAM 2000 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 4170 Decision Models for Small and Large Businesses
Fall. 3 credits. Prerequisites: junior or senior standing (priority given to AEM majors); AEM 2100 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 4180 Introduction to System Dynamics Modeling
Fall. 4 credits. Prerequisites: MATH 1106 or higher and upper-level standing or permission of instructor. C. Nicholson.
Introduction to concepts of system dynamics modeling, including the modeling process, fundamental modes of dynamic behavior and the stock-flow-feedback structures that generate them, system mapping tools, and modeling human behavior. Emphasis on examples from agriculture, natural resource management, and international development. Lab develops skills in the use of dynamic modeling software.

AEM 4190 Strategic Thinking
Spring. 3 credits. Prerequisite: PAM 2000 or ECON 3130. S–U or letter grades. 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 4200 Investments]

[AEM 4210 Derivatives and Risk Management]

AEM 4220 Estate Planning (also NBA 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 4230 Contemporary Topics in Applied Finance
Fall. 3 credits. Prerequisites: ECON 1110, MATH 1110 or equivalent, AEM 2100 or equivalent, AEM 3240. 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 4240 Management Strategy
Fall and spring. 3 credits. Prerequisite: AEM seniors. 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 4260 Fixed-Income Securities
Fall. 3 credits. Prerequisites: MATH 1110 or equivalent, AEM 2100 or equivalent, AEM 3240. Letter grades. V. Bogan.
This course focuses on fixed-income securities including corporate bonds, default-free bonds, and floating rate notes. Other topics include related financial instruments such as forwards and futures on fixed-income securities, interest rate swaps, bond options, and mortgage-backed securities. In addition to the analysis of specific types of fixed-income securities, there will be an examination of the tools used in bond portfolio management.

AEM 4270 Agribusiness Strategy
Fall. 3 credits. Prerequisite: AEM 1200 or 3020. B. 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 4280 Valuation of Capital Investment
Spring. 3 credits. Prerequisites: AEM 1200 and 3240 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 4290 International Finance
Spring. 3 credits. Prerequisites: AEM 2100 and 3240. S–U or letter grades. 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 4300 International Trade Policy
Spring. 3 credits. Prerequisites: ECON 1110–1120 or equivalents and intermediate microeconomics course. S–U or letter grades. 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 4310 Agricultural and Food Policy
Fall. 3 credits. Prerequisites: junior, senior, or graduate standing; PAM 2000, ECON 3010, 3130, or equivalent. S–U or letter grades. 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. The approach combines historical, political, and economic interpretation and analysis.

AEM 4320 Public Private Sector Economics Linkages
Spring. 3 credits. Prerequisite: intermediate microeconomics course. C. K. Ranney.
This course examines the role of government tax and expenditure policies in the United States using tools from microeconomic theory. Given that the government sector is almost 40 percent of total U.S. economic activity, we analyze two related questions: First, when and why should some economic activities be undertaken in the public rather than private sector? Second, what are the implications of governmental economic activity on private sector decision makers? An array of tax and expenditure policies are investigated with particular foci changing from year to year based on current events and student interests.

AEM 4350 Political Economy of the WTO
Spring. 3 credits. Prerequisite: intro microeconomics. H. deGorter.
The politics of the WTO and trade policy are explored. We examine what the WTO is, how it operates, how much power it really has, why it was created, incentives for governments to cooperate. How WTO rules affect domestic politics and foreign policy goals and how WTO rules and agreements are enforced. We also debate the effect of trade on growth and poverty.

AEM 4360 Entrepreneurial Leadership
Fall, weeks 7–14. 1 credit. Prerequisite: permission of instructor. D. Streeter.
Participants learn about concepts and practice skills important to becoming an entrepreneurial leader in startup or small business, corporate environment, and/or the public sector. Set in a global context, issues-related entrepreneurial leadership are covered: vision, opportunity identification, engagement of teams in resource-constrained situations, and tolerance for ambiguity and risk.

[AEM 4370 Innovation Strategy]

AEM 4420 Emerging Markets
Fall. 3 credits. Prerequisites: senior or graduate standing; AEM 2400 and PAM 2000 or ECON 3130. 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 4430 Food-Industry Strategy
Fall. 2 credits. Prerequisite: AEM juniors, seniors, or graduate students; AEM 2400 or 4480; or permission of instructor. Staff.
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 4440 Managing for Market-Driven Growth
Fall. 3 credits. Prerequisite: AEM 2400; junior or senior standing. Staff.
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 4450 Food Policy for Developing Countries (also NS 4450) (SBA)
Fall. 3 credits. Prerequisites: 6 credits in economics, applied economics, or sociology and 6 credits in nutrition and/or agricultural sciences. P. Pinstrup-Andersen.
Comprehensive presentation and discussion of policy options for a sustainable global food system, with focus on developing countries. Topics include economic policy related to nutrition, health, consumption, production, natural resource management, trade, markets, gender roles, armed conflict, and ethics. A social entrepreneurship approach based on case studies and active participation by students will be used.

[AEM 4460 Food Marketing Colloquium]

AEM 4470 Retail Speaker Series
Spring. 1 credit. D. J. Perosio.
Seminars and guest lectures by faculty and guest lecturers engaged in the study and practice of retailing. This class provides a unique opportunity for successful industry leaders to share their experiences with Cornell students. Speakers share their view about successful management styles, possible career paths, critical industry-related issues, and qualities conducive to successful business leadership. Students have an unprecedented opportunity to learn and question how retail leaders view the current and future status of retailing, the largest sector in the U.S. economy.

AEM 4480 Food Merchandising
Spring. 3 credits. Prerequisite: junior or senior standing; AEM 2400. 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 policy makers, and consumers.

AEM 4500 Resource Economics (also ECON 4500) (SBA)
Fall. 3 credits. Prerequisites: MATH 1110, ECON 3130, 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 4510 Environmental Economics (also ECON 4090) (SBA)
Spring. 3 credits. Prerequisites: undergraduate standing; intermediate microeconomics course and calculus. S–U or letter grades. Staff.
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 4520 Accounting for Mergers and Acquisitions
Fall. 3 credits. Prerequisite: AEM 3360 Intermediate Accounting I. E. Lewis.
Detailed analytical study of special issues and situations in financial accounting. Continuous emphasis is placed on the relationship between theory and practice to reflect the latest professional pronouncements. Highly technical topics related to corporation, partnership, government, and not-for-profit organizations, with a focus on business combinations and the particular accounting challenges that they present.

AEM 4530 Risk Management, Internal Control and Assurance
Fall. 3 credits. Prerequisite: AEM 3360 Intermediate Accounting I. J. Lippitt.
Theory and practice of independent examination of financial statements. Discussion of relationships with clients; working papers, assurance procedures, including evaluations of internal controls; accounting principles; risk assessment; liability and professional ethics.

AEM 4540 China's and India's Growth Miracles (also ECON 4540)
Fall. 2 or 3 credits. Prerequisites: basic course in macroeconomics, international economics, and econometrics/statistics. E. Prasad.
This is an advanced undergraduate course that will cover topics in international finance and open economy macroeconomics. The course will be organized around a detailed examination of the growth experiences of China and India as a device for illustrating and delving into key analytical concepts.

AEM 4620 Technology and Financial Markets
Fall. 2 credits. Prerequisites: AEM 3240 and one 4000-level AEM finance course; permission of instructor. V. Bogan.
The course focuses on issues involving technology and financial markets. It is designed to equip future finance professionals with the knowledge of key finance systems (Bloomberg) skills and technologies. The lectures and labs will teach students to apply their theoretical finance knowledge in real-world situations for the purpose of optimizing their future job performance and increase their marketability. Lectures will explore topics on the effects of technology on financial markets. The lab component of the course will require students to complete the 30-hour, self-paced Bloomberg certification process.

AEM 4640 Economics of Agricultural Development (also ECON 4640)
Fall. 3 credits. Prerequisite: ECON 1110–1120 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 4940 Undergraduate Special Topics in Applied Economics and Management
Fall or spring. 4 credits max. 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 beginning of the semester.

AEM 4970 Individual Study in Applied Economics and Management
Fall or spring. Variable credit. S–U or letter grades. 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 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 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 or letter grades. 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 4991 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 6050 Agricultural Finance
Fall. 3 credits. Prerequisite: AEM 3240 or 4050 or equivalent 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 6080 Production Economics (also ECON 4080)
Fall. 3 credits. Prerequisite: ECON 3130 and MATH 1110 or equivalents. R. Boisvert.
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 6120 Applied Econometrics
Fall. 1 credit. Corequisite: AEM 4110. D. Just.
Designed for M.S. and Ph.D. students who do not meet the prerequisites for other graduate-level econometrics courses. Complements AEM 4110, 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 6180 System Dynamics Applications
Spring. 4 credits. Prerequisite: graduate standing or permission of instructor. C. Nicholson.
This course provides more detailed discussion of SD concepts and further develops skills in system dynamics modeling through application to a project chosen by the student. Iterative writing assignments and peer review are used to refine problem statements, causal hypotheses, simulation models, model evaluation, and policy analysis. Final project includes development and application of a simulation model.

AEM 6300 Policy Analysis: Welfare Theory, Agriculture, and Trade (also ECON 4300)
Spring. 4 credits. Prerequisites: AEM 6080 or PAM 6030, ECON 3130, 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 6320 Open Economy Analysis: Theory and Applications
Spring. 2 credits. Prerequisites: ECON 3130/3140 or permission of instructor. S–U or letter grades. N. Chau.
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 6400 Analysis of Agricultural Markets (also ECON 4400)
Fall. 3 credits. Prerequisites: AEM 4110 and 4150 or equivalents. Offered even-numbered years. 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 6410 Commodity Futures Markets
Spring, weeks 8–14. 2 credits. Prerequisites: AEM 4110 and 4150 or equivalents. Recommended: AEM 6400. 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 6420 Globalization, Food Safety, and Nutrition (also NS 6420)
Fall. 2 credits. Prerequisites: permission of instructor, graduate standing, and basic understanding of economics and nutrition. Letter grades only. P. Pinstrup-Andersen.
Directed readings course with a weekly 50-minute discussion session. The course is aimed at graduate students in nutrition, agricultural economics, and other relevant fields, who wish to explore how globalization may affect poverty, food security, and nutrition in developing countries and how national policies and international agreements and institutions may influence the outcome. The discussion sessions are based on assigned readings for each week.

AEM 6510 Environmental and Resource Economics
Spring. 4 credits. Core course for environmental management concentration/option. Prerequisite: graduate standing. Open to graduate students outside economics. G. L. Poe.
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 6550 Electric Systems Engineering and Economics (also ECE 5510)
Fall. 2 credits. Prerequisites: basic calculus and microeconomics courses. T. D. Mount.
For description, see ECE 5510.

AEM 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 or letter grades. 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 6670 Topics in Economic Development (also ECON 7770)
Spring. 3 credits. Targeted to second- and third-year graduate students. Prerequisite: basic first-year courses in ECON or AEM or permission of instructor. S–U or letter grades. 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 6700 Economics of Consumer Demand (also PAM 6080)
Fall. 3 credits. Prerequisites: ECON 3110 or 3130 and two semesters of calculus. S–U or letter grades. Next offered 2009–2010. 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 6840 Economics of Biofuels: Implications for the Nexus of Agricultural, Energy, and Environmental Policies
Fall. 2 to 3 credits. Prerequisite: knowledge of microeconomics. S–U or letter grades. H. deGorter.
Topics include feedstock–biofuel–oil price linkages, profitability, tax credits versus mandates, sub-optimal environmental and energy policies, policy interactions, international trade models, import tariffs, 'subsidy' component of biofuel policies and the WTO, life-cycle accounting and sustainability standards, developing countries and poverty, food-versus-fuel debate, and implications for technology and farm subsidies.

AEM 6900 Biofuels: The Economic and Environmental Interactions (also BEE 4900)
Spring. 2 credits. Prerequisites: senior or graduate standing, others by permission of instructor. S–U or letter grades. P. G. Hess.
For description, see BEE 4900.

AEM 6940 Graduate Special Topics in Applied Economics and Management
Fall or spring. 4 credits max. 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 beginning of the semester.

AEM 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 4980. Students must register using independent study form (available in undergraduate program office in Warren Hall). S–U or letter grades. 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 6990 M.P.S. Research
1–6 credits. Prerequisite: M.P.S. students. Credit granted for M.P.S. project report. Staff.

AEM 7000 Individual Study in Applied Economics and Management
Fall or spring. Prerequisite: graduate standing. S–U or letter grades. 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 7010 Applied Microeconomics I
Fall. 3 credits. Required for all second-year AEM Ph.D. students. Prerequisites: Ph.D. students only; ECON 6090 and 6100, and AEM 7100 or equivalent. W. D. Schulze and R. N. Boisvert.
This course covers economic models and empirical applications in consumer demand and production economics.

AEM 7020 Applied Microeconomics II
Spring. 3 credits. Required for all second-year AEM Ph.D. students. Prerequisites: Ph.D. students only; ECON 6090 and 6100, and AEM 7100 or equivalent. H. DeGorter, D. R. Just, and J. Prince.
This course covers economic models and empirical applications in welfare economics, risk analysis and industrial organization.

[AEM 7080 Advanced Production Economics]

AEM 7100 Econometrics I
Spring. 3 credits. Prerequisites: matrix algebra and statistical methods courses at level of ILRST 3110 or ECON 6190. T. D. Mount.
Provides (together with AEM 7110) 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 7110 Econometrics II
Fall. 3 credits. Prerequisite: AEM 7100 or equivalent. T. D. Mount.
Coverage beyond AEM 7100 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 7120 Quantitative Methods I
Fall. 4 credits. Prerequisite: some formal training in matrix algebra. Highly recommended: course at level of BTRY 4170. 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 7130 Dynamic Optimization
Spring. 3 credits. Prerequisite: ECON 6090 and ECON 6170. Letter 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 7140 Experimental Economics
Fall. 4 credits. Prerequisite: ECON 6090. 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 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 7300 Seminar on International Trade Policy: Agriculture, Resources and Development
Spring. 3 credits. Prerequisite: graduate standing; AEM 6300 or equivalent. 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 7350 Public Finance: Resource Allocation and Fiscal Policy (also ECON 7350)
Spring. 4 credits. Prerequisite: ECON 6090. R. Kanbur.
For description, see ECON 7350.

AEM 7400 Empirical Analysis of Industrial Organization
Spring. 3 credits. Prerequisites: ECON 6090, ECON 6100, and AEM 7100. J. Prince.
This course will analyze in detail leading papers in the empirical industrial organization (IO) literature. In doing so, the objective will be to develop students' skills in determining appropriate theoretical and corresponding econometric models for applied research, and to improve students' proficiencies with a variety of econometric models (e.g., OLS, IVs, MLE, GMM, discrete choice).

AEM 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 7500 Resource Economics
Fall. 3 credits. Prerequisites: ECON 6090 and 6180, or AEM 7130. J. M. Conrad.
Uses optimal control and other methods of dynamic optimization to study the allocation and management of natural resources.

AEM 7510 Environmental Economics
Spring. 4 credits. Prerequisites: ECON 6090 and graduate-level econometrics course. S–U or letter grades. G. L. Poe.
The objective of this course is to provide a graduate-level survey of the two prevailing contemporary themes in environmental economics: the measurement of the demand for environmental resources as input into benefit-cost analyses, and the design of incentive-based, cost-effective policy instruments to achieve environmental goals. Core topics include market failure, conceptual foundations for valuing changes in environmental quality, empirical applications of nonmarket valuation methods, and cost-effective market mechanism design for reducing pollution. Additional topics include information asymmetries and mechanism design for nonpoint source pollution, and international/global environmental issues.

[AEM 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 or letter grades. Offered even years; next offered 2010–2011. 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 7650 Development Microeconomics Graduate Research Seminar
Spring and fall. 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 7670 Topics in International Finance
Fall. 3 credits. Prerequisite: ECON 7620 or equivalent. E. Prasad.
This course will provide a selective overview of topics at the cutting edge of academic research and policy debates about the international financial system. Main areas will include the effects of financial globalization on growth, volatility, and the transmission of business cycles. We will also examine the determinants of the direction and composition of capital flows, and analyze the implications of the rising prominence of hedge funds, sovereign wealth funds, and other institutional investors. This course is intended for advanced Ph.D. students, especially those in search of thesis topics, and will require extensive student involvement in preparing research proposals and critiques of existing literature.

AEM 7900 Graduate-Level Thesis Research
Fall or spring. 1–9 credits. Prerequisite; permission of graduate committee chair. For Ph.D. students only **before** "A" exam has been passed. S–U grades only. Graduate faculty.

AEM 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 9900 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. students only **before** "A" exam has been passed.

ANIMAL SCIENCE

W. R. Butler, chair (149 Morrison Hall, 255-2862); R. E. Austic, D. E. Bauman, Y. R. Boisclair, S. A. Brooks, D. L. Brown, L. E. Chase, D. J. R. Cherney, W. B. Currie, H. N. Erb, D. M. Galton, J. Gavalchin, I. Imumorin, P. A. Johnson, Q. M. Ketterings, X. G. Lei, Q. M. Long, 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

[ANSC 1100 Domestic Animal Biology I
Fall. 4 credits. S–U or letter grades. Staff.
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. Laboratory exercises include animal handling, examining aspects of anatomy, and small group discussions of contemporary biotechnologies. Living farm animals are used noninvasively, and fresh organs from dead animals are examined.]

ANSC 1105 Contemporary Perspectives of Animal Science
Spring. 1 credit. Prerequisite: freshmen, sophomores, or first-year transfer standing. J. Gavalchin.
A forum to discuss the students' career planning and the contemporary and future role of animals in relation to human needs.

ANSC 1120 Sustainable Animal Husbandry
Summer. 3 credits. S–U or letter grades. D. L. Brown.
Students completing this course will understand the many roles of domestic animals and the importance of their interdependence with humans; appreciate the scope, diversity, and problems related to domestic animal systems; be able to design and operate simple sustainable animal systems; and know how to continue learning about sustainable animal systems. This intensive summer course includes 25 hours of lecture and 39 hours of hands-on laboratory/demonstrations at various field sites and facilities all within a three-week period. Topics include domestication, sustainability, dogs, cats, rabbits, sheep, genetics, swine, nutrition, beef cattle, grazing, dairy cattle, dairy products, goats, poultry, aquaculture, camelids, horses, draft animals, animal systems modeling, Third World limited-resource animal systems, toxicology, lab animals, toxicology, veterinary medicine, and ethics of human interactions with domestic animals.

ANSC 1160 Animal Agriculture and Society—From Food to Medicine
Fall. 4 credits. Letter grades only. D. L. Brown, J. R. Giles, X. Lei, and M. E. Van Amburgh.
The course is designed to integrate concepts of physiology, immunology, growth biology, lactation, and pregnancy with current production systems, cultural and societal aspects of animal food production and use, and the current economic forces driving some of the production system evolution. The course is intended for majors and nonmajors with an emphasis on integrating animal biology with our current production and food systems from an Animal Science perspective. Topics include Domestication, Pre-technology Agriculture, Production Systems and Economics, Food Systems and Safety, Environmental Issues and Perspectives, Animal-Derived Food in Human Health, and Use of Animals in Biomedicine.

ANSC 2120 Animal Nutrition
Fall. 4 credits. Prerequisite: CHEM 2080 or equivalent. Recommended: ANSC 1100 and 1160. 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.

ANSC 2140 Captive Raptor Management and Propagation
Summer. 3 credits. Prerequisites: high school chemistry and biology. J. E. Parks.
This course is an introduction to the natural history and the care and management of raptors (birds of prey). Approaches to captive care and maintenance, restraint, training, and captive breeding with potential for reducing pressures on wild populations of avian species will be included. A major objective is to present and discuss the scientific basis and merit of avian husbandry and breeding practices in species relevant to the course. Hands-on opportunities in basic raptor handling techniques are included.

ANSC 2150 Exotic Avian Husbandry and Propagation
Fall. 2 credits. Prerequisite: ANSC 1100, 1160, or one year introductory biology. 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.

ANSC 2210 Introductory Animal Genetics
Spring. 3 credits. Prerequisite: one year of college biology. I. Imumorin.
Examination of basic genetic principles and their application to the improvement of domestic animals, with emphasis on the effects of selection on animal populations.

ANSC 2250 Fertilization and New Life Technologies
Summer 3 credits. Prerequisite: high school biology. J. E. Parks.
Course covers the biology of fertilization in mammals and birds including production of gametes (sperm and ova), the physiological events required for fertilization in vivo, early embryo development, and associated reproductive technologies (in vitro fertilization, intracytoplasmic sperm injection, cloning, cryopreservation, etc.).

ANSC 2400 Animal Reproduction and Development
Spring. 3 credits. Prerequisite: one year introductory biology. 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; emphasis on physiological mechanisms and application to fertility regulation. Separate laboratory is offered to demonstrate fundamental aspects of reproduction and reproductive technology.

ANSC 2410 Animal Reproduction and Development Lab
Spring. 1 credit. Limited to 30 students per lab. Pre- or corequisite: ANSC 2400. 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.

ANSC 2500 Dairy Cattle Principles
Fall. 3 credits. Prerequisite for ANSC 2510, 3510, 3540, and 3550. S–U or letter grades. D. M. Galton.
Introduction to the background and scientific principles relating to dairy cattle production. Laboratories are designed to provide an understanding of dairy cattle production.

ANSC 2510 Applied Dairy Cattle Genetics
Spring. 2 credits. Prerequisite: ANSC 2500. S–U or letter grades. 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 performance.

ANSC 2650 Equine Biology and Management
Fall. 3 credits. Prerequisites: ANSC 1100 and 1160 or permission of instructor. S–U or letter grades. S. A. Brooks.
This course is designed to provide the basics of equine form, function, care, management, and handling. Students will learn the basic biology of the horse and how to apply this knowledge to solve problems in horse care. Hands-on labs will include safe handling techniques, basic groundwork, and daily care of class horses. Short trips and tours will illustrate applied concepts in horse industry and health care.

[ANSC 2900 Meat Science (also FDSC 2900)
Fall. 2 credits. 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.]

ANSC 3100 Introduction to Animal Welfare
Fall. 2 credits. S–U or letter grades. Staff.
Animal welfare issues will be discussed, mainly for farm animals, but companion animals will also be considered. Both animal specific and general areas of animal welfare will be discussed.

ANSC 3200 Comparative Animal Nutrition and Toxicology: Horses, Dogs, Cats, and More
Spring. 4 credits. Suggested prerequisites: one year college biology and ANSC 2120 Animal Nutrition or equivalent. S–U or letter grades. One weekend field trip. D. Brown.
At the end of this course, students will (1) be able to match feed resources to the physiological needs of horses, dogs, cats, rabbits, deer, reindeer, birds, reptiles, and a variety of other animals found at home, in zoos, rehabilitation centers, on ranches and farms, (2) understand the intellectual processes by which a successful, science-based feeding strategy should be developed for animals without a history of domestication, (3) understand the evolutionary and physiological basis for some of the diversity in nutritional strategies and toxicological vulnerabilities found among animals.

ANSC 3410 Biology of Lactation
Spring. 2 credits. Prerequisites: ANSC 1100–1160 or animal physiology course. Y. R. Boisclair.
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. Information used comes from a variety of species, including the mouse for developmental aspects, the dairy cow for production aspects, and the human for health issues.

ANSC 3510 Dairy Herd Management
Spring. 4 credits. Prerequisite: ANSC 2500 or permission of instructor. Recommended: AEM 3020. 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.

ANSC 3540 Dairy Cattle Herd Health
Fall. 3 credits. Prerequisite: ANSC 2500 or permission of instructor. S–U or letter grades. T. R. Overton.
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.

ANSC 3550 Dairy Cattle Nutrition
Spring. 3 credits. Prerequisite: ANSC 2500 or permission of instructor. Letter grades only. T. R. Overton 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.

ANSC 3600 Beef Cattle
Spring. 3 credits. Offered even-numbered years. M. L. Thonney.
Emphasizes the management of reproduction, nutrition, and selection in beef cattle enterprises. Laboratories acquaint students with management skills through computerized simulations and working with cattle.

ANSC 3700 Immunology in Animal Health and Disease
Spring. 2 credits. Prerequisite: introductory biology. S–U or letter grades. J. Gavalchin.
Course covers basic immunological concepts, including inflammation, and mechanisms of innate and acquired immunity. Focus will be on diseases of companion animals and livestock. Topics include pathogenetic mechanisms, immunodiagnostics, therapeutics, and vaccine development.

[ANSC 3800 Sheep
Spring. 3 credits. Offered odd-numbered years; next offered 2010–2011. M. L. Thonney.
Emphasizes breeding, feeding, management, and selection of sheep from a production-system approach. Lec/labs offer practical knowledge and scientific background for improved management practices.]

ANSC 3920 Mechanisms of Animal Growth and Development
Spring. 2 credits. Prerequisites: ANSC 1100–1160 or equivalent introductory physiology courses. Letter grades only. Q. Long and Y. Boisclair.
A course on the basic biology of animal growth and development. The course employs model systems (cell culture, fish, and mice) to examine cellular and molecular mechanisms of animal growth and development, and farm animals to discuss whole-animal growth patterns and applications of new technologies. Lectures cover (1) patterns of whole-animal growth during fetal and postnatal life; (2) molecular and cellular basis of formation and development of skeletal muscle, adipose tissue, and bone; (3) regulation of growth and development by hormones and growth factors; (4) emerging molecular technologies and whole-genome approaches for improving growth and meat quality.

[ANSC 3980 Animals in Biomedical Research
Fall. 2 credits. Prerequisites: one year introductory biology, ANSC 1100 or equivalent introductory physiology course. Offered alternate years; next offered 2010–2011. Letter grades only. X. Lei.
This course introduces features and applications of various animal models for biomedical research on human health, diseases, and nutritional deficiencies.]

ANSC 4010 Dairy Production Seminar
Spring. 1 credit. Prerequisite: junior or senior standing. 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.

ANSC 4020 Seminar in Animal Sciences
Spring. 1 credit. Prerequisite: students engaged in undergraduate honors research projects. S–U or letter grades. S. Quirk.
Reports of undergraduate honors research projects. Students present oral reports of their work for class discussion.

ANSC 4050 Molecular and Cellular Approaches to Reproductive Physiology
Fall. 3 credits. Prerequisites: one year introductory biology and introductory physiology (ANSC 1100 and ANSC 2400 or BIOAP 3110) or equivalent. S. Quirk.
Lectures on selected topics in reproductive biology of male and female mammals with a focus on how research questions are formulated, addressed and influenced by previous discoveries. Concepts introduced apply to investigation of all areas of animal physiology. Laboratory exercises provide experience in cellular and molecular methods used to study reproductive function.

[ANSC 4100 Nutritional Physiology and Metabolism
Fall. 3 credits. Prerequisites: biochemistry and physiology courses. Next offered 2010–2011. Staff.
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.]

ANSC 4110 Integrated Cattle Nutrition
Fall. 4 credits. Designed for juniors, seniors, and entering graduate students. Prerequisites: ANSC 1100 and 2120 (or equivalent). Highly recommended: ANSC 3550. M. E. Van Amburgh.
Integrates concepts of cattle nutrition and farm nutritional management to help students understand and appreciate factors influencing the performance of cattle under diverse conditions. Topics covered include the effect of environment on maintenance costs; the nutrient requirements for various stages of growth, lactation, and pregnancy; rumen function, feed composition and chemistry, nutrient partitioning and the environmental impacts of cattle and how to minimize them. Computer models (Cornell Net Carbohydrate and Protein System) are used in the laboratory to actualize the information presented in lectures. Herd case studies are used in lab and there are field trips to farms to evaluate the nutritional management.

ANSC 4120 Whole-Farm Nutrient Management (also CSS 4120)
Spring. 4 credits. Prerequisite: junior, senior, or graduate standing; ANSC 4110 preferred but not required. M. E. Van Amburgh and Q. M. Ketterings.
This course provides students with an understanding of the concepts and practices underlying whole-farm nutrient management planning of livestock and dairy farms. Improving profitability and efficiency are key factors considered while improving air and water quality associated with dairy production. Students learn about nutrient management on Confined Animal Feeding Operations (CAFO's) and conduct their own Comprehensive Nutrient Management Plan on a case-study farm. This course integrates crop and manure management with nutrition and herd management to provide a broad but focused and action-oriented approach. The course utilizes two software programs developed at Cornell for nutrient management planning and herd nutritional management, the Cornell Nutrient Management Planning System and the Cornell Net Carbohydrate and Protein System. Current topics are also discussed, such as greenhouse gas emissions and impacts of dairy and livestock production and local versus global food production and environmental impacts.

ANSC 4140 Ethics and Animal Science
Spring. 2 credits. Prerequisite: junior or senior standing. 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.

ANSC 4250 Gamete Physiology and Fertilization (also BIOAP 4250)
Fall. 2 credits. Limited to 50 students. Prerequisite: ANSC 2400 or equivalent. Offered alternate years. 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.

ANSC 4270 Fundamentals of Endocrinology (also BIOAP 4270)
Fall. 3 credits. Prerequisite: animal or human physiology course or permission of instructor. 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.

ANSC 4510 Dairy Herd Business Management
Fall. 3 credits. Corequisite: ANSC 4560. J. Karszes and D. M. Galton.
Emphasizes dairy herd business management with application to herd management analysis. Laboratory includes farm tours and analysis.

ANSC 4560 Dairy Management Fellowship
Spring. 2 credits. Prerequisites: senior standing; ANSC 3510; permission of instructor. S–U grades only. 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.

ANSC 4570 Introductory Spanish for Dairy Producers
Spring. 3 credits. Prerequisite: ANSC 2500 or permission of instructor. S–U or letter grades. 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.

ANSC 4580 Advanced Spanish for Dairy Producers
Fall. 3 credits. Prerequisite: ANSC 4570 or permission of instructor. S–U or letter grades. Staff.
Students with a focus on dairy management need to be able to communicate with the Spanish-speaking 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 Spanish-speaking dairy workers.

ANSC 4700 Merchandising Beef Cattle
Fall. 2 credits. S–U or letter grades. M. J. Baker.
Introduction to the merchandising of replacement beef heifers. Topics of study will include budgeting, advertising, animal preparation, cataloging, clerking, and reporting. Students will gain practical knowledge through lecture as well as hands-on experience by planning, organizing, and conducting a sale of bred beef heifers from the Empire Heifer Development Program.

ANSC 4940 Special Topics in Animal Science
Fall or spring. 4 credits max. Prerequisite: undergraduate standing. 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 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.

ANSC 4960 Internship in Animal Science
Fall or spring. 1–3 credits, variable; 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 advisor. The internship should provide a professionally supervised experience with at least 60 hours on the job per credit required. All 4960 internship courses must adhere to the CALS guidelines at www.cals.cornell.edu/cals/current/student-research/internship/index.cfm.

ANSC 4970 Individual Study in Animal Science
Fall or spring. 1–3 credits, variable; 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 or letter grades. 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.

ANSC 4980 Undergraduate Teaching
Fall or spring. 1–3 credits, variable; 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.

ANSC 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.

ANSC 4991 Undergraduate Honors Research in Animal Science
Fall and spring. 1–6 credits; max. 6. Prerequisite: permission of instructor. Students must register using independent study form (available in 140 Roberts Hall).
Intended for qualified students pursuing the research honors program in animal science.

[ANSC 6030 Mineral Nutrition: Metabolic, Health, and Environmental Aspects (also NS 6030)
Fall. 2 credits. Prerequisites: biochemistry, physiology, and nutrition courses. Letter grades only. Offered alternate years; next offered 2010–2011. X. G. Lei and C. C. McCormick.
Emphasizes metabolism, gene regulation, antioxidation, and genetic defects related to mineral nutrition. Discusses effective approaches to improve global mineral nutrition by agriculture and food systems.]

[ANSC 6060 Ruminant Nutrition: Microbial Ecology and Forage Chemistry
Spring. 4 credits. Prerequisites: ANSC 2120, biochemistry course; senior or graduate standing or permission of instructor. S–U or letter grades. Offered alternate years; next offered 2010–2011. Staff.
Provides an overview of ruminant nutrition with an emphasis on microbial ecology, forage chemistry, and rumen function.]

ANSC 6100 Animal Science Seminar
Fall and spring. 1 credit. Prerequisite: graduate standing. S–U grades only. R. E. Austic.
Weekly seminar on topics related to animal science. The requirement for an S grade is regular attendance at seminars during the semester.

ANSC 6190 Field of Nutrition Seminar (also NS 6190)
Fall and spring. 0 credits. No grades given.
For description, see NS 6190.

ANSC 6210 Reproductive Physiology/ Endocrinology Seminar
Fall and spring. 1 credit. Prerequisite: graduate standing or permission of instructor. S–U grades only. W. R. Butler and staff.
Current research in reproductive physiology is presented by faculty and staff members, graduate students, and invited speakers.

ANSC 6220 Seminar in Animal Metabolism
Fall and spring. 1 credit. Prerequisite: permission of instructor. S–U grades only. 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.

ANSC 6940 Special Topics in Animal Science
Fall or spring. 4 credits max. Prerequisite: graduate standing. S–U or letter grades.
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.

ANSC 7900 Graduate-Level Thesis Research
Fall or spring. Credit TBA, max. 12 per semester. Prerequisite: permission of advisor. S–U grades only. Graduate faculty.
For students in a Ph.D. program *only before* "A" exam has been passed.

ANSC 8900 Master's-Level Thesis Research
Fall or spring. Credit TBA, max. 12 per semester. Prerequisite: permission of advisor. S–U grades only. Graduate faculty.
For students admitted specifically to a master's program.

ANSC 9900 Doctoral-Level Thesis Research
Fall or spring. Credit TBA, max. 12 credits per semester. Prerequisite: permission of advisor. 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 3110)

Animal Physiology Experimentation (BIOAP 3190)

Milk Quality (FDSC 3510)

Agriculture in the Developing Nations (IARD 6020)

Lipids (NS 6020)

Basic Immunology Lectures (BIOG 3050)

Micronutrients: Function, Homeostasis, and Assessment (NS 6310)

Regulation of Macronutrient Metabolism (NS 6320)

BIOLOGICAL AND ENVIRONMENTAL ENGINEERING

D. J. Aneshansley, chair (104 Riley-Robb Hall; 255-2270, -2465); B. A. Ahner, associate chair; L. D. Albright, L. T. Angenent, A. J. Baeumner, J. A. Bartsch, A. K. Datta, K. G. Gebremedhin, D. A. Haith, P. G. Hess, J. B. Hunter, L. H. Irwin, D. Luo, J. C. March, J.-Y. Parlange, G. E. Rehkugler, N. R. Scott, R. M. Spanswick, T. S. Steenhuis, M. B. Timmons, L. P. Walker, M. F. Walter, M. T. Walter. Lecturers: C. L. Anderson, L. D. Geohring

BEE 1200 The BEE Experience
Spring. 1 credit. Requirement for CALS BEE freshmen. Not required for students who have completed ENGRG 1050. Prerequisite: BEE majors or permission of instructor. Letter grades only. M. F. Walter.
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 1510 Introduction to Computer Programming
Fall. 4 credits. Limited to 18 students per lab and rec. No previous programming experience assumed. Pre- or corequisite: MATH 1910 or equivalent. Letter grades only. C. L. Anderson.
Introduction to computer programming and concepts of problem analysis, algorithm development, and data structure in an engineering context. The structured programming language MATLAB is used, implemented on interactive personal computers and applied to problems of interest in biological and environmental engineering.

BEE 2220 Bioengineering Thermodynamics and Kinetics
Spring. 3 credits. Prerequisites: MATH 1920, BIOG 1110, PHYS 2213, and chemistry course completed or concurrent. Letter grades only. 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 2510 Engineering for a Sustainable Society (also ENGRD 2510)
Fall. 3 credits. Pre- or corequisite: MATH 2930. Letter grades only. 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 2510 or BEE 2600 according to their academic plan. BEE students who complete both BEE 2510 and BEE 2600 receive engineering credit for only one of these courses.

BEE 2600 Principles of Biological Engineering (also ENGRD 2600)
Fall. 3 credits. Pre- or corequisite: MATH 2930, BIOG 1101–1104 or 1105/1106. Letter grades only. 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 2510 or BEE 2600 according to their academic plan. BEE students who complete both BEE 2510 and BEE 2600 receive engineering credit for only one of these courses.

BEE 3050 Principles of Navigation (also NAVS 3050)
Spring. 4 credits. Three classes each week (lec-rec-project work). Letter grades only. Lt. Raineault.
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 3299 Sustainable Development: A Web-Based Course
Spring, summer. 3 credits. Prerequisite: at least sophomore standing. S–U or letter grades. M. F. Walter and 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, renewable energy, and life cycle analysis.

BEE 3310 Bio-Fluid Mechanics
Fall. 4 credits. Prerequisites: ENGRD 2020 and engineering math sequence. Letter grades only. K. G. Gebremedhin.
Properties of Newtonian and non-Newtonian fluids; hydrostatic and dynamic forces; principles of continuity, conservations of mass, energy and momentum and their applications; laminar and turbulent flows and boundary layer, introduction to Navier Stokes; dimensional analysis and similarity; blood flow in the cardiovascular system; gas exchange in the pulmonary system; blood flow and sodium transport in the kidney. The major concepts are covered by case studies.

BEE 3500 Biological and Environmental Transport Processes
Fall. 3 credits. Pre- or corequisites: MATH 2930 and fluid mechanics course. Letter grades only. A. K. Datta.
Focuses on understanding the principles of heat and mass transfer in the context of biological (biomedical/bioprocessing/bioenvironmental) systems. Emphasizes physical understanding of transport processes and simple reaction rates with application examples from plant, animal, and human biology in the bioenvironment (soil/water/air), and industrial processing of food and biomaterials.

BEE 3600 Molecular and Cellular Bioengineering (also BME 3600)
Spring. 3 credits. Prerequisite: BEE 2600, biochemistry, linear algebra, ordinary differential equations, or permission of instructor. Letter grades only. J. C. March.
Biotechnology viewed at the cellular and molecular level. Advances in biotechnology will be broken down to their functional parts using the tools of biological engineering (thermodynamics, transport, kinetics, etc.) to understand how and why they work with an emphasis on design. Particular attention paid to gene therapy, synthetic biology, protein engineering, and nucleic acid engineering. Case studies in biomedical, bioprocess, and bioenvironmental engineering.

BEE 3650 Properties of Biological Materials
Spring. 3 credits. Satisfies BE laboratory experience requirement. Pre- or corequisite: ENGRD 2020. Letter grades only. 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.

BEE 3680 Biotechnology Applications: Animal Bioreactors
Fall. 3 credits. Prerequisite: biochemistry course or permission of instructor. Letter grades only. Offered alternate years. J. B. Hunter.

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 3710 Physical Hydrology for Ecosystems
Spring. 3 credits. Prerequisite: MATH 1920 or permission of instructor. Letter grades only. Offered alternate years; next offered 2010–2011. M. T. Walter.
This is an introduction to physical hydrology with an emphasis on roles and interactions between hydrological processes and ecological, biogeochemical, and human systems. http://hive.bee.cornell.edu/faculty/walter/BEE371Index.htm]

BEE 4010 Renewable Energy Systems
Spring. 4 credits. Prerequisite: college physics. Letter grades only. L. D. Albright.
Introduces energy systems with emphasis on quantifying costs and designing/optimizing 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 4270 Water Measurement and Analysis Methods
Fall. 3 credits. Satisfies BE and EnvE laboratory experience requirement. Prerequisites: fluids or hydrology course and MATH 1910. Letter grades only. L. D. Geohring and T. S. Steenhuis.
Get wet and muddy learning how to monitor and characterize water and soil management problems in the natural environment. This is a field-based lab course that integrates science and engineering technologies, using various measurement equipment and analytical techniques to quantify water flow and quality parameters in surface and subsurface environments. Measurement accuracy, water sampling quality assurance protocols, and interpretation of watershed contaminants are addressed.

BEE 4350 Principles of Aquaculture
Spring. 3 credits. Prerequisite: at least junior standing. Letter grades only. No-one is allowed to add course after 2nd lec. Two required field trips require class to return to campus at 7 p.m. M. B. Timmons.
An in-depth treatment of the principles of aquaculture: fish biology, waste treatment, engineering design, fish health, nutrition, processing, etc. This course is intended to build upon the undergraduate's previous course background and interests. Includes supervised "hands-on" laboratory experiences.

BEE 4500 Bioinstrumentation
Spring. 4 credits. Satisfies both BE laboratory experience and BE capstone design requirement. Prerequisites: MATH 2940, introductory computing, two semesters of physics, statistics, or permission of instructor. Letter grades only. D. J. Aneshansley.
Bioinstrumentation applications are emphasized in this laboratory-based course. Electronic instruments from sensor to computer are considered. Static and dynamic characteristics of components and systems are examined theoretically and empirically. General analog and digital signal condition circuits are designed, constructed, and tested. A variety of biological applications of instrumentation are discussed.

BEE 4530 Computer-Aided Engineering: Applications to Biomedical Processes (also MAE 4530)
Spring. 3 credits. Satisfies BE capstone design requirement. Satisfies College of Engineering technical writing requirement. Prerequisite: heat and mass transfer (BEE 3500 or equivalent). Letter grades only. A. K. Datta.
Introduction to simulation-based design as an alternative to prototype-based design; analysis and optimization of complex real-life processes for design and research, using industry-standard physics-based computational software. Emphasis is on problem formulation, starting from a real process and developing its computer model. Covers biomedical processes in thermal therapy and drug delivery that involve heat transfer, mass transfer, and fluid flow. Computational topics introduce the finite-element method, pre- and post-processing, and pitfalls of using computational software. Students choose their own semester-long biomedical project, which is the major part of the course (no final exam).

[BEE 4540 Physiological Engineering
Fall. 3 credits. Satisfies BE laboratory experience requirement. Prerequisites: differential equations, 2 semesters of physics, introductory biology, statistics. Letter grades only. Next offered 2010–2011. D. J. Aneshansley.
Measurements of biological systems are integrated with mathematical models of animal physiology. Laboratory experiments and problem sets examine membrane transport, senses, and interacting physiological systems.]

BEE 4590 Biosensors and Bioanalytical Techniques
Fall. 3 credits. Prerequisites: biochemistry course and permission of instructor. Letter grades only. 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 MicroTAS applications in environmental analysis, food safety, and medical diagnostics are explored. Students give oral presentations in lecture, analyze biosensors published in literature, and theoretically design a biosensor based on criteria discussed in class. Undergraduate students work together in teams of two to three. Meets concurrently with BEE 6590. BEE 6590 students work independently on individual biosensor projects.

BEE 4600 Deterministic and Stochastic Modeling in Biological Engineering
Fall. 3 credits. Prerequisites: MATH 2930, MATH 2940, BEE 3500 or equivalent, Mass and Energy Balances, or permission of instructor. Letter grades only. J. C. March.
This course covers modeling biological systems from an engineering standpoint. Starting with deterministic approaches, the class will functionally decompose and mathematically model systems important to biological engineers (including bioprocessing, biomedicine, and microbial ecology). Mechanistic aspects of biology will be handled using stochastic (probabilistic) approaches in the second half of the semester.

BEE 4640 Bioseparation Processes
Fall. 3 credits. Prerequisites: introductory biochemistry, physics, MATH 1920, BEE 2600 or equivalent, or permission of instructor. Offered alternate years. S–U or letter grades. 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 4710 Introduction to Groundwater (also EAS 4710)
Spring. 3 credits. Prerequisites: MATH 2930, fluid mechanics or hydrology course. S–U or letter grades. Field trip. Offered alternate years; next offered 2010–2011. L. M. Cathles, M. T. Walter, and T. S. Steenhuis.
Intermediate-level study of aquifer geology, groundwater flow, and related design factors. Includes description and properties of natural aquifers, groundwater hydraulics, soil water, and solute transport.]

BEE 4730 Watershed Engineering
Fall. 4 credits. Satisfies BE and EnvE capstone design requirement. Satisfies College of Engineering technical writing requirement. Satisfies BE laboratory experience requirement. Prerequisite: CEE 3310 or hydrology course. Letter grades only. M. T. Walter.
This course teaches basic design and analysis as practiced for water control and nonpoint source pollution prevention. We will discuss the origins of design approaches including their theoretical bases but this is not a theory course. Most of the course is dedicated to practicing applied design. Assignments are generally representative of real-life engineering problems and will involve as much hands-on experience as possible. Some example topics include risk analysis, water conveyance, nonpoint source pollution control, stream restoration, stormwater management, and erosion control.

BEE 4740 Water and Landscape Engineering Applications
Spring. 3 credits. Satisfies BE capstone design requirement. Prerequisites: fluids or hydrology course or permission of instructor. Letter grades only. L. D. Geohring and T. S. Steenhuis.
This course will focus on how water moves in soil and the implications for design of drainage and irrigation systems in the landscape. The course addresses aspects of soil physics, flow in porous media, water quality and water supply or disposal in regard to drainage and irrigation applications. Emphasis is on problem solving of actual

situations, and a major site-design project is required.

BEE 4750 Environmental Systems Analysis
Fall. 3 credits. Prerequisites: computer programming and one year of calculus. Letter grades only. D. A. Haith.
Applications of 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). Software packages for watershed analyses of point and nonpoint source water pollution.

BEE 4760 Solid Waste Engineering
Spring. 3 credits. Prerequisites: one semester of physics and chemistry. Letter grades only. 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 4800 Our Changing Atmosphere: Global Change and Atmospheric Chemistry (also EAS 4800)
Fall. 3 credits. Prerequisites: CHEM 2090, MATH 1920, PHYS 1112 or equivalent, or permission of instructor. S–U or letter grades. P. G. Hess.
This course investigates the science behind changes in our atmosphere's composition and its relation to global change. We will examine the chemistry and physics that determines atmospheric composition on global scales including the effects of biogeochemistry and atmospheric photochemistry.

BEE 4810 LRFD–Based Engineering of Wood Structures (also CEE 4810)
Spring. 3 credits. Satisfies BE capstone design requirement when co-registered in BEE 4960. Prerequisite: ENGRD 2020. Letter grades only K. G. Gebremedhin.
Computer-aided and manual computation procedures of Load and Resistance Factor Design (LRFD)–based engineering of wood structures. National design codes and standards; estimation of factored design loads and load combinations; mechanical properties of wood and wood products; designs of beams, columns, trusses, frames, arches, bridges, diaphragms; connections and wood structural systems. Also discusses engineering design judgment as an integral component of the quantitative design procedure.

BEE 4840 Metabolic Engineering
Spring. 3 credits. Prerequisite: biochemistry course or permission of instructor. Letter grades only. 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 4860 Industrial Ecology of Agriculturally Based Bioindustries
Spring. 3 credits. Prerequisites: one year of calculus, some knowledge of MATLAB. Letter grades only. L. P. Walker.
Agricultural-based biofuels and bioproducts systems are very complex and highly integrated. Each of these subsystems are composed of a number of biological, chemical, and physical processes that can be interconnected to a multitude of ways to generate the essential material and energy flows for the production of biofuels and bioproducts. For this course an input/output modeling methodology is employed to develop and manipulate the structure of complex agriculturally based bio-industries and to generate the material, energy, and monetary flows. Students will use linear algebra and state space tools in the MATLAB toolbox to simulate static and dynamic behavior of these complex webs of connected processes and to conduct life-cycle analysis of these complex webs.

BEE 4870 Sustainable Energy Systems
Fall. 3 credits. Satisfies BE capstone design requirement. Intended for upper-level undergraduates and graduate students. Prerequisites: BEE 3500 and thermodynamics course. Letter grades only. L. T. Angenent and N. R. Scott.
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 4890 Entrepreneurial Management for Engineers
Fall. 4 credits. Satisfies College of Engineering technical writing requirement. Prerequisites: junior standing; ENGRD 2700 or CEE 3040 or equivalent highly recommended. Letter grades only. No one allowed to add course after second week. M. B. Timmons.
The course focuses on how to start a new company centered on engineering or biological technologies. Course objectives include coverage of entrepreneurship principles, fundraising, negotiation, financial calculations (internal rate of return, time value of money, pro forma statements); legal structures of businesses; project management; and to develop an awareness of issues related to professional ethics; and technical writing and communication. Majority of work done in teams including a complete business plan that is presented to angel investors. Business plans must require less than $100K in startup funding and may result in actual investment by the angel investor group.

BEE 4900 Biofuels: The Economic and Environmental Interactions (also AEM 6900)
Spring. 2 credits. Prerequisites: senior or graduate standing, others by permission of instructor; course in microeconomics. S–U or letter grades. P. G. Hess.
This course surveys the latest research on the science and economics of biofuels. Questions addressed include the environmental and economic impacts of biofuel use and whether the use of biofuels justifies public policy intervention. The class will consist of a colloquium, discussion with the colloquium speaker, and an in-class discussion section.

BEE 4930 Technical Writing for Engineers
Fall, spring. 1 credit. Meets College of Engineering technical writing requirement. Letter grades only. Staff.
Covers communication skills necessary for oral and written technical project reports. Also considers outlines, style, audience, and general presentation mechanics.

BEE 4940 Special Topics in Biological and Environmental Engineering
Fall or spring. 4 credits max. S–U or letter grades. Staff.
The department teaches "trial" courses under this number. Offerings vary by semester and will be advertised by the department. Courses offered under this number will be approved by the department curriculum committee and the same course will not be offered twice under this number. Each 4940 has a unique course ID for enrollment.

BEE 4960 Capstone Design in Biological and Environmental Engineering
Spring. 1 credit. Corequisite: BEE 4810. Letter grades only. 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 4970 Individual Study in Biological and Environmental Engineering
Fall and spring. 1–4 credits. 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 from all colleges must register using independent study form (available in 207 Riley-Robb Hall). Letter grades only. See department office for course ID specific to your project advisor. 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 4980 Undergraduate Teaching
Fall and spring. 1–4 credits. Prerequisite: written permission of instructor. Letter grades only. Students from all colleges must register using independent study form (available in 207 Riley-Robb Hall). See department office for course ID specific to your project advisor. 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 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. Letter grades only. Students from all colleges must register using independent study form (available in 207 Riley-Robb Hall). See department office for course ID specific to your project advisor. 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 4991–4992 BEE Honors Research
Fall and spring. 1–6 credits, variable. Prerequisite: enrollment in BEE research honors program. Students must be eligible for Latin honors and 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 5010 Bioengineering Seminar (also BME 5010)
Fall, spring. 1 credit. Prerequisite: junior, senior, or graduate standing. S–U grades only. Staff.
To give you, the engineer-in-training, a *broad* overview of different aspects of biological and biomedical engineering including business, legal, and clinical issues. To give the students a working knowledge of how abstracts are written and revised.

BEE 5330 Engineering Professionalism
Spring. 1 or 2 credits*. Prerequisite: graduate student with accredited engineering degree or senior who will graduate with accredited engineering degree. Must register to take Fundamentals of Engineering Exam.** S–U or letter grades. Lec only 1st 10 weeks of semester. M. B. Timmons, J. R. Stedinger, other Engineering Faculty.
Presentations address engineering professionalism and ethics and provide preparation for the general NY FE Examination taught in a team-based format. The second-credit ethics portion emphasizes the engineer's professional responsibilities for the health and welfare of the public and the guiding principles for a professional engineer. Case histories on engineering ethics will be examined and students will write their own personal statement addressing integrity. Homework addresses FE exam preparation, and students complete the formal comprehensive review of engineering subjects associated with the Fundamentals of Engineering Exam.

*1-credit option includes FE review only.

**Students must file their N.Y. FE Exam application by either November 1 of the previous year or by May 1 of the spring semester to be enrolled in BEE 5330. The FE exam registration and sitting fees total $205 and are paid to the N.Y. State Education Department and the testing service, not to Cornell. The N.Y. FE Exam is offered in April and October; the April exam may be taken at Cornell and other N.Y. locations; the October exam is not offered at Cornell.

BEE 5901–5902 M.P.S. Project
Fall and spring. 1–6 credits. Requirement for each M.P.S. candidate in field. Letter grades only. BEE graduate faculty.
Comprehensive project emphasizing the application of agricultural technology to the solution of a real problem.

BEE 5951–5952 Master of Engineering Design Project
Fall and spring. 3–6 credits. Prerequisite: admission to M.Eng. degree program. Letter grades only. BEE graduate faculty.
Comprehensive engineering design projects relating to the candidate's area of specialization. Projects are supervised by faculty members on an individual basis. A formal project report and oral presentation of the design project are required for completion of the course(s). A minimum of 3 to a maximum of 12 credits of 5951–5952 is required for the M.Eng. degree.

BEE 6430 Veterinary Perspectives on Pathogen Control in Animal Manure (also VTMED/BIOMI 6430)
Spring, eight weeks. 2 credits. Prerequisite: third- and fourth-year veterinary students; graduate students, advanced undergraduate students interested in agricultural engineering as related to animal manure management. 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 6470 Water Transport in Plants (also BIOPL 6510)
Fall. 2 credits. Letter grades only. 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 6490 Solute Transport in Plants (also BIOPL 6490)
Fall. 3 credits. Letter grades only. Offered alternate years; next offered 2010–2011. R. M. Spanswick.
A fundamental treatment of the transport of ions and small organic molecules in plants.]

[BEE 6510 Bioremediation: Engineering Organisms to Clean Up the Environment
Spring. 3 credits. Prerequisites: BIOMI 2900 or BIOBM 3310 or permission of instructor. Letter grades only. Next offered 2010–2011. B. A. Ahner.
Through lectures and current literature, students evaluate the benefits as well as the current obstacles to effective bioremediation; includes examples of genetically engineered organisms.]

BEE 6550 Thermodynamics and Its Applications
Fall. 3 credits. Prerequisite: MATH 2930 or equivalent; for undergraduates, permission of instructor. Letter grades only. 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 6590 Biosensors and Bioanalytical Techniques
Fall. 3 credits. Prerequisites: biochemistry course and permission of instructor. Letter grades only. A. J. Baeumner.
For description, see BEE 4590.

[BEE 6710 Analysis of the Flow of Water and Chemicals in Soils
Fall. 3 credits. Prerequisites: four calculus courses and fluid mechanics course; for undergraduates, permission of instructor. Letter grades only. Offered alternate years; next offered 2010–2011. J.-Y. Parlange.
Describes the chemical and water flows on a soil surface, in the vadose zone, and through the aquifer. Discusses current analytical, semi-analytical, and computer-based techniques.]

BEE 6720 Drainage
Spring. 4 credits. Prerequisites: BEE 4710 or BEE 4730. Letter grades only. Offered alternate years. 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 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 6740 Ecohydrology
Spring. 3 credits. Prerequisite: ecology or hydrology course. Offered alternate years. Letter grades only. M. T. Walter.
The objective of this course is to investigate novel topics that involve the interactions between physical hydrological processes and ecosystem processes, including the impacts of human activities on the ecohydrological system. The course is designed to encourage teams of students from historically disparate disciplines to collaboratively combine their unique skills and insights to answer multidisciplinary ecohydrological questions. This course will consider a broad range scales from a stomate and a soil pore to a forest, watershed, and region, with emphasis placed on those scales and systems most appropriate to student interests. Through course work we will clarify the current understanding of various topics, identify knowledge gaps, develop hypotheses, and test them quantitatively by creating models and analyzing available data. The goal of this course is to identify the basic principles of ecohydrology and become familiar and comfortable with a range of quantitative tools and approaches for answering ecohydrological questions.

BEE 6870 The Science and Engineering Challenges to the Development of Sustainable Bio-Based Industries
Fall. 1 credit. Prerequisite: graduate standing. S–U grades only. L. P. Walker.
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 6940 Graduate Special Topics in Biological and Environmental Engineering
Fall or spring. 4 credits max. S–U or letter grades. BEE graduate faculty.
The department teaches "trial" courses under this number. Offerings vary by semester and are advertised by the department. 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. Each 6940 has a unique course ID number.

BEE 6970 Graduate Individual Study in Biological and Environmental Engineering
Fall or spring. 1–6 credits. Prerequisite: permission of instructor. S–U or letter grades. BEE graduate faculty.
Topics are arranged by the staff at the beginning of the semester.

BEE 7000 Orientation to Graduate Study
Fall, first seven weeks. 1 credit. Prerequisite: new graduate students in BEE. S–U grades only. A. J. Baeumner.
Introduction to BEE research policy, programs, methodology, resources, and degree candidates' responsibilities and opportunities.

BEE 7010 BEE Seminar Series
Spring. 1 credit. S–U or letter grades. J. C. March and M. T. Walter.
Presentation and discussion of research and special developments pertinent to biological and environmental engineering and related fields.

BEE 7540 Water and Culture in the Mediterranean: A Crisis
Spring. 3 credits. Prerequisite: graduate standing or permission of instructors. S–U or letter grades. T. S. Steenhuis, G. Holst-Warhaft, et al.
The course addresses the crisis of water in the Mediterranean region, through case studies situated in watershed basins, especially the Nile. It focuses on attitudes, conflicts, and relationships of local people and nations toward water, expressed in culture, environmental laws, and watershed management practices.

BEE 7600 Nucleic Acid Engineering (also BME 7600)
Spring. 2 credits. Prerequisite: graduate standing; seniors by permission of instructor. S–U or letter grades. 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 are introduced. Efficient and effective literature reading and evaluation are emphasized.

BEE 7710 Soil and Water Engineering Seminar
Fall and spring. 1 credit. Prerequisite: graduate standing or permission of instructor. S–U or letter grades. T. S. Steenhuis, J.-Y. Parlange, M. F. Walter, and M. T. Walter.
Study and discussion of research or design procedures related to selected topics in watershed management, erosion control, hydrology, colloid transport, and water quality.

BEE 8900 Master's-Level Thesis Research
Fall and spring. 1–15 credits. Prerequisite: permission of advisor. S–U grades only. BEE graduate faculty. Variable credit for M.S. research.

BEE 9900 Doctoral-Level Thesis Research
Fall and spring. 1–15 credits. Prerequisite: permission of advisor. S–U grades only. BEE 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

J. Booth, chair (1178 Comstock Hall, 254-6505, 255-5488), C. Bustamante, G. Hooker, J. Mezey, S. J. Schwager, A. C. Siepel, R. Strawderman, M. Wells

The Department of Biological Statistics and Computational Biology offers the following courses in Biometry and Statistics. Students must register under Course Listings: College of Agriculture and Life Sciences—Biometry and Statistics.

BTRY 1150 Introduction to Quantitative Methods
Spring. 4 credits.
Review of basic algebra concepts, the equation of a line, and systems of linear equations; properties of functions and applications, including polynomial, exponential, and logarithmic functions; basic probability laws, counting principles, discrete probability distributions, expected value; frequency distributions, measures of central tendency and variation; the binomial and normal distributions.

BTRY 3010 Biological Statistics I (also NTRES 3130, STSCI 2200)
Fall. 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 a statistical computing environment.

BTRY 3020 Biological Statistics II (also NTRES 4130, STSCI 3200)
Spring. 4 credits. Prerequisite: BTRY 3010 or 6010.
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 a statistical computing environment.

BTRY 3100 Statistical Sampling (also ILRST/STSCI 3100)
Fall. 4 credits. 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 4070 Principles of Probability and Statistics (also ILRST 4070)
Fall. 4 credits. Cannot be taken for credit after completion of BTRY 4080/4090 or MATH 4710/4720 sequence. Prerequisites: one year of calculus. Course is prerequisite for upper-division statistical genomics courses. Recommended: some knowledge of multivariate calculus and statistics. S–U or letter grades.
A one-semester version of the BTRY 4080/4090 sequence. Topics include combinatorial probability, conditional probability and independence, random variables (and their moments), standard distributions (multinomial, Poisson, normal, gamma, beta, etc.) and their properties. The second half of the course focuses on parametric inference using maximum likelihood and Bayesian approaches. Computational methods are emphasized using the R programming language. The course is a prerequisite for upper-division statistical genomics courses.

BTRY 4080 Theory of Probability (also STSCI 4080)
Fall. 4 credits. Prerequisites: MATH 1110, 1120, at least concurrent enrollment in 2130 or 2220 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 4090 Theory of Statistics (also STSCI 4090)
Spring. 4 credits. Prerequisites: BTRY 4080 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 4080. Topics include sampling distributions, principles of data reduction, likelihood, parameter estimation, hypothesis testing, interval estimation, and basic asymptotic theory.

BTRY 4100 Multivariate Analysis (also ILRST/STSCI 4100)
Spring. 4 credits. Prerequisites: BTRY 3010, some knowledge of matrix algebra. S–U or letter grades.
Application of classical multivariate methods to data from a variety of fields using a statistical software package. Topics include the multivariate normal distribution, multivariate regression, and MANOVA; principal components and factor analysis; canonical correlation; discriminant analysis and clustering.

[BTRY 4790 Probabilistic Graphical Models (also CS 4782)
Fall. 4 credits. Prerequisites: probability theory (BTRY 4080 or equivalent), programming and data structures (CS 2110 or equivalent). Recommended: course in statistical methods (BTRY 4090 or equivalent). Next offered 2010–2011.
A thorough introduction to graphical models, a flexible and powerful framework for machine learning and probabilistic modeling that combines graph theory and probability theory.]

BTRY 4820 Statistical Genomics
Fall. 4 credits. Prerequisites: MATH 1110 and BTRY 4070. Highly recommended: at least one previous course in statistical methods and one in biology. S–U or letter grades.
A course on the statistical analysis of genetic, molecular, and genomic data. The first module of the course presents a thorough treatment of important probability distributions and the concepts of likelihood and Bayesian inference. We then focus on how statistical models are developed for linkage analysis, basic Quantitative Trait Locus mapping, analysis of pedigrees, molecular population genetics and genomics, and phylogenetic inference.

BTRY 4830 Quantitative Genomics and Genetics
Spring. 4 credits. Prerequisites: BTRY 4070 and introductory statistics or equivalent. S–U or letter grades.
A rigorous treatment of analysis techniques used to understand complex genetic systems. This course will cover both the fundamentals and advances in statistical methodology used to analyze disease, agriculturally relevant, and evolutionarily important phenotypes. Topics will include mapping quantitative trait loci (QTLs), application of microarray and related genomic data to gene mapping, and evolutionary quantitative genetics. Analysis techniques will include association mapping, interval mapping, and analysis of pedigrees for both single and multiple QTL models. Application of classical inference and Bayesian analysis approaches will be covered and there will be an emphasis on computational methods. Meets concurrently with BTRY 6830.

BTRY 4840 Computational Genomics
Fall. 4 credits. Prerequisites: BTRY 4070 and at least one course in statistical methods and at least one in algorithms. S–U or letter grades.
A rigorous treatment of important computational principles and methods for the analysis of genomic data, emphasizing comparative and evolutionary genomics. Topics include sequence alignment, gene and motif finding, phylogeny reconstruction, and inference of gene regulatory networks. Covers both maximum likelihood and Bayesian principles, and both exact and approximate algorithms for inference. Draws heavily on general concepts from probabilistic graphical models. Meets concurrently with BTRY 6840.

BTRY 4940 Undergraduate Special Topics in Biometry and Statistics
Fall or spring. 1–3 credits. S–U or letter grades.
Course of lectures selected by the faculty. Because topics usually change from year to year, this course may be repeated for credit.

BTRY 4970 Undergraduate Individual Study in Biometry and Statistics
Fall and spring. 1–3 credits. S–U or letter grades. 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 4980 Undergraduate Supervised Teaching
Fall and spring. 1–3 credits. S–U or letter grades. 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 4990 Undergraduate Research
Fall or spring. 1–3 credits. Prerequisite: statistics and biometry undergraduates; permission of faculty member directing research. S–U or letter grades. Students must register using independent study form (available in 140 Roberts Hall).

BTRY 6010 Statistical Methods I (also ILRST 6100)
Fall. 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 statistical software. Emphasizes basic principles and criteria for selection of statistical techniques.

BTRY 6020 Statistical Methods II
Spring. 4 credits. Prerequisite: graduate standing or permission of instructor; BTRY 6010 or equivalent.
Continuation of BTRY 6010. 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 6030 Statistical Methods III: Categorical Data (also ILRST/STSCI 4110)
Spring. 4 credits. Prerequisite: BTRY 6010 and 6020 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 6040 Statistical Methods IV: Applied Design (also STSCI 4120)
Spring. 4 credits. Prerequisites: BTRY 6010 and 6020 or permission of instructor.
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 6070 Principles of Probability and Statistics
Fall. 4 credits. Prerequisite: one year of calculus. Recommended: some knowledge of multivariate statistics. S–U or letter grades.
For description, see BTRY 4070.

[BTRY 6150 Applied Functional Data Analysis
Fall. 3 credits. Prerequisites: BTRY 6010 and 6020 or permission of instructor. Next offered 2010–2011.
Functional data analysis studies data that may be thought of as continuously sampled smooth curves. The course focuses on extensions of standard statistical techniques to these data.]

BTRY 6520 Computationally Intensive Statistical Inference
Spring. 4 credits. Prerequisite: ORIE 6700 and at least one course in probability. S–U or letter grades. 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 6790 Probabilistic Graphical Models (also CS 6782)
Fall. 4 credits. Prerequisites: probability theory (BTRY 4080 or equivalent), programming and data structures (CS 2110 or equivalent). Recommended: course in statistical methods (BTRY 4090 or equivalent). Next offered 2010–2011.
For description, see BTRY 4790.]

BTRY 6820 Statistical Genomics
Fall. 4 credits. Prerequisites: MATH 1110 and BTRY 6070. Highly recommended: at least one previous course in statistical methods and one in biology. S–U or letter grades.
For description, see BTRY 4820.

BTRY 6830 Quantitative Genomics and Genetics
Spring. 4 credits. Prerequisites: BTRY 4070 and introductory statistics course or equivalent. S–U or letter grades.
For description, see BTRY 4830.

BTRY 6840 Computational Genomics
Fall. 4 credits. Prerequisites: BTRY 4070 and at least one previous course in statistical methods and at least one in algorithms. S–U or letter grades.
For description, see BTRY 4840.

BTRY 6890 Topics in Population Genetics and Genomics
Fall. 1 credit; may be repeated for credit. Prerequisite: BTRY 6820 or permission of instructor.
This course is a graduate seminar on current topics in population genetic data analysis. Topics this semester may include detecting signatures of natural selection, estimating demographic parameters, and recombination rate variation from whole-genome data; statistical methods for association mapping; efficient methods for disease gene mapping; use of comparative genomic data for population genetic inference. Readings will be chosen primarily from current literature.

BTRY 6940 Graduate Special Topics in Biometry and Statistics
Fall or spring. 1–3 credits. S–U or letter grades.
Course of lectures selected by the faculty. Because topics usually change from year to year, this course may be repeated for credit.

BTRY 6970 Individual Graduate Study in Biometry and Statistics
Fall, spring, or summer. 1–3 credits. S–U or letter grades.
Individual tutorial study selected by the faculty. Because topics usually change from year to year, this course may be repeated for credit.

[BTRY 7170 Theory of Linear Models
Fall. 3 credits. Prerequisites: BTRY 4090, 6020, or equivalents. S–U or letter grades. Next offered 2010–2011.
Properties of the multivariate normal distribution. Distribution theory for quadratic forms. Properties of least squares and maximum likelihood estimates. Methods for fixed-effect models of less than full rank. Analysis of balanced and unbalanced mixed-effects models. Restricted maximum likelihood estimation. Some use of software packages and illustrative examples.]

BTRY 7180 Generalized Linear Models
Fall. 3 credits. Prerequisites: primarily for Ph.D. students in statistics; BTRY 6020, BTRY 4090, or equivalent. S–U or letter grades.
A theoretical development of generalized linear models and related topics including generalized estimating equations, and generalized linear mixed models.

BTRY 7200 Topics in Computational Genomics
Spring. 1 credit. Prerequisite: BTRY 4840/6840 or permission of instructor.
Weekly seminar series on recent advances in computational genomics. A selection of the latest papers in the field will be read and discussed. Methods will be stressed, but biological results and their significance will also be addressed.

BTRY 7210 Topics in Quantitative Genomics
Fall. 1 credit. Prerequisites: BTRY 4830/6830 or permission of instructor.
Weekly seminar series on recent advances in quantitative genomics. A selection of the latest papers in the field will be read and discussed. Methods will be stressed, but biological results and their significance will also be addressed.

[BTRY 7270 Advanced Survival Analysis
Spring. 3 credits. Prerequisites: at least one graduate-level course in probability, mathematical statistics, and regression modeling. S–U or letter grades. Next offered 2010–2011.
This course focuses on the rigorous development of nonparametric, semiparametric, and parametric modeling and statistical inference procedures appropriate for analyzing right censored data.]

BTRY 7900 Graduate-Level Dissertation Research
Fall or spring. 1–9 credits. Prerequisite: Ph.D. candidates; permission of graduate field member concerned. S–U grades only.
Research at the Ph.D. level.

BTRY 7950 Statistical Consulting
Fall and spring. 2–3 credits. Pre- or corequisites: BTRY 6020 and 4090 and permission of instructor. S–U or letter grades.
Participation in the Cornell Statistical Consulting Unit (CSCU): 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 7980 Graduate Supervised Teaching
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 8900 Master's-Level Thesis Research
Fall or spring. 1–9 credits. Prerequisite: M.S. candidates; permission of graduate field member concerned. S–U grades only.
Research at the M.S. level.

BTRY 9900 Doctoral-Level Dissertation Research
Fall or spring. 1–9 credits. S–U grades only.

COMMUNICATION

G. K. Gay, chair; K. L. Berggren, J. P. Birnholtz, S. E. Byrne, S. R. Fussell, T. L. Gillespie, D. A. Grossman, J. T. Hancock, L. M. Humphreys, L. C. Levitan, B. V. Lewenstein, K. A. McComas, P. L. McLeod, S. M. Nelson, J. D. Niederdeppe, C. W. Scherer, M. A. Shapiro, L. P. Van Buskirk, Y. C. Yuan

COMM 1101 Cases in Communication (SBA)
Fall. 3 credits. T. Gillespie.
Through analysis of cases, this course introduces students to key principles and theories in the study of human communication. Cases cover personal situations, entertainment, national crises, business situations, new technologies, and other contexts. The goal is to understand the links between these daily activities, "mid-range" theories of human behavior, and broad social concepts of modernity and post-modernity.

COMM 1300 Visual Communication (SBA)
Spring. 3 credits. 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 to develop a theoretical framework for becoming more visually aware and for thinking more critically about how visuals influence us.

COMM 1310 Writing about Communication
Spring. 3 credits. Corequisite: COMM 1300. 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. Several assignments focus on visual communication theories explored in COMM 1300 as well as ideas from COMM 1101.

COMM 2010 Oral Communication
Fall, winter, spring, or summer. 3 credits. Limited to 24 students per sec (fall and spring) or 15 students per sec (summer). Priority given to juniors and seniors, then sophomores. Fluency in spoken English assumed. Sections meet beginning first day of instruction; may precede lecture. Students absent twice during first week of class are dropped from course roster. Enrolled students must drop by end of second week to allow wait-listed students to add course. K. Berggren 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 2030 Argumentation and Debate
Fall, spring, and summer. 3 credits. S. Nelson.
Students learn the principles of argumentation and debate. Topics emphasize Internet database research, synthesis of collected data, policy 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 2200 Media Communication (SBA)
Fall. 3 credits. S. Byrne.
Introduction to media history, industry, content, policy, process, and effects.

COMM 2450 Communication and Technology (also INFO 2450) (SBA)
Fall. 3 credits. J. Hancock and J. Birnholtz.
This course introduces students to the Communication and Information Technologies focus area of the communication department and the Human Systems track for information science. It examines several approaches to understanding technology and its role in human behavior and society. Topics include psychological aspects of computer-mediated communication; how design plays a role in the way we interface with technology and collaborate with each other; and the ways in which communication technology is situated inside social and institutional structures and cultural formations.

COMM 2630 Organizational Writing
Fall, winter, spring, or summer. 3 credits. Limited to 25 students per sec. Prerequisite: junior, senior, or graduate standing; college-level writing course. 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 2720 Principles of Public Relations and Advertising
Winter and 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 2760 Persuasion and Social Influence (SBA)
Spring. 3 credits. Prerequisite: COMM 1101. P. McLeod.
Social influence and persuasion are the most basic and important functions of communication. The course covers characteristics of persuasive messages, message sources, and targets; interpersonal influence; influence in groups, organizations, and institutions. Special emphasis is given to topics in health, science, risk, media, and technology. This course is taught with a case-study format with strong emphasis on class attendance and participation. Supplementing the cases are interactive lectures and in-class activities and demonstrations. A semester-long field research project done in groups is a major component of the course. Exams and short individual homework assignments are also part of the student evaluation.

COMM 2820 Research Methods in Communication Studies (SBA)
Spring. 3 credits. Pre- or corequisite: sophomore standing. J. Niederdeppe.
The course covers social scientific methods to solve communication research problems empirically. Topics include basic principles of social scientific research, random sampling, questionnaire design, experimental research design, focus group techniques, content analysis, and basic descriptive and inferential statistics. Students will also learn basic data manipulation, presentation. and analysis techniques using SPSS and EXCEL.

COMM 2840 Sex, Gender, and Communication (also FGSS 2840) (SBA)
Fall. 3 credits. Not open to freshmen. 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, self-identity, social structures, personal relationships, and gender concerns in the workplace. The course devotes equal time to men and to women and focuses on important contemporary communication issues.

COMM 2850 Communication, Environment, Science, and Health (also STS 2851) (SBA)
Spring. 3 credits. B. Lewenstein and staff.
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 scientifically based social issues and research findings. This course examines the institutional and intellectual contexts, processes, and practical constraints on communication in the life sciences.

[COMM 3010 Speech Communication in Context
Fall and spring. 3 credits. Prerequisite: COMM 2010; second-semester sophomore, junior, or senior standing. Staff.
This course introduces students to advanced theories of speech communication and then demonstrates the uses of these theories in several different contexts, including business and professional, small groups, interpersonality, and intercultural settings. Grades are based on a combination of in-class presentation, tests, and a final paper.]

COMM 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. Travel fee: $200. S. Nelson and 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 3100 Communication and Decision Making in Groups (SBA)
Spring. 3 credits. Prerequisite: junior or senior standing; priority given to COMM majors. P. McLeod.
This course will provide students with a greater understanding of information sharing, persuasion, and decision development in small work groups. Through practical exercises, class discussions, and lectures, students will learn firsthand how tools such as decision structuring process can affect group performance. The course will be taught in an interactive hands-on format that emphasizes application of tested theory.

COMM 3200 New Media and Society (also INFO 3200) (CA)
Spring. 3 credits. T. Gillespie.
This course builds on mass communication research and the study of culture and technology to investigate the social, political, and technological dynamics of contemporary media. We investigate how new media frame our experience of the world and shape our political involvement in it, and how new media intersect with our sense of identity and involvement in culture.

COMM 3300 Media and Human Development (SBA)
Spring. 3 credits. Prerequisite: COMM 2200. S. Byrne.
Provides a developmental perspective on how children and adolescents interact with, interpret, and respond to media content. Major areas of consideration include the effects of media violence, health and pro-social messages, educational programming, advertising, video games, sexual media, and content children find frightening. Students will evaluate the strategies that have been proposed to mitigate negative effects of the media on children.

[COMM 3400 Psychology of Social Computing (also INFO 3400) (SBA)
Fall. 3 credits. Prerequisite: COMM/INFO 2450. J. Birnholtz.
Course focuses on understanding online communication through principles of cognitive and social psychology and aspects of the Internet that defy traditional psychology understandings. Topics include impression formation and management, deception and trust, group dynamics, social support, "Internet addiction," online pornography, and organizational impacts of new communication technology.]

COMM 3450 Human–Computer Interaction Design (also INFO 3450) (SBA)
Fall. 3 credits. Pre- or corequisite: COMM/INFO 2450. D. Cosley, F. Guimbretière, and staff.
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 3490 Media Technologies (also STS/INFO 3491) (CA)
Spring. 3 credits. Offered odd-numbered years. 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 3520 Science Writing for the Mass Media (also STS 3521)
Fall. 3 credits. Limited to 24 students. Not open to freshmen. Prerequisite: college-level writing course. Next offered 2010–2011. B. Lewenstein.
How to write about science, technology, and medicine for the media. Writing assignments focus on writing news for web sites, blogs, magazines, and other media.]

[COMM 3530 Science Writing Practicum
Spring. 1 credit. Prerequisite: COMM/STS 3520, ENGRC 3500, or permission of instructor. Next offered 2010–2011. B. Lewenstein.
Students cover the annual meeting of the American Association for the Advancement of Science. Students are responsible for all costs of travel, lodging, and meals.]

[COMM 3551 Computers: From the 17th Century to the Dotcom Boom (also STS 3551)
Fall. 4 credits. Next offered 2010–2011. J. Ratcliff.
For description, see STS 3551.]

COMM 3561 Computing Cultures (also STS 3561)
Spring. 4 credits. R. Prentice.
For description, see STS 3561.

COMM 3600 Writing for New Media: Theory, Analysis, and Practice
Fall and spring. 3 credits. Prerequisites: sophomore standing and at least one college-level writing course. F. Joseph.
This advanced-level writing course emphasizes academic, analytical, and practical writing skills. Students will research and write analyses of texts that appear in new media outlets, including independent wikis and blogs and those linked to conventional journalistic sources. The first three or four class essays will analyze style, content, reliability, and readability of such texts. In the second half of the course, students will write their own blogs and wikis on approved communication and social science topics.

COMM 3650 Technology and Collaboration (also INFO 3650) (SBA)
Spring. 3 credits. Prerequisite: COMM 2450. J. Birnholtz.
Course focuses on understanding the use of communication technologies in groups, with a particular focus on the unique and sometimes difficult issues raised by groups that are geographically distributed. Topics include theories of group and organizational behavior, interpersonal awareness, privacy, trust, technology-mediated communication, and technology evaluation and adoption.

COMM 3760 Planning Communication Campaigns (SBA)
Fall. 3 credits. Pre- or corequisites: COMM 2820 or equivalent social research course and one semester of introductory statistics. J. Niederdeppe.
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 3980 Issues in Teaching Communication (KCM)
Fall and spring. 1 credit. Pre- or corequisite: junior or senior standing; present or past undergraduate teaching assistant for COMM course. 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 4050 Speech and Debate in the Community
Fall and spring. 1 credit; may be repeated once for credit. Meets one hour weekly. S. Nelson and 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 4100 Organizational Communication: Theory and Practice (CA)
Spring. 3 credits. Prerequisite: junior, senior, or graduate standing; COMM 1101 or permission of instructor. 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.

[COMM 4200 Public Opinion and Social Process (SBA)
Spring. 3 credits. Prerequisite: COMM 2820. Offered even-numbered years. Next offered 2010–2011. Staff.
The course provides a scientific and applied overview of the concept of "public opinion" and its implications for macrosocial processes.]

COMM 4210 Communication and the Environment (SBA)
Spring. 3 credits. 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 4220 Psychology of Entertainment Media (SBA)
Fall. 3 credits. Prerequisites: introductory psychology or COMM 1101 or 2200. M. Shapiro.
Every media format uses entertainment including video games, advertising, television, movies, sports, and news. This course examines the psychology (conscious and unconscious) of entertainment, including why people like entertainment, what makes a story entertaining, how people mentally process entertainment, what makes things frightening or funny, and can entertainment persuade.

COMM 4280 Communication Law
Spring. 3 credits. Prerequisite: junior, senior, or graduate standing or permission of instructor. D. Grossman.
This course 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 4290 Copyright in the Digital Age (also INFO 4290) (CA)
Fall. 3 credits. Offered odd-numbered years. T. Gillespie.
This course looks at recent legal and cultural battles about digital copyright, to investigate how participation in a digital world is structured: who speaks, what they can say, who hears, and with what consequences. We use these cases to look at the collision of authorship and the market, technology and law, individual and institution, culture and power.

COMM 4400 Advanced Human-Computer Interaction Design (also INFO 4400) (SBA)
Spring. 3 credits. Prerequisite: COMM/INFO 3450 or permission of instructor. D. Cosley, G. Gay, and staff.
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 4450 Seminar in Computer-Mediated Communication (also INFO 4450) (SBA)
Spring. 3 credits. Prerequisite: COMM/INFO 2450. S. Fussell.
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 4500 Language and Technology (also INFO 4500) (SBA)
Spring. 3 credits. J. Hancock and staff.
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 4560 Community Involvement in Environmental Decisions (SBA)
Spring. 3 credits. Prerequisite: junior or senior standing or permission of instructor. Offered odd-numbered years. K. McComas.
Community involvement is an essential part of environmental decision making, but it is also one of the most challenging aspects of the decision-making process. Through selected readings and course activities, this class will examine both traditional and contemporary methods of community involvement. When evaluating the methods, the class will discuss how social structures work to define criteria for success.]

COMM 4650 Mobile Communication in Public Life (CA)
Fall. 3 credits. Prerequisites: COMM/INFO 2450. L. Humphreys.
Mobile technology is an increasingly prominent tool for modern communication. This course will critically explore the role of mobile communication and its impact on public life. The course is divided into three main areas: social and political uses of mobile communication, mobility and sense of place, and mobile social software.

COMM 4660 Public Communication of Science and Technology (also STS 4661) (SBA)
Spring. 3 credits. Prerequisite: COMM 2850, or 3520, ENGRC 3500, or permission of instructor. Offered even-numbered years. 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 4860 Risk Communication (SBA)
Fall. 3 credits. 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 4940 Special Topics in Communication
Fall, spring, or summer. 1–3 credits, variable. Prerequisite: permission of instructor. S–U or letter grades.
Study of topics in communication not otherwise provided by a department course and determined by the interest of the faculty and students.

COMM 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. All 4960 internship courses must adhere to the CALS guidelines at www.cals.cornell.edu/cals/current/student-research/internship/index.cfm.

COMM 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 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 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 4991 Independent Honors Research in Social Science
Fall or spring. 1–6 credits. Prerequisite: undergraduate standing; requirements met for honors program. Staff.
Intended for students pursuing the research honors thesis in communication. Students must complete the CALS Honors program application by the third week of the fall semester of their senior year. Students should select a faculty advisor and begin proposal development during their junior year.

COMM 5660 Workshop in Science Communication for Scientists
Spring. 2 credits. Prerequisite: graduate standing. B. Lewenstein.
This workshop will train researchers in the sciences (including natural sciences, engineering, experimental social sciences, etc.) to communicate effectively with nonscientists such as policy makers, political stakeholders, the media, and the general public. Training activities may include role-play, reading/discussion, writing press releases and other outreach materials, and discussion with invited speakers. Outside of the regularly scheduled time, additional activities may include field trips to newsrooms and a training session with a professional media trainer.

COMM 6100 Seminar in Social Networks
Fall. 4 credits. Prerequisite: graduate standing. Offered even-numbered years. C. Yuan.
Examination of the structures and processes of group, organizational, and social networks. Review of research literature in communication and social networks. Survey of network methods with an emphasis on quantitative analysis using relevant software. Application of graph theory, matrix algebra, and sociometry techniques. Analysis and social interpretation of extant network datasets.

COMM 6180 Media Influence and Persuasion
Spring. 3 credits. Prerequisite: graduate standing. Offered odd-numbered years. S. Byrne.
This graduate seminar covers classic, influential, and disruptive theories of media influence and mediated persuasion. Readings include cutting-edge empirical tests of those theories across communication contexts. Students develop skills in operationalizing theoretical concepts in preparation for empirical test.

COMM 6210 Advanced Communication and the Environment
Spring. 3 credits. 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 4210; graduate students should enroll in COMM 6210.

COMM 6220 Advanced Psychology of Entertainment Media
Fall. 3 credits. Prerequisites: graduate standing and permission of instructor. M. Shapiro.

Graduate seminar examining the psychology (conscious and unconscious) of entertainment media (including video games, advertising, television, movies, sports, and news). Specific topics examined will vary. Depending on preparation, students may be asked to attend COMM 4220 lectures and take exams.

COMM 6400 Human–Computer Interaction Design (also INFO 6400)
Spring. 3 credits. Prerequisite: graduate standing or permission of instructor. D. Cosley, G. Gay, and staff.
Graduate-level readings and research supplementing COMM/INFO 4400. 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 6450 Seminar in Computer-Mediated Communication (also INFO 6450)
Spring. 3 credits. Prerequisite: graduate standing or permission of instructor. S. Fussell.
Graduate-level readings and research supplementing COMM/INFO 4450. 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 6500 Language and Technology (also INFO 6500)
Spring. 3 credits. J. Hancock and staff.
Graduate-level readings and research supplementing COMM/INFO 4500. 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 6660 Public Engagement in Science (also STS 6661)
Spring. 3 credits. Offered even-numbered years. B. Lewenstein.
In recent years, the scientific community has increasingly referred to "public engagement in science." This seminar explores the scholarly literature addressing that move; the links between "public engagement" and earlier concerns about sciences literacy, public understanding of science, and outreach; and the intersections between literature in communication and in science studies on issues involving the relationships among science(s) and public(s).

COMM 6760 Public Health Communication
Spring. 3 credits. Prerequisite one graduate-level research methods course. Offered even-numbered years. J. Niederdeppe.
This graduate course provides an overview of theory and research on public communication related to health behavior and policy change. Topics include theories of behavior change and message effects; formative and evaluative research; campaigns related to cancer, AIDS, obesity, smoking, nutrition, and drug use; and heterogeneity in campaign effects between populations.

COMM 6800 Studies in Communication
Fall. 3 credits. Prerequisite: communication graduate students or permission of instructor. S. Fussell.
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 6810 Advanced Communication Theory
Spring. 3 credits. Prerequisite: COMM 6800 or graduate standing and permission of instructor. M. Shapiro.
Development of, and contemporary issues in, communication theory. Discusses the interaction between communication and society, social groupings, and mental processing.

COMM 6820 Methods of Communication Research
Fall. 3 credits. Recommended: familiarity with basic statistical concepts. J. Birnholz.
Analyzes methods of communication research based on a social science foundation. Goals will be to understand processes and rationales for qualitative, textual, survey, and experimental methods and to experience each method through modest individual or group research projects. Critiques of selected contemporary communication studies.

COMM 6830 Qualitative Research Methods in Communication
Spring. 3 credits. Prerequisite: COMM 6820 and graduate standing. L. Humphreys.
Course will review qualitative methods used in communication research, including interviews, focus groups, fieldwork (ethnography), and case studies. Students will practice the various methods so they can learn to apply them to their own research. Course will also discuss how researchers analyze qualitative data and build theories from their observations.

COMM 6840 Theory and Research in Group Communication and Decision Making
Fall. 3 credits. Offered odd-numbered years. P. McLeod.
This graduate seminar will focus on theory and research in communication and decision-making in small groups. Emphasis will be on task-oriented groups. Topics will include information exchange, decision-making processes, types of tasks, social influence, group development processes, group support systems, intergroup processes, and leadership. Special attention will be given to methodological challenges in group research.

[COMM 6860 Risk Communication
Spring. 3 credits. Next offered 2010–2011. K. McComas and C. Scherer.
Examination of theory and research related to the communication of scientific information about environmental, agricultural, food, health, and nutritional risks.]

COMM 6910 Seminar: Topics in Communication
Fall and spring. 0 credits. Staff.
Scholars from a wide variety of fields present varied topics in theory or research as it relates to communication.

COMM 6940 Special Topics in Communication
Fall, spring, or summer. 1–3 credits, variable. Prerequisite: permission of instructor.
Study of topics in communication not otherwise provided by a department course and determined by the interest of faculty members and students.

COMM 6950 Structural Equation Modeling Techniques in Social Science Research
Spring. 3 credits. Prerequisite: course in multiple regression; graduate standing. C. Yuan.
This is an advanced research methods class for graduate students in the social sciences with an emphasis on data analysis using structural equation modeling (SEM). The class will cover both its basic principles and practical applications (e.g., multi-group models, growth curve models) using LISREL/PRELIS software.

COMM 7810 Seminar in Psychology of Communication
Spring. 3 credits. Prerequisite: COMM 6800 and 6810 or equivalent graduate-level theory in psychology or social psychology. 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 7940 Seminar in Communication Issues
Fall, spring, or summer. 1–3 credits. Prerequisite: permission of instructor.
Small group study of topical issue(s) in communication not otherwise examined in a graduate field course.

COMM 7970 Graduate Independent Study
Fall, spring, or summer. 1–3 credits. Prerequisite: permission of instructor.
Individual study concentrating on locating, assimilating, synthesizing, and reporting existing knowledge on a selected topic.

COMM 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.) 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 7990 Graduate Research
Fall, spring, or summer. 1–3 credits. Prerequisite: appropriate communication graduate course work or permission of instructor.
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 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.
Thesis research for M.S. (communication) students.

COMM 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.
Dissertation research for Ph.D. candidates.

CROP AND SOIL SCIENCES

H. M. van Es, chair (232 Emerson Hall, 255-5459); D. Buckley, J. H. Cherney, W. J. Cox, A. DiTommaso, J. M. Duxbury, G. W. Fick, R. R. Hahn, P. Hobbs, L. V. Kochian, J. Lehmann, M. B. McBride, R. L. Obendorf, J. M. Russell-Anelli, T. L. Setter, J. E. Thies, O. Vatamaniuk, R. M. Welch

Courses by Subject

Crop Science: 2110, 3150, 3170, 4030, 4050, 4140, 4260, 4440, 4551–4555, 6080, 6100, 6120, 6140, 6420, 6941, 7910, 8900, 9910

Environmental Information Science: 3970, 4100, 4110, 4200, 4650, 6200, 6210, 6600, 6740, 6750, 6943, 7920, 8910, 9920

Soil Science: 1120, 2600, 3210, 3620, 3630, 3650, 3720, 4120, 4660, 4720, 4830, 6630, 6660, 6690, 6710, 6720, 6840, 6942, 7900, 8920, 9900

General Courses

CSS 1900 Sustainable Agriculture: Food, Farming, and the Future
Fall. 3 credits. Limited to 60 students. G. W. Fick.
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.

CSS 2940 Introduction to Agricultural Machinery (also AGSCI/HORT 2940)
Fall. 2 credits. B. Flannigan and A. DiTommaso.
This course is an overview of agricultural machinery used in the production of field crops. Information will be presented in a lecture and field laboratory format, stressing "hands-on" equipment demonstrations and use, particularly of tractors. Successful completion will provide a broad understanding of agricultural machinery operation and design rationale.

CSS 3800 Organic Food and Agriculture (also AGSCI/HORT 3800)
Fall. 3 or 4 credits. Prerequisites: CSS 1900, CSS 2600, HORT 1101 recommended, or permission of instructor.
Discussion of techniques and methods of organic food production, including vegetables, orchard crops, grains and animal systems. Critically evaluates relevant issues that affect the environment, consumers, and the industry. Optional lab includes interaction with experts, field trips to farms, and living laboratory at Dilmun Hill.

CSS 4910 Food, Farming, and Personal Belief (also IARD 4910)
Spring. 1 credit. Recommended: Sustainable Agriculture (CSS 1900) or equivalent. G. Fick.
Reading and discussion course focusing on the relationship between agricultural sustainability and religious faith, especially the linkage between the motivation to adopt practices of sustainability and personal value systems of farmers and consumers. Principles of scientific agriculture are examined with the holistic view of sustainable development.

[CSS 4940 Biotechnology and Development (also GOVT 4300)
Spring. 2 credits. Sec 2. J. E. Thies and R. J. Herring.
Class discussions, presentations, and scholarly and popular articles are used to introduce students to the dominant contentions around biotechnology in the context of international development.]

CSS 4940 Special Topics in Crop and Soil Sciences (undergraduate level)
Fall or spring. 4 credits max.
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 4970 Individual Study in Crop and Soil Sciences
Fall or spring. 1–6 credits. 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 4980 Teaching Experience in Crop and Soil Sciences
Fall or spring. 1–5 credits. 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. This course should not be taken by teaching assistants.

CSS 4990 Undergraduate Research
Fall or spring. Credit TBA. 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 6900 Scientific Method in Practice
Spring. 1 credit. Prerequisite: junior, senior, or graduate standing. H. G. Gauch, Jr., and G. W. Fick.
Students in this course study Hugh Gauch's book *Scientific Method in Practice*, which is designed to help scientists become better scientists through deeper understanding of common themes that extend across the disciplines. Topics include the history and philosophy of science, reliance on evidence, deductive and inductive logic, probability, parsimony, and hypothesis testing.

CSS 6950 Planning and Reporting Research
Summer, six-week session. 3 credits. P. Hobbs.
This course is designed to help graduate students improve their technical writing skills for various scientific outputs. Students will be guided through written output that includes review articles, scientific papers, thesis, research and funding proposals, manuscripts, and Power Point and slide presentations. The goal will be to increase proficiency in writing that will improve the chances of acceptance of research outputs in good quality, refereed publications. The students will also review ways to present data in tables and figures with proper statistical analysis. Professional ethics in the conduct and communication of science will also be covered. Much of the course will have students using their own research data in preparation of various good quality publications and outputs. Special attention will be given to M.P.S. students who need to complete a problem -olving or applied project.

CSS 6960 Agroecological Perspectives for Sustainable Development
Fall and spring. 1 credit. S–U grades only. L. Buck, L. Fisher, and P. Hobbs.
Agroecological perspectives for sustainable development.

CSS 6970 Seminar in Crop and Soil Sciences
Fall and spring. 1 credit. S–U grades only. H. van Es.
Covers current research and selected topics in the crop and soil sciences and related fields.

CSS 6980 Graduate Teaching or Extension Experience
Fall. 1–12 credits. S–U or letter grades. Staff.
Planning and teaching courses or extension programs under the supervision of departmental faculty. This may include lectures, laboratories, discussion sessions, workshops, in-service training events, etc.

CSS 7970 Graduate Individual Study in CSS
Fall and spring. 1–6 credits.

Crop Sciences

CSS 2110 Field Crop Systems
Fall. 4 credits. Prerequisite: none. Two to four field trips during lab periods (until 5 p.m. or on weekends). R. L. Obendorf.
Principles of field-crop growth, development and maturation, species recognition, soil and climatic adaptations, tillage systems, liming and mineral nutrition, cropping sequences, management systems, nutrition and health, and crop improvement are considered. Grain, protein, oil, fiber, biofuel and forage crops are emphasized. Laboratory utilizes living plants, extensive crop garden, and computer simulation.

CSS 3150 Weed Biology and Management
Fall. 4 credits. Prerequisite: introductory course in biology or botany. 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, crop-weed interactions, herbicide application, selectivity, and symptomology.

CSS 3170 Seed Science and Technology (also HORT 3170)
Fall. 3 credits. Prerequisite: BIOPL 2410 or equivalent. Two all-day field trips. Next offered 2011–2012. 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 4030 Traditional Agriculture in Developing Nations (also IARD 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 4050 Field Crop Systems
Fall. 4 credits. Prerequisite: none. Two to four field trips during lab periods (until 5 p.m. or on weekends). R. L. Obendorf.
Principles of field-crop growth, development and maturation, species recognition, soil and climatic adaptations, tillage systems, liming and mineral nutrition, cropping sequences, management systems, nutrition and health, and crop improvement are considered. Grain, protein, oil, fiber, biofuel, and forage crops are emphasized. Laboratory utilizes living plants, extensive crop garden, and computer simulation. Lab report and term paper on contemporary field crop systems required. Designed for professional students or advanced undergraduates. Credit for both CSS 4050 and CSS 2110 (or CSS 3110) not permitted.

CSS 4130 Physiology and Ecology of Yield
Spring. 3 credits. Prerequisites: coursework in plant physiology or molecular biology or biochemistry, or advanced plant science. T. L. Setter.
Study of processes involved in the conversion of solar energy into harvested plant products and environmental constraints on crop productivity. Topics include photosynthesis and essential processes that utilize photosynthetic energy, including nitrogen assimilation, phloem translocation and partitioning; canopy-scale influences on solar radiation use efficiency; regulation of growth processes in leaf, root, and floral/fruit/grain sinks in response to environment; seed and fruit set; water transport and stomatal regulation; root architecture and function, and behavior in water-limited situation. Examples will be from the full spectrum of crops and model-plant systems. Students will develop an ability to identify processes that could be improved through optimization of crop cultural practices or genetic change.

CSS 4140 Tropical Cropping Systems: Biodiversity, Social, and Environmental Impacts (also IARD 4140)
Fall. 3 credits. Prerequisite: introductory crop science or soil science or biology course or permission of instructor. 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 4260 Practicum in Forest Farming as an Agroforestry System (also HORT/NTRES 4260)
Fall. 2 credits. K. W. Mudge, L. E. Buck, and P. Hobbs.
For description, see HORT 4260.

CSS 4440 Integrated Pest Management (also ENTOM 4440)
Fall. 4 credits. Prerequisites: biology course or permission of instructor. J. E. Losey and A. DiTommaso.
For description, see ENTOM 4440.

CSS 4551–4555 Mineral Nutrition of Crops and Landscape Plants (also HORT 4551–4555)
Spring. 5 modules, 1 credit each. Next offered 2011–2012. Coordinator: H. C. Wien.
For description, see HORT 4551–4555.

CSS 6080 Water Status in Plants and Soils
Fall. 1 credit. Prerequisite: permission of instructor. S–U grades only. Next offered 2011–2012. T. L. Setter.
This is a lecture and lab course that introduces students to 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, soil water content analyzers, sap flow instrumentation, and abscisic acid analysis with ELISA.

[CSS 6100 Physiology of Environmental Stresses
Fall. 3 credits. Prerequisite: course work in plant physiology and/or plant molecular biology or permission of instructor. Next offered 2010–2011. T. L. Setter and O. Vatamaniuk.
Study of the responses of plants to environmental stresses, including drought, high temperature, salinity, chilling, freezing, 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 6120 Seed Biology
Fall. 3 credits. Prerequisite: plant physiology course or permission of instructor. 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 6140 Weed Ecology and Management
Spring. 3 credits. Prerequisite: CSS 3150 or equivalent. Next offered 2010–2011. A. DiTommaso.
Examination of plant ecological principles governing weed population dynamics and weed-crop competitive interactions in crop and noncrop ecosystems. Development of sustainable weed management strategies.]

[CSS 6420 Mineral Nutrition: From Plants to Humans (also BIOPL 6420)
Spring. 3 credits. Prerequisite: BIOPL 3410 or equivalent. Next offered 2010–2011. O. Vatamaniuk, L. V. Kochian, and R. M. Welch.
The course explores the molecular, biochemical, biophysical, and physiological mechanisms of acquisition, translocation, and utilization of mineral nutrients by plants for growth and development.]

CSS 6941 Special Topics in Crop Science
Fall or spring. 1–6 credits. 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 7910 Graduate-Level Thesis Research in Crop Science
Fall or spring. Credit TBA. S–U grades only. Graduate faculty.
Thesis research for Ph.D. students **before** "A" exam has been passed.

CSS 8900 Master's-Level Thesis Research in Crop Science
Fall or spring. Credit TBA. S–U grades only. Graduate faculty.
Thesis research for M.S. candidates.

CSS 9910 Doctoral-Level Dissertation Research in Crop Science
Fall or spring. Credit TBA. S–U grades only. Graduate faculty.
Dissertation research for Ph.D. candidates **after** "A" exam has been passed.

Environmental Information Science

CSS 3970 Environmental Microbiology (also BIOMI 3970)
Spring. 3 credits. Prerequisite: BIOMI 2900. Recommended: BIOEE 2610, NTRES 3030, or permission of instructor. Offered alternate even-numbered years. 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 4100 The GMO Debate: Science and Society
Spring. 3 credits. Prerequisite: BIOG 1109 or equivalent. J. Thies and P. Hobbs.
Biotechnology is causing global changes in agricultural production systems. Social movements have arisen to contest the adoption of transgenic or genetically modified organisms. Students will assess the science behind this debate and examine the interplay among science, society, and politics. We introduce the history of the GMO debate, how GMOs are developed, and their potential impacts on agriculture, the environment, and the food system. Social movements contest deployment of biotech products on grounds of food sovereignty, intellectual property,

social justice, and environmental and human health concerns. Scientific evidence is used in a variety of ways in these debates. We integrate concepts from diverse fields to promote understanding of how the use of scientific evidence in social and political contexts impacts the assessment of agricultural biotechnologies.

CSS 4110 Environmental Information Science (also CEE 4110)
Spring. 3 credits. Prerequisite: permission of instructor. S. DeGloria and S. Hoskins.
Survey of geo-spatial data and information applied to the science of natural and environmental systems. Experiential approaches emphasize use and integration of maps, spatial databases, aerospace imagery, field data, and the global positioning system (GPS) to discriminate, measure, inventory, and monitor agricultural and environmental resources and processes.

CSS 4200 Geographic Information Systems
Fall. 4 credits. Prerequisite: CSS 4110 or equivalent or permission of instructor. S. DeGloria.
Principles and applications of geographic information systems for characterizing and assessing agronomic and environmental systems. Emphasizes accessing, updating, analyzing, and mapping geo-spatial data and information. Considers information needs assessment; spatial data accession; coordinate systems; spatial database design, construction, and maintenance; modeling and analysis; map accuracy assessment; and digital cartography.

[CSS 4650 Global Positioning System
Spring, 3 hrs/wk. 1 credit. Prerequisite: CSS 4110 or 4200, or equivalent, or permission of instructor. S. DeGloria.
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 and mapping of geo-positional data.]

[CSS 6200 Spatial Modeling and Analysis
Spring. 3 credits. Prerequisites: CSS 4110 or CSS 4200, or equivalent or permission of instructor. Next offered 2011–2012. S. DeGloria.
Theory and practice of applying geo-spatial data for resource inventory and analysis, biophysical process modeling, and land surveys. Emphasizes use and evaluation of spatial analytical methods applied to agronomic and environmental systems and processes. Laboratory section is used to process, analyze, and visualize geo-spatial data of interest to the student.]

[CSS 6210 Applications of Space–Time Statistics
Spring. 2 credits. Prerequisite: BTRY 6010 or equivalent. S–U grades only. Offered alternate years; next offered 2010–2011. H. Van Es.
Introduction to space-time statistics with applications in agriculture and environmental management. Topics include geostatistics, temporal statistics, sampling, experimental design, state-space analysis, data mining, and fuzzy logic. Focuses on landscape-scale processes and a user's perspective.]

CSS 6600 Remote Sensing Fundamentals (also CEE 6100)
Fall. 3 credits. Prerequisite: permission of instructor. W. D. Philpot.
Introduction to the principles, equipment, and methods used in obtaining information about earth resources and the environment from aircraft or satellite sensors. Topics include basic interactions of electromagnetic radiation with the earth, sensors, sensor and ground-data acquisition, data analysis and interpretation, and project design in the form of a proposal to use remote sensing for a specific application.

CSS 6740 Environmental Genomics
Spring. 2 credits. D. Buckley.
Genomics opens new avenues for exploring interactions between oganisms and their environment. Through lectures and discussion of current research we will learn how genomic tools can provide insight on processes occurring at individual, population, and ecosystem scales that govern the response of biological systems to environmental change. Emphasis will be placed on microbial systems, but this course will also be useful to those interested in the other applications of environmental genomics. The course will provide students with experience in writing and reviewing grant proposals by culminating in the creation of the short research proposals to be reviewed by the class in the style of an NSF panel.

CSS 6750 Modeling the Soil-Plant-Atmosphere System (also EAS 6750)
Spring. 3 credits. Prerequisite: EAS/CSS 4830 or equivalent. 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 6943 Special Topics in Environmental Information Science
Fall or spring. 1–6 credits. 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 7920 Graduate-Level Dissertation Research in Environmental Information Science
Fall or spring. TBA. S–U grades only. Graduate faculty.
Dissertation research for Ph.D. students **before** "A" exam has been passed.

CSS 8910 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 9920 Doctoral-Level Dissertation Research in Environmental Information Science
Fall or spring. Credit TBA. S–U grades only. Graduate faculty.
Dissertation research for Ph.D. candidates **after** "A" exam has been passed.

Soil Science

CSS 1120 Microbes, the Earth, and Everything (also BIOMI 1120)
Fall. 3 credits. D. Buckley and E. Angert.
We live on a microbial earth. If we happen to consider microbes in our daily lives most people conjure images of disease, but in reality we depend on microbes to sustain our world. This course will showcase the vast microbial world that hides in plain sight all around us and use microbial examples to explore both fundamental biological principles and the scientific method. Course modules will emphasize basic concepts from: evolution, molecular biology and genetics, diversity, and ecology. Learn about the tiny titans and miniature monsters that are the life support system of our planet, how they have shaped human civilizations, and how they reveal the unifying principles of life.

CSS 2600 Soil Science
Fall. 4 credits. 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 3210 Soil Management for Sustainability
Spring. 2 credits. Prerequisites: CSS 2600 or equivalent. H. van Es, J. Lehmann, and J. Thies.
Integrated perspectives on the physical, biological, and chemical aspects of soil management in the broader context of agroecosystems. Understanding of the interactions between soil, water, organisms, and chemical inputs forms the basis for discussions on conventional and organic cropping systems, soil health, water quality and quantity, bioenergy, greenhouse gases, and sustainability. Lab sessions elaborate through case studies and discussion of current topics.

[CSS 3620 Soil Morphology
Fall, spring. 1 credit. Prerequisite: undergraduate standing. Recommended for sophomores and juniors. One all-day field trip required. Next offered 2010-2011. 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 3630 Soil Genesis, Classification, and Survey
Fall. 4 credits. Prerequisite: CSS 2600. 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 3650 Environmental Chemistry: Soil, Air, and Water
Spring. 3 credits. Prerequisites: CHEM 2070–2080 or CHEM 1560. M. B. McBride.
Overview of the chemistry of the biosphere and biogeochemical processes that control the fluxes, concentrations, and bioavailability of essential elements 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, with emphasis on behavior and properties of pollutants that pose the greatest risk to human and ecological health.

CSS 3720 Nutrient Management in Agroecosystems
Spring. 4 credits. Prerequisite: CSS 2600 or permission of instructor. Graduate students should enroll in CSS 4720. 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 4660 Soil Ecology (also HORT 4660)
Spring. 4 credits, with lab. Prerequisite: one year of biology or ecology and CSS 2600 or permission of instructor. J. E. Thies.
Discover the wonder of life underground. In this course, you will study the amazing diversity of soil organisms along with their multifaceted functions in terrestrial ecosystems. The fundamental principles and features of biologically mediated processes in the soil and the functions of soil biota in both managed and unmanaged ecosystems will be highlighted. Special topics include beneficial symbioses, biological control of plant pathogens, biogeochemistry of unique habitats, bioremediation and composting of organic wastes, among others. Laboratory focuses on molecular activities and traditional methods for assessing the abundance, activity, and diversity of soil organisms.

CSS 4720 Nutrient Management and Research in Agroecosystems
Spring. 4 credits. Prerequisite: CSS 2600 or permission of instructor. 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 expands knowledge in discussion groups and through oral as well as poster presentations. The laboratory experiments conclude with a final paper.

[CSS 4830 Land, Water, Agriculture, and Environment (also EAS 4830)
Fall. 3 credits. Prerequisites: CSS 2600 or equivalent, calculus. Next offered 2010–2011. H. van Es and S. J. Riha.
Discussion of energy and mass transfer in the soil-plant-atmosphere system, and their relevance to important environmental processes. Covers water, heat and gas flow, energy budgets, and nutrient dynamics. Discussion of management approaches to sustainable crop production, soil and water conservation, greenhouse gas mitigation, as well as research methods and instrument design for monitoring soil processes. Domestic and international perspectives are covered.]

[CSS 6630 Pedology
Spring. 3 credits. Prerequisite: CSS 3610 or permission of instructor. Next offered 2010–2011. 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 6660 Applied Plant–Microbe Interactions
Fall. 3 credits. Prerequisite: CSS 4660 or equivalent or permission of instructor. Offered alternate years. J. E. Thies.
Study and discussion course on the nature of microbial interactions with plant roots aimed at helping students improve their professional practice within the content area.

CSS 6690 Organic Matter—Soils, Sediments, and Waters
Spring. 3 credits. Prerequisites: CSS 2600 and CHEM 3570–3580 or equivalent. 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 6710 Soil Chemistry
Fall. 3 credits. Prerequisite: one year of physical chemistry or permission of instructor. 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 6720 Nutrient Cycling in Natural and Managed Ecosystems
Fall. 3 credits. Prerequisite: CSS 3720 or NTRES 3210 or BIOEE 4780, or permission of instructor. Next offered 2010–2011. J. Lehmann.
Examines the biogeochemistry and cycles of nutrients in terrestrial ecosystems, and the interface with the biosphere, atmosphere, and hydrosphere, using hands-on field experimentation and research proposals.]

[CSS 6840 Topics in Soil Microbial Ecology
Fall. 1 credit. Disc. S–U grades. Next offered 2010–2011. D. Buckley.
Seminar and discussion course dealing with current topics in soil microbial ecology, including community ecology and diversity, microbial biogeography, biogeochemistry, plant-microbe interactions, microbial feedbacks on plant communities, gene exchange and evolution in soils, soil microbial genomics, and relationships between structure and function of microbial communities in soil systems.]

CSS 6942 Special Topics in Soil Science
Fall, spring, or summer. 1–6 credits.
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 7900 Graduate-Level Dissertation Research in Soil Science
Fall or spring. Credit TBA. S–U grades only. Graduate faculty.
Dissertation research for Ph.D. students **before** "A" exam has been passed.

CSS 8920 Master's-Level Thesis Research in Soil Science
Fall or spring. Credit TBA. S–U grades only. Graduate faculty.
Thesis research for master's students.

CSS 9900 Doctoral-Level Dissertation Research in Soil Science
Fall or spring. Credit TBA. S–U grades only. Graduate faculty.
Dissertation research for Ph.D. candidates **after** "A" exam has been passed.

DEVELOPMENT SOCIOLOGY

M. J. Pfeffer, chair (133A Warren Hall, 255-1676); A. Basu, D. L. Brown, P. Eloundou-Enyegue, S. Feldman, J. D. Francis, C. C. Geisler, A. Gonzales, D. T. Gurak, T. A. Hirschl, F. Makki, P. D. McMichael, R. L. Mize, L. B. Williams

DSOC 1101 Introduction to Sociology (SBA) (KCM)
Fall or spring. 3 credits. Students may not take both DSOC 1101 and SOC 1101 for credit. Fall, T. Hirschl; spring, A. Gonzales.
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.

DSOC 1200 Development Sociology First-Year Writing Seminar (SBA)
Fall, spring. 3 credits. 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.

DSOC 2010 Population Dynamics (also SOC 2202) (SBA)
Spring. 3 credits. ALS students must enroll in DSOC 2010. S–U or letter grades. A. Basu and D. Brown.
This course provides an introduction to population studies. The primary focus is on the relationships between demographic processes (fertility, mortality, and immigration) and social and economic issues. Discussion will cover special topics related to population growth and spatial distribution, including marriage and family formation, population aging, changing roles and statuses of women, labor force participation, immigrations, urban growth and urbanization, resource allocation, and the environment.

DSOC 2050 International Development (also SOC 2206) (SBA) (HA)
Spring. 3 credits. 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.

DSOC 2070 Problems of Contemporary Society (also SOC 2070) (SBA)
For description, see SOC 2070.

DSOC 2090 Social Inequality (also SOC 2208) (SBA)
For description, see SOC 2208.

DSOC 2150 Introductory Organizations (also SOC 2150) (SBA)
For description, see SOC 2150.

DSOC 2200 Sociology of Health of Ethnic Minorities (also LSP 2200) (SBA) (D)
Fall. 3 credits. S–U or letter grades. 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.

DSOC 2201 Society and Natural Resources (also NTRES 2201) (SBA)
For description, see NTRES 2201.

DSOC 2220 Controversies About Inequality
For description, see SOC 2220.

DSOC 2650 Latinos in the United States (also SOC 2650, LSP 2010) (SBA)
For description, see SOC 2650.

DSOC 2750 Immigration and a Changing America (SBA) (HA)
Spring. 3 credits. S–U or letter grades. D. Gurak.
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.

DSOC 3010 Theories of Society and Development (SBA) (KCM)
Spring. 3 credits. Prerequisite: development sociology or sociology course. S–U or letter grades. F. Makki.
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.

DSOC 3050 Education, Inequality, and Development (SBA)
Spring. 3 credits. Prerequisite: introductory social science course or permission of instructor. Letter grades. P. Eloundou-Enyegue.
The main goal of this course is to examine the functions of education institutions, as they affect individual welfare, inequality, and development. It begins with a review of basic definitions and measures of education, inequality, and development, it then examines the individual and societal functions of education, from theoretical perspectives drawn from sociology, economics, and demography. The insights from these various perspectives are examined critically. The course also reviews studies that have examined how investments in education appear to affect selected outcomes.

DSOC 3060 Farmworkers: Contemporary Issues and Their Implications (SBA)
Fall. 1 credit. S–U or letter grades. M. J. Dudley.
Introduction to contemporary issues of farmworkers in the United States. Examines issues related to unauthorized immigrant workers, farmworker demographics, farmworker access to health services, labor concerns, farmworker needs, and integration into new home communities. Will include guest lectures by faculty members from throughout the university currently engaged in related research.

DSOC 3130 Social Indicators and Introduction to Social Science Research (SBA)
Spring. 3 credits. P. Eloundou–Enyegue.
This course is an introduction to social science research. It reviews the general process through which social scientists derive credible answers to important questions about social change and social influences on individual behavior. It covers all steps in the research process, from the formulation of a research question to the final presentation of findings. The course is designed as a preparation for future work in social science research, but it is also intended for students who simply want to sharpen their capacity to evaluate the claims made by researchers. The course combines theory and application. A real-life research project on campus is used to apply the concepts and ideas from the textbook and lectures.

DSOC 3140 Spatial Thinking, GIS, and Related Methods (SBA) (KCM)
Fall. 4 credits. Letter grades only. J. Francis.
Everything occurs in space. Knowing where organizations are located and events occur in space provides clues to understanding social order and processes not revealed by traditional social analysis techniques. At the same time, spatial thinking and methods are becoming increasingly used in the social sciences. The purpose of this course is to introduce the undergraduate to both aspects of spatial patterns, trends, and themes but also to methodologies for bringing spatial considerations into their research. The course will provide a practical introduction to GIS via lab assignments.

DSOC 3240 Environment and Society (also STS 3241, SOC 3240) (SBA)
Spring. 3 credits. G. Gillespie.
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.

DSOC 3290 Latin American Politics, Economy, and Society (also GOVT 3992, LATA 3290)
Spring. 3 credits. Prerequisite: introductory sociology recommended. S–U or letter grades. G. Flores-Macias.
This course is designed as an introduction to political, economic, and social issues in 20th-century Latin America. In the first section of the course the region is analyzed through a political lens, focusing on issues including state formation, populism and corporatism, revolutions, the breakdown of democracy, military rule, and democratization. We then turn to issues under the heading of economic perspectives including dependency theory, import-substitution industrialization, the debt crisis, market reform, and the period of the post-Washington Consensus. The third section of the course presents a selection of the region's

central social issues including class structures, civil-military relations, church-state relations, social movements, and both internal and international migration. Throughout the semester, we will make reference to specific countries to illustrate each topic. Knowledge of Spanish or Portuguese is not required.

[DSOC 3311 Environmental Governance]

DSOC 3360 Rural Areas in Metropolitan Society (SBA)
Spring. 3 credits. Prerequisite: social science course. 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.

DSOC 3400 Agriculture, Food, and Society (SBA) (KCM)
Fall. 3 credits. S–U or letter grades. G. W. Gillespie.
Changing food and agricultural systems reflect the development patterns and social organization of an increasingly global society. Sociological questions include: What are major trends? What drives them? What benefits and costs accrue to people, communities, and ecosystems? How can we evaluate issues in such a way as to promote problem-solving? What development strategies might better manifest shared values?

DSOC 3550 Latinos, Law, and Identity (also LSP/AMST 3550) (SBA)
Fall. 3 credits. Prerequisite: DSOC 1101 or permission of instructor. R. Mize.
Critical exploration of the critical justice movement and Latina/o identities. Legal cases, federal and state laws, and constitutional issues that impact Latina/os residing in U.S. highlighted. Theoretical contributions of law and society, critical race theory, LatCrit, and outsider jurisprudence perspectives applied to precedent-setting cases and current attempts at marginalizing/empowering Latina/o communities.

DSOC 3700 Comparative Social Inequalities (also SOC 3710) (SBA)
Fall and spring. 3 credits. Prerequisite: introductory social science course. Fall, R. Mize; spring, T. Hirschl.
Reviews both classical and contemporary issues in the comparative study of social inequality. Employing a global perspective, the course examines various relations of inequality—in the labor market and the reorganization of work and employment and in relation to questions of difference—of race, gender, ethnicity, sexuality, and ability—as these pattern unequal access to resources, differentially provide economic and social security, and shape life chances and lived experiences. Throughout the course special attention is given to the importance of understanding patterns of change in relation to the reconfiguration of global production, consumption, and migration.

DSOC 3750 Comparative U.S. Racial and Ethnic Relations (also AMST/LSP 3750) (SBA) (HA)
Spring. 3 credits. Prerequisite: DSOC 1101 or permission of instructor. Letter grades only. R. L. Mize.
A 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.

DSOC 4100 Health and Survival Inequalities (also SOC 4100) (SBA)
Fall. 4 credits. Letter grades only. A. Basu.
Historical inequalities in health and survival continue to exist today. This course will cover some of the markers of such inequalities, including region, class, race, gender, and age and examine some of the biological, socioeconomic, and political determinants of these differences. Macro as well as individual and family level determinants will be examined. Policy prescriptions will be evaluated and new innovative approaches proposed.

DSOC 4210 Theories of Reproduction (also SOC 4210) (SBA)
Spring. 4 credits. Letter grades only. A. Basu.
Examines the contentious debate of what makes women have any, few, and many children. It covers theories of population growth and changing fertility in both historical and contemporary populations. Demographic concepts like "the demographic transition" and "natural fertility" are discussed. Primary attention is given to "sociocultural" and "gender-based" explanations of reproductive behavior. The course also looks at theories about the place of the state in women's lives.

DSOC 4300 Human Migration: Internal and International (SBA)
Fall. 3 credits. S–U or letter grades. D. Brown.
This course analyzes the determinants and consequences of internal and international migration in developed and developing nations. Multilevel and multidisciplinary approaches are emphasized. Public policy implications of the volume and composition of migration for origin and destination communities are examined. Techniques and measurement issues are discussed.

[DSOC 4320 Environmental Strategies]

DSOC 4380 Population and Development (also DSOC 6380, SOC 4370) (SBA)
Spring. 3 credits. 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 prior to, during, and following the onset and conclusions of the demographic shifts. Case studies from diverse historical periods and geographic locations are used. Graduate students also meet with the instructor every other week to discuss graduate readings and topics relevant to their papers.

DSOC 4630 Islam in Africa and Its Diaspora
For description, see ASRC 4630.

DSOC 4810 Global Conflict and Terrorism (SBA) (KCM)
Spring. 3 credits. C. Geisler.
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.

DSOC 4940 Special Topics in Development Sociology (SBA)
Fall or spring. 4 credits max. S–U or letter grades.
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.

DSOC 4960 Internship in Development Sociology
Fall and spring. 1–3 credits. Prerequisite: permission of student's advisor in advance of participation in internship program. Staff.
Students must register using individual study form (available in 140 Roberts Hall) signed by faculty member who will supervise study and assign grade. All 4960 internship courses must adhere to the CALS guidelines on the web site at www. cals.cornell.edu/cals/current/student-research/internship/index.cfm.

DSOC 4970 Independent Study in Development Sociology (SBA)
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 or letter grades.
Informal study may include a reading course, research experience, or public service experience.

DSOC 4991 Independent Honors Research in Social Science (SBA) (KCM)
Fall and spring. 1–6 credits; 6 credits max. may be earned in honors program. Prerequisite: requirements for honors program met. A. Gonzales.
Students should select a faculty advisor 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.

DSOC 5600 Analytical Mapping and Spatial Modeling (also CRP 6290) (SBA) (KCM)
Fall. 4 credits. Prerequisite: one course in statistics. J. Francis.
The goal of this course is to introduce students in the social sciences and related fields to geographic information systems and spatial statistics as a set of tools to complement traditional analysis methods. Spatial relationships have become increasingly recognized as important in

socioeconomic, political, and demographic analysis. Recent research in these fields has demonstrated that understanding spatial relationships, in addition to other factors that account for differences and similarities between people and organizations, significantly increase our explanatory power. The first part of the course focuses on various features of GIS that are most useful to social scientists in their endeavors. The second part of the course introduces spatial statistics that further this understanding as well as control for spatial autocorrelation when it exists.

DSOC 6001 The Empirics of Development and Social Change (SBA)
Spring. 3 credits. Prerequisite: graduate standing. P. Eloundou-Enyegue.
The purpose of this course is to review, critique, and apply several analytical approaches for measuring and explaining societal change. As such, it serves as a complement to theories of development. More broadly, the course critically examines the empirical record on global development, drawing from several methodological approaches, both quantitative and qualitative.

DSOC 6030 Classical Sociological Theory
Fall. 4 credits. Prerequisite: graduate students only. 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.

DSOC 6060 Sociological Theories of Development
Spring. 3 credits. Prerequisite: DSOC 6030 or permission of instructor. F. Makki.
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.

DSOC 6080 Demographic Techniques (also PAM 6060)
Spring. 3 credits. Prerequisite: multivariate statistics or permission of instructor. S–U or letter grades. D. Lichter.
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.

[DSOC 6150 Qualitative Research Methods]

DSOC 6170 Foundations in Social Research: Comparative Epistemologies
Fall. 3 credits. Letter grades only. G. Menon.
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.

DSOC 6190 Quantitative Research Methods
Spring. 4 credits. Prerequisite: statistics course. Letter grades only. D. Gurak.
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.

[DSOC 6200 Sociology of the Community (SBA)]

DSOC 6210 Foundations of Environmental Sociology (SBA)
Fall. 3 credits. Graduate students only. C. Geisler.
Foundations of environmental sociology provide graduate students with a broad survey of the literature in this disciplinary specialty area. Students review the history of thought in environmental sociology as well as key literature in the various substantive foci of this specialty. The principle objective of this course is to provide graduate students specializing in environmental sociology with a firm grasp of the content, controversies, and trends in the area. Sessions are conducted in a seminar style, and discussions are focused on close review of assigned readings.

[DSOC 6250 State, Economy, and Society (SBA) (HA)]

DSOC 6300 Human Migration: Internal and International (also DSOC 4300)
For description, see DSOC 4300.

[DSOC 6320 Environmental Governance]

DSOC 6380 Population and Development (also DSOC 4380)

[DSOC 6400 Community and Changing Property Institutions (SBA)]

DSOC 6630 Islam in Africa and Its Diaspora
For description, see ASRC 4630.

DSOC 6940 Special Topics in Development Sociology
Fall or spring. 4 credits max. Prerequisite: graduate standing. S–U or letter grades.
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.

[DSOC 7001 The Historical Sociology of Modernity (KCM) (HA)
Fall. 3 credits. Graduate students only. F. Makki.
The notion of modernity as a postulated relationship between social change and institutional form, and as a conceptual schema for making sense of large-scale social transformations, supplies the deep structure for much present-day social theory. Conceived as a uniquely European phenomenon that spread to the rest of the world through the impact of colonial empires and the world market, it also provides the normative framework for contemporary theories of development. This conception of modernity, and the meta-theory that legitimates it, has increasingly been the subject of heated controversy. In this course, we will explore the distinct debates that animate this field of historical sociology, alternating between substantive historical studies and critical analysis of how these studies are shaped by the adoption of particular epistemologies.]

DSOC 7190 Advanced Regression and Spatial Statistics (SBA) (KCM)
Spring. 4 credits. Prerequisite: graduate students or permission of instructor and two courses in statistics and one in methods. J. Francis.
This course will cover two topics, logistic regression and spatial linear regression. The course opens with a brief review of multiple regression theory and procedures. Then a little more than half the semester is devoted to logistic regression modeling. Spatial linear regression will be covered in five weeks of the semester. As both of these techniques are based on maximum likelihood procedures, some time will be devoted to an overview of maximum likelihood procedures.

DSOC 7250 Theories of State, States of Theory (SBA)
Fall. Graduate students only. S. Feldman.
This course 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.

DSOC 7300 Sociology of Global Change (SBA)
Spring. 3 credits. Graduate students only. P. 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). The 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.

DSOC 7600 Environment and Social Transitions: Graduate Seminar in Environmental Sociology (also NTRES 7600)
Spring or fall. 3 credits. Graduate Students Only. Graduate faculty.
Graduate seminar on advanced sociology-of-environment themes. We seek to focus analysis on contemporary socioecological transitions and their implications, theoretical and applied. Attention will be directed toward ecological, social, political, and technological dimensions of policy regimes, conventions, and governance. The seminar aims to understand and advance social science responses to prevailing paradigms in domains of conservation, energy, climate, agriculture, and natural resource conservation; the emphasis will rotate according to year and instructor.

DSOC 7900 Graduate-Level Thesis Research
Fall or spring. Credit TBA. Prerequisite: DSOC graduate standing and permission of instructor. S–U or letter grades. Graduate faculty.
Thesis research for Ph.D. students **only before** "A" exam has been passed.

DSOC 7910 Teaching Experience
Fall or spring. 1–3 credits. Prerequisite: DSOC graduate standing. S–U grades only. Graduate faculty.
Participation in the ongoing teaching program of the department.

DSOC 8720 Development Sociology
Prerequisite: master's and doctoral degree candidates, permission of graduate field member concerned. S–U or letter grades. Graduate faculty.

DSOC 8900 Master's-Level Thesis Research
Fall or spring. Credit TBA. Prerequisite: DSOC graduate standing and permission of instructor. S–U or letter grades. Graduate faculty.
Thesis research for master's students.

DSOC 9900 Doctoral-Level Thesis Research
Fall or spring. Credit TBA. Prerequisite: DSOC graduate standing and permission of instructor. S–U or letter grades. 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 2050)

Gender Relations, Gender Ideologies, and Social Change (FGSS 5240)

EARTH AND ATMOSPHERIC SCIENCES

L. D. Brown, chair (2116 Snee Hall, 255-6346); A. T. DeGaetano, assoc. chair; director of undergraduate studies: J. L. Cisne (Science of Earth Systems); M. W. Wysocki (Atmospheric Science), R. W. Allmendinger, W. D. Allmon, C. Andronicos, L. M. Cathles, S. J. Colucci, L. A. Derry, M. Goman, C. H. Greene, D. L. Hysell, T. E. Jordan, R. W. Kay, S. Mahlburg Kay, R. Lohman, N. Mahowald, B. Monger, A. Moore, J. Phipps Morgan, M. Pritchard, S. J. Riha, W. M. White, D. S. Wilks

General Courses

EAS 1150 Severe Weather Phenomena
Summer. 3 credits. S–U or letter grades. M. W. Wysocki.
A description of the structure of the Earth's atmosphere and forces that govern its motion will be presented and then applied to understanding the aspects of severe weather including snowstorms/lake effect snow, windstorms, tornadoes, thunderstorms, tropical cyclones, El Niño, floods, drought, and heat waves.

EAS 1400 Freshman Writing Seminar "Writing in the Sciences: Environmental Perspectives"
Spring. 3 credits. S. Jessup.
This course is a Freshman Writing Seminar in which students examine interactions between humans and the natural environment from individual, societal, and scientific perspectives. Readings include a brief historical survey of humanity's role within the natural world and short readings about current environmental issues. Includes a research project where each student explores a current environmental issue.

EAS 2900 Computer Programming and Meteorology Software
Spring. 3 credits. Prerequisites: EAS 1310; MATH 1110 or equivalent. N. Mahowald and B. Belcher.
Introduction to Fortran computer programming and visual software packages specifically tailored for meteorological application usage. Topics include basic FORTRAN 90 programming (this includes problem analysis, algorithm development, and program writing and execution), data manipulation, and instruction in the use of GrADS, and GEMPACK visual display tools.

EAS 4960 Internship Experience
Fall or spring. 1–2 credits. S–U grades only. Staff. See individual units for requirements.
All 4960 internship courses must adhere to the CALS guidelines at www.cals.cornell.edu/cals/current/student-research/internship/index.cfm.

EAS 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 1310 Basic Principles of Meteorology
Fall. 3 credits. 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 1330.

EAS 1330 Basic Meteorology Lab
Fall. 1 credit. Corequisite: EAS 1310. M. W. Wysocki.
This course is required for atmospheric science majors but is optional for other students taking EAS 1310.

EAS 1340 Weather Analysis and Forecasting
Spring. 1 credit. Prerequisites: EAS 1310 and EAS 1330. S–U grades only. M. W. Wysocki and staff.
This course will serve as an extension of the EAS 1330 first-year majors lab. It will provide opportunity for formal weather briefings, explore specific atmospheric storms (synoptic and mesoscale, including the climatology of each storm type), through assigned readings, map analysis, and weather discussions.

EAS 2500 Meteorological Observations and Instruments
Fall. 4 credits. Prerequisite: EAS 1310. M. W. Wysocki.
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.

EAS 2680 Climate and Global Warming
Spring. 3 credits. Prerequisite: basic college math. S–U or letter grades. 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. Readings focus on recent scientific findings related to climate change.

EAS 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: undergraduate 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 3050 Climate Dynamics
Fall. 3 credits. Prerequisites: two semesters of calculus and one semester of physics. N. Mahowald.
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 3340 Microclimatology
Spring. 3 credits. Prerequisite: physics course. D. S. Wilks.
The relationship of radiant energy, temperature, wind, and moisture in the atmosphere near the ground. The interplay between physical processes of the atmosphere, plant canopies, and soil is examined with emphasis on the energy balance.

EAS 3410 Atmospheric Thermodynamics and Hydrostatics
Fall. 3 credits. Prerequisites: one year of calculus and one semester of physics. 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 3420 Atmospheric Dynamics (also ASTRO 3342)
Spring. 3 credits. Prerequisites: familiarity with multivariate calculus (e.g., MATH 2930, 2130, or 2220 or equivalent); one semester of university physics. Staff.
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 3520 Synoptic Meteorology I
Spring. 3 credits. Prerequisite: EAS 3410. Corequisite: EAS 3420. 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 4350 Statistical Methods in Meteorology and Climatology
Fall. 3 credits. Prerequisites: one introductory course each in statistics (e.g., AEM 2100) and calculus. 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 4470 Physical Meteorology
Fall. 3 credits. Prerequisites: one year each of calculus and physics. Offered alternate years. A. T. DeGaetano.
Primarily a survey of natural phenomena of the atmosphere, with emphasis on their underlying physical principles. Topics include an introduction to atmospheric radiation processes; atmospheric optics and electricity; microphysical cloud processes; and principles of radar probing of the atmosphere.

EAS 4510 Synoptic Meteorology II
Fall. 3 credits. Prerequisites: EAS 3410 and 3420. 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 4560 Mesoscale Meteorology
Spring. 3 credits. Prerequisites: EAS 3410 and 3420 or permission of instructor. S. J. Colucci.
Structure and dynamics of midlatitude mesoscale weather systems such as fronts, jets, squall lines, convective complexes, precipitation bands, downslope windstorms, mountain breezes, seas breeze circulations, and lake effect snowstorms. The course also considers tropical weather systems and mesoscale modeling.

[EAS 4570 Atmospheric Air Pollution
Fall. 3 credits. Prerequisites: EAS 3410 or one course in thermodynamics, and one semester of chemistry, or permission of instructor. Offered alternate years; next offered 2010–2011. M. W. Wysocki.]

EAS 4700 Weather Forecasting and Analysis
Spring. 3 credits. Prerequisites: EAS 3520 and 4510. 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 4800 Our Changing Atmosphere: Global Change and Atmospheric Chemistry (also BEE 4800)
Fall. 3 credits. Prerequisites: CHEM 2090, MATH 1920, PHYS 1112 or equivalent, or permission of instructor. S–U or letter grades. P. G. Hess.
For description, see BEE 4800.

EAS 4820 Atmospheric Modeling
Spring. 3 credits Prerequisite: differential equations, introductory computer background, junior standing or above or permission of instructor. N. Mahowald.
Climate and numerical weather prediction models are important tools for policy and science. This course describes the basic principle of the numerics in these models, including dynamical cores and subgrid-parameterization. Included will be a discussion of evaluation of models and effective presentation of model results.

[EAS 4830 Land, Water, Agriculture, and Environment (also CSS 4830)
Fall. 3 credits. Next offered 2010–2011. H. van Es and S. J. Riha.
For description, see CSS 4830.]

EAS 4840 Inverse Methods in the Natural Sciences
Fall. 3 credits. Prerequisites: MATH 2940. D. L. Hysell.
An exploration of solution methods for inverse problems with examples taken from geophysics and related fields, with particular attention to making inferences from inaccurate, incomplete, or inconsistent physical data. Applications include medical and seismic tomography, earthquake location, image processing, and radio/radar imaging. Linear algebra (including condition numbers) and probability and statistics (including error analysis, Bayes theorem, Gibbs distribution, and Markov chains) will be reviewed. Methods to be covered include nonlinear least-squares, maximum likelihood methods, and local and global optimization methods, including simulated annealing and genetic algorithms.

EAS 4870 Introduction to Radar Remote Sensing (also ECE 4870)
Spring. 3 credits. Prerequisite: PHYS 2208 or 2213 or equivalent, or permission of instructor. 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 4940 Special Topics in Atmospheric Science (undergraduate level)
Fall or spring. 8 credits max. 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. The same course is not offered more than twice.

EAS 4970 Individual Study in Atmospheric Science
Fall or spring. 1–6 credits. S–U grades only. 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 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 5050 Fluid Dynamics in the Earth Sciences
Spring. 3 credits. Prerequisites: MATH through 2940, PHYS through 2208 or 2214, or permission of instructor.
L. Cathles and M. Wysocki.
The Earth System provides many fascinating examples of fluid dynamics phenomena that are also of societal importance. Turbulent convection in the outer core generates the earth's magnetic field. The viscous mantle (outer half of the Earth) is slowly but vigorously convecting, and consequently the Earth's surface is dynamic. Viscosity is not important in the oceans and atmosphere, but the flow there is fast enough for the rotation of the Earth to become to dominant control. Electromagnetic effects again dominate in the solar wind and magnetosphere. This course will investigate the Earth using fluid dynamics. For students in the Earth sciences it will provide an opportunity to learn the insights that can be provided by fluid dynamics. For students who know fluid dynamics from other fields it will provide some spectacular applications and an opportunity to learn about the Earth system in a different and unusually fundamental way.

[EAS 5750 Planetary Atmospheres (also ASTRO 6575)
Fall. 4 credits. Next offered 2010–2011.
P. Gierasch.
For description, see ASTRO 6575.]

EAS 5840 Inverse Methods in the Natural Sciences
Fall. 3 credits. Prerequisite: MATH 2940.
D. L. Hysell.
An exploration of solution methods for inverse problems with examples taken from geophysics and related fields, with particular attention to making inferences from inaccurate, incomplete, or inconsistent physical data. Applications include medical and seismic tomography, earthquake location, image processing, and radio/radar imaging. Linear algebra (including condition numbers) and probability and statistics (including error analysis, Bayes theorem, Gibbs distribution, and Markov chains) will be reviewed. Methods to be covered include nonlinear least-squares, maximum likelihood methods, and local and global optimization methods, including simulated annealing and genetic algorithms. Students in EAS 5840 will be expected to complete and present a substantial class project to be negotiated with the instructor.

EAS 6480 Air Quality and Atmospheric Chemistry (also MAE 6480)
Fall. 3 credits. Prerequisites: freshman chemistry, fluid mechanics or equivalent, thermodynamics. S–U or letter grades.
K. M. Zhang.
Factors determining air quality and effects of air pollutants on public health, ecological systems and global climate change.

[EAS 6520 Advanced Atmospheric Dynamics (also ASTRO 7652)
Spring. 3 credits. Prerequisites: EAS 3410 and 3420 or equivalents. Next offered 2010–2011. S. J. Colucci.
Covers quasigeostrophic theory, atmospheric waves, hydrodynamics instability, 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 6660 Applied Multivariate Statistics
Spring. 3 credits. Prerequisites: multivariable calculus, matrix algebra, two statistics courses. Offered alternate years; next offered 2010–2011. D. S. Wilks.]

EAS 6750 Modeling the Soil–Plant–Atmosphere System (also CSS 6750)
Spring. 3 credits. Prerequisite: EAS/CSS 4830 or equivalent. 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. Discuses use of soil-plant-atmosphere models for teaching, research, extension, and policy formation.

EAS 6920 Special Topics in Atmospheric Science
Fall or spring. 1–6 credits. S–U or letter grades. 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 7110 Upper Atmospheric and Space Physics
Fall or spring. 1–6 credits. Seminar course.
D. L. Hysell.

EAS 8500 Master's-Level Thesis Research in Atmospheric Science
Fall or spring. Credit TBA. S–U grades only. Graduate faculty.
Thesis research for atmospheric science master's students.

EAS 9500 Graduate-Level Dissertation Research in Atmospheric Science
Fall or spring. Credit TBA. S–U or letter grades. Graduate faculty.
Dissertation research for atmospheric science Ph.D. students only *before* "A" exam has been passed.

EAS 9510 Doctoral-Level Dissertation Research in Atmospheric Science
Fall or spring. Credit TBA. S–U or letter grades. Graduate faculty.
Dissertation research for atmospheric science Ph.D. candidates *after* "A" exam has been passed.

Science of Earth Systems

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 3400, 3220, and 3510. 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. For further information on the EES program see www.geo.cornell.edu/geology/classes/hawaii/course.html.

EAS 1101 Introductory Geological Sciences (To Know Earth)
Fall. 3 credits. C. Andronicos and R. Allmendinger.
Designed to enhance an appreciation of the physical world for nonscientists and science majors. 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.

EAS 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 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 1190 Fossil Preparation
Fall, 1 credit. Prerequisite: EAS 1109 or related EAS course. W. Allmon and J. Cisne.
Hands-on experience in the preparation and curation of fossils in laboratories at the Paleontological Research Institution (PRI). Students provide own transportation to the Museum of the Earth via public transit or other means. Activities include preparation and study of vertebrate, invertebrate, and plant specimens; sorting of bulk material such as field collections and mastodon dung, and curation of prepared specimens.

EAS 1220 Earthquake! (also ENGRI 1220)
Spring. 3 credits. L. D. Brown.
Explores the science of natural hazards, their societal impacts, and means of mitigation. The focus is on earthquakes, volcanoes and tsunami, but hurricanes, severe weather, climate change, landslides, wildfires and the threat of extinction from a future impact by an extraterrestrial body are also considered.

EAS 1540 Introductory Oceanography—Lecture (also BIOEE 1540)
Fall, summer. 3 credits; optional 1-credit lab offered as EAS/BIOEE 1550. S–U or letter grades. Fall: C. H. Greene and B. Monger; summer: B. 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 1550 Introductory Oceanography—Laboratory (also BIOEE 1550)
Fall. 1 credit. Corequisite: EAS/BIOEE 1540. B. Monger and C. H. Greene.
Laboratory course covering topics presented in EAS/BIOEE 1540.

EAS 1551 Introduction to Oceanography Lab (also BIOSM 1151)
Summer. 1 credit. Prerequisite: college-level science course, or EAS 1540, or marine science course or permission of instructor. B. Monger and C. Greene.
For description, see BIOSM 1151.

EAS 1700 Evolution of the Earth and Life
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 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), on Appledore Island in the Gulf of Maine. For more details, including estimated cost and an application, contact SML office, G14 Stimson Hall, or visit www.sml.cornell.edu.

EAS 2200 The Earth System
Fall, spring. 4 credits. Prerequisites: MATH 1110/1910. Letter grades only. W. M. White and A. Moore.
An integrated introduction to the earth system stressing the biological, chemical, geological, and physical interactions among the atmosphere, ocean, and solid earth. Topics will include biogeochemical cycles, climate dynamics, and the evolution of the atmosphere, biosphere, cryosphere (ice), hydrosphere (oceans and inland waters), and lithosphere (solid earth).

EAS 2220 Seminar: Hawaii's Environment
Fall. 1 credit. S–U grades only. A. Moore.
A seminar for students interested in the unique environmental systems of the Hawaiian Islands. This course is designed to bring together students returning from field studies in Hawaii with students interested in going there to study. Through reading and discussion we will explore the geology, biology, ocean, atmosphere, and culture of the Hawaiian environment.

EAS 3010 Evolution of the Earth System
Fall. 4 credits. Prerequisites: EAS 2200, MATH 1110 or 1910 and one course in chemistry (college or high school) Two Sat field trips. T. Jordan, S. Riha, and W. Allmon.
Life activities alter the physical and chemical environment and are altered by that environment. This interaction over very long times constitutes a co-evolution of earth and life. Course uses modern systems, tens of thousand year old systems, and hundreds of million year old systems to illustrate principles, methods of reconstructing deep history, and the context of natural change inherent to life and earth.

EAS 3030 Introduction to Biogeochemistry (also NTRES 3030)
Fall. 4 credits. Prerequisites: CHEM 2070 or equivalent, MATH 1120, and biology and/or geology course. 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 3040 Interior of the Earth
Spring. 3 credits. Prerequisite: EAS 2200 or permission of instructor. C. Andronicos.
This class will investigate the geology of the solid earth with emphasis on igneous and metamorphic petrology, structure of the continents and ocean basins, and large-scale tectonics. Interaction between deformation, melt generation, and metamorphism will be examined as mechanisms by which the crust is differentiated from the underlying mantle. Geophysical and geochemical techniques for probing the deep interior of the earth will be investigated. Plate tectonics will be used as a unifying theme to understand processes operating in the solid earth.

EAS 3060 Evolution of Ancient and Modern Oceans (also BIOSM 3060)
Summer. 6 credits. Prerequisites: introductory biology (two semesters) and college-level course in Earth science, or permission of instructor. W. Allmon.
For description, see BIOSM 3060.

EAS 3220 Biogeochemistry of the Hawaiian Islands
Spring. 4 credits. Prerequisites: enrollment in EES semester in Hawaii; EAS 2200, EAS 3030 or permission of instructor. L. A. Derry.
A field-oriented study biogeochemistry course held on the island of Hawaii. 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 3400 Field Study of the Earth System
Spring. 6 credits. Prerequisites: enrollment in EES Semester in Hawaii, one semester of calculus (MATH 1910/1920 or 1110/1120), and two semesters of any of the following: PHYS 2207/2208 or 1112/2213; CHEM 2070/2080 or 2090/2080; BIOG 1101/1103–1102/1104 or 1105/1106 or 1109/1110 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 3500 Dynamics of Marine Ecosystems (also BIOEE 3500)
Fall. 3 credits. Prerequisites: one year of calculus and one semester of oceanography (i.e., BIOEE/EAS 1540) or permission of instructor. Offered alternate years. C. H. Greene and R. W. Howarth.
Lecture course covering the interactions of physical and biological processes in marine ecosystems.

EAS 3510 Conservation Oceanography (also BIOEE 3510)
Spring. 4 credits. Prerequisite: EAS 3400. Recommended: oceanography course. C. H. Greene 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 works 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 3530 Physical Oceanography
Fall. 3 credits. Prerequisites: MATH 1120 or 1920, or one year of physics, or permission of instructor. Offered alternate years. B. Monger.
The course covers thermohaline and wind-driven circulation and surface-ocean boundary-layer dynamics. Mathematical expressions for describing conservation of momentum, mass, and heat in a fluid are used to explain the ocean's responses to wind and buoyancy forcing.]

EAS 4010 Fundamentals of Energy and Mineral Resources
Fall. 3 credits. Recommended: previous course in geology. L. Cathles.
The Earth's energy and mineral resources reflect some of the most important changes and dramatic events that have punctuated earth history. Course provides an overview of resource types in the context of the Earth's atmospheric evolution, rifting, mantle convection, and hydrologic cycle. The processes of resource accumulation are described in terms of simple chemical and physical principles and in the societal

contexts of supply, demand, and sustainability.

[EAS 4040 Geodynamics
Spring. 3 credits. Prerequisite: calculus and calculus-based physics courses or permission of instructor. Offered alternate years; next offered 2010–2011. 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 4050 Active Tectonics
Spring. 3 credits. Recommended: mechanical background equivalent to EAS 4260/4880. Offered alternate years. R. Lohman.
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 4060 Marine Geology and Geophysics
Spring. 4 credits. Prerequisite: EAS 2200 or comparable courses. Recommended: completion of some EAS classes. Offered alternate years. J. Phipps-Morgan.
This course will use geological, geochemical, and geophysical approaches to explore the geology of the ocean floor. We will begin by discussing in depth the mid-ocean ridge system where the basaltic seafloor is created by plate spreading. This complex system involves a rich interplay of volcanism, hydrothermal flow, mantle flow, and lithosphere deformation, and is responsible for both the architecture of the ocean crust and the chemical composition of seawater. After this, we will discuss the evolution of the seafloor during its residence at Earth's surface. We end up by discussing the complex faulting, melting, and fluid flow processes at subduction zones where seafloor is transmuted into mantle and crust. There will be a lab section focusing on the use of GMT to make maps of relevant geological and geophysical information.]

EAS 4170 Field Mapping in Argentina
Summer. 4 credits. Prerequisite: introductory EAS course and EAS 4260 or EAS 3040. S. Mahlburg Kay.
Field mapping course in Argentina that fulfills field requirement for majors with interests in geological sciences and provides a field geological experience for others. Course consists of lectures in Buenos Aires followed by field exercises in the Sierras Pampeanas, Precordillera, and Main Cordillera Ranges of the Argentine Andes in the provinces of San Juan and Mendoza. A variety of exercises use modern techniques in the field mapping of a broad range of variably deformed sedimentary, metamorphic, and igneous rocks. The course further provides an introduction to the tectonics and magmatic processes of the central Andes with emphasis on comparable processes in the United States. Exercises are done in combination with students and faculty of the University of Buenos Aires.

[EAS 4250 European Discovery of Impacts and Explosive Volcanism
Spring. 2 credits. Prerequisite: junior, senior, or graduate students with background in geology and permission of instructor. Letter grades only. Meets one day per week plus field trip during spring break. Fee probably charged for required weeklong field trip. Offered alternate years; next offered 2010–2011. J. Phipps Morgan.]

EAS 4260 Structural Geology
Spring. 4 credits. Prerequisite: one semester of calculus plus introductory geology course, or permission of instructor. One weekend field trip. C. Andronicos.

[EAS 4340 Exploration Geophysics
Fall. 3 credits. Prerequisites: MATH 1920 and PHYS 2208, 2213, or equivalent. Offered alternate years; next offered 2010–2011. L. D. Brown.
Fundamentals of subsurface imaging by geophysical methods as used in oil exploration and environmental investigations.]

EAS 4370 Geophysical Field Methods (also ARKEO 4370)
Fall. 3 credits. Prerequisites: PHYS 2208 or 2213, or permission of instructor. Offered alternate years. L. D. Brown.
Field exercises using geophysical techniques to probe the subsurface.

[EAS 4400 Seminar on Climate Change Science, Impacts, and Mitigation
Fall. 2 credits. Prerequisites: junior or higher standing. Offered alternate years; next offered 2010–2011. N. Mahowald.
The course will focus on reading, understanding, and evaluating the IPCC report (2007 version).]

EAS 4530 Mineralogy
Fall. 4 credits. Prerequisite: CHEM 2070 or 2090 or permission of instructor. S. Mahlburg Kay.
Chemical and physical properties and identification of minerals with emphasis on the rock-forming minerals that are the principal constituents of the Earth and nearby planets. Topics include internal and external crystallography, crystal chemistry, introductions to x-ray crystallography and optical mineralogy, and a systematic examination of the structures, chemistry, and occurrence of the rock-forming minerals. Independent project includes use of electron microprobe (EPMA) and x-ray facilities.

[EAS 4540 Petrology and Geochemistry
Spring. 3–4 credits. Prerequisite: EAS 4530. Offered alternate years; next offered 2010–2011. R. W. Kay.
Principles of phase equilibrium as applied to igneous and metamorphic systems. Distribution of trace elements and isotopes as used to define processes and chronologies. Kinetics, reaction pathways, and textural and mineralogical characterization. Geochemistry, origin, and dating of igneous and metamorphic rocks as applied the formation and evolution of the earth, terrestrial planets, and meteorites.]

EAS 4550 Geochemistry
Fall. 4 credits. Prerequisites: CHEM 2070 or 2090 and MATH 1920 or equivalent. Recommended: EAS 3040. Offered alternate years. W. M. White.
The Earth from a chemical perspective.

[EAS 4580 Volcanology
Fall. 3 credits. Prerequisite: EAS 3040 or equivalent. Offered alternate years; next offered 2010–2011. R. W. Kay.
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 4600 Late Quaternary Paleoecology
Fall. 4 credits. Offered alternate years; next offered 2010–2011. M. Goman.
Explores topics in Late Quaternary paleoecology. Broadly divides into 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 students learn the basics of core description, pollen, and macrofossil analysis.]

EAS 4610 Paleoclimate: Since the Last Ice Age
Fall. 3 credits. Prerequisites: EAS 2200 or permission of instructor. Offered alternate years. M. Goman.
This course examines changes and variability in climate for the last 21,000 years.

[EAS 4620 Marine Ecology (also BIOEE 4620)
Fall. 3 credits. Limited to 75 students. Prerequisite: BIOEE 2610. Offered alternate years; next offered 2010–2011. C. D. Harvell and C. H. Greene.
For description, see BIOEE 4620.]

[EAS 4710 Introduction to Groundwater (also BEE 4710)
Spring. 3 credits. Prerequisite: MATH 2930, fluid mechanics or hydrology course. Offered alternate years; next offered 2010–2011. L. M. Cathles and T. S. Steenhuis.
Intermediate-level study of aquifer geology, groundwater flow, and related design factors. Includes description and properties of natural aquifers, groundwater hydraulics, soil water, and solute transport.]

EAS 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. Monger.
Undergraduate instruction and participation in advanced areas of oceanographic research. Topics change from semester to semester. Contact instructor for further information.

EAS 4760 Sedimentary Basins
Spring. 3 credits. Prerequisite: EAS 3010 or permission of instructor. Offered alternate years. T. E. Jordan.
The focus is on the physical characteristics of sedimentary basins, which host fossil fuels and groundwater, and can potentially store CO_2.

[EAS 4780 Advanced Stratigraphy
Fall. 3 credits. Prerequisite: EAS 3010 or permission of instructor. Offered alternate years; next offered 2010–2011. T. E. Jordan.
Covers modern improvements on traditional methods of the study of ages and of genetic relations among sedimentary rocks, emphasizing 3-D relationships. Introduces techniques and applications of sequence stratigraphy.]

EAS 4790 Paleobiology (also BIOEE 4790)
Spring. 4 credits. Prerequisites: one year of introductory biology and BIOEE 2740 or 3730 or EAS 3010, or permission of instructor. 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 4840 Inverse Methods in the Natural Sciences
Fall. 3 credits. Prerequisites: MATH 2940. D. L. Hysell.
An exploration of solution methods for inverse problems with examples taken from geophysics and related fields, with particular attention to making inferences from inaccurate, incomplete, or inconsistent physical data.]

EAS 4870 Introduction to Radar Remote Sensing (also ECE 4870)
Spring. 3 credits. Prerequisite: PHYS 2208 or 2213 or equivalent or permission of instructor. 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 4880 Global Geophysics
Spring. 3 credits. Prerequisites: MATH 1920 (or 1120) and PHYS 2208 or 2213. Offered alternate years. M. Pritchard and R. Lohman.
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 4910–4920 Undergraduate Research
Fall, spring. 1 to 4 credits. Fill out form at 2124 Snee Hall. Staff (J. L. Cisne, coordinator).
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.

EAS 4960 Internship Experience
Fall, spring. 2 credits. Prerequisite: enrollment in EES semester in Hawaii and EAS 3400. S–U grades only. 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.

EAS 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 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.

EAS 5020 Case Histories in Groundwater Analysis
Spring. 4 credits. L. M. Cathles.
Groundwater flow in a specific area, such as a proposed nuclear-waste disposal site, is analyzed in depth. Geological and resource data on the area are presented early in the course. Then the material is analyzed by students working as an engineering analysis team. 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 term.

EAS 5050 Fluid Dynamics in the Earth Sciences
Spring. 3 credits. Prerequisites: MATH through 2940, PHYS through 2208 or 2214, or permission of instructor. Offered alternate years. L. Cathles and M. Wysocki.
The Earth system provides many fascinating examples of fluid dynamic phenomena that are also of societal importance. Turbulent convection in the outer core generates the earth's magnetic field. The viscous mantle (outer half of the Earth) is slowly but vigorously convecting, and consequently the Earth's surface is dynamic. Viscosity is not important in the oceans and atmosphere, but the flow there is fast enough for the rotation of the Earth to become a dominant control. Electromagnetic effects again dominate in the solar wind and magnetosphere. This course will investigate the Earth using fluid dynamics. For students in the Earth sciences it will provide an opportunity to learn the insights that can be provided by fluid dynamics. For students who know fluid dynamics from other fields it will provide some spectacular applications and an opportunity to learn about the Earth system in a different and unusually fundamental way.

EAS 5110 Earth System Interactions
Fall. 1 credit (S–U grades) or 2 credits (includes paper, letter grades). Prerequisite: permission of instructor. J. L. Cisne.
New ways of conceptualizing, characterizing, and measuring phenomena can be as important as new instruments or empirical discoveries in opening new areas to exploration or established ones to more rigorous investigation. This seminar aims to prepare seniors and beginning graduate students for independent research on Earth systems by analyzing examples ranging from epoch-making classics to work now appearing in the literature.

EAS 5220 Advanced Structural Geology I
Fall. 3 credits. Prerequisites: EAS 4260 and permission of instructor. Offered alternate years. R. W. Allmendinger and C. Andronicos.
Stress-strain theory and application. Advanced techniques of structural analysis. Topics include finite and incremental strain measurement; microstructure, preferred orientation, and TEM analysis; 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 5240 Advanced Structural Geology II
Fall. 3 credits. Prerequisites: EAS 4260 and permission of instructor. Offered alternate years. R. W. Allmendinger.
Geometry, kinematics, and mechanics of structural provinces.

EAS 5530 Advanced Petrology
Fall. 3 credits. Prerequisite: EAS 4540. Offered alternate years R. W. Kay.

EAS 5540 Advanced Mineralogy
Spring. 3 credits. Prerequisites: EAS 4530 or permission of instructor. Offered alternate years. S. Mahlburg Kay.
Advanced crystallography and crystal chemistry of minerals and methods of their study. Intended to follow EAS 4530 or equvalent. Includes X-ray diffraction, optical and electron microprobe methods and can include other more advanced techniques. Concentration is on chemistry and structures of minerals and their use in understanding the thermal and pressure structure and evolution of the Earth and other planets. Includes an individual research project.

[EAS 5750 Planetary Atmospheres (also ASTRO 6575)
Fall. 4 credits. Prerequisites: undergraduate physics, vector calculus. Offered alternate years; next offered 2010–2011. P. Gierasch.
Introduction to radiative transfer in emitting and scattering atmospheres in the solar system. Introduction to motions in atmospheres. Planetary examples of balanced flows. Mesoscale waves, wave absorption and wave accelerations. Planetary waves. The influence of wave accelerations on thermal structure and composition. Introduction to atmospheric chemistry. Dynamical transports. Observation. At the level of Andrews, *Atmospheric Physics*.]

EAS 5770 Planetary Surface Processes (also ASTRO 6577)
Spring. 3 or 4 credits. Offered alternate years. J. Bell.

[EAS 5780 Planet Formation and Evolution (also ASTRO 6578)
Fall. 4 credits. Prerequisites: familiarity with elementary physics and math or permission of instructor. Offered alternate years. J-L. Margot and M. Pritchard.
For description, see ASTRO 6578.]

[EAS 5840 Inverse Methods in the Natural Sciences
Fall. 3 credits. Prerequisites: MATH 2940. (((Next offered ??))) D. L. Hysell.
An exploration of solution methods for inverse problems with examples taken from geophysics and related fields, with particular attention to making inferences from inaccurate, incomplete, or inconsistent physical data.]

EAS 5880 Advanced Methods in Radar
Fall. 3 credits. Prerequisite: EAS 4870 or permission of instructor. D. Hysell.
This course will address the theory and practice of advanced radar techniques used for remote sensing, with emphasis placed on studying the upper atmosphere and ionosphere. Roughly the first half of the course will be devoted to incoherent scatter theory, the theory that relates the statistics of the signals scattered from an ionospheric plasma to the state variables that describe the plasma. The second half of the course will examine methods for measuring ionospheric parameters using incoherent scatter theory in concert with advanced radar modes and data analysis techniques. Students taking this course should be familiar with radar fundamentals and plasma kinetic theory.

EAS 6280 Geology of Orogenic Belts
Spring. 3 credits. Prerequisite: permission of instructor. S. Mahlburg Kay.
Seminar course in which students study specific geologic topics of an orogenic belt selected for study during the semester.

[EAS 6410 Analysis of Biogeochemical Systems
Spring. 2 credits. Prerequisite: MATH 2930 or permission of instructor. Offered alternate years; next offered 2010–2011. 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.]

[EAS 6560 Isotope Geochemistry
Spring. 3 credits. Open to undergraduates. Prerequisite: EAS 4550 or permission of instructor. Offered alternate years; next offered 2010–2011. W. M. White.
Nucleosynthetic processes and the isotopic abundance of the elements; geochronology and cosmochronology using radioactive decay schemes.]

EAS 6930 Special Topics in Geological Sciences
Fall or spring. 1–3 var. credits. S–U or letter grades. Staff.
Study of specialized advanced topics in the Earth sciences through readings from the scientific literature, seminars, and discussions.

EAS 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 7220 Advanced Topics in Structural Geology
R. W. Allmendinger.

EAS 7310 Advanced Topics in Remote Sensing and Geophysics
M. Pritchard.

EAS 7330 Advanced Topics in Geodynamics
Spring. J. Phipps Morgan.

EAS 7500 Satellite Remote Sensing in Biological Oceanography
Summer. 3 credits. B. C. Monger.

EAS 7510 Petrology and Geochemistry
R. W. Kay.

EAS 7550 Advanced Topics in Tectonics and Geochemistry
J. Phipps Morgan.

EAS 7570 Current Research in Petrology and Geochemistry
S. Mahlburg Kay.

EAS 7620 Advanced Topics in Paleobiology
W. D. Allmon.

EAS 7650 Topics in Paleoecology
Fall. 1 credit. S–U grades. G. Dietl.

EAS 7710 Advanced Topics in Sedimentology and Stratigraphy
T. E. Jordan.

EAS 7730 Paleobiology
J. L. Cisne.

EAS 7750 Advanced Topics in Oceanography
C. H. Greene.

EAS 7800 Earthquake Record Reading
Fall. M. Barazangi and R. Lowman.

EAS 7810 Advanced Topics in Exploration Geophysics
L. D. Brown.

EAS 7930 Andes-Himalaya Seminar
S. Mahlburg Kay, R. W. Allmendinger, T. E. Jordan, and M. Pritchard.

EAS 7950 Low Temperature Geochemistry
L. A. Derry.

EAS 7960 Geochemistry of the Solid Earth
W. M. White.

EAS 7970 Fluid-Rock Interactions
L. M. Cathles.

EAS 7990 Soil, Water, and Geology Seminar
Spring. L. M. Cathles and T. S. Steenhuis.

EDUCATION

A. Wilson, chair (435 Kennedy Hall, 255-2207); G. Applebee, R. Caffarella, W. Camp, M. Constas, B. Crawford, T. Park, S. Peters, T. Richardson, R. Ripple, V. Rockcastle, D. Schrader, J. Sipple, D. Trumbull, T. Tucker, S. Villenas

[EDUC 1110/1111 Exploring Agricultural Education and Research
Fall and spring. 2 credits. Year-long course. Letter grades only. Next offered 2010–2011. W. Camp.
Educational, career, and research opportunities; independent research; CALS admissions, career, student services; interview agricultural professionals; participate in team projects; write papers; a research project for presentation.]

EDUC 2200 Community Learning and Service Partnership (CLASP)
Fall only. 2 credits. Prerequisite: permission of instructor. Students must commit to taking EDUC 2210 the following spring. S–U or letter grades. 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 2210 the following spring semester.

EDUC 2210 Community Learning and Service Partnership (CLASP)
Spring only. 2–4 credits, variable. Prerequisites: EDUC 2200 and permission of instructor. S–U or letter grades. A. Wilson.
Continues the field experience and curriculum begun in EDUC 2200. 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 2400 The Art of Teaching (CA)
Fall and spring. 3 credits. T. Richardson and D. Trumbull.
This exploratory course is designed for students of all backgrounds and interests who have a desire to learn more about education and 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 occupational 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 2710 Social and Political Context of American Education (also SOC/AMST 2710) (HA) (SBA)
Fall. 4 credits. Disc. J. 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 3110 Educational Psychology (also HD 3110) (KCM) (CA)
Fall. 4 credits. Prerequisite: PSYCH 1101 or permission of instructor. S–U or letter grades. Additional disc sec TBA. D. 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 3310 Careers in Agriculture, Extension, and Adult Education
Fall. 3 credits. Letter grades only. Next offered 2010–2011. G. Applebee.
Designed to examine program development, methodologies, leadership, evaluation, and implementation in three areas of teaching: adult education, cooperative extension, and agricultural education.]

EDUC 3350 Youth Organizations (CA)
Fall. 3 credits. T. Park.
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 4040 Learning and Teaching I
Fall. 4 credits. Prerequisite: admission to Cornell Teacher Education program or permission of instructor. Letter grades. 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 students' understandings of pupils and classroom structures.

EDUC 4050 Learning and Teaching II
Spring. 4 credits. Prerequisite: admission to Cornell Teacher Education program or permission of instructor. Letter grades. B. Crawford.
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 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 or letter grades. 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 4410 Language, Literacy, and Schooling (KCM)
Spring and summer. 3 or 4 credits. Lab TBA. T. Park.
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 research project based on fieldwork.

EDUC 4510 Multicultural Issues in Education (also AMST/LSP 4510)
Fall. 3 credits. Letter grades. S. Villenas.
This course explores research on race, ethnicity, and language in American education. It examines historical and current patterns of minority school achievement and the cultural premises undergirding educational practices in diverse communities and schools. Policies, programmatic and pedagogical responses to diversity, including multicultural and bilingual education, are addressed.

EDUC 4590 Educational Innovations in Africa and the Diaspora (also ASRC 4601)
Fall. 3 credits; 4 in College of Arts and Sciences. N. Assié-Lumumba.
For description, see ASRC 4601.

EDUC 4630 Policies, Practices, and Critical Issues of Distance Learning in Developing Countries
Summer. 3 credits. S–U or letter grades. 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 learning institutions are examined. 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 4720 Philosophy of Education
Fall. 3 credits. Advanced undergraduates permitted. Letter grades only. T. Richardson.
Discussions for this course will be organized around a wide variety of philosophical positions which have influenced scholarly approaches to philosophy of education during the 20th century. We will be concerned primarily with the development of John Dewey's humanist approach to educational philosophy and the post-humanist philosophical positions from Continental post-colonial and feminist philosophies that have emerged in response to it.

EDUC 4940 Special Topics in Education
Fall, spring, or summer. 4 credits max. Prerequisite: permission of instructor. S–U or letter grades. 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 4970 Individual Study in Education
Fall, spring, or summer. 1–3 credits. S–U or letter grades. Students must register using independent study form (available in 140 Roberts Hall). Staff.
A student may, with approval of a faculty advisor, 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 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 or letter grades. 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 4990 Undergraduate Research
Fall, spring, or summer. 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 of 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 4991 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 or letter grades. Staff.

EDUC 5020 Education and Development in Africa (also ASRC 5020)
Spring. 3 credits; 4 in College of Arts and Sciences. S–U or letter grades. N. Assié-Lumumba.
For description, see ASRC 5020.

EDUC 5030 Diversity in the Classroom
Spring or summer. 2–4 credits. Prerequisite: enrollment in CTE program or permission of instructor. S–U or letter grades. S. Villenas.
Builds on knowledge of cultural diversity gained from prior course work and field activities. With a focus on classroom teaching, topics include learning and inequality, multiple literacies across home and school, culturally relevant teaching, and English-language learners. A service learning component is optional for 3 or 4 credits.

[EDUC 5320 Educational Programs in Agricultural Science
Fall. 3 credits. Next offered 2011–2012. W. Camp.
Organization and planning processes for public school agricultural education. Local needs assessments, advisory committees, community-partnering, course development, sequencing instruction, professional development. Fieldwork required.]

EDUC 5350 Youth Organizations for Agricultural Science Education
Spring. 3 credits. Prerequisite: senior or graduate standing in Agricultural Science Education. Letter grades only. T. Park.
Provides future agriculture educators a comprehensive overview of the components of an agriculture education program including supervised agricultural experience (SAE) and FFA. Students examine factors affecting membership, purpose, design, operation, and administration of career and technical student organizations and FFA organization, structure, and functions on national, state, and local levels.

[EDUC 5440 Curriculum and Instruction
Spring. 3 credits. S–U or letter grades. Next offered 2010–2011. Staff.
The focus of this curriculum and instructional planning course will be on the concepts and principles for developing curriculum and the processes for delivering curriculum.]

EDUC 5710 Social and Political Context of American Education (also SOC/AMST 5710) (HA) (SBA)
Fall. 4 credits. Prerequisites: admission to Cornell Teacher Education Program or permission of instructor. J. 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 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 first 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 5790 Further Training for International Teaching Assistants
Fall, spring, summer. 2 credits. Prerequisite: EDUC 5780. S–U or letter grades. Lec, three contact hours per week. ITADP staff.
Designed for international teaching assistants from countries in which English is not the first language and who have completed EDUC 5780, the ITADP follow-up course provides further instruction and practice in oral English and pedagogical skills.

EDUC 6010 Secondary Agriculture, Science, and Mathematics Teaching Practicum
Fall or spring. 6 credits. Prerequisite: graduate students enrolled in Cornell Teacher Education Program. S–U grades only. D. Trumbull, B. Crawford, W. Camp, and T. Park.
Supervised student teaching in agriculture, mathematics or science at the secondary level. Program includes teaching in a local school for 14 weeks.

EDUC 6020 Practicum Seminar
Fall or spring. 9 credits. Prerequisite: EDUC 6010 or permission of instructor. W. Camp, B. Crawford, D. Trumbull, and T. Park.
Begins with full-day sessions of intensive consideration of classroom practice relevant to all aspects of student teaching. Assignments and an online seminar during the semester require students to use theories to develop and evaluate teaching materials and practices. Students also complete an extensive portfolio documenting their work.

[EDUC 6140 Gender, Context, and Epistemological Development (also FGSS 6240)
Fall. 3 credits. Prerequisite: EDUC/HD 3110 or senior status. S–U or letter grades. Offered alternate years; next offered 2010–2011. D. Schrader.
We explore how our thinking and view of the nature of knowledge is influenced by gender and culture. Awareness shapes decisions, actions, and educational practices.]

EDUC 6160 Moral Psychology and Education (also FGSS 6060)
Fall. 3 credits. Prerequisites: EDUC 3110, graduate standing or permission of instructor. S–U or letter grades. Offered alternate years. D. Schrader.
This seminar examines questions of the psychological development of knowing what is right, just, good, and of value. We study moral development from cognitive-developmental, social-contextual, normative, and gendered perspectives. Topics vary by semester but include the relationship between judgment and action, moral education, social aggression, moral leadership, and integrity.

EDUC 6170 Psychology of Adolescence in Case Study (also FGSS 6180)
Spring. 3 credits. Prerequisite: any one of the following: EDUC 3110, HD 6170, or permission of instructor. S–U or letter grades. D. Schrader.
Adolescent psychological development is examined from the perspective of the individual subject and the researcher. Using a case study approach we explore classic and contemporary theories of adolescence, relying on primary source readings and first-person accounts to give us insight into adolescent issues, such as identity, values, and behaviors.

EDUC 6180 Learning in Adulthood: An Introduction
Fall. 3 credits. S–U or letter grades. R. Caffarella.
An introduction of learning in adulthood is provided with emphasis on understanding adult learning in contemporary society, reviewing key seminal and current theory and research, and exploring how this knowledge relates to practice. Students from other disciplines, in addition to education, who work with adults in formal and informal learning settings are welcomed.

EDUC 6200 Internship In Education
Fall or spring. 1–6 credits. Each student, before course enrollment, must obtain approval of faculty member who will assume responsibility for supervising work. S–U or letter grades. Staff.
Opportunity for practical experience in educational professions development.

EDUC 6330 Program Planning in Adult and Extension Education
Spring. 3 credits. S–U or letter grades. Offered alternate years. 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 6470 Innovative Teaching in the Sciences
Spring. 3 credits. S–U or letter grades. B. Crawford.
This seminar on innovative ways to teach is designed for doctoral and master's-level students in education, sciences, math, and possibly other disciplines, including extension and outreach. Readings will include issues of gender and underrepresented populations in science, math, and engineering. Students will design inquiry-based instruction in their field.

EDUC 6510 Anthropology and Education
Spring. 3 credits. Letter grades. Lec. S. Villenas.
A study of schooling and education from anthropological perspectives and ethnographic methodology. Participants examine teaching and learning in families, communities, and schools as cultural processes. Some topics include the differential school achievements of racial/ethnic minorities, school reform efforts, youth culture and identities, and literacy in adult learning spaces.

EDUC 6610 Administrative Leadership and Organizational Change
Fall. 3 credits. J. 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 6620 Evaluation Design
Spring. 3 credits. Prerequisite: survey of research methods (or other graduate-level class in research methods), statistics. S–U grades only. M. Constas.
This course is designed to introduce graduate students to the principles and practices of program evaluation. It addresses practical realities and political features of a range of evaluation designs that may be used to support decision making related to educational, social, and community-based programs. Students who enroll in the class will become familiar with the technical characteristics, practical realities, and political features of a range of evaluation designs that may be used to support decision making related to educational, social, and community-based programs. Course readings, class

discussions, and assignments will support the development of the proposal.

EDUC 6640 Methods for Interpretive Research
Spring. 3 credits. Prerequisites: course in research methods/research design. S–U or letter grades. D. Trumbull.
Studies interpretive qualitative research, which attends to the complex interactions between researcher, researched, and contexts and accepts the centrality of interpretation in research.

[EDUC 6670 Discourse Analysis in Education
Spring. 3 credits. S–U or letter grades. Next offered 2010–2011. A. Wilson.
Course functions as an advanced study in the theory and practice of conducting discourse analysis in education. Discourse analysis is one of the preferred analytical approaches in cultural studies, but "discourse analysis" means different things to different people. Participants will examine a range of those differences.]

[EDUC 6680 Narrative Inquiry in Social Science and Action Research
Spring. 3 credits. S–U or letter grades. Next offered 2010–2011. S. Peters.
Provides an introduction to the theory and practice of narrative inquiry in action-oriented social science research.]

EDUC 6710 American School Reform: Organizational and Sociological Perspectives
Spring. 3 credits. S–U or letter grades. J. 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 6720 Philosophy of Education
Fall. 3 credits. Letter grades only. T. Richardson.
Discussions for this course will be organized around a wide variety of philosophical positions that have influenced scholarly approaches to philosophy of education during the 20th century. We will be concerned primarily with the development of John Dewey's humanist approach to educational philosophy and the post-humanist philosophical positions from Continental Post-Colonial and Feminist philosophies which have emerged in response to it. Advanced undergraduates will be permitted.

EDUC 6800 Foundations of Adult and Extension Education
Fall. 3 credits. Limited to 20 students. S–U or letter grades. Offered alternate years. 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 6810 Democracy, Science, and Education
Spring. 3 credits. S–U or letter grades. Next offered 2010–2011. S. Peters.
Explores the actual and potential connections between democracy, science, and education in both formal and non-formal education, both historically and in contemporary society.]

[EDUC 6820 Community Education and Development
Fall. 3 credits. Limited to 25 students. Letter grades only. Next offered 2010–2011. S. Peters.
Reviews traditions of community education and development in their historical, cultural, social, and political contexts, examining implications for practice in a range of settings.]

EDUC 6850 Training and Development: Theory and Practice (also IARD 6850)
Spring. 4 credits. Limited to 20 students. S–U or letter grades. R. Caffarella.
Provides practitioners and researches conceptions from different perspectives of training and development, primarily in international settings. Engages students in critical and reflective analysis related to adults as learners, training and education at the instructional and program levels, major development issues at national and global levels, and ethical practice. Examines two majors themes that drive training and development: the impact of context and the role of power.

EDUC 6940 Special Topics in Education
Fall, spring, or summer. 1–3 credits. Prerequisite: permission of instructor. S–U or letter grades. Staff.
Topics TBA.

EDUC 6970 Graduate Individual Study in Education
Fall, spring, or summer. 1–3 credits. Prerequisite: graduate standing; permission of instructor. S–U or letter grades. Staff.
A graduate student may, with approval of a faculty advisor, 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 6980 Graduate Supervised Teaching in Education
Fall or spring. 1-2 credits. Prerequisite: graduate standing; permission of instructor. S–U or letter grades. Staff.
Participating graduate 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 7000 Directed Readings
Fall, spring, or summer. 6 credits, variable. Prerequisite: graduate standing; permission of instructor. S–U or letter grades. Staff.
For study that predominantly involves library research and independent study.

EDUC 7010 Empirical Research
Fall, spring, or summer. 6 credits, variable. Prerequisite: graduate standing; permission of instructor. S–U or letter grades. Staff.
For study that primarily involves collection and analysis of research data.

EDUC 7020 Practicum
Fall, spring, or summer. 6 credits, variable. Prerequisite: graduate standing; permission of instructor. S–U or letter grades. Staff.
For study that predominantly involves field experience in community settings.

EDUC 7030 Teaching Assistantship
Fall, spring, or summer. 6 credits, variable. Prerequisite: graduate standing; permission of instructor. S–U or letter grades. Staff.
For students assisting faculty with instruction. Does not apply to work for which students receive financial compensation.

EDUC 7040 Research Assistantship
Fall, spring, or summer. 6 credits, variable. Prerequisite: graduate standing; permission of instructor. S–U or letter grades. Staff.
For students assisting faculty with research. Does not apply to work for which students receive financial compensation.

EDUC 7050 Extension Assistantship
Fall, spring, or summer. 6 credits, variable. Prerequisite: graduate standing; permission of instructor. S–U or letter grades. Staff.
For students assisting faculty with extension activities. Does not apply to work for which students receive financial compensation.

EDUC 7620 Comparative and International Education
Summer. 3 credits. S–U or letter grades. N. Assié-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 7830 Farmer-Centered Research and Extension (also IARD 7830)
Fall. 3 credits. S–U or letter grades. T. Tucker.
For description, see IARD 7830.

EDUC 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 or letter grades. Times TBA. Staff.

EDUC 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 or letter grades. Times TBA. Staff.
Doctoral or other research and development projects for Ph.D. students.

ENTOMOLOGY

J. G. Scott, chair (2130 Comstock Hall, 255-7723); A. Agrawal, N. W. Calderone, B. N. Danforth, A. DiTommaso, A. Douglas, C. Gilbert, A. E. Hajek, L. C. Harrington, B. P. Lazzaro, J. K. Liebherr, J. E. Losey, J. P. Nyrop, L. S. Rayor, J. S. Thaler, W. M. Tingey

Courses by Subject

Apiculture: 2600, 2640
Behavior: 2150, 3150, 3250, 3940, 6620
Ecology: 3690, 4550, 4700, 6900
Introductory courses: 2010, 2011, 2100, 2120, 2150, 2410
Medical and veterinary entomology: 2100, 3520, 4100, 4101
Outreach: 3350, 3360, 7090
Pathology: 4630, 6700
Pest management: 2410, 4200, 4440, 6700
Physiology, development, and toxicology: 3070, 3940, 4830, 4900, 6850
Systematics: 3310, 3311, 3330, 4400, 6340, 6550

ENTOM 2010/2011 Alien Empire: Bizarre Biology of Bugs
Spring. 2 (2010) or 3 (2011) credits. S–U or letter grades. Optional field trips. Staff.
Insects are the most abundant and diverse animals on earth. This course explores the bizarre biology of insects and their interaction with humans. We will examine both the detrimental roles insects play (e.g., pests and vectors of disease) as well as their beneficial roles (e.g., pollination, edible insects, insect products such as waxes, dyes, and silk). We will also explore the symbolic representation of insects in art, literature, and religion. Students taking the course for 3 credits will meet once per week (on Friday) for discussion and documentary films on the biology of insects.

ENTOM 2020 Invasions
Spring. 3 credits. S–U or letter grades. A. E. Hajek and J. P. Nyrop.
The purpose of this course is for students to learn about the biology and ecology of invasions by plants, animals, and microbes. We will discuss the expanding problems caused by invasive species and how invasions are prevented, mitigated, and managed. These topics are grounded in biology; however, they have social, economic and philosophical implications. Invasive species impact agriculture, forestry, natural systems, and human health. Local, national, and international examples of invaders in diverse systems will be included in investigations of invasive species.

ENTOM 2100 Plagues and People (also BSOC 2101)
Fall. 2 or 3 credits. Prerequisites: introductory biology or permission of instructor. Offered alternate years. 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, and quizzes and have a comprehensive final project.

ENTOM 2120 Insect Biology
Fall. 4 credits. Pre- or corequisites: BIOG 1101–1102 or equivalent. Lec, lab. Lab fee: $50. J. K. Liebherr.
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 2150 Spider Biology: Life on a Silken Thread
Fall. 2 credits. Prerequisite: introductory biology or permission of instructor. S–U or letter grades. Lec. 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 2410 Insect Pest Management for Practitioners
Spring. 3 credits. Limited to 18 students. Prerequisites: BIOG 1101–1102 or equivalent. Lec, lab/disc. 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 2600 Biology of the Honey Bee
Fall. 2 credits. Lec. Offered alternate years; next offered 2010–2011. N. W. Calderone.
Introduces students to the life history, physiology, ecology, and behavior of honey bees. Reviews classical and contemporary research on the dance language, chemical communication, behavioral genetics, division of labor, and evolution of social behavior.]

[ENTOM 2640 Practical Beekeeping
Fall. 1 credit. Limited to 20 students. Pre- or corequisite: ENTOM 2600. Lab. Offered alternate years; next offered 2010–2011. 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.]

[ENTOM 3070 Pesticides, the Environment, and Human Health (also TOX 3700)
Fall. 2 credits. Prerequisites: BIOG 1101–1102 or equivalent. Lec. Offered alternate years; next offered 2010–2011. 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 3150 Spider Biology
Fall. 3 credits. Prerequisite: introductory biology or permission of instructor. Letter grades only. Lec. L. S. Rayor.
In-depth introduction to the fascinating world of spiders and their relatives. Meets concurrently with ENTOM 2150 (2 credits). Students in ENTOM 3150 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 3150 rather than 2150. Students may not take both ENTOM 2150 and 3150 for credit.

ENTOM 3250 Insect Behavior (also BIONB 3250)
Spring. 3 credits. Prerequisite: introductory biology and either ENTOM 2120 or BIONB 2210. Lec. Offered alternate years. 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 3310 Insect Phylogeny and Evolution
Fall. 3 credits. Prerequisite: ENTOM 2120. Corequisite: ENTOM 3311. Offered alternate years. B. N. Danforth.
This course will provide a broad overview of insect diversity, morphology, phylogeny, evolution, and fossil history. Evolution of the insects will be discussed in light of real data sets based on morphology and/or DNA sequence data. Basic principles of phylogeny reconstruction using both morphological and DNA sequence data will be presented using published data sets. Analytical methods such as parsimony, maximum likelihood, and Bayesian methods will be discussed and compared. We will also cover how phylogenies are used to analyze evolutionary patterns, such as historical biogeography, co-evolution, and host–parasite relationships.

ENTOM 3311 Insect Phylogeny and Evolution Laboratory
Fall. 1 credit. Prerequisite: ENTOM 2120 lab. Lab fee: $40. Corequisite: ENTOM 3310. B. N. Danforth.
Introduction of the diversity, phylogeny, evolution, and fossil history of insects. Includes lab practice in insect morphology, insect diversity, and phylogenetic analysis. Entomology undergraduates wishing to count this course toward their Group A requirement are required to take the laboratory, as well as the lecture for a total of 4 credits.

ENTOM 3330 Maggots, Grubs, and Cutworms: Larval Insect Biology
Spring. 3 credits. Prerequisites: ENTOM 2120 or permission of instructor. S–U or letter grades. Offered alternate years. 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 3350 Naturalist Outreach Practicum
Fall. 3 credits. Prerequisite: introductory biology. S–U or letter grades. L. S. Rayor.
Learn the skills to do effective scientific outreach. This interdisciplinary course combines lectures on topics relevant to teaching about natural history, with more pedagogic lectures on developing and presenting scientific inquiry–based presentations. The course emphasizes developing different approaches to effectively communicate science at different scales from classroom settings, through museum programs, to large outreach events. Students participate in the Naturalist Speakers Bureau to provide lively multimedia presentations in classrooms throughout the region. With feedback from peers and instructors, students develop their own biological presentations, display materials, and teacher resource guides.

ENTOM 3360 Naturalist Outreach in Biology
Fall. 1–2 credits, variable. Prerequisite: ENTOM 3350. S–U or letter grades. L. S. Rayor.
For students who have already taken Naturalist Outreach Practicum (ENTOM 3350) who wish to continue doing scientific outreach through the Naturalist Outreach Speakers Bureau. This course can be taken twice.

[ENTOM 3520 Medical and Veterinary Entomology
Fall. 3 credits. Prerequisites: BIOG 1101–1102 or permission of instructor. S–U or letter grades. Offered alternate years; next offered 2010–2011. L. C. Harrington.
This course explores the impact of vector-borne disease and provides a comprehensive overview of the fields of medical and veterinary entomology. Undergraduate and graduate students from entomology as well as other disciplines including pre-medical and veterinary students are encouraged to enroll.]

[ENTOM 3521 Lab in Medical and Veterinary Entomology
Fall. 1 credit. Prerequisites: ENTOM 3520 concurrently or have taken another medical/veterinary entomology course. S–U or letter grades. Offered alternate years; next offered 2010–2011. L. C. Harrington.
The laboratory compliments the lecture course ENTOM 3520. Includes field trips, collection and identification and arthropods of medical/veterinary importance, and hands-on experience with modern laboratory research methods.]

ENTOM 3690 Chemical Ecology (also BIOEE/BIONB 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 or letter grades. Lec. A. Agrawal, G. Jander, A. Kessler, and J. Thaler.
For description, see BIOEE 3690.

ENTOM 4100–4101 Malaria Interventions in Ghana
4100, fall; 4101, spring. 2 credits each semester. S–U grades only. R grade given at end of fall semester and final grade at end of spring semester. L. C. Harrington.
This service learning class will educate students about malaria, Ghanaian culture, and general public health intervention strategies. During the fall semester, students will hear from a variety of speakers and will read and discuss key papers. Students in the class will travel to Ghana over winter break and create a malaria needs indicator to evaluate intervention strategies in partnership with the Ghana Health and Education Initiative. After returning from the service trip, students will evaluate their survey and intervention plan.

ENTOM 4200 Grape Pest Management (also PLPA/VIEN 4200)

ENTOM 4400 Phylogenetic Systematics (also BIOPL 4400)

ENTOM 4440 Integrated Pest Management (also CSS 4440)
Fall. 4 credits. Prerequisite: introductory biology or permission of instructor. S–U or letter grades. Lec. 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 4550 Insect Ecology (also BIOEE 4550)
Fall. 4 credits. Recommended: ENTOM 2120 or BIOEE 2610 or permission of instructor. S–U or letter grades. Offered alternate years; next offered 2010–2011. J. S. Thaler.
Focuses on individual and population aspects of insect ecology as well as some topics in community and ecosystem ecology. Laboratory includes indoor and outdoor field trips illustrating the major concepts in insect ecology as well as experimental techniques.]

[ENTOM 4630 Invertebrate Pathology
Fall. 4 credits. Prerequisites: one year introductory biology. S–U or letter grades. Lec, lab. Offered alternate years; next offered 2010–2011. A. E. Hajek.
Lecture and lab cover pathology and ecology of infectious diseases of invertebrates.]

[ENTOM 4700 Ecological Genetics (also BIOEE 4800)
Spring. 4 credits. Prerequisite: BIOEE 2780. Recommended: introductory course in genetics and/or statistics. S–U or letter grades. Offered alternate years; next offered 2010–2011. 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.]

[ENTOM 4830 Insect Physiology
Spring. 4 credits. Prerequisite: ENTOM 2120 or permission of instructor. Lec, lab. Offered alternate years; next offered 2010–2011. C. Gilbert and A. Douglas.
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 4900 Toxicology of Insecticides (also TOX 4900)
Spring. 3 credits. Prerequisite: general chemistry course. S–U or letter grades. Lec. Offered alternate years. 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 4940 Special Topics in Entomology
Fall or spring. 4 credits max. 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.

ENTOM 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 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 4990 Undergraduate Research
Fall and spring. Credits TBA. S–U or letter grades. Staff.
Prerequisite: permission of instructor. Students must register using independent study form (available in 140 Roberts Hall).

ENTOM 4991 Undergraduate Honors Research
Fall and spring. Credit TBA. For students who enroll under this number, but do not complete an Honors Thesis, course credit reverts to ENTOM 4990 Undergraduate Research. Students must register using an Independent Study Form (available in 140 Roberts Hall). Staff.
This course is intended for students doing independent research that will lead to Honors with Distinction in Research.

ENTOM 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 6550 Nomenclature Seminar
Spring. 1 credit. S–U or letter grades. Lec. Offered alternate years; next offered 2010–2011. J. K. Liebherr.
This seminar will expose you to the rules of zoological nomenclature supported by the International Trust for Zoological Nomenclature.]

[ENTOM 6620 Insect Behavior Seminar
Spring. 2 credits. Prerequisite: permission of instructor or ENTOM 2120 and BIONB 2210 or equivalents. S–U or letter grades. Offered alternate years; next offered 2010–2011. C. Gilbert.]

[ENTOM 6700 Seminar on Biological Control
Fall. 1 credit. Prerequisite: ENTOM 2770, 4400, or 4630 or permission of instructor. S–U or letter grades. Offered alternate years; next offered 2010–2011. A. E. Hajek.
Seminar series covering topics in biological control chosen by participating students and faculty.]

[ENTOM 6850 Seminar in Insect Physiology
Spring. 1 credit. Prerequisite: permission of instructor. S–U or letter grades. Offered alternate years; next offered 2010–2011. C. Gilbert.]

ENTOM 6900 Seminar in Ecology and Evolution of Infectious Diseases
Fall and spring. 1 credit. B. Lazzaro and A. Hajek.
Graduate-level discussion of the ecology, epidemiology, genetics, and evolution of infectious disease in animal and plant systems. Weekly discussion of research papers published in the primary scientific literature. Participation in discussion and presentation of at least one paper required for course credit.

ENTOM 7070 Individual Study for Graduate Students
Fall or spring. Credit TBA. Prerequisite: permission of instructor. Not for thesis research. Staff.

ENTOM 7090 Teaching Entomology
Credit TBA. Staff.
Teaching entomology or for extension training.

ENTOM 7670 Current Topics in Entomology
Fall and spring. 1 or 2 credits. Requirement for first- and second-year entomology graduate students. S–U grades only. Staff.
This course provides first- and second-year graduate students with an overview of the field of entomology. The course format changes from year to year but generally involves attendance at the weekly entomology seminar as well as a one-hour meeting TBA with faculty from the department or with visiting speakers. Additional readings may be required. Graduate students in entomology are required to attend the class for a total of two semesters (ideally in the first year of their graduate program). The 2-credit option is for students attending the Jugatae seminar and a one-hour meeting following the seminar. The 1-credit option is for attendance at the seminar only.

ENTOM 8900 Master's–Level Thesis Research
Fall and spring. 15 credits per semester if taking no classes; if taking other courses, use ENTOM 8900 to bring yourself up to a total of 15 credits. Prerequisite: permission of instructor. S–U or letter grades. Staff.
Research at the master's level.

ENTOM 9900 Doctoral–Level Thesis Research
Fall and spring. 15 credits per semester if taking no classes; if taking other courses, use ENTOM 9900 to bring yourself up to a total of 15 credits. Prerequisite: permission of instructor. S–U or letter grades. 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.

ENVIRONMENTAL TOXICOLOGY

B. A. Ahner, A. J. Baeumner, K. W. Beyenbach, S. E. Bloom, K. J. Boor, P. R. Bowser, D. L. Brown, J. W. Casey, E. Cooch, R. Davisson, 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, R. Richardson, M. Roberson, E. Rodriguez, J. G. Scott, M. L. Shuler, S. M. Snedeker, D. A. Soderlund, J. R. Stedinger, B. J. Strupp, D. Tumbar, O. K. Vatamaniuk, 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 3070 Pesticides and the Environment (also ENTOM 3070)
Fall. 2 credits. Prerequisites: BIOG 1101–1102 or equivalent. Offered alternate years; next offered 2010–2011. J. G. Scott.
For description, see ENTOM 3070.]

TOX 4370 Eukaryotic Cell Proliferation (also BIOBM 4370)
Spring. 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: BIOG 1101–1102 or 1105–1106 and BIOBM 3300 or 3310/3320. Recommended: BIOGD 2810 and BIOBM 4320. S. Lee.
For description see BIOBM 4370.

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

TOX 5970 Risk Analysis and Management (also CEE 5970)
Spring. 3 credits. Prerequisite: introduction to probability and statistics course (e.g., CEE 3040, ENGRD 2700, ILRST 2100, BTRY 2610 or AEM 2100); two semesters of calculus. Prerequisite: senior or graduate standing or permission of instructor. J. R. Stedinger.
For description, see CEE 5970.

[TOX 6100 Introduction to Chemical and Environmental Toxicology (also BIOMI 6100)
Fall. 3 credits. Prerequisite: graduate standing in field or permission of instructor. Offered alternate years; next offered 2010–2011. A. G. Hay.
For description, see BIOMI 6100.]

[TOX 6110 Molecular Toxicology (also NS 6110)
Spring. 3 credits. Prerequisites: TOX 6100 or permission of instructors. Offered alternate years; next offered 2010–2011. S. Bloom, R. Dietert, D. Muscarella, and B. Strupp.
For description, see NS 6110.]

TOX 6990 Environmental Toxicology Journal Club (also BIOMI 6990)
Spring only. 1 credit. Requirement for env. tox. students until post–A exam. A. G. Hay.
For description, see BIOMI 6990.

TOX 7010 Mouse Pathology and Transgenesis (also VTBMS 7010)
Fall, meets during second half of fall semester and relies on background information from NS/BIOGD 4900 Manipulating the Mouse Genome, which meets during first half. Students interested in both courses must register for them separately. 1 credit. Prerequisites: permission of instructor. Highly recommended: NS/BIOGD 4900 and basic course in histology (BIOAP 4130 or equivalent). A. Niktin.
For description, see VTBMS 7010.

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

TOX 7130 Cell Cycle Analysis (also VTBMS 7130)
Spring. 1 credit. S–U grades only. Offered alternate years. A. Yen.
For description, see VTBMS 7130.

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

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

Related Course in Another Department

FDSC 6210 Food Lipids

FOOD SCIENCE

K. J. Boor, chair (114 Stocking Hall, 255-7912); T. E. Acree, K. J. Arnink, D. M. Barbano, C. A. Batt, J. W. Brady, R. B. Gravani, J. H. Hotchkiss, H. T. Lawless, C. Y. Lee, R. H. Liu, D. D. Miller, R. de Mira Orduña, C. I. Moraru, S. J. Mulvaney, A. Orta–Ramirez, J. M. Regenstein, S. S. H. Rizvi, G. Sacks, K. J. Siebert, M. Wiedmann

FDSC 1101 Science and Technology of Foods
Fall. 1 credit. S–U grades only.
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. A laboratory exercise in food development will be undertaken.

FDSC 1102 Leadership and Career Skills in Food Science
Spring. 2 credits. Prerequisite: FDSC 1101; limited to freshman Food Science majors. Letter grades only. R. Gravani and J. Hotchkiss.
This course will provide students with opportunities to learn more about their personality type and apply this information to leadership and team building skills, diversity and ethics issues, as well as career skills in the field of food science. Topics and concepts addressed in the course will be reinforced through presentations, interactive exercises and activities, case studies, and networking with food science alumni. Students will be required to participate in a project using the Food Science Alumni Career Link network.

FDSC 1104 Introduction to Wines and Vines (also HORT/VIEN 1104)
Spring. 3 credits. Prerequisite: students must be 21 years of age, or taking this course to fulfill requirements for their degree program. Letter grades only. K. Arnink and I. Merwin.
Introduction to grape cultivation, wine fermentation and composition, and wine sensory evaluation. Topics include history and culture of wines, viticultural regions, vineyard and winery practices, wine chemistry and microbiology, and wine flavor development and perception. Wines are used to illustrate the components and processes that determine wine quality.

FDSC 1105 Lab/Field Practice in Wines and Vines (also HORT/VIEN 1105)
Spring. 1 credit. Limited to 25 students; preference given to students in CALS enology/viticulture or Hotel School food and beverage programs. Prerequisites: students must be 21 years of age or taking course to fulfill requirements for their degree program; concurrent or previous enrollment in HORT/FDSC/VIEN 1104 and permission of instructor. Letter grades only. K. Arnink and I. Merwin.
Hands-on laboratory work, wine sensory and chemical analysis, and practical experience in viticulture and wine-making.

FDSC 1500 Food Choices and Issues
Spring. 2 credits. S–U or letter grades.
R. B. Gravani and D. D. Miller.
The goal of this course is to help students develop improved strategies for making healthier food choices. Concepts and principles that form the bases for current dietary guidelines and food safety regulations are discussed. Topics include the U.S. food system, relationships between diet and health, food processing, food safety, and selected contemporary issues relating to nutrition, food quality, and safety. Students conduct nutritional analyses of their diets using a computer software program.

FDSC 2000 Introduction to Physicochemical and Biological Aspects of Food (also NS 3450)
Fall. 3 credits. Prerequisite: college-level courses in chemistry and biology. Letter grades only. Two evening prelims are given. J. H. Hotchkiss and R. S. Parker.
Comprehensive introduction to the physical, chemical, and nutritional properties of foods and to the principles and practice of food science and technology. Topics include chemistry and functionality of commodities and ingredients, chemical and physical phenomena that affect food quality, techniques of processing and preservation, microbiology and fermentation, food safety, and regulation.

FDSC 2100 Food Analysis
Spring. 3 credits. Limited to 24 students. Prerequisite: CHEM 2080 or equivalent. Lec, lab. R. H. Liu and A. Orta–Ramirez.
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.

FDSC 2300 Chef's Chemistry
Spring. 1 credit. S–U or letter grades.
J. Regenstein.
Do you understand scientifically what takes place when you cook food? Learn the science behind some of your favorite foods and foods from around the world. Working with chefs from Cornell Dining, food scientist faculty members will explain the underlying principles of the foods that are prepared in the class. The final EXAM (!) will be an Iron Chef cooking contest.

FDSC 2400 Wines and Grapes: Composition Analysis (also VIEN 2400)
Fall. 2 credits. Prerequisite: one semester of chemistry. Preference given to Enology and Viticulture and Food Science majors. Letter grades only. G. Sacks.
This course will investigate the composition of grapes and wine and the most common analytical tools used in their evaluation. Both the theoretical and practical aspects of grape and wine analyses will be considered.

FDSC 2500 Kosher and Halal Food Regulations
Spring. 2 credits. Prerequisite: at least sophomore standing. S–U or letter grades. 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.

FDSC 2900 Meat Science (also ANSC 2900)
Fall. 2 credits. Letter grades only.
D. E. Shaw.
For description, see ANSC 2900.

FDSC 3210 Food Engineering Principles
Fall. 3 credits. Prerequisites: FDSC 2000 and introductory physics. Letter grades only. 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, refrigeration, and psychrometrics.

FDSC 3400 Microbiology and Technology of Winemaking (also VIEN 3400)
Fall. 3 credits. Limited to 30 students. Prerequisite: introductory microbiology or permission of instructor. Priority given to enology or viticulture students for whom lab is required. Letter grades only. K. Arnink.
This course provides a systematic overview of the microbiological technological and organizational fundamentals of winemaking considering differences among winemaking regions.

FDSC 3410 Microbiology and Technology of Winemaking Lab (also VIEN 3410)
Fall. 1 credit. Limited to 20 students; preference given to students in enology and viticulture programs in Food Science and Plant Science (Horticulture). Prerequisite: permission of instructor. Letter grades only. K. Arnink.
Laboratory practice in winemaking microbiology and technology. Students will produce grape wines from several grape varieties and according to different vinification protocols. The laboratory includes introductory lectures, grape handling, and vinification practices as well as chemical and sensorial grape must and wine analysis.

FDSC 3510 Milk Quality
Fall. 1 credit. Prerequisite: ANSC 2500 or equivalent or permission of instructor. Letter grades only. 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.

FDSC 3940 Applied and Food Microbiology (also BIOMI 3940)
Fall. 3 credits. Prerequisites: BIOMI 2900–2910. 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. A focus on the impact of genomics and the emerging understanding of the microbiome provides an underlying foundation for the course. A 2-credit core section on food microbiology is complemented by a 1-credit section on industrial/biotechnological applications.

FDSC 3950 Food Microbiology Laboratory
Fall. 3 credits. Prerequisite: BIOMI 2910 or equivalent. Letter grades only. A. Orta–Ramirez.
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.

[FDSC 3960 Food Safety Assurance]

FDSC 4000 Current Topics in Food Science and Technology
Spring. 1 credit. S–U grades only. S. J. Mulvaney and staff.
Discussion of current topics in food science. Topics vary and are chosen from scientific literature and popular press.

[FDSC 4010 Concepts of Product Development]

FDSC 4020 Agriculture in Developing Nations I (also IARD 4020)
Fall. 2 credits. K. V. Raman and W. R. Coffman.
For description, see IARD 4020.

[FDSC 4050 Managing Food Waste Without Trashing the Environment]

FDSC 4060 Dairy and Food Fermentations
Fall. 2 credits. Prerequisite: BIOMI 2900. Letter grades only. 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.

FDSC 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. 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 data collection and analysis.

FDSC 4150 Principles of Food Packaging
Spring. 3 credits. Letter grades only. Offered alternate years. 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.

FDSC 4170 Food Chemistry I
Spring. 3 credits. Prerequisites: CHEM 1570 or BIOBM 3300 or 3310. S–U or letter grades. 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.

FDSC 4180 Food Chemistry II
Fall. 3 credits. Prerequisite: FDSC 4170. S–U or letter grades. C. Y. Lee, C. I. Moraru, and J. M. Regenstein.
Discusses the chemical composition of several food groups (meats, fruits, vegetables, and dairy) and describes the chemical reactions and changes that take place during processing and storage, as well their effects on the quality and nutritional characteristics of these foods.

FDSC 4190 Food Chemistry Laboratory
Fall. 2 credits. Prerequisites: BIOBM 3300 or 3310 or CHEM 1570 or equivalent. Corequisite: FDSC 4170. D. D. Miller and A. Orta-Ramirez.
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 sensory 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.*

[FDSC 4220 Functional Foods and Nutraceuticals
Spring. 2 credits. Prerequisites: Basic biochemistry course or permission of instructor. Letter grades only. Offered alternate years; next offered 2010-2011. R. H. Liu.
Covers functional foods and nutraceuticals, bioactive compounds, antioxidants and dietary supplements, micronutrient fortification, botanicals, and herbs in disease prevention and health promotion. Emphasizes the mechanisms of action and scientific evidence of efficacy. Biomarkers, safety and efficacy testing, and regulations for functional foods and nutraceuticals will be discussed.]

FDSC 4230 Physical Principles of Food Preservation and Manufacturing
Fall. 3 credits. Prerequisite: FDSC 3210. Letter grades only. Lec, disc. S. J. Mulvaney.
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.

FDSC 4250 Unit Operations and Dairy Foods Processing
Spring. 3 credits. Prerequisites: FDSC 3210, 3940, 4170, 4180, and 4230 or permission of instructor. Letter grades only. Lec, lab. 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.

FDSC 4300 Understanding Wine and Beer (also VIEN 4300)
Spring. 3 credits. Prerequisites: introductory biology and chemistry or permission of instructor; age 21 by first day of class (Jan. 25, 2010). S–U or letter grades. T. E. Acree, K. J. Siebert, G. L. Sacks, and R. Mira de Orduña.
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.

FDSC 4400 Wine and Grape Flavor Development (also VIEN 4400)
Spring. 3 credits. Limited to 30 students; preference given to students in the enology or viticulture program. Prerequisites: at least one semester of general chemistry and one semester of organic chemistry required. Prior coursework in or knowledge of viticulture and enology recommended. FDSC 1104 and CHEM 2570. Letter grades only. G. Sacks.
This course will use a (bio)-chemical perspective to investigate viticulture and enological factors that impact flavor and other quality attributes (mouthfeel, color, stability) of wine and wine grapes.

FDSC 4500 Fundamentals of Food Law
Spring. 2 credits. Letter grades only. Offered alternate years. 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.

[FDSC 4560 Advanced Concepts in Sensory Evaluation]

FDSC 4666 U.S. Food Industry and Food Science Research
Summer. 1 credit. Prerequisite: enrollment in Food Science summer scholars program or M.P.S. in Food Science and Technology. S–U grades only. M. Wiedmann.
This course will introduce students to the U.S. food industry and food science research. Students will participate in weekly meetings to cover topics such as food science research methods, ethics in food science and research; field trips to food processing plants and R&D facilities, and panel discussions on food science careers in the United States. Students will be required to keep journals with weekly entries that reflect critical thinking on the challenges and opportunities in the discipline of food science.

FDSC 4800 Global Seminar: Building Sustainable Environments and Secure Food Systems for a Modern World (also NTRES/IARD 4800)
Spring. 3 credits. Prerequisite: junior, senior, or graduate standing. J. Lassoie and D. Miller.
For description, see NTRES 4800.

FDSC 4910 Viticulture and Enology Research Practices (also VIEN 4910)
Fall. 3 credits. Prerequisite: VIEN/FDSC/HORT 1105 or permission of instructor. Letter grades only. K. Arnink.
Collaborative wine research project for students in the Viticulture and Enology major. Original research experience, including critical evaluation of literature, experimental protocols and analytical procedures, data collection and evaluation, and scientific research writing. Emphasis on practical winemaking and laboratory methods, with sufficient lecture and discussion time to support student learning of relevant scientific concepts.

FDSC 4940 Special Topics in Food Science
Fall or spring. 4 credits max. 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.

FDSC 4960 Undergraduate Internship in Food Science
Fall or spring. 1–6 credits. Prerequisite: permission of instructor. Students must submit a CALS independent study, research, teaching, or internship form signed by faculty member who will supervise study and assign credits and grade. S–U grades only. 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 students, stating the conditions of the work assignment, supervision, and reporting. All 4960 internship courses must adhere to the CALS guidelines at www.cals.cornell.edu/cals/current/student-research/internship/index.cfm.

FDSC 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 or letter grades. 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.

FDSC 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.

FDSC 4990 Undergraduate Research in Food Science
Fall or spring. 4 credits max; may be repeated for credit. S–U or letter grades. Students must register using independent study form (available in 140 Roberts Hall). Staff.
Students conduct original research directed by a food science faculty member.

FDSC 4991 Food Science Honors Research
Fall. 1 to 4 credits, variable. Prerequisite: enrollment in Food Science research honors program. Students must be eligible for Latin honors and complete honors program application by third week of fall semester, senior year. S–U or letter grades. Staff.
Intended for students pursuing the research honors program in Food Science.

FDSC 4992 Food Science Honors Research
Spring. 1 to 4 credits, variable. Prerequisite: enrollment in Food Science research honors program. Students must be eligible for Latin honors and complete honors program application by third week of fall semester, senior year. S–U or letter grades. Staff.
Intended for students pursuing the research honors program in Food Science.

FDSC 5000 Master of Professional Studies (Agriculture) Project
Fall, spring, summer. 1–6 credits. Requirement for M.P.S. students in graduate field of Food Science and Technology. S–U or letter grades. Staff.
Problem solving project involving analysis and/or active research to the field of Food Science and Technology.

FDSC 5200 Advanced Food Processing and Engineering
Summer. 2 credits. Prerequisites: M.P.S. standing or permission of instructor. Letter grades only. S. Rizvi and S. Mulvaney.
This course is intended primarily for M.P.S. students in the field of Food Science and Technology enrolled in the dual Cornell-TNAU M.P.S. degree program. An intensive overview of the principles of food polymer science and rheology and analysis of current and emerging processes for food manufacturing.

FDSC 5990 Research for Lausanne Exchange Students
Fall/spring. 10 credits max. Prerequisite: permission of instructor. S–U or letter grades. 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.

FDSC 6000 Seminar in Food Science
Fall and spring. 1 credit. Requirement for all graduate students in field of food science and technology; highly recommended for graduate students minoring in food science and technology. S–U grades only. 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.

FDSC 6020 Agriculture in Developing Nations II (also IARD 6020)
Spring, field trip to Asia during Jan. intersession. 3 credits. Prerequisites: IARD 4020 and (or) permission of instructors. Cost of field-study trip is $4,000 (including airfare, local transportation, and lodging). Some merit and need-based financial aid may be available. K. V. Raman and W. R. Coffman.
For description, see IARD 6020.

[FDSC 6040 Chemistry of Dairy Products]

FDSC 6070 Advanced Food Microbiology
Spring. 2 credits. Prerequisites: BIOMI 2900, FDSC 3940. Letter grades only. Offered alternate years. 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).

[FDSC 6080 Chemometric Methods in Food Science]

FDSC 6160 Flavors—Analysis and Applications
Spring. 2 credits. S–U or letter grades. Lec, disc. Offered alternate years. 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.

FDSC 6210 Food Lipids
Spring. 2 credits. Prerequisite: basic biochemistry course. Letter grades only. Offered alternate years. R. H. Liu.
Describes the physical, chemical, biochemical, and functional properties of lipids. Emphasizes lipid oxidation, lipids and human health, and functional foods associated with lipids.

[FDSC 6220 Functional Foods and Nutraceuticals
Spring. 2 credits. Prerequisites: basic biochemistry course or permission of instructor. Letter grades only. Offered alternate years; next offered 2010–2011. R. H. Liu.
Covers functional foods and nutraceuticals, bioactive compounds, antioxidants and dietary supplements, micronutrient fortification, botanicals and herbs in disease prevention and health promotion. Emphasises the mechanisms of action and scientific evidence of efficacy. Biomarkers, safety and efficacy testing, and regulations for functional foods and nutraceuticals will be discussed.]

FDSC 6640 Food Polymer Science: Principles and Applications
Spring. 2 credits. Prerequisites: introductory chemistry and physics. Offered alternate years. 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.

[FDSC 6650 Food and Bioprocessing Systems]

FDSC 6940 Special Topics in Food Science
Fall or spring. 4 credits max. 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.

FDSC 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: 3000- to 4000-level course relevant to chosen topic. S–U grades only. 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.

FDSC 6960 Graduate Internship in Food Science
Fall or spring. 1–6 credits. Prerequisite: permission of instructor. S–U grades only. 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 students, stating the conditions of the work assignment, supervision, and reporting. All 6960 internship courses must adhere to the CALS guidelines at www.cals.cornell.edu/cals/current/student-research/internship/index.cfm.

FDSC 6970 Graduate Individual Study in Food Science
Fall or spring. 1 to 3 credits. S–U or letter grades. Staff.

FDSC 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.

FDSC 8900 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.

FDSC 9900 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, T. L. Bauerle, R. R. Bellinder, M. P. Bridgen, L. J. Bushway, L. Cheng, P. Cousins, L. E. Drinkwater, M. Eames-Sheavly, S. Gan, M. C. Goffinet, D. E. Halseth, A. N. Lakso, N. S. Mattson, I. A. Merwin, W. B. Miller, J. Mt. Pleasant, K. W. Mudge, C. Owens, A. M. Petrovic, D. A. Rakow, A. Rangarajan, B. I. Reisch, F. S. Rossi, J. E. Vanden Heuvel, C. B. Watkins, T. H. Whitlow, H. C. Wien, D. W. Wolfe

HORT 1101 Horticultural Science and Systems
Fall. 4 credits. 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 1102 Hands-On Horticulture
Spring. 2 credits. Not for seniors or plant science majors. Nominal materials fee. 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 1104 Introduction to Wines and Vines (also FDSC/VIEN 1104)
Spring. 3 credits. Letter grades only. K. J. Arnink and I. A. Merwin.
For description, see FDSC 1104.

HORT 1105 Lab/Field Practice in Wines and Vines (also FDSC/VIEN 1105)
Spring. 1 credit. K. J. Arnink and I. A. Merwin.
For description, see FDSC 1105.

HORT 1110 Collaboration, Leadership, and Career Skills in the Plant Sciences
Fall. 2 credits. Prerequisite: permission of instructors. M. P. Pritts and M. Eames-Sheavly.
For all new plant sciences students; seminar will provide opportunities to meet other students and faculty, develop collaboration, leadership, and career skills in the discipline, and to make connections with the world beyond the campus.

HORT 1160 Nature Writing
Spring. 3 credits. Letter grades only. D. W. Wolfe.
Today more than ever we need individuals who not only enjoy or study nature, but also can write effectively about it so that others will know what they know, and feel what they feel. We will begin by reading and writing about the technique of others, from Thoreau and Whitman, to Edward Abbey and Wendell Berry, to emerging new voices in this genre. We will critique essay structure, literary creativity, and evidence of careful research and observation. Nature writing is more than a desk job, and in that spirit we will have at least two shared field trips. Students will develop their unique "voice" for expressing their views, expertise, and passion for nature by research and revision of essay topics of personal interest.

HORT 2010 The Art of Horticulture
Fall. 2–3 credits. Fee for materials: $35. M. Eames-Sheavly.
Experiential survey course, two distinct units: plants used in/as art; plants as a subject of art. Unit 1: sculpture methods, such as turf-works, tree sculpture, Unit 2: drawing, botanical illustration, watercolor/pastel painting. Required: attendance; critical reflection in journals; original, creative final project. Optional third credit: pursue proficiency in drawing.

HORT 2200 Practicing Sustainable Land Care
Fall. 2–3 credits; 1 additional credit for student projects by permission of instructor. Offered odd-numbered years. L. E. Drinkwater.
Experiential course emphasizing interdisciplinary, ecosystem-based approaches to land management and food production. Covers concepts from biological and environmental sciences 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 2350 Plants and Human Well-Being (CA) (HA)
Spring. 3 credits. Offered even-numbered years 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 2400 Exploring the Small Farm Dream
Spring. 1 credit. Prerequisite: permission of instructors. S–U grades only. J. Green and A. Rangarajan.
Explore opportunities and challenges involved in starting up and managing a small farm. Weekly presentations and discussion with innovative farmers and others. Topics include diversified farming, high-value horticulture, grass-based farming, agroforestry, dairy and livestock opportunities, community-supported agriculture, farm business planning, access to land, marketing strategies, juggling jobs, family-farming, and more.

[HORT 2430 Taxonomy of Cultivated Plants (also BIOPL 2430)
Fall. 4 credits. Prerequisite: one year introductory biology or written permission of instructor. May not be taken for credit after BIOPL 2480. Offered even-numbered years; next offered 2010–2011. M. A. Luckow.
For description, see BIOPL 2430.]

HORT 2940 Introduction to Agricultural Machinery (also CSS/AGSCI 2940)
Fall. 2 credits. B. Flannigan and A. DiTommaso.
For description, see CSS 2940.

HORT 3000 Herbaceous Plant Materials
Fall. 3 credits. 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 3100 Production and Marketing of Greenhouse Crops
Spring. 4 credits. Prerequisites: HORT 1101 and any other horticulture course; junior standing preferred. Letter grades only. Cost of required three-day field trip: approx. $130. Offered odd-numbered years; next offered 2010–2011. W. B. Miller.
Covers basics of establishing a greenhouse operation, growing crops in optimized environments and serving niche or mass market. Discusses technology basics and production management.]

HORT 3170 Seed Science and Technology (also CSS 3170)
Fall. 3 credits. Prerequisite: BIOPL 2410 or equivalent course approved by instructor. Letter grades only. Offered odd-numbered years. A. G. Taylor, Geneva Experiment Station.
For description, see CSS 3170.

[HORT 3300 Golf and Sports Turf Management I
Spring. 3 credits. Prerequisite: CSS 2600 or permission of instructor. Letter grades only. Offered odd-numbered years; next offered 2010–2011. 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.]

HORT 3400 Golf and Sports Turf Management Techniques
Fall. 2 credits. Prerequisite: HORT 3300. Letter grades only. Offered odd-numbered years. F. S. Rossi.
A course designed to provide hands-on learning of essential turfgrass management skills including mower set-up, sprayer calibration, calibration mathematics, budget development, etc.

HORT 3800 Organic Food and Agriculture (also CSS/AGSCI 3800)
Fall. 3–4 credits. Prerequisite: CSS 1900, CSS 2600, HORT 1101, or permission of instructor. Staff.
For description, see CSS 3800.

HORT 3910 Woody Plant Identification and Use I
Fall. 2 credits. Limited enrollment. Prerequisite: permission of instructor. Letter grades only. N. L. Bassuk.
Module of HORT/LA 4910 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 4910 or the 4910–4920 sequence.

HORT 3920 Woody Plant Identification and Use II
Spring. 2 credits. Limited enrollment. Prerequisite: permission of instructor. Letter grades only. N. L. Bassuk.
Module of HORT/LA 4920 covering the identification of approximately 160 evergreen trees and shrubs and deciduous plants using winter identification. HORT 3910 (fall module) need not be taken before taking HORT 3920 (spring module). Students also assist in the establishment of a new landscape on campus.

HORT 4000 Principles of Plant Propagation
Spring. 3 credits. Prerequisites: BIOPL 2420 and 2421 or another plant physiology course or permission of instructor. K. W. Mudge.
Asexual (vegetative) propagation including cuttage, graftage, tissue culture, layering, and specialized vegetative reproductive structures and sexual (seed) propagation. 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 4030 Plant Cell and Tissue Culture (also PLBR 4010)
Fall. 3 credits. Letter grades only. E. D. Earle.
For description, see PLBR 4010.

HORT 4040 Plant Tissue Culture Laboratory (also PLBR 4011)
Fall. 1 credit. E. D. Earle.
For description, see PLBR 4011.

HORT 4200 Nursery-Crop Production
Fall. 3 credits. Prerequisite: HORT 4000 or permission of instructor. Cost of field trips: $75. Offered odd-numbered years. K. W. Mudge.
Principles and practices of commercial nursery crop production. Term project required. Includes field trips to commercial nurseries.

HORT 4250 Postharvest Biology of Horticultural Crops
Fall. 2 credits. Offered odd-numbered years. S. Gan.
Study of 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 4251 Postharvest Biology of Horticultural Crops Lab
Fall. 1 credit. Pre- or corequisite: HORT 4250. Offered odd-numbered years. S. Gan.
Laboratory exercises are intended to supplement/complement HORT 4250 lectures. Labs, taught by scientists who are experts in their respective subject areas, will involve some experimental manipulations and physiological and biochemical analysis of harvested fruits, vegetables and flowers, data analysis, and oral and written discussion of the results. Lab periods will also provide time for formal discussion of research papers and topics. May include one field trip during regularly scheduled lab.

HORT 4260 Practicum in Forest Farming as an Agroforestry System (also NTRES/CSS 4260)
Fall. 2 credits. Prerequisite: junior, senior, or graduate standing or permission of instructor. K. W. Mudge, P. Hobbs, 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 site evaluation and planning, temperate-nut harvest and variety evaluation, mushroom culture, small-fruit and fruit-tree culture, and medicinal-herb culture. Outdoor activities are integrated with selected readings via an online discussion board.

HORT 4400 Restoration Ecology
Fall. 5 credits. Prerequisite: upper-division or graduate standing and permission of instructor. Letter grades only. Lec, lab, 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 4420 Berry Crops: Culture and Management
Fall. 3 credits. Offered even-numbered years; next offered 2010–2011. M. P. Pritts.
Study of the evolution, breeding history, and physiology of strawberries, raspberries, blackberries, blueberries, and other small fruit crops. Frequent field trips.]

HORT 4430 Viticulture and Vineyard Management—I (also VIEN 4430)
Fall. 3 credits. Prerequisite: any two-semester college biology course. Letter grades only. J. E. Vanden Huevel and P. Cousins.
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 4440 Viticulture and Vineyard Management—II (also VIEN 4440)
Spring. 3 credits. Pre- or corequisites: HORT 4430 or permission of instructor. Letter grades only. J. E. Vanden Heuvel.
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 4444 Grapevine Biology (also VIEN 4444)
Spring. 3 credits. Prerequisite: introductory botany; BIOPL 2420 or equivalent. Letter grades only. Offered odd-numbered years. A. N. Lakso, M. C. Goffinet, B. I. Reisch, P. S. Cousins, and C. L. Owens.
Focuses on the whole-plant biology of the grapevine that underpins grape-growing. Major topics include vine structure and its organization, vegetative and reproductive development, biomass and carbon balance, water and mineral nutrition, grapevine species and taxonomy, grape scion varieties, rootstocks, breeding and genetic improvement, and genomics.

HORT 4450 Ecological Orchard Management
Spring. 3 credits. Prerequisite: introductory biology. Recommended: previous horticulture/plant science courses. S–U or letter grades. Offered even-numbered 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 4490 Green Signals and Triggers—The Plant Hormones (also BIOPL 4490)
Spring. 2 credits. Prerequisites: introductory biology and BIOPL 2420 or 3420 or permission of instructor. S–U or letter grades. Offered even-numbered years. P. J. Davies.
For description, see BIOPL 4490.

[HORT 4500 Principles of Vegetable Production
Fall. 3 credits. Prerequisite: HORT 1101, CSS 2600, or equivalent. Letter grades only. Two Sat. field trips; students responsible for cost of their meals. Offered even-numbered years; next offered 2010–2011. R. R. Bellinder and S. Reiners.
Commercial vegetable production from variety selection to postharvest. Topics include: crop physiology and culture, soil and pest management, stand establishment, marketing, and history of production.]

HORT 4551–4555 Mineral Nutrition of Crops and Landscape Plants (also CSS 4551–4555)
Spring. 5 modules, 1 credit each. Prerequisite: CSS 2600 and BIOPL 2420. Offered even-numbered years. Coordinator: H. C. Wien.
Students learn 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 4551 Crop Nutrition Principles (also CSS 4551)
Spring, weeks 1–3. 1 credit. Prerequisite: CSS 2600 and BIOPL 2420, or equivalent. Offered even-numbered years. H. C. Wien.
Required module to be taken in addition to at least two, or up to four other modules.

HORT 4552 Agronomic Crop Nutrition (also CSS 4552)
Spring, weeks 4–6. 1 credit. Prerequisite: CSS 2600 and BIOPL 2420, or equivalent. Offered even-numbered years. J. M. Duxbury.
Must be taken with the required Crop Nutrition Principles module—HORT 4551—and at least one other module.

HORT 4553 Vegetable Crop Nutrition (also CSS 4553)
Spring, weeks 7–9. 1 credit. Prerequisite: CSS 2600 and BIOPL 2420, or equivalent. Offered even-numbered years. S. Reiners.
Must be taken with the required Crop Nutrition Principles module—HORT 4551—and at least one other module.

HORT 4554 Landscape Plant Nutrition (also CSS 4554)
Spring, weeks 10–12. 1 credit. Prerequisite: CSS 2600 and BIOPL 2420, or equivalent. Offered even–numbered years. A. M. Petrovic.
Must be taken with the required Crop Nutrition Principles module—HORT 4551—and at least one other module.

HORT 4555 Fruit Crop Nutrition (also CSS 4555)
Spring, weeks 13–14. 1 credit. Prerequisite: CSS 2600 and BIOPL 2420, or equivalent. Offered even-numbered years. L. Cheng.
Must be taken with the required Crop Nutrition Principles module—HORT 4551—and at least one other module.

HORT 4600 Cropping Systems Ecology
Spring. 3 credits. Prerequisite: any crop production or plant ecology course or permission of instructor. Offered even-numbered years. D. W. Wolfe.
Course utilizes the basic principles of plant population biology, environmental physiology, and ecology to evaluate the management, productivity, and environmental impact of various cropping systems. Emphasis is on agricultural systems, but the role of plant-plant interactions and biodiversity in succession and productivity of natural ecosystems will also be discussed.

[HORT 4620 Physiology of Vegetables and Flowers
Spring. 4 credits. Prerequisite: BIOPL 2420 or equivalent. Offered odd-numbered years; next offered 2010–2011. H. C. Wien.
Study of the physiological principles that govern growth, development, and production of reproductive structures of vegetable crops and herbaceous ornamental plants. Hands-on greenhouse experiments.]

HORT 4660 Soil Ecology (also CSS 4660)
Spring. 4 credits, with lab. Prerequisite: one year of biology or ecology and CSS 2600 or permission of instructor. J. E. Thies.
For description, see CSS 4660.

[HORT 4730 Ecology of Agricultural Systems (also BIOEE 4730)
Fall. 3 credits. Prerequisite: BIOEE 2610 or permission of instructor. S–U or letter grades. During first six weeks, R meetings may run later due to field trips. Offered even-numbered years; next offered 2010–2011. L. E. Drinkwater and A. G. Power.
For description, see BIOEE 4730.]

HORT 4800 Plantations Lecture Series
Fall, 12 weeks, 6 lec. 1 credit. S–U grades only. Meets alternate W evenings. D. A. Rakow.
Covers a range of subjects related to the plant and natural sciences, and human-cultural themes. On non-lecture Wednesdays, the class meets to discuss content from the previous week. Students are required to write a reaction paper for each lecture.

HORT 4850 Public Garden Management
Spring. 3 credits. Prerequisites: HORT 3000; HORT 4910 or 4920. Cost of two-and-a-half-day field trip to botanical gardens and arboreta: approx. $85. Offered even-numbered years. D. A. Rakow.
Explores the history of public gardens, types of contemporary public gardens, and the operation of public gardens including botanical gardens and arboreta. Includes separate units on administration and business management of gardens, collections curatorship, collections design, educational programs, research, and management of landscapes and natural areas.

HORT 4900 Golf and Sports Turf Management II
Spring. 2 credits. Prerequisite: HORT 3300. Offered even-numbered years. F. S. Rossi.
Designed for students familiar with turfgrass science and a strong interest in the design, construction, and maintenance of golf courses and sports fields. This course focuses on current and emerging issues concerning the scientific, economic and environmental aspects of golf courses and sports fields.

HORT 4910 Creating the Urban Eden: Woody Plant Selection, Design, and Landscape Establishment (also LA 4910)
Fall. 4 credits. Limited to 48 students. Prerequisite: horticulture or landscape architecture majors or permission of instructor. Preregistration required. 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 4920 Creating the Urban Eden: Woody Plant Selection, Design, and Landscape Establishment (also LA 4920)
Spring. 4 credits. Limited to 48 students. Prerequisite: passing grade in HORT/LA 4910; horticulture or landscape architecture majors or permission of instructors. Preregistration required. 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 4910 and 4920 constitute an integrated course.

HORT 4940 Special Topics in Horticulture
Fall or spring. 4 credits max. S–U or letter grades. 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 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 6000. S–U grades only. L. Cheng.
Undergraduate participation in weekly departmental seminar series.

HORT 4960 Internship in Horticulture
Fall or spring. Variable credit. Prerequisite: permission of student's advisor **in advance of participation** in internship programs. S–U or letter grades. Students must register using individual study form (available in 140 Roberts Hall) signed by faculty member who will supervise study and assign grade. All 4960 internship courses must adhere to the CALS guidelines at www.cals.cornell.edu/cals/current/student-research/internship/index.cfm. Staff.

HORT 4970 Individual Study in Horticulture
Fall or spring. Variable credit. Prerequisite: permission of instructor(s). S–U or letter grades. Students must register using individual study form (available in 140 Roberts Hall). Staff.
Undergraduate individual study in horticultural sciences under the direction of one or more faculty members.

HORT 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 or letter grades. Students must register using individual 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 4990 Undergraduate Research
Fall or spring. Variable credit. Prerequisite: permission of instructor. S–U or letter grades. Students must register using individual study form (available in 140 Roberts Hall.) Staff.
Undergraduate research projects in horticultural sciences.

HORT 5900 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 or letter grades. Staff.
Comprehensive project emphasizing the application of principles and practices to professional horticultural teaching, extension, and research programs and situations.

HORT 6000 Seminar in Horticulture
Fall and spring. 1 credit. Requirement for graduate students majoring or minoring in horticulture. Undergraduate students enroll in HORT 4950. S–U grades only. 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 6100 Extension Volunteer Development in Garden-based Learning
Fall. 2 credits. Prerequisite: course work in horticulture and related fields. Undergraduate plant sciences students by permission of instructor. Offered even-numbered years; next offered 2010–2011. L. J. Bushway.
Extension/outreach training course for graduate entomology, pathology, and horticulture students. Learn skills to effectively develop knowledge of adult volunteers in garden-based learning programs.]

[HORT 6110 Field Experience in Extension Volunteer Development in Garden-based Learning
Spring. 1 credit. Prerequisite: HORT 6100. Offered odd-numbered years; next offered 2010–2011. L. J. Bushway.
Lead introductory horticultural science training sessions for Master Gardener Volunteers and/or other volunteer groups associated with garden-based learning outreach.]

HORT 6150 Quantitative Methods in Horticultural Research
Spring, weeks 1–7. 2 credits. Prerequisite: BTRY 6010, 6020, or permission of instructor. S–U grades only. Offered even-numbered 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 6170 Advanced Analytical Methods for Plant Systems
Spring. 2 credits. Prerequisite: one year of general chemistry, one semester of organic chemistry, plant physiology. Letter grades only. Offered odd-numbered years; next offered 2010–2011. L. Cheng.
Principles and practical applications of selected laboratory methods in the plant and environmental sciences. Emphasizes enhancement of laboratory technique and problem-solving skills.]

HORT 6180 Breeding for Pest Resistance (also PLBR 6180)
Fall. 2 credits. Prerequisites: BIOGD 2810 and PLBR 4030 or equivalents. Highly recommended: introductory plant pathology and/or entomology course. Letter grades only. Offered even-numbered years. P. D. Griffiths.
For description, see PLBR 6180.

HORT 6251 Advanced Postharvest Biology: Postharvest Physiology
Fall. 1 credit (12 lec). Offered even-numbered years. S. Gan.
Emphasizes the physiological and biochemical aspects of growth and maturation, ripening, and senescence of harvested horticulture plant parts.

HORT 6252 Advanced Postharvest Biology: Plant Senescence (also BIOPL 4836)
1 credit. (12 lec). S. Gan.
Introduces molecular, genetics, and genomics approaches in plant senescence and postharvest research.

HORT 6253 Advanced Postharvest Biology: 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 6350 Tools for Thought
Fall. 1 credit. Prerequisite: graduate standing. S–U grades only. 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 6450 Advanced Viticultural Topics (also VIEN 6450)
Spring. 2 credits. Prerequisite: HORT 4430 or equivalent. Letter grades only. Offered even-numbered years. A. N. Lakso.
In-depth lecture/discussion of complex topics of viticulture that have important impacts on fruit composition and wine quality. These include crop load effects, canopy management, water relations, vineyard efficiency, and vineyard variability/precision viticulture.

HORT 6940 Special Topics in Horticulture
Fall or spring. 4 credits max. 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 committees, and the same course is not offered more than twice under this number.

HORT 6970 Graduate Individual Study in Horticulture
Fall or spring. Variable credit. Prerequisite: permission of instructor(s). S–U or letter grades. Staff.
Graduate individual study in horticultural sciences under the direction of one or more faculty members.

HORT 7000 Graduate Teaching Experience
Fall or spring. Variable credit. Prerequisite: permission of instructor; graduate standing. Undergraduates should enroll in HORT 4980. S–U or letter grades. 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 8900 Thesis Research, Master of Science
Fall or spring. Variable credit. S–U grades only.

HORT 9900 Thesis Research, Doctor of Philosophy
Fall or spring. Variable credit. S–U grades only.

INFORMATION SCIENCE

C. Cardie, director; J. Abowd, W. Y. Arms, G. Bailey, K. Bala, J. Birnholtz, L. Blume, R. Constable, D. Cosley, D. Easley, S. Edelman, E. Friedman, S. Fussell, G. Gay, J. Gehrke, T. Gillespie, P. Ginsparg, C. Gomes, F. Guimbretiere, J. Halpern, J. Hancock, A. Hedge, L. Humphreys, D. Huttenlocher, R. Jarrow, T. Joachims, J. Kleinberg, L. Lee, A. E. Leiponen, B. Lust, M. Macy, P. Martin, T. Pinch, R. Prentice, M. Rooth, B. Selman, P. Sengers, D. Shmoys, D. Strang, E. Tardos, E. Wagner, S. Wicker, D. Williamson, C. Yuan

INFO 1300 Introductory Design and Programming for the Web (also CS 1300)
Fall. 3 credits.
For description, see INFO 1300 in CIS section.

INFO 2040 Networks (also CS 2850, ECON 2040, SOC 2090) (SBA)
Spring. 4 credits.
For description, see ECON 2040.

INFO 2140 Cognitive Psychology (also COGST/PSYCH 2140) (KCM)
Spring. 4 credits. Limited to 175 students. Prerequisite: sophomore standing. Graduate students: see INFO 6140.
For description, see PSYCH 2140.

INFO 2300 Intermediate Design and Programming for the Web (also CS 2300)
Spring. 3 credits. Prerequisite: INFO 1300 strongly recommended. Must be taken before INFO 3300.
For description, see INFO 2300 in CIS section.

[INFO 2310 Topics in Web Programming and Design]

INFO 2450 Communication and Technology (also COMM 2450) (SBA)
Fall, summer. 3 credits.
For description, see COMM 2450.

INFO 2921 Inventing an Information Society (also AMST/ECE/ENGRG 2980, HIST 2920, STS 2921)
Spring. 3 credits.
For description, see ENGRG 2980.

INFO 2950 Mathematical Methods for Information Science
Fall. 4 credits. Corequisite: MATH 2310 or equivalent.
For description, see INFO 2950 in CIS section.

INFO 3200 New Media and Society (also COMM 3200) (CA)
Spring. 3 credits.
For description, see COMM 3200.

INFO 3300 Data-Driven Web Applications (also CS 3300)
Spring. 3 credits. Prerequisite: CS 2110 and (INFO 2300 or permission of instructor).
For description, see INFO 3300 in CIS section.

[INFO 3400 Psychology of Social Computing (also COMM 3400)
Fall. 3 credits. Prerequisite: COMM/INFO 2450. Next offered 2010–2011.
For description, see COMM 3400.]

INFO 3450 Human–Computer Interaction Design (also COMM 3450) (SBA)
Fall. 3 credits. Prerequisite: INFO 2450 or permission of instructor. May be taken simultaneously with INFO 2450.
For description, see COMM 3450.

[INFO 3490 Media Technologies (also COMM 3490, STS 3491) (CA)
Spring. 3 credits. Offered odd-numbered years; next offered 2010–2011.
For description, see COMM 3490.]

INFO 3551 Computers: From the 17th Century to the Dotcom Boom (also STS 3551)
Fall. 4 credits.
For description, see STS 3551.

INFO 3561 Computing Cultures (also STS 3561) (CA)
Spring. 4 credits. No technical knowledge of computer use presumed or required. INFO 3551 and 3561 may be taken separately or in any order.
For description, see STS 3561.

INFO 3650 Technology and Collaboration (also COMM 3650) (SBA)
Spring. 3 credits. Prerequisite: INFO 2450.
For description, see COMM 3650.

[INFO 3660 History and Theory of Digital Art (also ARTH 3650) (CA)
Fall. 4 credits. Next offered 2010–2011.
For description, see ARTH 3650.]

INFO 4290 Copyright in the Digital Age (also COMM 4290) (CA)
Fall. 3 credits. Offered odd-numbered years.
For description, see COMM 4290.

INFO 4300 Information Retrieval (also CS 4300)
Fall. 3 credits. Prerequisite: CS 2110 or equivalent.
For description, see INFO 4300 in CIS section.

INFO 4302 Web Information Systems (also CS 4302)
Spring. 3 credits. Prerequisites: CS 2110 and some familiarity with web site technology.
For description, see INFO 4302 in CIS section.

[INFO 4350 Seminar on Applications of Information Science (also INFO 6350)]

INFO 4400 Advanced Human–Computer Interaction Design (also COMM 4400) (SBA)
Spring. 3 credits. Prerequisite: INFO 3450.
For description, see COMM 4400.

INFO 4450 Seminar in Computer-Mediated Communication (also COMM 4450) (SBA)
Spring. 3 credits. Prerequisite: INFO 2450.
For description, see COMM 4450.

INFO 4470 Social and Economic Data (also ILRLE 4470)
Fall. 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 4470 in CIS section.

INFO 4500 Language and Technology (also COMM 4500) (SBA)
Spring. 3 credits. Prerequisites: INFO 2450 or permission of instructor.
For description, see COMM 4500.

INFO 4900 Independent Reading and Research
Fall, spring. 1–4 credits.
Independent reading and research for undergraduates.

INFO 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 5150 Culture, Law, and Politics of the Internet (SBA)]

INFO 5300 The Architecture of Large-Scale Information Systems (also CS 5300)
Spring. 4 credits. Prerequisite: INFO 3300 or CS 4320.
For description, see INFO 5300 in CIS section.

INFO 6140 Cognitive Psychology (also COGST/PSYCH 6140)
Spring. 4 credits.
For description, see PSYCH 6140.

INFO 6300 Advanced Language Technologies (also CS 6740)
Fall, spring. 3 credits. Prerequisite: permission of instructor. Neither INFO 4300 nor CS 4740 are prerequisites.
For description, see CS 6740 in CIS section.

INFO 6341 Information Technology in Sociocultural Context (also STS 6341)
Spring. 4 credits.
For description, see INFO 6341 in CIS section.

[INFO 6350 Seminar on Applications of Information Science (also INFO 4350)]

INFO 6400 Human–Computer Interaction Design (also COMM 6400)
Spring. 3 credits. Prerequisite: graduate standing or permission of instructor.
For description, see COMM 6400.

INFO 6450 Seminar in Computer-Mediated Communication (also COMM 6450)
Spring. 3 credits. Prerequisite: graduate standing or permission of instructor.
For description, see COMM 6450.

[INFO 6648 Speech Synthesis by Rule (also LING 6648)
Spring. 4 credits. Prerequisite: LING 4401, 4419, or permission of instructor. Next offered 2010–2011.
For description, see LING 6648.]

INFO 6500 Language and Technology (also COMM 6500)
Spring. 3 credits. Prerequisite: graduate standing or permission of instructor.
For description, see COMM 6500.

[INFO 6850 The Structure of Information Networks (also CS 6850)]

INFO 7090 IS Colloquium
Fall, spring. 1 credit. For staff, visitors, and graduate students interested in information science.

INFO 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 9900 Thesis Research
Fall, spring. Variable credit. Prerequisite: permission of an information science faculty member.
Thesis research for post–A exam Ph.D. students.

INTERNATIONAL AGRICULTURE AND RURAL DEVELOPMENT

IARD 2020 Perspectives in International Agriculture and Rural Development
Fall. 3 credits. R. Nelson, R. Herdt, and L. Harrington.
The course is designed to enable students to gain an understanding of major issues in international agricultural development. It provides an overview of world poverty and hunger and of varying perspectives on approaches being taken to address these and related problems. Students will characterize the state of agriculture and rural livelihoods in selected developing countries, and will analyze how innovations in agriculture in these countries can contribute to rural development.

IARD 4010 Experience Latin America: Rural and Urban Realities I (also LATA 4010)
Fall. 2 credits. T. Tucker and D. Castillo.
Acquaints students with fundamental cultural, historical, socio-political, literary, anthropological, health, agricultural, and development issues in southern Mexico. The lectures/discussions establish the global and regional contexts for better transcultural understanding. This course may be taken as a stand-alone survey course in international agriculture and rural development or in Latin American studies. However, it is primarily a preparatory course for participants selected to participate in the spring-semester course Experience Latin America II: Chiapas Edition (IARD or LATA 6010), which includes a field-study trip to southern Mexico (Chiapas during the January intersession).

IARD 4020 Agriculture in Developing Nations I (also FDSC 4020)
Fall. 2 credits. K. V. Raman and W. R. Coffman.
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 India and Thailand. The lectures/discussions establish the global and regional contexts for sustainable agricultural development and focus on development challenges in Asia through cases in India and Thailand. 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 6020), which includes a field trip to Asia during the January intersession.

IARD 4030 Traditional Agriculture in Developing Countries (also CSS 4030)
Fall. 1 credit. S–U grades only. P. Hobbs.
For description, see CSS 4030.

IARD 4040 Crop Evolution, Domestication, and Diversity (also PLBR/BIOPL 4040)
Fall. 2 credits. Prerequisite: BIOGD 2810 or PLBR 2250 or permission of instructor. S–U or letter grades. S. Kresovich.
For description, see PLBR 4040.

IARD 4050 Patents, Plants, and Profits: Intellectual Property Management for Scientists and Entrepreneurs (also PLBR 4050)
Spring. 3 credits. Prerequisite: senior or graduate standing. S–U or letter grades. A. F. Krattiger and S. Kowalski.
For description, see PLBR 4050.

IARD 4140 Tropical Cropping Systems: Biodiversity, Social, and Environmental Impacts (also CSS 4140)
Fall. 3 credits. Prerequisite: introductory crop science, soil science, or biology course or permission of instructor. P. Hobbs.
For description, see CSS 4140.

IARD 4800 Global Seminar: Building Sustainable Environments and Secure Food Systems for a Modern World (also FDSC/NTRES 4800)
Spring. 3 credits. Prerequisite: junior, senior, or graduate standing. J. Lassoie and D. Miller.
For description, see NTRES 4800.

IARD 4910 Food, Farming, and Personal Belief (also CSS 4910)
Spring. 1 credit. Prerequisites: Sustainable Agriculture (CSS 1900) or equivalent recommended. S–U grades only. G. Fick.
For description, see CSS 4910.

IARD 4940 Special Topics in International Agriculture and Rural Development (also LATA 4940)
Fall, spring, summer. 1–3 credits. S–U or letter grades. 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 4960 International Internship
Fall, spring. 1–6 credits. Prerequisite: submission of approved internship form (see CALS internship policy guidelines). S–U or letter grades. 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. All 4960 internship courses must adhere to the CALS guidelines at www.cals.cornell.edu/cals/current/student-research/internship/index.cfm.

IARD 4970 Independent Study in IARD
Fall and spring. 1–3 credits. Prerequisite: permission of instructor. S–U or letter grades. 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 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 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 6010 Experience Latin America II (Chiapas Edition) (also LATA 6010)
Spring. 3 credits. Prerequisite: IARD or LATA 4010. T. Tucker and D. Castillo.
Designed to provide students with an opportunity to observe the rich living cultures, environments, ecologies, rural and urban communities, and development issues in tropical southern Mexico. Also designed to promote interdisciplinary exchange among faculty, staff, and students and their Mexican hosts and counterparts. A two-week field-study trip in January is followed by discussions, written projects, and oral presentations dealing with a range of topics pertinent to the target cultures of Chiapas. Optional 1-credit discussion in Spanish can be taken concurrently (SPAN 3020).

IARD 6020 Agriculture in Developing Nations II (also FDSC 6020)
Spring, field trip to Asia during Jan. intersession. 3 credits. Prerequisites: IARD 4020 and (or) permission of instructors. Cost of field-study trip is $4,000 (including airfare, local transportation, and lodging). Some merit and need-based financial aid may be available. K. V. Raman and W. R. Coffman.
Designed to provide students with an opportunity to observe agricultural development in Asia and to promote interdisciplinary exchange among faculty, staff, students and their Indian and Thai counterparts. A three-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 India and Thailand.

IARD 6030 Planning and Management of Agriculture and Rural Development (also GOVT 6927)
Spring. 4 credits. N. T. Uphoff and T. W. Tucker.
Reviews experience and approaches in agricultural and rural development in a range of developing countries, with particular attention to contemporary issues of participation, decentralization, local institutions, capacity-building, civil society, social capital, and empowerment. Case studies from Asia, Africa, and Latin America.

IARD 6850 Training and Development: Theory and Practice (also EDUC 6850)
Spring. 4 credits. S–U or letter grades. R. Caffarella.
For description, see EDUC 6850.

IARD 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 6960 Agroecological Perspectives for Sustainable Development (also NTRES/CSS 6960)
Fall, spring. 1 credit. S–U grades only. L. Fisher, L. Buck, and P. Hobbs.
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 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 6990 International Agriculture and Rural Development M.P.S. Project Seminar
Fall, spring. 1 credit. Prerequisite: required for, and limited to, M.P.S. IARD students or permission of instructor. S–U grades only. 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 7830 Farmer-Centered Research and Extension (also EDUC 7830)
Fall. 3 credits. S–U or letter grades. 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, conduct their own research and empower them to take direct action to solve those problems.

LANDSCAPE ARCHITECTURE

P. J. Trowbridge, chair (443 Kennedy Hall, 255-2738); S. Baugher, J. Foster, K. L. Gleason, A. Hammer, P. H. Horrigan, D. W. Krall, L. J. Mirin, A. Okigbo, D. Ruggeri

LA 1410 Grounding in Landscape Architecture
Fall. 4 credits. Limited to 15 students. Letter grades only. Fee for required package of drafting equipment plus materials for projects: approx. $300.
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 landscape within a cultural and ecological paradigm.

LA 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 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 2020 Medium of the Landscape
Spring. 5 credits. Prerequisite: LA 2010 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 2150 Writing Seminar: Engaging Places
Fall. 4 credits. Lec. Next offered 2010–2011. 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 2610 Fieldwork in Urban Archaeology (also CRP/ARKEO 2610) (CA) (LA)]

[LA 2620 Laboratory in Landscape Archaeology (also ARKEO 2620)]

LA 2820 Photography and the American Landscape (CA) (LA)
Fall. 3 credits. A. Hammer.
Interdisciplinary study of the relationship between photography, the American landscape, and cultural meaning. Topics include representation and perception, photography and painting in the 19th century, expeditionary surveys and national identity, pictorialism, the American sublime, photography and tourism, modernism and postmodernism, the industrial landscape and American ruins, and contemporary practice.

LA 3010 Integrating Theory and Practice I
Fall. 5 credits. Prerequisite: LA 2020 with grade of C or better. Supplies and fees: approx. $250; field trip: approx. $250.
This studio engages participants in the art and science of design as well as focusing on site-scaled projects that consider significant cultural and natural landscapes. This course explores theories of landscape design, restoration, sustainable design, and landscape representation through projects that derive form from a specific site and place.

LA 3020 Integrating Theory and Practice II
Spring. 5 credits. Supplies and fees: approx. $250; field trip: approx. $250; international studios: $500.
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 historical factors and their relationship to site design and planning are critically explored through theory and practice.

LA 3160 Site Engineering
Fall. 5 credits.
Lectures and studio projects dealing with earthwork estimating; storm water management, site surveys, site layout, and horizontal and vertical road alignment.

LA 3180 Site Construction
Spring. 5 credits. Prerequisite: permission of instructor. P. Trowbridge.
This course emphasizes detail design and use of landscape materials in project implementation. It explores construction materials, including specifications, cost estimates, and methods used by landscape architects in project implementation. It includes lectures, studio problems, and development of drawings leading to construction documentation for one or more comprehensive projects.

[LA 3600 Pre-Industrial Cities and Towns of North America (also ARKEO 3600, CRP 3600/6660, LA 6660) (CA) (LA)]

LA 4010 Urban Design Studio
Fall. 5 credits.
This studio focuses on the integration of theory and practice in landscape architecture at the urban scale. Urban design methods and strategies are introduced and applied to city-scaled projects including community engagement.

LA 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 4030 Directed Study: The Concentration
Fall, spring. 1 credit. Prerequisite: landscape architecture undergraduates in final year of study.
Working with their advisor, students create a written and visual paper that documents the concentration intent.

LA 4100 Computer Applications in Landscape Architecture
Fall or spring. 3 credits. Limited to 15 students. Prerequisite: landscape architecture students. S. Curtis.
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 4120 Professional Practice
Fall. 1 credit.
This course presents the student with an understanding of the emerging role of the professional landscape architect. The course helps students choose a type of practice and introduces the problems and opportunities one may encounter in an office or in other professional situations. Topics include job-seeking preparation, practice diversity, marketing professional services, office and project management, construction management, computers in the profession, and ethics.

LA 4180/7900 Audio Documentary: Stories from the Land (CA) (LA)
Spring. 3 credits. Limited to 15 students. Letter grades only. A. Hammer.
Offers hands-on experience in basic audio documentary. Students create aural portraits of New York landscapes and communities undergoing critical change. Encourages projects appropriate for podcasting, webcasting, and radio. Explores relationship between sound and the still or moving image.

LA 4830 Seminar in Landscape Studies (CA) (LA)
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.

LA 4860/7910 Placemaking by Design
Fall. 3 credits. Limited to 20 students. Priority given to juniors, seniors, and graduate students. S–U or letter grades. P. Horrigan.
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 4910 Creating the Urban Eden: Woody Plant Selection, Design, and Landscape Establishment (also HORT 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. $25. P. Trowbridge and N. Bassuk.
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 remediation and plant establishment. Design followed by written specifications and graphic details is produced to implement these practices.

LA 4920 Creating the Urban Eden: Woody Plant Selection, Design, and Landscape Establishment (also HORT 4920)
Spring. 4 credits. Limited to 48 students. Prerequisite: horticulture or landscape architecture majors or permission of instructors; passing grade in HORT/LA 4910. Preregistration required. Supplies: approx. $50; field trips: approx. $25. P. Trowbridge and N. Bassuk.
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, surface detailing, and planting techniques. Students critically assess

potential planting sites and select appropriate trees, shrubs, vines, and groundcovers for a given site. Designs for specific sites are followed by written specifications and graphic details that are produced to implement these proposals. Students are engaged in a hands-on manner in site remediation and planting techniques they have learned by creating new landscapes that serve to integrate theory, principles, and practices. Together, HORT/LA 4910 and 4920 constitute an integrated course.

LA 4940 Special Topics in Landscape Architecture
Fall or spring. 1–3 credits; may be repeated for credit. S–U or letter grades.
Topical subjects in landscape architectural design, theory, history, or technology. Group study of topics not considered in other courses.

LA 4950 Green Cities: The Future of Urban Ecology (also CRP 3840/5840)
Fall. 4 credits. R. Young.
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 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 or letter grades.
Work on special topics by individuals or small groups.

LA 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 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 academically appropriate faculty supervision. Research goals should include description, prediction, and explanation, and should generate new knowledge in the field of landscape architecture.

LA 4991 Undergraduate Honors Research in Landscape Architecture
Fall or spring. 1–5 credits. Students must register using independent study form (available in 140 Roberts Hall).
Permits outstanding students 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 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 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 5010.

LA 5050 Landscape Representation I
Fall. 3 credits. Corequisite: LA 5010 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 5060 Graphic Communication II
Spring. 3 credits. Prerequisite: LA 5050. Corequisite: LA 5020 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 5240 History of European Landscape Architecture*
Fall. 3 credits. L. Mirin.
*Offered through College of Architecture, Art, and Planning.

LA 5250 History of American Landscape Architecture*
Spring. 3 credits. L. Mirin.
*Offered through College of Architecture, Art, and Planning.

LA 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. K. Gleason.
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 forums and public parks of the ancient Roman world. Seminar involves students in current research and publication in this emerging area of archaeology and landscape history.

LA 5820 Photography and the American Landscape
Fall. 3 credits. A. Hammer.
Interdisciplinary study of the relationship between photography, the American landscape, and cultural meaning. Topics include representation and perception, photography and painting in the 19th century, expeditionary surveys and national identity, pictorialism, the American sublime, photography and tourism, modernism and postmodernism, the industrial landscape and American ruins, and contemporary practice.

LA 5900 Theoretical Foundations
Spring. 2 credits. Prerequisite: senior or graduate standing. A. Hammer.
This seminar is intended to provide students in the Department of Landscape Architecture with an overview of the theories and discourses related to the field. Topics may include, but not be limited to, environmental perception, issues of language and representation, pertinent debate in cultural geography, developments in ecological design, landscape urbanism, infrastructure, etc. Weekly readings, discussion, short papers.

LA 5970 Graduate Individual Study in Landscape Architecture
Fall or spring. 1–5 credits; may be repeated for credit.
Work on special topics by individual or small groups.

LA 5980 Graduate Teaching
Fall or spring. 1–3 credits. Prerequisite: permission of instructor. 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 6010 Integrating Theory and Practice I
Fall. 5 credits. Prerequisite: graduate standing or permission of instructor. Supplies and fees: approx. $250.
This studio focuses upon site-scaled projects that consider significant cultural and natural landscapes. Explores theories of landscape restoration, sustainable design, and landscape representation. These are explored through projects that derive form from specific site and place. The integration of site history, ecology, and site construction supports an understanding and relationship between theory and practice.

LA 6020 Integrating Theory and Practice II
Spring. 5 credits. Prerequisite: graduate standing. Drafting supplies and fees: approx. $250; field trip: approx. $250.
This studio builds 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. Projects focus upon 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 6030 Directed Study: The Concentration
Fall, spring. 1 credit. Prerequisite: landscape architecture graduate students in final year of study.

Working with their advisor, students create a written and visual paper that documents the concentration intent.

LA 6160 Site Engineering
Fall. 5 credits.
Lectures and studio projects dealing with earthwork estimating, storm water management, site surveys, site layout, and horizontal and vertical road alignment.

LA 6180 Site Construction
Spring. 5 credits. Prerequisite: permission of instructor. P. Trowbridge.
This course emphasizes detail design and use of landscape materials in project implementation. It explores materials, including specifications, cost estimates, and methods used by landscape architects in project implementation. It includes lectures, short studio problems, and the development of drawings leading to construction documentation for one or more comprehensive projects.

LA 6660 Pre-Industrial Cities and Towns of North America (also CRP 6660)
Spring. 3 credits.

LA 6900 Methods of Landscape Architectural Inquiry
Spring. 3 credits. Prerequisite: graduate standing. S–U or letter grades.
This class builds on the theoretical foundations provided in LA 5900 with an investigation of the variety of methods used in landscape architectural and urban design research and practice. These methods may include, but are not limited to, physical analysis, mapping, site inventory, behavioral observations, cultural landscape investigations, surveys, and interviews. The format of the class combines weekly lecture and applied research.

LA 6940 Special Topics in Landscape Architecture
Fall or spring. 1–3 credits; may be repeated for credit. S–U or letter grades.
Topical subjects in landscape architectural design, theory, history, or technology. Includes group study of topics not considered in other courses.

LA 7010 Urban Design and Planning
Fall. 5 credits. Prerequisite: graduate standing. Supplies and fees: approx. $250; required field trip: approx. $50.
This studio explores the application of urban design and landscape urbanism techniques to the problems and opportunities of contemporary city making. The studio investigates the social, cultural, natural, and infrastructural systems of urban environments, and develops integrated spatial design strategies involving streets, built form, and open space networks. The course introduces three-dimensional computer modeling and digital design media as tools for urban design.

LA 7020 Advanced Design Studio
Spring. 5 credits.
This advanced design studio provides students in the final year of the graduate program in Landscape Architecture with the opportunity to work on complex, real-time projects. The overarching goal of this class is to test the student's theoretical, methodological, technical, and representational competency and ability to engage with a range of scales and issues. Through intensive studio work, seminar sessions, independent research, and site visits students will gain the knowledge and skills necessary to develop sound and creative solutions to environmental design problems.

LA 7900 Audio Documentary: Stories from the Land
Spring. 3 credits. Letter grades only. A. Hammer.
Offers hands-on experience in basic audio documentary. Students create aural portraits of New York landscapes and communities undergoing critical change. Encourages projects for podcasting, webcasting, and radio. Explores relationship between sound and the still or moving image.

LA 7910 Placemaking by Design
Fall. 3 credits. Limited to 20 students. S–U or letter grades. P. Horrigan.
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 7920 Landscape Preservation: Theory and Practice
Fall. 3 credits. Prerequisite: junior, senior, or graduate standing. D. Krall.
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 8900 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

M. E. Krasny, chair (118 Fernow Hall, 255-2822); M. B. Bain, B. L. Bedford, B. Blossey, S. R. Broussard-Allred, L. E. Buck, E. Cooch, P. Curtis, D. J. Decker, J. Dickinson, T. J. Fahey, W. Fisher, G. Goff, M. P. Hare, J. R. Jackson, K. Kassam, B. A. Knuth, C. Kraft, J. P. Lassoie, B. Lauber, S. Morreale, L. Rudstam, R. Schneider, R. Sherman, P. J. Smallidge, C. R. Smith, R. C. Stedman, K. Sullivan, P. Sullivan, J. Tantillo, D. Weinstein, S. Wolf, J. B. Yavitt

NTRES 1101 Intro to the Science and Management of Environmental and Natural Resources (also SNES 1101)
Fall. 3 credits. Prerequisite: first-year students accepted to Natural Resources, Science of Natural and Environment Systems, or Environmental Undecided majors in CALS. J. Yavitt and E. Madsen.
This course provides an overview of the science and management of natural and environmental resources. Material highlights facts and principles from the physical, biological, social, and economic sciences. The focus is on identifying knowledge required to enhance intelligent and sustainable management of the Earth's ecological and environmental systems. Case studies, guided readings, multi-media presentations, videos, discussions, and field and laboratory exercises are used to introduce students to the interdisciplinary basis for understanding the complexities of such systems within the text of modern society. Active student participation in all phases of the course is expected.

NTRES 1102 Introduction to Environmental Studies
Summer. 3 credits. S–U or letter grades. 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 1103 Science Fiction and Environment
Summer. 3 credits. S–U or letter grades. R. J. McNeil.
This course is intended to be primarily for Summer College students (high school rising seniors), new freshmen, Cornell staff, and other people with an interest in, but little formal background in, environmental studies. Science fiction short stories and two books will be used as vehicles for illustrating environmental predicaments and to enable easy discussion of environmental principles that may be helpful to us in choosing ways to live. Some extra attention to studying and learning may be helpful to new college students.

NTRES 2010 Environmental Conservation
Spring. 3 credits. T. Fahey.
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 2100 Introductory Field Biology
Fall. 4 credits. Limited to 60 students. Prerequisite: sophomore or junior standing with advisor in natural resources or permission of instructor; BIOG 1101–1102 or equivalent. Cost of two required overnight weekend field trips: approx. $20. 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 2201 Society and Natural Resources (also DSOC 2201) (SBA)
Spring. 3 credits. Letter grades only. R. Stedman.
The actions of people are crucial to environmental well-being. This course addresses the interrelationships between social phenomena and the natural (i.e., biophysical) environment. It is intended to: (1) increase student awareness of these interconnections in their everyday lives; (2) introduce students to a variety of social science perspectives, including sociology, economics, psychology, and political science, that help us make sense of these connections; (3) identify the contributions of each of these perspectives to our understanding of environmental problems; and (4) discuss how natural resource management and environmental policy reflect these perspectives.

NTRES 2320 Nature and Culture (HA) (CA)
Spring. 3 credits. S–U or letter grades. J. Tantillo.
We will examine the history of human-environment relationships, the diversity of environmental values and ethics, cultural manifestations of nature, and the role of society in forming natural resource and environmental policy. The history of natural resource conservation and management in North America, including the history and philosophy of ecology, will be introduced.

NTRES 2830 DNA, Genes, and Conserving Genetic Diversity
4 credits. Prerequisites: introductory biology or equivalent or permission of instructor. Letter grades only. Lec/lab. M. Hare.
This course is designed to provide a broad understanding of molecular, Mendelian, and population genetic principles relating to genetic diversity and its conservation. This class is recommended as a preliminary to upper-level ecology, evolution, and conservation biology courses. We will focus on eukaryotes and cover a broad range of molecular and cellular genetic concepts including DNA replication, recombination, and gene expression. Mendelian inheritance and linkage mapping also will be covered in depth before expanding the scope to population genetics and quantitative genetics. A laboratory section will be devoted to problem solving, computer exercises, and discussions.

NTRES 3030 Introduction to Biogeochemistry (also EAS 3030)
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 3030.

NTRES 3100 Applied Population Ecology
Fall. 3 credits. Prerequisite: completion of calculus (MATH 1106, 1110, or equivalent). Highly recommended: background in biology or ecology. Letter grades only. 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. Computer exercises are used to reinforce concepts presented in lecture.

[NTRES 3110 Fish Ecology, Conservation, and Management]

[NTRES 3111 Fish Ecology Laboratory]

NTRES 3130 Biological Statistics I (also BTRY 3010, STS 2200)
Fall. 4 credits. Prerequisite: one semester of calculus. P. 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 3140 Conservation of Birds
Spring, summer. 2 credits. Prerequisite: NTRES 2100 or permission of instructor. Offered alternate years. Next offered 2010–2011. C. R. Smith.
A course for majors and nonmajors, focusing on science-based bird conservation and management at the organism, population, community, and landscape levels.]

[NTRES 3141 Conservation of Birds Laboratory
Spring, summer. 1 credit. Corequisite: NTRES 3140. Offered alternate years; next offered 2010–2011. C. R. Smith.
A field-oriented course designed to teach skills of bird observation and identification based on the integration of field marks, songs and calls, and habitat cues.]

NTRES 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 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 3250 Forest Management and Maple Syrup Production]

NTRES 3260 Applied Conservation Ecology
Spring. 3 credits. Prerequisite: BIOEE 2610 or permission of instructor. S. Morreale.
Field and lab course designed to provide direct experience with some of the most important field methods and analytical techniques used to examine ecosystem and community function, structure, and value, especially within the context of contemporary conservation ecology and evolutionary theory. Tools include field sampling techniques, resource and conservation mapping, spatial referencing, GIS, measures of biodiversity, and manual and automated techniques for studying soil, stream, and forest biota and related physical factors.

NTRES 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 3311 Environmental Governance (also STS/BSOC/DSOC 3311) (SBA)]

NTRES 3320 Introduction to Ethics and Environment (KCM)
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 3330 Ways of Knowing: Indigenous and Local Ecological Knowledge (also AIS 3330) (CA, SBA) (D)
Fall. 3 credits. Prerequisites: junior, senior, or graduate standing. K-A. Kassam.
Based on indigenous and local "ways of knowing," this course: (1) presents a theoretical and humanistic framework from which to understand generation of ecological knowledge; (2) examines processes by which to engage indigenous and local knowledge of natural resources, the nonhuman environment, and human-environment interactions; and (3) reflects upon the relevance of this knowledge to climatic change, resource extraction, food sovereignty, and issues of sustainability and conservation.

NTRES 4100 Advanced Conservation Biology: Concepts and Techniques
Fall. 3 credits. Limited to 30 students. Prerequisite: CALS math requirement; NTRES 3100 or equivalent or permission of instructor. E. G. Cooch.
A thorough analysis of the ecological and quantitative dimensions for decision making in modern conservation biology and management. Emphasis is on formal analysis of variation and maintenance of biological diversity, and will focus on principles and quantitative techniques, including

demographic viability analysis of populations, genetic analysis, and adaptive management.]

[NTRES 4110 Quantitative Ecology and Management of Fisheries Resources
Spring. 4 credits. Prerequisites: NTRES 3130 recommended or permission of instructor. S–U or letter grades. Offered alternate years; next offered 2010–2011. 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.]

[NTRES 4120 Wildlife Population Analysis: Techniques and Models
Spring. 3 credits. Prerequisites: NTRES 3100 or 4100 (or equivalent or permission of instructor), NTRES statistics requirement. Lec/lab. Offered alternate years; next offered 2010–2011. E. Cooch.
This course will explore the theory and application of a variety of statistical estimation and modeling techniques used in the study of wildlife population dynamics.]

NTRES 4130 Biological Statistics II (also BTRY 3020, STS 3200)
Spring. 4 credits. Prerequisite: NTRES 3130 or BTRY 3010. P. 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 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 4201 Forest Ecology Laboratory
Fall. 1 credit. Corequisite: NTRES 4200. 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 4220 Wetland Ecology Lecture
Fall. 3 credits. Prerequisite: BIOEE 2610. B. L. Bedford.
Examination of the structure, function, and dynamics of wetland ecosystems with an emphasis on ecological 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. Biodiversity conservation, state and federal wetland regulations, and other approaches to wetland protection are considered.

NTRES 4221 Wetland Ecology Laboratory
Fall. 1 credit. Optional. Corequisite: NTRES 4220. One all-day Sat 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 4240 Landscape Impact Analysis
Spring. 3 credits. Prerequisites: junior, senior, or graduate standing; one introductory and one advanced course in ecology, natural resources, or soil ecology. Offered alternate years. B. L. Bedford.
Advanced course in applied ecology focusing on environmental impact analysis within the context of watersheds, landscapes, and regions rather than individual development projects. The course seeks to critically examine the different temporal and spatial scales at which human impacts operate to alter natural resources and ecosystem services. This expanded perspective forces consideration of the ways in which different components of the environment, the patterning of those components in space and time, and past and present human actions interact to produce environmental effects. Lecture topics include an introduction to the environmental impact assessment process, ecosystem functions versus ecosystem services, the problem of determining "significant" impacts, fundamental concepts of scale, defining assessment boundaries in space and time, current conceptual frameworks for impact analysis of large geographic areas, tools available on-line for impact analysis, and detailed analysis of specific case studies. Students will work in teams to develop an integrated ecological assessment of a specific, large geographic area of the Earth.

NTRES 4260 Practicum in Forest Farming as an Agroforestry System (also HORT/CSS 4260)
Fall. 2 credits. Prerequisite: junior, senior, or graduate standing or permission of instructor. K. W. Mudge, L. E. Buck, and P. Hobbs.
For description, see HORT 4260.

[NTRES 4280 Principles and Practices of Applied Wildlife Science
Spring. 3 credits. Prerequisites: NTRES 3100 or equivalent; permission of instructor. S–U or letter grades. Offered alternate years; next offered 2010–2011.
The course covers the theory and practice of solving wildlife-related resource issues. Differences between basic and applied wildlife science will be discussed.]

NTRES 4300 Environmental and Natural Resources Policy Processes
Spring. 3 credits. Prerequisites: junior standing; special application process. Lec, Wash., D.C., during winter session, approx. Jan. 6–16; three two-hour orientation sessions in fall semester and four two-hour sessions in Feb. and March. Fee: approx. $500. Completed applications due by Oct. 15. Applications available by contacting map10@cornell.edu or at www.dnr.cornell.edu/teaching/ugrad/courses. B. A. Knuth.
Intensive field-based exploration of the environmental policy process and its conceptual framework. Defining environmental problems; aggregating interests; agenda-setting; formulating and selecting alternative solutions; implementation and evaluation stages; roles of lobbyists, legislature, executive branch, and other actors. Case studies; discussion with about 20 prominent Washington policy makers who appear as guest panelists. Self-selected research topic requires conducting independent interviews with Washington experts, policy analysis paper, and oral presentation.

[NTRES 4310 Environmental Strategies (also DSOC 4320) (SBA)]

[NTRES 4320 Human Dimensions of Natural Resource Management]

NTRES 4330 Applied Environmental Philosophy (KCM)
Spring. 3 credits. Recommended: NTRES 3320. J. Tantillo.
Special topic for 2010: Environmental justice. 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 4340 International Conservation: Communities and the Management of the World's Natural Resources
Fall. 4 credits. Prerequisite: junior, senior, or graduate standing. Letter grades only. J. Lassoie.
This course builds an interdisciplinary understanding of the conservation and management of protected areas and fragile landscapes around the world. It uses lectures, readings, library assignments, and multi-media information, including a new Internet-based platform linking students to conservation practitioners, to examine the role of local communities in protecting biodiversity and ecosystem services. Stakeholder analyses of case studies from Africa, Latin America, Asia, and the United States explore conservation science and management issues from different geopolitical perspectives.

NTRES 4440 Resource Management and Environmental Law (also CRP 4440)
Spring. 3 credits. Prerequisite: junior, senior, or graduate standing. S–U or letter grades. R. Booth.
For description, see CRP 4440.

NTRES 4560 Stream Ecology (also BIOEE 4560)
Fall. 4 credits. Prerequisite: BIOEE 2610 or permission of instructor. S–U or letter grades. One Sat field trip. Offered alternate 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 4800 Global Seminar: Building Sustainable Environments and Secure Food Systems for a Modern World (also FDSC/IARD 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 and ecosystem services, including those critical to food security worldwide. This interdisciplinary course uses case studies to explore interrelationships among social, economic, and environmental factors basic to sustainable development. Cases examine contemporary issues identified by participants (i.e., population growth, genetically modified foods, biodiversity, sustainable resource management, 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, and Australia through live interactive videoconferences and electronic discussion boards.

NTRES 4940 Special Topics in Natural Resources
Fall or spring. 4 credits max. S–U or letter grades.
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 4960 Internship in Natural Resources
Fall or spring. Credit TBA. Prerequisite: permission of instructor (academic staff in major). S–U or letter grades. Students must register using the CALS Course Enrollment Form for Undergraduates (available in 140 Roberts Hall).
On-the-job learning experience under the supervision of professionals in a cooperating organization. A learning contract is written between the faculty supervisor and the student, stating the learning objectives, conditions of the work assignment, nature of on-the-job supervision, and reporting requirements, including the formal basis on which the faculty supervisor will assign a grade. All 4960 internship courses must adhere to the CALS guidelines at http://www.cals.cornell.edu/cals/current/student-research/internship/index.cfm.

NTRES 4970 Individual Study in Environmental Social Science and Resource Policy
Fall, spring, or winter. Credit TBA. Prerequisite: permission of instructor. S–U or letter grades. Students must register using independent study form (available in 140 Roberts Hall). S. R. Broussard, T. Brown, L. E. Buck, D. J. Decker, J. Enck, K. Kassam, B. Knuth, J. Lassoie, T. B. Lauber, R. Stedman, J. Tantillo, and S. Wolf.
Individual study under faculty supervision. Topics in environmental social science resource policy are arranged depending on the interests of students and availability of staff.

NTRES 4971 Individual Study in Applied Ecology and Conservation Biology
Fall or spring. Credit TBA. Prerequisite: permission of instructor. S–U or letter grades. Students must register using independent study form (available in 140 Roberts Hall). M. Bain, E. Cooch, P. Curtis, T. Gavin, M. Hare, J. R. Jackson, C. Kraft, J. Lassoie, S. Morreale, M. Richmond, L. Rudstam, C. Smith, and P. Sullivan.
Individual study under faculty supervision. Topics in applied ecology or conservation biology are arranged depending on the interests of students and availability of staff.

NTRES 4972 Individual Study in Ecosystem Science and Biochemistry
Fall or spring. Credit TBA. Prerequisite: permission of instructor. S–U or letter grades. Students must register using independent study form (available in 140 Roberts Hall). B. Bedford, B. Blossey, T. Fahey, M. Krasny, R. Schneider, R. Sherman, P. Smallidge, and J. Yavitt.
Individual study under faculty supervision. Topics in ecosystem science and biogeochemistry are arranged depending on the interests of students and availability of staff.

NTRES 4980 Undergraduate 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 or letter grades.
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 4991 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 qualified 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 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 6000 Introduction to Graduate Study in Natural Resources
Fall. 2 credits. Prerequisite: beginning graduate students whose faculty advisors are in Natural Resources. S–U grades. C. E. Kraft.
Includes discussions of the role of science in natural resource management and conservation, with a particular focus on how scientists pursue career paths toward effective participation in this realm. Discussions focus on the practices of scientists and institutions that provide a framework for scientific endeavors.

NTRES 6010 Seminar on Selected Topics in Environmental Social Science and Resource Policy
Fall or spring. 1–4 credits. S–U grades only. Check with department for availability. Staff.
Selected readings and discussions of research and/or current issues in environmental social science and resource policy. Offering varies by semester and is subject to availability of staff.

NTRES 6040 Seminar on Selected Topics in Resource Policy and Management
Fall or spring. 1–4 credits. S–U grades only. Check with department for availability. Staff.
Special topics seminar on subjects related to resource policy and management. Offering varies by semester and is subject to availability of staff.

[NTRES 6110 Quantitative Ecology and Management of Fisheries Resources
Spring. 4 credits. Prerequisite: NTRES 3130 or permission of instructor. S–U or letter grades. Offered alternate years; next offered 2010–2011. P. J. Sullivan.
Taught in conjunction with NTRES 4110 (see description above). Students taking the course for graduate credit are asked, in addition to the 4000-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 6120 Wildlife Population Analysis: Techniques and Models
Spring. 3 credits. Prerequisites: NTRES 3100 (or equivalent or permission of instructor), college-level math and statistics course. Offered alternate years; next offered 2010–2011. E. Cooch.
For description, see NTRES 4120.]

NTRES 6140 Seminar on Selected Topics in Applied Ecology and Conservation Biology
Fall and spring. 1–4 credits. Prerequisite: permission of instructor. S–U grades only. Check with department for availability. Staff.
Discussion of individual research, current problems, and current literature in applied ecology and conservation biology. Offering varies by semester and subject to availability.

NTRES 6160 Seminar on Selected Topics in Ecosystem Science and Biogeochemistry
Fall or spring. 1–4 credits. Prerequisite: upper-level undergraduate or graduate standing. S–U grades only. Check with department for availability. Staff.
Reviews current literature, student research, and selected topics of interest.

[NTRES 6280 Principles and Practices of Applied Wildlife Science (also NTRES 4280)
Spring. 3 credits. Prerequisites: NTRES 3100 or equivalent; permission of instructor. S–U or letter grades. Offered alternate years; next offered 2010–2011.
For description, see NTRES 4280. Students taking the course for graduate credit are required to participate, read supplemental materials, and complete an additional out-of-class assignment.]

NTRES 6340 International Conservation: Communities and the Management of the World's Natural Resources
Fall. 4 credits, variable. Prerequisite: graduate students; seniors by permission of instructor. Letter grades only; S–U grades by permission of instructor. J. P. Lassoie.
For description, see NTRES 4340. Students taking the course for graduate credit are required to read supplemental materials, undertake more complex assignments, and participate in a seminar discussion once a week (TBA) with the instructor and other staff members, in addition to fully participating in NTRES 4340.

NTRES 6360 Systems in the Environment
Spring. 2 credits. Prerequisite: graduate student standing. S–U grades only. M. Bain.
Ecosystems are posed as human-natural entities that can be understood, managed, and conserved. Systems theory provides principles for analyzing ecosystems and ecosystem research provides practices and methods for conservation. Both perspectives will be developed to investigate ecosystems as units of management and study. Examples will range from sand to society with an emphasis on plants and animals.

NTRES 6700 Spatial Statistics
Spring. 3 credits. Prerequisites: BTRY 6010 and 6020. Highly recommended: introductory GIS course. S–U or letter grades. Offered alternate years. 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 6200.

NTRES 6940 Special Topics in Natural Resources
Fall or spring. 4 credits max. S–U or letter grades.
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 6960 Agroecological Perspectives for Sustainable Development (also IARD/CSS 6960)
Fall and spring. 1 credit. S–U grades only. L. Buck, L. Fisher, and S. DeGloria.
For description, see IARD 6960.

NTRES 6970 Graduate Individual Study in Natural Resources
Fall or spring. Credit TBA. Prerequisite: permission of instructor. S–U or letter grades. 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 7330 Social-Cultural and Ecological Role of Diversity (D)
Spring. 3 credits. Prerequisites: seniors and graduate students. K-A. Kassam and B. Blossey.
Given the dramatic and coupled nature of environmental and social change as well as the current limitations on understanding the implications of these changes for adaptation and resilience, this research seminar explores the roles of and linkages between biological and cultural diversity. The graduate seminar will: (1) examine the concepts of biological and cultural diversity; (2) explore empirical research that elaborates upon the relationship between biological and cultural diversity; and (3) determine the relevance of these coupled concepts to issues of sustainability and conservation.

NTRES 7600 Environment and Social Transitions: Graduate Seminar in Environmental Sociology (also DSOC 7600)
Fall or spring. 3 credits. Graduate students only. C. Geisler, S. Wolf, and R. Stedman.
For description, see DSOC 7600.

NTRES 7800 Graduate Seminar in Ornithology (also BIOEE 7800)
Fall or spring. 1 credit. S–U grades only. Undergraduates must have permission of instructor. J. Dickinson, W. Koenig, I. Lovette, A. Dhondt, and D. Winkler.
Group intensive study of current research in ornithology. Topics vary from semester to semester. Course may be repeated for credit.

NTRES 7900 Graduate-Level Thesis Research
Fall and spring. Credit TBA. Prerequisite: Ph.D. students **before** "A" exam has been passed. S–U grades only.

NTRES 8900 Master's Thesis Research
Fall and spring. Credit TBA. Prerequisite: graduate students working on master's thesis research. S–U grades only.

NTRES 9900 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.

Ecology and Biology (ENTOM 4550, 4700; BIOEE 2610, 2630, 2740, 2780, 3630, 4500, 4570, 4620, 4660, 4690, 4700, 4730, 4750, 4760, 4780; BIOMI 2900–2920, 3970, 4180; BIONB 2210, 2220; BIOPL 2410, 2470, 2480, 3420, 4480; CSS 4660, 4720; EAS 1540, 2200, 3010, 3030, 3500, 3510, 4400)

Environment and Society (DSOC 2010, 3240, 3400, 4100)

Environmental Law, Ethics, and Philosophy (STS 2061, CRP 3840, 4440, 4510, PHIL 2410, 2460, 3810)

Human Systems and Communication (COMM 2850, 3520, 4210, 4560, 4660; ENTOM 3350; CRP 3840)

Physical Sciences (BEE 1510, 2510, 3710, 4010, 4270, 4350, 4710, 4730, 4750; CSS 2600, 3650, 3720, 3970, 4110, 4200, 4830; EAS 1101, 1540, 3050; CEE 4320, 4510)

Public Policy and Politics (GOVT 2947, 3071, 3131, 4281; BSOC 4616)

Resource Economics (AEM 2500, 4310, 4500, 4510)

Spatial Data Interpretation (CSS 4110, 4200, 4650, 6200, 6600; DSOC 3140)

PLANT BREEDING AND GENETICS

T. Brutnell, E. S. Buckler, W. R. Coffman, W. De Jong, J. J. Doyle, E. D. Earle, V. Gracen, P. Gregory, O. Hoekenga, M. M. Jahn, J. L. Jannink, A. F. Krattiger, S. Kresovich, D. Matthews, L. Li, S. R. McCouch, M. A. Mutschler, R. J. Nelson, W. Pawlowski, K. V. Raman, T. L. Setter, F. Shotkoski, M. E. Smith, M. E. Sorrells, S. D. Tanksley, D. R. Viands. Emeritus: R. E. Anderson, H. M. Munger, R. P. Murphy, W. D. Pardee, R. L. Plaisted

PLBR 2010 Plants, Genes, and Global Food Production
Fall. 3 credits. May be used for partial fulfillment of CALS distribution requirement Physical and Life Sciences. Prerequisite: one year introductory biology or permission of instructor. S. McCouch.
Introduction to plant breeding; offers a sense of the importance of the field, tracing its evolution from the pre-scientific days of crop domestication to modern applications of biotechnology. Offers examples of how breeding objectives are realized and raises questions about the environmental, social, and economic consequences of intensive food production systems. Emphasizes the connection between the genetics of plants, modern scientific research, and the potential to respond to the growing human demand for food, fiber, fuel, and environmental sustainability.

PLBR 2250 Plant Genetics
Spring. 3 or 4 credits; 2 credits if taken after BIOGD 2810. Prerequisites: one year of introductory biology or equivalent; permission of instructor for students who have taken BIOGD 2810. Staff.
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.

PLBR 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.

PLBR 4010 Plant Cell and Tissue Culture (also HORT 4030)
Fall. 3 credits. Prerequisite: plant biology or genetics course or permission of instructor. 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.

PLBR 4011 Plant Tissue Culture Laboratory (also HORT 4040)
Fall. 1 credit. Limited enrollment. Pre- or corequisite: PLBR 4010 or permission of instructor. S–U or letter grades. E. D. Earle.
Provides hands-on experience in plant tissue culture and complements PLBR 4010. 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.

PLBR 4030 Genetic Improvement of Crop Plants
Fall. 3 credits. Prerequisites: BIOGD 2810, PLBR 2250, or other standard genetics course and course in crops or horticulture. 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.

PLBR 4040 Crop Evolution, Domestication, and Diversity (also BIOPL/IARD 4040)
Fall. 2 credits. Prerequisite: BIOGD 2810 or PLBR 2250 or permission of instructor. S–U or letter grades. S. Kresovich.
Evolution, domestication, and breeding of crop plants have affected the current diversity we conserve and use. Based on advances in genetics, systematics, and crop improvement, this course presents an integrated approach to understanding and describing diversity of agricultural and horticultural species. Also addressed are underlying ethical, legal, and social issues affecting crop conservation and use.

PLBR 4050 Patents, Plants, and Profits: Intellectual Property Management for Scientists and Entrepreneurs (also IARD 4050)
Spring, eight weeks. 3 credits. Prerequisite: senior or graduate standing. S–U or letter grades. A. F. Krattiger and S. Kowalski.
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.

PLBR 4060 Methods of Plant Breeding Laboratory
Fall. 2 credits. Pre- or corequisite: PLBR 4030 or equivalent. S–U or letter grades. 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.

PLBR 4070 Nutritional Quality Improvement of Food Crops
Spring. 1 credit. Prerequisite: one year introductory biology or permission of instructors. S–U or letter grades. L. Li, L. Kochian, and R. Welch.
Introduction to biofortification of crop plants for enhancing their nutritional quality and health-promoting properties. The course discusses strategies to increase the contents of micronutrients, vitamins, phytochemicals, as well as the qualities of proteins and lipids with regard to improving food crops for human nutrition and health.

PLBR 4075 Evolution of Plant Breeding and Genetics
Spring. 2 credits. Prerequisite: permission of instructors. Letter grades only. O. Hoekenga and T. Brutnell.
We will discuss seminal research papers that advanced the fields of basic and applied plant genetics. We will juxtapose the original discovery with a recent report that speaks to our present understanding of the same phenomenon. Participation in discussion, a presentation, and end of term paper will determine the grade.

PLBR 4080 QTL Analysis: Mapping Genotype to Phenotype in Practice
Spring. 1 credit. Prerequisite: BTRY 6010 or 4070 or permission of instructor. J. L. Jannink and E. Buckler.
Discussion of mating designs and populations as well as statistical models to identify genetic loci that affect the phenotype and to predict breeding and genotypic value using DNA polymorphisms. Practical application to real datasets.

PLBR 4460 Plant Cytogenetics Laboratory
Spring, two-week module. 1 credit. Prerequisite: genetics course or permission of instructor. Check with department for further information. S–U grades only. W. Pawlowski.
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.

PLBR 4826 Plant Biotechnology (also BIOPL 4826)
Spring. 1 credit. Prerequisite: BIOPL 4831 or permission of instructor. S–U or letter grades. 12 lec. E. D. Earle.
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.

PLBR 4831 Concepts and Techniques in Plant Molecular Biology (also BIOGD/BIOPL/PLPA 4831)
Fall, eight weeks. 2 credits. Prerequisites: see BIOPL 4830. S–U or letter grades. Two lec and one day of disc per week. M. Hanson, T. Owens, and M. Scanlon.
For description, see BIOPL 4831.

PLBR 4832 Proteomics and Protein Mass Spectrometry in Biology (also BIOPL/PLPA 4832)
Fall. 1 credit. Prerequisites: BIOGD 2810, BIOBM 3300 or 3320, or equivalent. Recommended: BIOBM 3310. S–U or letter grades. Offered alternate years. K. van Wijk.
For description, see BIOPL 4832.

[PLBR 4833 Plant Genome Organization (also BIOPL 4833)]

PLBR 4835 Molecular Breeding (also BIOPL 4835)
Fall. 1 credit. S–U or letter grades. Offered alternate years. S. Tanksley.
For description, see BIOPL 4835.

PLBR 4940 Special Topics in Plant Breeding
Fall or spring. 4 credits max. S–U or letter grades.
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.

PLBR 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 advisor 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. All 4960 internship courses must adhere to the CALS guidelines at www.cals.cornell.edu/cals/current/student-research/internship/index.cfm.

PLBR 4970 Individual Study in Plant Breeding
Fall or spring. Variable credit; may be repeated to max. of 6. Prerequisite: permission of instructor. S–U or letter grades. Students must register using independent study form (available in 140 Roberts Hall). Staff.

PLBR 4980 Undergraduate Teaching
Fall or spring. Variable credit; may be repeated to max. of 6. Prerequisites: permission of instructor and previous enrollment in course to be taught or equivalent. S–U or letter grades. 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.

PLBR 4990 Undergraduate Research
Fall or spring. Variable credit. Prerequisite: permission of instructor. S–U or letter grades. Students must register using independent study form (available in 140 Roberts Hall). Staff.
Undergraduate research projects in plant breeding.

PLBR 6060 Advanced Plant Genetics
Spring. 3 credits. Prerequisites: BIOGD 2810 or equivalent and permission of instructor. S–U or letter grades. W. Pawlowski.
Advanced survey of genetics in higher plants including selected topics in transmission genetics, epigenetics, and chromosome biology. Emphasizes development of critical analytical skills through reading of current literature and a class project.

[PLBR 6180 Breeding for Pest Resistance (also HORT 6180)]

PLBR 6220 Seminar
Fall or spring. 1 credit. S–U grades only. Staff, graduate students, and visitors.

PLBR 6500 Special Problems in Research and Teaching
Fall or spring. 1 or more credits. Prerequisite: permission of instructor supervising research or teaching. Staff.

PLBR 6940 Special Topics in Plant Breeding
Fall or spring. 4 credits max. S–U or letter grades.
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.

[PLBR 7160 Perspectives in Plant Breeding Strategies].

PLBR 7170 Quantitative Genetics in Plant Breeding
Spring. 3 credits. Prerequisites: PLBR 4030 and BTRY 6010 or equivalent. Letter grades only. Offered even-numbered years. D. R. Viands.
Discussion of quantitative genetics for more effective plant breeding. Specific topics include population genetics, linkage, components of variance (estimated from various mating designs); 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.

PLBR 7900 Graduate-Level Dissertation
Fall or spring. Variable credit. Prerequisite: doctoral students who have not passed "A" exam; permission of instructor. S–U grades. Graduate faculty.

PLBR 8900 Master's-Level Thesis Research
Fall or spring. Variable credit. Prerequisite: master's candidates; permission of instructor. S–U grades. Graduate faculty.
For students working on a master's thesis.

PLBR 9900 Doctoral-Level Dissertation Research
Fall or spring. Variable credit. Prerequisite: doctoral students who have passed "A" exam; permission of instructor. S–U grades. Graduate faculty.
For students admitted to candidacy **after** "A" exam has been passed.

PLANT PATHOLOGY AND PLANT-MICROBE BIOLOGY

G. W. Hudler, chair (331 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, T. A. Zitter

PLPA 1100 Symbiotic Associations in Nature
Fall or spring. 3 credits. Letter grades only. E. B. Nelson.
This course is a Freshman Writing Seminar where students will explore symbiotic biology and the nature of science and written scientific communication through discussions of a broad range of symbiotic relationships. Students will be exposed to a broad range of writing styles in scientific communication. Students will gain experience writing in a number of styles common in the biological sciences. Additionally, students will learn to use evidentiary and inferential reasoning, articulate their thoughts and ideas through writing, make logical and systematic arguments, learn to revise their own writing, and effectively critique others' writing content, organization, and style.

PLPA 1200 Evolution: Evaluating the Public Debate
Fall or spring. 3 credits. Letter grades only. R. Loria.
Though we live in a world infused with science and technology, most of the general public and a significant number of Cornell students do not believe in evolution. Evolution, the theory that organisms are connected by genealogy and change over time, is well supported and accepted as true by the scientific community. Nevertheless, there is an emotional debate outside scientific circles about the legitimacy of evolution as an explanation for the diversity of life on earth, and the existence of humans in particular. Readings will include books and articles that address the evidence for evolution. We will also analyze the writings of proponents of "Intelligent Design" and study descriptions of the controversy in the popular press, both current and historical.

PLPA 2010–2015 Magical Mushrooms, Mischievous Molds
Spring. 2 or 3 credits. S–U or letter grades. G. W. Hudler and B. G. Turgeon.
The Department of Plant Pathology and Plant-Microbe Biology offers several course options for students who want to learn about the kingdom FUNGI. All three courses (PLPA 2010, 2013, and 2015) have the same two-lecture-per-week core, and students wanting only the core should enroll in PLPA 2010 for 2 credits. Students interested in additional exposure to the FUNGI can enroll in PLPA 2013 or 2015 (each for 3 credits). See individual course descriptions below for more detail.

PLPA 2010 Magical Mushrooms, Mischievous Molds
Spring. 2 credits. S–U or letter grades. 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.

PLPA 2013 Mushrooms, Molds, and More
Spring. 3 credits. Fulfills 3 credits of introductory biology for non–life science majors. Limited to 24 students per sec. Letter grades only. G. W. Hudler.
Lectures and exams for this course are the same as those in PLPA 2010. However, students in PLPA 2013 will also participate in a weekly 55-minute discussion section where they will grow mushrooms and other fungi in culture, learn about contemporary classification of fungi, see examples of major taxa growing on natural substrates, and determine whether suspect pathogens really can kill agricultural crops. Students also teach their peers about the fungus world with presentations of their own creation. (CALS non–life science majors can receive college physical/life science distribution credits upon completion of this course but they must register for a letter grade.)

PLPA 2015 Mushrooms, Molds, and Molecules
Spring. 3 credits. Fulfills 3 credits of introductory biology for non–life science majors. Limited to 30 students per sec. Letter grades only. B. G. Turgeon.
Lectures and exams for this course are the same as those in PLPA 2010. However, students in PLPA 2015 will also participate in a weekly 55-minute discussion section to provide more in-depth exposure to some of the issues raised in 2010 lecture. Experts will emphasize that fungi produce myriads of molecules that are beneficial to other organisms (e.g., antibiotics, immunosuppressants, biocontrol agents) or to themselves (e.g., for development, reproduction, nutrient gathering, stress reduction), or detrimental to other organisms (e.g., toxins, poisons, allergens, hallucinogens). (CALS non–life science majors can receive college physical/life science distribution credits upon completion of this course but they must register for a letter grade.)

PLPA 3010 Biology and Management of Plant Diseases
Fall. 4 credits. Prerequisite: one year of biology. Letter grades only. W. E. Fry.
Introduction to the biology of the pathogens that cause plant diseases, and the diagnosis and management of plant diseases. Topics include the biology of bacteria, fungi, oomycetes, viruses, and nematodes; disease cycles, plant disease epidemiology, and the principles and practices of plant disease management. Intended for students who want a practical knowledge of plant diseases and their control, as well as for students preparing for advanced courses in plant pathology and plant–microbe biology.

[PLPA 3090 Fungi
Fall. 3 credits. Prerequisite: one year of biology. Recommended: concurrent enrollment in PLPA 3190. S–U or letter grades. K. T. Hodge.
A thorough introduction to the astounding kingdom of fungi, including mushrooms, molds, yeasts, athlete's foot, histoplasmosis, and the blue stuff in blue cheese. We cover fungal biodiversity, how fungi work, and their roles in the environment and in human affairs. Students work with living and preserved fungi and learn basic lab and identification skills.]

PLPA 3190 Mushrooms of Field and Forest
Fall, weeks 1–8. 2 credits. Letter grades only. K. T. Hodge.
Students learn to identify mushrooms and other macrofungi on a series of eight field trips to local forests. Mushrooms are collected during afternoon lab field trips. During the evening labs, students use keys and microscopes to identify mushrooms they've collected, and brief lectures introduce fungal ecology and diversity. Students must attend both lab times.

PLPA 3290 Medical and Veterinary Mycology (also VETMI 3290)
Spring. 2 credits. Prerequisite: introductory biology. Letter grades only. K. T. Hodge.
Introduction to fungi that cause human and animal disease. Lectures introduce topics including important fungi and the diseases they cause, which range from athlete's foot to equine guttural pouch aspergillosis. We cover the ecology and epidemiology of animal pathogenic fungi, mycotoxins, mushroom poisoning, disease management, and clinical diagnosis.

[PLPA 3940 Circadian Rhythms (also ENTOM/BIOGD/BIONB 3940)
Fall. 2 credits; optional 3rd-credit lab. Prerequisite: 2000-level biology. S–U or letter grades. K. Lee.
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).]

PLPA 4090 Principles of Virology (also VETMI/BIOMI 4090)
Fall. 3 credits. Prerequisites: BIOMI 2900, 2910 or permission of instructor. Recommended: BIOBM 3300–3320, 4320. Letter grades only. S. G. Lazarowitz, J. S. L. Parker, and N. Osterrieder.
For description, see VETMI 4090.

PLPA 4161 Microbes and Food: Contemporary Issues Affecting Humanity
Spring. 4 credits. Prerequisite: senior standing. S–U or letter grades. S. Beer.
Addresses the all-encompassing role that microbes play in contemporary life. How do microbes affect food production, processing, preservation, safety, and waste disposal? Assesses the role of microbes in industrial and environmental processing. Deals with origins of agriculture, GMOs, and high-input versus sustainable food production. Intense seminar/discussion format.

PLPA 4190 Agricultural Application of Plant Disease Concepts
Fall. 2 credits. Eight sessions. Prerequisite: PLPA 3010 **and** permission of instructor. S–U or letter grades. H. S. Aldwinckle and B. Nault.
Addresses real-world problems in plant pathology and entomology through the application of research. Students tour fields of diverse fruit and vegetable field crops, a nursery, forests, and a golf course that have been impacted by diseases and arthropod pests. Strategies for managing diseases and pests based on research and the interface between Research and Extension are emphasized. **This course is taught at Geneva. Free transportation available.**

PLPA 4200 Grape Pest Management (also ENTOM/VIEN 4200)
Fall. 3 credits. Prerequisite: PLPA 3010, ENTOM 2410, or permission of instructors. S–U or letter grades. W. Wilcox, G. Loeb, and A. Landers.
The course emphasizes general integrated pest management concepts, the biology and specific management practices pertaining to the major diseases and arthropod pests of grapes, and modern spray application technologies. Laboratories emphasize field illustrations of classroom concepts. Team taught by a plant pathologist, entomologist, and agricultural engineer.

PLPA 4330 Ecology of Infectious Diseases
Fall. 3 credits. Prerequisites: at least two semesters of introductory biology or equivalent. Letter grades only. E. Nelson.
Introduction to the ecology of plant, animal, and human diseases. The course will emphasize a science-based approach for understanding the nature of disease development, the behavior of infectious agents and hosts, the ecological principles influencing disease emergence, transmission, and resurgence, and the general approaches to disease prediction, detection, and management.

[PLPA 4430 Pathology of Trees and Shrubs
Fall. 4 credits. Limited to 30 students. Prerequisites: PLPA 3010 or equivalent. S–U or letter grades. Offered even-numbered years; next offered 2010–2011. G. W. Hudler.
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.]

PLPA 4480 Evolution and Ecology of Symbiotic Associations (also BIOMI 4480)
Spring. 2 credits. Prerequisites: BIOG 1101–1102 or equivalent. Letter grades only. T. Pawlowska.
Symbiosis, a living together of two organisms in close associations, encompasses a spectrum of interactions ranging from mutually detrimental to mutually beneficial. We will focus on a selection of ecologically important symbiotic interactions, consider their evolutionary origins, and explore conditions that would favor their establishment and maintenance.

PLPA 4821–4822 Molecular Plant-Pathogen Interactions I and II (also BIOPL 4821–4822)
Spring, 4 weeks. 1 credit. Prerequisites: BIOGD 2810, BIOBM 3300 or 3310, and BIOPL 4831. A. R. Collmer and B. G. Turgeon (odd years); S. G. Lazarowitz and G. B. Martin (even years).
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.

PLPA 4823 Molecular Plant-Microbe Interactions (also BIOPL/BIOMI 4823)
Spring, weeks 1–4. 1 credit. Prerequisites: BIOGD 2810, BIOBM 3300 or 3310 or 3330, and BIOPL 483.1 or equivalents. S–U or letter grades. Offered even-numbered years. S. C. Winans.
For description, see BIOPL 4823.

PLPA 4831 Plant Molecular Biology I—Concepts and Techniques in Plant Molecular Biology (also BIOGD/BIOPL/PLBR 4831)
Fall, weeks 1–4. 2 credits. Prerequisites: BIOGD 2810, BIOBM 3300, or 3310. S–U or letter grades. M. Hanson, T. Owens, and M. Scanlon.
For description, see BIOPL 4831.

PLPA 4832 Proteomics and Protein Mass Spectrometry in Biology (also BIOPL/PLBR 4832)
Fall. 1 credit. Prerequisites: BIOGD 2810, BIOBM 3300 or 3320, or equivalent. Recommended: BIOBM 3310. S–U or letter grades. Offered alternate years. K. van Wijk.
For description, see BIOPL 4832.

PLPA 4940 Undergraduate Special Topics in Plant Pathology and Plant-Microbe Biology
Fall or spring. 4 credits max. 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.

PLPA 4970 Independent Study in Plant Pathology and Plant-Microbe Biology
Fall or spring. 1–5 credits. S–U or letter grades. 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.

PLPA 4980 Undergraduate Teaching Experience
Fall or spring. 1–5 credits. S–U or letter grades. 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.

PLPA 4990 Undergraduate Research
Fall or spring. 3–5 credits. S–U or letter grades. Students must register using independent study form (available in 140 Roberts Hall).
Opportunity for research experience under the direction of a faculty member.

PLPA 6010 Concepts of Plant Pathology and Plant-Microbe Biology
Spring. 3 credits. Prerequisite: PLPA 3010 or equivalent. S–U or letter grades. 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.

PLPA 6020 Biology of Plant Pathogens
Spring. 3 credits. Prerequisite: PLPA 3010. S–U or letter grades. K. L. Perry and M. M. Milgroom.
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 PLPA 6010 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.

[PLPA 6080 Genomics of Bacterium–Host Interactions (also BIOMI 6080)
Fall, weeks 2–5. 1 credit. Prerequisite: BIOMI 2900 or equivalent or permission of instructor. S–U or letter grades. Offered even-numbered years; next offered 2010–2011. A. Collmer, S. C. Winans, and D. Schneider.
Introduction to genomic approaches, tools, and discoveries involving the study of bacterial interactions with plant and animal hosts. Topics include the TIGR Comprehensive Microbial Resource and Artemis tools, the pathogens *Yersinia pestis, V. enterocolitica, Pseudomonas syringae, Ralstonia solanacearum,* and *Agrobacterium tumefaciens,* and the symbiont *Sinorhizobium meliloti*.]

[PLPA 6380 Filamentous Fungal Genomics and Development (also BIOGD 6380)
Spring, weeks 9–12. 1 credit. Prerequisite: BIOGD 2810 or equivalent. S–U or letter grades. Offered odd-numbered years; next offered 2010–2011. 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*.]

PLPA 6420 Pathogen Population Biology
Fall. Prerequisite: permission of instructor. S–U grades only. M. G. Milgroom.
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.

PLPA 6440 Current Topics in Oomycete Biology
Fall. Prerequisite: permission of instructor. S–U grades only. E. B. Nelson.
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.

PLPA 6450 Plant Virology
Fall. Prerequisite: permission of instructor. S–U grades only. S. M. Gray.
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.

PLPA 6490 Fungal Biology
Spring. 1 credit. Recommended: some background in mycology or plant pathology. S–U grades only. 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.

PLPA 6500 Diseases of Vegetable Crops
Fall. 1 credit. Prerequisite: permission of instructor. S–U grades only. J. W. Lorbeer and T. A. Zitter.
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.

PLPA 6520 Field Crop Pathology
Spring. 1 credit. Prerequisite: permission of instructor. S–U grades only. W. G. C. Bergstrom.
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.

PLPA 6600 Special Topics in Plant Disease Management
Fall and spring. 1 credit. S–U grades only. 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.**

PLPA 6610 Diagnostic Lab Experience
Fall and spring. 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.

PLPA 6810 Plant Pathology and Plant-Microbe Biology Seminar
Fall and spring. 1 credit. Requirement for all plant pathology and plant-microbe biology majors. S–U grades only. B. G. Turgeon.

PLPA 6820 Graduate Student Research Updates
Spring and fall. 1 credit. Requirement for all plant pathology and plant-microbe biology graduate students. S–U grades only. S. Cartinhour and H. Aldwinckle.
Weekly graduate student seminar series. Guests with an interest in plant pathology research are welcome to attend. Classes meet simultaneously in Geneva and Ithaca and are linked by teleconference.

PLPA 6940 Graduate Special Topics in Plant Pathology and Plant-Microbe Biology
Fall or spring. 4 credits max. 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.

PLPA 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.

PLPA 7970 Special Topics Independent Study
Fall or spring. 1–5 credits. S–U or letter grades. Staff.
Opportunity for independent study of a special topic.

PLPA 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.

PLPA 7990 Graduate-Level Thesis Research
Fall or spring. Credit TBA. S–U or letter grades. Prerequisite: permission of advisor. Graduate faculty.
For Ph.D. students who have not passed "A" exam.

PLPA 8900 Master's-Level Thesis Research
Fall or spring. Credit TBA. S–U or letter grades. Prerequisite: permission of advisor. Graduate faculty.
For students working on a master's degree.

PLPA 9900 Doctoral-Level Thesis Research
Fall or spring. Credit TBA. S–U or letter grades. Prerequisite: permission of advisor. Graduate faculty.
For Ph.D. candidates who have passed "A" exam.

SCIENCE OF NATURAL AND ENVIRONMENTAL SYSTEMS

B. Chabot, S. J. Colucci, J. Conrad, A. DiTommaso, L. Drinkwater, J. Elliot, G. W. Evans, T. J. Fahey, A. S. Flecker, C. C. Geisler, C. Goodale, C. J. Lehmann, E. L. Madsen, I. Merwin, E. B. Nelson, M. J. Pfeffer, G. P. Poe, J. Regenstein, S. J. Riha, C. W. Scherer, R. Schneider, W. D. Schulze, N. R. Scott, J. Thies, P. J. Trowbridge, M. F. Walter, M. T. Walter, D. W. Wolfe, J. B. Yavitt

SNES 1101 Intro to the Science and Management of Environmental and Natural Resources (also NTRES 1101)
Fall. 3 credits. Prerequisite: first-year students in Natural Resources, Science of Natural and Environment Systems, or other Environmental Undecided majors in CALS. J. Yavitt and E. Madsen.
For description, see NTRES 1101.

SNES 2000 Environmental Sciences Colloquium
Fall. 1 credit. S–U grades only. S. Riha and J. Lehmann.
This colloquium consists of a series of lectures on an annually changing theme central to the Environmental Sciences, which poses biophysical, economic, and political challenges to modern society. Participants will become familiar with contemporary issues of environmental degradation and opportunities for their mitigation. The colloquium is mandatory for SNES majors and is open to the public.

SNES 4960 Internships in Environmental Science
Fall, spring, summer. 1 credit; may be repeated once for a total of 2 credits. S–U grades only.
Student internships involving on- or off-campus supervised, structured work experience. Member of SNES faculty must serve as mentor and complete the term grade report. All 4960 internship courses must adhere to the CALS guidelines at www.cals.cornell.edu/cals/current/student-research/internship/index.cfm.

SNES 4970 Individual Studies in Environmental Sciences
Fall, spring, or summer. 1–6 credits, variable. S–U or letter grades.
Individual studies are arranged under the supervision of one or several SNES faculty members. They provide opportunity to design a course that fills the need of an individual student and addresses pertinent issues in the environmental sciences.

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 in the CIS section of this catalog.

VITICULTURE AND ENOLOGY

T. E. Acree, K. Arnink, T. Bates, P. Cousins, M. Goffinet, A. N. Lakso, A. Landers, G. English-Loeb, A. K. Mansfield, I. A. Merwin, R. Mira de Orduña, C. Owens, B. I. Reisch, G. Sacks, K. Siebert, J. Vanden Heuvel, W. Wilcox

VIEN 1104 Introduction to Wines and Vines (also FDSC/HORT 1104)
Spring. 3 credits. Lec (VIEN 1104) and lab (VIEN 1105) required for Viticulture and Enology majors. Letter grades only. K. Arnink and I. Merwin.
For description, see FDSC 1104.

VIEN 1105 Lab/Field Practice in Wines and Vines (also FDSC/HORT 1105)
Spring. 1 credit. Limited to 30 students. Priority given to Viticulture and Enology majors. Prerequisite: concurrent or previous enrollment in VIEN 1104. Letter grades only. K. Arnink and I. Merwin.
For description, see FDSC 1105.

VIEN 2400 Wines and Grapes: Composition and Analysis (also FDSC 2400)
Fall. 2 credits. Prerequisite: one semester of chemistry. Preference given to Enology and Viticulture and Food Science majors. Letter grades only. G. Sacks.
For description, see FDSC 2400.

VIEN 3400 Microbiology and Technology of Winemaking (also FDSC 3400)
Fall. 3 credits. Prerequisite: introductory microbiology or permission of instructor. Priority given to Viticulture and Enology majors for whom lab is required. Letter grades only. K. Arnink.
For description, see FDSC 3400.

VIEN 3410 Microbiology and Technology of Winemaking: Lab (also FDSC 3410)
Fall. 1 credit. Limited to 20 students; preference given to Viticulture and Enology majors. Prerequisite: permission of instructor. Letter grades only. K. Arnink.
For description, see FDSC 3410.

VIEN 4200 Grape Pest Management (also PLPA/ENTOM 4200)
Fall. 3 credits. Prerequisites: PLPA 3010, ENTOM 2410, or permission of instructor. S–U or letter grades. W. Wilcox, G. Loeb, and A. Landers.
For description, see PLPA 4200.

VIEN 4300 Understanding Wine and Beer (also FDSC 4300)
Spring. 3 credits. Prerequisites: introductory biology and chemistry or permission of instructor; age 21 by first day of class. S–U or letter grades. T. Acree and K. Siebert, G. Sacks, and R. Mira de Orduña.
For description, see FDSC 4300.

VIEN 4400 Wine and Grape Flavor Development (also FDSC 4400)
Spring. 3 credits. Limited to 30 students. Required: at least one semester of general chemistry and one semester of organic chemistry. Prior course work in or knowledge of viticulture and enology recommended. FDSC 1104 and CHEM 2570. Letter grades only. G. Sacks.
For description, see FDSC 4400.

VIEN 4430 Viticulture and Vineyard Management I (also HORT 4430)
Fall. 3 credits. Prerequisites: any two-semester college biology course. Letter grades only. J. Vanden Huevel and P. Cousins.
For description, see HORT 4430.

VIEN 4440 Viticulture and Vineyard Management II (also HORT 4440)
Spring. 3 credits. Prerequisite or corequisite: HORT 4430 or permission of instructor. Letter grades only. J. Vanden Heuvel.
For description, see HORT 4440.

VIEN 4444 Grapevine Biology (also HORT 4444)
Spring. 3 credits. Prerequisite: introductory botany; BIOPL 2420 or equivalent. Letter grades only. Offered odd-numbered years. A. N. Lakso, M. C. Goffinet, B. I. Reisch, P. S. Cousins, and C. L. Owens.
For description, see HORT 4444.

VIEN 4910 Viticulture and Enology Research Practices (also FDSC 4910)
Fall. 3 credits. Prerequisite: FDSC/HORT/VIEN 1105. Letter grades only. K. Arnink.
For description, see FDSC 4910.

VIEN 4960 Viticulture and Enology Internship
Fall, spring, summer. Variable credit. Prerequisite: VIEN/FDSC 1105. S–U grades only. K. Arnink and staff.
Internships provide experiential learning opportunities in real-life winery and vineyard circumstances where classroom knowledge is applied and evaluated. Students are able to master new skills, compare pilot-scale with commercial-scale winemaking practices, solve problems, interact in workplace situations, and build networks for future career opportunities. While working with industry mentors, students apply classroom knowledge, critical thinking, and self-directed learning skills to work effectively. Limit of 3 credits per internship and no more than 6 credits total for all internships. All 4960 internship courses must adhere to the CALS guidelines at www.cals.cornell.edu/cals/current/student-research/internship/index.cfm.

VIEN 6450 Advanced Viticulture Topics (also HORT 6450)
Spring. 2 credits. Prerequisite: HORT 4430 or equivalent. Letter grades only. Offered even-numbered years. A. Lakso.
For description, see HORT 6450.

FACULTY ROSTER

Abawi, George S., Ph.D., Cornell U. Prof., Plant Pathology and Plant-Microbe Biology (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 and Plant-Microbe Biology (Geneva)
Aneshansley, Daniel J., Ph.D., Cornell U. Prof., Biological and Environmental Engineering
Angenent, Largus T., Ph.D., Iowa State U. Assoc. 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). 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
Basu, Alaka, M.S., U. of London (UK). Prof., Development Sociology
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
Bauerle, Taryn L., Ph.D., Pennsylvania State U. Asst. Prof., Horticulture
Beer, Steven V., Ph.D., U. of California, Davis. Prof., Plant Pathology and Plant-Microbe Biology
Bellinder, Robin R., Ph.D., Virginia Polytechnic Inst. and State U. Prof., Horticulture
Bento, Antonio, Ph.D., U. of Maryland. Assoc. Prof., Applied Economics and Management
Bergstrom, Gary C., Ph.D., U. of Kentucky. Prof., Plant Pathology and Plant-Microbe Biology
Bills, Nelson L., Ph.D., Washington State U. Prof., Applied Economics and Management
Birnholtz, Jeremy P., Ph.D., U. of Michigan. Asst. Prof., Communication
Bjorkman, Thomas N., Ph.D., Cornell U. Assoc. Prof., Horticultural Sciences (Geneva)
Blalock, Garrick, Ph.D., U. of California, Berkeley. Asst. Prof., Applied Economics and Management
Blossey, Bernd, Ph.D., Christian-Albrechts U. (Germany). Assoc Prof., Natural Resources
Bogan, Vicki L., Ph.D., Brown U. Asst. Prof., Applied Economics and Management
Boisclair, Yves R., Ph.D., Cornell U. 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. 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
Bridgen, Mark P., Ph.D., Virginia Polytechnic Inst. and State U. Prof. and director, LIHR and EC, Horticulture
Brooks, Samantha A., Ph.D., U. of Kentucky. Asst. Prof., Animal Science
Broussard, Shorna R., Ph.D., Oregon State U. Assoc. Prof., Natural Resources
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 and Plant-Microbe Biology (Geneva)
Bustamante, Carlos D., Ph.D., Harvard U. Prof., Biological Statistics and Computational Biology
Butler, Walter R., Ph.D., Purdue U. Prof. and Chair, Animal Science
Byrne, Sahara E., Ph.D., U. of California, Santa Barbara. Asst. Prof., Communication
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
Cartinhour, Samuel W., Ph.D., U. of Utah. Courtesy Prof., Plant Pathology and Plant-Microbe Biology
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. Assoc. Prof., Horticulture
Cherney, Debbie J., U. of Florida. Prof., Animal Science
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 and Plant-Microbe Biology
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). Assoc. Prof., Natural Resources
Cooke, J. Robert, Ph.D., North Carolina State U. Prof. Emeritus, Biological and Environmental Engineering
Cox, Kerik D., Ph.D., U. of Georgia. Asst. Prof., Plant Pathology and Plant-Microbe Biology (Geneva)
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. Prof., Entomology
Daouk, Hazem, Ph.D., Indiana U. Assoc. 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 Breeding
DeVault, Travis, Ph.D., Purdue U. Adj. Prof., Natural Resources
Dickinson, Janis L., Ph.D., Cornell U. Assoc. Prof., Natural Resources
Dillard, Helene R., Ph.D., U. of California, Davis. Prof., Plant Pathology and Plant-Microbe Biology (Geneva)
DiTommaso, Antonio, Ph.D., McGill U. (Canada). Assoc. Prof., Crop and Soil Sciences
Dong, Shikui, Ph.D., Gansu Agric. U. (China). Adj. Prof., Natural Resources
Douglas, Angela, Ph.D., U. of Aberdeen (Scotland). Prof., Entomology
Drinkwater, Laurie, Ph.D., U. of California, Davis. Assoc. Prof., Horticulture
Duxbury, John M., Ph.D., U. of Birmingham (England). Prof., Crop and Soil Sciences
Earle, Elizabeth D., Ph.D., Harvard U. Prof., Plant Breeding
Eloundou-Enyegue, Parfait M., Ph.D., Pennsylvania State U. Assoc. Prof., Development Sociology
Fahey, Timothy J., Ph.D., U. of Wyoming. Prof., Natural Resources
Feldman, Shelley, Ph.D., U. of Connecticut. Prof., Development Sociology
Fick, Gary W., Ph.D., U. of California, Davis. Prof., Crop and Soil Sciences
Fisher, William L., Ph.D., U. of Louisville (Kentucky). Courtesy Assoc. Prof., Natural Resources
Forney, John, Ph.D., Cornell U. Adj. Prof., Natural Resources
Forsline, Philip L., M.S., U. of Minnesota. Courtesy Asst. Prof., Horticultural Sciences (Geneva)
Francis, Joe D., Ph.D., U. of Missouri. Assoc. Prof., Development Sociology
Fry, William E., Ph.D., Cornell U. Prof., Plant Pathology and Plant-Microbe Biology
Fuchs, Marc, Ph.D., U. Louis Pasteur (France). Asst. Prof., Plant Pathology and Plant-Microbe Biology (Geneva)
Fussell, Susan R., Ph.D., Columbia U. Assoc. Prof., Communication
Galton, David M., Ph.D., Ohio State U. Prof., Animal Science
Gan, Susheng, Ph.D., U. of Wisconsin. Assoc. Prof., Horticulture
Gavalchin, Jerrie, Ph.D., Rutgers U. Assoc. Prof., Animal Science, Microbiology and Immunology
Gay, Geraldine K., Ph.D., Cornell U. Prof., Communication
Gebremedhin, Kifle G., Ph.D., U. of Wisconsin. Prof., Biological and Environmental Engineering
Geisler, Charles C., Ph.D., U. of Wisconsin. Prof., Development Sociology
Gilbert, Cole, Ph.D. U. of Kansas. Assoc. Prof., Entomology
Gillespie, Tarleton L., Ph.D., U. of California, San Diego. Asst. Prof., Communication
Gleason, Kathryn L., Ph.D., Oxford U. (UK). Assoc. Prof., Landscape Architecture
Gloy, Brent A., Ph.D., Purdue U. Assoc. Prof., Applied Economics and Management
Gomes, Carla P., Ph.D., U. of Edinburgh (UK). Assoc. Prof., Applied Economics and Management
Gonzales, Angela, M.A., Harvard U. Asst. Prof., Development Sociology
Gorewit, Ronald C., Ph.D., Michigan State U. Prof. Emeritus, Biological and Environmental Engineering
Gravani, Robert B., Ph.D., Cornell U. Prof., Food Science
Gray, Stewart M., Ph.D., North Carolina State U. Courtesy Prof., Plant Pathology and Plant-Microbe Biology
Greene, Charles H., Ph.D., U. of Washington. Prof., Earth and Atmospheric Sciences
Griffiths, Phillip D., Ph.D., U. of Florida. Assoc. Prof., Horticultural Sciences (Geneva)
Gurak, Douglas T., Ph.D., U. of Wisconsin. Prof., Development Sociology
Hahn, Russell R., Ph.D., Texas A&M U. Assoc. Prof., Crop and Soil Sciences
Haith, Douglas A., Ph.D., Cornell U. Prof., Biological and Environmental Engineering
Hajek, Ann E., Ph.D., U. of California, Berkeley. Prof., Entomology
Halseth, Donald E., Ph.D., Cornell U. Assoc. Prof., Horticulture
Hancock, Jeffrey T., Ph.D., Dalhousie U. (Canada) Assoc. Prof., Communication
Hang, Yong D., Ph.D., McGill U. (Canada). Prof., Food Science and Technology (Geneva)
Hare, Matthew P., Ph.D., U. of Georgia. Assoc. Prof., Natural Resources
Harman, Gary E., Ph.D., Oregon State U. Prof., Horticultural Sciences (Geneva)
Harrington, Laura, Ph.D., U. of Massachusetts. Assoc. Prof., Entomology
Hess, Peter G., Ph.D., U. of Washington. Assoc. Prof., Biological and Environmental Engineering
Hirschl, Thomas A., Ph.D., U. of Wisconsin. Prof., Development Sociology
Hoch, Harvey C., Ph.D., U. of Wisconsin, Madison. Prof., Plant Pathology and Plant-Microbe Biology (Geneva)
Hodge, Kathie, Ph.D., Cornell U. Asst. Prof., Plant Pathology and Plant-Microbe Biology
Hoffmann, Michael P., Ph.D., U. of California, Davis. Prof., Entomology
Hooker, Giles J., Ph.D., Stanford U. Asst. Prof., Biological Statistics and Computational Biology
Horrigan, Paula H., M.L.A., Cornell U. Assoc. Prof., Landscape Architecture
Hotchkiss, Joseph H., Ph.D., Oregon State U. Prof., Food Science
Hudler, George W., Ph.D., Colorado State U. Prof., Plant Pathology and Plant-Microbe Biology
Hullar, Theodore L., Ph.D., U. of Minnesota. Prof., Natural Resources
Humphreys, Lee M., Ph.D., U. of Pennsylvania. Asst. Prof., Communication
Hunter, Jean B., D.En.Sc., Columbia U. Assoc. Prof., Biological and Environmental Engineering
Imumorin, Ikhide G., Ph.D., Texas A&M U. Asst. Prof., Animal Science
Irwin, Lynne H., Ph.D., Texas A&M U. Assoc. Prof., Biological and Environmental Engineering
Jewell, William J., Ph.D., Stanford U. Prof. Emeritus, Biological and Environmental Engineering
Johnson, Patricia A., Ph.D., Cornell U. Prof., Animal Science
Just, David R., Ph.D., U. of California, Berkeley. Asst. Prof., Applied Economics and Management
Kaiser, Harry M., Ph.D., U. of Minnesota. Prof., Applied Economics and Management
Kanbur, Sanjiv Madhwarao, Ph.D., U. of Oxford (UK). Prof., Applied Economics and Management
Kassam, Karim-Aly, Ph.D., Cornell U. Assoc. Prof., Natural Resources
Ketterings, Quirine, Ph.D., Ohio State. Assoc. Prof., Animal Science
Knipple, Douglas C., Ph.D., Cornell U. Assoc. Prof., Entomology (Geneva)
Knoblauch, Wayne A., Ph.D., Michigan State U. Prof., Applied Economics and Management
Knuth, Barbara A., Ph.D., Virginia Tech. Senior Assoc. Dean and Prof., Natural Resources
Kochian, Leon V., Ph.D., U. of California, Davis. Courtesy Prof., Crop and Soil Sciences
Koeller, Wolfram D., Ph.D., Phillips U.-Marburg (Germany). Prof., Plant Pathology and Plant-Microbe Biology (Geneva)
Kraft, Clifford E., Ph.D., U. of Wisconsin, Madison. Assoc. Prof., Natural Resources
Krall, Daniel W., M.L.A. Cornell U. Assoc. Prof., Landscape Architecture
Krasny, Marianne E., Ph.D., U. of Washington. Prof., Natural Resources
Kresovich, Stephen, Ph.D., Ohio State U. Prof., Plant Breeding
Kyle, Steven C., Ph.D., Harvard U. Assoc. Prof., Applied Economics and Management
LaBastille, Anne, Ph.D., Cornell U. Adj. Prof., Natural Resources
Lakso, Alan N., Ph.D., U. of California, Davis. Prof., Horticultural Sciences (Geneva)
Lassoie, James P., Ph.D., U. of Washington. Prof., Natural Resources
Lawless, Harry T., Ph.D., Brown U. Prof., Food Science
Lazarowitz, Sondra G., Ph.D., Rockefeller U. Prof., Plant Pathology and Plant-Microbe Biology
Lazzaro, Brian, Ph.D., Pennsylvania State U. Assoc. Prof., Entomology
Lee, Chang Y., Ph.D., Utah State U. Prof., Food Science and Technology (Geneva)
Lee, David R., Ph.D., U. of Wisconsin, Madison. Prof., Applied Economics and Management
Lee, Kwangwon, Ph.D., Texas A&M U. Asst. Prof., Plant Pathology and Plant-Microbe Biology
Lehmann, C. Johannes, Ph.D., U. of Bayreuth (Germany). Assoc. Prof., Crop and Soil Sciences
Lei, Xingen, Ph.D., Michigan State U. Prof., Animal Science
Leiponen, Aija, Ph.D., U. of California, Berkeley. Asst. Prof., Applied Economics and Management
Lesser, William H., Ph.D., U. of Wisconsin, Madison. Prof., Applied Economics and Management
Levine, Gilbert, Ph.D., Cornell U. Prof. Emeritus, Biological and Environmental Engineering
Lewenstein, Bruce V., Ph.D., U. of Pennsylvania. Prof., Communication

Liebherr, James K., Ph.D., U. of California, Berkeley. Prof., Entomology
Liu, Ruihai, Ph.D., Cornell U. Assoc. Prof., Food Science
Loeb, Gregory M., Ph.D., U. of California, Davis. Assoc. Prof., Entomology (Geneva)
Lohman, Rowena B., Ph.D., California Inst. of Technology. Asst. Prof., Earth and Atmospheric Sciences
Long, Qiaoming, Ph.D., U. of Edinburgh (Scotland). Asst. Prof., Animal Science
Lorbeer, James W., Ph.D., U. of California, Berkeley. Prof., Plant Pathology and Plant-Microbe Biology
Loria, Rosemary, Ph.D., Michigan State U. Prof., Plant Pathology and Plant-Microbe Biology
Losey, John E., Ph.D., U. of Maryland. Assoc. Prof., Entomology
Lovette, J. Irby, Ph.D., U. of Pennsylvania. Asst. Prof., Ornithology
Luo, Dan, Ph.D., Ohio State U. Assoc. Prof., Biological and Environmental Engineering
Mahowald, Natalie, Ph.D., Massachusetts Institute of Technology. Assoc. Prof., Earth and Atmospheric Sciences
Makki, Fouad M., Ph.D., Binghamton U. Asst. Prof., Development Sociology
Mansfield, Anna K., Ph.D., U. of Minnesota. Asst. Prof., Food Science and Technology (Geneva)
March, John C., Ph.D., U. of Maryland. Asst. Prof., Biological and Environmental Engineering
Martin, Gregory B., Ph.D., Michigan State U. Prof., Plant Pathology and Plant-Microbe Biology
Mattson, Neil S., Ph.D., U of California, Davis. Asst. Prof., Horticulture
McBride, Murray B., Ph.D., Michigan State U. Prof., Crop and Soil Sciences
McComas, Katherine A., Ph.D., Cornell U. Assoc. Prof., Communication
McCouch, Susan, Ph.D., Cornell U. Prof., Plant Breeding
McGrath, Margaret T., Ph.D., Pennsylvania State U. Assoc. Prof., Plant Pathology and Plant-Microbe Biology
McLaughlin, Edward W., Ph.D., Michigan State U. Prof., Applied Economics and Management
McLeod, Poppy L., Ph.D., Harvard U. Assoc. Prof., Communication
McMichael, Philip D., Ph.D., SUNY, Binghamton. Prof., Development Sociology
Meloy, Margaret G., Ph.D., Cornell U. Adj. Asst. Prof., Applied Economics and Management
Merwin, Ian A., Ph.D., Cornell U. Prof., Horticulture
Mezey, Jason G., Ph.D., Yale U. Asst. Prof., Biological Statistics and Computational Biology
Milgroom, Michael G., Ph.D., Cornell U. Prof., Plant Pathology and Plant-Microbe Biology
Miller, Dennis D., Ph.D., Cornell U. Prof., Food Science
Miller, William B., Ph.D., Cornell U. Prof., Horticulture
Mira de Orduña Heidinger, Ramon, Ph.D., Massey U. (New Zealand). Assoc. Prof., Food Science and Technology
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