COLLEGE OF AGRICULTURE AND LIFE SCIENCES

ADMINISTRATION

Susan A. Henry, dean

William E. Fry, senior associate dean

John M. Finamore, associate dean for financial affairs

Mary Lou Doyle, assistant dean for human resources

Michael P. Riley, assistant dean for public affairs

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

Vacant, associate director of academic programs

Jeffrey J. Doyle, director of undergraduate biology

Daniel J. Decker, associate dean and director of the Cornell University Agricultural Experiment Station

Max J. Pfeffer, associate director of the Cornell University Agricultural Experiment Station

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

Edward D. Harwood, associate director of cooperative extension

Michael P. Hoffmann, associate director of cooperative extension

W. Ronnie Coffman, director of international programs

Norman T. Uphoff, director of Cornell International Institute for Food, Agriculture and Development

James E. Haldeman, associate director of international agriculture

Terry W. Tucker, associate director of international agriculture

Office of Academic Programs Staff

Counseling and advising: Lisa Ryan, Bonnie Shelley

Registrar: Barbara Smith, Patricia Austic, Amy Paolangeli

Admissions: Robert Springall, Ann LaFave, Dana Brown

Career development: Amy Benedict-Augustine, Laurie Gillespie, Pamela Hampton

Minority programs: Catherine Thompson

Department Chairs

Applied economics and management: W. H. Lesser, Warren Hall

Animal science: A. W. Bell, Morrison Hall

Atmospheric science unit (part of earth and atmospheric sciences): S. J. Riha, Bradfield Hall

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

Biological statistics and computational biology: M. T. Wells, Ives Hall

Communication: J. B. Walther, Kennedy Hall

Crop and soil sciences: S. D. DeGloria, Emerson Hall

Ecology and evolutionary biology: N. G. Hairston, Corson Hall

Education: R. S. Caffarella, Kennedy Hall

Entomology: D. A. Rutz, Comstock Hall

Food science: J. H. Hotchkiss, Stocking Hall

Horticultural science: M. P. Pritts, Plant Science Building

Landscape architecture: K. L. Gleason, Kennedy Hall

Microbiology: S. H. Zinder, Wing Hall

Molecular biology and genetics: T. D. Fox, Biotechnology Building

Natural resources: B. A. Knuth, Fernow Hall

Neurobiology and behavior: R. M. Harris-Warrick, S. G. Mudd Hall

Plant breeding: W. R. Coffman, Emerson Hall

Plant pathology: R. Loria, Plant Science Building

Rural sociology: P. D. McMichael, Warren Hall

Statistical sciences: B. W. Turnbull, Mallott Hall

College Focus

The College of Agriculture and Life Sciences provides educational programs that prepare men and women with technical, management, and leadership skills.

The college focuses on a broad-based education for its students, and on a problem-solving and basic research program. The program is geared to the discovery and dissemination of knowledge for the purpose of advancing the food system, agriculture, nutrition, biological sciences, environmental quality, and community and rural development throughout New York State, the nation, and the world.

There are six primary areas of focus, developed in response to the needs of society, and representing agriculture and life sciences in their broadest and most dynamic meaning:

- Agriculture (production and marketing)
- Biological Sciences
- Community, Human, and Rural Resources
- Environment
- Food and Nutrition
- International

Facilities

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

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

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

Mann Library, with its extensive collections of materials in the agricultural and biological sciences, is at the east end of the Ag Quad. The student lounge and service center, known as the Alfalfa Room, and many of the college classrooms are in Warren Hall. Public computer facilities are available in Warren Hall, in Riley-Robb Hall, and in Mann Library.

DEGREE PROGRAMS

The College of Agriculture and Life Sciences offers programs leading to the degrees of Bachelor of Science, Master of Science, and Doctor of Philosophy. Professional degrees include the Master of Professional Studies and the Master of Arts in Teaching. Some registered professional licensing and certification programs are also available.

Each curriculum in the college creditable toward a degree is registered with the New York State Education Department and is linked with the national Higher Education General Information Survey (HEGIS) codes for federal and state reporting.

Graduate Degrees

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.

Agriculture [M.P.S. (Agr.)]: D. R. Viands, Roberts Hall

Agricultural and Biological Engineering: D. J. Aneshansley, Riley-Robb Hall

Agricultural Economics: D. R. Lee, Warren Hall

Animal Breeding: E. J. Pollak, Morrison Hall

Animal Science: R. L. Quaas, Morrison Hall

Atmospheric Sciences: D. S. Wilks, Bradfield Hall

Biochemistry, Molecular, and Cell Biology: W. J. Brown, Biotechnology Building

Biometry: M. Wells, Warren Hall

Communication: J. E. Shanahan, Kennedy Hall

Development Sociology: C. C. Geisler, Warren Hall

Ecology and Evolutionary Biology: D. W. Winkler, Corson Hall

Education [also M.A.T.]: D. E. Schrader, Kennedy Hall

Entomology: E. Shields, Comstock Hall

Environmental Toxicology: A. Yen, Rice Hall

Food Science and Technology: H. T. Lawless, Stocking Hall

Genetics and Development: K. J. Kemphues, Biotechnology Building

Horticulture: N. L. Bassuk, Plant Science Building

International Agriculture and Rural Development [M.P.S. (Agr.)]: R. W. Blake, Morrison Hall

International Development: N. T. Uphoff, Warren Hall

Landscape Architecture [M.L.A.]: D. W. Krall, Kennedy Hall

M.P.S. Agriculture with Peace Corps Option (offered by most agriculture fields with M.P.S. programs): J. Haldeman, Warren Hall or see director of graduate studies for chosen field

Microbiology: S. C. Winans, Wing Hall

Natural Resources: M. E. Krasny, Fernow Hall

Neurobiology and Behavior: C. D. Hopkins, Seeley-Mudd Hall

Nutritional Sciences: M. N. Kazarinoff, Martha Van Rensselaer Hall

Physiology: M. S. Robertson, Vet Research Tower

Plant Biology: J. B. Nasrallah, Plant Science Building

Plant Breeding: E. D. Earle, Bradfield Hall

Plant Pathology: E. B. Nelson, Plant Science Building

Plant Protection [M.P.S. (Agr.)]: W. H. Reissig, Geneva Campus

Soil and Crop Sciences: H. van Es, Bradfield Hall

Statistics: M. Wells, Malott Hall

Zoology: J. W. Hermanson, Vet Research Tower

Bachelor of Science Degree

Departments in the College of Agriculture and Life Sciences sponsor study for the B.S. degree in 20 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 majors within the College of Agriculture and Life Sciences. Students need an adviser in each major. Course requirements for double majors may overlap. The Counseling and Advising office (140 Roberts Hall) and department representatives have a form for students to complete to officially recognize the double major. The following units offer major fields of study for undergraduates. A faculty advising coordinator is listed for each unit. Students should consult with the faculty coordinator regarding requirements and opportunities for concentrations in the major field.

Biological Engineering: James Bartsch, 314 Riley-Robb Hall

Applied Economics and Management: Dale Grossman, 204 Warren Hall

Animal Sciences: W. Bruce Currie, 434 Morrison Hall

Biological Sciences: Jeffrey Doyle, 216 Stimson Hall; Bonnie Comella, 216 Stimson

Biology and Society: Douglas Gurak, 234 Warren Hall

Biometry and Statistics: Steven Schwager, 424 Warren Hall

Communication: Brian Earle, 328 Kennedy Hall

Crop and Soil Sciences: Gary Fick, 505 Bradfield Hall

Earth and Atmospheric Sciences: Steven Colucci, 1116 Bradfield Hall

Education: George Posner, 416 Kennedy Hall

Entomology: Bobbie Peckarsky, 3134 Comstock Hall

Food Science: Janice Brown, 107 Stocking Hall

Horticulture units (Floriculture, Pomology, Vegetable Crops, Horticulture): Ken Mudge, 20 Plant Science Building

International Agriculture and Rural Development: Terry Tucker, B22 Mann Library

Landscape Architecture: Peter Trowbridge, 440 Kennedy Hall

Natural Resources: Tim Fahey, 12 Fernow Hall

Nutrition, Food, and Agriculture: J. Thomas Brenna, B38 Savage Hall; Elise West, 334 MVR Hall

Plant Science Units (Plant Biology, Genetics and Breeding, Pathology/Protection): George Hudler, 315 Plant Science

Rural Sociology: Tom Hirschl, 333 Warren Hall

Science of Earth Systems: Kerry Cook, 3114 Snee Hall

Special Programs in Agriculture and Life Sciences: Lisa Ryan, 140 Roberts Hall; Terry Tucker, 31 Warren Hall, for International Agriculture Program

Students in the College of Agriculture and Life Sciences may pursue one or more minor fields of study. Minor fields of study do not require an academic adviser, but each minor field will have 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 offer minors. Minors available at the printing of this catalog are listed below with contact person and e-mail address:

Animal Science	Deloris Bevins dgb1@cornell.edu
Atmospheric Science	Pam Vitale pmv2@cornell.edu
	Stephen Colucci sjc25@cornell.edu
Communication	Linda Van Buskirk lpv1@cornell.edu
	Brian Earle boe1@cornell.edu
Food Science	Janice Brown jmb14@cornell.edu
Information Science	Geri Gay gkg1@cornell.edu
Natural Resources	Marian Hovencamp mth6@cornell.edu
Nutrition and Health	Elise West aadns@cornell.edu
Rural Sociology	Tom Hirschl tah4@cornell.edu
	Renee Hoffman rmh6@cornell.edu
Soil Science	Gary Fick gwf2@cornell.edu
	Sue Murphy sm17@cornell.edu

Summary of Basic College Requirements for Graduation

1. **Credit Hours**

a. Minimum: 120

Exception: Credit for tutorial courses (MATH 109, EDUC 005, and 00 level) **increase** the number of credits required for graduation by the number of credits in the course. The credits **do** count toward the minimum 12 credits for full-time status.

b. Minimum at Cornell: **60**; maximum transferred in (C- or higher): **60**

c. Minimum from College of Agriculture and Life Sciences: **55** (includes credit used in the distribution and appropriate transfer credit)

d. Maximum from endowed colleges (Arts and Sciences; Architecture, Art, and Planning; Engineering; and Hotel School) without additional charge: **55** (includes credit used in the distribution **AND** failed courses)

e. Minimum with letter grade: 100; maximum with S-U grade based on 120 credits: 20 (prorated for transfer students) with maximum of one course per semester

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

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

2. **Residence**

a. Students are entitled to enroll eight full-time semesters (prorated for transfer students). A full-time semester requires a minimum of 12 credits per semester, **not** counting physical education. Tutorial courses (see #1A) **are** counted. No new student may enroll in the first semester for more than 18 credits in addition to physical education.

b. A minimum of seven semesters is required. Transfer students are credited with one semester in residence for each 15 credits from another institution.

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

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

Exception: Students with eight or fewer credits remaining for graduation and with circumstances that prevent full-time study may petition for approval to complete remaining credits at another institution or part-time in CALS.

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

Cumulative GPA: 2.00 or above must be maintained. Includes only grades earned at Cornell after matriculating into the college.

For students matriculated prior to 8/01: Cumulative GPA: 1.70 or above must be maintained. Includes only grades earned at Cornell after matriculating into the college.

4. **Distribution**

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

Credits received for independent study, field, teaching, research, work experience, and internships cannot be used to fulfill the distribution requirement. Courses judged to be remedial in the discipline, such as Education 005, will not be counted.

In 2002, the CALS Faculty Senate approved a proposal from the CALS Curriculum Committee to combine Groups A (Physical Sciences) and B (Biological Sciences) into one group to provide more flexibility for students to fulfill the physical and life sciences distribution requirement. This policy applies to both new and current students in CALS. Letter designations no longer will be used for the groups described below.

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

Intro Biology: BIOG 101–104, 105–106, 107–108 or 109–110

Biology Sciences (except BIOG 200 and 499 [unless permission of the director of undergraduate biology is obtained], BIOG 209, BIOG 498, and BIOSM 204)

CHEM

PHYS

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

AEM 210 (310 if taken before fall 1997)

ASTRO

BEE 454, 456, 458, 459

BTRY

CSS 190, 260, 311, 312, 314, 315, 317, 366, 415, 455, 473, 483

EAS (except 150)

EDUC 115

ENTOM 201, 212, 213, 215, 241, 260, 277, 325, 344, 370, 463

FOOD 200

HORT 243, 317, 366, 400, 415, 425, 440, 445, 449, 455, 460

ILRST 210

MATH*

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

NTRES 210, 301, 305, 315, 316, 320, 350, 370

PLBR 201, 225, 401, 402, 403, 404

PLPA 201, 241, 309, 401

* The college mathematics requirement is described below.

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

Social Sciences. 100- through 400-level courses in the following departments (*excluding* Freshman Seminars):

- AIS 401
- Anthropology
- Archaeology
- AEM (ARME) 416
- COMM 116, 120, 410, 418, 420, 422
- Economics (excluding all AEM (ARME) courses)
- EDUC 317, 378, 411(311), 451, 471
- Government
- HD 250 (cannot receive credit for this course and SOC 251)
- LA/CRP/AIS 261, 260 (360), 263 (363)
- NTRES 314 (403)
- Psychology (except 111)
- S&TS 324, 350, 390, 391, 400, 401, 403, 406, 407, 427, 442, 467, 483
- Sociology (includes Rural Sociology except RS 100, 175, 305, 311, 318, 325, 333, 442)

Humanities. 100- through 400-level courses in the following departments (*excluding* Freshman Seminars and language courses):

- Africana Studies (literature and history)
- American Indian Studies
- Asian American Studies
- Asian and Near Eastern Studies (literature and history)
- Classics (literature and history)
- Comparative Literature
- EDUC 473
- English (*literature only*)
- FGSS 444
- French, German, Italian, Russian, and Spanish (*literature only*)
- History
- History of Art/History of Architecture
- LA 140, 155, 266, 282, 483
- Music and Theatre Arts (theory, literature, and history only)
- NTRES 212, 407, 411
- Philosophy
- Religious Studies
- R SOC 100, 175, 318, 442
- S&TS 205, 206, 233, 250, 281, 282, 286, 292, 360, 381, 433, 444, 447, 481, 490

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

Written Expression

- Freshman Seminars
- COMM 117, 260, 263, 350, 352, 365
- ENG 280–281, 288–289, 382–385, 388–389

Oral Expression

- COMM 201, 203

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

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

5. **Math Requirement**

Faculty legislation requires minimum competency in mathematics to complete a degree in the College of Agriculture and Life Sciences. As a measure of competency in mathematics, all entering undergraduates, including those with advanced placement or transfer credit in calculus, must take the college math proficiency exam (administered during orientation). The following students are exempt from the CALS Math Placement Exam: (1) internal transfer students who already have passed one math course listed below under Group II section 1, and (2) entering BEE students (who take the placement exam in the College of Engineering).

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

Mathematics requirements and placement suggestions:

Group I Students in this group are considered proficient in math for college graduation requirements. If further math is needed for the major, placement score *suggests* calculus skill level (e.g., MATH 111, 191, 193).

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

(1) Successfully complete an approved mathematics or statistics course at Cornell. EDUC 115 is recommended. Other approved courses are any mathematics course (except for MATH 103, 109); AEM 210; BTRY 100, 101, 102, 201, 261, 302; ILRST 210, 211, 310, 311, 312, 313, 314; ENGRD 270; PAM 210.

(2) Successfully complete or have completed an approved calculus course at another college or university with a final grade of B- or better.

(3) Receive AP credit for calculus or statistics.

Group III Students in this group must successfully complete an approved mathematics or statistics course at Cornell (see list in Group II above). Prior completion of EDUC 005 may be recommended at the discretion of the student's academic adviser.

Transfer and AP math credit (up to six) will be recorded in Group A of the college distribution requirements. Additional transfer credit in math will be recorded as general electives. BEE students typically receive fewer AP credits than other CALS students with the same scores. BEE students also may receive AP credits based on the Engineering Mathematics Placement Exam.

6. **Physical Education**

a. Pass a required swim test, administered during orientation.

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

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

d. Transfer students are credited with one course of physical education for each semester previously enrolled **full-time** (12 or more credits) at another college.

Faculty Advising

a. Each student is assigned to a faculty adviser soon after being admitted to the college. The faculty adviser will help the student plan a program of study of courses appropriate to the degree programs offered by the college.

b. Course enrollment each semester should be planned in consultation with the faculty adviser. Students pre-enroll for courses by computer through CoursEnroll, under courses, classes, and exams on the Bear Access menu. Pre-enrollment by computer is not valid until the student's individual code is entered. This code, or adviser key, is provided to the student by the faculty adviser after approval of the choice of courses.

c. All academic plans, such as acceleration and graduate study, should be made in consultation with the student's faculty adviser. Support of the adviser is essential if a student petitions for an exception to any of the requirements of the college.

Progress toward the Degree

a. The progress of each student toward meeting the degree requirements is recorded each fall term in the college registrar's office on a *Summary of Record* form.

b. Students who have been in residence for eight semesters and who have met the graduation requirements will be graduated. Students are entitled to attend for the full eight semesters even if they have completed the graduation requirements in fewer semesters. A student who wishes to continue study after graduation must apply for admission as a special student through the college admissions office, 177 Roberts Hall.

c. Application to graduate. In the first semester of their senior year, students must complete and submit an Application to Graduate to the college registrar's office by the end of the eighth week of class. The adviser must first sign the application verifying that the student will be able to satisfy all major requirements. Students with two majors or a minor must obtain signatures for each major and/or minor. Students must meet with the college registrar, who signs the application after verifying that the college requirements will be fulfilled after successful completion of the student's final semester. Note: It is the student's responsibility to meet all graduation requirements. The student must resolve all problems, even if discovered late in the term, before the degree can be awarded.

Credit Earned While in High School

Transfer credit will *not* be accepted for the Syracuse Project Advance Program and similar programs. If a student is enrolled in a college/university course during his/her high school years, transfer credit will be given *only* if certain criteria are met:

1. Course must be a standard course taught by a post-secondary institution.
2. High school must be a satellite location, one of several options available to *all* students taking the course.
3. Course syllabus, text, examinations, and evaluation process must be the same for *all* students at *all* sites.
4. Students must be enrolled for college credit and pay college tuition.
5. Instructor must be a faculty member (includes adjunct) at the offering college.

If one of these is not met, no transfer credit will be given. Written verification may be necessary.

CLEP Credit

The College of Agriculture and Life Sciences awards CLEP (College-Level Examination Program) credit if a student achieves an acceptable score on the CLEP exam. Please contact the Registrar's Office in 140 Roberts Hall for specific information about CLEP credit.

STUDENTS

Undergraduate enrollment is approximately 3,015, with about 56 percent in the upper division. Each year about 850 students are graduated, while 635 freshmen and 250 new transfer students are enrolled. College faculty members serve as chairs of the Special Committees of roughly 1,014 graduate students.

Admission

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

While most students come from New York State, about 33 percent come from other parts of the United States or abroad. Slightly more than half of the undergraduates are women. Approximately 22 percent are self-identified as members of minority ethnic groups.

The CALS Admissions Office is in 177 Roberts Hall (607–255–2036, www.cals.cornell.edu/admissions/).

Transfer Students

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

Intra-University Transfer

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

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

Special Students

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

Off-Campus Students

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

Off-Campus Courses

Students in CALS must be registered for at least 12 credits of course work each semester. It is expected that students will not be enrolled in course work at another institution while they are enrolled at CALS.

Two exceptions to enrollment elsewhere while being a full-time student at Cornell would be the joint enrollment agreements between Cornell and Ithaca College and Wells College. Other exceptions must be reviewed by the Committee on Academic Achievement and Petitions. Students must petition *before* enrolling for a course elsewhere. The committee may approve such petitions only when there are compelling circumstances such as severe scheduling problems or no equivalent course available at Cornell. Enrolling in a course at another college to avoid taking it at Cornell is not permitted.

Leave of Absence

A student wishing a break from studies in a future semester, or those who find it necessary to leave the university before the end of a semester, should submit a written petition for a leave of absence. Such action is necessary to clear the record for the semester and if not

taken may adversely affect the student's subsequent readmission to the university.

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

A database is maintained by the Counseling and Advising Office to assist participation in pre-course enrollment the semester before a student's return.

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.

Graduation and Diplomas

Graduating seniors must complete the Application to Graduate (see the details in Part C of "Progress toward the Degree"). Diplomas are distributed to those who have completed the degree requirements and have been approved by the college faculty. After the commencement ceremony at Schoellkopf Field in May, graduates return to the Ag Quad to obtain their diplomas. For January and August graduates, diplomas are mailed.

ADVISING AND COUNSELING SERVICES

Faculty members in the College of Agriculture and Life Sciences recognize that students need information and advice to make intelligent decisions while in college. They believe that personal contact is the best way to provide information and advice on both academic and personal matters; they consider advising to be an important and integral part of the undergraduate program. Each student enrolled in the college is assigned to a faculty adviser in his or her major field of study for assistance and guidance in developing a program of study, and to enhance the student's academic experience.

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

Multicultural and Diversity Programs serves to monitor, support, and influence policy on behalf of all minority students in the College of Agriculture and Life Sciences. This population is defined as encompassing all African American, Latin American, Asian American, and Native American people. In the past academic year this represented approximately 20 percent of the college's undergraduate population. Additionally, the office is charged with monitoring and programming for the Educational Opportunity Program (EOP) and Prehealth Collegiate Science and Technology Entry Program (CSTEP). EOP and CSTEP are state-supported programs intended to assist New York State students who meet economic and academic criteria set by the college, the State Programs Office, and the New York State Board of Regents. For further information, please contact Catherine Thompson in 140 Roberts Hall.

Within the university, Multicultural and Diversity Programs is charged with acting as the college liaison with the central Office of Minority Education Affairs, the Learning Strategies Center, and the State Programs Office. Other university connections regarding the concerns of the minority student population include the University Career Center and the Office of Financial Aid. The director and 7 to 10 peer advisers primarily carry out the duties of Multicultural and Diversity Programs. Together, the staff acts as the major advocacy group as well as an informational and referral center. The director provides support for the Academic Human Diversity and Resources Committee. Its constituency includes students, faculty, and the general public.

Given the college's policy on non-exclusionary programming, Multicultural and Diversity Programs is also responsible for some functions that serve the college's entire population. Presently, that includes general college diversity activities and serving as the Prehealth Program adviser and liaison and providing ongoing support at all levels for the Office of Counseling and Advising.

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

The Career Library contains an extensive collection of current and useful material, including career information books, extensive internship files, employer directories, and job listings. Alumni Career Link is a database of more than 300 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 resume writing, cover letter writing, and interview skills are presented throughout the semester and are available on videotape. An active on-campus recruiting program brings more than 90 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 and the staff in 177 Roberts Hall.

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

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 advanced permission
   - knowingly deprive other students of library resources, laboratory equipment, computer programs, or similar aids
   - in any other manner violate the principle of absolute integrity
3) Faculty members assume responsibility to make clear to students and teaching assistants specific regulations that apply to scholarly work in a discipline.

4) Faculty members fulfill their responsibility to
   - maintain in all class, laboratory, and examination activities an atmosphere conducive to academic integrity and honor
   - make clear the conditions under which examinations are to be given
   - make clear the consequences of violating any aspects of the code
   - provide opportunities for students to discuss the content of courses with each other and help each other to master that content and distinguish those activities from course assignments that are meant to test what students can do independently
   - state explicitly the procedures for use of materials taken from published sources and the methods appropriate to a discipline by which students must cite the source of such materials
   - approve in advance, in consultation with other faculty members, which work submitted by a student and used by a faculty member to determine a grade in a course may be submitted by that student in a different course
   - monitor the work and maintain such records as will support the crucial underpinning of all guidelines: the students' submitted work must be their own and no one else's

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

The Academic Integrity Hearing Board for the College of Agriculture and Life Sciences consists of three elected faculty members, three elected student members, a chair appointed by the dean, and the director of counseling and advising, who serves as a non-voting 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 POLICIES AND PROCEDURES

Records

The office of the college registrar maintains a complete academic record for each matriculated student. The registrar and associate registrar are available to consult with students regarding the assignment of credit toward meeting distribution and elective requirements as listed on the *Summary of Record* form.

Registration Procedures

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

Course Enrollment Procedures

Students will receive course enrollment information from the university registrar. After planning a schedule of courses in consultation with their faculty adviser, students pre-enroll by computer, through CoursEnroll in "Just the Facts" located in the Bear Access menu. Pre-enrollment is not valid until the student enters the adviser key code, received from their faculty adviser, into the computer. The adviser key code changes each semester to ensure ongoing contact between student and faculty adviser.

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

Students may enroll again for a course in which they received a grade of F in a previous semester. Both grades will be recorded and calculated as part of their GPA. If a student retakes a course in which a passing grade was earned, the second time will be for no credit.

Students must *not* enroll again for a course in which they received an incomplete or NGR. Instead, work for that course should be completed without further enrollment. The instructor files a manual grade form to 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.

Students enrolled in a two-semester course will receive an R at the end of the first semester and should enroll again for the same course the second semester. The letter grade will be recorded for the second semester when all work for the course is completed. A note on the transcript will explain the R grade.

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 on-line add/drop through "Just the Facts" or the official course drop and add form at the Registrar's Office, 140 Roberts Hall. Approval of the faculty adviser is required to change course enrollment. Department or course instructor approval may be required on select courses.

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

Students wishing to withdraw from a course after the end of the seventh week must petition to the college Committee on Academic Achievement and Petitions (also see Petitions Procedures below). Petition forms are available in Counseling and Advising, 140 Roberts Hall. 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.

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 upon 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 upon 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 regulation may be filed by any student who has grounds for exemption. Forms are available in the Counseling and Advising Office, 140 Roberts Hall. Counselors are available to assist with the process.

A petition is usually prepared with the assistance of a student's faculty adviser, whose signature is required. The adviser's recommendation is helpful to the committee. The committee reviews the written petition and determines whether there is evidence of mitigating and unforeseen circumstances beyond the control of the student that would warrant an exemption or other action. Petitions for withdrawing from a course are discussed above.

Academic Deficiency Policies

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 2.0*
- cumulative GPA of at least 2.0*

- satisfactory completion of 12 or more credits per semester
- reasonable progress toward completion of distribution requirements
- appropriate completion of college and university requirements

In general terms, regular participation in course work with academic loads at a level sufficient to assure graduation within eight semesters and grades averaging C (2.0) or higher are prima facie evidence of satisfactory progress and good academic standing.

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

Grade Reports

Grade reports for the fall semester are available on "Just the Facts" in January; grade reports for the spring semester are mailed by the Office of the University Registrar to students at their home addresses unless alternative addresses are reported to the college or university registrar by mid-May.

ACADEMIC HONORS

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

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

1) a minimum course load for the semester of 12 letter-graded credits;
2) achievement of a semester GPA of at least 3.50; and
3) 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.

Bachelor of Science with Honors. Students receiving a cumulative GPA of 4.0 or greater (based on the last four residential semesters of Cornell credits, with a minimum of 48 letter-graded credits) will graduate "summa cum laude."

Students receiving a cumulative GPA of greater than or equal to 3.75 and less than 4.0 (based on the last four residential semesters of Cornell credits, with a minimum of 48 letter-graded credits) will graduate "magna cum laude."

Students receiving a cumulative GPA of greater than or equal to 3.5 and less than 3.75 (based on the last four residential semesters of Cornell credits, with a minimum of 48 letter-graded credits) will graduate "cum laude."

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.

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.

Gamma Sigma Delta is an honor society of faculty and students in the Colleges of Agriculture and Life Sciences, Human Ecology, and Veterinary Medicine. The common bond is promotion of excellence in work related to the quality of our environment and life as it relates to agriculture and the related sciences. The Cornell chapter recognizes the academic achievements of students, faculty, and alumni of those colleges with nominations for membership and with special awards. To be eligible, seniors must be in the upper 15 percent of their major. Five juniors with the highest grade point average in the college are also nominated. Gamma Sigma Delta also promotes academic excellence through sponsorship of special programs in the three colleges.

Golden Key is a National Honor Society that recognizes and encourages scholastic achievement and excellence in all undergraduate fields of study. Juniors and seniors with a cumulative GPA of 3.66 or higher are eligible. Visit Golden Key's web site at http:goldenkey.gsu.edu/gk/

RESEARCH HONORS PROGRAM

The Research Honors Program provides students with a special opportunity to work with a faculty mentor to experience the research process. Successful completion of this program requires a thesis written in the style of a master's thesis or professional journal article in that area of research. Original honors research occasionally is published in a professional journal. Students are required to send an electronic version of their thesis title, abstract, student's name, and the research adviser's name to Ann Gantner, amg28@cornell.edu, by the end of the spring semester. During the summer of each year, the *CALS Research Honors Abstracts* is published as a compilation of abstracts of the honors theses. In addition to copies of the entire thesis requested by the program area, one copy is required by the Office of Academic Programs (140 Roberts Hall). This copy is made available in Mann Library.

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

Research may be done under the appropriate program area: Animal Sciences, Biological Sciences, Biology and Society, Entomology, 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 (www.cals.cornell.edu/stud_research/) for information about identifying a research topic, conferring with faculty, and undergraduate funding opportunities.

College 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. Also, the student must have attained a cumulative Cornell GPA of at least 3.0 (unless otherwise noted by a particular program) at the time of entry.

Interested students must make written application to the CALS Registrar's Office no later than the end of the sixth week of the first semester of their senior year, but are encouraged to make arrangements with a faculty member during the second semester of their junior year (or earlier if required by the program area). Earlier application deadlines to program area committees are noted in the sections below. For most of the program areas, an application form is available from the college registrar in 140 Roberts Hall. The application form also can be printed from the web at www.cals.cornell.edu/oap/registrar/res_hon_main.htm. Applications for Biological Sciences students can be picked up at 200 Stimson Hall, and for Biology and Society students, at 275 Clark Hall.

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

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

Unless otherwise indicated in the following program area descriptions, the research report in the form of a thesis or journal article should be submitted to the research program committee no later than four weeks before the end of classes of the semester in which the student expects to graduate. Students in the College of Agriculture and Life Sciences wishing to participate in the research honors program must be accepted in one of the program areas approved by the faculty.

Students are not eligible for distinction in research by participating in a program offered by another college or administrative unit.

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

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

For more information, consult the web at www.cals.cornell.edu/oap/registrar/res_hon_main.htm

Animal Sciences

Faculty committee: W. B. Currie, chair; Y. R. Boisclair, S. M. Quirk, P. A. Johnson, R. E. Austic

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

Those students with majors in animal sciences who are interested in doing a research project should consult with their faculty advisers early in 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 early in the second semester of the junior year.
- Preregister during the spring semester for AS 495, Animal Sciences Honors Seminar, which is offered in the fall semester.
- Register for AS 499, Undergraduate Research.
- Participate in AS 402, Seminar in Animal Sciences, during the spring semester and report on and discuss the project and results (see exceptions under particular program areas).
- Submit a written thesis to the Animal Sciences Research Honors Committee by the scheduled deadline. Specific information regarding deadlines, format, and organization for the thesis will be provided.
- Meet with the Animal Sciences Research Honors Committee for a short oral defense of the thesis following a review of the thesis by the student's sponsor and the research committee.

Details pertaining to the specific requirements of the program can be obtained from the office of the committee chair, 434 Morrison Hall.

Biological Sciences

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

Biology & Society

Faculty committee: D. Pimentel, chair

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

Biology & society students are considered for entry into the research honors program at the end of the second semester of the junior year. Application forms for the program are available in the biology & society office, 275 Clark Hall. To qualify for the biology & society research honors project, 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/her adviser. The director of undergraduate studies will appoint a third reader of the completed research thesis. Applications will be reviewed by a committee headed by the director of undergraduate studies, who will notify students directly of the outcome. Students will be permitted to register for the research honors program only by permission of the biology & society program. Students must enroll for two semesters and may take three to five credits per semester up to a maximum of eight credits in B&SOC 498 and 499, Honors Project I and II. More information on the honors program is available in the biology & society office, 275 Clark 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 275 Clark Hall.
- April 15: Thesis completed in a form satisfactory for evaluation and submitted to the three readers.
- April 29: Thesis defense accomplished.
- May 13: Two bound copies of completed and defended thesis submitted to director of undergraduate studies.

Entomology

Faculty committee: B. L. Peckarsky, chair

The Program

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

Prerequisites

An undergraduate wishing to enroll in the honors program must have completed at least 55 credits, at least 30 of the 55 at Cornell. Also, the student must have attained a cumulative GPA of at least 3.0 at the time of entry and maintain this GPA to graduate with distinction in research. The CALS registrar will verify GPAs of applicants before officially enrolling them in the Research Honors Program. Research honors students have the option of earning academic credit by enrolling in Independent Study (ENTOM 497) during any semester while working toward a research honors thesis. Credits and grade option for satisfying requirements of ENTOM 497 should be discussed with the thesis adviser (see below.) Note: Enrolling in independent study is not a requirement for graduating with distinction in research honors in entomology.

Sequence of Requirements

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

- Discuss the matter with his or her academic adviser, preferably in the junior year. This schedule makes it possible to carefully plan a research project and implement some research during the junior year and/or summer before the senior year.
- Select an appropriate faculty member in the Department of Entomology who can serve as a supervisor to oversee the honors research. This need not be the student's academic adviser. The academic adviser will be of assistance in determining which faculty entomologist has expertise most compatible with the interests of the student.
- 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.
- Submit a completed application and proposal (approved by the honors project supervisor and the chair of the Entomology Research Honors Committee) no later than the end of the sixth week of the first semester of the senior year. Earlier submission is encouraged. Applications are available and should be submitted to the CALS registrar, 140 Roberts Hall. These applications include an opportunity to request a modest

amount of funding from the CALS honors program. These funds are distributed only one time per year (in late fall).

- 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.
- 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.
- 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.
- 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.

Landscape Studies

Faculty committee: Kathryn Gleason, chair

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

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

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

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

Junior year: Identify a potential research honors project sponsor and secure that faculty member's commitment to sponsor the student in the research project. This should be accomplished early in the second semester of the junior year and be finalized by the end of the spring semester. Pre-register during the spring for the research honors program (LA 499).

Work with a faculty adviser to identify and formulate a research problem.

If the faculty adviser is not in the Department of Landscape Architecture, select a co-adviser from the department to ensure that the research is consistent with the field.

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 submission is 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.

Carry out an independent research effort that is original and separate from the work of others who may be investigating similar subjects.

Submit an outline of the thesis to the chair of the committee by the end of January for a May graduation.

April 15: Draft due to readers. 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 honor committee chair regarding the acceptability of the honors thesis.

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.

May 13: Two bound copies of the completed and defended thesis submitted to the honors committee chair. These copies are in addition to the unbound copy required for Mann Library. A 250-word abstract must be provided electronically to the CALS Office of Academic Programs and must appear at the front of the thesis (see CALS Requirements for Honors Thesis).

Natural Resources

Faculty director: J. B. Yavitt

The research honors program in natural resources provides an opportunity for undergraduates to pursue supervised independent research in the areas of applied ecology or resource policy and management. The subject matter and nature of the research experience may be quite varied. The guidance and supervision of a faculty member with substantial interest and expertise in the subject area is essential to the success of the project.

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

- Register for the research honors program in the junior year or earlier.
- Work with a faculty adviser to identify and formulate a research problem.
- If the faculty adviser is not in the Department of Natural Resources, select a co-adviser from the department to ensure the research is consistent with the field.
- Describe and summarize the work in the format of a conventional master's thesis or scientific paper ready for publication in a scientific or policy journal. Submit a copy the first week of April (senior year) to the honor's director. This version will be reviewed by two ad hoc reviewers, and the student will be able to incorporate their comments and suggestions into the final version, which will be due the last day of classes. About half of the theses have been published.
- 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.
- Students should be aware that this requires a considerable time commitment, and they are responsible for meeting deadlines and being prepared for presentations and other meetings.

Nutritional Sciences

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

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

The honors research program is an excellent opportunity for students who are highly interested in research and wish to commit substantial time and intellectual energy to a project that will span at least four semesters of their undergraduate experience. Honors students experience the excitement of designing a project to generate new knowledge on a topic that interests them and reporting the project findings. By working with faculty mentors and other researchers, they develop skills in research methods and data analysis. Students also learn that research projects are labor intensive and that writing research reports, such as the honors thesis, is

a vital, but time-consuming, aspect of the research process. This intensive research experience is not suitable for all students, and those who wish a less intensive research experience may conduct research with a faculty member under NS 401.

After the sophomore year, students demonstrating scholastic achievement in the sciences and courses for their majors as well as satisfactory progress toward their degree requirements are invited to apply to the program. Students interested in the program submit the "Intent to Apply to the Honors Research Program" form in the fall of their junior year. Final acceptance into the honors research program occurs when the student (1) is accepted into a faculty member's research program and (2) submits a research proposal abstract that is approved by the directors of the honors research program. Students may apply to the program at any time, provided that they can fulfill all program requirements.

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

Students receive academic credit for work on their honors project under NS 499. The six required credits may be taken over several semesters. How much time is spent on the project each term will be the decision of the student and the faculty mentor. For each three to four hours of work, 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 honors research project is the major component of the honors research 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 term and fall senior term. Students may arrange with their faculty mentor to work on the project during the summer. The spring senior term 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 term.

Physical Sciences

Faculty committee: R. L. Strawderman, chair; S. Colucci, S. J. Mulvaney

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 Biometrics.

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

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

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

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

Plant Sciences

Faculty committee: R. L. Obendorf, chair; I. A. Merwin, E. B. Nelson, F. S. Rossi

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.

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 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.

Social Sciences

Faculty committee: D. A. Scheufele

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 earlier, after evaluation of the student's written application, and on approval of a detailed thesis proposal. The application and proposal are due to the program area chair no later than the third week of the first semester of the senior year. Each student is encouraged to begin working on this proposal with a prospective faculty thesis adviser during the junior year. The purpose of the proposal is two-fold. First, it formalizes a plan of study and establishes a set of expectations between the student and his or her faculty adviser. Second, the honors committee reviews the proposal to determine whether it is consistent with honors thesis requirements and to make suggestions for improvement.

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

- **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.
- **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.
- **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.
- **Expected Significance:** State what new knowledge or information is likely to be forthcoming and why it is important. State any practical applications expected as a result of the research.

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

Distinction in research is awarded upon approval of the research honors thesis by the Social Science Research Honors Committee. The research should deal with a substantive issue in one of the fields in the social sciences. Both the results of the research and the

methodology (or the logical argument by which the results were achieved) must be reported. Reviews of the literature, practical conclusions or applications, or broad characterizations of an area of inquiry may constitute part of the research report but are not themselves sufficient to count as research.

Honors theses should be written according to the form of any standard journal within the appropriate field. Three copies of the thesis must be submitted to the chair of the social science committee no later than three weeks before the last day of classes of the semester for which the degree is sought. A supporting letter from the faculty member supervising the work also must be submitted. The thesis will be independently reviewed and revisions may be required before the thesis is accepted. Final approval of the thesis requires a majority vote of the honors committee.

INTERCOLLEGE PROGRAMS

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

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

Students in the Engineering Program in Biological and Environmental Engineering (BEE) are usually enrolled in the College of Agriculture and Life Sciences during the freshman and sophomore years and jointly enrolled in this college and the College of Engineering in the junior and senior years. All BEE engineering students pay the engineering college tuition during the senior year and graduate from the College of Engineering. The B.S. degree is awarded in cooperation with the College of Engineering. The curriculum is accredited by the Accreditation Board for Engineering and Technology.

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.

The Division of Nutritional Sciences is an intercollege unit affiliated with the College of Human Ecology and the College of Agriculture and Life Sciences. The nutrition, food, and agriculture major offers students in the College of Agriculture and Life Sciences the opportunity to focus their studies in human nutrition while obtaining a strong background in courses related to agriculture and the life sciences. Students in the biological sciences major may complete the program of study in human nutrition. Courses offered by the Division of Nutritional Sciences support many undergraduate programs in the College of Agriculture and Life Sciences including animal science, biological sciences, communication, food science, international agriculture, plant sciences, and rural sociology. Nutritional sciences courses count toward the undergraduate degree requirement for 55 credit hours of courses in Agriculture and Life Sciences.

The American Indian Program (AIP) is a multidisciplinary program consisting of academic, research, extension, and student support components. Course work is intended to enhance students' understanding of the unique heritage of North American Indians and their relationship to other peoples in the United States and Canada. Students tackle such challenging topics as the sovereign rights of Indian nations and the contemporary relevance of Indian attitudes toward the environment. The program's instructional core consists of courses that focus on American Indian life from pre-contact times to the present, and feature the perspectives of Native American people.

Research areas among faculty active in the program include American Indian education, social and economic development, agriculture, environmental issues, history, sociology, language, literature, and the arts and cultural preservation. Extension and outreach efforts within the program seek to develop solutions to problems identified by American Indian communities and to facilitate the application of institutional resources, research, and expertise to community needs.

Akwe:kon, the American Indian Residence House, offers undergraduate students a living environment that promotes intercultural exchange.

The American Indian Program offers a concentration in American Studies to undergraduate students in conjunction with their major defined elsewhere in the university. The concentration is earned upon completion of five courses: American Indian Studies 100 (Indian America to 1890) and American Indian Studies 175 (Contemporary American Indian Issues), plus three other courses selected from the American Indian Studies course listing, for a total of at least 15 credits. Students choosing a concentration in American Indian Studies must obtain application materials from the AIP office in 450 Caldwell. AIP also offers a graduate minor.

Science of Earth Systems (SES) major emphasizes the rigorous and objective study of the Earth system as one of the outstanding intellectual challenges of modern science and as the necessary foundation for the future management of our home planet. Within this program, Cornell's strengths across a broad range of earth and environmental sciences have been brought together to provide students with the tools to engage in what will be the primary challenge of the twenty-first century.

The major is available to students in the College of Agriculture and Life Sciences as well as students in the Colleges of Arts and Sciences and, as an option, Engineering. The SES major has its home in the Department of Earth and Atmospheric Sciences, which spans all three colleges, but relies on the collaboration of several departments across the university.

The SES curriculum provides strong preparation in mathematics, physics, chemistry, and biology during the freshman and sophomore years. In the junior and senior years, students take a set of common SES core courses and an additional set of advanced disciplinary or interdisciplinary courses that build on the basic sequences. Graduates of Cornell's SES program are well prepared for graduate studies in the earth and environmental sciences. The SES major also provides an excellent background for students wishing to pursue careers, with or without advanced study, in environmental law and policy, and environmental protection. SES is also a good major for students wishing to teach earth and environmental science at the high school level, perhaps in conjunction with Cornell's Teacher Education in Agriculture, Mathematics, and Science (TEAMS) program.

See the Science of Earth Systems listing in the section "Major Fields of Study" for complete information about the SES curriculum. For more information contact Professor Kerry H. Cook, Department of Earth and Atmospheric Sciences, khc6@cornell.edu, and visit the web site: www.geo.cornell.edu/ses/

The Comparative and Environmental Toxicology Program is an interdisciplinary intercollege program with research, teaching, and Cooperative Extension components coordinated by the Institute for Comparative and Environmental Toxicology (ICET). Courses are cosponsored by academic departments in several colleges of the university. A description of the program and general information is available from the director of the program through the ICET office, 213 Rice Hall, or at www.cfe.cornell.edu/icet. See also the Interdisciplinary Centers, Programs, and Studies section at the front of this catalog.

The Cornell Institute for Resource Information Systems (Cornell IRIS) is an interdisciplinary, intercollege unit affiliated with the Department of Crop and Soil Sciences. The mission of Cornell IRIS is to advance the development and use of spectral and spatial information science and technology to benefit the environment. The institute comprises three program areas: environmental resource inventory, remote sensing, and geographic information systems. A description of these programs and general information is available from the institute director, Cornell IRIS office, 302 Rice Hall.

OFF-CAMPUS STUDY PROGRAMS

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

Students who plan to enroll in courses at another institution in the United States must petition for a leave of absence. Courses should be selected in consultation with the faculty adviser.

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 term prior to assignments. Those accepted should plan a program of study in consultation with their faculty adviser. At least 12 credits must be carried to meet the residency requirement. To receive academic credit for the internship, students enroll in ALS 400 for an S-U grade only.

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

Cornell in Washington

The Cornell in Washington program offers students from all colleges in the university an opportunity to earn full academic credit for a semester in Washington, D.C. Students take courses from Cornell faculty, conduct individual research projects, and work as externs. The Cornell in Washington program offers two study options: (1) studies in public policy, and (2) studies in the American experience. Students take part in a public policy or humanities seminar, which requires them to serve as externs in federal agencies, congressional offices, or nongovernmental organizations and to carry out individual research projects under the supervision of Cornell faculty. The required externships and all course enrollments are arranged through, and approved by, the Cornell in Washington program. Students in the College of Agriculture and Life Sciences must register for ALS 500 and cannot receive credit for the externship experience alone. For further information, see p. 21, inquire at M101 McGraw Hall, 255–4090, or visit the Cornell in Washington web site at ciw.cornell.edu.

SEA Semester

The Sea Education Association is a nonprofit educational institution offering ocean-focused academic programs and the opportunity to live, work, and study at sea. Science, the humanities, and practical seamanship are integrated in small, personal classes. The 17-credit program is 12 weeks in length. Six weeks are spent in Woods Hole, and the following six weeks are spent on either one of SEA's two sailing vessels: the SSV Robert Seamans or the SSV Corwith Cramer. For more information, students should contact the Cornell Marine Programs office, G14 Stimson Hall (607–255–3717) or visit SEA's web site: 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 the 95-acre Appledore Island off the coast of Portsmouth, New Hampshire, in the Gulf of Maine. SML offers undergraduates and other interested adults a unique opportunity to study marine science in a setting noted for its biota, geology, and history. Please refer to "Courses in Marine Science," under the section on the Office of Undergraduate Biology, for a list of courses offered.

For more information, contact the Shoals Marine Laboratory office, G14 Stimson Hall, 607–255–3717 or visit their web site: 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 three credits per internship and no more than six 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 six-credit allotment includes transfer credit and credit from other internships in other colleges at Cornell. The six-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 (pro-rated for transfer students) of the 120 credits required for the degree may be taken in internships, independent study courses, and undergraduate teaching or research. For internships not governed by an established internship course, the student must enroll in a 497 course for the number of credits assigned.

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

- Credit will only be assigned or accepted in cases where a Cornell faculty member is directly involved in determining both the course content and in evaluating the student's work.
- 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.
- Before a student begins the internship, a learning contract needs to be written between the Cornell faculty internship adviser on campus, the supervisor at the location, and the student. This contract should state the conditions of the work assignments, supervisor, learning goals, number of credits, and methods of evaluation of the work. A contract form can be obtained from the college Registrar's Office, or departments may have their own.
- Students should further develop the internship experience based on the college Experiential Learning Criteria, which can be obtained from the Registrar's Office in 140 Roberts Hall.
- Students need to keep their faculty internship adviser updated on the progress of the internship while away from campus.

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

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

One option is that you 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, 177 Roberts Hall, or Cornell Career Services, 103 Barnes Hall. Another option is to receive credit through a 499 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 list of sources provides information about research and internships:

CALS Career Development Office:
www.cals.cornell.edu/oap/careers/

CALS Undergraduate Research Opportunities:
www.cals.cornell.edu/oap/admin/undergrad_res_oppor.htm (information about how to explore research opportunities.)

CALS Research Honors Program:
www.cals.cornell.edu/oap/registrar/res_hon_main.htm

CALS Undergraduate and Graduate Research Funding:
www.cals.cornell.edu/oap/admin/undergrad_grad_grants.htm

CALS Undergraduate Underrepresented Minority Research Funding:
www.cals.cornell.edu/oap/admin/minority_research.htm

CALS Internship Guidelines:
www.cals.cornell.edu/oap/admin/intern_guide.htm

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

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

Biological Sciences:
www.bio.cornell.edu

International Exchange Programs in the College of Agriculture and Life Sciences

Any student whose grade-point average is 2.75 or above and has completed one year of continuous study in CALS may apply to a CALS international student exchange program.

These undergraduate exchange opportunities are for **CALS students only**. For more information on programs and application process, see the CALS Study Abroad Adviser in 140 Roberts Hall or visit the web site www.cals.cornell.edu/oap/advising/international/index.html.

Students who are interested in international study but not in one of the CALS programs must apply through **Cornell Abroad** in 474 Uris Hall. Please refer to the Cornell Abroad section of *Courses of Study*.

MAJOR FIELDS OF STUDY

The college curriculum consists of 21 major program areas that reflect the departmental academic effort in the college. Faculty curriculum committees in each area identify a sequence of courses appropriate to all students studying in that field. Courses of study are designed to provide systematic development of basic skills and concepts as well as critical thinking. Opportunity for concentration in an area of particular interest is usually available.

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

Animal Sciences

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

The program focuses on the application of science to the efficient production of animals for food, fiber, and pleasure and easily accommodates a variety of interests and goals. Beyond a core of basic courses (suggested minimum, 15 credits) students select production and advanced courses to fulfill an individually tailored program worked out in consultation with their advisers. In this way it is possible to concentrate by species as well as by subject matter (nutrition, physiology, growth biology, breeding, management). For each subject area, supporting courses in other departments are readily available and strongly encouraged. Many science-oriented students elect a program emphasizing supportive preparation in the physical and biological sciences appropriate to graduate, veterinary, or professional study following graduation. Dairy management is a popular program among students who may be preparing to manage a dairy farm or enter a related career. Other students may elect a program oriented toward economics and business in preparation for a career in the poultry, dairy, meat-animal, horse, feed, or meats industry. These are examples of the flexibility within these programs that can be developed to meet a student's career interest related to animals.

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

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

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

Applied Economics and Management

The Department of Applied Economics and Management (AEM) offers undergraduate programs of study in three broad areas: Business, Agribusiness, and Applied Economics.

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

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

The six areas of specialization offered in AEM are:

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

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

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

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

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

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

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

Atmospheric Science

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

Atmospheric science courses are offered through the Department of Earth and Atmospheric Sciences (EAS). There are three options for the B.S. in atmospheric science through the College of Agriculture and Life Sciences:

Option A

1. Mathematics, Computer Science, and Statistics:
   a. MATH 190/191, 192, 293; or MATH 111, 112, 213
   b. COM S 100 or EAS 150 or equivalent
   c. AEM (ARME) 210 or equivalent
   d. MATH 294 (or MATH 221 and 222, without MATH 213) or EAS 435
2. Basic Physical Sciences:
   a. PHYS 207, 208, or PHYS 112, 213, 214
   b. CHEM 206, 207, or 211
3. Atmospheric Science:
   a. EAS 131, 250, 341, 342, 352, 447, 451
   b. At least two atmospheric science electives

Option B

1. Mathematics, Computer Science, and Statistics:
   a. MATH 190/191, 192, 293, 294; or MATH 111, 112, 221, 222
   b. COM S 100 or EAS 150 or equivalent
   c. AEM 210 or equivalent
   d. MATH 321, MATH 420, or T&AM 310
2. Basic Physical Sciences:
   a. PHYS 112, 213, 214
   b. CHEM 207 or 211
3. Atmospheric Science:
   a. EAS 341, 342, 352, 451

Option C

1. Mathematics, Computer Science, and Statistics:
   a. MATH 190/191, 192, 293; or MATH 111, 112, 213
   b. COM S 100 or EAS 150 or equivalent
   c. AEM 210 or equivalent
2. Basic Physical Sciences:
   a. PHYS 207, 208
   b. CHEM 206, 207, or 211
3. Atmospheric Science:
   a. EAS 341, 342, 352, 451
4. Earth Sciences:
   a. one semester of introductory astronomy
   b. one semester of introductory geology
   c. six additional semesters of earth science (astronomy, atmospheric science, geology)

Option A is intended to meet the needs of students whose primary interests are in forecasting and operational meteorology. Upon graduation, a student who has completed Option A will have satisfied both the curricular guidelines of the American Meteorological Society and the educational requirements of the National Weather Service for employment as a meteorologist. They will also be well qualified for positions in private-sector forecasting, environmental consulting firms, and broadcast meteorology. In addition, Option A provides good preparation for graduate work in atmospheric science and closely related fields.

Option B is designed to focus on preparation for graduate study in atmospheric as well as other sciences, and includes somewhat stronger course work in mathematics and physics than does Option A. The minimum course work in Option B does not satisfy the National Weather Service requirements or American Meteorological Society guidelines for employment in operational meteorology, but may be more appropriate for students with academic or research career goals. It can also be an attractive option for students transferring into the program as juniors.

Option C is intended for students who wish to become secondary school earth science teachers. It provides good preparation for graduate study in earth science education, and includes the minimum course work required for secondary earth science teaching certification in New York. It does not satisfy the National Weather Service or American Meteorological Society guidelines for employment as an operational meteorologist.

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

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 and career advising. For more details about the biology curriculum see the section in this catalog on Biological Sciences or visit the office of Undergraduate Biology web site, www.bio.cornell.edu.

Biological and Environmental Engineering

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

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

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

Many undergraduate students participate in honors programs, undergraduate teaching and research, internships, independent study, design teams, and study abroad. Students in the engineering program are also eligible to do Engineering Co-Op. Students completing the BEE major should have a strong aptitude for the sciences and mathematics and an interest in the complex social issues that surround technology.

Career opportunities cover the spectrum of private industry, public agencies, educational institutions, and graduate programs in engineering, science, medicine, law, and other fields. In recent years graduates have developed careers in environmental consulting, biotechnology, the pharmaceutical industry, biomedical engineering, management consulting, and international development.

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

Engineering is educating the next generation of engineers to meet these challenges.

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

Specific course distribution requirements for the academic programs in Biological Engineering Technology and Environmental Engineering Technology include

A. Basic Subjects	*Credits*
1. Calculus	8
2. Chemistry	7
3. Physics	8
4. Introductory biological sciences	6
5. Computer programming	4
6. Probability and statistics	3
7. Written and oral expression	9
B. Advanced and Applied Subjects	
1. Five courses in the biological, environmental, or life sciences	15
2. Five engineering or technology courses at the 300 level or above; at least 9 credits in Biological and Environmental Engineering	15
C. Electives	
Additional courses to complete College of Agriculture and Life Sciences requirements	
D. Total (minimum)	*120*

For further details on the Biological and Environmental Engineering and Technology Programs, see the BEE Undergraduate Program Handbook, available at 207 Riley-Robb Hall or online at www.bee.cornell.edu. Contact Professor Jim Bartsch at 255–2800, jab35@corenll.edu, or visit the department's web site for more information.

Biology & Society

The Biology & Society program area is designed for students who wish to combine the study of biology with exposure to 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 the section on biology & society under the College of Arts and Sciences in this publication or visit the web site at www.sts.cornell.edu.

Students who elect Biology & Society as their major field of study leave 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 must have completed a year of college-level biology and must submit an application during their sophomore year. Students in the College of Agriculture and Life Sciences may be admitted directly into the field of study when they apply to the college; as with all students admitted prior to completing the biology prerequisite, the admission is provisional. It is the student's responsibility to assure that final acceptance is granted upon completion of the introductory biology sequence and the application form. Although only introductory biology is a prerequisite for acceptance, students will find it useful to have completed some of the other requirements (obtain course checklist in 306 Rockefeller Hall) by the end of their sophomore year. Juniors are considered on a case-by-case basis. Upper-division applicants should realize the difficulties of completing the Biology & Society requirements in less than two years.

The application includes:

- A one- to two-page statement explaining your intellectual interests in biology & society and why it is consistent with your academic goals and interests.
- A selected theme.
- A tentative plan of courses fulfilling Biology & Society requirements, including courses you have taken and those you plan to take.
- A transcript of work taken at Cornell University, current as of the date of application.

The faculty admissions committee reviews applications twice a year, once each during the fall and spring semesters. A faculty adviser is assigned on admittance to the field. Approximately 50 faculty members from four colleges serve as advisers to Biology & Society students. The major program is coordinated for students in all colleges through the Biology & Society office, 306 Rockefeller Hall, where students can get information, specific course requirements, and application forms. Faculty and student advisers are available to discuss the Biology & Society requirements with you.

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 on the web at www.sts.cornell.edu. Also refer to the section on Biology & Society under the College of Arts and Sciences in this publication.

Biology & Society Requirements:

- Introductory biology (101–104, 105–106, or 107–108 or a 5 in AP biology)
- College calculus (one course)
- Ethics (one course)
- Two social sciences/humanities foundation courses
- Three biology foundation courses
- One biology depth course
- Statistics (one course)
- Core course
- 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 faculty is available in 306 Rockefeller Hall. Further information may be obtained by logging onto the departmental web site: www.sts.cornell.edu.

I. Basic Courses

(may not be used to fulfill major requirements)

A. First-Year Writing Seminars

Check the current FWS pamphlet for information.

B. S&TS 101 Science and Technology in the Public Arena
Fall. 3 credits. T. Gillespie.
For description, see S&TS 101.

II. Foundation Courses

A. Ethics (select one)

B&SOC 205 Ethical Issues in Health and Medicine (also S&TS 205)
Fall. 4 credits. Limited to 150 students. S. Hilgartner.
For description, see B&SOC 205 in Arts and Sciences.

B&SOC 206 Ethics and the Environment (also S&TS 206 and PHIL 246)
Spring. 4 credits. Limited to 100 students. N. Sethi.
For description, see B&SOC 206 in Arts and Sciences.

B. Social Sciences/Humanities Foundation (two courses, one from any two areas)

1. History of Science

S&TS 233 Agriculture, History, and Society: From Squanto to Biotechnology
Fall. 3 credits. M. Rossiter.
For description, see S&TS 233.

S&TS 282 Science in Western Civilization (also HIST 282) #
Spring. 4 credits. P. Dear.
For description, see HIST 282.

[S&TS 283 The Sciences in the Twentieth Century (also HIST 280)
Fall. 4 credits. Staff.
For description, see S&TS 283.]

S&TS 287 Evolution (also BIOEE 207 and HIST 287)
Fall or summer. 3 credits. W. Provine.
For description, see BIOEE 207.

S&TS 355 Computers: From Babbage to Gates
Spring. 4 credits. T. Gillespie.
For description, see S&TS 355.

[S&TS 390 Science in the American Polity: 1800–1960 (also GOVT 308, AM ST 388)
Fall. 4 credits. Not offered 2003–2004. Staff.
For description, see S&TS 390.]

[S&TS 433 Comparative History of Science
Spring. 4 credits. Not offered 2003–2004. M. Rossiter.
For description, see S&TS 433.]

S&TS 444 Historical Issues of Gender and Science (also FGSS 444)
Spring. 4 credits. M. Rossiter.
For description, see S&TS 444.

2. Philosophy of Science

S&TS 201 What Is Science? An Introduction to the Social Studies of Science and Technology (also SOC 210)
Spring. 3 credits. T. Pinch.
For description, see S&TS 201.

S&TS 286 Science and Human Nature (also PHIL 286)
Fall. 4 credits. May be used to meet the philosophy of science requirement *if not* used to meet the core course requirement. R. Boyd.
For description, see PHIL 286.

[S&TS 381 Philosophy of Science: Knowledge and Objectivity (also PHIL 381)
Fall. 4 credits. Limited to 30 students. R. Boyd.
For description, see PHIL 381.]

3. Sociology of Science

B&SOC 301 Life Sciences and Society (also S&TS 301)
Fall. 4 credits. Limited to 50 students. May be used to meet the sociology of science requirement if not used to meet the core course requirement. M. Lynch.
For description and prerequisites, see B&SOC 301 in Arts and Sciences.

B&SOC 442 Sociology of Science (also S&TS 442, CRP 442, and SOC 442)
Fall. 4 credits. Staff.
For description, see S&TS 442.

HD 452 Culture and Human Development
Fall.
For description, see HD 452.

NS 245 Social Science Perspectives on Food and Nutrition
Fall. 3 credits. J. Sobal.
For description, see NS 245.

[R SOC 208 Technology and Society
Fall. 3 credits. Not offered 2003–2004. C. Geisler.
For description, see R SOC 208.]

R SOC 220 Sociology of Health and Ethnic Minorities (also LSP 220)
Fall. 3 credfits. P. Parra.
For description, see R SOC 220.

S&TS 201 What Is Science? An Introduction to the Social Studies of Science and Technology (also SOC 210)
Spring. 3 credits. T. Pinch.
For description, see S&TS 201.

[S&TS 311 The Sociology of Medicine
Spring. 4 credits. Staff.
For description, see S&TS 311.]

[S&TS 411 Knowledge, Technology, and Property
Spring. 4 credits. S. Hilgartner.
For description, see S&TS 411.]

4. Politics of Science

[B&SOC 406 Biotechnology and the Law (also S&TS 406)
Spring. 4 credits. Staff.
For description, see S&TS 406.]

B&SOC 407 Law, Science, and Public Values (also S&TS 407)
Spring. 4 credits. M. Lynch.
For description, see S&TS 407.

[B&SOC 427 Politics of Environmental Protection (also GOVT 420 and S&TS 427)
Fall or summer. 4 credits. Not offered 2003–2004.
For description, see S&TS 427.]

CRP 380 Environmental Politics
Fall. 4 credits. R. Booth.
For description, see CRP 380.

PAM 230 Introduction to Policy Analysis
Spring. 3 credits. J. Gerner.
For description, see PAM 230.

S&TS 324 Environment and Society (also R SOC 324 and SOC 324)
Spring. 3 credits. C. Geisler.
For description, see R SOC 324.

S&TS 391 Science in the American Polity: 1960–Now (also GOVT 309 and AM ST 389)
Spring. 4 credits. J. Reppy.
For description, see S&TS 391.

5. Science Communication

COMM 260 Scientific Writing for Public Information
Fall or spring. 3 credits. Limited to 25 non-freshman or graduate students per section. S. Conroe.
For description and prerequisites, see COMM 260.

COMM 421 Communication and the Environment
Spring. 3 credits. May be used in the foundation only if **not** taken as a senior seminar. J. Shanahan.
For description, see COMM 421.

S&TS 285 Communication in the Life Sciences (also COMM 285)
Spring. 3 credits. B. Lewenstein.
For description, see COMM 285.

S&TS 352 Science Writing for the Mass Media (also COMM 352)
Fall. 3 credits. Not open to freshmen. Limited to 25 students. B. Lewenstein.
For description and prerequisites, see COMM 352.

S&TS 466 Communication of Science and Technology (also COMM 466)
Fall. 3 credits. May be used in the foundation only if **not** taken as a senior seminar. Limited to 15 students. B. Lewenstein.
For description and prerequisites, see COMM 466.

C. *Biology Foundation* (breadth requirement): Three courses: one from three of the following subject areas:

1. Biochemistry, Molecular and Cell Biology

BIOBM 330 Principles of Biochemistry, Individual Instruction
Fall or spring. 4 credits. J. Blankenship, P. Hinkle, staff.
For description and prerequisites, see BIOBM 330.

BIOBM 331 Principles of Biochemistry: Proteins and Metabolism
Fall. 3 credits. May not be taken for credit after BIOBM 330 or 333. G. Feigenson.
For description and prerequisites, see BIOBM 331.

BIOBM 333 Principles of Biochemistry, Lectures
Summer. 4 credits. H. T. Nivison.
For description and prerequisites, see BIOBM 333.

NS 320 Introduction to Human Biochemistry
Fall. 4 credits. W. Arion and P. Stover.
For description and prerequisites, see NS 320.

2. Ecology

BIOEE 261 Ecology and the Environment
Fall or summer. 4 credits. Not open to freshmen. B. Chabot, A. Dhondt, N. Hairston, and A. Vawter.
For description and prerequisites, see BIOEE 261.

3. Genetics and Development

BIOGD 281 Genetics
Fall, spring, or summer. 5 credits. Not open to freshmen fall semester. Limited to 200 students. M. Goldberg, et al.
For description and prerequisites, see BIOGD 281.

BIOGD 282 Human Genetics
Spring. 3 credits (2 cr. if taken after BIOGD 281). Must be taken for 3 credits for Biology & Society requirement. M. Goldberg.
For description and prerequisites, see BIOGD 282.

4. Evolutionary Biology

BIOEE 278 Evolutionary Biology
Fall or spring. 3 or 4 credits. Limited to 300 students. Staff.
For description, see BIOEE 278.

5. Microbiology

BIOMI 290 General Microbiology Lectures
Fall, spring, or summer. 2 or 3 credits (2 credits if taken after BIOMI 192). Staff.
For description and prerequisites, see BIOMI 290.

6. Neurobiology and Behavior

BIONB 221 Neurobiology and Behavior I: Introduction to Behavior
Fall. 3, 4, or 5 credits. Not open to freshmen. T. Seeley.
For description and prerequisites, see BIONB 221.

BIONB 222 Neurobiology and Behavior II: Introduction to Neurobiology
Spring. 3 or 4 credits. Not open to freshmen. Each discussion limited to 20 students. Staff.
For description and prerequisites, see BIONB 222.

7. Plant Biology

BIOPL 241 Introductory Botany
Fall. 3 credits. K. J. Niklas.
For description, see BIOPL 241.

8. Physiology and Anatomy

BIOAP 311 Introductory Animal Physiology, Lectures (also VET MED 346)
Fall. 3 credits. E. Loew and staff.
For description and prerequisites, see BIOAP 311.

NS 341 Human Anatomy and Physiology
Spring. 4 credits. Permission only. Must preregister for lab in 309 MVR during CoursEnroll. V. Utermohlen.
For description and prerequisites, see NS 341.

D. Biology Foundation (depth requirement): one course for which one of the above breadth requirement courses (2C) is a prerequisite.

E. Statistics (select one)

AEM 210 Introductory Statistics
Fall. 4 credits. C. van Es.
For description and prerequisites, see AEM (ARME) 210.

BTRY 301 Statistical Methods I
Fall, summer. 4 credits. Staff.
For description and prerequisites, see BTRY 301.

[CRP 223 Introduction to Statistical Reasoning for Urban and Regional Analysis
Fall. 3 credits. Staff.
For description, see CRP 223.]

ECON 319 Introduction to Statistics and Probability
Fall. 4 credits. Y. Hong.
For description and prerequisites, see ECON 319.

ILRST 210 Statistical Reasoning I
Fall, spring, summer. 3 credits. P. Velleman, T. DiCiccio.
For description, see ILRST 210.

MATH 171 Statistical Theory and Application in the Real World
Fall, spring. 4 credits. Staff.
For description and prerequisites, see MATH 171.

PAM 210 Introduction to Statistics
Fall, spring. 4 credits. R. Swisher, K. Joyner.
For description, see PAM 210.

PSYCH 350 Statistics and Research Design
Fall. 4 credits. T. Gilovich.
For description, see PSYCH 350.

SOC 301 Evaluating Statistical Evidence (also R SOC 302)
Fall. 3 credits. M. Clarkberg.
For description, see SOC 301.

III. Core Courses

B&SOC 301 Life Sciences and Society (also S&TS 301)
Fall. 4 credits. Limited to 50 students. M. Lynch.
For description and prerequisites, see B&SOC 301.

S&TS 286 Science and Human Nature (also PHIL 286)
Fall. 4 credits. R. Boyd.
For description, see PHIL 286.

IV. Theme

A. Natural Sciences Issues/Biology Elective (two courses). Select from the following list of B&SOC approved Natural Sciences Issues courses or choose course(s) with introductory biology as a prerequisite.

B&SOC 214 Biological Basis of Sex Differences (also BIOAP 214 and FGSS 214)
Spring. 3 credits. J. Fortune.
For description, see BIOAP 214.

[B&SOC 347 Human Growth and Development: Biological and Behavioral Interactions (also HD 347 and NS 347)
Spring. 3 credits. Offered alternate years. Next offered spring 2005. J. Haas and S. Robertson.
For description and prerequisites, see HD 347.]

[BIOEE 275 Human Biology and Evolution (also ANTHR 275 and NS 275)
Fall. 3 credits. J. Haas and K. Kennedy.
For description, see BIOEE 275.]

[BIOEE 474 Laboratory and Field Methods in Human Biology (also ANTHR 474)
Spring. 5 credits. K. Kennedy.
For description, see BIOEE 474.]

[BIOEE 673 Human Evolution: Concepts, History, and Theory (also ANTHR 673)
Fall. 3 credits. Offered alternate years. K. Kennedy.
For description, see BIOEE 673.]

[BIOPL 247 Ethnobiology
Fall. 3 credits. D. Bates.
For description, see BIOPL 247.]

HD 266 Emotional Functions of the Brain
Spring. 3 credits. R. DePue.
For description and prerequisites, see HD 266.

HD 344 Infant Behavior and Development
Fall. 3 credits. Not open to freshmen. S. Robertson.
For description and prerequisites, see HD 344.

HD 433 Developmental Cognitive Neuroscience
Spring. 3 credits. E. Temple.
For description, see HD 433.

[HD 436 Language Development (also LING 436, PSYCH 436, and COGST 436)
Spring. 4 credits. B. Lust.
For description, see HD 436.]

NS 222 Maternal and Child Nutrition
Fall. 3 credits. Limited to 20. C. Garza and P. Brannon.
For description and prerequisites, see NS 222.

NS 331 Physiological and Biochemical Bases of Human Nutrition
Spring. 4 credits. May be used to fulfill the Biology Depth requirement. C. McCormick.
For description and prerequisites, see NS 331.

NS 361 Biology of Normal and Abnormal Behavior (also PSYCH 361)
Fall. 3 credits. Limited to juniors and seniors only. B. Strupp.
For description and prerequisites, see NS 361.

NS 452 Molecular Epidemiology and Dietary Markers of Chronic Disease
Spring. 3 credits. P. Cassano.
For description and prerequisites, see NS 452.

NS 475 Mechanisms of Birth Defects
Spring. 3 credits. P. Stover.
For description and prerequisites, see NS 475.

NTRES 201 Environmental Conservation
Spring. 3 credits. T. Fahey.
For description, see NTRES 201.

PSYCH 326 Evolution of Human Behavior
Fall. 4 credits. R. Johnston.
For description and prerequisites, see PSYCH 326.

Examples of biology electives

AN SCI 300 Animal Reproduction and Development
Spring. 3 credits.
For description, see AN SCI 300.

HD 220 The Human Brain and Mind
Fall. 3 credits.
For description, see HD 220.

HD 366 Psychobiology of Temperament and Personality
Fall, 3 credits. R. DePue.
For description and prerequisites, see HD 366.

B. Humanities/Social Sciences Elective (two courses)

Courses listed earlier as social science/humanities foundation courses (2.B) are particularly appropriate as social science/humanities electives. A single course, however, cannot be used to meet both requirements. Additional courses that are recommended as social science or humanities electives are:

Examples of humanities/social sciences electives

AEM 464 Economics of Agricultural Development
Spring. 3 credits. R. Christy.
For description, see AEM 464.

[ANTHR 211 Nature and Culture ☮
Spring. 3 credits. Staff.
For description, see ANTHR 211.]

B&SOC 314 Environmental Governance (also S&TS 314 and NTRES 314)
Spring. 3 credits. S. Wolf.
For description, see NTRES 314.

HD 457 Health and Social Behavior (also SOC 457)
Fall. 3 credits. E. Wethington.
For description, see HD 457.

NS 450 Public Health Nutrition
Spring. 3 credits. K. Rasmussen, D. Pelletier.
For description, see NS 450.

NTRES 407 Religion, Ethics, and the Environment
Fall. 4 credits. R. Baer.
For description, see NTRES 407.

PAM 303 Ecology and Epidemiology of Health
Spring. 3 credits. E. Rodriguez.
For description, see PAM 303.

PAM 380 Human Sexuality
Spring. 3 credits. A. Parrot.
For description, see PAM 380.

PAM 435 U.S. Health Care Systems
Fall. 3 credits. R. Battistella.
For description, see PAM 435.

PAM 437 Economics of Health Policy
Fall. 3 credits. K. Simon.
For description, see PAM 437.

PHIL 241 Ethics
Spring. 4 credits. N. Sturgeon.
For description, see PHIL 241.

[PHIL 368 Global Climate and Global Justice (also GOVT 468)
Fall. 4 credits. Staff.
For description, see PHIL 368.]

R SOC 205 International Development (also SOC 206)
Spring. 3 credits. P. McMichael.
For description, see R SOC 205.

[R SOC 261 Sociology of Sustainable Development
Fall. 3 credits. Staff.
For description, see R SOC 261.]

[R SOC 490 Society and Survival
Fall. 3 credits. Staff.
For description, see R SOC 490.]

[S&TS 453 Reflections on Scientific Personae: Visibility and Invisibility of the Body
Spring. 4 credits. H. Mialet.
For description, see S&TS 453.]

[S&TS 481 Philosophy of Science (also PHIL 481)
Spring. 4 credits. R. Boyd.
For description, see PHIL 481.]

[SOC 340 Health, Behavior, and Policy
Spring. 4 credits. S. Caldwell.
For description, see SOC 340.]

C. Senior Seminars: Representative seminars listed below. Complete list available in 306 Rockefeller Hall.

[B&SOC 406 Biotechnology and the Law (also S&TS 406)
Spring. 4 credits. Staff.
For description, see S&TS 406.]

B&SOC 461 Environmental Policy (also BIOEE 661 and ALS 661)
Fall and spring. 3 credits each term. Limited to 12 students. (Students must register for 6 credits each term since an "R" grade is given at the end of the fall term).
D. Pimentel.
For description, see BIOEE 661.

COMM 421 Communication and the Environment
Spring. 3 credits. J. Shanahan.
For description, see COMM 421.

HD 336 Connecting Social, Cognitive and Emotional Development
Fall. 3 credits. M. Casasola.
For description, see HD 336.

HD 366 Psychobiology of Temperament and Personality
Fall. 3 credits. R. A. DePue.
For description and prerequisites, see HD 366.

HD 418 Psychology of Aging
Fall. 3 credits. S. Cornelius.
For description and prerequisites, see HD 418.

[HD 419 Midlife Development
Spring. 3 credits. S. Cornelius.
For description, see HD 419.]

HD 464 Adolescent Sexuality (also FGSS 467)
Spring. 3 credits. R. Savin-Williams.
For description, see HD 464.

HD 660 Social Development
Spring. 3 credits. Permission of the instructor required for undergraduates.
K. Greene.
For description, see HD 660.

NTRES 411 Seminar in Environmental Ethics
Fall. 3 credits. R. Baer.
For description, see NTRES 411.

PAM 552 Health Care Services: Consumer and Ethical Perspectives
Fall. 3–4 credits. If using this course as a senior seminar, Biology & Society majors must take it for 4 credits. Enrollment limited; preference given to PAM students.
A. Parrot.
For description and prerequisites, see PAM 552.

PAM 556 Managed Care
Spring. 3 credits. For undergraduate seniors only by permission of instructor.
J. Kuder.
For description and prerequisites, see PAM 556.

PAM 559 Epidemiology, Clinical Medicine, and Management Interface Issues
Spring. 3 credits. E. Rodriguez.
For description, see PAM 559.

[R SOC 410 Population and Environment
Spring. 3 credits. Staff.
For description, see R SOC 410.]

[R SOC 438 Population and Development (also SOC 437)
Fall. 3 credits. Staff.
For description, see R SOC 438.]

[R SOC 495 Population, Environment, and Development in Sub-Saharan Africa
Fall. 3 credits. P. Eloundou-Enyegue.
For description, see R SOC 495.]

[S&TS 411 Knowledge, Technology, and Property
Spring. 4 credits. S. Hilgartner.
For description and prerequisites, see S&TS 411.]

[S&TS 438 Minds, Machines, and Intelligence (also COGST 438)
Spring. 4 credits. Staff.
For description, see S&TS 438.]

[S&TS 446 Biomedical Ethics
Spring. 4 credits. Staff.
For description, see S&TS 446.]

S&TS 466 Public Communication of Science and Technology (also COMM 466)
Fall. 4 credits. Limited to 15 students.
B. Lewenstein.
For description and prerequisites, see COMM 466.

[S&TS 490 Integrity of Scientific Practice
Spring. 4 credits. S. Hilgartner.
For description, see S&TS 490.]

[S&TS 491 Disease and Culture
Fall. 4 credits. Staff.
For description, see S&TS 491.]

[S&TS 492 Politics and the Public Health
Spring. 4 credits. Staff.
For description, see S&TS 492.]

[S&TS 645 Genetics: Politics and Society in Comparative Perspective (also GOVT 634)
Fall. 4 credits. S. Hilgartner.
For description, see S&TS 645.]

V. Other Courses

B&SOC 375 Independent Study
Fall or spring. 1–4 credits.
For description and prerequisites, see B&SOC 375.

B&SOC 498 Honors Project I
Fall. 3–5 credits. Staff.
For description and requirements, see B&SOC 498.

B&SOC 499 Honors Project II
Spring. 3–5 credits. Staff.
For description and requirements, see B&SOC 499.

Biometry and Statistics

The major of Biometry and Statistics in the Department of Biological Statistics and Computational Biology deals with the application of mathematical and statistical techniques to the life sciences. Statistics is concerned with quantitative aspects of scientific investigation: design, measurement, summarization of data, and drawing 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 biomathematician can encompass research, teaching, consulting, and computing in almost any combination and in a wide variety of applications. Opportunities for employment are abundant in universities, government, and businesses ranging from large corporations to small consulting firms; salaries are usually excellent.

While satisfying course requirements for the major, students can also take a wide variety of courses in other disciplines. In fact, students are encouraged to take courses in applied disciplines such as agriculture, biology, business, computer science, economics, and the social sciences that involve numerical data and their interpretation.

Students majoring in this area are required to take a computer science course (e.g., COM S 100), mathematics courses (at least three semesters of calculus), BTRY 301–302 or 601–602, and 408–409, as well as a number of electives. Experience gained through summer employment or work as an undergraduate teaching assistant is highly recommended. Students should contact Professor Steven J. Schwager for information.

Communication

The single most important thing to learn in college is how to assess and manage constantly changing information. Because the amount of information the public receives and is expected to understand is growing exponentially, communication is taking a

more central role in science, technology, business, and public policy. Increasingly, government, industry, and special interest groups rely on communication specialists to aid in managing information—collecting, sorting, interpreting or reinterpreting, summarizing, and making information understandable and accessible to the general public, to interest groups, and to decision-makers in organizations. Effective information management requires a thorough understanding of the communication process.

Students who graduate from this department have excellent speaking, writing, and listening skills. Communication majors are taught:

- Communication processes, such as how communication influences attitudes, opinions, and behaviors.
- How communication systems work in our society.
- How to apply their understanding of communication to solving problems in science, 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 are:

Fall semester:

COMM 120 Contemporary Mass Communication

Spring semester:

COMM 116 Communication in Social Relationships

COMM 117 Writing about Communication

This set of courses provides students with a basic understanding of communication and the communication process. These courses also provide a unique opportunity to link practical application (such as writing and critical analysis) with up-to-date research and knowledge about communication.

During the sophomore year, students take:

Fall semester:

COMM 201 Oral Communication

COMM 282 Communication Industry Research

Spring semester:

COMM 230 Visual Communication

After completing the courses in the core curriculum, all majors take an additional 18 credits in communication. Students can choose to concentrate in one of three focus areas:

- Communication in the Life Sciences (studies of the impact of communication on environmental, health, science, and agricultural issues, and public perceptions of risk).
- Communication Planning and Evaluation (development of communication plans to solve problems for individuals or for organizations and evaluating the success of these plans).
- Communication and Information Technologies (principles of how we use communication technologies and how we are influenced by these technologies).

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

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

Through the Department of Communication, CALS students may complete a minor program of study in communication or a minor program of study in information science or both. The minor in communication consists of four required courses (COMM 116, 120, 201, 230), one advanced presentation course (chosen from COMM 203, 260, 263, 301, 350, 352) and two elective courses totaling six credit hours at the 300-400 level, excluding COMM 496 and 498.

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

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

Crop and Soil Sciences

The Department of Crop and Soil Sciences provides instruction in three specializations: agronomy, crop science, and soil science. Employment opportunities are increased with practical experience, and the faculty of the department and the Career Development Office of the college are glad to help students search for relevant summer jobs and internship opportunities. Professional certification can also be obtained in these specializations.

Agronomy combines the study of crop production and soil management. It provides the student with a broad array of career opportunities after completion of the B.S. degree, including agricultural business, extension service work, and farming. Graduate school is also possible after a well-planned program. Students should take at least 12 credits of crops and 12 credits of soils and design the remainder of their curriculum to meet specific interests and goals. Some students pursue a major in agronomy with a concentration in international agriculture. Agronomy is also offered as a specialization within the plant sciences major field of study.

Crop science is the application of basic biological and ecological science to the improvement and management of the world's main field crops used for human food and livestock feed. Courses required include 18 credits of crops, 12 credits of plant biology, and 6 credits of soils. Students who anticipate a career in agricultural production or service after completion of the B.S. degree should take additional courses in economics, communication, plant pathology, entomology, and nutrition. Students planning graduate or professional study beyond the bachelor's degree should take advanced course work in organic chemistry and biochemistry, calculus, physics, and statistics. Crop science is also offered as a specialization within the plant sciences major field of study.

Soil science is a basic discipline important in ecology, engineering, agriculture, and conservation. The curriculum in soil science combines physical and biological training to address critical issues in environmental and agriculture management related to soils. Students take 18 credits in soil science, including four credits in the introductory course. In addition, chemistry, mathematics, physics, and microbiology are required, as well as six credits of crop science to satisfy the major. Soil science is also offered as a specialization within the Science of Earth Systems major and will become a specialization in the Environmental Science major that is now being planned.

Education

Building on strong academic disciplines and grounding in sociopolitical, psychological, empirical, and theoretical bases of educational practice, the department has two foci to meet societal demands for teachers of mathematics, science, and agriculture and for leaders in nonformal educational settings: Curriculum and Instruction, which includes the Cornell Teacher Education Program, and 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 research, practice, and scholarship. Our undergraduate program leads to provisional certification in agricultural education. The latest information on program developments may be found on our web site, http://education.cornell.edu.

Adult and Extension Education (AEE). The College of Agriculture and Life Sciences has identified five "great challenges" to creating a livable world: environment, food, health, economy, and community. Responding to those challenges requires more than new knowledge and technology; it also requires sustained and expert practice in learning and education. The purpose of the AEE program is to facilitate learning in nonformal settings through participatory practices to link learning and education to the global challenge of facilitating sustainability.

The program prepares scholars and practitioners for adult and extension educational leadership and professional roles in domestic and international nonformal and community-based settings such as adult education, agricultural education, domestic extension and community development, and international agricultural education and development. As public universities focus a greater share of their research, teaching, and extension resources on critical environmental, economic, and social problems domestically and globally, the program provides opportunities for participants to ask who benefits from such efforts and in what ways. Using a reflective practice approach to professional development, graduate preparation includes the study of ethical, political, empirical, and theoretical bases of educational endeavors; analyses of current and historical practices in adult, extension, and international education; the integration of adult and extension practice within other disciplinary endeavors; and the practice of education in a global environment. Students may pursue the following graduate degrees in education: Master of Professional

Studies (M.P.S.), Master of Science (M.S.), or Doctor of Philosophy (Ph.D.).

Following is a curricular template for developing programs of study in the Adult and Extension Graduate Program. Graduate students for MPS, MS, or PhD degrees will in consultation with their advisory committees take courses from these areas: social and philosophical foundations, AEE program courses, and research methods. Program participants are also generally expected to develop programs of study that integrate their course and research work in adult and extension education with other disciplinary pursuits available in CALS or elsewhere in the university (see Programmatic Alliances below).

Master of Professional Studies (M.P.S.—Agriculture and Life Sciences) in Adult and Extension Education

The purpose of this program is to provide opportunity for professional development and graduate study for adult, extension, and international educators working in a variety of nonformal and community-based settings.

Master of Science (M.S.) and Doctor of Philosophy in Education (Ph.D.) in Adult and Extension Education

The M.S. and Ph.D. programs of advanced graduate study are designed to provide intellectual and professional preparation of scholars and practitioners for faculty roles in higher education, leadership roles in nonformal and community-based educational agencies domestically and internationally, and activist roles in a variety of adult and extension education endeavors.

Curriculum and Instruction. The Curriculum and Instruction (C&I) program prepares scholars and practitioners to address present and future issues and challenges facing public schools as these schools strive to prepare students for successful participation in democratic life in the 21st century. Public education is central to the U.S. vision of a democratic society, yet there are differing conceptions of how schools should prepare students. It is crucial that those involved with public education understand the conflicts and the bases for these conflicts. Students in C&I study the philosophical, ethical, historical, and sociopolitical bases of different views of education. They also study the range of learning theories that have shaped visions of public education. The C&I program is committed to helping its students understand the central debates in education so that they will make reasoned and informed decisions about the positions they take, whether in research or in practice.

Faculty and students in research programs in C&I (M.S. and Ph.D. degree programs) participate in projects that examine impacts of policy on rural schools; ethical thinking and decision making of school-aged youth, educational professionals, and community members; factors contributing to the development of scientific and quantitative literacy; curriculum design and evaluation in agriculture, mathematics, and the sciences; economics of education; teacher development; uses of technology in schools; community colleges; and educational transitions.

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

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

Current offerings include:

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

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

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

Graduate Teaching Development Workshops

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

EDUC 620 Internship In Education
Fall and spring. 1 credit. 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. Prerequisite: the CALS Graduate Student Professional Development Workshop.

Educational Leadership

The Institute for Community College Development (ICCD), a partnership with the State University of New York (SUNY), Cornell University, and community colleges is located in the School of Industrial and Labor Relations, Extension Division, and draws on faculty in the Department of Education with expertise in the personal and social competencies related to leadership. ICCD offers professional development for leaders in community colleges, a research program, and a course in leadership. Contact ICCD, (607) 255–2959 or iccd@cornell.edu, for more information.

Current Offerings Include:

Professional Development

The Administrative Leadership Program is designed for senior and mid-level administrators in academics, student affairs, and professional and foundation offices who are interested in current issues affecting community colleges and the way they operate their campuses. The three-day program is held during the summer at Cornell. The program includes opportunities for self-reflection and group problem-solving activities.

The **Great Teachers Seminar** and **Successful Teaching Conference** are designed for faculty interested in improving, learning about, and reflecting on their own theory and practice and on general principles of effective teaching and learning. The events are held in upstate New York in the spring and fall, respectively. Faculty from the Department of Education are frequent presenters.

The Presidents Leadership Conference is designed for current and future community college presidents who need information and ideas about leading a diverse, learning-centered campus that is connected to the local and global communities.

Research

ICCD's research agenda is centered on leadership theory and practice, and on social and economic policies affecting education.

Education

EDUC 694 Analysis of Leadership Theories: Developing a Leadership Philosophy is a three-credit course offered in the fall term. It is designed for faculty and administrators in higher education, particularly in the community colleges.

Entomology

The entomology curriculum provides students with a basic background in biological and environmental 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 a common core of requirements allowing flexibility in electives selected by students in consultation with their advisers.

Specific requirements

Basic Sciences

One year of college mathematics, including a course in calculus, may substitute statistics and biometry
One semester of physics
CHEM 206–208 or 207–208 (General Chemistry)
CHEM 257 (Organic and Biological Chemistry)

General Biology

Introductory Biology
BIOGD 281 (Genetics) or Plant Breeding 225 (Plant Genetics)
BIOEE 278 (Evolutionary Biology)
A choice of one: BIOEE 261 (Ecology and the Environment) or BIOBM 330 or 331 (Principles of Biochemistry)

Entomology

ENTOM 212 (Insect Biology)
A choice of two:
ENTOM 322 (Insect Morphology)
ENTOM 331 (Insect Systematics)
ENTOM 483 (Insect Physiology)

Students must also enroll in at least two additional entomology courses offered at the 300–400 level on more specialized topics.

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 five specialization options in the major: (1) Basic Food Science; (2) Food Engineering; (3) Food Processing; (4) Food Operations and Management; or (5) Food Biotechnology. The first three options meet 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 (intro and organic), biology, microbiology, calculus, physics, freshman 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 Engineering Principles, Physical Principles of Food Manufacturing, Food Safety Assurance, Food Chemistry, Sensory Evaluation of Foods, and Food Microbiology, with many elective courses offered as well. Students choose electives to both satisfy college distribution requirements and their individual interests within the major and beyond.

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

Enology and Viticulture. The College of Agriculture and Life Sciences announces its intent to introduce a curriculum in viticulture and enology within existing undergraduate B.S. degree programs in Plant Sciences and Food Science.

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

Students with primary interest in enology and secondary interest in viticulture (E/V) will "major" in Food Science (with a concentration in enology) and a "minor" in Plant Sciences (with a concentration in Horticulture).

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

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

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

International Agriculture and Rural Development

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

In addition to the college distribution requirements, students in International Agriculture and Rural Development must take a minimum of 36 credits toward the major. A minimum of seven credits in International Agriculture (INTAG) and eight credits in a modern foreign language are required. Students are expected to complete an overseas field experience of a minimum of six weeks. The other courses recommended are drawn from a wide range of disciplines. The objective is to familiarize students with the many facets of agricultural development in low-income countries. Students are encouraged to take additional specialized courses in one of the other program areas of the college.

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

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

One semester of the Global Seminar, INTAG 480.

Four semesters of foreign language instruction, or demonstrated language competency equivalent to that achieved by the end of the fourth semester of instruction at Cornell.

An approved overseas experience (exchange, study abroad program, internship, or faculty-led short course).

For more information, contact the Academic Programs Coordinator in the International Programs Office, (607) 255–3037.

Landscape Architecture

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

The course of study prepares students for the practice of landscape architecture. The curriculum focuses on graphic communication, basic and advanced design methods, landscape history and theory, plant materials, construction and engineering technology, and professional practice. Design studios deal with the integration of cultural and natural systems requirements as applied to specific sites at varying scales. Projects range from 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 two-year 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 concentration in the American Cultural Landscape 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 graduates 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: (Please note that each semester the studio classes require a supply and field trip fee, and all landscape architecture majors are required to pay an annual technology fee.)

First Year

Fall Term	*Credits*
*LA 141, Grounding in Landscape Architecture	4
†Biological sciences elective	3
†Physical sciences elective	3
†Social sciences or humanities elective	3
†Written or oral expression elective	3
	16

Spring Term	
*LA 142, Grounding in Landscape Architecture	4
†Biological sciences elective	3
†Social sciences or humanities elective	3
†Written or oral expression elective	3
‡Physical sciences elective	3
	16

Second Year

Fall Term	
*LA 491, Creating the Urban Eden: Woody Plant Selection, Design and Landscape Establishment	4
*LA 201, Medium of the Landscape	5
†Biological sciences elective	3
†Social sciences or humanities elective	3
‡Free electives	2
	17

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

Third Year

Fall Term	
*LA 301, Integrating Theory and Practice	5
*LA 316, Site Engineering II (second 7 weeks)	2
**Concentration	3
*Historical studies	3
‡Free electives	2
	15

Spring Term	
*LA 302, Integrating Theory and Practice II	5
**Concentration	3
*Historical studies	3
*LA 318, Site Construction	5
	16

Fourth Year

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

Spring Term	
*LA 402, Integrating Theory and Practice: Community Design Studio	5
**Concentration	3
*LA 412, Professional Practice	1
‡Free elective	2
	11

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

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

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

First Year

Fall Term	*Credits*
*LA 505, Graphic Communication I	3
‡Free electives	2
*LA 501, Composition and Theory	5
*Historical studies	3
*LA 491, Creating the Urban Eden: Woody Plant Selection, Design and Landscape Establishment	4
	17

Spring Term	
*LA 502, Composition and Theory	5
*LA 492, Creating the Urban Eden: Woody Plant Selection, Design and Landscape Establishment	4
**Concentration	2
*LA 615, Site Engineering I	3
*LA 590, Theory Seminar	3
	17

Second Year

Fall Term	
*LA 601, Integrating Theory and Practice	5
*LA 616, Site Engineering II	2
*Historical studies	3
**Concentration	6
	16

Spring Term	
*LA 602, Integrating Theory and Practice	5
*LA 618, Site Construction	5
*Historical studies	3
**Concentration	3
	16

Third Year

Fall Term	
*LA 701, Urban Design and Planning	5
‡Free elective	3
**Concentration	4
	12

Spring Term	
*LA 800, Master's Thesis in Landscape Architecture	9
or *LA 702, Advanced Design Studio	5
*LA 412, Professional Practice	1
‡Free elective(s)	2 or 6
	12

Summary of credit requirements	
*Specialization requirements	64 or 68
**Concentration	15
‡Free electives	7 or 11
	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 Concentration for Nonmajors

Students outside the professional program may choose the undergraduate concentration in the American Cultural Landscape to complement their major. The courses center on the landscape as an object, something to be studied for its own sake, and as a subject, as a means to understand society and its relationship to natural systems and diverse cultures. The cultural landscape includes its visible elements as well as perceptions and cultural ideas and values. The concentration consists of four courses, two required and two electives. Students may petition to substitute one course in the electives list. Direct inquiries to professors H. Gottfried or S. Baugher.

Required.

Visual Studies (choose one):

ART 121 Introduction to Painting (3 cr)

ART 141 Introduction to Sculpture (3 cr)

ART 151 Introduction to Drawing (3 cr)

ART 158 Conceptual Drawing (3 cr)

ART 159 Life and Still-Life (3 cr)

ART 161 Photography I (3 cr)

DEA 101 Design I: Fundamentals (3 cr)

LA 141 Grounding in Landscape Architecture (3 cr)

The Landscape

+LA 282 The American Landscape (3 cr)

Electives (choose two):

ARCH 390 American Architecture and Building I (3 cr.)

ARCH 391 American Architecture and Building II (3 cr.)

+LA 260 Pre-Industrial Cities and Towns of North America (3 cr) offered alternate years

+LA 261 Urban Archaeology (3 cr)

+LA 262 Laboratory in Landscape Archaeology

LA 263 American Indians, Planners, and Public Policy (3 cr)

LANAR 525 History of American Landscape Architecture (3 cr)

LA 569 Archeology in Preservation Planning and Design (3 cr) offered alternative years

+Distribution elective

Natural Resources

As the number of humans living on the Earth surpasses six billion at the start of the twenty-first century, knowing how to conserve and manage well our Earth's remaining biological resources and natural environments takes on increasing importance and urgency. The undergraduate curriculum in natural resources provides students with the concepts and tools needed to understand the Earth's natural resources and ecological systems, and to participate with intelligence and foresight in their conservation and management. The department's program allows students flexibility to pursue a variety of paths to an integrated, broadly-based understanding of relationships of organisms to their environments, and ways in which humans affect, and are affected by, those relationships. Students are encouraged to understand the scientific, ethical, and societal basis for management and protection of natural resources and environments through the application of ecological principles and knowledge of societal needs.

The Future for Natural Resource Majors

Most students entering the department have a strong interest in the natural world and contributing in some way to greater harmony between humans and the environment. An undergraduate degree in natural resources prepares students to make these contributions as informed citizens with a strong liberal arts education and a firm grasp of the scientific, ethical, and societal dimensions of environmental conservation and management. It also prepares them for entry-level positions with conservation organizations, state and federal resource management agencies, environmental consulting firms, and environmental education centers, or for graduate study in several environmentally-related fields, including the biological, physical, and chemical sciences; forest, wetland, stream, wildlife, or fisheries management; and environmental law and public policy.

Because high-level positions in environmental fields usually require advanced study, most career-minded natural resource majors eventually pursue graduate or professional degrees. These students will assume positions of leadership in government, colleges and universities, national and international conservation organizations, environmental design firms, environmental consulting firms, the environmental divisions of private industry, and organizations involved in environmental education or communication.

Curriculum

Freshmen and sophomores all take a similar set of courses, many of which fulfill distribution requirements in the College of Agriculture and Life Sciences. These include courses in general biology and ecology, chemistry, mathematics, statistics, ethics, economics, and communication. They also take a series of four foundation courses designed to introduce them to the field of natural resources and environment. These courses include "Introduction to the Field of Natural Resources," "Environmental Conservation," "Field Biology," and "People, Values, and Natural Resources."

At the *junior and senior level*, students may specialize in one of three areas of concentration (see below). Within these concentrations, students take a prescribed number of courses from specified sets selected by the faculty to provide an in-depth understanding of key principles, concepts, and practices. They also have flexibility to gain exposure to a wide variety of environment-related courses offered by Natural Resources and other departments at Cornell, as well as to the University's many offerings that ground the student in a first-rate liberal arts education. Seniors are encouraged to take one of several upper-division courses in the department that provides an intensive experience in synthesis, integration, and critical thinking applied to current issues in the conservation and management of natural resources, ecological systems, or the environment. Many juniors and seniors also choose to conduct a research honors thesis.

Areas of Concentration

The concentration in **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 resource management, 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 Sciences, Atmospheric and Earth Sciences, Animal Sciences, and Plant Biology.

The concentration in **Resource Policy and Management** provides a foundation for students who wish to pursue careers or advanced study in the human dimensions or policy aspects of natural resource conservation and management. Students who select this

concentration typically focus on courses related to the development of environmental policy, management strategies for particular species or ecosystems, 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, Rural Sociology, Communication, Applied Economics and Management, City and Regional Planning, and Policy Analysis and Management.

The concentration in **Environmental Studies** is intended for those who wish to obtain the broadest possible, yet rigorous, grounding in the wide range of subjects needed to understand human interactions with the environment. The concentration's emphasis is on developing an ability to think critically about these interactions. As juniors and seniors, students who choose Environmental Studies design a cohesive sequence of five courses in the social sciences, natural sciences, and humanities related to environment. Together with their departmental adviser, they decide on an environmental theme that the student wishes to pursue in depth. That theme should identify a specific set of interrelationships between humans and the environment that the student wishes to understand. For example, students could choose to explore themes such as evaluating legal and economic incentives for conservation or studying human views of the environment as expressed in literature or history. Many upper-division sequences of courses are acceptable if the student can formulate and defend a reasonable rationale for the choice of courses.

For details about the core curriculum in the Department of Natural Resources, consult our web site at www.dnr.cornell.edu. Information also is available in the department's Undergraduate Program Office in 12 Fernow Hall.

Research and Work Opportunities for Undergraduates

The department offers many opportunities for field-oriented studies, independent research, internships, and jobs. These opportunities include several field-based courses and access for research to the department's Arnot Teaching and Research Forest near Ithaca, the Little Moose Field Station in the Adirondacks, and the Cornell Biological Field Station on Oneida Lake near Syracuse, as well as numerous natural areas near campus. Students also may choose to do independent research or work during the summer at the Hubbard Brook Forest in New Hampshire, New York's Adirondack Park, or in many types of forest, aquatic, and wetland ecosystems in New York and beyond where departmental faculty members have on-going research projects. Part-time jobs in the research and extension programs of several faculty members offer students many opportunities for career-related work experience. A research honors program is available for qualified students. In addition, the department coordinates an internship program for students and encourages students to seek relevant work experience to complement their academic studies.

Nutrition, Food, and Agriculture

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 nutrition, food, and agriculture 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 of 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 together with specialists in areas such as agricultural economics, food production, and rural sociology. Advances in biotechnology provide researchers with new ways to understand human nutritional requirements and the regulation of human metabolism.

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

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

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

The major in nutrition, food, and agriculture 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-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. The nutritional sciences Learning Resource Center in MVR is used by students for study and small group discussion. The center contains class materials, computers, audio-visual aids, and supplementary books and periodicals for independent study and special projects.

For additional information about the nutrition, food, and agriculture program, contact the Division of Nutritional Sciences Academic Affairs Office, 335 MVR, 607–255–2628, e-mail: aadns@cornell.edu.

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

Plant Sciences

Plant Sciences is a multidepartmental program governed by faculty in the Departments of Crop and Soil Sciences, Horticulture, Plant Biology, Plant Breeding, and Plant Pathology. Students in the program share a common interest in learning about topics associated with plant growth and development in the broadest sense, and many have their sights set on careers in applied agricultural fields. In addition to the college distribution requirements, they 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 usually 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 General Plant Science without declaring a specialization. Those students have fewer required courses but are still expected to develop a strong background in plant science.

More than one hundred 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 undergraduate teaching and research experience, and qualified students, especially those expecting to go on for graduate degrees, are encouraged to avail themselves of such opportunities. Students who are planning to enter the work force immediately upon completion of the B.S. degree are encouraged to obtain practical experience. This may involve summer employment in research or in a plant production or maintenance related industry such as a lawn and tree care company, commercial greenhouse, nursery, orchard, vineyard or

winery, botanical garden or arboretum, crop production farm, or with Cooperative Extension. Plant Science faculty 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 provide students with ample opportunities for hands-on practice, technical training, independent research projects, and internships in plant science. Facilities available to students include research orchards and vineyards, golf courses and a turf research facility, the Cornell Plantations, 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 Science consortium and are available for undergraduate and graduate field study.

Crop Science and Agronomy are specializations that focus on the science and management of the major food and feed crops of the world such as wheat, corn, rice, soybean, and alfalfa. In addition to several courses in crop science, students in this program also take courses in the sister disciplines of weed science, seed science, and soil science. At present, the specialization is described in detail under the major field of study called Crop and Soil Sciences, but it will become a part of the Plant Science major field of study in the near future.

Enology and Viticulture. The College of Agriculture and Life Sciences announces its intent to introduce a curriculum in viticulture and enology within existing undergraduate B.S. degree programs in Plant Sciences and Food Science.

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

Students with primary interest in enology and secondary interest in viticulture (E/V) will "major" in Food Science (with a concentration in enology) and a "minor" in Plant Sciences (with a concentration in Horticulture).

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

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

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

Horticulture. Derived from the Latin word "hortus," meaning garden, horticulture is a blend of science and culture involving knowledge of plants in farms and gardens, parks and landscapes, and athletic and recreational facilities; indoor plants; greenhouse and nursery plant production; and crops used for wines, herbs and spices, medicinal purposes, and coffee and teas. The knowledge and skills essential to grow, maintain, process, and market horticultural plants are in high demand in a world increasingly concerned with environmental quality, recreation, and health.

There are about 40 faculty members in horticulture—specializing 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 the minimum 40-credits of core courses for the Plant Science major, plus the following courses:

HORT 101-Horticultural Science and Systems (4 credits)

HORT 400-Plant Propagation (3 credits)

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

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

A dual concentration in Viticulture and Enology is also available. Students transferring into Cornell from other colleges can petition to waive or adjust these requirements, in consultation with their faculty advisers.

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

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

Plant Pathology is the study of plant disease—its causes and how they are identified, the molecular basis for pathogenicity and resistance, and disease management. For most students, a concentration in plant pathology as an undergraduate is preparation for graduate study in plant pathology or another field of plant science. However, study in plant pathology also prepares students for careers as technical representatives with agribusiness firms, Cooperative Extension educators,
integrated pest management practitioners, state or federal plant pest regulatory agents, and laboratory technicians. Suggested courses beyond the plant science core include organic chemistry and biochemistry, calculus, introductory plant pathology, plant disease diagnosis, 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.

Rural 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, rural sociology students study these and other facets of social change in both domestic and international settings. The Rural 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 grass roots social movements through which people seek change in these dimensions. Courses offered by the department cover topics such as: the impact of changes in agricultural systems on rural development; community and regional development; environmental sociology; rural industrialization and labor markets; technology and social change; the implications of the genomic revolution for agriculture and communities; the linkages between population dynamics, the environment, and development; the political economy of globalization; women in development; and ethnic competition and stratification. Most courses provide background in both domestic and international aspects of the subject matter. Students can develop a specialization with a domestic, international, or global emphasis by choosing appropriate elective courses. All students learn the theory and methodology of sociology and how to apply both to research and policy in their subject areas.

Majors in Rural Sociology are required to successfully complete seven core courses:

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

Recognizing that students are concerned with future career opportunities, the Rural 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. Rural sociology offers degree programs at both the undergraduate and graduate levels (B.S., M.S., M.P.S., and Ph.D.). These programs are offered through the Department of Rural Sociology and the graduate field of Development Sociology, both of which are located in Warren Hall. 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. Rural Sociology faculty are committed to both quality instruction and cutting-edge research programs.

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

Science of Earth Systems (SES)

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

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

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

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

The requirements for the major are as follows:

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 191 or 193, and MATH 192 (or MATH 111, 112)

   b. PHYS 207 and 208 (or PHYS 112, 213)

   c. CHEM 207 and 208

   d. BIOGD 101/103–102/104 (or 105–106) or BIOGD 109/110

   e. Three additional 3–4 credit courses in basic science and math, generally 100 and 200-level classes. At least one of the following courses must be included in the selection:

      GEOL 201 Physics and Chemistry of the Earth

      BIOEE 261 Ecology and the Environment

      Other examples are MATH 293 and MATH 294, biochemistry, organic chemistry, PHYS 214, and introductory statistics. With the exception of the introductory statistics course, the additional basic courses will require at least one of the classes listed above as a prerequisite.

2. Science of Earth Systems Core Courses

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

   EAS 302 Evolution of the Earth System

   EAS 331/ASTRO 331 Climate Dynamics

   EAS 321/NATRES 321 Biogeochemistry

3. Concentration Courses

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

For more information contact Professor Kerry H. Cook, Department of Earth and Atmospheric Science, khc6@cornell.edu, and visit the web site: www.geo.cornell.edu/ses/

Science of Natural and Environmental Systems

Environmental stewardship and sustainability are increasingly recognized as human and planetary imperatives. Graduates who understand how people both generate and can resolve environmental problems will contribute significantly to creating a sustainable environment for their own and future generations. This new major in environmental science provides a broad-based, integrative program in the physical, biological, social, and economic sciences, as well as disciplinary strength in one or more subjects suitable for entry-level professional positions or post-baccalaureate studies.

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

Foundation Courses

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

two semesters of college-level biology

two semesters of college-level calculus

four semesters of college-level chemistry and physics (at least one semester of each)

one semester of college-level statistics

NTRES 201 Conservation Biology

DEA 150 Introduction to Human-Environment Relationships

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

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

Environmental Core

The environmental core consists of four 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. DEA 150 will provide the required core understanding of human behavior related to environmental issues.

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.

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

Biotic Systems: BIOEE 261 Ecology and the Environment

Economic Systems: AEM 250 Environmental and Resource Economics

Social Systems: R SOC 324 (STS 324, SOC 324) Environment and Society

Programs of Study

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

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

Environmental Biology

Environmental Information Science

Sustainable Development

Agroecosystem Science

Environmental Health

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

Special Programs in Agriculture and Life Sciences

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

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

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

DESCRIPTION OF COURSES

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

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

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

INTERDEPARTMENTAL/ INTERCOLLEGE COURSES

American Indian Studies

American Indian Studies is the instructional component of the American Indian Program. It is a multidisciplinary program offering course work that enhances students' understanding of the unique heritage of North American Indians and their relationships to other peoples in the United States and Canada. Students address such challenging topics as the sovereignty rights of Indian nations and the contemporary relevance of Indian attitudes toward the environment. The program's instructional core consists of courses that focus on American Indian life from pre-contact times to the present and feature the perspectives of Native American peoples.

The American Indian Program offers a concentration in American Indian Studies to undergraduate students in conjunction with their majors defined elsewhere in the university. The concentration is earned upon completion of five courses: AIS 100 and AIS 175, plus three other courses selected from the AIS course listing, for a total of at least 15 credits. Students choosing a concentration in American Indian Studies should obtain application materials from the AIP office in 450 Caldwell Hall.

AIP also offers a graduate minor. Students interested in choosing the minor should contact Professor Charles Geisler, Associate Director of Academic Development, American Indian Program, 255–1691.

J. Mt. Pleasant, Director; E. Cheyfitz, L. Donaldson, C. Geisler, A. Gonzales, B. Lambert, K. Morris, M. Tsosie

AIS 100 Introduction to American Indian Studies

Fall. 3 credits. T R 1:25–2:40 plus sections. M. Tsosie.

Slide lectures survey the rich cultures and complex histories of the Indian nations north of Mexico. Indian arts and philosophies are compared and contrasted with those of Europe, Africa, Asia, Canada, and the United States. The origins of today's major legal issues involving American Indians are also discussed. The course begins with a survey of Indian America before Columbus and ends at Wounded Knee in 1890, the event that marks the end of the conquest of Indian America. Guest lecturers, including American Indian leaders, provide additional perspectives.

AIS 175 Issues in Contemporary American Indian Society (also R SOC 175)

Spring. 3 credits. M W 11:15–12:05 plus sections. M. Tsosie.

This course addresses major U.S. policies affecting American Indians in the twentieth century, and ways American Indians pursued

strategies to sway the process of social change. American Indian political, economic, and cultural issues are examined through history, literature, art, and film. The approach of this course is interdisciplinary and an emphasis is placed on the study of American Indians as living cultures. Current trends are discussed, and the implications for American Indians in the twenty-first century are explored. Guest lecturers, including American Indian scholars and leaders, provide additional perspectives.

AIS 215 Beyond Tradition: Native American Art 1850–Present (also ART H 215)
Fall. 4 credits. T R 10:10–11:25. Limited to 60 students. K. Morris.
Explores both the formal and contextual aspects of Native American art, drawing on examples from the arts of the Far North, the Pacific Northwest coast, and the Great Plains. Lectures, slides, and readings will examine the myriad and complex pressures that have been brought to bear on these cultures over the past century and a half. Missionization, termination, the repeated interventions of the U.S. and Canadian governments, tourism, and the rise of the art market will be addressed, as will the nature of the artistic process and the changing role of the Native artist with respect to his/her community. Contemporary works, along with the writings of Native American historians, critics, and artists will be incorporated throughout the semester.

AIS 230 Cultures of Native North America (also ANTHR 230)
Fall. 3 or 4 credits. M W F 11:15–12:05. B. Lambert.
A survey of the principal Inuit and American Indian culture area north of Mexico. Selected cultures are examined to bring out the distinctive features of the economy, social organization, religion, and worldview. Although the course concentrates on traditional cultures, some lectures and readings deal with changes in native ways of life that have occurred during the period of European-Indian contact.

[AIS 276 American Indian History 1500–1850 (also HIST 276)
4 credits. Staff.
A survey of North American history from the sixteenth century to the mid-nineteenth century. Relations between Indian nations and with European colonies will be explored. Different cultural groups and cross cultural encounters will be compared, with emphasis on resistance and adaptation to European colonialism. The formative years of U.S. Indian policy and the experiences of Indian people through the removal era will receive close attention.]

[AIS 277 American Indian History Since 1850 (also HIST 277)
4 credits. Staff.
A historical study of American Indians in the United States and Canada from the mid-nineteenth century to the present. The active and complex role played by Indian people in their responses to government policies and to socioeconomic changes will be emphasized. Challenges faced and initiatives taken by Indians will be traced from the early reservation years to the current era of self-determination. Cultural change and continuity within Indian communities will be closely examined.]

AIS 311 Social Movements (also R SOC 311)
Spring. 3 credits. Prerequisites: R SOC 101/SOC 101 or permission of instructor. S-U grades optional. T R 1:25–2:40. A. Gonzales.
Social movements are collective efforts by relatively powerless groups of people to change society. Typically conceptualized as political activity outside the institutional framework, social movements are "politics by other means." This course examines the transnational dimensions of social movements to assess the implications of globalization for political mobilization and the ways that social movement actors engage global political process to effect social change. Under what circumstances do movements emerge? How do global processes shape both domestic and transnational political mobilization? How do movements internally organize and choose political tactics and strategies to achieve their goals? How have social movements changed history, identities, society, and politics? This course addresses these and related questions through an examination of indigenous peoples movements in the United States, Canada, and Latin America.

[AIS 361 Sociology of American Indians (also R SOC 360)]

[AIS 367 American Indian Politics and Policy (also GOVT 357 and R SOC 367)]

[AIS 435/635 Indigenous Peoples and Globalization (also R SOC 435/465)
Spring. 3 credits. Prerequisite: for undergraduates, permission of instructor. S-U grades optional. Limited to 25 students. M 10:10–1:10. A. Gonzales.
Explores ways in which processes of globalization affect indigenous peoples worldwide and the strategies indigenous peoples are using to deal with those pressures. Globalization, whether under the auspices of the World Trade Organization and regional economic agreements such as the NAFTA or the d e-territorialization of social and political arrangements cotemporal with modernization or the expansion of communication technology and its impact on traditional knowledge systems, have had profound social, cultural, and economic impacts on indigenous peoples. At issue are the lands, resources, traditional knowledge, intellectual and cultural property, and indigenous struggles for recognition and self-determination.]

[AIS 450 Practicum in American Indian Studies]

AIS 470 Reel/Real Indians: Art and Indigenous Identities in the 20th Century (also ART H 470, AM ST 472)
Spring. 4 credits. Not open to freshmen or sophomores, except by permission of the instructor. R 2:30–4:25. K. Morris.
For much of the 20th century, American Indian identities were shaped, at least in the public imagination, by John Wayne films, Edward Curtis photographs, tourist propaganda, and advertising imagery. In the past few decades, however, Native American artists and filmmakers have wrested their own image from these external forces, interrogating the established codes of representation. While exploring this history, this course introduces students to the more important texts regarding the gaze and identity formation theory. Those writings are used as the theoretical lens through which the works of contemporary indigenous artists such as Jimmie Durham, Shelley Niro, James Luna, Gerald McMaster, and Hachivi Edgar Heap of Birds are viewed. The course offers a unique opportunity to explore issues of race; ethnicity, and gender as seen through indigenous eyes. Self-representation in a variety of visual media, including painting and photography, film, performance, and the digital arts, are considered.

AIS 486 American Indian Women's Literature (also ENGL 486)
Fall. 4 credits. R 10:10–12:05. L. Donaldson.
This course explores the development of women's literature in a number of different American Indian cultures. We attend to native paradigms of cultural production such as women's songmaking, weaving, basketmaking, and storytelling, as well as the appropriation of European literary forms such as the novel. We read a diverse range of materials including novels, autobiography, poetry, drama, and short stories.

AIS 497 Independent Study
Fall or spring. 1–4 credits. Staff.
Topic and credit hours to be mutally arranged between faculty and student. The American Indian Program Office must approve Independent Study forms.

[AIS 600 American Indian Studies
4 credits. Staff.]

Department of Statistical Science

The university-wide Department of Statistical Science coordinates undergraduate and graduate study in statistics and probability.
A list of suitable courses can be found at the front of this catalog (see p. 24).

NONDEPARTMENTAL COURSES

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

ALS 134 Emergency Medical Technician
Fall and spring. 3 credits each semester. Two-semester course. S-U grades optional. Prerequisite: none—but basic and advanced first aid recommended. Lec, M 1:30–5:00; lab, W 1:30–5:00. D. A. Grossman, P. Rach, and A. E. Gantert.
E.M.T. is an intensive 140-hour course taught throughout the fall and spring semesters. Enrollment, therefore, occurs in the fall term only. Course includes training in C.P.R. for the professional rescuer, oxygen administration, airway management, fracture management, bleeding control, patient assessment, spinal

immobilization, medical antishock trousers, and defibrillation. Students will qualify for the New York State E.M.T. Certification Exam upon successful completion of the course. Please consult Course and Room Roster for the location of the lab and lecture classes.

ALS 135 Advanced Emergency Medical Technician, Critical Care
Fall and spring. 4 credits each term. Two-semester course. S-U grades optional. Prerequisite: must be currently certified as a NYS Basic EMT, or have applied for reciprocity. Lec, T 1:25–4:25; lab, R 1:25–4:25, Sat 9:00–12:00. D. Grossman, P. Rach, D. Spaulding.
Advanced Emergency Medical Training includes topics such as Emergency Pharmacology, Patient Assessment, Advanced Cardiac Life Support, Emergency Hypoperfusion Management and Basic Trauma Life Support. Classroom, lab, hospital, and field sessions are used to teach skills such as intubation, emergency IV access, electro-cardioversion and defibrillation, and patient assessment and pharmacological intervention. Extensive out of classroom (exceeds 140 hours) time is required.

ALS 400 Internship
Fall, spring, or summer. 6 credits maximum. Not open to students who have earned internship credits elsewhere or in previous terms. 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. Participation is required in any structured learning activities associated with the internship.

ALS 402 Agricultural Study Tour to Burgundy, France
Spring. 2 credits. Prerequisite: must be a registered CALS student. S-U grades optional. L. A. Weston and P. Durand.
A two-week study tour held in the month of May in Burgundy, France. Students experience French agriculture, history, and cuisine. Tour includes wine, fruit, vegetable, cheese, dairy, beef, and poultry production, and French university facilities featuring modern agricultural research. Ten- to 20-page paper requirement. Students travel throughout Burgundy and eastern France with Pascal Durand, professor at ENESAD in Dijon France.

ALS 403 Internship Opportunities in Burgundy, France
Spring. Variable to 4 credits. Prerequisites: enrollment in the Agricultural Study Tour of Burgundy, France. Some French language experience preferred. S-U grades optional. L. A. Weston and P. Durand.
Six- to eight-week internship experiences in Burgundy, France, in agriculturally related subject areas including viticulture, agribusiness, agronomy, food science, and biotechnology. Final paper documenting internship experience required.

ALS 477 Environmental Stewardship in the Cornell Community
Spring. 2–4 variable credits. T R 11:40–1:10. J. M. Regenstein plus a faculty adviser.
Each student undertakes an original project to improve the environment at Cornell while working with a faculty adviser and the Cornell infrastructure (generally campus life and/or facilities). Through class discussions, students learn how to be more effective at developing environmental programs in the future, both during and after college. The final written project report is also presented orally at a public forum. (Note: If students prefer to take one or two credits of independent research in a department in the College of Agriculture and Life Sciences, this can be arranged. Assistance in finding a faculty adviser is provided. This course may be taken more than once.)

ALS 480 Global Seminar: Environment and Sustainable Food Systems (also EDUC 480 and INTAG 480)
Spring. 3 credits. Prerequisite: juniors, seniors, and graduate students. Letter grade. J. Lassoie, L. Buck, D. Miller.
A distance learning course involving Cornell and universities in Australia, India, The Netherlands, Sweden, Costa Rica, and Honduras. The seminar provides students the opportunity to explore and learn about the dynamic linkages between sustainable development, food security, population, the environment, and socio-economic progress from a global perspective. Students across the different sites interact via Internet, satellite, and videoconferencing technologies to analyze a series of interdisciplinary case studies related to global sustainable development. Teams of international students collaborate on a number of projects that are presented during a live videoconference at the end of the semester.

ALS 481 Global Conflict and Terrorism
Spring. 2 credits. Prerequisite: permission of instructor. Lec, M 7:30–9:30. J. Shanahan.
Reviews and discusses issues concerning global development and its relationship to conflict and terrorism. Each class session focuses on a specific topic presented by either a faculty member or a guest speaker leading the discussion and actively engaging the students.

ALS 494 Special Topics in Agriculture and Life Sciences
Fall or spring. 4 credits maximum. S-U grades optional.
The college teaches "trial" or temporary courses under this number. Offerings vary by semester and are advertised by the college before the beginning of the semester. The same course is not offered more than twice under this number.

ALS 500 Politics and Policy: Theory, Research, and Practice (also AM ST 501, PAM 406, and GOVT 500)
Students in the College of Agriculture and Life Sciences must register for ALS 500. S. Jackson and staff.
This course, taught in Washington, D.C., forms the core of the public policy option of the Cornell in Washington program. The central course 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. Applications are made through the Cornell in Washington office, M101 McGraw Hall.

ALS 661 Environmental Policy (also B&SOC 461 and BIOEE 661)
Fall and spring. 3 credits each term. (Students must register for 6 credits each term since an "R" grade is given at the end of the fall term.) Limited to 12 students. Prerequisite: permission of instructor. Sem R 2:30–4:30. D. Pimentel.
This course focuses on complex environmental issues. Ten to 12 students, representing several disciplines, investigate significant environmental problems. The research team spends two semesters preparing a scientific report for publication in *Science* or *BioScience*. Thus far, every study has been published.

APPLIED ECONOMICS AND MANAGEMENT

W. H. Lesser, chair; B. L. Anderson, C. B. Barrett, N. L. Bills, G. Blalock, R. N. Boisvert, L. D. Chapman, N. H. Chau, R. D. Christy, J. M. Conrad, R. T. Curtis, H. Daouk, H. de Gorter, G. A. German, B. A. Gloy, D. A. Grossman, J. M. Hagen, M. J. Hubbert, D. R. Just, H. M. Kaiser, S. M. Kanbur, W. A. Knoblauch, S. C. Kyle, E. L. LaDue, D. R. Lee, A. E. Leiponen, E. W. McLaughlin, S. F. Melendy, R. A. Milligan, T. D. Mount, D. T.-C. Ng, A. M. Novakovic, P. D. Perez, D. J. Perosio, G. L. Poe, J. E. Pratt, C. K. Ranney, L. A. Robinson, W. D. Schulze, D. H. Simon, M. W. Stephenson, D. H. Streeter, L. W. Tauer, W. G. Tomek, C. L. van Es, S. Wang, G. B. White

Courses by Subject

Farm management, agricultural finance, and production economics: 302, 403, 404, 405, 605, 608, 708

Statistics, quantitative methods, and analytical economics: 210, 410, 411, 412, 414, 415, 416, 417, 419, 610, 611, 711, 712, 713, 714, 717

Management, finance, law, and accounting: 220, 221, 222, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429

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

Marketing and food distribution: 240, 241, 340, 344, 346, 442, 443, 446, 447, 448, 449, 640, 641, 740

Environmental and resource economics: 250, 450, 451, 555, 651, 652, 655, 750, 751

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

Consumer economics: 670

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

AEM 101 Introduction to Applied Economics and Management
Fall. 1 credit. Required of and limited to freshmen in Applied Economics and Management. S-U grades only. D. A. Grossman.

This freshman transition course explores the major courses of study available to AEM students, including a discussion of "hot topics", research, and career paths in each field. Numerous AEM faculty members are guest presenters. Students are introduced to campus resources such as the library system, study abroad opportunities, course planning, career planning, and learning strategies. Short written assignments and active group participation are required.

AEM 200 Contemporary Controversies in the Global Economy

Fall. 3 credits. Prerequisites: ECON 101 and COMM 201 completed or concurrent, ECON 102 and Freshman Writing Seminars recommended. Priority given to sophomores with prerequisites (or taking COMM 201 concurrently) and juniors in AEM. C. Barrett.

Aims to stimulate critical thinking and cogent writing and speaking about contemporary controversies that attract regular attention in the international press and among key private and public sector decision-makers. Students read and discuss competing arguments about current issues such as patenting and pricing of pharmaceuticals worldwide, controls on commercial and humanitarian distribution of genetically modified foods in food aid, and immigration restrictions. Students write a series of short briefing papers and give regular oral briefs, which are evaluated for quality of communication and content.

AEM 210 Introductory Statistics

Fall. 4 credits. Prerequisite: EDUC 115 or equivalent level of algebra. 2 evening prelims. C. van Es.

An introduction to statistical methods. Topics covered include the descriptive analysis of data, probability concepts and distributions, estimation and hypothesis testing, regression, and correlation analysis. Applications from business, economics, and the biological sciences are used to illustrate the methods covered in the course.

AEM 220 Introduction to Business Management

Spring. 3 credits. Enrollment limited to AEM majors and those in the process of transferring to the major. Preference given to other CALS majors. Additional enrollment as capacity permits, with permission of the instructor. 2 evening prelims. P. D. Perez.

This course provides an overview of management and business. Human resources, marketing, finance, and strategy concerns are addressed with consideration paid to current issues such as technology and its impact on operations, globalization, ethics, quality, and entrepreneurship. Guest speakers are an important part of the course.

AEM 221 Financial Accounting

Fall. 3 credits. Not open to freshmen. Priority given to CALS majors. 2 evening prelims and a comprehensive final; weekly homework assignments; and one project using an electronic spreadsheet. S. F. Melendy.

A 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. Coverage of topics includes methods of recording inventory, receivables, depreciation, bonds, and equity.

AEM 222 Business Management Case Analysis

Spring. 1 credit. Prerequisites: concurrent enrollment in AEM 220. Required of and limited to AEM majors in AEM 220; others admitted by permission of instructor. D. J. Perosio.

The course offers students, working in teams, the opportunity for hands-on application of general business management concepts through discussion and written analysis of a series of cases. All AEM majors registered in AEM 220 are required to take AEM 222. Additional students may be accommodated on a space-available basis with permission of the instructor. Case topics are closely coordinated with both the content and sequencing of material being presented in AEM 220.

AEM 230 International Trade and Finance (also ECON 230)

Spring. 3 credits. Prerequisites: ECON 101 or equivalent required; ECON 102 or equivalent recommended. 1 evening prelim. S-U grades optional. D. R. Lee.

This course provides a one-semester introduction to international economics principles and issues. The course first surveys key topics such as the elements of comparative advantage, tariff and non-tariff 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. Current issues such as the effects of trade liberalization, trade and economic growth, and instability in international capital markets are discussed throughout. This course is designed as a less technical introduction to concepts developed at a more advanced level in AEM 430 and ECON 361–362.

AEM 240 Marketing

Fall. 3 credits. E. W. McLaughlin.

This course provides a broad introduction to the fundamentals of marketing. The components of an organization's strategic marketing program, including how to price, promote, and distribute goods and services to people are explored. Industry guest lectures and current marketing applications from various companies are presented and analyzed. Concurrent enrollment in AEM 241 is required for AEM majors.

AEM 241 Marketing Plan Development

Fall. 1 credit. Prerequisites: concurrent enrollment in AEM 240. Rquired of and limited to AEM majors enrolled in AEM 240; others by permission of instructor. D. J. Perosio.

The course offers students, working in 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 not-for-profit organization. All AEM majors registered in AEM 240 are required to take AEM 241. Additional students are accommodated on a space available basis with permission of the instructor. Assignments are closely coordinated with both the content and sequencing of material being presented in AEM 240.

AEM 250 Environmental and Resource Economics

Spring. 3 credits. S-U grades optional. G. L. Poe.

The objectives of this course are to introduce fundamental economic principles and the "economic approach" to policy issues, and to demonstrate 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. These tools are used to explore major current policy issues such as economic incentives in environmental policy, endangered species protection, air and water pollution, depletion of renewable and non-renewable resources, and global warming.

AEM 302 Farm Business Management

Fall. 4 credits. Not open to freshmen. This course is a prerequisite for AEM 405 and 427. On days farms are visited the section period is 1:25–6:00. W. A. Knoblauch.

An intensive study of planning, directing, organizing, and controlling a farm business, with emphasis on the tools of managerial analysis and decision making. Topics include financial statements, business analysis, budgeting, and acquisition, organization, and management of capital, labor, land, buildings, and machinery.

AEM 320 Business Law I (also NBA 560)

Fall and summer. 3 credits. Limited to juniors, seniors, and graduate students. 1 evening prelim. D. A. Grossman.

Consideration is given chiefly to legal problems of particular interest to persons who expect to engage in business. Emphasis is on the law pertaining to contracts, sales, agency, and property.

AEM 321 Business Law II (also NBA 561)

Spring. 3 credits. Limited to juniors, seniors, and graduate students. Prerequisite: a course in business law 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 of the course reviews selected topics in business law, like employment discrimination, debtor/creditor relations, product liability, unfair competition, e-commerce law, and international business law.

AEM 322 Technology, Information, and Business Strategy

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

This course explores the impact of new technologies on business processes and industries. We focus particularly on the effects of information and communication technologies (ICT). The objective is to understand the nature of information as an economic good, business opportunities and challenges created by ICT, and organizational constraints involved in exploiting these opportunities.

AEM 323 Managerial Accounting

Spring. 3 credits. Priority given to CALS majors. Prerequisite: AEM 221 or equivalent. 2 evening prelims, a third exam, weekly homework, and one project using an electronic spreadsheet. S. F. Melendy.

An introduction to cost accounting that emphasizes 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. Use of electronic spreadsheets is required.

AEM 324 Finance Management
Fall. 4 credits. Priority given to CALS majors. Prerequisites: AEM 210, AEM 220, and AEM 221, or equivalents. 3 evening prelims. R. Curtis.
This course focuses on the mathematics of finance, the economics of managerial decisions, corporate financial policy, risk management, and investments. Topics include the time value of money, capital budgeting decisions, financing alternatives, the cost of capital and the capital structure decision, distribution policy, mergers and acquisitions and restructurings, options, forward and futures contracts, market efficiency and market anomalies, strategies of successful investors, and personal finance.

AEM 325 Personal Enterprise and Small Business Management
Spring. 4 credits. Limited to juniors and seniors. Prerequisites: AEM 220 and 221 or permission of instructor. Absolutely no adds or drops after second class meeting. Term project work will amount to approximately $100 per team. D. Streeter.
Course is focused 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 326 Human Resource Management in Small Businesses
Fall. 3 credits. Prerequisite: AEM 220 or AEM 302 or equivalent. S-U grades optional. 1 evening prelim. Staff.
An introduction to the management of human resources in small businesses. The focus is on developing and using all of the capabilities of all small business personnel. Topics include people-oriented management, vision and mission, organizational change, coaching, performance evaluation, recruitment, selection, compensation, training, empowerment, team building, leadership, and conflict resolution. Student involvement and active learning experiences are emphasized.]

AEM 327 Technological Change and Innovation Strategy
Fall. 3 credits. Prerequisites: AEM 220 and ECON 101. A. Leiponen.
This course explores innovation and technological change. We will study how technological change affects economies and industries, and how innovation of new products, processes, and services takes place in firms. The focus is on the creation, management, and exchange of knowledge within and across organizational boundaries.

[AEM 328 Innovation and Dynamic Management (also H ADM 449)
Spring. 3 credits. Limited to juniors and seniors. Staff.
For description, see H ADM 449.]

AEM 329 International Agribusiness Study Trip
Fall. 2 credits. Prerequisites: AEM 220 or AEM 302, and AEM 240. Open by application prior to March 1 of the spring semester before the course is offered. A co-payment of $800 is required for the field study. B. A. Gloy and L. W. Tauer.
Provides students interested in agribusiness management an exposure to the managerial practices essential to the success of agriculture, agribusiness, and food companies competing in the global marketplace. The course 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. Applications for the field study are due prior to March 1 of the spring semester before the course is offered. Approximately 12 students are selected with preference given to sophomores and juniors in CALS.

AEM 335 International Technology Marketing of Biotechnology
Spring. 3 credits. Prerequisites: ECON 101 and BIO G 109 or equivalents. S-U grades optional. W. H. Lesser.
This class 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 class is of interest to students of biotechnology, public technology policy, and international technology marketing.

[AEM 340 Futures and Options Trading
Spring. 3 credits. Limited to juniors and seniors. Priority given to CALS juniors and seniors, then out of college seniors. Prerequisites: ECON 101, EDUC 115, and AEM 210 or equivalent. S-U grades optional. Not offered spring 2004. Staff.
The focus of the course is on the use of futures and options as risk management tools. Commodities, exchange rate, and interest rate derivatives are covered from the perspective of the hedger, but those interested in arbitrage and speculation are provided some insights as well. Students participate in a simulated trading exercise in which they use price and market information and input from industry experts to manage a hedge position.]

[AEM 344 Consumer Behavior
Fall. 3 credits. Prerequisites: AEM 210 and AEM 240 or equivalents. Limited to 45 juniors and seniors. Priority given to CALS students. Not offered fall 2003. Staff.
This course introduces students to the psychological, sociological, and cultural theories of buyer behavior, with specific attention to consumer information processing and decision making. Class discussions, lectures, experiential exercises, and group projects are used to illustrate behavioral concepts and their application to marketing practice. The role of research in understanding and explaining consumer behavior is emphasized.]

AEM 346 Dairy Markets and Policy
Spring. 2 credits. Limited to juniors and seniors. Prerequisites: ECON 101 or equivalent. S-U grades optional. A. Novakovic.
An introduction to dairy markets and policy. Major topics include: milk pricing, marketing channels, dairy trends and demographics, world trade for dairy products, and policy issues. Class participation is expected as topics and new ideas are explored.

AEM 380 Independent Honors Research in Social Science
Fall or spring. 1–6 credits. Limited to students who have met the requirements for the honors program. See "Honors Program" in CALS section of this catalog. Provides qualified students an opportunity to conduct original research under supervision. Information available in AEM Undergrad Program Office in Warren Hall.

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

AEM 404 Advanced Agricultural Finance Seminar
Spring. 3 credits. Limited to 16 seniors with extensive course work in farm management and farm finance. Open by application prior to March 1 of the year before the course is offered. E. L. LaDue.
A special program in agricultural finance, conducted with financial support from the Farm Credit System. Includes two days at Northeast Farm Credit offices, one week in Farm Credit Association offices, a one-day program on FSA financing during fall term, a two- to four-day trip to financial institutions in New York City, and an actual farm consulting and credit analysis experience in the spring term.

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

AEM 410 Business Statistics
Spring. 3 credits. Prerequisite: preference given to AEM majors. AEM 210 or equivalent. 2 evening prelims. C. van Es.
This course focuses on techniques used to analyze data from marketing research, business, and economics. Topics studied are: survey sampling procedures, contingency table analysis, time series and forecasting, and experimental design and ANOVA. A brief introduction to nonparametric methods is also included. The course involves a research project designed to give experience in collecting and interpreting data.

AEM 411 Introduction to Econometrics
Fall. 3 credits. Prerequisite: AEM 210 and either ECON 313 or PAM 200, or equivalents. D. Just.

The course 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 and simultaneous equation models, simulation, and forecasting techniques are introduced.

AEM 412 Introduction to Mathematical Programming
Fall. 3 credits. Primarily for juniors, seniors, and M.S. degree candidates. Prerequisite: AEM 210 or equivalent. C. Gomes.
This is a course in applied mathematical programming. Emphasis is on formulation of and interpretation of solutions to mathematical models of problems in economics and business. Blending, resource allocation, capital budgeting, transportation and financial planning, and inventory management are studied. Integer and nonlinear programming are introduced.

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

AEM 415 Price Analysis (also ECON 415)
Fall. 3 credits. Prerequisites: AEM 210 or equivalent. ECON 313 or PAM 200 or equivalent. H. M. Kaiser.
The focus of this course is on the analysis of supply and demand characteristics of commodities with particular attention to agricultural products. Special attention is paid to empirical analysis. Institutional aspects of pricing, temporal and spatial price relationships, price forecasting, and the economic consequences of pricing decisions are included.

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

AEM 417 Decision Models for Small and Large Businesses
Spring. 3 credits. Limited to juniors and seniors. Preference given to AEM majors. Prerequisites: AEM 210 or equivalent. In weeks labs are held, there will be no Friday lecture. C. L. van Es.
The course focuses on economic and statistical models of decision analysis and their application in large and small business settings. The course demonstrates how use of models can improve the decision-making process by helping the decision maker: understand the structure of the decision, incorporate subjective probabilities as a way to portray risk, measure outcomes in a way that is consistent with attitudes toward risk, and understand the value of information. The importance of sensitivity analysis is emphasized, as is the need to combine both quantitative and qualitative considerations in decision making. Cases are drawn from small business scenarios, the public policy arena, and corporate settings. Implementing decision models with computers is the focus of lab sessions.

[AEM 419 Strategic Thinking
Fall. 3 credits. Prerequisite: intermediate microeconomics (PAM 200 or ECON 313). S-U grades optional. N. H. Chau.
The art of thinking strategically puts outdoing your adversary at the core of your decision-making process, while anticipating that your adversary is doing exactly the same thing. Businesses make investment decisions and innovate new 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; and how often is your decision to pay attention in class based on whether or not someone else is paying attention? 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, entry deterrence), and strategic policy interaction in international economic relations (e.g. trade wars, arms race).]

AEM 420 Investments
Fall. 3 credits. Prerequisites: AEM 210 or equivalent and AEM 324. Recommended: ECON 313 and a calculus course. Preference given to students in AEM. S-U grades optional. H. Daouk.
This course covers theories and empirical data in the field of financial investments. Descriptions of financial institutions, markets, and instruments are also covered. Topics include: equilibrium models of security prices (CAPM, APT), fixed income markets, performance evaluation, efficient market hypothesis, and behavioral finance. A portion of this course involves the use of a spreadsheet or other computer programs.

[AEM 421 Derivatives and Risk Management
Fall. 3 credits. Prerequisites: AEM 210 and AEM 324 or equivalents. Recommend: ECON 313 or equivalent and a calculus course. Preference given to students in AEM. S-U grades optional. S. Wang.
This course covers the pricing of derivatives and how derivatives can be used for the purpose of risk management and speculation. While no prior knowledge of futures and options is necessary, familiarity with calculus and probability and statistics will be helpful. A portion of this course involves the use of a spreadsheet or other computer programs.]

AEM 422 Estate Planning (also NBA 562)
Fall. 1 credit. Limited to juniors, seniors, and graduate students. S-U grades only. D. A. Grossman.
Fourteen sessions on the various aspects of estate-planning techniques. The law and use of trusts, the law of wills, federal and New York State estate and gift taxes, and substitutes for probate procedures are covered.

AEM 423 Risk Management in Business
Fall. 3 credits. Prerequisites: AEM 210 and AEM 324 or equivalents. L. Tauer.
A comprehensive approach to risk management in the business firm. Discusses what risks exist in the business and whether the business or stakeholders should shoulder those risks. If the business eliminates or manages those risks, how can it best accomplish that task? Discusses the appropriate tools to engage in risk management effectively and how to implement those tools.

AEM 424 Management Strategy
Fall and spring. 3 credits. Limited to AEM seniors in Business. D. Simon.
This is a capstone course designed to integrate what students have learned in other AEM courses with an emphasis on strategic decision making. Issues are approached from the standpoint of the board of directors, chief executive officer, and business unit managers. What should be considered and how strategic decisions should be made are the focus of the course.

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

[AEM 426 Cooperative Management and Strategies
Spring. 3 credits. Recommended: AEM 220 or equivalent. Estimated cost of field trip, $60. 2-day field trip required. Not offered spring 2004. B. L. Anderson.
Investigates the unique aspects of cooperative, membership, and not-for-profit organizations. Issues are approached from the point of view of management, the board of directors, and members. Topics include characteristics of various types of business organizations, cooperative principles, legislation, and taxation as well as the unique nature of strategies, management, financing, and marketing in cooperative, membership, and not-for-profit organizations. Primary focus is on operating cooperatives in agriculture, although alternative types of cooperative organizations are discussed, such as credit unions, insurance cooperatives, employee stock ownership plans, housing cooperatives, flexible manufacturing networks, consumer cooperatives, and membership organizations.]

AEM 427 Agribusiness Strategy
Fall. 3 credits. Prerequisites: AEM 220 or AEM 302. B. A. Gloy.
The course is intended for students with an interest in agribusiness and is designed to integrate previous course work and enhance problem identification and solving skills. The focus is on the evaluation, formulation, and implementation of strategy designed to create and sustain competitive advantage for

agribusiness firms. The course covers industry analysis, firm analysis, market analysis and selection, risk analysis, strategy development, organizational design and structure, and leadership for agribusiness firms. This course is designed as a capstone course for the agribusiness management specialization.

AEM 428 Valuation of Capital Investment
Spring. 3 credits. Prerequisites: AEM 210 and AEM 324 or equivalents. Preference given to AEM students. D. T.-C. Ng.
This course is about 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. Various valuation models are examined in detail and applied 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, pro-forma analysis for strategy and planning, analysis of risk, and the determination of price/earnings and market-to-book ratios.

AEM 429 International Finance
Spring. 3 credits. Prerequisites: AEM 210 and AEM 324. Preference given to students in AEM. S-U grades optional. D. T.-C. Ng.
The purpose of this course is to learn about issues in international financial management and international investment. The major issues that are discussed include exchange rate volatility, the benefit of international diversification, and the analysis of international capital budgeting decisions. Specific topics include the determination of the cost of capital for foreign investments, the determination and management of foreign exchange risks and country risks, and the use of innovative financing for the multinational corporation.

[AEM 430 International Trade Policy
Spring. 3 credits. Prerequisites: ECON 101–102 or equivalents and intermediate microeconomics. Recommended: AEM 230. Optional section TBA. N. H. Chau.
This course examines the economic principles underlying international trade and monetary policy, and the policies, practices, and institutions that influence trade and foreign exchange markets. Applications to current topics in international trade policy, to trade in primary commodities, and to both developed and developing countries are also emphasized.]

AEM 431 Food and Agricultural Policies
Spring. 3 credits. Prerequisite: intermediate microeconomics. S-U grades optional. A. Novakovic.
The course deals broadly with food and agricultural policies, including price support and storage or reserve policies, agricultural protection, soil conservation programs, the structure of agriculture, domestic food subsidy programs, environmental issues, and food safety. The importance of international trade and agricultural policies in other countries is emphasized.

AEM 432 Business and Governments in a Global Marketplace
Fall. 3 credits. Prerequisite: intermediate microeconomics. C. K. Ranney.
The government agency and the individual business enterprise are two of the most powerful institutions in modern society. The aim of this course is to look at the economic interfaces between government and business. The shifting and complicated relationships between them exert great influence on the changing performance of the economy and on the lives of citizens. These relationships range from cooperative to competitive, from friendly to hostile. It is an uneasy relationship, each side possessing basic powers and yet each having an important need for the other. In the United States, the result is a mixed economy in which the public and the private sectors interact in many ways. Government exercises a variety of important powers in dealing with the individual private enterprise, ranging from taxation to regulation. Business, in turn, relies on constitutional protections as well as on public support of its basic role in creating income, employment, and material standards of living. In a dynamic and increasingly globalized economy the business-government relationship is constantly changing and the line between public and private sectors frequently shifts. Future managers will be constantly confronted with issues that relate to government-business interfaces.

AEM 433 Devolution, Privatization, and the New Public Management (also CRP 412 and FGSS 411)
Fall. 3 credits. S-U grades optional. M. E. Warner.
For description, see CRP 412.

AEM 434 Government Policy Workshop (also CRP 418 and FGSS 420)
Spring. 4 credits. S-U grades optional. M. E. Warner.
For description, see CRP 418.

AEM 442 Emerging Markets
Fall. 3 credits. Prerequisites: AEM 240 and PAM 200 or ECON 313. Limited to seniors and graduate students. R. D. Christy.
This course 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. The risk of entering markets in low-income economies is appraised and assessment of the political, legal, cultural, and economic forces is conducted. Case studies of companies are analyzed and discussed.

AEM 443 Food-Industry Strategy
Fall. 4 credits. Limited to AEM juniors and seniors in Business or Food Industry Management and grad students. Prerequisite: AEM 240 or 448 or permission of instructor. G. A. German.
A case-study approach is used to examine the application of management principles and concepts to marketing and distribution problems of the food industry. Cases covering new product introductions, merchandising strategies, and investment decisions are included. Guest speakers from the food industry present case-study solutions at the Tuesday afternoon section.

AEM 446 Food Marketing Colloquium
Fall. 1 credit. Limited to juniors and seniors with extensive course work in food industry management and marketing. D. J. Perosio.
AEM 446 and 447 have been developed as a two-semester special seminar that provides the weekly focus for the Food Marketing Fellows Program. The seminar covers advanced topics in food marketing, many of which have an important international dimension and are presented by industry members. A number of field trips are taken. Students participate in research topics on various aspects of the food industry.

AEM 447 Food Marketing Colloquium
Spring. 1 credit. Limited to juniors and seniors with extensive course work in food industry management and marketing. D. J. Perosio.
AEM 446 and 447 have been developed as a two-semester special seminar that provides the weekly focus for the Food Marketing Fellows Program. The seminar covers advanced topics in food marketing, many of which have an important international dimension and are presented by industry members. A number of field trips are taken. Students participate in research topics on various aspects of the food industry.

AEM 448 Food Merchandising
Spring. 3 credits. Limited to juniors and seniors. Prerequisite: AEM 240. D. J. Perosio.
Covers merchandising principles and practices as they apply to food industry situations. The various elements of merchandising such as buying, pricing, advertising, promotion, display, store layout, profit planning and control, and merchandising strategy are examined. The consequences of food industry trends and initiatives for other industry members, public policymakers, and consumers are considered.

AEM 449 Global Marketing Strategy
Spring. 3 credits. Prerequisite: a previous marketing course. Limited to juniors, seniors, and graduate students. J. M. Hagen.
This course examines opportunities and challenges in the rapidly changing global marketplace. Topics include the decision to serve a foreign market, alternative strategies for entry into foreign markets (such as exporting or establishing a local subsidiary), and issues in implementing those strategies. The course includes case analysis and discussion.

AEM 450 Resource Economics (also ECON 450)
Fall. 3 credits. Prerequisites: MATH 111, ECON 313, and a familiarity with EXCEL. J. M. Conrad.
Dynamic models of renewable, nonrenewable, and environmental resources are constructed to examine market allocation and optimal resource management.

AEM 451 Environmental Economics (also ECON 409)
Spring. 3 credits. Prerequisites: ECON 313, or intermediate microeconomics course, and calculus. Limited to undergraduate students. S-U grades optional. G. L. Poe.
This course explores the economic foundations for public decision making about environmental commodities and natural resources, using tools from intermediate microeconomics. Emphasis is placed on the welfare economic approach for allocating public goods, with specific emphasis on market failure, externalities, benefit-cost analysis, and the use of nonmarket valuation techniques. Property rights/institutional perspectives and ecological economic concepts are also examined.

AEM 464 Economics of Agricultural Development (also ECON 464)
Spring. 3 credits. Prerequisites: ECON 101–102, or permission of instructor. R. D. Christy.
This course is designed to provide an understanding of the economics of the agricultural sector in low-income countries. In addition, more general issues of economic development beyond the agricultural sector are covered to provide the necessary context for an understanding of rural problems. Among the areas covered are 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. Examples from a wide variety of developing countries are used to illustrate the basis for economic analysis.

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

AEM 497 Individual Study in Applied Economics and Management
Fall or spring. Variable credit. S-U grades optional. Students must register with an Independent Study form (available in the Undergraduate Program Office in Warren Hall). Staff.
Used for special projects designed by faculty members.

AEM 498 Supervised Teaching Experience
Fall or spring. 1–4 credits. Total of 4 credits maximum during undergraduate program. Students must register with an Independent Study form (available in the 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 are expected to teach at least one hour per week for each credit awarded. Students cannot receive both pay and credit for the same hours of preparation and teaching.

AEM 499 Undergraduate Research
Fall, spring, or summer. 1–4 credits. Limited to students with GPAs of at least 2.7. Students must register with an Independent Study form (available in the Undergraduate Program Office in Warren Hall). S-U grades optional. Staff.
Permits outstanding undergraduates to carry out independent study of suitable problems under appropriate supervision. Students cannot receive both pay and credit for the same hours of work.

AEM 555 Environmental Management and Policy
Fall. 3 credits. Prerequisite: ECON 101 and 102 or equivalents and calculus. L. D. Chapman.
This seminar intends to familiarize students with the rapidly evolving state of the art in the analysis and management of environmental policy and practice in enterprise. Although focused on the private sector, some attention is given to public enterprises.

[AEM 605 Agricultural Finance
Fall. 3 credits. Prerequisite: AEM 324 or 405 or equivalent. B. A. Gloy.
Advanced topics in agricultural finance. Topics include investment analysis, capital budgeting under uncertainty, decision analysis, risk management, capital structure, and financial intermediaries.]

AEM 608 Production Economics (also ECON 408)
Fall. 3 credits. Recommended: ECON 313 and MATH 111 or equivalents. L. W. Tauer.
The theory of production economics with emphasis on applications to agriculture and natural resources is studied. Topics include the derivation, estimation, and use of production, cost, profit, revenue, demand, and supply functions. The concepts of efficiency and productivity are discussed. Production response over time and under risk is introduced.

AEM 610 Econometrics I
Spring. 3 credits. Prerequisites: statistical methods at the level of ILRST 311 or ECON 619. Undergraduates must have permission of instruction. H. Daouk.
This course, together with AEM 711, provides a graduate sequence in applied econometrics that is suitable for M.S. and Ph.D. students. AEM 610 covers linear regression models and the associated estimation and testing procedures. Models from demand and production theory are used as illustrations.

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

AEM 612 Applied Econometrics
Fall. 1 credit. Prerequisite: concurrent enrollment in AEM 411. D. Just.
Designed for M.S. and Ph.D. students who do not meet the prerequisites for other graduate-level econometrics courses. AEM 612 complements AEM 411, providing greater depth of understanding of econometric methods and exposure to applied econometric literature. Course work focuses on preparing students to conduct their own applied economic research.

AEM 630 Policy Analysis: Welfare Theory, Agriculture, and Trade (also ECON 430)
Spring. 4 credits. Prerequisites: AEM 608 or PAM 603, ECON 313, or equivalent intermediate micro theory 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 of the course focuses on public policy analysis as applied to domestic agricultural policy and international trade. The domestic policy component examines major U.S. farm commodity programs and related food and macroeconomic policies and analyzes their effects on producers, consumers, and other groups. The international trade component examines the structure of world agricultural trade, analytical concepts of trade policy analysis, and the principal trade policies employed by countries in international markets.

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

AEM 633 Devolution, Privatization, and the New Public Management (also CRP 612 and FGSS 611)
Fall. 3 credits. S-U grades optional. M. E. Warner.
For description, see CRP 612.

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

[AEM 640 Analysis of Agricultural Markets (also ECON 440)
Fall. 3 credits. Prerequisites: AEM 411 and 415 or equivalents. Not taught fall 2003. H. M. Kaiser.
This course focuses on the unique features of agricultural commodity markets. Focus is placed on government and private institutions impacting these markets, as well as on models of price behavior including marketing margins and imperfect competition. Empirical tools to evaluate market characteristics are also covered.]

[AEM 641 Commodity Futures Markets (also ECON 441)
Spring, weeks 8–14 (starts Mar. 11). 2 credits. Prerequisites: AEM 411 and 415 or equivalents. Recommended: AEM 640. Staff.
This course is about markets for agricultural futures contracts. Emphasis is placed on 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 651 Environmental and Resource Economics
Spring. 4 credits. Limited to graduate students. W. D. Schulze.

A review of welfare economics, environmental externalities, and common property resources, and a survey of current environmental and natural resource policy. Techniques for measuring benefits and cost—including property value and wage hedonic approaches, travel cost models, and contingent valuation—are covered. Survey/data collection methods are described in detail. Innovative market mechanisms for resolving public good, common property, and externality problems are explored. Students are required to complete a paper describing their own formal economic analysis of a natural resource or environmental problem. Open to graduate students outside of economics. AEM 651 is a core course for the Environmental Management concentration/option.

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

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

AEM 660 Agroecosystems, Economic Development, and the Environment
Spring. 3 credits. Limited to graduate students. An additional section will be arranged for economics majors. S-U grades optional. D. R. Lee.
This course examines selected topics in agricultural and economic development, technology assessment, ecosystem management and the environment, with a focus on developing countries. Topics covered 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. This course is open to graduate students outside of economics.

[AEM 667 Topics in Economic Development (also ECON 770)
Fall. 3 credits. Prerequisite: basic first-year courses in ECON or AEM, or instructor's permission. S-U grades optional. Not offered fall 2003. R. Kanbur.
This course is targeted to second-year graduate students. Topics covered vary from year to year but may include: poverty, inequality, intra-household allocation, structural adjustment, and debt. Examination is by term paper.]

AEM 670 Economics of Consumer Demand (also PAM 608)
Fall. 3 credits. Prerequisites: ECON 311 or 313 and 2 semesters of calculus. S-U grades optional. C. K. Ranney.
A graduate level introduction to theory and empirical research on household demand, consumption, and saving. Emphasis is on the use of the theory in empirical research. Topics include neo-classical theory of demand, duality, complete demand systems, conditional demand, demographic scaling and translating, consumption, and savings. As time allows, Becker and Lancaster models of demand may be introduced.

AEM 694 Graduate Special Topics in Applied Economics and Management
Fall or spring. 4 credits maximum. S-U grades optional. Staff.
The department teaches "trial" courses under this number. Offerings vary by semester, and are advertised by the department before the beginning of the semester.

AEM 698 Supervised Graduate Teaching Experience
Fall or spring. 1–4 credits. Total of 4 credits maximum during graduate program. Students must register with an Independent Study form (available in the Undergraduate Program Office in Warren Hall). Open only to graduate students. Undergraduates should enroll in AEM 498. Prerequisite: permission of instructor. S-U grades optional. Staff.
Designed to give graduate students teaching experience through involvement in planning and teaching courses under the supervision of departmental faculty members. The experience may include leading discussion sections, preparing, assisting in, or teaching lectures and laboratories, and tutoring. Students are expected to actually teach at least one hour per week for each credit awarded. Students cannot receive both pay and credit for the same hours of preparation and teaching.

AEM 699 M.P.S. Research
1–6 credits. Prerequisite: registration as an M.P.S. student. Credit is granted for the M.P.S. project report. Staff.

AEM 700 Individual Study in Applied Economics and Management
Fall or spring. Limited to graduate students. S-U grades optional. Credit, class hours, and other details arranged with a faculty member. Staff.
This course is used for special projects designed by faculty members. More than one topic may be given each semester in different sections. The student must register in the section appropriate to the topic being covered; the section number is provided by the instructor.

[AEM 708 Advanced Production Economics
Fall. 3 credits. Prerequisite: AEM 608, 710, or equivalents; ECON 609 is highly recommended. Offered alternate years. Not offered 2003–2004. R. N. Boisvert.
Covers theoretical and mathematical developments in production economics, with emphasis on estimating production relationships, scale economies, technical change, and factor substitution. Developments in flexible functional forms, duality, and dynamic adjustment models are emphasized. Considerable emphasis is given to empirical specification and estimation. Discussions of other topics (risk, supply response, and household production functions) based on student interest.]

AEM 711 Econometrics II
Fall. 3 credits. Prerequisite: AEM 610 or equivalent. T. D. Mount.
Coverage beyond AEM 610 of dynamic models, including single equation ARIMA, vector ARIMA, Kalman filtering, structural dynamic models, and regime switching. Topics covered include endogeneity, stability, causality, and cointegration.

AEM 712 Quantitative Methods I
Fall. 4 credits. Prerequisite: some formal training in matrix algebra. A course at the level of BTRY 417 is highly recommended. R. N. Boisvert.
A comprehensive treatment of linear programming and its extensions, including postoptimality analysis. Topics in nonlinear programming, including separable, spatial equilibrium and risk programming models. Input-output models and their role in social accounting matrices and computable general equilibrium models are discussed. Applications are made to agricultural, resource, and regional economic problems.

AEM 713 Quantitative Methods II
Spring. 3 credits. Prerequisite: ECON 609. S-U only. J. M. Conrad.
This course is concerned with the analysis and optimization of dynamic systems. Course objectives are to (1) present the basic theory of dynamical systems and dynamic optimization, (2) introduce associated methods of optimization and numerical analysis, (3) review some applications of dynamic analysis from various subfields in economics, and thereby (4) equip students with basic theory and methods to perform applied research on dynamic allocation problems.

AEM 714 Experimental Economics
Fall. 4 credits. Prerequisite: ECON 609. Offered alternate years. W. D. Schulze.
The course will survey both experimental economics methods and research as an approach to test economic theory. Students will participate as subjects in a series of illustrative computerized experiments ranging from double auctions to public goods provision. Topics covered include experimental methods; decisions and games; markets (testing auction institutions); market power (monopoly, oligopoly); bargaining, compensation and performance; public goods; externalities and voting; information and uncertainty; and economic anomalies. Students must design and write a paper describing their own experiment.

AEM 717 Research Methods in Agricultural Economics
Spring. 2 credits. Limited to graduate students. R. N. Boisvert.
Discussion of the research process and scientific method as applied in agricultural economics. Topics include problem identification, hypotheses, sources of data, sampling concepts and designs, methods of collecting data, questionnaire design and testing, field organization, and analysis of data. During the semester each student develops a research proposal that may be associated with his or her thesis.

[AEM 730 Seminar on International Trade Policy: Agriculture, Resources and Development
Spring. 3 credits. Limited to graduate students. Prerequisites: AEM 630 or equivalent. Not offered spring 2004. D. R. Lee.
This course examines selected topics in the professional literature on international trade policy, focusing on agricultural trade and related topics, including trade liberalization, trade and environmental linkages, technological change and trade policy, and agricultural trade and development.]

AEM 735 Public Finance: Resource Allocation and Fiscal Policy (also ECON 735)
Fall. 4 credits. R. Kanbur.
For description, see ECON 735.

AEM 740 Agricultural Markets and Public Policy
Spring, weeks 1–7. 2 credits. Limited to graduate students. Prerequisite: familiarity with multiple regression techniques at the AEM 411 level or higher. Recommended: AEM 640. W. H. Lesser.
Develops the concepts and methodology for applying and analyzing the effects of public-policy directives to the improvement of performance in the U.S. food marketing system. Prospective topics include a survey of industrial organization principles, antitrust and other legal controls, and coordination systems in agriculture. Topics may be adjusted to students' interests.

AEM 750 Resource Economics
Fall. 3 credits. Prerequisites: ECON 609 and 618, or AEM 713. J. M. Conrad.
Optimal control and other methods of dynamic optimization are used to study the allocation and management of natural resources.

[AEM 781 Environmental Economics
Spring. 4 credits. Prerequisites: ECON 609 and 618, or AEM 713. S-U grades optional. Not offered spring 2004. R. N. Boisvert.
This course is the study of the basic theory and applications of environmental economics and policy. Extensions include comparisons of taxes, subsidies and other policy instruments, an examination of the effects on policy of market imperfections, multiple positive and negative externalities, and other government regulations such as those in agriculture. Also examined are the effects of uncertainty, and special problems associated with non-point externalities and asymmetric information. There is an extensive treatment and evaluation of contingent valuation and other methods for valuing non-market goods. Throughout, the theoretical results are highlighted through discussions of important empirical policy applications.]

AEM 762 Microeconomics of International Development
Fall. 3 credits. Prerequisite: completion of first year Ph.D. course sequence in AEM or ECON, or instructor's permission. S-U grades optional. C. B. Barrett.
This course focuses on models of individual, household, firm/farm, and market behavior in low- and middle-income developing economies. Topics covered 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. Empirical investigation is emphasized.

AEM 765 Development Microeconomics Graduate Research Seminar
Fall or spring. 1–3 credits. Prerequisite: graduate students only with permission of instructor. C. B. Barrett.
In this course graduate students and the faculty 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 in addition present their own proposal or paper receive 2 credits. Presentations will be 45–90 minutes and thus represent a substantial investment of time. Students who present a second proposal or paper receive 3 credits.

AEM 800 Master's-Level Thesis Research
Fall or spring. 1–9 credits. Prerequisite: permission of graduate committee chair. S-U grades only. Graduate faculty.
For students admitted specifically to a master's program.

AEM 900 Graduate-Level Thesis Research
Fall or spring. 1–9 credits. Prerequisite: permission of graduate committee chair. S-U grades only. Graduate faculty.
For students in a Ph.D. program **only before** the "A" exam has been passed.

AEM 901 Doctoral-Level Thesis Research
Fall or spring. 1–9 credits. Prerequisite: permission of graduate committee chair. S-U grades only. Graduate faculty.
For students admitted to candidacy **after** the "A" exam has been passed.

ANIMAL SCIENCE

A. W. Bell, chair; R. E. Austic, D. E. Bauman, R. W. Blake, Y. R. Boisclair, D. L. Brown, W. R. Butler, L. E. Chase, G. F. Combs, W. B. Currie, H. N. Erb, R. W. Everett, D. G. Fox, D. M. Galton, J. Gavalchin, R. C. Gorewit, H. F. Hintz, P. A. Johnson, X. G. Lei, P. A. Oltenacu, T. R. Overton, J. E. Parks, A. N. Pell, E. J. Pollak, R. L. Quaas, S. M. Quirk, R. D. Smith, M. L. Thonney, M. E. Van Amburgh

AN SC 100 Domestic Animal Biology I
Fall. 4 credits. S-U grades optional. Lecs, M W F 9:05; sec, T W or R 2:00–4:25. W. B. Currie.
An 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 covered include: fundamentals of genetic selection and relevant biometry, anatomy, quantitative cell biology, regulatory mechanisms, public domain genetic databases, major life support systems, and digestion. Students undertake the care and management of several species of farm animals and conduct a genetic selection experiment with a large colony of Japanese quail. Laboratory exercises include examining aspects of growth and development. Living farm animals are used noninvasively, and fresh organs from dead animals are examined.

AN SC 105 Contemporary Perspectives of Animal Science
Spring. 1 credit. Limited to freshmen, sophomores, and first-year transfers. T 1:25 or W 12:20. D. J. R. Cherney and D. E. Bauman.
A forum to discuss the students' career planning and the contemporary and future role of animals in relation to human needs.

AN SC 110 The Animals That Sustain Us
Spring. 3 credits. S-U grades optional. Lecs, T R 9:05; lab, T 1:25–4:25. D. L. Brown.
Students completing this course understand the importance of the symbiosis between humans and domestic animals, learn how animal enterprises can be ethically, environmentally, and economically sound, and are able to care for various species of domestic animals. Lab sessions feature both live farm animals and computer simulations.

AN SC 150 Domestic Animal Biology II
Spring. 4 credits. S-U grades optional. Lec, M W F 9:05; lab/disc T W or R 2:00–4:25. W. R. Butler and staff.
Second of a two-semester sequence (100/150) applying the basic biology of growth, defense mechanisms, reproduction, and lactation to aspects of the production and care of domestic animals. Fresh tissues and organs from dead animals along with preserved specimens are used in laboratories, exercises, and demonstrations. A quail colony will be used for growth exercises and data collection.

AN SC 212 Animal Nutrition
Fall. 4 credits. Prerequisite: CHEM 208 or equivalent. Recommended: AN SC 100 and 150. Lecs, M W F 10:10; lab, M T W R or F 1:25–4:25. A. W. Bell and D. J. R. Cherney.
An introduction to animal nutrition, including digestive physiology and metabolism of domestic animals and other species; nutrient properties and requirements for different aspects of animal production and performance; principles of feed evaluation and ration formulation. Laboratory classes include gastrointestinal tract dissections and nutritional experiments performed on laboratory or farm animal species.

[AN SC 213 Nutrition of the Dog
Spring, weeks 1–7. 1 credit. Prerequisite: AN SC 212 or equivalent. Offered alternate years. Next offered spring 2005; not offered spring 2004, 2006. Lecs W 7:30–9:25 P.M. H. F. Hintz.
Nutrition of the dog. Digestive physiology, nutrient requirements, feeding practices, and interactions of nutrition and disease.]

AN SC 214 Nutrition of Exotic Animals
Spring, weeks 1–7. 1 credit. Prerequisite: AN SC 212. Offered alternate years. Next offered spring 2004, 2006; not offered spring 2005. Lec, W 7:30–9:25 P.M. H. F. Hintz.
Principles of nutrition for exotic animals. Nutrient requirements, sources of nutrients, feeding management systems, and ration formulation are discussed. Signs of nutrient deficiencies and excesses are described.

AN SC 215 Exotic Avian Husbandry and Propagation
Fall. 2 credits. Limited to 100 students. Prerequisites: AN SC 100, 150, or one year of introductory biology. Lec, M 2:30–4:25. J. Parks and D. Muscarella.
Natural history, care, management, health, and breeding of exotic avian species with emphasis on psittacines (parrots and related species) and raptors (birds of prey). Includes lectures, demonstrations, and local field trips.

[AN SC 216 Nutrition of the Cat
Fall, weeks 1–7. 1 credit. Prerequisite: AN SC 212 or equivalent. Offered alternate years. Next offered fall 2004; not offered fall 2003, 2005. Lecs, W 7:30–9:25 P.M. H. F. Hintz.
Nutrition of the cat. Digestive physiology, nutrient requirements, feeding practices, and interactions of nutrition and disease.]

AN SC 221 Introductory Animal Genetics
Spring. 3 credits. Prerequisite: a year of college biology. Lecs, T R 9:05; sec, T W R or F 2:00–4:25. E. J. Pollak.
An examination of basic genetic principles and their application to the improvement of domestic animals, with emphasis on the effects of selection on animal populations.

AN SC 222 Introduction to Canine Genetics
Fall, spring or summer. 1 credit. Prerequisites: introductory biology or permission of instructor. S-U grades only. To receive credit, register through the School of Continuing Education, www.sce.cornell.edu/DL/html/caninegenetics.html. E. J. Pollak and P. A. Oltenacu.
Introduction to basic Mendelian genetics and simply inherited characteristics in the dog. This distance-education course delivered by CD and web interaction for residents and nonresidents consists of lectures on basic genetic principles, probabilities, linkage and genetic testing, and seminars on genome mapping, inherited sexual disorders, bleeding disorders, and eye defects. This course cannot be taken for credit by students who have successfully completed AN SC 221.

AN SC 250 Dairy Cattle Principles
Fall. 3 credits. S-U grade optional. Lecs, T R 10:10; lab, R or F 1:25–4:25. D. M. Galton and T. Batchelder.
Introduction to the background and scientific principles relating to dairy cattle production. Laboratories are designed to provide an understanding of production techniques. This course is a prerequisite for AN SC 251, 351, 354, and 355.

AN SC 251 Dairy Cattle Selection
Fall. 2 credits. Prerequisite: open only to seniors or permission of instructor. S-U grades optional. Lec, T R 11:15–12:05. D. M. Galton.
Application of scientific principles of genetic programs in herds with different breeding programs. Emphasis is on economical traits to be used to improve genetic progress and herd profitability.

AN SC 265 Horses
Fall. 3 credits. Prerequisites: AN SC 100 and 150 or permission of instructor. S-U grades optional. Lecs, T R 9:05; lab, R 1:25–4:25. H. F. Hintz.
Selection, management, feeding, breeding, and training of light horses.

[AN SC 280 Molecular Biology in Agriculture and Medicine
Fall. 3 credits. Prerequisite: one year of introductory biology. Lec, T R 10:10–11:25. Not offered fall 2003. S. M. Quirk.
The applications of molecular biology to animal research, animal agriculture, industry and medicine are discussed. An introduction of basic recombinant DNA techniques is followed by topics such as genome projects, comparative and functional genomics, genetic screening, gene therapy, transgenic animal production, and mammalian cloning. Ethical issues raised by the use of these technologies are explored in class discussions. Laboratory demonstrations are used to support some lectures.]

AN SC 290 Meat Science (also FOOD 290)
Fall. 2 or 3 credits. Lecs, T R 11:15; lab, M or R 12:20–3:20. Lecture only, 2 credits; lecture plus lab, 3 credits; lab cannot be taken without lecture. D. Shaw.
An introduction to meat science through a study of the structure, composition, and function of muscle and its conversion to meat. Properties of fresh and processed meat, microbiology, preservation, nutritive value, inspection, and sanitation are also studied. Laboratory exercises include anatomy, meat-animal slaughter, meat cutting, wholesale and retail cut identification, inspection, grading, curing, sausage manufacture, and quality control. An all-day field trip to commercial meat plant may be taken.

AN SC 300 Animal Reproduction and Development
Spring. 3 credits. Prerequisite: AN SC 100–150 or equivalent and 1 year of introductory biology. Lecs, M W F 10:10. J. E. Parks.
Comparative anatomy and physiology of mammalian and avian reproduction, with emphasis on domestic and laboratory animals. Fertilization through embryonic development, pregnancy, and growth to sexual maturity; emphasis on physiological mechanisms and application to fertility regulation. Separate laboratory offered to demonstrate fundamental aspects of reproduction and reproductive technology.

AN SC 301 Animal Reproduction and Development Lab
Spring. 1 credit. Prerequisite: AN SC 100–150 or equivalent. Concurrent enrollment in or completion of AN SC 300 required to register. Labs, M W or F 1:25–4:25. Each lab limited to 30 students. J. E. Parks.
Demonstration of fundamental principles and applied aspects of mammalian and avian reproduction. A limited number of live animals are used in some demonstrations. Dissection and examination of tissues from vertebrate animals are included in selected laboratories.

AN SC 305 Farm Animal Behavior (also BIOAP 312)
Spring. 2 credits. Prerequisites: one year of introductory biology and introductory animal physiology (AN SC 100 and 150 or equivalent is sufficient or BIOAP 311); at least 1 animal production course or equivalent experience is recommended. S-U grades optional. Lec, T R 11:15. Staff.
The behavior of production species (avian and mammalian) influences the success of any management program. Students study behaviors relating to communication, learning, social interactions, reproduction, and feeding of domestic animals and their physiological basis. Management systems for commercial livestock production and their implications for animal behavior and welfare are stressed.

AN SC 323 Equine Genetics Seminar
Fall. 2 credits. S-U grades only. Prerequisite: AN SC 221 or equivalent. Disc, T 1:25–2:15. P. A. Oltenacu.
Topics of equine genetics are presented and discussed. Students are also required to view one seminar each week. These seminars are animated PowerPoint presentations available in computer lab and can be viewed at flexible times during the week.

[AN SC 341 Biology of Lactation
Spring. 2 credits. Prerequisite: AN SC 100–150 or Animal Physiology. Offered alternate years. Next offered spring 2005; not offered spring 2004, 2006. Lecs. T R 9:05. Y. R. Boisclair and staff.
A comprehensive survey of the biology of the mammary gland. Lectures cover: (1) basic aspects such as anatomy and development of the mammary gland, biochemistry and hormone regulation of milk synthesis and regulation of gene expression in the mammary cells; (2) practical aspects such as the impact of lactation on nutrition, reproduction, and diseases. Lactation in the dairy cow provides the primary context to the course, but examples from other mammals including humans are used.]

AN SC 351 Dairy Herd Management
Spring. 4 credits. Prerequisites: AN SC 250 or permission of instructor. Recommended: AEM 302. Lecs, M W F 11:15; labs, W 1:25–4:25, and F (alternate weeks) 1:25–4:25. D. M. Galton.
Application of scientific principles to practical herd management with components of reproduction, milking, housing, records, and production economics. Laboratories emphasize practical applications, analyses of alternatives, decision making, field trips, and discussion.

AN SC 354 Dairy Cattle Herd Health
Fall. 3 credits. Prerequiste: AN SC 250 or permission of instructor. Lecs, T R 9:05–9:55; lab, R 1:25–4:25. D. M. Galton and W. Stone.
Application of scientific principles to practical herd management with emphasis on herd health and animal well-being. Laboratory emphasizes practical applications of herd health management including on-farm herd health analysis.

AN SC 355 Dairy Cattle Nutrition
Spring. 3 credits. Prerequisite: AN SC 250 or permission of instructor. Letter only. Lecs, W F 10:10; lab, R 1:25–4:25. T. L. Batchelder and L. E. Chase.
Application of scientific principles to practical herd nutrition relating to herd production and feeding management. Laboratory emphasizes practical applications and field trips.

AN SC 360 Beef Cattle
Spring. 3 credits. Lec, T R 10:10; sec, W 2:00–4:25. Offered alternate years. Next offered spring 2004, 2006; not offered spring 2005. M. L. Thonney.
Emphasis is on the management of reproduction, nutrition, and selection in beef cattle enterprises. A cattle growth model is studied. Laboratories acquaint students with management skills through computerized simulations and working directly with cattle. Students spend several days during the semester feeding and caring for cows and their newborn calves.

AN SC 365 Equine Nutrition
Fall. 3 credits. Prerequisites: AN SC 100, 212, and 265 or equivalent. S-U grades optional. Lec, M W F 9:05–9:55. H. F. Hintz.
The principles of nutrition for horses are presented. Digestive physiology, sources of nutrients, feeding programs for various classes of horses and interactions of nutrition and diseases are discussed.

[AN SC 370 Swine Nutrition and Management
Fall. 3 credits. Recommended: AN SC 212. Lec, T R 11:15; lab, T 2:00–4:25. Offered alternate years. Next offered fall 2004; not offered fall 2003, 2005. X. G. Lei and K. Roneker.
This course focuses on swine nutrition, feeding, and management. Lectures are integrated basic nutrition and swine system including pig biology, digestive and metabolic development, nutritional biochemistry and physiology, impact of swine nutrition on environment, use of pig model in medicine, and current swine nutrition and biotechnology. Laboratory practice, animal projects, and problem troubleshooting are offered.]

[AN SC 380 Sheep
Spring. 3 credits. Lec, T R 10:10; sec, W 2:00–4:25. Offered alternate years. Next offered spring 2005; not offered spring 2004, 2006. M. L. Thonney.
Emphasis is on the breeding, feeding, management, and selection of sheep from a production-system approach. Lectures and laboratories are designed to give students a practical knowledge of sheep production as well as the scientific background for improved management practices. Students work directly with sheep during laboratories and spend several days during the semester feeding and caring for ewes and their newborn lambs.]

AN SC 400 Livestock in Tropical Farming Systems
Spring. 3 credits. Prerequisite: upperclass standing. Lecs, T R 9:05; disc W 1:25–3:20. R. W. Blake.
An analysis of constraints on livestock production in developing countries of the tropics, economic objectives and risk, and production methods. Emphasis is on strategic use of animal and plant resources, animal performance with inputs restricted, decision making, and alternative systems of production. Principles, real examples, independent study projects, and classroom interactions aid problem-solving efforts to improve food security.

AN SC 401 Dairy Production Seminar
Spring. 1 credit. Limited to juniors and seniors. Disc, M 7:30 P.M. D. E. Bauman and T. R. Overton.
Capstone course where students, with the help of faculty members, complete a study of the research literature on topics of current interest in the dairy industry. Students then make an oral and a written report on their topic with emphasis on integrating theory and practice.

AN SC 402 Seminar in Animal Sciences
Spring. 1 credit. Limited to juniors and seniors. May be repeated. S-U grades optional. Disc, M 4:30. W. B. Currie.
Review of literature pertinent to contemporary topics of animal science or reports of undergraduate research and Honors projects. Students present oral reports of their work for class discussion in addition to written reports.

[AN SC 403 Tropical Forages
Spring. 2 credits. Limited to seniors and graduate students except by permission of instructor. Prerequisites: crop production and livestock nutrition. Next offered spring 2006. Lecs, T R 10:10. A. N. Pell.
An overview of tropical grasslands, seeded pastures, and crop residues as feed resources; grass and legume characteristics; establishment and management of pastures; determination of feeding value of forages and crop residues; physiology of digestion of ruminants that affects feeding behavior; problems of chemical inhibitors in plants; and preservation of tropical forages as hay or silage.]

AN SC 410 Nutritional Physiology and Metabolism
Fall. 3 credits. Prerequisites: biochemistry and physiology. M W F 11:15. R. E. Austic and D. E. Bauman.
A fundamental approach to nutrition focusing on the metabolic fate of nutrients and the interrelationships among nutrients, nutritional state, and metabolic processes. The overall goal is to increase understanding of metabolism and metabolic regulation through an integration of nutrition, biochemistry, and physiology.

AN SC 411 Applied Cattle Nutrition
Fall. 4 credits. Prerequisites: AN SC 100 and 212 (or equivalent); AN SC 355 is strongly encouraged. Lecs, M W F 10:10; lab, M 1:25–4:25. M. E. Van Amburgh.
An applied approach to predicting nutrient requirements and feed utilization to meet requirements with wide variations in cattle type, feed composition, and environmental conditions. Dairy cattle are emphasized. Nutrient management to minimize cost of production and environmental effects is discussed. Computer models (Cornell Net Carbohydrate and Protein System) are used in the laboratory to apply the information presented in lectures, including evaluation of feeding programs on case study farms. Course is designed for juniors, seniors, and entering graduate students.

AN SC 412 Whole Farm Nutrient Management (also CSS 412)
Spring. 2 or 4 credit option. Open to juniors, seniors, and graduate students only. Course offered as two modules. Enrollment in Module 1 for the first half of the semester is required (2 credits). Module 1 consists of crop and manure nutrient management planning; no prerequisites for CALS students. Enrollment in Module 2 for the second half of the semester is optional (additional 2 credits). This module builds on the crop and manure nutrient management planning module by integrating agronomic nutrient management planning with herd nutrient management planning. AN SC 411 required. Lec, T R 11:15 and lab T 1:25–4:25 for both modules, with work on case studies outside of lab. M. E. Van Amburgh and Q. M. Ketterings.
This course provides students with an understanding of the concepts underlying whole farm nutrient management planning to improve profitability while protecting water and air quality. Students learn and apply concepts in the development of a Comprehensive Nutrient Management Plan (CNMP) that is required for a Concentrated Animal Feeding Operation plan to meet environmental regulations. Students develop components of a CNMP for a case study farm, using the Cornell University Nutrient Management Planning System (*cu*NMPS) and other tools. All students enrolled learn the concepts and processes of developing the crop and manure nutrient management plan component of a CNMP during the first half of the semester in Module 1. Students opting to continue through the end of the semester in Module 2 (4 credit option) build upon knowledge gained in the first half of the semester by learning the knowledge and skills necessary to integrate crop production and herd feeding management for reducing nutrient imports on farms.

AN SC 413 Contemporary Issues in Animal Science
Spring. 1 credit. Open to juniors, seniors, and graduate students only. Lec and disc, R 1:25–3:20, weeks 1–8. L. O. Tedeshi and D. G. Fox.
Course lectures and discussions explore contemporary issues affecting animal agriculture, including competition with humans for food resources, biotechnology, impact of consumption of animal products on human health, and impact of livestock farms on environmental/community problems, including odor, pathogens, and excess nutrients effects on water quality. May not be repeated for credit.

AN SC 414 Ethics and Animal Science
Fall. 2 credits. Enrollment limited to 40 students, juniors and seniors only. Lec, M 12:20; disc, W 12:20–1:10. D. J. R. Cherney.
Exploration of 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 on-line, and a project of the student's choice are used to evaluate the performance of each student.

AN SC 420 Quantitative Animal Genetics
Spring. 2 credits. S-U grades only. Prerequisite: AN SC 221 or equivalent. Limited to 30 students. Lec, M 12:20; sec, M 2:00–4:25. E. J. Pollak.
A consideration of problems involved in improvement of animals through application of the theory of quantitative genetics, with emphasis on genetic evaluation and analysis of data for genetic parameters. Computer labs use interactive matrix algebra programs for problem solving.

AN SC 425 Gamete Physiology and Fertilization
Fall. 2 credits. Limited to 50 students. Prerequisite: AN SC 300 or equivalent. Offered alternate years. Next offered fall 2003, 2005; not offered fall 2004. Lecs, R 2:30–4:25. J. E. Parks.
Study of the formation, growth, differentiation, and maturation of mammalian sperm and oocytes; gamete transport and interaction with male and female reproductive tracts; and cytological, physiological, and molecular changes required for fertilization. Lecture, discussion, and aspects of gamete physiology and *in vitro* technologies such as cryopreservation, oocyte maturation, and fertilization are covered.

AN SC 427 Fundamentals of Endocrinology (also BIOAP 427)
Fall. 3 credits. Prerequisite: animal or human physiology or permission of instructor. Lecs, M W F 9:05. P. A. Johnson.
Physiology and regulation of endocrine secretions. Neuroendocrine, reproductive, growth, and metabolic aspects of endocrinology are emphasized. Examples are selected from many animals, including humans.

AN SC 451 Dairy Herd Business Management
Fall. 3 credits. Prerequisite: enrollment in Dairy Fellows. Lec, W 1:25–2:15; disc W 2:30–4:25; lab, F 1:25–4:25. D. M. Galton and J. Karszes.
Emphasis on dairy herd business management with application to herd management analysis. Laboratory includes farm tours and analysis.

AN SC 456 Dairy Management Fellowship
Spring. 2 credits. Limited to seniors. Prerequisites: AN SC 351 and permission of instructor. S-U grades only. Hours TBA. D. M. Galton.
The program is designed for undergraduates who have a sincere interest in dairy farm management. Objective is to gain further understanding of the integration and application of dairy farm management principles and programs with respect to progressive dairying and related industries.

AN SC 494 Special Topics in Animal Science
Fall or spring. 4 credits maximum. Prerequisite: undergraduate standing. S-U grades optional. Staff.
The department teaches "trial" courses under this number. Offerings vary by semester and are advertised by the department before the semester begins. Courses offered under the number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

AN SC 495 Introduction to Research
Fall. 1 credit. S-U grades only. Required of students undertaking Honors in Animal Science. Open to Honors students in other programs and those planning to pursue research, by permission of the instructor. Disc, M 12:20–1:10. W. B. Currie.
An exposure to the world of scientific research including: identifying problems; devising hypotheses and realistic research plans; evaluating scientific writings and other forms of communication; finding and managing reference materials; examining the cost of research and opportunities for funding; discussing the obligations imposed on investigators by society and a host of regulatory agencies, along with responsibilities and freedom in science; and considering ethical issues that affect scientists. Students make oral presentations and prepare brief items of technical writing.

AN SC 496 Internship in Animal Science
Fall or spring. 1–3 credits; limited to 6 credits maximum during undergraduate career. Students must register with an 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 must be approved in advance by the student's academic adviser and must provide an acceptable, professionally supervised experience of at least 60 hours on the job per credit required.

AN SC 497 Individual Study in Animal Science
Fall or spring. 1–3 credits; may be repeated for credit. Intended for students in animal sciences. Prerequisite: permission of instructor. Students must register with an Independent Study form (available in 140 Roberts Hall). S-U grades optional. Staff.
May include individual tutorial study or a lecture topic selected by a professor. Since topics may change, the course may be repeated for credit.

AN SC 498 Undergraduate Teaching
Fall or spring. 1, 2, or 3 credits; limited to 2 experiences during undergraduate career. Limited to students with a GPA of at least 2.7. Students must register with an 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 the student's education and experience. The student is expected to meet regularly with a discussion or laboratory section, to gain teaching experience, and regularly to discuss teaching objectives, techniques, and subject matter with the professor in charge.

AN SC 499 Undergraduate Research
Fall or spring. 6 credits maximum during undergraduate career. Not open to students who have earned 6 or more undergraduate research credits elsewhere in the college. Limited to juniors and seniors with a GPA of at least 2.7. Students must register with an Independent Study form (available in 140 Roberts Hall).
Affords opportunities for students to carry out independent research under appropriate supervision. Each student is expected to review pertinent literature, prepare a project outline, conduct the research, and prepare a report.

AN SC 601 Amino Acids (also NS 601)
Spring. 2 credits. Prerequisites: physiology, biochemistry, and nutrition. Lecs, W F 12:20. Offered alternate years. Next offered spring 2004, 2006; not offered spring 2005. R. E. Austic.
A course emphasizing the dynamic aspects of protein digestion and absorption, amino acid transport and amino acid and nitrogen metabolism, and their relationships to the nutritional requirements for amino acids.

[AN SC 603 Mineral Nutrition: Metabolic, Health, and Environmental Aspects (also NS 603)
Fall. 2 credits. Prerequisites: biochemistry, physiology, and nutrition. Lec T 2:20–4:25. Offered alternate years. Next offered fall 2004; not offered fall 2003, 2005. X. G. Lei and C. C. McCormick.
Emphasizes metabolism, gene regulation, functional genomics, and genetic defects of mineral nutrition. Team-taught lectures span from single gene mutation to social and environmental aspects of mineral nutrition and mineral-related disorders. Effective approaches to improve global mineral nutrition by agriculture and food systems are discussed.]

AN SC 604 Vitamins (also NS 604)
Fall. 2 credits. Lec, T R 10:10. Staff.
For description, see NS 604.

[AN SC 606 Ruminant Nutrition: Microbial Ecology and Forage Chemistry
Spring. 4 credits. Prerequisites: AN SC 212, Biochemistry. S-U grades optional. Lecs, M W F 9:05; disc, W 8:00. Offered alternate years. Next offered spring 2005; not offered spring 2004, 2006. A. N. Pell.
This course provides an overview of ruminant nutrition with an emphasis on microbial ecology, forage chemistry, and rumen function.]

AN SC 610 Animal Science Seminar
Fall and spring. 1 credit. Registration limited to graduate students. S-U grades only. Lec T 12:20–1:10. D. J. R. Cherney.
Students attend a weekly seminar on topics related to animal science. The requirement for an S grade is to regularly attend seminars during the semester.

AN SC 619 Field of Nutrition Seminar (also NS 619)
Fall and spring. No credit. No grades given.
For description, see NS 619.

AN SC 620 Seminar in Animal Breeding
Fall and spring. 1 credit. Limited to graduate students with a major or minor in animal breeding. S-U grades only. Hours TBA. E. J. Pollak.
Seminar on current topics in animal breeding and statistics as applied to genetic evaluation and selection of domestic animals.

AN SC 621 Seminar: Endo/Reprod Biology
Fall and spring. 1 credit. Prerequisites: permission of instructor. Registration limited to graduate students. S-U grades only. Lec, W 4:00. W. R. Butler and staff.
Current research in reproductive physiology is presented by staff members, graduate students, and visitors.

[AN SC 625 Nutritional Toxicology (also TOX 625)
Spring. 2 credits. Prerequisites: biochemistry and nutrition courses. S-U grades optional. Offered alternate years. Next offered spring 2005; not offered spring 2004, 2006. Lec, W 1:25–2:15; lab/disc, W 2:30–4:25. D. L. Brown.
Exploration of toxicological principles and a selective survey of natural food and feed toxicants. At the end of this course, students understand relationships between nutrition and toxicology; are prepared to conduct research concerning the effects of naturally occurring toxicants; and are able to use multimedia to present their understanding of a class of toxicants. Occasionally, the class takes walking field trips. In addition, students read printed and electronic communications and create STELLA simulation models and a system of web pages related to a specific family of toxicants.]

AN SC 640 Individual Study in Animal Science
Fall or spring. 1 or more credits. S-U grades optional. Staff.
Study of topics in animal science more advanced than, or different from, other courses. Subject matter depends on interests of students and availability of staff.

AN SC 650 Molecular Techniques for Animal Biologists
Spring. 4 credits. Prerequisites: BIOBM 330 or BIOBM 332 or BIOBM 333 or equivalents and permission of instructors. Enrollment limited to 15 students. Offered alternate years. Next offered spring 2004, 2006; not offered spring 2005. Lec, T 11:15; labs, T and R 1:25–4:25. Y. Boisclair and S. Quirk.
A laboratory course designed for students with little or no experience with techniques in

molecular biology. Emphasis is on modern techniques used in conducting research in animal-related sciences such as nutrition, physiology, pharmacology, and immunology (e.g., subcloning, mutagenesis of DNA, RT-PCR, analysis of gene and protein expression, overexpression of proteins, and study of protein-DNA interactions). Lectures introduce laboratory exercises and supplement laboratory topics. Students perform an independent project requiring time outside scheduled laboratories and give a scientific presentation.

AN SC 694 Special Topics in Animal Science

Fall or spring. 4 credits maximum. Prerequisite: graduate standing. S-U grades optional.

The department teaches "trial" courses under this number. Offerings vary by semester and are advertised by the department before the semester begins. Courses offered under the number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

AN SC 720 Advanced Quantitative Genetics

Spring. 3 credits. Prerequisites: matrix algebra, linear models, and mathematical statistics. S-U grades optional. Hours TBA. Offered alternate years. Next offered spring 2004, 2006; not offered spring 2005. R. L. Quaas.

This course covers statistical methods used in a variety of problems in the quantitative genetics of animal populations. The initial focus is the estimation of breeding values for purposes of ranking animals for selection. The core of the course is the mixed linear model; linear estimators and predictors are treated extensively. The importance of appropriate modeling is emphasized. Generalizations to nonlinear models, via Bayesian principles, are made, i.e,, inferences from posterior distributions.

AN SC 800 Master's-Level Thesis Research

Fall or spring. Credit TBA, maximum 12 credits/semester. Prerequisite: permission of adviser. S-U grades only. Graduate faculty.

For students admitted specifically to a master's program.

AN SC 900 Graduate-Level Thesis Research

Fall or spring. Credit TBA, maximum 12 credits/semester. Prerequisite: permission of adviser. S-U grades only. Graduate faculty.

For students in a Ph.D. program **only before** the "A" exam has been passed.

AN SC 901 Doctoral-Level Thesis Research

Fall or spring. Credit to be arranged, maximum 12 credits/semester. Prerequisite: permission of adviser. S-U grades only. Graduate faculty.

For students admitted to candidacy **after** the "A" exam has been passed.

Related Courses in Other Departments

Introductory Animal Physiology (BIOAP 311)

Introductory Animal Physiology Laboratory (BIOAP 319)

Milk Quality (FOOD 351)

Agriculture in the Developing Nations (INTAG 602)

Lipids (NS 602)

Basic Immunology, Lectures (BIOG 305)

BIOLOGICAL AND ENVIRONMENTAL ENGINEERING

M. F. Walter, chair; B. A. Ahner, L. D. Albright, D. J. Aneshansley, A. J. Baeumner, J. A. Bartsch, J. R. Cooke, A. K. Datta, K. G. Gebremedhin, D. A. Haith, J. B. Hunter, L. H. Irwin, W. J. Jewell, C. D. Montemagno, J.-Y. Parlange, N. R. Scott, R. M. Spanswick, T. S. Steenhuis, M. B. Timmons, L. P. Walker; T. J. Cook, L. D. Geohring, P. E. Hillman, lecturers

Note: Class meeting times are accurate at the time of publication. If changes occur, the department will provide new information as soon as possible.

BEE 102 Introduction to Microcomputer Applications

Fall or spring. 3 credits. Letter only. Graduating seniors are guaranteed admittance. All students, including those pre-enrolled (and graduating seniors), must attend the first lecture to guarantee admittance and to select a laboratory section. Lec, fall: T R 12:20–1:10, spring: M W 12:20–1:10, labs, M 1:25–4:25 or 7:30–10:30 P.M. or T 1:25–4:25 or W 1:25–4:25 or 7:30–10:30 or R 1:25–4:25 p.m. Fee, $25. P. E. Hillman.

Introduction to application packages on microcomputers. Laboratories provide experience with word processing, object-oriented and bit-mapped graphics, spreadsheets, visual basic macros database management, presentation graphics, and web page authoring. An independent project related to the student's major is required. These packages and others such as desktop publishing, multimedia, anti-virus software, and those used for searching the Internet for information are discussed and demonstrated in the lectures, along with an overview of computer hardware, health hazards of computing, and software privacy.

BEE 110 Introduction to Metal Fabrication Techniques

Spring. 3 credits. Each lab limited to 18 students. Lec, T R 9:05; labs M T or R 1:25–4:25, M or T 7:30–10:30. T. J. Cook.

Emphasis is on selection of proper materials and techniques to accomplish a variety of metal fabrication and maintenance projects. Covers hand and machine tools, fasteners, strengths of materials, classification and identification of metals, soldering, brazing, forging, pipe fitting, sheet metal work, controlling distortion, oxy-acetylene cutting, and arc welding.

BEE 132 Introduction to Wood Construction

Fall. 3 credits. Each lab limited to 15 students. Lec, T R 9:05; labs, T W or R 1:25–4:25, T or W 7:30–10:30. T. J. Cook.

Principles and practice of wood construction. Covers site selection and preparation, drainage, water and septic development, footers and foundations, material properties, framing and roofing, comparison of alternatives to wood construction, use of hand and power tools, wood joining methods, fasteners, concrete work, and block construction. Each student plans and constructs an approved carpentry project.

BEE 151 Introduction to Computing

Fall. 4 credits. Lecs, M W F 11:15–12:05; labs, W R 12:20–2:15, 2:30–4:25, F 1:25–2:30. Each lab and recitation section limited to 22 students. L. D. Albright.

An introduction to computer programming and concepts of problem analysis, algorithm development, and data structure in an engineering context. The structured programming language, JAVA, is used, implemented on interactive personal computers, and applied to problems of interest in biological and environmental engineering. No previous programming experience is assumed.

BEE 152 Computer Applications for Engineers

Spring. 1–3 credits variable (three 1-credit modules). A student can take any one, any two, or all three modules. Prerequisites: BEE 151 or equivalent computer programming course and 1 semester of calculus for the Matlab module. No prerequisites for the other two modules. Letter grades only. Lec, T 2:30–3:20, sec, R 1:25–2:15; lab, R 2:30–4:25. P. E. Hillman.

Major application packages useful to engineering and science students are covered in three modules. The first module introduces Matlab and explores the problem-solving capabilities of Matlab through examples. The second module investigates the data processing and graphing capabilities of spreadsheets. The third module uses presentation graphics to create an effective professional presentation.

Module 01 Matlab (weeks 1 to 5 of the spring semester)

Covers matrix/vector manipulation, basic math functions, graphing of 2-D and 3-D plots, file I/O, string and numerical manipulation, problem solving of linear and nonlinear algebraic functions and ordinary differential equations, integration, curve fitting, and data analysis and statistics. In lab, students learn Matlab through examples. Grading is based on completion of lab assignments, lecture quizzes, and lecture attendance.

Module 02 Spreadsheets (weeks 6 to 10 of the spring semester)

Covers the use of a spreadsheet application such as Microsoft Excel to include built-in functions, lookup tables, graphs, Visual Basic macros, what-if analysis, and advantages and disadvantages compared to a programming language. Grading based on completion of lab assignments, lecture quizzes, and lecture attendance.

Module 03 Presentation Tools for the Professional Engineer (weeks 11 to 14 of the spring semester)

Covers the use of a presentation graphics application such as Microsoft PowerPoint to create slides for an oral presentation of engineering projects for professional presentations. Special attention is given to the execution of quality presentations. Grading based on lab assignments, lecture quizzes, lecture participation, and an oral PowerPoint presentation and written report submitted as the final exam.

BEE 200 The BEE Experience
Spring. 1 credit. Letter only. Prerequisite: nonmajors by permission of instructor. Lec, T 1:25–2:15. J. A. Bartsch.
A required course for freshman majors in Biological and Environmental Engineering. A 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 offices, and students. Students develop their undergraduate course plans, complete a web search assignment to locate jobs and internships, and select future courses to meet their academic objectives and career goals.

BEE 222 Bioengineering Thermodynamics and Kinetics
Spring. 3 credits. Prerequisites: MATH 192, BIO SCI 110; PHYS 213 and one course in chemistry completed or concurrent. Lec, M W F 9:05–10:10. J. Hunter.
Living systems rely on chemical and phase equilibria, precise coordination of biochemical pathways, and the release of chemical energy as heat, all of which are governed by the laws of thermodynamics and the rates of chemical reactions. The course covers concepts and laws of thermodynamics as applied to phase transformations, work, heat, and chemical reactions; and reaction kinetics applied to industrial processes and living systems, all with a focus on biological examples.

BEE 251 Engineering for a Sustainable Society
Spring. 3 credits. Prerequisite: MATH 293 concurrent. Lec, T R 10:10–11:25. B. A. Ahner.
Case studies of contemporary environmental issues including pollutant distribution in natural systems, air quality, hazardous waste management, and sustainable development. Emphasis is on the application of math, physics, and engineering sciences to solve energy and mass balances in environmental sciences. The students will be introduced to the basic chemistry, ecology, biology, ethics, and environmental legislation relevant to the particular environmental problem. BEE engineering students must complete either BEE 251 or BEE 260 according to their academic plan. BEE students who complete both BEE 251 and BEE 260 will receive engineering credit for only one of these courses.

BEE 260 Principles of Biological Engineering
Spring. 3 credits. Prerequisite: MATH 293 completed or concurrent. Lec, T R 8:40–9:55. A. 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. Topic areas 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 engineering students must complete either BEE 251 or BEE 260 according to their academic plan. BEE students who complete both BEE 251 and BEE 260 will receive engineering credit for only one of these courses.

BEE 299 Sustainable Development: A Web-Based Course
Spring. 3 credits. Prerequisite: sophomore standing and above. S-U grades optional. N. R. Scott.
Sustainable development is the dominant economic, environmental, and social issue of the twenty-first century. This web-based course develops the concepts of sustainable development as an evolutionary process, demanding the integration of the physical sciences and engineering with the biological and social sciences for design of systems. Topics include the nature of ecosystems, global processes, sustainable communities, and industrial ecology and life cycle analysis.

BEE 301 Renewable Energy Systems
Spring. 3 credits. Prerequisite: college physics. Lec, T R 10:10–11:25. L. D. Albright.
Introduction to energy systems with emphasis on quantifying costs and designing renewable energy systems to convert environmental inputs into useful forms of energy. Course covers solar energy, small-scale hydropower, wind, bio-conversion processes, house energy balances. Focus is on the technologies and small-scale system design, not policy issues. Use of spreadsheets is extensive.

BEE 305 Principles of Navigation (also Nav S 301)
Fall. 4 credits. 4 classes each week (lecture-recitation-project work). Lecs, M W F 8:00–8:50; lab, R 8:00 or 9:05. Lt. Seymour.
An introduction to the fundamentals of marine navigation emphasizing piloting and celestial navigation procedures. The course covers coordinate systems, chart projections, navigational aids, instruments, compass observations, time, star identification, use of the nautical almanac, tides and currents. Electronic navigation systems are also *briefly* discussed.

BEE 310 Advanced Metal Fabrication Techniques
Spring. 1 credit (2-credit option available). Prerequisite: BEE 110 or permission of instructor. Lab, F 1:25–4:30. T. J. Cook.
Principles and practices extending beyond the scope of BEE 110. Includes out-of-position, high- carbon steel and cast iron welding. Topics such as soldering and brazing of aluminum, hard surfacing, both tungsten (TIG) and metallic (MIG) inert gas welding, plasma-arc and oxy cutting of metals are covered. Planning, development, and fabrication of a metal construction project is required for the two-credit option.

BEE 325 Environmental Management
Fall. 3 credits. Lec, T R 2:55–4:10. W. J. Jewell.
Explores the decline in environmental quality caused by human activities and the limits of science and technology solutions. Understanding complex issues such as global warming and deriving sustainable solutions are emphasized and illustrated with case studies. Field trips to water supply and waste treatment facilities are included. Emphasis is on water, with energy, air quality, and soil evaluations used to illustrate environmental quality problems. (BEE 325 and BEE 625 meet together.) BEE 625 students will complete a semester-long design-oriented project.

BEE 350 Biological and Environmental Transport Processes
Fall. 3 credits. Prerequisites: MATH 294 and fluid mechanics (co-registration permissible). Lecs, M W F 11:15–12:05; disc, W 2:30–3:20. 2 evening prelims. K. G. Gebremedhin.
Focus is on understanding the principles of heat and mass transfer in the context of biological, biomedical, and environmental systems. Physical understanding of transport processes and simple reaction rates with application examples from plant, animal, and human biology, the environment (soil/water/air), and industrial processing of food and biomaterials are emphasized.

BEE 360 Molecular and Cellular Bioengineering
Spring. 3 credits. Prerequisites: biochemistry or AEP 252 or permission of instructor. Lec, T R 2:55–4:10. D. Luo.
Biological engineering at the molecular and cellular level focusing on different organisms (viruses, bacteria, cells, animals, and plants) and different scales (nano, molecular, cellular, tissue, and environment) with two underlying themes: DNA and cancer; and introduction of quantitative analysis and measurement as well as ethics in molecular and cellular bioengineering with emphasis on integration of molecular and cell biology with engineering.

BEE 365 Properties of Biological Materials
Spring. 3 credits. Prerequisites: ENGRD 202 (coregistration permissible). Lec, T R 12:20–1:10; lab W 2:30–4:25, R 2:30–4:25 or F 2:30–4:25. J. A. Bartsch.
Mechanics and structural properties of biological materials. Mechanical testing of animal, plant, and food products. Laboratory exercises in quasi-static and dynamic testing of materials and interpretation of test results. Experimental techniques for determining engineering properties of these materials. This course satisfies the BEE laboratory exeprience requirement.

BEE 371 Hydrology and the Environment
Spring. 3 credits. Prerequisite: one course in calculus. 2 lecs, 1 lab. Lecs, T R 9:05–9:55; lab, F 2:30–4:25. M. T. Walter, T. S. Steenhuis.
Introduction to hydrology: the hydrologic cycle and the role of water and chemicals in the natural environment. Includes precipitation, infiltration, evaportranspiration, ground water, surface runoff, river meandering, floods, and droughts. Case studies, short field trips, and laboratories foster an understanding of concepts and principles of hydrologic processes.

BEE 411 Biomass Processing: Modeling and Analysis
Spring. 3 credits. Prerequisites: BEE 250; BEE 350 (or any course in heat and mass transport); BIOBM 331, 332, or BIOMI 290. Lec, M W F 9:05–9:55. L. P. Walker.
This course is designed to introduce students to how basic concepts from physical chemistry, enzyme and microbial kinetics, and transport phenomena are used to model biomass conversion and degradation processes. Examples of different agricultural and environmental processes are used to explore model development, solutions, and validation. Strong emphasis on the use of differential equations to model process dynamics.

BEE 427 Water Sampling and Measurement
Fall. 3 credits. Prerequisites: fluids or a hydrology course and MATH 191. Lec, T 9:05–9:55; lab, T 1:25–4:25. L. D. Geohring and T. S. Steenhuis.
Get your feet wet and your hands busy with this course on water sampling methods where science and engineering technologies are integrated to quantify, characterize, and analyze environmental engineering problems. This field-based laboratory course focuses on quantification of surface and subsurface flow and quality, and includes sampling techniques of soils, sediment, and biological waste products. Quality assurance and control protocols and interpretation of watershed loading of contaminants are addressed. This course satisfies the BEE laboratory exeprience requirement.

BEE 435 Principles of Aquaculture
Spring. 3 credits. Prerequisite: must be at least a junior. Lec, W 1:25–4:25. M. B. Timmons.
An in-depth treatment of the principles of aquaculture: fish biology, waste treatment, engineering design, fish health, nutrition, processing, and so on. This course is intended to build upon the undergraduate's previous course background and interests. Includes supervised "hands-on" laboratory experiences.

BEE 450 Bioinstrumentation
Spring. 4 credits. Prerequisites: MATH 294, BEE 151, PHYS 213, or permission of instructor. Lec, M W 8:40–9:50; lab, M or W 2:30–4:25. D. Aneshansley.
Biological and biomedical applications are emphasized in this laboratory-based course. The electronic instrument from sensor to computer is considered. Static and dynamic characteristics of components and systems are determined theoretically and empirically. General analog and digital signal condition circuits are designed, constructed, and tested. This course satisfies both the BEE laboratory experience and the BEE capstone design requirement.

BEE 453 Computer-Aided Engineering: Applications to Biomedical Processes (also M&AE 453)
Spring. 3 credits. Prerequisite: heat and mass transfer (BEE 350 or equivalent). Lecs, M W 11:15–12:05; computation disc/lab: F 11:15. A. K. Datta.
Introduction to simulation-based design as an alternative to prototype-based design. Analysis and optimization of complex real-life processes using an industry-standard physics-based computational software on a supercomputer or on high-end personal computers. Biomedical processes and industrial food processing applications of heat and mass transfer are covered. Computational topics introduce the finite-element method, pre- and post-processing, and pitfalls of using computational software. Students choose their own term project, which is the major component of the course (no final exam). The course satisfies the College of Engineering upper-level computing application requirement. This course satisfies the BEE capstone design requirement.

BEE 454 Physiological Engineering
Fall. 3 credits. Corequisite: fluid mechanics. Lecs, T R 12:20–1:10; lab T R 1:25–4:25. D. J. Aneshansley.
Engineering analysis and design in the physiology of animals and humans. Covers the use of engineering principles to study how animals work in nature and to intervene in physiological functions. The two major engineering themes are: signal processing as related to neural conduction, sound processing, vision, and image processing; and systematics as applied to cardiovascular and respiratory systems, bioenergetics, and bird flight. Laboratories involve experiments, computing applications, field trips, and live animal demonstrations. This course satisfies the BEE laboratory experience requirement.

[BEE 456 Biomechanics of Plants (also BIO PL 456)
Fall. 3 credits. Prerequisites: upper division undergraduate or graduate status, completion of introductory sequence in biology and one year of calculus, or permission of instructor. S-U or letter grade optional. Lec, T R 11:15–12:05; disc, W 2:30–3:20. J. R. Cooke and K. J. Niklas.
An engineering approach is taken to plant form and function following the text *Plant Biomechanics*. Topics include: mechanical behavior of materials, effect of geometry on mechanical behavior, plant-water relations, plant cell walls, mechanical behavior of tissues, mechanical attributes of organs, the plant body, fluid mechanics and biomechanics, and plant evolution.]

BEE 459 Biosensors and Bioanalytical Techniques
Spring. 4 credits. Prerequisites: biochemistry and permission of instructor. Lec, 11:40–12:55; lab, M 1:25–4:25 and 7:30–10:30 P.M. A. J. Baeumner.
This course provides students with an understanding of the scientific and engineering principles of biosensors and bioanalytical techniques. The course addresses selected topics from simple biosensors to micro/nanofabricated Micro Total Analysis Systems (MicroTAS). Biosensor and Micro TAS applications in environmental analysis, food safety, and medical diagnostics are explored. Students give oral presentations in lecture, prepare a biosensor of their choice in the laboratory, and present a poster in a biosensor workshop at the end of the semester. Undergraduate students work together in teams of 2 to 4 students. This course satisfies the BEE capstone design requirement and the BEE laboratory experience requirement for engineering students.

BEE 464 Bioseparation Processes
Fall. 3 credits. Prerequisites: intro biochemistry and physics, MATH 112 or 192, BEE 260 or equivalent, or permission of instructor. Lec, M W F 12:20–1:10. J. B. Hunter.
Bioseparation is the science and engineering of fractionating and purifying biological materials: DNA, proteins, living cells, antibiotics, biofuels, and even foods. The 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) will be supplemented with student presentations. Intended for seniors and graduate students in engineering, chemistry, biology, and food science.

BEE 471 Geohydrology (also CEE 431 and EAS 445)
Fall. 3 credits. Prerequisites: MATH 294 and ENGR 202. 2 lecs, 1 disc, lecture, field trip. W. Brutsaert, L. M. Cathles, J.-Y. Parlange, 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 473 Watershed Engineering
Fall. 3 credits. Prerequisite: fluid mechanics or hydrology. Lecs, T R 10:10–11:00; disc, R 1:25–4:30. M. F. Walter.
Engineering principles are applied to the design of management strategies aimed at solving natural resource problems in the context of watersheds. Emphasis is placed on rural systems and small-scale design for water conveyance, soil erosion control, flood damage control, earthen dams, ponds, moisture conservation, drainage, and water supply. BEE students who wish to take this course to satisfy the BEE capstone design requirement, must co-register in BEE 496 for one credit hour. This course satisfies the College of Engineering technical writing requirement when co-registered in BEE 493.

BEE 474 Drainage and Irrigation Design
Spring. 3 credits. Prerequisites: fluid mechanics or hydrology. Lecs, M W F 12:20–1:10. T. S. Steenhuis and L. D. Geohring.
This course will focus on design of drainage and irrigation systems for agriculture and nonagricultural purposes. The course will also briefly cover design for rural water supply and sanitation systems. Emphasis is placed on problem solving with actual situations used wherever possible. One major design project is required of each student. This course satisfies the BEE capstone design requirement.

BEE 475 Environmental Systems Analysis
Fall. 3 credits. Prerequisites: computer programming, and 1 year of calculus. Lecs, T R 11:40–12:55. D. A. Haith.

BEE 476 Solid Waste Engineering
Spring. 3 credits. Prerequisites: 1 semester of physics and chemistry. Lecs, T R 11:40–12:55. D. A. Haith.
Planning and design of processes and facilities for management of municipal solid wastes. Source characterization and reduction; collection and transport systems; waste-to-energy combustion; sanitary landfills; composting; recycling and materials recovery facilities; and hazardous waste management. Emphasis is on quantitative analyses.

BEE 478 Ecological Engineering
Spring. 3 credits. Prerequisite: junior-level environmental quality engineering course or equivalent. Lecs, T R 2:30–3:45. W. J. Jewell.
Ecological engineering is the language of sustainable living. Waste management with natural systems, the most advanced form of this new engineering direction, includes: constructed wetlands, hydroponic applications of plants in resource-recovery waste management systems, soil restoration, phytoremediation, and bioremediation of toxics. Biomass refineries to create energy-independent communities, sustainable drinking water systems, carbon sequestration, and zero polluting farms are future sustainable

living topics that also solve some of society's larger problems. BEE students who wish to take this course to satisfy the BEE capstone design requirement must co-register in BEE 496 for one credit hour.

BEE 481 LRFD-Based Engineering of Wood Structures (also CEE 481)
Spring. 3 credits. Prerequisite: ENG 202. Lecs, M W F 12:20–1:10 (Hollister Hall). Two evening prelims. K. G. Gebremedhin.
Computer-aided and manual computation procedures of Load and Resistance Factor Design (LRFD)–based engineering of wood structures. Topics include national design codes and standards; estimation of design loads (dead, live, wind, snow, and seismic loads); determination of factored resistance and stiffness values; mechanical properties of wood and wood products; designs of beams, columns, trusses, frames, arches, bridges, and diaphragms; and connections and special wood structural members and systems. Engineering design judgment is also discussed as an integral component of the quantitative design procedure. BEE students who wish to take the course to satisfy the BEE capstone design requirement must co-register in BEE 496 for one credit hour.

BEE 484 Metabolic Engineering
Spring. 3 credits. Prerequisite: biochemistry or permission of instructor. S-U grades optional. Lec, T R 10:10–11:25. R. M. Spanswick.
The principles of metabolic engineering as they relate to the regulation of metabolic pathways, including membrane transport, are considered in terms of enzyme kinetics and metabolic control analysis. Case studies, reflecting the interests of the instructor, emphasizes examples involving higher plants. Each student is expected to investigate one topic in depth and make a short class presentation.

BEE 489 Engineering Entrepreneurship, Management and Ethics
Spring. 4 credits. Prerequisites: ENGRD 270 or CEE 304 or equivalent, junior standing. Lec, T R 1:25–2:40; disc M 9:05–9:55, 1:25–2:15 or 3:35–4:25. M. B. Timmons.
The course focuses on engineering economics, engineering management and professional ethics, and associated ethical issues. Course objectives include coverage of: prediction/probability of net returns; financial calculations (internal rate of return, time value of money, pro forma statements); legal structures of businesses; project management; developing an awareness of issues related to professional ethics; and technical writing and communication. This course satisfies the College of Engineering technical writing requirement.

BEE 493 Technical Writing for Engineers
Fall or spring. 1 credit. Prerequisites: co-registration with BEE 473 (fall), BEE 450 (spring). Lec, M 7:30–9:25 (5 evenings in first half of semester). Staff.
This course meets the College of Engineering technical writing requirement when taken concurrently with BEE 473 in the fall or BEE 450 in the spring. Class meets for five evening sessions during the fall semester and covers writing skills necessary for technical project reports. Also considered: outlines, style, audience, and general writing mechanics.

BEE 494 Special Topics in Biological and Environmental Engineering
Fall or spring. 4 credits maximum. S-U grades optional. Staff.
The department teaches "trial" courses under this number. Offerings vary by semester and are advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

BEE 495 BEE Honors Research
Fall or spring. 1–6 variable credits. Prerequisite: enrollment in the BEE Research Honors program. Letter grade. Staff.
Intended for students pursuing the Research Honors program in BEE. Students must complete the Honors program application by the 3rd week of the fall semester senior year.

BEE 496 Capstone Design in Biological and Environmental Engineering
Fall and spring. 1 credit. Corequisite: students must co-register in one of the approved upper level courses (BEE 473, 478, 481). Students must register with an Independent Study form (available in 140 Roberts Hall). Staff.
Involves capstone design experience, including a team project incorporating analysis, design, evaluation, synthesis, and a written and oral report of the end-product. This course must be taken in conjunction with one of the following approved BEE courses (BEE 473, 478, 481).

BEE 497 Individual Study in Biological and Environmental Engineering
Fall and spring. 1–4 credits. S-U option. Prerequisite: written permission of instructor and adequate ability and training for the work proposed. Normally reserved for seniors in the upper two-fifths of their class. Students must register with an Independent Study form (available in 140 Roberts Hall). Staff.
Special work in any area of biological and environmental engineering on problems under investigation by the department or of special interest to the student, provided, in the latter case, that adequate facilities can be obtained.

BEE 498 Undergraduate Teaching
Fall and spring. 1–4 credits. Prerequisite: written permission of instructor. Students must register with an Independent Study form (available in 140 Roberts Hall). Staff.
The student assists in teaching a biological and environmental engineering course appropriate to his/her previous training. The student meets with a discussion or laboratory section, prepares course materials, grades assignments, and regularly discusses objectives and techniques with the faculty member in charge of the course.

BEE 499 Undergraduate Research
Fall and spring. 1–4 credits. Prerequisites: normally reserved for seniors in the upper two-fifths of their class; adequate training for work proposed; and written permission of instructor. Students must register with an Independent Study form (available in 140 Roberts Hall). Staff.
Research in any area of biological or environmental engineering on problems under investigation by the department or of special interest to the student, provided that adequate facilities can be obtained. The student must review pertinent literature, prepare a project outline, carry out an approved plan, and submit a formal final report.

BEE 501–502 M.P.S. Project
Fall and spring. 1–6 credits. Required of each M.P.S. candidate in the field. BEE graduate faculty.
A comprehensive project emphasizing the application of agricultural technology to the solution of a real problem.

BEE 551–552 Agricultural and Biological Engineering Design Project
Fall and spring. 3–6 credits. Prerequisite: admission to the M.Eng. degree program. BEE graduate faculty.
Comprehensive design projects dealing with existing engineering problems in the field. Emphasis is on the formulation of alternative design proposals that include consideration of economics, nontechnical factors, engineering analysis, and complete design for the best design solution. Projects are supervised by faculty members on an individual basis. There, however, is a formal orientation during the first four weeks of the semester. A formal report and public presentation of the results of the design project are required for completion of the course(s). A minimum of 3 to a maximum of 12 credits of 551–552 is required for the Master of Engineering degree. Students should register for 551 their first semester and complete any additional design project credits with 552. If more than six design project credits are desired in one semester, both 551 and 552 may be taken.

BEE 625 Environmental Management
Fall. 3 credits. Lec, T R 2:55–4:10. W. J. Jewell.
For description, see BEE 325.

BEE 647 Water Transport in Plants (also BIOPL 651)
Fall. 2 credits. Lec, T R 10:10–11:00. Offered alternate years. R. M. Spanswick.
Topics include water relations of plant cells and tissues using water potential terminology; permeability of plant cells to water and the role of aquaporins; transport of water through whole plants, including transpiration, stomatal physiology, and the modifications due to plant communities; water status and plant growth in relation to water stress.

[BEE 649 Solute Transport in Plants (also BIOPL 649)
Fall. 3 credits. Lec, T R 10:10–11:25. Offered alternate years. Not offered 2003–2004. R. M. Spanswick.
A fundamental treatment of the transport of ions and small organic molecules in plants. Topics will include: electrophysiology of cell membranes, including ion channels and electrogenic ion pumps; transport mechanisms for the major ions; intercellular and long-distance ion transport; cotransport systems for sugars and amino acids; phloem transport; ABC-type transporters.]

BEE 651 Bioremediation: Engineering Organisms to Clean Up the Environment
Spring. 3 credits. Prerequisites: BIOMI 290 or BIOMI 398 or BIOBM 331 or permission of instructor. Lec T R 10:10–11:00. B. Ahner.
This course examines ways in which organisms may be used to remove or metabolize pollutants in the environment including bacterial degradation of organics and phytoremediation of heavy metals.

Through lectures and current literature, students evaluate the benefits as well as the current obstacles. The current efforts to genetically engineer organisms for bioremediation and the potential risks of releasing them into the environment are examined.

BEE 652 Instrumentation: Sensors and Transducers

Spring. 3 credits. Prerequisites: linear differential equations, introductory chemistry and introductory physics, or permission of the instructor. Lec T R 12:20–1:10; lab 2:00–4:25. D. J. Aneshanley.

Application of instrumentation concepts and systems to the measurement of environmental, biological, and agricultural phenomena. Construction and characterization of electronic sensors and transducers is emphasized. Image processing techniques are introduced. A final project is required.

BEE 655 Thermodynamics and Its Applications

Spring. 3 credits. Prerequisite: MATH 293 or equivalent. Lecs, R 2:30–4:30. J.-Y. Parlange.

Thermodynamics and its applications to problems in engineering and agriculture. Topics include basic concepts (equilibrium, entropy, processes, systems, potentials, stability, phase transitions) and applications (soil and water processes, dilute solutions, electromagnetism, surface phenomena, heat and mass transport, and structure of organizations).

BEE 659 Biosensors and Bioanalytical Techniques

Spring. 4 credits. Prerequisites: biochemistry and permission of instructor. Lec, T R 8:40–9:55; lab, M 1:25–4:25 and 7:30–10:30 P.M. A. J. Baeumner.

This course provides students with an understanding of the scientific and engineering principles of biosensors and bioanalytical techniques. The course addresses selected topics from simple biosensors to micro/nanofabricated Micro Total Analysis Systems (MicroTAS). Biosensor and Micro TAS applications in environmental analysis, food safety, and medical diagnostics are explored. Students give oral presentations in lecture, prepare a biosensor of their choice in the laboratory, and present a poster in a biosensor workshop at the end of the semester. Graduate students work independently on individual biosensor projects.

BEE 671 Analysis of the Flow of Water and Chemicals in Soils

Fall. 3 credits. Prerequisites: four calculus courses and fluid mechanics. Lec, R 3:35–4:50 (first meeting—TBA). J.-Y. Parlange.

The course encompasses a full range from simple to complex methods to describe the chemical and water flows on the surface, in the vadose zone, and through the aquifer. Current analytical, semi-analytical, and computer-based techniques are discussed. Both homogeneous and heterogeneous soils are analyzed. Offered alternately with CEE 633—a complementary, but not identical, course.

BEE 672 Drainage

Spring. 4 credits. Prerequisites: BEE 471 or BEE 473. S-U grades optional. Lecs, M W F 12:20–1:10; lab, T 1:25–4:25. T. S. Steenhuis and L. D. Geohring.

Theory of water and solute flow in aquifers, hill slopes, and the vadose zone as it relates to artificial drainage is discussed. Drainage design as it relates to agricultural land, landfills, and land application sites is critically reviewed. The importance of preferential flow and matrix flow on water quality of drainage waters is examined. Laboratories are used for hands-on experience with measuring soil parameters and for actual drainage design. This course satisfies the capstone design experience requirement.

BEE 673 Sustainable Development Seminar (also NBA 573)

Spring. 1–3 credits. Prerequisites: upper division undergraduate and graduate students or permission of instructor. Lec, F 1:30–3:30. N. R. Scott.

Sustainable development is the most beneficial concept to come out of the environmental movement in years. The concept of a sustainable world, however, is not a constant. There are many aspects of sustainability involving economics, environment, and political, social, scientific, and technological developments. This seminar explores topics such as energy, agricultural and food systems, green buildings and ecological design, corporate sustainability, and other contemporary issues.

BEE 678 Nonpoint Source Models

Spring. 3 credits. Prerequisites: computer programming and calculus. Lecs, T R 8:40–9:55. D. A. Haith.

Development and programming of simulation models for management of water pollution from runoff and percolation. Emphasis is on prediction of water and chemical inputs to surface waters and groundwater. Applications include watershed hydrology and sediment yield, urban and rural runoff, lake eutrophication, waste disposal sites, and pesticides, nutrients, and salts in drainage.

BEE 685 Biological Engineering Analysis

Spring. 4 credits. Prerequisite: T&AM 310 or permission of instructor. Lecs, M W F 11:15–12:05. J. R. Cooke.

Engineering problem-solving strategies and techniques are explored. Students solve several representative engineering problems that inherently involve biological properties. Emphasis is on formulation and solution of mathematical models and the interpretation of results. The student's knowledge of fundamental principles is used extensively.

BEE 687 The Science and Engineering Challenges to the Development of Sustainable Bio-based Industries

Fall. 1 credit. Prerequisite: graduate standing. Lec, R 12:20–1:10; disc, R 1:25–2:15. B. Ahner.

Environmental sustainable alternatives for our energy and chemical needs are critical. This seminar series explores challenges facing the development of industries that use biologically derived materials to produce useful chemicals and energy for society. Topics include natural products from biological systems, conversion of biomass to fuel and other commodities, and the use of biological systems for environmental bioremediation.

BEE 694 Graduate Special Topics in Agricultural and Biological Engineering

Fall or spring. 4 credits maximum. S-U grades optional. ABEN graduate faculty.

The department teaches "trial" courses under this number. Offerings vary by semester, and are advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

BEE 697 Graduate Individual Study in Agricultural and Biological Engineering

Fall or spring. 1–6 credits. Prerequisite: permission of instructor. S-U grades optional. ABEN graduate faculty.

Topics are arranged by the staff at the beginning of the term.

BEE 700 General Seminar

Fall. 1 credit. S-U grades only. Staff.

Presentation and discussion of research and special developments in agricultural and biological engineering and related fields.

BEE 740 Veterinary Perspectives on Pathogen Control in Animal Manure (also VTMED 740 and BIOMI 740)

Spring. 2 credits. Prerequisite: graduate standing or permission of instructor. Lec, M T W R 3:00–4:00, March 24–May 16. D. D. Bowman.

Presents an in-depth look at the management of pathogens in animal manures. It reviews the pathogens involved, the role of governing agencies, the survival of pathogens in the field, and methods of pathogen destruction. The course discusses commercial methods of manure processing for the control of these pathogens for the protection of other animals and the human population. The course concludes with class discussions with major stakeholders representing the dairy, beef, pork, and poultry industries and their understanding of the problem as it relates to veterinary students.

BEE 750 Orientation to Graduate Study

Fall. 1 credit. Limited to new graduate students. S-U grades only. Lecs, first 7 weeks, M 3:35–4:25. D. J. Aneshansley.

An introduction to ABEN research policy, programs, methodology, resources, and degree candidates' responsibilities and opportunities.

BEE 754 Watershed Management

Spring. 2–3 credits. Prerequisite: graduate standing or permission of instructors. Lec, W 2:30–4:25. T. S. Steenhuis and M. J. Pfeffer.

Traditional top-down approaches to watershed management have been challenged by advocates of public participation. These challenges have raised questions about how to effectively integrate science, policy, and public participation. This course reviews different management approaches and evaluates their usefulness in dealing with different watershed management problems. Case examples from watersheds in the United States and overseas are considered.

BEE 760 Nucleic Acid Engineering

Fall. 3 credits. Prerequisites: BEE 360 or permission of instructor. Lec, T R 2:30–3:20; lab, W 12:20–2:15. 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 are introduced, including tool kits for nucleic acid engineering and current examples of DNA-based engineering, DNA nanotechnology, and DNA-based medicine. A design project and formal project presentation are required.

BEE 771 Soil and Water Engineering Seminar
Fall and spring. 1–3 credits. Prerequisite: graduate status or permission of instructor. S-U grades optional. T. S. Steenhuis, J.-Y. Parlange, and M. F. Walter.
Study and discussion of research or design procedures related to selected topics in irrigation, drainage, erosion control, hydrology, and water quality.

BEE 781 Structures and Related Topics Seminar
Spring. 1 credit. Prerequisite: graduate status or permission of instructor. S-U grades only. TBA. Staff.
Advanced analysis and design of production systems with emphasis on structural and environmental requirements, biological responses, and economic considerations.

BEE 785 Biological Engineering Seminar
Spring. 1 credit. Prerequisite: graduate status or permission of instructor. S-U grades only. J. R. Cooke.
The interactions of engineering and biology, especially the environmental aspects of plant, animal, and human physiology, are examined in order to improve communication between engineers and biologists.

BEE 787 Industrial Ecology of Agriculturally Based Bioindustries
Spring. 3 credits. Prerequisites: 1 year calculus, some knowledge of Matlab, BEE 687, limited to graduate students. L. P. Walker.
Input/output modeling methods are used to explore the use of the industrial ecology perspective for the design and analysis of sustainable bio-based industries.

BEE 800 Master's-Level Thesis Research
Fall and spring. 1–15 credits. Prerequisite: permission of adviser. S-U grades. ABEN graduate faculty.

BEE 900 Doctoral-Level Thesis Research
Fall and spring. 1–15 credits. Prerequisite: permission of adviser. S-U grades. ABEN graduate faculty. Variable credit for Ph.D. research.

BIOLOGICAL SCIENCES

The program of study in biology is coordinated by the Office of Undergraduate Biology. For course descriptions, see the section on Biological Sciences.

BIOLOGY & SOCIETY

The undergraduate major field of study in biology and society is offered through the Department of Science and Technology Studies. For a full description of courses that fulfill field requirements, see the Biology & Society listing under the College of Arts and Sciences in this publication.

BIOMETRY AND STATISTICS

M. Wells, chair, C. Bustamante, C. Castillo-Chavez, R. Lloyd, R. Nielsen, S. J. Schwager, R. Strawderman

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

BTRY 301 Biological Statistics I (also NTRES 315 and STBTRY 301)
Fall. 4 credits. Lec, T R 10:10–11:25; lab, M or W 1:25–2:15, or 2:30–3:20, or 3:35–4:25.
Statistical methods are developed and applied 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 S-Plus statistical computing environment.

BTRY 302 Biological Statistics II (also NTRES 316 and STBTRY 302)
Spring. 4 credits. Prerequisite: BTRY 301 or BTRY 601. Lec, T R 10:10–11:25; lab times TBA.
Linear statistical methods are applied 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 S-Plus statistical computing environment.

BTRY 382 Introduction to Statistical Genomics and Bioinformatics (also STBTRY 382)
Fall. 4 credits. Prerequisite: BTRY 101, MATH 111, BIO G 102, or equivalent. Lec, T R 10:10–11:25; lab, F 1:25–2:15.
Survey course focusing on the statistical analysis of genomic data. The course includes an introduction to probability and statistics and application to DNA sequence analysis, phylogenetic inference, population genetics, genetic mapping, molecular evolution, and macromolecular structure prediction. The course is intended for undergraduates and beginning graduate students in the mathematical and biological sciences. Evaluation is based on weekly problem sets and computer assignments as well as a midterm and final examination.

BTRY 400 Biometry Seminar (also STBTRY 400)
Fall and spring. 1 credit. S-U grades only. Prerequisite: BTRY 302, or 409, or 602, or permission of instructor. Sem, R 3:35–4:25.
Students attend a weekly seminar, the Biometrics Unit Discussion Series. Can be taken concurrently with BTRY 600 only with permission of instructor. Students can only take this course twice.

BTRY 408 Theory and Probability (also STBTRY 408)
Fall. 4 credits. Prerequisites: MATH 111, 112, 213, 231, or equivalents. Lec, M W F 10:10–11:00, Sec, M 3:35–5:00.
An 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. At least one introductory course in statistical methods is additionally recommended but not required.

BTRY 409 Theory of Statistics (also STBTRY 409)
Spring. 4 credits. Prerequisites: BTRY 408, at least one introductory course in statistics. Lec, M W F 10:10–11:00, sec, M 3:35–5:00.
An introduction to classical theory of parametric statistical inference that builds on the material covered in BTRY 408. Topics include sampling distributions, principles of data reduction, likelihood, parameter estimation, hypothesis testing, interval estimation, and basic asymptotic theory.

[BTRY 421 Matrix Computation
Fall. 4 credits. Prerequisite: calculus. Lecs, M W F 9:05–9:55; sec, M or T 1:25–2:15.
Introductory course in matrix computations that reviews linear algebra (vector spaces, linear independence) and emphasizes a matrix approach to solving systems (LU-factorization, QR-decomposition, SVD, Schur complements) and the role of the condition number of a matix. Positive definite matrices, eigenvalues, and their applications in mathematical modeling and statistics are discussed.]

BTRY 482 Statistical Genomics (also STBTRY 482)
Spring. 4 credits. S-U grades optional. Prerequisite: BTRY 382 or equivalent. Lec, T R 11:40–12:55; sec, F 12:20–1:10.
This course covers topics in the statistical analysis of genetic, molecular, and genomic data, including the statistics of DNA database searches and alignment, statistical methods in molecular evolution, population genetics, phylogenetics, molecular ecology, forensic genetics, the analysis of comparative molecular data, QTL mapping, and association mapping. Topics may vary from year to year. This course will be co-taught with BTRY 682. However, undergraduate students will be evaluated on the basis of a final exam and a term paper instead of a research project.

BTRY 494 Undergraduate Special Topics in Biometry and Statistics (also STBTRY 494)
Fall or spring. 1–3 credits. S-U grades optional.
A course of lectures selected by the faculty. Because topics usually change from year to year, this course may be repeated for credit.

BTRY 495 Statistical Consulting (also STBTRY 495)
Spring. 2–3 credits. Prerequisites or corequisites: BTRY 302 or BTRY 602 and BTRY 409 and permission of instructor. S-U grades optional. W 1:25–2:15.
Participation in the Department of Biological Statistics and Computational Biology consulting service: faculty-supervised statistical consulting with researchers from other disciplines. Discussion sessions are held for joint consideration of literature and selected consultations encountered during previous weeks.

BTRY 497 Undergraduate Individual Study in Biometry and Statistics (also STBTRY 497)
Fall and spring. 1–3 credits. S-U grades optional. Students must register with an Independent Study form (available in 140 Roberts Hall).
Consists of individual tutorial study selected by the faculty. Because topics usually change from year to year, this course may be repeated for credit.

BTRY 498 Undergraduate Supervised Teaching (also STBTRY 498)
Fall and spring. 2 credits. S-U grades optional. Students must register with an Independent Study form (available in 140 Roberts Hall).
Students assist in teaching a course appropriate to their previous training. Students meet with a discussion or laboratory section and regularly discuss objectives with the course instructor.

BTRY 499 Undergraduate Research (also STBTRY 499)
Fall or spring. 1–3 credits. S-U grades optional. Limited to statistics and biometry undergraduates. Prerequisite: permission of faculty member directing research. Students must register with an Independent Study form (available in 140 Roberts Hall).

BTRY 600 Statistics Seminar (also STBTRY 600)
Fall and spring. 1 credit. S-U grades only. Prerequisite or corequisite: BTRY 409 or permission of instructor. Sem 3:35–4:25.

BTRY 601 Statistical Methods I (also STBTRY 601)
Fall and summer. 4 credits. Limited to graduate students; others by permission of the instructor. Lecs, M W F 12:20–1:10; sec, M or T 2:30–4:00 or 7:30–9:00 P.M. or T 10:10–11:40.
Statistical methods are developed and used 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. Interactive computing is introduced through MINITAB statistical software. Emphasis is on basic principles and criteria for selection of statistical techniques.

BTRY 602 Statistical Methods II (also STBTRY 602)
Spring. 4 credits. Limited to graduate students; others by permission of instructor. Prerequisite: BTRY 601 or equivalent. Lecs, M W F 11:15–12:05; sec, M 1:00–2:45 or 7:30–9:25 P.M. or T 1:00–2:45.
A continuation of BTRY 601. Emphasis is on 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. Emphasis is on appropriate design of studies prior to data collection, and the appropriate application and interpretation of statistical techniques. For practical applications, computing is done with the MINITAB and SAS statistical packages.

[BTRY 603 Statistical Methods III (also STBTRY 603)
Spring. 3 credits. Prerequisite: BTRY 601 and 602 or permission of instructor.
Offered alternate years. Lecs T R 8:40–9:55.
Categorical data analysis, including logistic regression, loglinear models, stratified tables, matched pairs analysis, polytomous response and ordinal data. Applications in biomedical and social sciences.]

BTRY 604 Statistical Methods IV: Applied Design (also STBTRY 604)
Spring. 4 credits. Prerequisites: BTRY 601 and 602 or permission of instructor.
Offered alternate years. Lecs M W F 12:20–1:10; lab T 2:30–4:25.
Applications of experimental design including such advanced designs as split plots, incomplete blocks, fractional factorials. Use of the computer for both design and analysis is stressed, with emphasis on solutions of real data problems.

[BTRY 652 Computationally Intensive Statistical Inference (also STBTRY 652)
Spring. 4 credits. S-U grades optional. Prerequisite: BTRY 421 and BTRY 409 or equivalent. Offered alternate years. Lecs, M W F 2:30–3:20.
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 will be done in Matlab. The focus of the course is on the use of numerical analysis methods for solving problems in statistical inference and estimation.]

[BTRY 672 Topics in Environmental Statistics (also STBTRY 672)
Fall and spring. 2 credits. S-U grades optional. Prerequisite: BTRY 601 or permission of the instructor. Not offered 2003–2004. Lec, R 10:10–11:25.
This course is a discussion group focusing on statistical problems arising in the environmental sciences. These issues are explored in a number of different ways, such as student presentations of research papers, directed readings, and outside speakers.]

BTRY 682 Statistical Genomics (also STBTRY 682)
Spring. 4 credits. S-U grades optional. Prerequisite: BTRY 382 or equivalent. Lec, T R 11:40–12:55; sec, F 12:20–1:10.
This course covers topics in the statistical analysis of genetic, molecular, and genomic data, including the statistics of DNA database searches and alignment, statistical methods in molecular evolution, population genetics, phylogenetics, molecular ecology, forensic genetics, the analysis of comparative molecular data, QTL mapping, and association mapping. Topics may vary from year to year. All students are expected to participate in small research projects.

BTRY 694 Graduate Special Topics in Biometry and Statistics (also STBTRY 694)
Fall or spring. 1–3 credits. S-U grades optional. A course of lectures selected by the faculty. Because topics usually change from year to year, this course may be repeated for credit.

BTRY 697 Individual Graduate Study in Biometry and Statistics (also STBTRY 697)
Fall, spring, or summer. 1–3 credits. S-U grades optional.
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 717 Linear and Generalized Linear Models (also STBTRY 717)
Spring. 3 credits. S-U grades optional. Prerequisites: BTRY 409, BTRY 417, and BTRY 602 or equivalents. Offered alternate years. Not offered 2003–2004.
Statistical modeling and inference using linear models and generalized linear models. Estimation by least squares, maximum likelihood, quasi-likelihood, and generalized estimating equations. Covers the use of link functions and generalized linear models to accommodate nonlinear models and non-normally distributed data. Also covers the use of random effects to accommodate correlation structures in both linear mixed models and generalized linear mixed models and to model longitudinal data. Some use of software packages and illustrative examples.]

BTRY 726 Problems and Perspectives in Computational Molecular Biology (also PL BR 726 and COM S 726)
Fall and spring. 1 credit. S-U grades only. Prerequisite: permission of instructor. Lec, M 1:25–2:15.
This is a weekly seminar series discussing timely topics of computational molecular biology. The course addresses methodological approaches to sequence annotation, protein structure and function relationships, evolutionary relationships across species. Statistical and deterministic computational approaches are covered and specific and detailed biological examples are discussed. Topics of interest are discussed in relation to papers prepared by teams of students and/or faculty. We pair students/faculty from biology backgrounds with students from math, computer science, and statistics for paper preparation. Students summarize the salient questions addressed by the paper, the research methods used and the results obtained. At the end of the presentation, questions should be listed on an overhead slide to initiate discussion in the group.

BTRY 795 Statistical Consulting (also STBTRY 795)
Fall and spring. 2–3 credits. Prerequisites or corequisites: BTRY 602 and BTRY 409 and permission of instructor. S-U grades optional. Lec, W 1:25–2:15.
Participation in the Department of Biological Statistics and Computational Biology consulting service: faculty-supervised statistical consulting with researchers from other

disciplines. Discussion sessions are held for joint consideration of literature and selected consultations encountered during previous weeks.

BTRY 798 Graduate Supervised Teaching (also STBTRY 798)
Fall and spring. 2–4 credits. S-U grades only. Permission of instructor and chair of special committee plus at least 2 advanced courses in statistics and biometry.
Students assist in teaching a course appropriate to their previous training. Students meet with a discussion section, prepare course materials, and assist in grading. Credit hours are determined in consultation with the instructor, depending on the level of teaching and the quality of work expected.

BTRY 800 Master's-Level Thesis Research
Fall or spring. Credit TBA. S-U grades only. Limited to candidates for graduate degrees. Prerequisite: permission of the graduate field member concerned.
Research at the M.S. level.

BTRY 900 Graduate-Level Dissertation Research
Fall or spring. Credit TBA. S-U grades only. Limited to candidates for graduate degrees. Prerequisite: permission of the graduate field member concerned.
Research at the Ph.D. level.

BTRY 901 Doctoral-Level Dissertation Research
Fall or spring. Credit TBA. S-U grades only.

COMMUNICATION

J. B. Walther, chair; K. Berggren, S. Conroe, R. D. Colle, B. O. Earle, G. Gay, D. A. Grossman, J. Hancock, J. Hayman, B. Lewenstein, J. Marston, K. McComas, R. E. Ostman, T. M. Russo, C. Scherer, D. Scheufele, J. Shanahan, M. A. Shapiro, L. VanBuskirk.

Note: class meeting times are accurate at the time of publication. If changes are necessary, the department will provide new information as soon as possible.

COMM 116 Communication in Social Relationships
Spring or summer. 3 credits. Spring: lecs, M W F 1:25–2:15. Staff.
An overview of current knowledge about communication, with particular emphasis on interpersonal communication. Introduction to a wide range of contemporary theories and research about effective communication in contexts such as friendships, small groups, organizations, and health care settings.

COMM 117 Writing about Communication
Spring. 3 credits. Concurrent enrollment in COMM 116 required. T R 10:10–11:25, 11:40–12:55, 1:25–2:40. L. VanBuskirk and staff.
Students develop skill in various writing styles and genres. The class explores communication practices and theories as they are observed and studied in personal and professional contexts. Assignments polish students' ability to gather information, to analyze information, to integrate ideas about communication, and to express those ideas clearly and cogently.

COMM 120 Contemporary Mass Communication
Fall or summer. Lecs, M W F 12:20–1:10. J. Shanahan.
The processes and effects of mass communication systems. Topics include the evolution of communication media, current knowledge about mediated communication, and the role of communication in contemporary social issues.

COMM 201 Oral Communication
Fall, spring, or summer. 3 credits. Each section limited to 20 students (fall and spring) or 15 students (summer). Preference given to sophomores, juniors, and seniors. Fluency in spoken English is assumed. Students missing the first two class meetings without university excuse are dropped so others may register. No student will be added or dropped after the second week of classes. K. Berggren, J. Marston, T. Russo, and staff.
Through theory and practice students develop self-confidence and competence in researching, organizing, and presenting material to audiences. Students give four graded speeches, write short papers, perform speaker evaluations, and engage in other speech-related activities.

COMM 203 Argumentation and Debate
Fall, spring, and summer. 3 credits. Fall: T R 11:40–12:55; spring: T R 11:40–12:55. J. Hayman.
Students learn the principles of argumentation and debate. Topics emphasize Internet database research, synthesis of collected data, analysis of evidentiary quality, refutation of counter claims, identification of logical fallacies, risk evaluation, framing of issues, and coherent storytelling. Students are prepared to work with a great range of opinion and evidence. The course emphasizes different viewpoints, including those of different cultures. Assumptions are questioned and interrogated.

COMM 230 Visual Communication
Spring. 3 credits. Lec 01, T R 9:05–9:55; lab T 2:30—4:25; W 10:10–12:05; 12:20–2:15, 2:30–4:25. C. Scherer.
An introduction to visual communication theory. The course examines how visuals influence our attention, perspectives, and understanding. Examples of visuals drawn from advertising, TV news, documentaries, entertainment movies, print, and interactive media are used to develop a theoretical framework for becoming more visually aware and for thinking more critically about how visuals influence us.

COMM 240 Introduction to Computer-Mediated Communication
Fall. 3 credits. T R 10:10–11:25. Staff.
Explores the nature of communication and how it is affected by technologies. Topics include a history of communication technologies and function, types of Internet communication systems, barriers and benefits, and descriptions of uses and impacts in cultural, professional, community, and personal social systems.

COMM 245 Psych and Social Computing
Spring. 3 credits. T R 10:10–11:25. J. Hancock.
Offers an in-depth examination of several social aspects of computing, drawing upon recent and classical social psychology and social cognition research. A small number of topics will be closely examined and may include impression formation/management, group behavior, deception and trust, and online relationships.

COMM 260 Science Writing for Public Information
Fall, spring, or summer. 3 credits. Limited to 25 nonfreshman or graduate students per section. Prerequisite: one college-level writing course. Fall: Lec 01, M W F 9:05–9:55, Lec 02, M W F 10:10–11:00; spring: Lec 01, M W F 9:05–9:55 or Lec 02, M W F 1:25–2:15. S. Conroe.
An intensive course in simplifying scientific and technical material for specific audiences within the general public. Weekly assignments include instructions, descriptions, explanations, and summaries in such formats as the newsletter, brochure, and report. Audience analysis is emphasized. Not oriented to the mass media.

COMM 263 Organizational Writing
Fall, spring, or summer. 3 credits. Limited to 25 junior, senior, or graduate students per section. Prerequisite: any college-level writing course. Fall: lec 01, M W F 9:05–9:55; lec 02, M W F 10:10–11:00; lec 03, M W F 11:15–12:05. Spring: lec 01, M W F 10:10–11:00, lec 02, M W F 11:15–12:05. L. VanBuskirk and staff.
Students write from the point of view of various organizations, including businesses, government agencies, and non-profit organizations. Emphasis is on appropriate representation of the writer's organization, audience analysis, and clear and effective written presentation of detailed content. Assignments include text for web sites, reports, proposals, memoranda, letters, and e-mail.

COMM 272 Principles of Public Relations and Advertising
Summer. 3 credits. Not open to freshmen. Staff.
Survey of the fields of public relations and advertising. Descriptions of organizations, jobs, and functions in the industry. The roles of public relations and advertising in society, the economic system, and organizations. Psychological and sociological principles as bases for appeals. Strategies for media selection and message execution. Introduction to research and regulation.

COMM 282 Communication Industry Research
Fall. 3 credits. Prerequisite: COMM 116, 120. Lec, M W F 1:25–2:15. D. Scheufele.
Public opinion polls, readership/viewership studies, audience segmentation techniques, and media and message effect evaluation are all widely used in communication industries. This course covers the use of basic research design, measurement, sampling, and simple descriptive statistics in conducting these studies.

COMM 284 Sex, Gender, and Communication
Fall. 3 credits. Not open to freshmen. T R 2:55–4:10. L. VanBuskirk.
The course explores the personal, career, social, and economic implications of gender categories. Topics considered include theories of gender construction, social structures, personal relationships, and gender concerns in the workplace.

COMM 285 Communication in Life Sciences (also S&TS 285)
Spring. 3 credits. M W F 10:10–11:05. B. Lewenstein.
Environmental problems, public health issues, scientific research—in each of these areas, communication plays a fundamental role. From the mass media to individual conversations, from technical journals to textbooks, from lab notes to the web, communication helps define social issues and research findings. This course examines the institutional and intellectual contexts, processes, and practical constraints on communication in the life sciences.

COMM 301 Business and Professional Speaking
Fall or spring. 3 credits. Prerequisite: COMM 201. Limited to second term sophomores, juniors, and seniors during fall and spring. Lec, M W 11:15–12:05; sec, T 12:20–2:15 and 2:30–4:25; W 1:25–3:20; R 10:10–12:05. B. Earle.
The study and practice of written and oral communication skills used in formal and informal organizations, including interviews, informative and persuasive speeches, reports, and discussions. Students exercise and enhance the organizational, analytical, and presentational skills needed in particular settings suited to their own business and professional careers.

COMM 303 Speech and Debate Practicum
Fall and spring. 2 credits. Limited to 10–15 Program in Speech and Debate members only; permission of instructor and completion of 1-year trial basis. J. Hayman.
Students learn preparation for practice in 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 eight credits.

COMM 345 Human-Computer Interaction Design
Spring. 3 credits. T R 10:10–11:25. G. Gay.
Covers key issues of the design of the interaction between computers and people. Students develop the ability to evaluate solutions to design problems and a familiarity with implementing HCI designs.

COMM 349 Media Technologies (also S&TS 349)
Spring. 3 credits. T R 2:55–4:10. T. Gillespie.
Commonplace notions of communication and media regularly overlook the role of the material technologies. Yet, how and why we communicate shape the technologies we design; those technologies shape our efforts to communicate and the consequences of those efforts. This course considers technologies of media as an opportunity to analyze the intersection of technology and its social context.

COMM 350 Writing for Magazines
Fall, spring, and summer. 3 credits. Prerequisite: any college-level writing course. Limited to 25 juniors, seniors, and graduate students, or others with permission of instructor. No drops after third week. Extensive out-of-class writing assignments. Fall: M 1:25–4:25. spring: lec, T R 8:40–9:55; lab, R 1:25–2:15. S. Conroe.
A course in nonfiction freelance writing for magazines. Intensive fact writing to help students communicate more effectively through the medium of the printed word in magazines. Art and techniques of good writing are studied; magazines in many fields of interest are reviewed. All articles are analyzed and returned to the student to rewrite and submit to a magazine.

COMM 352 Science Writing for the Mass Media (also S&TS 352)
Fall. 3 credits. Not open to freshmen. Limited to 24 students. Prerequisite: 1 college-level writing course. Lecs, M W 9:05–9:55; lab, W 12:20–2:15. B. Lewenstein.
How to write about science, technology, and medicine for the mass media. Discussion topics include accuracy, simplicity, comprehensiveness, risk communication, and the history and social structure of science. Writing assignments focus on writing news and feature stories for newspapers and magazines, with excursions into newsletters, radio, TV, and other media.

COMM 353 Science Writing Practicum
Spring. 1 credit. Prerequisite: COMM 260, COMM/S&TS 352, ENG 350, or permission of instructor. Offered even-numbered years. B. Lewenstein.
Students cover the annual meeting of the American Association for the Advancement of Science, held in February each year. Before the meeting, students review science writing techniques and issues. At the meeting, students meet with science writers and attend press conferences and scientific sessions. Students write at least two stories. Students are responsible for all costs of travel, lodging, and meals.

COMM 376 Planning Communication Campaigns
Spring. 3 credits. Prerequisites: COMM 282 or equivalent social research course (may be taken concurrently). T R 11:40–12:55. Staff.
This course provides a theoretical and practical overview of the audiences, messages, and evaluation of political and other types of communication campaigns. Emphasis is placed on political campaigns, but principles of campaign planning and evaluation relevant to other kinds of campaigns are stressed. Topics include campaign tactics and audience responses, audience segmentation, message construction, political advertising, agenda-setting, priming and framing in political campaigns, interrelationships between issues, framing of issues vs. content of issues, attitude-change, and audience behaviors. Common methods of data collections (focus groups, experiments, surveys, etc.) and analysis of campaign-related data sources are included.

COMM 382 Advanced Communication Research
Fall. 3 credits. Prerequisites: COMM 120, 282, may be restricted to honors students. TBA. Staff.
This course provides an advanced approach to data analysis and methods of data collection in communication research. It is intended for seniors who intend to complete an honors project or other advanced research. Every week we examine one or two research situations in greater detail, analyze specific problems connected to the method used, and discuss strategies for data analysis and presentation. This provides all students who graduate with distinction in research—independent of their specific thesis topic—with a more in-depth understanding of the methods used in communication research and how they are applied to concrete projects.

COMM 398 Issues in Teaching Communication
Fall and spring. 1 credit. Prerequisite: must be past or current undergraduate teaching assistant for COMM 201, 204, or 301. Alternate M 7:30–9:10 P.M. K. Berggren.
This seminar brings together novice educators to discuss ideas, experiences, and practice. Integration of theory into actual education efforts is challenging for professional educators. Novice teachers are not aware of their common experiences, much less of a theoretical component to education. In discussions of actual teaching experiences, literature reviews, research reports, textbook chapters, curriculum, and evaluation tools, students examine new ideas and practices. The primary goal of the seminar is to enrich and deepen the novice teaching experience.

COMM 405 Community Service Practicum
Fall and spring. 2 credits. May be repeated for credit. Limited to 10–15 Program in Speech and Debate members; permission of instructor required. TBA. J. Hayman.
Students share their communication talents in structured experiences in which they design and implement a speech or debate project in local schools or the community.

[COMM 410 Organizational Communication: Theory and Practice
Not offered 2003–2004.]

COMM 418 Communication and Persuasion
Spring. 3 credits. Limited to juniors and seniors only. Prerequisite: COMM 282 or equivalent social science research methods course; and COMM 116 and 120 or introductory psychology or social psychology. T R 10:10–11:40. Staff.
Focuses on persuasion and attitude change. Students become familiar with a variety of social-psychological theories of attitude change and persuasion. These theories are applied to a variety of communication situations, including mass communication, advertising, public relations, public information, and interpersonal communication. Lectures concurrent with COMM 618; graduate students should enroll in COMM 618.

COMM 420 Public Opinion and Social Processes
Fall. 3 credits. M W 2:55–4:10. D. Scheufele.
Provides an overview of the concept of "public opinion" and its implications for macrosocial processes—from both a scientific and an applied angle. The course examines the historical development of the concept in fields such as political science, social psychology, and communication science, and then takes a closer look at what we mean by "measuring" public opinion. Are we talking about merely summing across individual opinions, or are there macro-level dynamics of public opinion that go beyond what individuals in a society think? Based on this more theoretical work, we will focus on the importance of public opinion and public opinion perception for different aspects of

democratic societies, such as policymaking, risk perceptions, or political participation.

COMM 421 Communication and the Environment

Spring. 3 credits. Lec, T R 10:10–11:25. Offered even-numbered years. J. Shanahan.

Students investigate how values, attitudes, social structure, and communication affect public perceptions of environmental risk and public opinion about the environment. A primary focus is mass media's impact on public perceptions of the environment, how the media portray the environment, and discussion of the implications of public consumption of environmental content.

COMM 422 Psychology of Television (and Beyond)

Fall. 3 credits. Prerequisites: introductory psychology or HDFS or COMM 120 or COMM 116. Lec, M W F 12:20–1:10. Sec 01: T 11:15–12:05, Sec 02: W 1:25–2:15, Sec 03: W 2:30–3:20, Sec 04: R 1:25–2:15. M. Shapiro.

A survey of knowledge about how people mentally process television and other audio-visual communication technologies—including movies, video games, virtual reality, and the Internet. Topics include: why people watch, what happens mentally when they watch, how people understand and mentally process media, and how media psychologically influence beliefs, attitudes, thinking, and emotion.

COMM 424 Communication in the Developing Nations

Fall. 3 credits. Limited to juniors and seniors. Lec, T 1:25–2:35; lab T 2:35–4:25. R. Colle.

The role of communication in development programs, particularly in the Third World. Emphasis is on communication interventions in agriculture, health, nutrition, family planning, and community development and especially on methods for designing communication strategies for reaching low-income, rural people. Among the approaches considered are extension, social marketing, and development support communication. Lectures concurrent with COMM 624; graduate students should enroll in COMM 624.

COMM 428 Communication Law

Spring. 3 credits. Limited to junior, senior, and graduate students; others by permission of the instructor. Lec, M W F 11:15–12:20. D. Grossman.

This course deals with the law governing communication media. Topics covered include First Amendment concepts, restraints on newsgathering and dissemination, libel, invasion of privacy, copyright protection, regulation of broadcast and nonbroadcast electronic media, advertising law, and current legal issues unique to online communication.

COMM 440 Advanced Human-Computer Interaction Design

Fall. 3 credits. T R 10:10–11:25. G. Gay.

Focuses on the design of computer interfaces and software from the user's point of view. The goal is to teach user interface designs that "serve human needs" while building feelings of competence, confidence, and satisfaction. Topics include formal models of people and interactions, collaborative design issues, psychological and philosophical design considerations, and cultural and social issues.

COMM 445 Seminar in Computer-Mediated Communication

Spring. 3 credits. Prerequisites: COMM 240 or 245. T R 11:40–12:55. J. Walther.

Focuses on reading and evaluating the theories and research methodologies used to investigate communication via computer systems. Assignments include student collaborations using electronic conferencing and other advanced communication technologies, as well as reflections on and evaluations of these collaborations in light of current theories and research findings. Topics include virtual teams, videoconferencing, and others as they emerge.

COMM 450 Language and Technology

Fall. 3 credits. T R 11:40–12:55. J. Hancock.

Examines how new communication technologies affect the way we produce and understand language and modify interaction with one another. Attention will focus on the collaborative nature of language use and how Internet technologies affect the joint activities of speakers and listeners during the construction of meaning in conversation.

COMM 466 Public Communication of Science and Technology (also S&TS 466)

Fall. 3 credits. Limited to 15 students. Prerequisite: COMM 352 or 360, or ENGR 350, or permission of instructor. Offered even numbered years. M W 2:55–4:10. B. Lewenstein.

Explore the structure, meanings, and implications of "public communication of science and technology" (PCST). Examine the contexts in which PCST occurs, look at motivations and constraints of those involved in producing information about science for nonprofessional audiences, and analyze the functions of PCST. Tie existing ideas about PCST to general communication research, and learn how to develop new knowledge about PCST. Course format is primarily seminar/discussion.

COMM 476 Communication Fellows Program

Spring. 2 credits. Prerequisites: permission of instructor; limited to communication seniors selected based on goals and academic preparation. M 2:55–4:10. B. O. Earle.

A series of lectures, seminars, and guest speakers exploring the planning, evaluation, and policy-making process. Includes a three-day trip to a metropolitan area to visit corporate leaders, administrative agencies, and policymakers. Fee of $150.00 charged.

COMM 480 Independent Honors Research in Social Science

Fall or spring. 1–6 credits. Limited to undergraduates who have met the requirements for the honors program. TBA. D. Scheufele.

Students who have successfully completed 382 will register for no more than 3 credits. Students who have not completed an advanced research methods course may register for up to 6 credit hours.

COMM 486 Risk Communication

Spring. 3 credits. T R 1:25–2:15; lab R 2:30–4:25. C. Scherer.

An examination of theory and research related to the communication of scientific information about environmental, agricultural, food, health, and nutritional risks. Course concentrates on social theories related to risk perception and behavior. Case studies involving pesticide residues, waste management, water quality, environmental hazards, and personal health behaviors are examined. Emphasis is placed on understanding, applying, and developing theories of risk communication. Lectures concurrent with COMM 686; graduate students should enroll in COMM 686.

COMM 494 Special Topics in Communication

Fall, spring, or summer. 1–3 credits variable. S-U grades optional. Prerequisite: permission of instructor.

Study of topics in communication not otherwise provided by a department course and determined by the interest of the faculty and students.

COMM 496 Communication Internship

2 credits (sec. 1) or 1 credit (sec. 2) K. Berggren.

Students who register for section 1 will receive a structured, on-the-job learning experience under the supervision of communication professionals in a cooperating organization. Requirements include mandatory participation in two pre-internship symposiums (spring semester; will receive an "R" grade) and two post-internship discussions (fall semester) plus a minimum of 120 hours of work experience in communication (summer or fall) and a final paper that analyzes the work experience according to communication theories. The preparatory symposiums and summary evaluation sessions may be done by distance education if necessary. The preliminary symposiums may be taken by students who are still seeking a specific internship. Students may register in a subsequent semester for one additional hour (section 2) for an internship with an organization that requires interns to receive academic credit. 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 for section 2. All internships must be approved prior to the work experience segment by the internship coordinator.

COMM 497 Individual Study in Communication

Fall or spring. 1–3 credits; may be repeated to 6 credits with a different supervising faculty member. Prerequisite: 3.0 cumulative average. Students must register with an Independent Study form (available in 140 Roberts Hall).

Individual study under faculty supervision. Work should concentrate on locating, assimilating, synthesizing, and reporting existing knowledge on a selected topic. Attempts to implement this knowledge in a practical application are desirable.

COMM 498 Communication Teaching Experience

Fall or spring. 1–3 credits; may be repeated to 6 credits with different courses. **Limited to juniors and seniors.** Intended for undergraduates desiring classroom teaching experience. Prerequisite: 3.0 cumulative average (2.7 if teaching assistant for a skill development course) and permission of the faculty member who will supervise the work and assign the grade. Students must register

with an Independent Study form (available in 140 Roberts Hall).

Periodic meetings with the instructor cover realization of course objectives, evaluation of teaching methods, and student feedback. In addition to aiding with the actual instruction, each student prepares a paper on some aspect of the course.

COMM 499 Independent Research

Fall or spring. 1–3 credits; may be repeated to 6 credits. Limited to seniors and graduate students. Prerequisite: 3.0 cumulative average. Students must register with an 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 510 Organizational Communication: Theory and Practice

Not offered 2003–2004.]

COMM 540 Impact of Information Technology

Spring. 3 credits. Prerequisite: permission of instructor. Letter grade only. T R 1:25–2:40. G. Gay.

The collection, management, analysis, and representation of data are increasingly mediated through electronic tools. This course examines a range of approaches and tools, including Internet-based data collection, tracking, digital video interaction analysis, information visualization, eyetracking, and analysis. Students also examine social and ethical implications and concerns. Readings range from classic papers in cognitive science, social psychology, film theory, and anthropology to recent studies of the sociology of online communities.

[COMM 610 Seminar in Communication and Social Networks

Not offered 2003–2004.]

COMM 618 Communication and Persuasion

Spring. 3 credits. Prerequisite: introductory research methods course and introductory psychology or social psychology course. T R 10:10–11:25. Staff.

The course focuses on theories of communication's influence on persuasion and attitude change. Students become familiar with a variety of social-psychological theories of attitude change and persuasion. Those theories are also applied to a variety of communication situations including mass communication, advertising, public relations/ public information, and interpersonal communication. Lectures concurrent with COMM 418; graduate students should enroll in COMM 618.

COMM 620 Public Opinion and Social Processes

Fall. 3 credits. T R 10:10–11:25. D. Scheufele.

The course provides an overview of the theoretical and applied literature related to the concept "public opinion." Students investigate how public opinion is perceived and acted upon by society. Relationships between public opinion, communcation, and social psychological variables are examined. Public opinion is studied using current theoretical and practical applications. Analysis and interpretation of public opinion polls and trends in public opinion on specific issues. Lectures concurrent with COMM 420; graduate students should enroll in COMM 620.

COMM 621 Advanced Communication and the Environment

Spring. 3 credits. T R 10:10–11:25. Offered even-numbered years. J. Shanahan.

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 622 Advanced Psychology of Television (and Beyond)

Fall. 3 credits. Prerequisites: graduate student status and permission of instructor. TBA. M. Shapiro.

A survey of knowledge about how people mentally process television and other audio-visual communication technologies—including movies, video games, virtual reality, and the Internet. Topics include: why people watch, what happens mentally when they watch, how people understand and mentally process media, and how media psychologically influence beliefs, attitudes, thinking, and emotion.

COMM 624 Communication in the Developing Nations

Fall. 3 credits. Open to juniors, seniors, and graduate students. Lec, T 1:25–2:35; lab, T 2:30–4:25. R. D. Colle.

The role of communication in development programs, particularly in Third World nations. Emphasis is on communication interventions in agriculture, health, nutrition, family planning, and community development, and especially on methods for designing communication strategies for reaching low-income, rural people. Among the approaches considered are extension, social marketing, and development support communication. Lectures concurrent with COMM 424; graduate students should enroll in COMM 624.

COMM 640 Human Computer Interaction Design

Fall. 3 credits. Prerequisites: graduate standing or permission of instructor. T R 10:10–11:25. G. Gay.

Graduate-level readings and research supplementing COMM 440. This course focuses on the design of computer interfaces and software from the user's point of view. The goal is to teach user interface designs that "serve human needs" while building feelings of competence, confidence, and satisfaction. Topics include formal models of people and interactions, collaborative design issues, psychological and philosophical design considerations, and cultural and social issues.

COMM 645 CMC Graduate Seminar

Spring. 3 credits. Prerequisites: graduate standing or permission of instructor. J. Walther.

Graduate-level readings and research supplementing COMM 445. Through close reading and research in communication and technology, and participation in projects using these technologies, students enhance experiential, theoretical, and critical understanding of contemporary computer-mediated communication systems and uses. Topics include virtual teams, videoconferencing, and others.

COMM 650 Language and Technology

Fall. 3 credits. T R 11:40–12:55. J. Hancock.

Graduate-level readings and research supplementing COMM 450. The course examines how new communication technologies affect the way we produce and understand language and modify interaction with one another. Attention will focus on the collaborative nature of language use and how Internet technologies affect the joint activities of speakers and listeners during the construction of meaning in conversation.

[COMM 676 Communication Planning for Social and Behavioral Change

Spring. 3 credits. T R 10:10–11:25. Not offered 2003–2004. Staff.]

COMM 680 Studies in Communication

Fall. 3 credits. Limited to graduate students in communication; others by permission of instructor. M W 8:40–9:55. J. Shanahan.

A review of classical and contemporary readings in communication, including key concepts and areas of investigation. An exploration of the scope of the field, the interrelationships of its various branches, and an examination of the role of theory in the research process.

COMM 681 Advanced Communication Theory

Spring. 4 credits. Offered odd-numbered years. Prerequisite: COMM 680 or graduate standing and permission of instructor. M W 2:55–4:10 with additional meetings TBA. M. Shapiro.

Development of, and contemporary issues in, communication theory. Discussion includes the interaction between communication and society, social groupings, and mental processing.

COMM 682 Methods of Communication Research

Spring. 3 credits. Lec, M W F 12:20. D. Scheufele.

An analysis of the methods used in communication research. Emphasis is on understanding the rationale for survey, textual, experimental, and ethnographic research methods. Development of class research project from research question to final report. Computer use of Statistical Package for the Social Sciences (SPSS) to assist in data analysis. Familiarity with basic statistical concepts helpful.

[COMM 683 Qualitative Research Methods in Communication

Not offered 2003–2004.]

COMM 686 Risk Communication

Spring. 3 credits. T R 1:25–2:15, lab R 2:30–4:25. C. Scherer.

An examination of theory and research related to the communication of scientific information about environmental, agricultural, food, health, and nutritional risks. Course concentrates on social theories related to risk perception and behavior. Case studies involving pesticide residues, waste manage-ment, water quality, environmental hazards, and personal health behaviors are examined. Emphasis is placed on understanding, applying, and developing theories of risk communication. Lectures concurrent with COMM 486; graduate students should enroll in COMM 686.

COMM 691 Seminar: Topics in Communication
Fall and spring. No credit. S-U grades only. Staff.
Some weeks scholars from a wide variety of fields present varied topics in theory or research as it relates to communication; other weeks graduate students present thesis (project) proposals to faculty and peers.

COMM 694 Special Topics in Communication
Fall, spring, or summer. 1–3 credits variable. S-U grades optional. Prerequisite: permission of instructor. Staff.
Study of topics in communication not otherwise provided by a department course and determined by the interest of the faculty and students.

[COMM 781 Seminar in Psychology of Communication
Spring. 3 credits. Letter grade. Prerequisite: COMM 680 and 681 or equivalent graduate level theory in psychology or social psychology. Offered odd-numbered years. Not offered 2003–2004. M. Shapiro.
Discussion and analysis of selected current issues in the psychology of communication. Students discuss and synthesize current research and theory in the mental processing of communication.]

COMM 794 Seminar in Communication Issues
Fall, spring, or summer. 1–3 credits. Letter grade only. Prerequisite: permission of instructor.
Small group study of topical issue(s) in communication not otherwise examined in a graduate field course.

COMM 797 Graduate Independent Study
Fall, spring, or summer. 1–3 credits. Letter grade only. Prerequisite: permission of instructor.
Individual study concentrating on locating, assimilating, synthesizing, and reporting existing knowledge on a selected topic.

COMM 798 Communication Teaching Laboratory
Fall and spring. 1–3 credits each semester. Letter grade only. May be repeated once. Limited to graduate students. Prerequisite: permission of the faculty member who will supervise the work and assign the grade. Students must use the 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 799 Graduate Research
Fall, spring, or summer. 1–3 credits. Letter grade only. 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 800 Master's-Level Thesis Research
Fall or spring. 1–6 credits. May be repeated for a maximum of 6 credits. S-U grades only. Prerequisite: permission of committee chair.
Thesis research for Master of Science (Communication) students.

COMM 901 Doctoral-Level Dissertation Research
Fall or spring. 1–9 credits. May be repeated for a maximum of 9 credits. S-U grades only. Prerequisites: completion of "A" exam; permission of committee chair.
Dissertation research for doctoral candidates.

CROP AND SOIL SCIENCES

S. D. DeGloria, chair; M. Alexander, P. C. Baveye, D. R. Bouldin, R. B. Bryant, J. H. Cherney, A. Comis, W. J. Cox, A. DiTommaso, J. M. Duxbury, E. C. Fernandes, G. W. Fick, D. L. Grunes, R. R. Hahn, Q. Ketterings, L. V. Kochian, T. A. LaRue, J. Lehmann, M. B. McBride, J. Mt. Pleasant, R. L. Obendorf, W. D. Pardee, W. S. Reid, S. J. Riha, T. W. Scott, T. L. Setter, J. E. Thies, H. M. van Es, A. Van Wambeke, R. M. Welch

Note: class meeting times are accurate at the time of publication. If changes are necessary, the department will provide new information as soon as possible.

Courses by Subject

Crop Science: 311, 312, 314, 315, 317, 415, 444, 455, 608, 610, 612, 613, 614, 642, 691, 820, 920, 921

Environmental Information Science: 398, 410, 411, 420, 465, 485, 620, 660, 675, 694, 860, 960, 961

Soil Science: 260, 321, 362, 363, 365, 372, 373, 412, 466, 471, 472, 473, 483, 621, 663, 666, 667, 669, 671, 672, 693, 880, 980, 981

All following Crop and Soil Sciences course prefixes were previously listed as SCAS.

General Courses

CSS 190 Sustainable Agriculture (also HORT 190)
Fall. Credits variable, 2 or 3. Limited to 60 students. S-U grades optional. Lec, R 10:10; labs, M T 2:00–4:25. C. J. Peters and J. Mt Pleasant.
This course is designed to be an enjoyable introduction to basic food production resources (soils, crops, and climates), and it emphasizes scientific principals of management that conserve or renew those resources for continuing benefit to society. The information is of general value for nonmajors and students new to the field. Laboratories include several field trips and stress hands-on experience with soils, crops, and descriptive climatology. Written assignments are prepared for the web. Extra credit can be earned by participation in team preparation and delivery of a lesson in sustainable agriculture.

CSS 494 Special Topics in Crop and Soil Sciences (undergraduate level)
Fall or spring. 4 credits maximum. S-U grades optional.
The department teaches "trial" courses under this number. Offerings vary by semester, and are advertised by the department before the semester begins. Courses offered under this number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

CSS 497 Individual Study in Crop and Soil Sciences
Fall or spring. 1–6 credits. S-U grades optional. Students must register with an Independent Study form (available in 140 Roberts Hall).
The topics in soil science, crop science, or environmental information science are arranged at the beginning of the term for individual study or for group discussions.

CSS 498 Teaching Experience in Crop and Soil Sciences
Fall or spring. 1–5 credits. Students must register with an Independent Study form (available in 140 Roberts Hall). S-U grades optional.
Teaching experience in soil science, crop science, or environmental information science is obtained by assisting in the instruction of a departmental course.

CSS 499 Undergraduate Research
Fall or spring. Credit TBA. Students must register with an Independent Study form (available in 140 Roberts Hall). S-U grades optional.
Independent research on current problems selected from any phase of crop science or soil science.

[CSS 695 Planning and Reporting Research
Spring. 2 credits. First meeting the first T of the semester in 102 Bradfield. Next offered spring 2005. G. W. Fick.
New graduate students and students starting to write their theses have found this course very helpful. Topics covered include scientific writing, reviewing, seminar presentations, and poster presentations. The nature of science and the scientific method are also discussed along with professional ethics in the conduct and communication of science.]

CSS 696 Seminar in Crop and Soil Sciences
Fall and spring. 1 credit. S-U grades only. Lec, T 3:30–4:30. Staff.
Seminars cover current research and selected topics in the crop and soil sciences and related fields.

Crop Science

CSS 311 Grains and Nutriceuticals
Fall. 4 credits. Prerequisite: CSS 260 or BIOPL 241. Lecs, M W F 10:10; lab, M 1:25–4:25. 1 or 2 field trips during lab periods (until 5 P.M. or on weekends). R. L. Obendorf.
Globally, six seed crops provide 75 percent of the caloric and protein needs of mankind by direct consumption or indirectly through animal and microbial products. Seed crops for starch, protein, oil, fiber, sugar, nutriceutical, pharmaceutical, and industrial uses are emphasized, including adaptation, growth and development, environmental stress, optimization of yield and quality, and genetic improvement in the context of food systems for improved health. Laboratory uses living plants, extensive crop garden, and computer simulation.

[CSS 312 Forage Crops
Spring. 4 credits. Prerequisites: introductory course in crop and/or soil science. Recommended: course in animal nutrition. Lecs, M W F 11:15; lab, M or W 1:25–4:25. Next offered spring 2005. G. W. Fick.
The production and management of crops used for livestock feed are considered in terms of establishment, growth, maintenance, harvesting, and preservation. Forage grasses, forage legumes, and corn are emphasized, and consideration is given to their value as livestock feed in terms of energy, protein, and other nutritional components.]

CSS 314 Tropical Cropping Systems: Biodiversity, Social, and Environmental Impacts (also INTAG 314)
Fall. 3 credits. Prerequisite: an introductory course in crop science or soil science or biology or permission of instructor. Lec, T R 8:40–9:55. E. C. Fernandes.
Characterization and discussion of: traditional shifting cultivation; lowland rice-based systems; upland cereal-based systems; smallholder mixed farming including root crops and livestock; plantation fruit and oil crop systems; and agroforestry. In addition to species diversity and domestication, factors such as climate, land quality, soil management, land tenure, labor, and markets are considered. The impact of tropical cropping systems on the environment are evaluated.

CSS 315 Weed Science
Fall. 4 credits. Prerequisite: introductory course in biology or botany. Lecs, T R 10:10–11:25; lab, T or W 2:00–4:25. A. DiTommaso.
Principles of weed science are examined. Emphasis is on: (a) weed biology and ecology; (b) chemistry of herbicides in relation to effects on plant growth and the environment; and (c) current management strategies that are relevant to both crop and noncrop ecosystems. Hands-on laboratory sessions cover weed identification and ecology, and herbicide selectivity and symptomology.

CSS 317 Seed Science and Technology (also HORT 317)
Fall. 3 credits. Prerequisite: BIOPL 241 or equivalent. Lecs, T R 11:15–12:05; lab, R. Two all-day field trips will be scheduled during the semester. Offered alternate years. 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 415 Principles and Practices of Agroforestry (also NTRES 415 and HORT 415)
Fall. 3 credits. Prerequisites: senior or graduate standing or permission of instructor. S-U option. Lec, M W F 10:10–11:00. Optional laboratory, CSS [SCAS] 416 (also NTRES 416 and HORT 416). E. Fernandes, K. Mudge, L. Buck, J. Lassoie.
An introduction to modern and traditional agroforestry systems that involves spatial or temporal integration of multipurpose woody plants (trees and/or shrubs) with annual or perennial crops and/or with livestock. Interactions between woody and nonwoody components of agroforestry systems are considered, based on above- and below-ground processes. The sustainability of agroforestry systems is critically examined from biophysical, socio-economic, and policy perspectives.

CSS 416 Principles and Practices of Agroforesty—Laboratory (also NTRES 416 and HORT 416)
Fall. 1 credit. Optional lab component of HORT 415 (also NTRES and CCS [SCAS]). S-U grades optional. Prerequisites: junior, senior, or graduate standing or permission of instructor; prior or concurrent enrollment in HORT 415. W 1:25–4:25. K. Mudge, E. Fernandes, L. Buck, J. Lassoie.
An integrated set of laboratory and field exercises designed to develop competency in diagnostic and management skills applied to agroforestry practice. Sessions include field trips to local practitioners as well as working demonstration farms and forests, case study design and analysis, use of computer-based sources of information, and practical skills with woody plants including identification, propagation, planting, pruning, and measurement.

CSS 444 Integrated Pest Management (also ENTOM 444)
Fall. 4 credits. Prerequisites: BIOEE 261, ENTOM 212 or 241, and PL PA 241 or their equivalents or permission of instructor. Lecs, M W F 9:05; labs, M 1:25–4:25. J. E. Losey and A. DiTommaso.
Lectures integrate the principles of pest control, ecology, and economics in the management of pests across multiple systems. Laboratories consist of exercises to reinforce concepts presented in lecture and demonstrate pest monitoring techniques and the application of computer technology to management problems.

CSS 455 Mineral Nutrition of Crops and Landscape Plants (also HORT 455)
Spring. 3–5 credits. Prerequisite: CSS 260 and BIOPL 242, or equivalent. Lecs, M W F 9:05; lab, R 1:30–4:00. Offered alternate years. H. C. Wien and staff.
A modular course on principles of plant mineral nutrition and nutrient management. A mandatory module on principles is followed by others on agronomic crops, vegetables, floriculture, and fruit crops. Each module carries one credit; a minimum of three credits must be taken in one semester. By the end of the course, students understand the principles of mineral nutrient function in crop plants, and are able to diagnose deficiencies by symptoms and tissue tests and devise organic and conventional nutrient management schemes that maximize productivity and mineral nutrient quality.

CSS 608 Water Status in Plants and Soils
Fall. 1 credit. Prerequisite: permission of instructor. S-U grades only. Lec, 1 hour TBA; lab 1:25–4:25, first class meeting R. Offered alternate years. T. L. Setter.
Covers techniques for field appraisal of the status of water in plants and soil, including methods used in physiological studies, such as the psychrometer, pressure chamber, gas exchange analyzer, and abscisic acid analysis with ELISA.

[CSS 610 Physiology of Environmental Stresses
Fall. 3 credits. Prerequisite: plant physiology, BIOPL 242 or 341, or permission of instructor. Offered even years. Lecs, T R 10:10–11:25. Next offered 2004. T. L. Setter.
A study of the responses of plants to environmental stresses, including chilling, freezing, high temperature, salinity, drought, hypoxia, and toxic elements. Emphasis is on the physiological and biochemical basis of injury and plant resistance mechanisms at the whole-plant, cellular, and molecular levels.]

[CSS 612 Seed Physiology and Biotechnology
Spring. 3 credits. Prerequisite: plant physiology. Next offered spring 2005. T R 8:30–9:55. R. L. Obendorf.
This course in seed biology describes the molecular, biochemical, physiological, environmental, and genetic regulation of seed development, maturation, and germination events including the deposition and mobilization of seed reserves with illustrations from the world's major food and feed seeds. Illustrations extend the principles to practical situations, industrial uses, and food systems for improved health.]

CSS 613 Physiology and Ecology of Yield
Spring. 3 credits. Prerequisite: plant physiology. M W F 12:20–1:00. T. L. Setter.
A study of environmental constraints on crop-plant productivity from an eco-physiological perspective. Acclimation responses and genetic adaptation are examined for temperature, light, water, compacted soil, and mineral nutrient environments. Topics include: photosynthesis and nitrogen assimilation, translocation, and partitioning; canopy-scale influences on solar radiation use efficiency; regulation of growth processes in leaf, root, and floral sinks in response to environment; seed set; water transport and stomatal regulation; root growth in flooded and compacted soils; and drought responses. Emphasis is on growth processes of vegetative plant organs.

[CSS 614 Weed Ecology and Management
Spring. 3 credits. Prerequisite: CSS 315 or equivalent. Lec, T R 10:10–11:25. Offered alternate years. Next offered spring 2005. A. DiTommaso.
An examination of plant ecological principles governing weed population dynamics and weed-crop competitive interactions in different crop and noncrop ecosystems. Application of these fundamentals for the development and implementation of environmentally sound and sustainable integrated weed management strategies is explored. Topics include seed biology and seedbank dynamics, weed demography and spatial variation, weed-crop interferences, bio-economic weed thresholds, and site-specific weed management.]

[CSS 642 Plant Mineral Nutrition (also BIO PL 642)
Spring. 3 credits. Prerequisite: BIO PL 341 or equivalent. Lecs, M W F 10:10–11:00. Offered alternate years. L. V. Kochian, R. M. Welch.
A detailed study of the processes by which plants acquire and utilize mineral nutrients from the soil. Topics include the uptake, translocation, and compartmentation of mineral elements; root-soil interactions; metabolism of mineral elements; the

involvement of mineral nutrients in various physiological processes; and nutrition of plants adapted to extreme environmental stresses (e.g., acid soils). Specific mineral elements are emphasized to illustrate the above topics.]

CSS 691 Special Topics in Crop Science
Fall or spring. 1–6 credits. S-U grades optional. Staff.
Study of topics in crop science that are more specialized or different from other courses. Special topics to be offered depend on staff and student interests.

CSS 820 Master's-Level Thesis Research in Crop Science
Fall or spring. Credit by arrangement. S-U grades only. Hours by arrangement. Graduate faculty.
Limited to students specifically in a master's program.

CSS 920 Graduate-Level Thesis Research in Crop Science
Fall or spring. Credit by arrangement. S-U grades only. Hours by arrangement. Graduate faculty.
Limited to students in a Ph.D. program **only before** the "A" exam has been passed.

CSS 921 Doctoral-Level Dissertation Research in Crop Science
Fall or spring. Credit by arrangement. S-U grades only. Hours by arrangement. Graduate faculty.
Limited to students admitted for candidacy **after** the "A" exam has been passed.

Environmental Information Science

CSS 398 Environmental Microbiology (also BIOMI 397)
Fall. 3 credits. Prerequisite: BIOES 261 or BIOMI 290 or CSS (SCAS) 260 or permission of instructor. Lecs, M W F 10:10–11:00. W. C. Ghiorse.
The biology, behavior, and function of microorganisms in natural environments are discussed in relation to past and present environmental conditions on Earth. The role of microorganisms in ecologically and environmentally significant processes is also considered through discussion of specific topics such as elemental cycles, nutrient cycling, transformation of pollutant chemicals, wastewater treatment, and environmental biotechnology.

CSS 410 Environmental Impact of Agricultural Biotechnology
Spring. 3 credits. Prerequisite: BIO G 109 or equivalent. Lec, M W 1:25–2:15; lab, W 2:30–4:25. Staff.
Outlines how changes in agricultural practice associated with the introduction of genetically modified (GM) crops might impact the environment. Current knowledge of the different kinds of environmental problems caused by some GM crops will be discussed, as well as the principles and questions that have emerged from studies of environmental impact so far.

CSS 411 Resource Inventory Methods (also CEE 411)
Spring. 3 credits. Prerequisite: permission of instructor. Lec, M W 9:05–9:55; lab, M R 1:25–4:25. A. Lembo.
A survey of resource inventory methods applied to field-based studies of environmental systems. Laboratory emphasis is on using maps, spatial databases, global positioning systems, and aerospace imagery to discriminate, measure, inventory, and monitor environmental resources.

CSS 420 Geographic Information Systems
Fall. 4 credits. Prerequisite: CSS (SCAS) 411 or permission of instructor. Lecs, T R 9:05–9:55; lab, T 10:10–1:10; M W R F 1:25–4:25. A. Lembo.
Principles and applications of geographic information systems for the characterization and assessment of agronomic and environmental resources. Methods for accessing, updating, analyzing, and mapping spatial data and information are emphasized. Needs assessment, coordinate systems, database design and maintenance, data transformations, and map accuracy assessment are considered.

CSS 465 Global Positioning System
Fall and spring. 1 credit. Prerequisite: CSS 411 or CSS 420, or equivalent, or consent of instructor. Lec, F 9:05–12:05. A. Lembo.
Introduction to navigation-grade GPS instruments used in agricultural and environmental science. Topics include instrument familiarization; field-data collection and processing; real-time and post-differential correction; and GPS-GIS integration.

CSS 485 Problem Solving in Environmental and Agroecosystem Science
Fall. 4 credits. Prerequisite: CSS 260 or equivalent. Limited to seniors. Lec, 1st meeting F 1:25; lab, at least one 4-hour afternoon per week plus additional time as needed. P. Baveye.
Capstone experience for seniors, centering on the pluridisciplinary analysis of a specific problem (e.g., heavy metal contamination of Cornell orchard in fall 2003), with a number of faculty members serving as technical resources and lecturing as needed. This course involves field trips, in-depth discussions of data assembled prior to the course, gathering of relevant scientific information (in groups), and report writing. Students will be expected to work approximately 15 hours per week on a range of assignments. The course is conceived as the first of a sequence of two complementary courses, but it can be taken alone.

CSS 486 Problem Solving in Environmental and Agroecosystem Science II
Spring. 4 credits. Prerequisite: CSS 485. Limited to seniors. Lec, TBA; lab, at least one 4-hour afternoon per week plus additional time as needed. P. Baveye.
Capstone experience for seniors, in continuation of CSS 485. Students work in groups to carry out the laboratory measurements identified in the fall, with faculty members serving as technical support and lecturing as needed. Students are expected to work approximately 15 hours per week on a range of laboratory measurements. The results of these measurements are discussed as they become available and are combined with the rest of the assembled information to come up with recommendations about the management of the targeted problem (e.g., in spring 2004, heavy metals in Cornell orchard).

CSS 620 Spatial Modeling and Analysis
Spring. 3 credits. Prerequisites: CSS (SCAS) 420, CSS (SCAS) 461, or permission of instructor. Lecs, T R 9:05–9:55; lab, T W 1:25–4:25. A. Lembo.
Theory and practice in the development, integration, and visualization of spatial data for resource inventory, environmental process modeling, land classification, and evaluation. Application and evaluation of advanced spatial analytical methods applied to environmental systems and databases of interest to the student are emphasized.

CSS 660 Remote Sensing Fundamentals (also CEE 610)
Fall. 3 credits. Prerequisite: permission of instructor. Lecs, M W F 12:20–1:15; lab, F 12:20–1:25, 1:25–2:30, 2:30–4:25. W. D. Philpot.
An introduction to equipment and methods used in obtaining information about earth resources and the environment from aircraft or satellite. Coverage includes sensors, sensor and ground-data acquisition, data analysis and interpretation, and project design.

CSS 675 Modeling the Soil-Plant-Atmosphere System (also EAS 675)
Spring. 3 credits. Prerequisite: CSS (SCAS) 483 or equivalent. Offered alternate years. Lecs, T R 8:40–9:55. S. J. Riha.
Introduction to the structure and use of soil-plant-atmosphere models. Topics covered 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. Use of soil-plant-atmosphere models for teaching, research, extension, and policy formation are discussed.

CSS 694 Special Topics in Environmental Information Science
Fall or spring. 1–6 credits. S-U grades optional. Staff.
Study of topics in environmental science that are more specialized or different from other courses. Special topics to be covered will depend on staff and student interests.

CSS 860 Master's-Level Thesis Research in Environmental Information Science
Fall or spring. Credit by arrangement. S-U grades only. Graduate faculty.
Limited to students specifically in a master's program.

CSS 960 Graduate-Level Dissertation Research in Environmental Information Science
Fall or spring. Credit by arrangement. S-U grades only. Hours by arrangement. Graduate faculty.
Limited to students in a Ph.D. program **only before** the "A" exam has been passed.

CSS 961 Doctoral-Level Dissertation Research in Environmental Information Science
Fall or spring. Credit by arrangement. S-U grades only. Hours by arrangement. Graduate faculty.
Limited to students admitted to candidacy **after** the "A" exam has been passed.

Soil Science

CSS 260 Soil Science (also EAS 260)
Fall. 4 credits. S-U grades optional. Lecs, M W F 9:05; lab, M T W or R 1:25–4:25. S. Riha.
Designed for students interested in a comprehensive introduction to soil science from both an environmental and plant management perspective, this course is divided into three units. A unit on soil information introduces students to soil characterization, testing, mapping, classification, GIS, and land evaluation. A soil management unit addresses fertility, pest management, water, and microclimate, as well as erosion, conservation, pollution, and soil health. The 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 321 Soil and Water Management
Fall. 4 credits. Prerequisites: CSS (SCAS) 260. S-U grades optional. Lecs, T R 11:40–12:55; lab, R 2:30–4:30. Offered alternate years. H. M. van Es.
Introduces students to the principles of soil and water interaction and to the effects of human intervention on these processes. Aspects of soil and water management, including hydrology, soil erosion and conservation, water management, contaminant movement, tillage, soil compaction, and water quality are examined. Case studies and policy approaches from both the United States and abroad are discussed.

CSS 362 Soil Morphology
Fall. 1 credit. Undergraduates only. Recommended for sophomores and juniors. All-day field trip required. R 1:25–4:25. Staff.
The principles for field identification of soil properties, profiles, and landscapes are presented. A series of soil pits are examined, described, classified, and interpreted in the field.

CSS 363 Soil Genesis, Classification, and Survey
Fall. 4 credits. Prerequisite: CSS (SCAS) 260. Lecs, M W F 1:15; lab, W 1:25–4:25. One all day field trip is required. Staff.
Factors and processes of soil formation on which soil survey is based are discussed. Principles of field identification, classification, survey, and interpretation are practiced in a field setting. An overview of soil databases, their content, development, and use for site evaluation and land classification is provided.

CSS 365 Environmental Chemistry: Soil, Air, and Water
Spring. 3 credits. Prerequisites: CHEM 207–208. Lecs, M W F 10:10–11:00. M. B. McBride.
An overview of the chemical processes that control the concentrations and bioavailability of nutrients and pollutants in soil, air, and water. Particular attention is given to soil's function as a filter for contaminants. The history of environmental contamination and its impact on agricultural soils and ecosystems is described.

CSS 372 Nutrient Management in Agro-Ecosystems
Spring. 4 credits. Prerequisite: CSS (SCAS) 260 or permission of instructor. Lec, T R 8:40–9:55; lab, R 1:25–4:25. J. Lehmann.
Students become familiar 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 agro-ecosystems. Emphasis is placed on 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. Graduate students should enroll in CSS 472.

CSS 412 Whole Farm Nutrient Management (also AN SC 412)
Spring. 2 or 4 credit option. Open to juniors, seniors, and graduate students only. Course offered as two modules. Enrollment in Module 1 for the first half of the semester is required (2 credits). Module 1 consists of crop and manure nutrient management planning; no prerequisites for CALS students. Enrollment in Module 2 for the second half of the semester is optional (additional 2 credits). This module builds on the crop and manure nutrient management planning module by integrating agronomic nutrient management planning with herd nutrient management planning. AN SC 411 required. Lec, T R 11:15 and lab T 1:25–4:25 for both modules, with work on case studies outside of lab. D. G. Fox and Q. M. Ketterings.
This course provides students with an understanding of the concepts underlying whole farm nutrient management planning to improve profitability while protecting water and air quality. Students learn and apply concepts in the development of a Comprehensive Nutrient Management Plan (CNMP) that is required for a Concentrated Animal Feeding Operation plan to meet environmental regulations. Students develop components of a CNMP for a case study farm, using the Cornell University Nutrient Management Planning System (*cu*NMPS) and other tools. All students enrolled learn the concepts and processes of developing the crop and manure nutrient management plan component of a CNMP during the first half of the semester in Module 1. Students opting to continue through the end of the semester in Module 2 (4 credit option) build upon knowledge gained in the first half of the semester by learning the knowledge and skills necessary to integrate crop production and herd feeding management for reducing nutrient imports on farms.

CSS 466 Soil Ecology (also HORT 466)
Spring. 4 credits, with laboratory. Prerequisite: one year of biology or ecology and CSS 260 or permission of instructor. Lecs, T R 10:10–11:25; lab, W 1:25-4:25. J. E. Thies and L. Drinkwater.
Surveys the diversity of soil organisms and their roles in terrestrial ecosystems. The course covers the fundamental principles and features of biologically mediated processes in the soil and the function of soil organisms in the wider context of both managed and unmanaged ecosystems. The role of plant-microbe interactions in shaping the larger ecosystem serves as the basis for comparing soil community structure and function across a variety of ecosystems. The class investigates the consequences of anthropogenic activities from local soil management to global change on soil biodiversity and microbially mediated soil processes. In the laboratory, we will explore an array of methods for assessing soil biological community composition and microbially mediated processes in soil.

CSS 471 Properties and Appraisal of Soils of the Tropics
Spring. 3 credits. Prerequisite: CSS (SCAS) 260 or equivalent. S-U grades optional. No audits accepted. Lecs, T R 12:20; disc, W 1:25–3:25. Offered alternate years. A. VanWambeke.
The course examines the conditions in which soils form, and considers ecological, geological, and vegetational factors that produce the diversity that exists among them. The major kinds of soils are recognized, their management properties described, and methods to alleviate the constraints to crop production and preservation of the environment are examined. Topics include the identification of soils, and their functions in sustaining traditional farming systems and advanced technological packages. The course pursues these themes reviewing the most recent sources of information generated in tropical countries and published in Latin-American, French, and English journals. The last part of the course gives special attention to salt-affected soils, paddy rice cultivation, and the characteristics of acid-sulfate soils. Lectures include slides of soils, landscapes, and cropping systems. The course is available on a compact disk in Mann Library.

CSS 472 Nutrient Management and Research in Agro-Ecosystems
Spring. 4 credits. Prerequisite: CSS 260 or permission of instructor. Lecs T R 8:40–9:55; lab, R 1:25–4:25. J. Lehmann.
Students become familiar 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 agro-ecosystems. Emphasis is placed on the way 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. The laboratory experiments conclude with a final paper.

[CSS 473 Ecology of Agricultural Systems (also BIOEE 473)
Fall. 3 credits. Limited to 45 students. Prerequisite: BIOEE 261 or permission of instructor. S-U grades optional. Lec and disc, T R. During the first 6 weeks of class, the Thursday meetings may run to 5:30 because of field trips. T R 2:30–3:45. Not offered fall 2003. A. G. Power and E. C. Fernandes.
Analysis of the ecological processes operating in agricultural systems, with an emphasis on the interactions between organisms. Topics include nutrient dynamics in agroecosystems, plant competition and facilitation, intercropping, the ecology of species invasions, mutualism in agroecoystems, plant-herbivore relations, plant-pathogen interactions, biological pest control, and evolutionary processes in agriculture. Case

studies from both the tropics and the temperate zone are used to illustrate important concepts.]

[CSS 483 Environmental Biophysics (also EAS 483)
Spring. 3 credits. Prerequisite: CSS (SCAS) 260 or equivalent or permission of instructor. Offered alternate years. Lecs, M W F 11:15. S. J. Riha.
Introduction to basic principles of energy and mass transfer and storage in soil-plant systems. Energy budgets, soil heat flow, water movement in saturated and unsaturated soils, evapotranspiration, water, gas, and nutrient dynamics in the soil-plant-atmosphere continuum are covered. Applications to agronomic and environmental problems and instrument design and use are considered through discussion and problems sets.]

CSS 621 Applications of Space-Time Statistics
Spring. 2 credits. Prerequisite: STBTRY 601 or equivalent. Offered alternate years. TBA. H. Van Es.
An introduction to space-time statistics with applications in agriculture and environmental management. Topics include geostatistics (including use of ArcView's Geostatistical_Analyst), temporal statistics, sampling, experimental design, state-space analysis, data mining, and fuzzy logic. The focus is on landscape-scale processes and a user's perspective.

CSS 663 Pedology
Spring. 3 credits. Prerequisite: CSS (SCAS) 361 or permission of instructor. M W F 11:15–12:05. Staff.
Weathering, reactions, and processes of soil genesis. Principles of soil classification and the rationale and utilization of soil taxonomy. Development and significance of major groups of soils of the world.

CSS 666 Applied Plant/Microbe Interactions
Fall. 4 credits. Prerequisite: CSS 366 or equivalent, or permission of instructor. Lecs, T R 10:10–11:25; lab, F 1:25–4:25. Offered alternate years. J. E. Thies.
Discussions on current research into applied plant/microbe interactions including: molecular signaling between plants and microbes involved in symbiotic, associative, or pathogenic interactions; and new methodologies for understanding the role(s) soil microorganisms play in plant production. In the lab, students undertake an individual research project matched to their interests in which they employ current methods. Project results are presented as a final poster.

CSS 667 Advanced Soil Physics
Spring. 3 credits. Prerequisites: one year of college physics and CSS (SCAS) 483 or permission of instructor. S-U grades optional. Offered alternate years. M W F 11:15–12:05. P. C. Baveye.
A detailed study of measurement processes and of the hydrostatics of aqueous solutions in soils and porous media, with emphasis on fundamental principles. Examination of the molecular aspects of water-solid interactions, including shrink-swell phenomena and the properties of absorbed water. Analysis of equilibrium water adsorption from thermodynamical and mechanistic (molecular) standpoints. Also covered are mechanical and thermodynamical analysis of the equilibrium status of aqueous solutions in deformable soils. Formal lectures are complemented by tutorial sessions.

CSS 669 Organic Matter—Soils, Sediments, and Waters
Spring. 3 credits. Prerequisites: CSS (SCAS) 260 and CHEM 357–358 or equivalent. M W F 10:10–11:00. J. M. Duxbury.
A discussion of current concepts on the chemical nature, dynamics, and properties of natural organics and organo-mineral associations in terrestrial and aquatic environments. Includes a modeling project of soil carbon dynamics in natural or agricultural ecosystems.

CSS 671 Soil Chemistry
Fall. 3 credits. Prerequisite: 1 year of physical chemistry or permission of instructor. Lecs, M W F 10:10. Offered alternate years. M. B. McBride.
A detailed examination of the structure and surface chemistry of colloidal particles common to soils. Ion exchange, mineral-solution equilibria, and adsorption reactions of silicate clays, oxides, and organic matter are emphasized. The behavior of environmental contaminants in soils, particularly metals and toxic organics, is described.

[CSS 672 Nutrient Cycling in Natural and Managed Ecosystems
Fall. 3 credits. Prerequisite: CSS 372 or NTRES 321 or BIOEE 478, or permission of instructor. Next offered fall 2004. Lecs, T R 10:10–11:00; lab, F 1:25–4:25. Next offered fall 2004. J. Lehmann.
Nutrient cycling in soil and the interface between the soil and the vegetation, atmosphere and ground water are covered. We examine the biogeochemistry of nutrient elements in natural ecosystems, disturbed or degraded ecosystems, and agricultural systems including pollution in watersheds. Students develop independent projects, present a research proposal and conduct field research which concludes in a presentation and a paper in publishable format.]

CSS 693 Special Topics in Soil Science
Fall, spring, or summer. 1–6 credits. S-U grades optional.
Study of topics in soil science that are more specialized or different from other courses. Special topics to be covered will depend on staff and student interests.

CSS 696 Seminar: Organic Inputs in Tropical Soils and Agroforestry (also NTRES 696 and INTAG 696)
Fall, spring: 1 credit Section 2. S-U grades only. Lec, F 12:20–1:10. E. Fernandes, L. Fisher.
A variety of speakers present seminars on organic inputs in the tropics and agroforestry. Students are required to prepare synopsis of each seminar.

CSS 880 Master's-Level Thesis Research in Soil Science
Fall or spring. Credit by arrangement. S-U grades only. Hours by arrangement. Graduate faculty.
Limited to students specifically in a master's program.

CSS 980 Graduate-Level Dissertation Research in Soil Science
Fall or spring. Credit by arrangement. S-U grades only. Hours by arrangement. Graduate faculty.
Limited to students in a Ph.D. program **only before** the "A" exam has been passed.

CSS 981 Doctoral-Level Dissertation Research in Soil Science
Fall or spring. Credit by arrangement. S-U grades only. Hours by arrangement. Graduate faculty.
Limited to students admitted to candidacy **after** the "A" exam has been passed.

EARTH AND ATMOSPHERIC SCIENCES

T. E. Jordan, chair; S. J. Riha, co-chair; S. J. Colucci (atmospheric science), K. H. Cook (science of earth systems), undergraduate advising coordinators; R. W. Allmendinger, W. Allmon, M. Barazangi, J. M. Bird, L. D. Brown, L. M. Cathles, J. L. Cisne, S. J. Colucci, A. T. DeGaetano, L. A. Derry, P. J. Gierasch, C. H. Greene, D. L. Hysell, B. L. Isacks, R. W. Kay, S. Mahlburg Kay, M. C. Kelley, F. H. T. Rhodes, W. M. White, D. S. Wilks, M. W. Wysocki

EAS 101 Introductory Geological Sciences
Spring. 3 credits. Staff.
Designed to enhance an appreciation of the physical world. Natural environments, surface temperatures, dynamic processes such as mountain belts, volcanoes, earthquakes, glaciers, and river systems are emphasized. Interactions of the atmosphere, hydrosphere, biosphere, and lithosphere (Earth System Science) are covered. Water, mineral, and fuel resources and environmental concerns are also examined. Field trips in the Ithaca region.

EAS 102 Evolution of the Earth and Life (also BIO G 170)
Spring. 3 credits. Lecs T R 9:05–9:55 or 11:15–12:05; labs T W or R 2:00–4:25. J. L. Cisne.
This course covers: 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; and dinosaurs, mass extinctions, and human ancestry. Includes laboratories on reconstructing geological history and mapping ancient geography and fossil-collecting field trips.

EAS 107 How the Earth Works
Fall. 1 credit. Lecs M 12:20–1:10. J. L. Cisne.
A user-friendly introduction to the workings and interactions of solid earth, ocean, atmosphere, and life as they relate to understanding ongoing global change.

EAS 108 Earth in the News
Summer. 3 credits. S. L. Losh.
Provides an introduction to physical geology and earth systems 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.

EAS 109 Dinosaurs
Fall. 1 credit. Lecs T W or R 12:20–1:10. J. L. Cisne.
An introductory survey course for anyone interested in dinosaurs. Lectures examine the fossil evidence and illustrate how various geological and biological disciplines

contribute to understanding dinosaurs and their world.

EAS 111 To Know the Earth
Fall. 3 credits. Lecs T R 10:10–11:25. J. M. Bird.
Acquaints the nonscientist with Earth, its major features, how the Earth has evolved, Earth system science, and building a habitable planet. Covers the effects of human activity on geologic environments, mitigating environment damage, and living with natural hazards. Also covers mineral resource use in the twenty-first century and an environmentally sound fuel-minerals cycle.

EAS 122 Earthquake! (also ENGRI 122)
Spring. 3 credits. Lecs T R 1:25–2:40. L. D. Brown.
The science of natural hazards and strategic resources is explored. Covers techniques for locating and characterizing earthquakes and assessing the damage they cause; methods of using sound waves to image the Earth's interior to search for strategic minerals; and the historical importance of such resources. Includes seismic experiments on campus to probe for groundwater, the new critical environmental resource.

EAS 131 Basic Principles of Meteorology
Fall. 3 credits. Lecs, M W F 9:05. M. W. Wysocki.
A 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. In the laboratory, emphasis is on techniques of analysis of weather systems.

EAS 133 Basic Meteorology Lab
Fall. 1 credit. Prerequisite: concurrent enrollment in EAS 131. S-U grades optional. T W or R 1:25–4:25 or M W 7:00–9:30 P.M. M. W. Wysocki.
Laboratory course covering topics presented in EAS 131.

EAS 150 Introduction to Fortran Programming
Fall. 3 credits. Lec, T R 12:20–1:10; lab T 1:25. M. W. Wysocki.
An introduction to the elements of computer programming using Fortran. Exercises involve mainly meteorological problems.

EAS 154 The Sea: An Introduction to Oceanography, Lecture (also BIOEE 154)
Spring, summer. 3 credits. The optional one-credit laboratory for this course is offered as EAS/BIOEE 155. S-U grades optional. Lecs, T R 11:40–12:55. Spring: C. H. Greene, W. M. White; summer: B. C. Monger.
A survey of the physics, chemistry, geology, and biology of the oceans for both science and non-science majors. Topics include: seafloor spreading and plate tectonics, marine sedimentation, chemistry of seawater, ocean currents and circulation, the oceans and climate change, ocean ecology, and coastal processes.

EAS 155 The Sea: An Introduction to Oceanography, Laboratory (also BIOEE 155)
Spring. 1 credit. Prerequisite: concurrent enrollment in EAS/BIOEE 154. S-U grades optional. Lab, M 2:00–4:25 or 7:30–9:55 P.M., or W 7:30–9:55 P.M. C. H. Greene.
Laboratory course covering topics presented in EAS/BIOEE 154.

EAS 200 Art, Archaeology, and Analysis (also ENGRI 185, MS&E 285)
Spring. 3 credits. Lecs M W F 11:15–12:05. R. W. Kay.
An interdepartmental course on the use of techniques of science and engineering in cultural research. Applies physical and physiological principles to the study of archaeological artifacts and works of art. Covers historical and technical aspects of artistic creation. Includes analyses by modern methods to deduce geographic origins, and for exploration, dating, and authentication of cultural objects. Does not meet liberal studies distribution requirement for engineering.

EAS 201 Introduction to the Physics and Chemistry of the Earth (also ENGRD 201)
Fall. 3 credits. Prerequisites: PHYS 112 or 207. Lecs T R 10:10–11:00, lab R 2:00–4:25 or W 7:30–9:55. L. M. Cathles.
This course covers: formation of the solar system: accretion and evolution of the Earth; the rock cycle: radioactive isotopes and the geological time scale, plate tectonics, rock and minerals, earth dynamics, mantle plumes; the hydrologic cycle: runoff, floods and sedimentation, groundwater flow, and contaminant transport; and the weathering cycle: chemical cycles, CO_2 (weathering), rock cycle, controls on global temperature (CO_2 or ocean currents), and oil and mineral resources.

EAS 210 Introduction to Field Methods in Geological Sciences
1 lec, Saturday field trips. 3 credits. Prerequisite: EAS 101 (or 201) or permission of instructor. R. Allmendinger.
Considers the methods by which rocks are used as a geological database. Covers field methods used in the construction of geologic maps and cross sections; systematic description of stratigraphic sections. Field and laboratory sessions meet on Saturdays until Thanksgiving. There is also one additional lecture during most of these weeks. There is one weekend field trip to eastern New York.

EAS 213 Marine and Coastal Geology
Summer. 4 credits. Prerequisite: an introductory course in geology or ecology, or permission of instructor. Staff.
A special two-week course offered at Cornell's Shoals Marine Laboratory (SML), on an island near Portsmouth, New Hampshire. Estimated cost for 2003 (including tuition, room, board, and all required field trips) is $2,120. For more details and an application, contact the SML office, G14 Stimson Hall, or visit www.sml.cornell.edu.

EAS 250 Meteorological Observations and Instruments
Spring. 3 credits. Prerequisite: EAS 131. Lecs, M W 12:20; lab, R 1:25. M. W. Wysocki.
This course covers methods and principles of meteorological measurements and observations including surface, free-air, and remote systems. Also covered are: instrument siting, mounting, and protection; instrument response characteristics, calibration, and standardization; and recorders and data logging systems. Laboratory exercises are in observation and data analysis. The course is intended to serve as preparation for Observers Examination. Lab fee $50.

EAS 260 Soil Science (also CSS 260)
Fall. 4 credits. S-U grades optional. Lecs, M W F 9:05; lab, M T or W 1:25. S. J. Riha.
Designed for students interested in a comprehensive introduction to soil science from both an environmental and plant management perspective, this course is divided into three units. A unit on soil information introduces students to soil characterization, testing, mapping, classification, GIS, and land evaluation. A soil management unit addresses fertility, pest management, water, and microclimate, as well as erosion, conservation, pollution, and soil health. The 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.

EAS 268 Climate and Global Warming
Spring. 3 credits. Prerequisite: basic college math. S-U grades optional. Lecs, M W F 9:05. A. T. DeGaetano.
Students from a range of disciplines become familiarized with such contemporary issues in climatology as global warming and El Ni–o. Introductions to the natural greenhouse effect, past climates, observed and projected climate changes and impacts. Also natural climate variations (e.g. El Ni–o) and their consequences and predictability. Weekly student-led discussions of issues appearing in journals such as *Nature*.

EAS 296 Forecast Competition
Fall and spring. 1 credit. S-U grades only. Prerequisite: sophomore undergraduate standing in atmospheric science, or permission of instructor. D. S. Wilks.
This two-semester course provides daily exercise in probabilistic weather forecasting, in which students compete to forecast local weather most skillfully. Enroll for two consecutive semesters, with credit awarded after the second semester. May be repeated for credit.

EAS 302 Evolution of the Earth System
Spring. 4 credits. Prerequisites: MATH 112 or 192 and CHEM 207 or equivalent. Lecs M W F 10:10–11:00, Disc W 2:30–3:20. W. White and staff.
Co-evolution of life and the Earth system: Earth's early history; plate tectonics, continental drift, and climate changes during the past billion years; mountain building, ice ages, and our own emergence during the past ten million years. Introduction to methods of interpreting information preserved in the rock record.

EAS 315 Geomorphology
Fall. 4 credits. Prerequisite: one course in either geology, hydrology, or soil science. Lecs T R 8:40–9:55, lab M 2:00–4:25. B. L. Isacks.
A study of the processes that sculpt the Earth's landscapes (above and below sea level) and the nature of those landforms. Landforms constructed by Earth's internal processes are the point of departure, as we examine their modification by physical interaction with the atmosphere and oceans. Also treated are depositional landforms that are generated by accumulations of grains or sediment. Laboratory exercises include both field

examination of landforms of the Finger Lakes area and computer analysis of satellite images and Digital Elevation Models of examples from around the globe. Two Saturday field trips.

EAS 321 Introduction to Biogeochemistry (also NTRES 321)
Fall. 4 credits. Prerequisites: CHEM 207, MATH 112, plus a course in biology and/or geology. Lecs T R 12:20–1:10, disc W or R 2:00–4:25. L. A. Derry, J. Yavitt.
Control and function of the Earth's global biogeochemical cycles. The course 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, and mathematical models. Interactions between global biogeochemical cycles and other components of the Earth system are discussed.

EAS 326 Structural Geology
Spring. 4 credits. Prerequisite: MATH 112, EAS 101 or 201, or permission of instructor. One weekend fieldtrip. Lecs M W F 11:15–12:05, lab T 2:00–4:25. R. W. Allmendinger.
Nature and origin of deformed rocks at microscopic to macroscopic scales, with emphasis on structural geometry and kinematics. Topics include stress, strain, rheology, deformation mechanisms, minor structures, faulting, folding, and structural families.

EAS 331 Climate Dynamics (also ASTRO 331)
Fall. 4 credits. Prerequisites: two semesters of calculus and one semester of physics. Lecs, M W F 12:20–1:10; disc, F 1:25–2:15. K. H. Cook and P. J. Gierasch.
Processes that determine climate and contribute to its change are discussed, including atmospheric radiation, ocean circulation, and atmospheric dynamics. Contemporary climate change issues are investigated and discussed in the context of natural variability of the system.

EAS 334 Microclimatology
Spring. 3 credits. Prerequisite: A course in physics. T R 10:10–11:25. Offered alternate years. D. S. Wilks.
The relationships 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 341 Atmospheric Thermodynamics and Hydrostatics
Fall. 3 credits. Prerequisites: 1 year of calculus and 1 semester of physics. M W F 10:10–11:00. M. W. Wysocki.
Introduction to the thermodynamics and hydrostatics of the atmosphere and to the methods of description and quantitative analysis used in meteorology. Topics covered include thermodynamic processes of dry air, water vapor and moist air, and concepts of hydrostatics and stability.

EAS 342 Atmospheric Dynamics (also ASTRO 342)
Spring. 3 credits. Prerequisites: 1 year each of calculus and physics. Lecs M W F 10:10–11:00. K. H. Cook and P. J. Gierasch.
An 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). The governing equations of atmospheric flow are derived from first principles and applied to middle latitude and tropical meteorology. Topics include balanced flow, atmospheric waves, circulation, and vorticity.

EAS 350 Dynamics of Marine Ecosystems
Fall. 3 credits. Prerequisites: one year of calculus and a semester of oceanography (i.e., EAS 154), or instructor's permission. Lecs, T R 1:25–2:40. C. H. Greene.
This lecture course covers the interactions of physical and biological processes in marine ecosystems. It begins by looking at these processes on a global scale and works down to the scales relevant to individual organisms. Topics include: global patterns of ocean circulation; global patterns of ocean production; climate variability and the role of the ocean in global climate change; the El Niño/Southern Oscillation; ecosystem dynamics of the open ocean and coastal environments.

EAS 352 Synoptic Meteorology I
Spring. 3 credits. Prerequisites: EAS 341 and concurrent enrollment in EAS 342. Lecs, T R 9:05; lab, M 1:25. M. W. Wysocki.
Weather map analysis and forecasting techniques are studied by applying the principles of fluid and heat flow. This course strengthens previously introduced meteorological concepts which are applied to forecasting midlatitude synoptic scale weather systems, such as cyclones, anticyclones, jet streams, fronts, and waves.

EAS 355 Mineralogy
Fall. 4 credits. Prerequisite: EAS 101 or 201 and CHEM 207 or permission of instructor. Lecs M W F 10:10–11:00, lab W 2:00–4:25. S. Mahlburg Kay.
Examination of minerals by hand-specimen properties and optical microscopy. Geological setting, classification, crystal structures, phase relations, chemical properties, and physical properties of minerals are covered. X-ray diffraction is introduced. Includes an independent research project.

EAS 356 Petrology and Geochemistry
Spring. 4 credits. Prerequisite: EAS 355. Lecs T R 12:20–1:35, lab W 2:00–4:25. R. W. Kay.
Principles of phase equilibrium as applied to igneous and metamorphic systems. Description, classification, chemistry, origin, regional distribution, and dating of igneous and metamorphic rocks. Geochemical distribution of trace elements and isotopes in igneous and metamorphic systems. Also covers the petrological evolution of the planets.

EAS 375 Sedimentology and Stratigraphy
Fall. 4 credits. Prerequisite: EAS 101 or 201. Lecs M W F 11:15–12:05, lab T 2:00–4:25. J. L. Cisne.
Covers formation of sedimentary rocks; depositional processes and environments; correlation of strata in relation to time and environment; petrology of sandstones and limestones; geological age determination; reconstruction of paleogeography and interpretation of Earth history from stratigraphic evidence; and organization of strata in stratigraphic sequences.

EAS 388 Geophysics and Geotectonics
Spring. 4 credits. Prerequisites: MATH 192 (or 112) and PHYS 208 or 213. Lecs M W F 12:20–1:10, lab M 2:00–4:25. B. L. Isacks.
Covers global tectonics and the deep structure of the solid earth as revealed by investigations of earthquakes, earthquake waves, the Earth's gravitational and magnetic fields, and heat flow.

EAS 417 Field Mapping in Argentina
Summer. 3 credits. Prerequisites: EAS 210 and 326; Spanish desirable, but not required. S. Mahlburg Kay.
Modern techniques of geological mapping applied in the region of San Juan, Argentina, including folded and faulted sedimentary rock units of the Andean Precordillera (San Juan River section), intensely deformed Precambrian metamorphic rocks of the Pampean Ranges (Pie de Palo), and shallow-level silicic intrusives (Cerro Blanco-Ullun).

EAS 434 Reflection Seismology
Fall. 3 credits. Prerequisites: MATH 192 and PHY 208, 213, or equivalent. Lecs T R 1:25–2:40, labs TBA. L. D. Brown.
Fundamentals of subsurface imaging by multichannel seismic reflection techniques as used in oil exploration and geohydrological investigations. Covers survey design, acquisition, analysis, processing, and interpretation in both 2-D and 3-D. Includes discussion of related techniques such as seismic refraction analysis, tomographic inversion, vertical seismic profiling, shear wave exploration, and ground penetrating radar. Lab is keyed to state-of-the-art seismic processing, modeling, and interpretation software from LandMark.

EAS 435 Statistical Methods in Meteorology and Climatology
Fall. 3 credits. Prerequisites: 1 introductory course each in statistics (e.g., AEM 210) and calculus. T R 10:10–11:25. D. S. Wilks.
Statistical methods used in climatology, operational weather forecasting, and selected meteorological research applications. Includes some statistical characteristics of meteorological data including probability distributions and correlation structures. Covers operational forecasts derived from multiple regression models including the MOS system. Also covers forecast verification techniques and scoring rules, time series analysis, EOFs, and other research topics as time permits.

EAS 437 Geophysical Field Methods (also ARKEO 437)
Fall. 3 credits. Prerequisites: PHYS 213 or 208, or permission of instructor. L. D. Brown.
Introduction to field methods of geophysical exploration, especially as applied to environmental issues. Emphasis is on seismic, ground penetrating radar, gravity, and magnetic techniques. Field surveys carried out at the beginning of the semester are analyzed and interpreted.

EAS 447 Physical Meteorology
Fall. 3 credits. Prerequisites: 1 year each of calculus and physics. M W F 9:05–9:55. Offered alternate years. A. T. DeGaetano.

Primarily a survey of natural phenomena of the atmosphere, with emphasis on their underlying physical principles. Topics include composition and structure of the atmosphere, atmospheric optics, acoustics and electricity, microphysical cloud processes, and principles of radar probing of the atmosphere.

EAS 451 Synoptic Meteorology II
Fall. 3 credits. Prerequisites: EAS 341 and 342. Lecs, T R 9:05; lab, M 1:25–3:20. 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. Laboratory 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 453 Advanced Petrology
Fall. 3 credits. Prerequisite: EAS 356. Offered alternate years. R. W. Kay.
Magmas and metamorphism in the context of plate tectonics. Major and trace element chemistry and phase petrology as monitors of the creation and modification of igneous rocks. Temperature and stress in the crust and mantle and their influence on reaction rates and textures of metamorphic rocks. Application of experimental studies to natural systems.

EAS 455 Geochemistry
Fall. 4 credits. Prerequisites: CHEM 207 and MATH 192 or equivalent. Recommended: EAS 356. Lecs T R 8:40–9:55, lab TBA. Offered alternate years. W. M. White.
The Earth from a chemical perspective. Covers: the formation of the elements; cosmochemistry; chemical evidence regarding the formation of the Earth and solar system; trace-element geochemistry; isotope geochemistry; geochemical thermodynamics and kinetics; chemical evolution of the crust, mantle, and core; weathering and the chemistry of natural waters; chemistry of rivers and the oceans; hydrothermal systems; and ore deposition.

EAS 456 Mesoscale Meteorology
Spring. 3 credits. Prerequisites: EAS 341 and 342 or permission of instructor. T R 11:40–12:55. Offered alternate years. 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, sea breeze circulations, and lake effect snowstorms. The course also considers tropical weather systems and mesoscale modeling.

[EAS 457 Atmospheric Air Pollution
Fall. 3 credits. Prerequisites: EAS 341 or 1 course in thermodynamics, and 1 semester of chemistry, or permission of instructor. M W F 11:15–12:05. Offered alternate years. Not offered 2003–2004. M. W. Wysocki.
Course examines sources, effects, transport, measurement, and controls of air pollution. The basic principles in each area are discussed with an emphasis on their local, regional, and global impacts.]

[EAS 458 Volcanology
Fall. 3 credits. Prerequisite: EAS 356 or equivalent. Offered alternate years. Not offered 2003–2004. R. W. Kay and W. M. White.
Causes of volcanism, melting in the Earth, and the origin of magmas. Physical volcanology, nature and types of volcanic eruptions and associated deposits, and eruption mechanisms. Volcanic plumbing systems, magma chamber processes, evolution of magma. Volcanism and impact phenomena in the solar system. Volcanic hazard assessment and volcano monitoring. Ore deposits associated with volcanism.]

[EAS 462 Marine Ecology (also BIOEE 462)
Spring. 3 credits. Limited to 75 students. Prerequisite: BIOEE 261. Offered alternate years. Not offered 2003–2004. C. D. Harvell and C. H. Greene.
Lectures and discussion focus on current research in broad areas of marine ecology with an emphasis on processes unique to marine systems. A synthetic treatment of multiple levels of organization in marine systems including organismal, population, community, ecosystems, and evolutionary biology. Examples are drawn from all types of marine habitats, including polar seas, temperate coastal waters, and tropical coral reefs.]

EAS 470 Weather Forecasting and Analysis
Spring. 3 credits. Prerequisites: EAS 352 and EAS 451. M. W. Wysocki.
An applied course with an opportunity to focus 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 multi-scale weather systems. Students participate in weekly forecast discussions, write daily forecasts which include a synoptic discussion, quantitative precipitation prediction, and severe weather outlook for the forecast region, and lead class discussion on assigned readings.

EAS 475 Special Topics in Oceanography
Fall, spring, summer. 2–6 var. credits. Prerequisites: one semester of oceanography and permission of instructor. Fall, spring: C. H. Greene, summer: B. C. Monger.
Undergraduate instruction and participation in advanced areas of oceanographic research. Topics will change from term to term. Contact instructor for further information.

[EAS 476 Sedimentary Basins: Tectonics and Mechanics
Fall. 3 credits. Prerequisite: EAS 375 or permission of instructor. Offered alternate years. Not offered 2003–2004. T. E. Jordan.
Subsidence of sedimentary basins from the point of view of plate tectonics and geomechanics. Course covers interactions of subsidence, sediment supply, and environmental characteristics in development of stratigraphic sequences. Also covers stratigraphic characteristics of active-margin, passive-margin, and cratonic basins. Geophysical and stratigraphic modeling; sequence stratigraphy. Uses modern and ancient examples.]

EAS 478 Advanced Stratigraphy
Fall. 3 credits. Prerequisite: EAS 375 or permission of instructor. Offered alternate years. T. E. Jordan.
Course covers modern improvements on traditional methods of study of ages and of genetic relations among sedimentary rocks, emphasizing 3-D relationships. Introduces techniques and applications of sequence stratigraphy at scales ranging from beds to entire basins. Physical correlation, dating techniques, and time resolution in sedimentary rocks are considered as are physical controls on the stratigraphic record and numerical modeling.

EAS 479 Paleobiology (also BIOEE 479)
Fall. 4 credits. Prerequisites: 1 year of introductory biology and BIOEE 274 or 373 or EAS 375, or permission of instructor. Lecs T R 10:10–11:25, lab W 2:00–4:25. Offered alternate years. W. D. Allmon.
A survey of 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 481 Senior Survey of Earth Systems
Spring. 3 credits. Limited to seniors majoring in geological science. J. M. Bird.
A survey course that integrates undergraduate course work, intended to enhance overall understanding of geological sciences. Emphasis is on current models of Earth's dynamic systems (e.g., global climate change; mantle evolution). Utilizes guest lecturers; synthesis and review of literature; scientific literature readings; discussions; and student presentations.

[EAS 483 Environmental Biophysics (also CSS 483)
Spring. 3 credits. Prerequisite: EAS/CSS 260 or equivalent, or permission of instructor. M W F 11:15. Offered alternate years. Not offered 2003–2004. S. J. Riha.
Introduction to basic principles of energy and mass transfer and storage in soil-plant systems. Energy budgets, soil heat flow, water movement in saturated and unsaturated soils, evapotranspiration, water, gas, and nutrient dynamics in the soil-plant-atmosphere continuum are covered. Applications to agronomic and environmental problems and instrument design and use are considered through discussion and problem sets.]

EAS 487 Intro to Radar Remote Sensing (also ECE 487)
Fall. 3 credits. Prerequisite: PHYS 208 or 213 or equivalent, or permission of instructor. Lecs, M W F 9:05–9:55. D. L. Hysell.
Course on the fundamentals of radar, antennas, and remote sensing. Students are exposed to the principles underlying the analysis and design of antennas used for communication and for radar-related applications. They 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 turn them into practicing radar engineers. Each topic is developed from basic principles so students with a wide variety of

backgrounds will be able to take the course. Emphasis placed on radar applications in geophysics, meteorology and atmospheric sciences, and astronomy and space sciences. Radar remote sensing of the Earth from spacecraft receives special attention.

EAS 491–492 Undergraduate Research
Fall, spring. 1 to 4 credits. Staff.
Introduction to the techniques and philosophy of research in the earth 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 494 Special Topics in Atmospheric Science (undergraduate level)
Fall or spring. 8 credits maximum. S-U grades optional. Staff.
The department teaches "trial" courses under this number. Offerings vary by semester, and are advertised by the department before the semester starts. The same course is not offered more than twice.

EAS 496 Internship experience
Fall or spring. 1–2 credits. S-U grades only. Staff.

EAS 497 Individual Study in Atmospheric Science
Fall or spring. 1–6 credits. S-U grades optional. Students must register with an Independent Study form. Staff.
Topics are arranged at the beginning of the term for individual study or for group discussions.

EAS 498 Teaching Experience in Earth and Atmospheric Sciences
Fall, spring. 1–4 credits. S-U grades only. Students must register with an Independent Study Form. Staff.
The student assists in teaching an EAS course appropriate to his/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.

EAS 499 Undergraduate Research in Atmospheric Science
Fall or spring. Credit by arrangement. S-U grades only. Students must register with an Independent Study form. Staff.
Independent research on current problems in atmospheric science.

EAS 500 Design Project in Geohydrology
Fall, spring. 3–12 credits. An alternative to an industrial project for M.Eng. students choosing the geohydrology option. May continue over 2 or more semesters. L. M. Cathles.
The project may address one of the many aspects of groundwater flow and contamination, and must involve a significant geological component and lead to concrete recommendations or conclusions of an engineering nature. Results are presented orally and in a professional report.

EAS 502 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, 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 622 Advanced Structural Geology I
Spring. 3 credits. Prerequisites: EAS 326 and permission of instructor. Offered alternate years. Not offered 2003–2004. R. W. Allmendinger.
Stress-strain theory and application. Advanced techniques of structural analysis. Topics include finite and incremental strain measurement; microstructure, preferred orientation, and TEM analysis; and pressure solution and cleavage development; and experimental deformation. Applications to deformation of unconsolidated sediments, brittle and brittle-ductile deformation of supracrustal strata, and ductile deformation of high-grade metamorphic rocks. Kinematic analysis of shear zones and folds in these regimes.]

EAS 624 Advanced Structural Geology II
Spring. 3 credits. Prerequisites: EAS 326 and permission of instructor. Offered alternate years. R. W. Allmendinger.
Geometry, kinematics, and mechanics of structural provinces. Concentration is on thrust belts, rift provinces, or strike-slip provinces. Covers techniques of balanced cross sections.

EAS 628 Geology of Orogenic Belts
Spring. 3 credits. Prerequisite: permission of instructor. J. M. Bird.
A seminar course in which students study specific geologic topics of an orogenic belt selected for study during the term.

[EAS 634 Advanced Geophysics I: Fractals and Chaos in Geology and Geophysics
Fall. 3 credits. Prerequisite: EAS 388 or permission of instructor. Not offered 2003–2004.
Course covers: definitions of fractal sets and statistical fractals, scale invariance, self-affine fractals, multifractals, applications to fragmentation, seismicity and tectonics, petroleum distribution and reserves, ore grade and tonnage, drainage networks and landforms, and floods and droughts. Definitions of chaos and self-organized criticality, renormalization groups, diffusion limited aggregation and percolation clusters, wavelet transforms, applications to mantle convection, the Earth's dynamo, and distributed seismicity.]

[EAS 636 Advanced Geophysics II: Quantitative Geodynamics
Spring. 3 credits. Prerequisite: EAS 388 or permission of instructor. Not offered 2003–2004.
Stress and strain in the Earth, elasticity and flexure, heat transfer, gravity, fluid mechanics, rock rheology, faulting, chemical geodynamics, flow in porous media.]

[EAS 641 Analysis of Biogeochemical Systems
Spring. 3 credits. Prerequisite: MATH 293 or permission of instructor. Offered alternate years. Not offered 2003–2004. L. A. Derry.
Covers dynamics of biogeochemical systems; kinetic treatment of biogeochemical cycles; box models, residence time, response time; analytical and numerical solutions of model systems; Eigen-analysis of linear systems; feedback and nonlinear cases, problems of uncertainties in natural systems; modeling software such as Stella II and Matlab; and applications to current research of participants or from recent literature.]

[EAS 651 Atmospheric Physics (also ASTRO 651)
Fall. 3 credits. Prerequisites: a good background in undergraduate calculus and physics is required. Offered alternate years. Not offered 2003–2004. K. H. Cook, P. J. Gierasch, S. J. Colucci.
A survey of the fundamental physical processes in atmospheres. Topics include thermodynamics of atmospheric gases, moist effects, hydrostatics, convective instability, atmospheric radiation and radiative heating, radiative-convective equilibrium, clouds, cloud microphysics, and precipitation processes. Thermal structure and greenhouse effects on the Earth and other planets is discussed. The course is taught at the level of *Fundamentals of Atmospheric Physics* by Salby.]

[EAS 652 Advanced Atmospheric Dynamics (also ASTRO 652)
Spring. 3 credits. Prerequisites: EAS 341 and 342 or permission of instructor. T R 11:40–12:55. Offered alternate years. Not offered 2003–2004. S. J. Colucci and P. J. Gierasch.
Course covers quasigeostrophic theory, atmospheric waves, hydrodynamic instability, the general circulation of the atmosphere, and other topics selected from among numerical weather prediction and tropical, mesoscale, and middle atmosphere processes according to student interest.]

[EAS 656 Isotope Geochemistry
Spring. 3 credits. Open to undergraduates. Prerequisite: EAS 455 or permission of instructor. Offered alternate years. Not offerd 2003–2004. W. M. White.
Nucleosynthetic processes and the isotopic abundance of the elements. Geochronology and cosmochronology using radioactive decay schemes, including U-Pb, Rb-Sr, Sm-Nd, K-Ar, U-series isotopes, and cosmogenic isotopes such as ^{14}C and ^{36}Cl. Use of radiogenic and stable isotopes in petrology and their application to study of the evolution of the crust and mantle. Isotopic evidence regarding the formation of the Earth and the solar system. Stable isotopes and their use in geothermometry, ore petrogenesis, paleontology, and the global climate system.]

[EAS 666 Applied Multivariate Statistics
Spring. Prerequisites: multivariable calculus, matrix algebra, two previous courses in statistics. Offered alternate years. Not offered 2003–2004. T R 10:10–11:25. D. S. Wilks.
Statistical techniques for multivariable data. Topics include multivariate exploratory data analysis, the multivariate normal distribution, parametric and nonparametric inference about multivariate means, principal component analysis, canonical correlation analysis, discriminant analysis, and cluster analysis. Geophysical applications are emphasized, using primarily atmospheric and oceanographic data as examples, but the development is general enough to be of broader interest.]

EAS 675 Modeling the Soil-Plant-Atmosphere System (also CSS 675)
Spring. 3 credits. Prerequisite: EAS/CSS 483 or equivalent. T R 8:40–9:55. Offered alternate years. S. J. Riha.
Introduction to the structure and use of soil-plant-atmosphere models. Topics covered 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. Use of soil-plant-atmosphere models for teaching, research, extension, and policy formation is discussed.

EAS 692 Special Topics in Atmospheric Science
Fall or spring. 1–6 credits. S-U grades optional. Staff.
Study of topics in atmospheric science that are more specialized or different from other courses. Special topics to be covered depend on staff and student interests.

EAS 695 Computer Methods in Geological Sciences
Fall, spring. 3 credits. L. Brown and B. L. Isacks.
Independent research projects using modern computational resources in the Department of Earth and Atmospheric Sciences. Possibilities include: image and seismic processing, seismic and geomechanical modeling, GIS, use of interpretational workshops for 3-D seismics and satellite imagery; modeling fluid flow through complex media.

EAS 700–799 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 term to term. Contact appropriate professor for more information.

EAS 711 Upper Atmospheric and Space Physics
D. L. Hysell.

EAS 722 Advanced Topics in Structural Geology
R. W. Allmendinger.

EAS 731 Plate Tectonics and Geology
J. M. Bird.

EAS 751 Petrology and Geochemistry
R. W. Kay.

EAS 755 Advanced Topics in Petrology and Tectonics
J. M. Bird.

EAS 757 Current Research in Petrology
S. Mahlburg Kay.

EAS 762 Advanced Topics in Paleobiology
W. D. Allmon.

EAS 771 Advanced Topics in Sedimentology and Stratigraphy
T. E. Jordan.

EAS 773 Paleobiology
J. L. Cisne.

EAS 775 Advanced Topics in Oceanography
Spring. C. H. Greene.

EAS 780 Earthquake Record Reading
Fall. M. Barazangi.

EAS 781 Geophysics, Exploration Seismology, Ground-Penetrating Radar
L. D. Brown.

EAS 783 Advanced Topics in Geophysics
B. L. Isacks.

EAS 789 Lithospheric Seismology Seminar
L. D. Brown.

EAS 793 Andes-Himalaya Seminar
S. Mahlburg Kay, R. W. Allmendinger, B. L. Isacks, and T. E. Jordan.

EAS 795 Low Temperature Geochemistry
L. A. Derry.

EAS 796 Geochemistry of the Solid Earth
W. M. White.

EAS 797 Fluid-Rock Interactions
L. M. Cathles.

EAS 799 Soil, Water, and Geology Seminar
L. M. Cathles and T. S. Steenhuis.

EAS 850 Master's-Level Thesis Research in Atmospheric Science
Fall or spring. Credit by arrangement. S–U grades only. Hours by arrangement. Graduate faculty.
Limited to students specifically in the master's program in atmospheric science.

EAS 950 Graduate-Level Dissertation Research in Atmospheric Science
Fall or spring. Credit by arrangement. S-U grades optional. Hours by arrangement. Graduate faculty.
Limited to students in the atmospheric science Ph.D. program only **before** the "A" exam has been passed.

EAS 951 Doctoral-Level Dissertation Research in Atmospheric Science
Fall or spring. Credit by arrangement. S-U grades optional. Hours by arrangement. Graduate faculty.
Limited to students admitted to candidacy in the atmospheric science Ph.D. program **after** the "A" exam has been passed.

EDUCATION

R. S. Caffarella, chair; G. J. Applebee, N. T. Assie-Lumumba, D. E. Hedlund, M. M. Kroma, S. K. Kroma, S. J. Peters, S. C. Piliero, V. N. Rockcastle, D. E. Schrader, J. W. Sipple, D. J. Trumbull, D. G. Way, A. L. Wilson

EDUC 005 Basic Review Mathematics
Fall and spring. 3 credits (this credit is not counted toward the 120 credits required for the degree). Lecs, M W F 8:00 or 9:05. S. Piliero.
Review of concepts necessary for success in basic mathematics and statistics courses. Topics include problem solving, graphing, basic algebra skills, linear and quadratic functions, polynomial equations, exponents and logarithms, and trigonometry. Considerable emphasis is placed on learning mathematics for understanding and solving word problems.

EDUC 100 Multiculturalism in Education
Fall. 3 credits. M W F 10:10–11:25. S. Kroma.
Should schools provide mandatory bilingual education programs to non-English-speaking students? Should the United States adopt an "English Only" official language policy? Should Kwanza be celebrated as a public holiday? These are some of the many questions that challenge the notion of "cultural unity" one expressed as the "melting pot." In this course students develop writing skills as they explore discourse on the forces responsible for our cultural diversity and the changing perspectives on our "cultural unity." Through writing activities, students learn to critically examine the historical, political, and legal contexts of this diversity and define their own views on the competing public positions that multicultural education issues arouse.

EDUC 115 Introductory College Mathematics
Spring. 4 credits. M W F 11:15 or 12:20. S. Piliero.
Designed for students wishing to fulfill distribution requirements and/or prepare for study in calculus. This course offers a multi-representational approach to college-level precalculus mathematics, stressing conceptual understanding, problem solving, and applications in a technology-enhanced environment. Considerable emphasis is placed on numerical, graphical, and symbolic representations of functions and their transformations. Students use graphing calculators in a collaborative lab setting. EDUC 115 will **not** count toward graduation credit in the College of Arts and Sciences.

[EDUC 120 Education for Empowerment
Spring. 3 credits. W 1:25–4:25. Not offered 2003–2004. Staff.
Common themes running through the modules include human learning, teaching strategies, and political/social/economic factors affecting education. The course provides an opportunity to sample different areas of study and to gain knowledge and awareness of one's own educational processes.]

EDUC 151 Engaging Diversity: Multicultural Issues in Education and Society
Fall or spring. 3 credits. S-U grades optional. Lec, T R 1:25–2:40. S. K. Kroma.
The course explores diversity issues that affect students, for example, race, culture, gender, and class in the context of modern American society. Through selected readings and course activities, students recognize the strengths of a diverse community and acquire the knowledge and skills necessary for living and working in it. The focus is on critical thinking about the differences in our society, and the strategies we need for cross-cultural interactions.

[EDUC 210 Psychology of Learning and Memory
Fall. 3 credits. Prerequisite: introductory psychology. W 2:00–4:25; plus time TBA. Not offered 2003–2004. Staff.
This course deals with contemporary theories of learning, issues in the study of learning, and application of the principles of learning to the management of teaching and learning. Practical applications of research findings are emphasized. One or more experimental projects and the use of microcomputers is required.]

[EDUC 212 Psychological Foundations of Education
Spring and fall. 3 credits. Limited to 20 students. S-U option available. Prerequisite: introductory psychology. W 2:00–4:25 plus times TBA. Not offered 2003–2004. Staff.

A lecture/discussion survey of the psychological foundations of educational practice. Topics include the selective contributions of developmental, social, and experimental psychology, including instructional technology, to American education.]

EDUC 220 Community Learning and Service Partnership
Fall and spring. 3 or 4 credits. Limited to 25 students. S-U grades optional. T 2:30–4:25. A. Wilson.
In this service-learning course, students partner with Cornell service workers to accomplish a variety of learning goals selected by the employees. In addition to facilitating adult learning, students critically observe their own experiential learning. Class discussions focus on interpersonal communication, diversity, empowerment, and critical reflection. For a fourth credit, students agree to provide additional service through CLASP.

EDUC 240 The Art of Teaching
Fall and spring. 3 credits. Fall: M 12:20–2:15 or T 2:30–4:25, W 12:20–2:15 or 2:30–4:25; spring: M 8:00–9:55 or 12:20–2:15 or T 2:30–4:25 or W 12:20–2:15 or 2:30–4:25. Staff.
This course is designed for all students interested in finding out more about teaching. Students engage in field experiences to find out what teaching involves. Possible field experiences range from large group to tutorial situations, from preschool to adult education, from traditional school subject matters to recreational and vocational areas, and from school-based to nonformal situations. Class work builds on those experiences and provides skills and concepts to make the field experiences more profitable.

EDUC 317 Psychology of Adolescence
Spring. 3 credits. Prerequisite: introductory psychology. S-U grades optional. T R 11:15–12:05; F morning section TBA. D. E. Schrader.
This course surveys the nature of adolescent cognitive, social, moral, and self-development. Theories of adolescence are examined in the context of real-life experiences of adolescents using case analysis as a methodological tool. Educational implications are discussed for both formal and informal settings.

EDUC 331 Careers in Agriculture, Extension, and Adult Education
Fall. 1–3 credits. Letter grade only. F 2:00–4:25. G. J. Applebee.
This course offers modules in three areas of teaching: Adult Education, Cooperative Extension, and Agricultural Education. Each module offers one hour of credit, and students may take one or more of the modules. The course provides an historical perspective and an introduction to the organization and scope of programs for each module. Students examine career opportunities and characteristics of the professions addressed by each module. Course activities include field observations and experiences during arranged times.

EDUC 332 Instructional Methods in Agricultural Science Education
Spring. 1–3 credits. Prerequisite: enrollment in a Cornell teacher education program or permission of instructor. R 2:00–4:25. Staff.
Selection, practice, and evaluation of methods in Agricultural Science education are stressed. The course offers an opportunity to explore teaching strategies and methodology unique to teaching agriculture in schools. Content includes program planning and youth leadership in secondary agricultural education programs. Participants are required to participate in field experiences at arranged times.

EDUC 335 Youth Organizations
Spring. 3 credits. T R 10:10–11:25; lab TBA. Staff.
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. Field experience with a recognized youth organization is required.

EDUC 380 Independent Honors Research in Social Science
Fall or spring. 1–6 credits. Limited to students who have met requirements for the honors program. S-U grades optional. A maximum of 6 credits may be earned in the honors program. Staff.

EDUC 401 Our Physical Environment
Fall. 3 credits. Prerequisite: permission of instructor. Charge for laboratory supplies, approximately $7. T 1:25–4:25. V. N. Rockcastle.
A practical, relatively nonmathematical study of some basic relationships and physical interactions in the environment, with emphasis on physics and earth science. Attention is paid to analysis for understanding and techniques for teaching. An individual research project is included. Useful for teachers, environmental educators, and those for whom physical science seems difficult or uninviting.

EDUC 404 Learning and Teaching I
Fall. 4 credits. Prerequisite: admission to Cornell Teacher Education program, or permission of instructor. Letter grade. Lec, M W 7:30–8:45 P.M.; lab, 4 hours fieldwork TBA. Staff.
This course is designed to foster development of pedagogical and reflective understandings crucial to good teaching. Students explore what it means to understand and teach through examining key disciplinary topics, which requires rethinking disciplinary knowledge, assessment of learning, and motivation. Required fieldwork (4 hours weekly) focuses on learners' understandings and classroom structures.

EDUC 405 Learning and Teaching in Agriculture, Mathematics, and Science
Spring. 4 credits. Prerequisite: EDUC 404 or permission of instructor. Letter grade. Lec, M W 7:30–8:45 P.M.; lab, 4 hours fieldwork TBA. Staff.
Students analyze the art and science of teaching agriculture, mathematics or science and develop their skills and knowledge as teachers through furthering their study of the processes of learning, planning (in relation to state and national standards), assessment, and teaching. There are 40 hours of field work required.

EDUC 411 Educational Psychology
Fall. 3 credits. Prerequisite: PSYCH 101 or permission of instructor. S-U grades optional. Lec, T R 11:15–12:05; disc, F TBA. D. E. Schrader.
This course applies psychological concepts to educational settings with a focus on understanding the interaction between people, context, and knowledge in schools and other learning environments. It examines education as a social, moral, and interpersonal enterprise that respects differences between individuals. This course is designed to foster effective teaching and learning across the life span, but has a focus on secondary education.

[EDUC 413 Psychology of Human Interaction
Fall. 3 credits. Enrollment limited. Prerequisite: permission of instructor. T R 10:10–12:05. Not offered 2003–2004. D. E. Hedlund.
Designed to develop skills for, and understanding of, effective interpersonal communication and interaction. Appropriate for students in the helping professions, education, and areas involving management of human resources.]

EDUC 420 Field Experience
Fall or spring. 1–4 credits. S-U grades optional. Undergraduates must attach to their course enrollment material written permission from the faculty member who will supervise the work and assign the grade. Staff.
Students may engage in planned, semiprofessional, or professional practice in an educational enterprise. Each student prepares a plan of action including rationale, purposes, and procedures and arranges with a faculty member to supervise and evaluate their field experience.

EDUC 441 Language, Literacy, and Schooling
Spring. 3 or 4 credits. M W 2:55–4:10; lab, TBA. S. Kroma.
This course is a foundation for literacy activities in secondary education. It 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. For the fourth credit hour, students spend two out-of-class hours a week on individual project activities.

EDUC 445 Curriculum Design Workshop
Summer. 3 credits. Staff.
A general practical approach to course planning. Readings, group discussions, workshops, and individual conferences centering on each student's project. This project consists of designing a course in a subject area for an age level and an institutional setting of the student's choosing.

[EDUC 448 Instruction for Students with Disabilities
Summer. 3 credits. Prerequisites: educational psychology, introductory psychology, or permission of the instructor. S-U grades optional. Lec, TBA: 3 hours weekly. Not offered 2003–2004. Staff.
This course provides preservice middle and secondary school teachers a comprehensive overview of disability law, functional limitations caused by disabling conditions, and classroom strategies to provide academic accommodations/adjustments to meet the

needs of students with disabilities. The course focuses on specific classroom and curriculum strategies for adapting instruction to meet the needs of students with disabilities.]

[EDUC 450 Education Technology
Spring. 3 credits. Letter grade. Lec, TBA: 3 hours weekly. Not offered 2003–2004. Staff.
The use of intelligent tools changes how and what teachers teach. This course addresses applications and implications of technology in the educational setting. Students work with a variety of educational technologies including distance and distributed learning and investigate how technology can be used to facilitate the teaching of disciplinary knowledge and manage student data.]

EDUC 451 Multicultural Issues in Education
Fall. 3 credits. Letter grade. Lec, M W 2:55–4:10. S. K. Kroma.
This course explores issues pertaining to teaching and learning in multicultural classrooms in American schools. It examines events that have shaped contemporary American society, the educational policies and practices that affect cultural diversity that have emerged, and the teacher's role in dealing with cross-cultural issues in the classroom.

EDUC 452 Multicultural Issues in Secondary Education
Fall. 1 credit. Prerequisites: EDUC 451 and permission of instructor. Letter grade. S. K. Kroma.
Students spend two out-of-class hours a week in a classroom setting in the Ithaca school community and write a project on culturally responsive teaching based on their experience.

EDUC 459 Education in Africa and the Diaspora (also AS&RC 459)
Fall. 3 credits (4 in CA&S). T 10:10–12:35. N. Assié-Lumumba.
This course deals with educational innovations geared to promoting equal opportunity based on gender, race, and class in Africa and the African Diaspora. After an introduction on the concepts and innovations and the stages of innovation as planned change, the course focuses on concrete cases and different types of educational innovations. The selected case studies, in the United States, include the creation and expansion of historically black institutions with a focus on Tuskegee Institute (now Tuskegee University), Lincoln University, Spelman College, and the Westside Preparatory School in Chicago. The African cases to be studied include African languages for instructing in Nigeria and science education in Nigeria, Ujamaa and education for self-reliance in Tanzania, television as a medium of instruction and technological innovation in Côte d'Ivoire, classroom action research in Lesotho, and higher education and distance learning in South Africa.

EDUC 463 Policies, Practices, and Critical Issues of Distance Learning in Developing Countries
Spring. 3 credits. S-U grades optional. T 2:00–4:25. N. Assié-Lumumba.
Distance learning is being increasingly 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.

EDUC 471 Social and Political Context of American Education
Fall. 3 credits. S-U grades optional. Lec, T R 1:25–2:40. J. W. Sipple.
Investigation of goals, roles, and outcomes of schooling in American society and the policy environment in which schools operate. We analyze the behavior and impact of educational organizations (at local, state, and national levels) as they attempt to address societal problems and interpret and respond to changes in policy. The course includes current, historical, urban, and rural issues and problems.

EDUC 473 Philosophies of Education
Spring. 3 credits. Disc, T R 10:10–11:25. S-U grades optional. Staff.
This course provides historical and conceptual frameworks for students to develop theoretical perspectives on education and to analyze and critique arguments in contemporary educational debates. Focusing on the formal education system and reform movements in the United States, this course addresses moral, social, and political philosophies as they relate to educational decision-making practice.

[EDUC 477 Law and Educational Policy
Fall. 3 credits. M 2:30–4:25. Not offered 2003–2004. Staff.
A study of recent federal court decisions concerning education. Emphasis is on examining legal issues against a background of related educational issues and in terms of the consequences of legal decisions for the development and operation of educational institutions.]

EDUC 480 Global Seminar: Environment and Sustainable Food Systems (also ALS 480 and INTAG 480)
Spring. 1–3 credits. Prerequisite: juniors, seniors, and graduate students. Letter grade. Lec, R 8:00–9:55 A.M.; lab 3:35–4:25, one additional hour unscheduled. J. Lassoie, L. Buck, D. Miller.
For description, see ALS 480.

EDUC 483 Comparative Studies in Adult Education
Spring. 3 credits. S-U grades optional. T R 3:35–5:00. M. Kroma.
Focuses on the variety of adult-education programs in countries around the world. Literature on comparative adult education, international conferences on adult education, UNESCO adult-education publications, and international community development are analyzed in relationship to each student's exploration of adult education in two countries. Description of adult education in other countries is shared by international students.

EDUC 494 Special Topics in Education
Fall or spring. 4 credits maximum. S-U grades optional. Staff.
The department teaches "trial" courses under this number. Offerings vary by semester, and will be advertised by the department before the semester starts. Courses offered under this number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

[EDUC 495 Senior Seminar
Spring. 2 credits. Education majors or permission of instructors. S-U only. TBA. Undergraduate coordinator for the department. Not offered 2003–2004.
This seminar focuses in depth on two or three significant educational issues, which may vary from year-to-year depending on the interests and background of students and faculty. The seminar attempts to help students relate the knowledge gained in their particular concentrations to a set of broad issues in education. While education faculty is involved in selecting the issues and providing guidance for the seminar, students are expected to provide the initiative and leadership in the classroom.]

EDUC 497 Individual Study in Education
Fall or spring. 1–3 credits. S-U grades optional. Students must register with an Independent Study form (available in 140 Roberts Hall). Staff.
A student may, with approval of a faculty adviser, study a problem or topic not covered in a regular course or may undertake tutorial study of an independent nature in an area of educational interest.

EDUC 498 Undergraduate Teaching
Fall or spring. 1 or 2 credits; 4 credits maximum during undergraduate career. Limited to students with GPA of at least 2.7. S-U grades optional. Students must register with an Independent Study form (available in 140 Roberts Hall). Staff.
Participating students assist in teaching a course allied with their education and experience. Students are expected to meet regularly with a discussion or laboratory section, to gain teaching experience, and regularly to discuss teaching objectives, techniques, and subject matter with the professor in charge.

EDUC 499 Undergraduate Research
Fall or spring. 6 credits maximum during undergraduate career. Not open to students who have earned 6 or more undergraduate research credits elsewhere in the college. Limited to juniors and seniors with GPAs of at least 2.7. Students must register with an Independent Study form (available in 140 Roberts Hall). Staff.
Affords opportunities for students to carry out independent research under appropriate supervision. Each student is expected to review pertinent literature, prepare a project outline, conduct the research, and prepare a report.

EDUC 502 Education and Development in Africa (also AS&RC 502)
Spring. 3 credits (4 in CA&S). S-U grades optional. T 2:00–4:25. N. Assié-Lumumba.
In the 1950s and 1960s, human capital theory that emphasizes the importance of formal education for achievement of full productive potential of individuals and economic growth and development of countries enjoyed a renewed popularity. African countries promoted education expansion with the expectation that it would lead to socio-economic development. The initial euphoria, however, was followed by skepticism and then disillusion. Education, as it was being organized, delivered, received, and utilized began to be perceived even as a hindrance to development. This course examines the relationship between formal education and individual and national development. Different paradigms of development, including modernization and dependency theories, and Third World Forum are examined. Issues discussed include education and schooling, the role of primary, secondary, and higher education in development, the problems of employment, language, equity in access, and results based on social class, ethnicity, race, and gender. Endogenous knowledge, new perspectives for relevant education, and the role of international organization and cooperation are also discussed.

EDUC 503 Professional Seminar in Education
Fall, spring, or summer. 1–4 credits (1 credit each seminar). Prerequisite: admission to the CTE program. S-U grades optional. Discussion TBA. Staff.
This is a series of four seminars to be taken in each semester of the Cornell Teacher Education program. Students develop a professional portfolio aligned with core competencies in pedagogy, educational foundations, cultural diversity, exceptionalities, subject matter expertise, classroom competencies of planning, delivery, assessment, classroom management and technology, community context, and professionalism and ethics.

Seminar 1—Development of the Professional Portfolio. This segment lays the foundation for the student's professional portfolio; focus is on career opportunities, professional development, and linkages with outreach programs such as CERP and ICCD.

Seminar 2—Teaching in Diverse Classrooms. In this seminar, students consolidate their knowledge of diversity issues gained from other courses in the program and explore strategies for teaching in culturally diverse classrooms. Major topics include: culture and cultural diversity, cross-cultural communication, and limited English proficiency (LEP).

Seminar 3—Learning with Instructional Technologies. Technology and distance learning topics are covered in this seminar taken concurrently with the student teaching experience.

Seminar 4—Capstone Seminar. In this segment, students refine their program portfolio by integrating experiences in the field and the principles of culturally responsive teaching. Cultural diversity, literacy development, and connections with outreach programs are revisited in this capstone seminar in the Cornell Teacher Education experience.

EDUC 523 Food and Fiber Across the Curriculum
Summer. 0–3 credits. J. Hawkes.
An intensive five-day course designed to help New York State elementary teachers and administrators implement the New York Agriculture in the Classroom Program and understand the complexity of New York's leading industry. Participants learn how instructional materials and experiences with our food-fiber system can be used to teach students language arts, mathematics, science, and social studies. One credit is earned by class attendance and participation. Two credits require one additional project. Three credits require two additional projects.

EDUC 548 Effective College Teaching
Spring. 1–3 credits. S-U grade option. T 5:00–7:00. D. Way.
This course is designed to help participants become more effective college teachers. It examines the basic principle of learning, identifies different learning styles, and explores a variety of teaching techniques, methods, and technologies. Participants also learn how to design a course and improve their effectiveness as teachers.

EDUC 578 International TA Training Course: Cross-Cultural Classroom Dynamics, Pronunciation, and Language, Video Teaching Practicum
Fall and spring. 2 credits. S-U only. TBA. ITADP staff.
Designed for first-time international teaching assistants from countries in which English is not the primary language, the ITADP course 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 TAs develop their linguistic and pedagogical skills as they gain sensitivity to the dynamics of U.S. classrooms.

EDUC 579 Further Training for International Teaching Assistants
Fall, spring, summer. 1–2 credits. Prerequisite: EDUC 578. S-U grades optional. Lec, TBA: 3 contact hours per week. ITADP staff.
Designed for international teaching assistants from countries in which English is not the primary language and who have completed EDUC 578, the International TA Development follow-up course provides further instruction and practice in oral English and pedagogical skills. Students participating in the course through midterm receive one credit, those who are enrolled throughout the semester receive two credits.

EDUC 601 Secondary Agriculture, Science, and Mathematics Teaching Practicum
Fall or spring. 6 credits. Prerequisite: permission of instructor. S-U grades only. For graduate students enrolled in the Teacher Education in Science and Mathematics Program. M T W R F 8:00–3:00. S. C. Piliero, A. Solomon, and D. J. Trumbull and staff.
Supervised student teaching in agriculture, mathematics or science at the secondary level. Program includes teaching in a local school for fourteen weeks.

EDUC 602 Teaching Agriculture, Science/Mathematics: Methods, Materials, Practice
Fall or spring. 9 credits. Prerequisite: concurrent enrollment in EDUC 601 or permission of instructor. M T W R F 9:00–3:00. Staff.
The course begins with full-day sessions of intensive consideration of theoretical frameworks relevant to all aspects of student teaching. Assignments and a weekly seminar during the semester require students to use those theories to develop and evaluate teaching materials and practices. Students complete an extensive portfolio documenting their work.

EDUC 609 Methods for Interpretive Research
Spring. 3 credits. Prerequisite: course in research methods or measurement or permission of instructor. T R 2:55–4:10. D. J. Trumbull.
This course examines some of the methods of educational interpretive research. An interpretive research perspective attends to the complex interactions between researcher, researched, and contexts and accepts the centrality of interpretation in the conduct of human affairs. This perspective imposes some unique demands on researchers wishing to justify the quality of their projects. In the class, students practice methods for gathering and interpreting data by conducting a small project using methods as they relate to the aims and assumptions of interpretive research.

[EDUC 611 Educational Psychology
Fall. 3 credits. Prerequisite: introductory psychology. S-U grades optional. T R 11:15–12:05. Offered concurrently with EDUC 411. Not offered fall 2003. D. E. Schrader.]

EDUC 614 Gender, Context, and Epistemological Development (also FGSS 624)
Fall. 3 credits. S-U grades optional. T 12:20–2:15. D. E. Schrader.
Insight into how individuals make sense of knowledge is essential to teaching and learning. This course examines theories of intellectual development and their implications for educating students of various age groups, particularly college students. The role of reflection on thinking (metacognition) and its impact on development of thought is explored.

EDUC 615 Self and Interpersonal Development and Education (also FGSS 625)
Spring. 3 credits. S-U grades optional. T 12:20–2:15. Offered alternate years. D. E. Schrader.
Interpersonal interactions affect teaching and learning. This course takes a life-span perspective as it explores constructive-developmental theories of self and others, the influence of gender, and how such theories explain students' understanding of their own and others' actions in educational contexts.

EDUC 620 Internship in Education
Fall or spring. 1–6 credits. S-U grades optional. Each student, before course enrollment, must obtain the approval of a faculty member who will assume responsibility for supervising the work. Staff.
An opportunity for practical experience in educational professions development.

[EDUC 621 Work-Experience Coordinator Certification Course I
Summer. 3 credits. S-U grades optional. Not offered 2003–2004. Staff.
The first of a two-course sequence designed to develop the competencies needed for certification as a coordinator of diversified cooperative work experience programs. The course focuses on the history and philosophy, types, operation, and evaluation of work-experience programs including articulation with JPTA and VESID. Field interviews are required. A prerequisite for Course II, EDUC 622.]

[EDUC 622 Work-Experience Coordinator Certification Course II
Summer. 3 credits. Prerequisite: EDUC 621 Work-Experience Certification Course I. Not offered 2003–2004. Staff.
The second course for certification as a diversified cooperative work experience coordinator combines course work and directed field experience leading to the planning, development, and approval of a work-experience program in a local educational agency. Development of a philosophy and policy statement, budget, curriculum for related instruction, annual work plan by function, promotional materials, and all program forms for Board of Education approval required.]

EDUC 630 Special Problems in Agricultural, Extension, and Adult Education
Fall or spring; may also be offered in summer. 1–3 credits. S-U grades optional. Staff.
The course provides an opportunity for graduate-level study of individually selected problems and issues in agricultural, extension, and adult education.

EDUC 632 Teaching Agricultural, Extension, and Adult Education
Summer. 3 credits. Prerequisite: an introductory course in teaching methods or permission of instructor. Staff.
The focus of the course is on the selection, use, and evaluation of methods and materials for teaching. Methods for group and informal instruction are covered. Opportunity is provided for students to develop teaching competence based on their individual needs and interests. Development of self-evaluation skills is included. A class project on the development of instructional materials is required.

EDUC 633 Program Planning in Agricultural, Extension, and Adult Education
Spring. 3 credits. S-U grades optional. Lec, R 2:00–5:00. A. Wilson.
Current social and economic conditions affecting agricultural, extension, and adult education are examined. Principles, objectives, strategies, and sources of information are applied to program planning. Participants have an opportunity to observe ongoing programs in agricultural, extension, and adult education and to pursue individual interests in program development and improvement.

[EDUC 635 Experiential Learning
Fall. 2 credits. Prerequisite: open to undergraduates with permission of instructor. S-U grades optional. T 12:20–2:15. Not offered 2003–2004. Staff.
Participants explore various dimensions of scholar and practitioner thinking about the understanding and practice of experiential learning. Theoretical perspectives on experiential education, reflective practice, and a critical learning systems perspective are explored through readings and applied assignments. The instructor introduces methods of facilitation designed to encourage inquiry and dialogue for improvement of both nonformal and formal educational activities. The course process is intended to engage participants in reflective dialogue—nurturing emergence of learning community elements.]

EDUC 645 Curriculum for a Diverse and Technological Society
Spring. 3 credits. Letter grade only. Disc, TBA. Staff.
Basic curriculum concepts, principles, and theories are examined. Special emphasis is given to the ways that diversity and technology drive changes in the development of curriculum. Each student chooses a particular curriculum for analysis as a project. Within that context theoretical perspectives on curriculum and the basic elements of any curriculum are discussed.

EDUC 661 Administration Leadership and Organizational Change
Fall. 3 credits. T 3:35–6:00. J. W. Sipple.
Perspectives on the administration of educational organizations. Consideration of social science, legal and ethical theories, and their application to both public schools and higher education. Intended for students who are considering careers as educational administrators, as well as for those who want to further their understanding of educational organizations.

EDUC 671 American School Reform: Organizational and Sociological Perspectives
Spring. 3 credits. S-U grades optional. Lec, M 1:55–4:25. J. W. Sipple.
For individuals interested in the role of schools in society and in organizational behavior and public policy. This seminar investigates the sociological functions of schooling, including the stability of school organization given the long history of policy initiatives designed to reform schools. The focus is American K–12 public education, though issues of pre-K, private, and post-secondary education are covered.

EDUC 680 Foundations of Extension Adult Education
Fall. 3 credits. Limited to 20 students. S-U grades optional. R 3:35–6:00. A. Wilson.
An 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. Definitions, conceptual controversies, philosophical issues, and current research directions are examined through a seminar approach.

EDUC 682 Community Education and Development
Fall. 3 credits. Limited to 25 students. Letter grade only. W 1:25–4:25. S. Peters.
An examination of the concept of community; changes in community life; the analysis of community; alternative strategies for community development; patterns of response to community by universities, colleges, schools, Cooperative Extension, and government service agencies; and such functional dimensions of community education programming as participatory decision making, volunteers, leadership development, council formation and function, interagency coordination, and change-agents roles.

EDUC 685 Training and Development: Theory and Practice (also INTAG 685)
Spring. 4 credits. S-U grades optional. F 9:05–12:05; lab TBA. M. Kroma.
Analysis, design, conduct, administration, and evaluation of training programs for the development of human resources in small-farm agriculture, rural health and nutrition, literacy and nonformal education, and general community development. Designed for scientists, administrators, educator-trainers, and social organizers in rural and agricultural development programs in the United States and abroad.

EDUC 694 Special Topics in Education
Fall, spring, or summer. 1–3 credits. Prerequisite: permission of instructor. S-U grades optional. Staff.
Topics to be announced.

EDUC 700 Directed Readings
Fall or spring. Variable, 6 credits. Limited to graduate students with permission of instructor. S-U grades optional. Staff.
For study that predominantly involves library research and independent study.

EDUC 701 Empirical Research
Fall or spring. Variable, 6 credits. Limited to graduate students with permission of instructor. S-U grades optional. Staff.
For study that primarily involves collection and analysis of research data.

EDUC 702 Practicum
Fall or spring. Variable, 6 credits. Limited to graduate students with permission of instructor. S-U grades optional. Staff.
For study that predominantly involves field experience in community settings.

EDUC 703 Teaching Assistantship
Fall or spring. Variable, 6 credits. Limited to graduate students with permission of instructor. S-U grades optional. Staff.
For students assisting faculty with instruction. Does not apply to work for which students receive financial compensation.

EDUC 704 Research Assistantship
Fall or spring. Variable, 6 credits. Limited to graduate students with permission of instructor. S-U grades optional. Staff.
For students assisting faculty with research. Does not apply to work for which students receive financial compensation.

EDUC 705 Extension Assistantship
Fall or spring. Variable, 6 credits. Limited to graduate students with permission of instructor. S-U grades optional. Staff.
For students assisting faculty with extension activities. Does not apply to work for which students receive financial compensation.

EDUC 711 Contemporary Issues in Educational Psychology
Fall and spring. Variable, 3 credits. TBA. Staff.
This is a graduate-level seminar dealing with key issues in contemporary psychology having implications for educational practice and research. Topics vary from semester to semester. Students may take the course more than once.

EDUC 714 Moral Development and Education
Spring. 3 credits. S-U grades optional. T 12:20–2:15. Offered alternate years. D. E. Schrader.
This seminar focuses on current topics in moral development research as related to the educational process. Topics include the question of the development of moral reasoning, gender differences, the relationship between moral judgment and moral action, questions related to moral education in secondary schools and university settings, and professional ethics in educational settings. This course takes a life-span perspective; however, special emphasis is placed on development from adolescence through adulthood.

[EDUC 718 Adult Learning and Development
Spring. 3 credits. Prerequisite: permission of instructor. S-U grades optional. W 2:00–4:25. Not offered 2004. A. Wilson.
Deals with adult development and learning behavior from points of view of educational psychology and adult education. Inferences are drawn from theory and research to the practice of adult continuing education. Appropriate for graduate students in educational psychology, extension and continuing education, and community service education, and for others interested in adult learning and development.]

EDUC 730 Seminar in Agricultural, Extension, and Adult Education
Spring. 3 credits. S-U grades optional. R 8:00–9:55. S. Peters.
Emphasis is on current problems and research in agricultural, extension, and adult education. Includes discussion and analysis of student and staff research.

EDUC 762 Comparative and International Education
Fall. 3 credits. S-U grades optional. M 2:00–4:25. N. Assie-Lumumba.
This seminar critically analyzes education conceived both as a universal social institution and a reflection of cultural, economic, and political dynamics of the local and global contexts. The analysis focuses on policies, organization, and the functioning of education in industrial, new/emerging economies and developing countries. Specific case studies are drawn from different countries.

EDUC 783 Farmer-Centered Research and Extension (also INTAG 783)
Fall. 3 credits. S-U option. M. Kroma.
This course provides an 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 extension is its potential to legitimize people's knowledge by enhancing their capacity to critically analyze their own problems, to conduct their own research, and to empower them to take direct action to solve those problems.

EDUC 800 Master's-Level Thesis Research
Fall or spring. Credit TBA. S-U grades optional. Each student, before course enrollment, must obtain the approval of a faculty member who will assume responsibility for guiding the work. Hours TBA. Staff.

EDUC 900 Doctoral-Level Thesis Research
Fall or spring. Credit TBA. Limited to students working on theses or other research and development projects. S-U grades optional. Each student, before course enrollment, must obtain the approval of a faculty member who will assume responsibility for guiding the work. Hours TBA. Staff.

ENTOMOLOGY

D. A. Rutz, chair; A. M. Agnello, N. W. Calderone, B. N. Danforth, A. Ditommaso, T. Eisner, G. M. English-Loeb, J. Ewer, P. P. Feeny, C. Gilbert, A. E. Hajek, L. C. Harrington, G. W. Hudler, P. Kaufman, J. K. Liebherr, C. Linn, J. E. Losey, M. Luckow, J. P. Nyrop, B. L. Peckarsky, D. Pimentel, L. S. Rayor, J. P. Sanderson, J. G. Scott, E. J. Shields, W. M. Tingey, P. A. Weston, Q. D. Wheeler

Courses by Subject

Apiculture: 260, 264
Behavior: 215, 325, 394, 471, 662
Conservation: 344
Ecology: 452, 455, 456, 470, 471, 672
Introductory courses: 201, 210, 212, 213, 215
Medical entomology and veterinary entomology: 352, 652
Morphology: 322
Pathology: 463, 670
Pest management: 241, 277, 441, 443, 444, 477, 644, 670
Physiology, development, and toxicology: 370, 394, 400, 483, 490, 685
Systematics: 331, 333, 453, 631, 632, 634, 635

Note: class meeting times are accurate at the time of publication. If changes are necessary, the department will provide new information as soon as possible.

ENTOM 201 Alien Empire: Bizarre Biology of Bugs
Spring. 2 credits. Limited to 100 students. S-U grades optional. Lecs, T R 9:05; optional field trips, required lab demonstrations. Offered alternate years. B. N. Danforth.
Insects are the most abundant and diverse animals on earth. This course explores the bizarre biology of insects by examining their evolutionary history, anatomy, development, feeding habits, life-history strategies, behavior, and their interactions with humans (both positive and negative) through history. Optional field trips and one open lab provide hands-on opportunities for examining these amazing animals.

ENTOM 210 Plagues and People
Fall. 2 credits. Prerequisites: introductory biology or permission of instructor. Lecs, M W 2:30. Offered alternate years. L. C. Harrington.
Human diseases transmitted by insects and related forms (arthropods) have impacted human lives and society through history. This course focuses on the pathogens, parasites, and arthropods causing human plagues. Special attention is paid to those plagues that have had the greatest impact on human culture and expression. Lectures are supplemented with readings and films. Emerging diseases, bioterrorism, and future plagues also are addressed.

ENTOM 212 Insect Biology
Fall. 4 credits. Prerequisites: BIO G 101–102 (may be taken concurrently) or equivalent. Lecs, W F 10:10–11:00; labs T W or R 1:25–4:25. Lab fee $38. C. Gilbert.
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. A collection emphasizing ecological, behavioral, and taxonomic categories is required.

ENTOM 213 General Entomology
Summer. 3 credits. Limited to 20 students. Prerequisite: one year of college biology or permission of the instructor. M–F 9–12; lab, M T 1:30–3:30. Offered during the 3-week summer session. C. Gilbert.
Introduces the science of entomology by focusing on basic principles of systematics, morphology, physiology, behavior, and ecology of insects. The laboratory includes field trips to collect and study insects in their natural habitats. A collection emphasizing ecological, behavioral, and taxonomic categories is required. Students may not receive credit for both ENTOM 212 and 213.

ENTOM 215 Spider Biology: Life on a Silken Thread
Fall. 2 credits. Prerequisite: introductory biology or permission of instructor. S-U grades optional. Lecs, W F 1:25–2:15. L. S. Rayor.
An introduction to the fascinating world of spiders. Evolution, ecology, behavior, and physiology of spiders and their close kin are explored from a modern perspective. Topics include identification of major spider families, spiders' unique use of silk, risky courtship, predatory behavior, diverse life styles, social spiders, and potential use in IPM.

ENTOM 241 Applied Entomology
Spring. 3 credits. Limited to 18 students. Prerequisites: BIO G 101–102 or equivalent. Lecs, T R 10:10; lab/disc, T 12:20–3:15. W. M. Tingey.
Introduction to major pest species and tactics for their management. Discussions of insect pest management requirements on farms, gardens, forests, and urban environments, along with descriptions of control methods, materials, and equipment.

ENTOM 260 Introductory Beekeeping
Fall. 2 credits. Lecs, T R 11:15. N. W. Calderone.
Introduces students to the life history, physiology, and behavior of honey bees, as well as to the fundamentals of practical beekeeping. Classical and contemporary research on the dance language, chemical communication, behavioral genetics, division of labor, and evolution of social behavior are reviewed. Lectures on pollination of agricultural crops, honey and beeswax, bees in ancient and modern rituals, Africanized honey bees, and insect politics are also included.

ENTOM 264 Practical Beekeeping
Fall. 1 credit. Limited to 20 students. Prerequisite: ENTOM 260 (may be taken concurrently). Lab, R 2:00–4:25. N. W. Calderone.
This course 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. Some of the topics covered include management of bees for apple pollination, honey harvesting and processing, and disease identification/control. The class makes a number of field trips to commercial beekeeping operations. Students conduct simple experiments to demonstrate color perception by bees, as well as the chemical basis for swarming, nest guarding, and mating.

[ENTOM 277 Natural Enemies Managing Pests: An Introduction to Biological Control
Spring. 2 credits. S-U grades optional. Lecs, T R 1:25–2:15; lab demonstration; optional field trip. Offered alternate years. Not offered spring 2004; next offered spring 2005. A. E. Hajek.
An introduction to the dynamic field of biological control. What is it and when should it be used? This course covers a diversity of types of biological control including use of parasitoids, predators, pathogens, and competitors as well as plant breeding to control pests from microbes to weeds to invertebrates and vertebrates. This course is intended for students curious about safely controlling pests.]

[ENTOM 322 Comparative Insect Morphology
Spring. 5 credits. Prerequisite: ENTOM 212 or 241. Lecs, M W F 9:05; labs, M W 1:25–4:25. Offered alternate years. Not offered spring 2004; next offered spring 2005. B. N. Danforth.
This course provides a detailed introduction to the external and internal anatomy of insects. Lectures introduce basic concepts in insect morphology, such as the organization of the insect body plan and organ systems, functional morphology, homology, phylogeny, modularity, and development. The laboratory portion of the course introduces students to the basic methods of insect microdissection, specimen preparation, and scientific illustration. High-quality, publishable illustrations are produced based on student art-work.]

[ENTOM 325 Insect Behavior
Spring. 3 credits. Prerequisite: introductory biology or introductory entomology or permission of instructor. Lecs, T R 10:10–11:25. Offered alternate years. Not offered spring 2004; next offered spring 2005. L. S. Rayor.
Insects are the most diverse organisms on earth, with equally diverse behavior. This course explores the behavior of insects, ranging from the individual sensory and physiological mechanisms that are the basis of insect behavior, to the behavioral dynamics of foraging, courtship, parental care, and social behavior. Topics include insect learning, perceptual abilities, host finding strategies, predation, pollination, and examination of current issues in insect behavior.]

ENTOM 331 Introductory Insect Systematics
Spring. 4 credits. Prerequisite: ENTOM 212. Lecs, T R 12:20; labs, T R 1:25–4:25. Lab fee $50. Offered alternate years. Q. D. Wheeler.
An introduction to the classification, evolutionary history, and distribution of insects. Laboratory practice in the identification of orders, families, and representative genera of insects; methods of collection, preservation, and study. Lectures on theory and practice of insect systematics and major features of insect evolution. Insect collections are required.

[ENTOM 333 Maggots, Grubs, and Cutworms: Larval Insect Biology
Fall. 5 credits. Prerequisites: ENTOM 212 and permission of instructor. S-U grades optional. Lecs, T R 11:15; labs T R 1:25–4:25. Offered alternate years. Not offered fall 2003; next offered fall 2004. J. K. Liebherr.
This course introduces insect larval biology, anatomy, and ecological and phylogenetic relationships. The laboratory includes field sampling, preparation of specimens for descriptive study, identification of unknowns, and discussion of current topics. An independent project involving description of one or more larval stages is required. See instructor before course to best satisfy this requirement.]

ENTOM 344 Insect Conservation Biology
Spring. 3 credits. Prerequisite: one course in either entomology or conservation biology or permission of instructor. S-U grades optional. Lecs, T R 10:10–11:25. Offered alternate years. J. E. Losey.
Provides an in depth look at the concepts and issues surrounding the conservation of insects and other invertebrates. Topics covered include: sampling rare populations, insect conservation genetics, the role of phylogeny in determining conservation priorities, refuge design, saving individual species, plus the unique political, social and ethical aspects of insect conservation and preservation of the ecological services (i.e., pollination, decomposition, pest suppression, insectivore food sources).

[ENTOM 352 Medical and Veterinary Entomology
Fall. 3 credits. Prerequisites: BIO G 101–102 or permission of instructor. S-U grades optional. Lecs, T R 10:10; lab, R 1:25–4:25. Offered alternate years. Not offered fall 2003; next offered fall 2004. L. C. Harrington.
Diseases resulting from arthropod-borne pathogens (such as malaria, dengue, and yellow fever) cause considerable human and animal suffering and death worldwide. This course explores the impact of vector-borne disease and provides a comprehensive overview of the fields of medical and veterinary entomology. The goal of the course is to encourage an understanding of evolutionary and ecological issues associated with disease transmission. The laboratory includes field trips, collection and identification of arthropods of medical/veterinary importance, and hands-on experience with modern laboratory research methods. Undergraduate and graduate students from entomology as well as other disciplines including pre-medical and veterinary students are encouraged to enroll.]

[ENTOM 370 Pesticides, the Environment, and Human Health (also TOX 370)
Fall. 2 credits. Prerequisites: BIO G 101–102 or equivalent. Lecs, T R 9:05. Offered alternate years. Not offered fall 2003; next offered fall 2004. J. G. Scott.
A survey of the different types of pesticides, their uses, properties, and effects on the environment. Discussion of the risks, benefits, regulation, politics, and current controversies associated with pesticide use and genetically modified crops.]

ENTOM 394 Circadian Rhythms (also BIOGD 394 and BIONB 394)
Fall. 2 credits. Prerequisite: ENTOM 212, or BIOGD 281, or BIONB 221 or 222, or permission of instructor. S-U grades optional. Lec, W 7:30–9:10 P.M. Offered alternate years. J. Ewer.
This course explores the neural, endocrine, and molecular mechanisms by which organisms "keep time," and how their clocks are synchronized with the planet's 24 hour light and temperature cycles. The course leans heavily on the knowledge obtained from the analysis of rhythms in insects, especially *Drosophila*, but also includes an in-depth analysis of circadian rhythms in other organisms, from cyanobacteria to mammals.

ENTOM 400 Insect Development (also BIOGD 402)
Spring. 4 credits. Prerequisite: ENTOM 212 or BIOGD 281 or permission of instructor. S-U grades optional. Lecs, M W 11:15; lab, M 12:20–3:20; disc, F 11:15–12:05. Offered alternate years. J. Ewer.
The course emphasizes the mechanisms that underlie embryonic and post-embryonic developmental processes of insects. The portion of the course on embryonic development leans heavily on knowledge obtained from *Drosophila*, but also covers more classical studies as well as recent advances exploring the molecular basis for the evolution of body plan. The post-embryonic development portion covers the control of growth, molting, and metamorphosis. The laboratory uses modern techniques to illustrate developmental events at the organismal and cellular level. The discussion section involves the analysis and presentation of primary research papers.

[ENTOM 443 Entomology and Pathology of Trees and Shrubs (also PL PA 443)
Fall. 4 credits. Prerequisites: ENTOM 212 or equivalent and PL PA 241 or equivalent. S-U grades optional. Evening prelims. Lecs, M W F 11:15; lab, F 1:25–4:25. Offered alternate years. Not offered fall 2003; next offered fall 2004. P. A. Weston and G. W. Hudler.
For students preparing for careers in horticulture, urban forestry, pest management, and natural history/science education. Deals with the nature, diagnosis, assessment, and management of insect and disease pests on trees and shrubs in forests, urban landscapes, Christmas tree plantations, and other sites where intensive pest management is practiced.]

ENTOM 444 Integrated Pest Management (also CSS 444)
Fall. 4 credits. Prerequisites: BIOEE 261, ENTOM 212 or 241, and PL PA 241 or their equivalents or permission of instructor. Lecs, M W F 9:05; labs, M 1:25–4:25. J. E. Losey and A. Ditommaso.

Lectures integrate the principles of pest control, ecology, and economics in the management of pests across multiple systems. Laboratories consist of exercises to reinforce concepts presented in lecture and demonstrate pest monitoring techniques and the application of computer technology to management problems.

[ENTOM 452 Herbivores and Plants: Chemical Ecology and Coevolution (also BIOEE 452)
Spring. 3 credits. Prerequisites: 1 year of introductory biology; BIOEE 261; CHEM 257 or 357/358 and 251 or 301; or permission of instructor. Lecs, M W F 11:15. Offered alternate years. Not offered spring 2004; next offered spring 2005. P. P. Feeny.
Significance of plant chemistry in mediating interactions between plants and herbivorous animals; mechanisms and strategies of plant finding and exploitation by animals, especially insects, and of defense and escape by plants; evolutionary hypotheses for ecological patterns of resistance and attack; implications for human food and agriculture.]

ENTOM 453 Principles and Practice of Historical Biogeography (also BIOPL 453)
Fall. 3 credits. Prerequisite: a course in systematics or permission of instructor. S-U grades optional. Lecs, T R 10:10; lab T 1:25–4:25. Offered alternate years. J. K. Liebherr and M. Luckow.
A survey of techniques in historical biogeography, and the development of modern biogeographic theory in the context of classical, ecological, and phylogenetic analytical methods. Geological and paleontological aspects of biogeography are presented, and large-scale biogeographic patterns discussed. Laboratories focus on computer applications and discussion of controversial issues.

[ENTOM 455 Insect Ecology (also BIOEE 455)
Fall. 3 credits. Prerequisites: BIOEE 261 or equivalent and ENTOM 212 or equivalent knowledge of another taxon. S-U grades optional. Lecs, M W F 11:15. Offered alternate years. Not offered fall 2003; next offered fall 2004. Staff.
Topics include the nature and consequences of biotic diversity, biogeography, coevolution, adaptive syndromes exhibited by various guilds, population regulation, impact of insects on ecosystems, comparative and functional analysis of communities, and differences in the organization of natural and managed systems. Ecological and evolutionary principles are integrated by thorough study of exemplars.]

ENTOM 456 Stream Ecology (also BIOEE 456 and NTRES 456)
Spring. 4 credits. Limited to 60 students. Recommended: BIOEE 261. S-U grades optional. Lecs, T R 9:05; labs, T W or R 1:25–4:25. Offered alternate years. B. L. Peckarsky.
Lecture addresses the patterns and processes occurring in stream ecosystems, including channel formation, water chemistry, watershed influences, plant, invertebrate, and fish community structure, nutrient cycling, trophic dynamics, colonization and succession, community dynamics, conservation, and the impacts of disturbances. Lab: field projects include descriptive and experimental techniques, hypothesis testing and writing of scientific papers related to environmental assessment.

ENTOM 463 Invertebrate Pathology
Spring. 4 credits. Prerequisites: one year of introductory biology. S-U grades optional. Lecs, M W F 9:05; lab, W 1:25–4:25. Offered alternate years. A. E. Hajek.
Lecture presents principles of pathology as applied to invertebrates. Topics explored include noninfectious and infectious diseases caused by viruses, bacteria, fungi, protozoa, and nematodes, epizootiology of insect diseases, and use of pathogens for control. Laboratory involves a diversity of pathogens and hosts using techniques such as microinjection, electrophoresis, immunoassay, density gradient centrifugation, soil extraction, and computer simulation.

[ENTOM 470 Ecological Genetics]

[ENTOM 471 Freshwater Invertebrate Biology and Biomonitoring
Spring. 5 credits. Recommended: ENTOM 212. S-U grades optional. Lecs, T R 9:05; labs, T R 1:25–4:25. Offered alternate years. Not offered spring 2004; next offered spring 2005. B. L. Peckarsky.
Lecture explores the morphology, physiology, phylogeny, life histories, behavior, feeding ecology, and evolution of macroscopic freshwater invertebrates with an emphasis on contrasting the attributes of aquatic and terrestrial insects. Laboratory involves field collections and identification of invertebrates and stresses the use of taxonomic keys. Students prepare a collection of freshwater invertebrates or conduct a project using freshwater invertebrates to biomonitor stream habitat quality.]

ENTOM 477 Biological Control
Fall. 3 credits. Prerequisites: ENTOM 212, BIOEE 261, and permission of instructor. Lecs, T R 9:05; lab, T 1:25–4:15. Offered alternate years. J. Nyrop and A. Hajek.
Lectures present case studies exploring classical biological control, augmentation and conservation, and applications of strategies to control arthropods and weeds. Labs focus on selected concepts in more depth using live organisms.

[ENTOM 483 Insect Physiology
Fall. 5 credits. Prerequisite: ENTOM 212 or permission of instructor. Lecs, M W F 11:15; lab W 1:25–4:25 and a disc, TBA. Offered alternate years. Not offered fall 2003; next offered fall 2004. C. Gilbert.
An introduction to the often unique ways in which insects have met their basic needs. Each organ system is examined with emphasis on basic principles and specific examples. Students are also introduced to some common methods used in physiological research and to the critical reading of scientific literature.]

[ENTOM 490 Toxicology of Insecticides (also TOX 490)
Spring. 3 credits. Prerequisite: general chemistry. S-U grades optional. Lecs, M W F 9:05. Offered alternate years. Not offered spring 2004; next offered spring 2005. J. G. Scott.
The history, metabolism, and mechanism of action of genetically modified, synthetic, and naturally occurring insecticides. Insecticide resistance, resistance mangement, and new approaches to insect control with genetically modified organisms are discussed.]

ENTOM 494 Special Topics in Entomology
Fall or spring. 4 credits maximum. S-U grades optional. Staff.
The department teaches "trial" courses under this number. Offerings vary by semester, and are advertised by the department before the semester starts. Courses offered under the number will be approved by the department curriculum committee, and the same course is not to be offered more than twice under this number.

ENTOM 497 Individual Study in Entomology
Fall or spring. Credit TBA. Prerequisite: permission of instructor. Students must register with an Independent Study form (available in 140 Roberts Hall). Staff.

ENTOM 498 Undergraduate Teaching
Fall or spring. Credit TBA. Prerequisite: permission of instructor. Undergraduate teaching assistance in an entomology course by agreement with the instructor. Students must register with an 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.

[ENTOM 631 Systematics of the Coleoptera]

[ENTOM 632 Advanced Coleopterology]

ENTOM 634 Special Topics in Systematic Entomology
Fall or spring; taught on demand. 2–4 credits. Prerequisite: permission of instructor. Staff.
Lectures on the classification, evolution, and bionomics of selected taxa, with accompanying laboratory studies on identification and comparative morphology. Collections sometimes required.

ENTOM 635 Insect Molecular Systematics
Spring. 2 credits. Prerequisite: permission of instructor. Offered alternate years. TBA. B. N. Danforth.
Analysis of DNA sequence variation can provide a powerful tool for resolving problems in insect systematics, from species level taxonomic decisions to higher level (ordinal) relationships. This course introduces students, through readings of the primary literature, to the basic methods of insect molecular systematics, including DNA extraction, gel electrophoresis, PCR, DNA purification, and DNA sequencing (manual and automated). Results are analyzed using available computer programs. Students are encouraged to collect preliminary data for thesis or post-doctoral research.

ENTOM 644 Advanced IPM: Theory and Implementation
Spring. 1–4 credits. S-U grades optional. Lecs, M W F 10:10. Coordinator: J. E. Losey.
This advanced course in integrated pest management (IPM) consists of a rotating series of four-week intensive modules on specialized topics. Topics range from basic ecology and genetics of pests and their natural enemies to

specific strategies for pest management implementation. The course is designed to provide advanced IPM instruction for graduate and upper-level undergraduate students with intermediate backgrounds in IPM. In special cases, students with little or no background in IPM seeking intensive instruction on a specialized topic may enroll with permission of the instructor. Each module is a unique unit and students may take any or all modules each time the course is offered. Prerequisites and grading procedures are determined by the instructor(s) of each module. Potential modules include: Insecticide Resistance and Resistance Management—J. Scott: Entomology (Ithaca); Crop Protection Decision Making—J. Nyrop: Entomology (Geneva); Greenhouse and Floriculture IPM—J. Sanderson: Entomology (Ithaca); Agricultural Acarology—J. Sanderson: Entomology (Ithaca); Fruit Arthropod IPM Methods in NY—A. Agnello, G. English-Loeb: Entomology (Geneva); Plant Resistance—W. Tingey: Entomology (Ithaca); Aerial Sampling in Pest Management—E. Shields: Entomology (Ithaca); Conservation Biological Control—J. Nyrop and G. English-Loeb: Entomology (Geneva); Insect Population Ecology—J. Losey: Entomology (Ithaca); Veterinary Entomology—IPM Methods for NY—P. Kaufman and D. Rutz: Entomology (Ithaca); Chemical Conversations and Integrated Pest Management—C. Linn: Entomology (Geneva).

ENTOM 652 Seminar in Medical Entomology
Fall. 1 credit. Prerequisite: permission of instructor or ENTOM 352. Disc, TBA. L. C. Harrington.
Addresses a variety of topics in the field of medical entomology. The course consists of weekly discussions of key papers on topics chosen by participating students and faculty.

ENTOM 662 Insect Behavior Seminar
Spring. 2 credits. Prerequisites: permission of instructor and ENTOM 212 and BIONB 221 or equivalents. S-U grades optional. Offered alternate years. Hours TBA. C. Gilbert.

[ENTOM 670 Seminar on Biological Control
Fall. 1 credit. Prerequisite: ENTOM 463 or 644 or permission of instructor. S-U grades optional. Hour TBA. Offered alternate years. Not offered fall 2003; next offered fall 2004. A. E. Hajek.
This is an upper level seminar series in biological control covering topics chosen by participating students and faculty. The format consists of weekly discussion groups with each participant presenting at least one oral report based on independent reading or research focussing on a central theme for the semester.]

[ENTOM 672 Seminar in Aquatic Ecology
Spring. 1 credit. Prerequisites: permission of instructor or either ENTOM 456, 471, or BIOEE 261, 462. S-U grades optional. Hours TBA. Not offered spring 2004; next offered spring 2005. Offered alternate years. B. L. Peckarsky.
Discussion and analysis of current topics in the ecology of streams, lakes, and marine ecosystems, including student-generated synthesis of key papers in the literature. Generally appropriate for graduate students only. Interested undergraduates must contact the instructor.]

[ENTOM 685 Seminar in Insect Physiology
Spring. 1 credit. S-U grades optional. Prerequisite: permission of instructor. Hours TBA. Offered alternate years. Not offered spring 2004; next offered spring 2005. C. Gilbert.]

ENTOM 707 Individual Study for Graduate Students
Fall or spring. Credit TBA. Prerequisite: permission of instructor. Not for thesis research. Staff.

ENTOM 709 Teaching Entomology
Credit TBA. Staff.
Teaching entomology or for extension training.

ENTOM 767 Current Topics in Entomology
Fall. 1 credit. Required of graduate students pursuing a degree in the field of Entomology. Lecs and disc, TBA. Coordinator: E. J. Shields.
This course provides lectures, readings, and discussion to introduce first-year graduate students to the research activities of faculty in the graduate field of Entomology. Class meets weekly for one hour.

ENTOM 800 Master's-Level Thesis Research
Credit TBA. Prerequisite: permission of instructor. S-U grades optional. Staff.

ENTOM 900 Doctoral-Level Thesis Research
Credit TBA. Prerequisite: permission of instructor. S-U grades optional. Staff.

Jugatae Seminar
Fall and spring.
A 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.

FLORICULTURE AND ORNAMENTAL HORTICULTURE

See Horticulture.

FREEHAND DRAWING AND SCIENTIFIC ILLUSTRATION

Freehand Drawing and Scientific Illustration courses are offered through the Department of Horticulture and are described in the section "Freehand Drawing and Scientific Illustration."

FOOD SCIENCE

J. H. Hotchkiss, chair; T. E. Acree, D. M. Barbano, C. A. Batt, K. J. Boor, J. W. Brady, D.P. Brown, J. M. Brown, R. B. Gravani, T. Henick-Kling, H. T. Lawless, C. Y. Lee, R. H. Liu, D. D. Miller, C. Moraru, S. J. Mulvaney, J. M. Regenstein, S. S. H. Rizvi, J. S. Roberts, K. J. Siebert, M. Wiedmann.

Note: class meeting times are accurate at the time of publication. If changes are necessary, the department will provide new information as soon as possible.

FOOD 101 Science and Technology of Foods
Fall. 1 credit. S-U grades only. M 1:25–2:15. J. H. Hotchkiss and staff.
This course explores the application of science and technology to foods. Lectures will 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.

FOOD 102 Exploring Food Processing
Spring. 1 credit. S-U grades only. F 12:20, 5 field trips; one on F 12:30–4:00, four on F 12:30–5:30. D. P. Brown.
A series of seminars on current technological and regulatory developments in food science. Field trips to five commercial food manufacturing/processing plants are used to illustrate the application of current technologies. A course project, using the Food Science Alumni Network, is required.

FOOD 150 Food Choices and Issues
Spring. 2 credits. S-U grades optional. T R 12:20–1:10. R. B. Gravani and D. D. Miller.
This course provides Cornell students with the knowledge needed to make healthy food choices. Topics include the U.S. food system; relationships between diet and health; food processing; food safety; and discussions of contemporary issues relating to food quality, safety, and nutrition. Students assess the nutritional quality of their personal diets and learn how to make changes to improve their diets.

FOOD 200 Introductory Food Science
Fall. 3 credits. Prerequisite: college-level courses in chemistry and biology. Letter grades only. M W F 11:15–12:05. J. H. Hotchkiss.
A comprehensive introduction to the principles and practice of food science and technology. Topics include: chemistry of foods; nutritional significance; food formulation, preservation, and processing; microbiology and fermentations; composition and processing of food commodities; and contemporary issues including food safety, regulation, and world food needs. Interrelationships between the chemical, physical, nutritional, and quality properties of foods as affected by formulation, processing, and packaging are stressed.

FOOD 210 Food Analysis
Spring. 3 credits. Prerequisite: CHEM 208 or equivalent. Enrollment limited to 24 students. Lecs, W F 1:25–2:15; lab, M 12:20–3:20. R. H. Liu and J. M. Brown.
Introduces basic analytical techniques for food analysis and other biological analysis. Emphasizes fundamental principles of analytical chemistry, basic laboratory techniques, and modern instrumental methods. Gravimetric, volumetric, and spectrophotometric methods, gas chromatography (GC), high-performance liquid chromatography (HPLC), infrared spectra (IR), and atomic absorption spectrometry are discussed.

FOOD 250 Kosher and Halal Food Regulations
Spring. 2 credits. Sophomore standing and above. S-U grades optional. Lec M 7:30–9:25 p.m. J. M. Regenstein.
A comprehensive introduction to kosher and halal foods in the American food industry with

some coverage of home practices. The kosher food laws, their origin, and their application in modern food processing are examined. The nature of the kosher supervision industry in America is described. Halal laws are also examined and the interactions between the two communities explored. Current food-related issues in both communities are reviewed, including recent court decisions. Some aspects of ethnic foods may also be considered.

FOOD 290 Meat Science (also AN SC 290)
Fall. 2 or 3 credits. Letter grades only. Lecs, T R 11:15; lab M or R 12:20–3:20. Lab cannot be taken without lecture. D. E. Shaw.
An introduction to meat science through a study of the structure, composition, and function of muscle and its conversion to meat. Properties of fresh and processed meat, microbiology, preservations, nutritive value, inspection, and sanitation are also studied. Laboratory exercises include anatomy, meat-animal slaughter, meat cutting, wholesale and retail cut identification, processing, inspection, grading, quality control, and meat merchandising. An all-day field trip to commercial meat plants may be taken.

FOOD 321 Food Engineering Principles
Fall. 3 credits. Prerequisites: FOOD 200 and introductory physics. Letter grades only. M W F 9:05–9:55. S. S. H. Rizvi.
Introduces the engineering principles underlying food processes and equipment. Topics covered include thermodynamics, mass and energy balance, fluid mechanics, heat and mass transport, and refrigeration and psychrometrics.

FOOD 351 Milk Quality
Fall. 1 credit. Prerequisite: AN SCI 250 or equivalent or permission of instructor. Letter grades only. F 12:20. M. Wiedmann.
This course 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.

FOOD 394 Applied and Food Microbiology (also BIOMI 394)
Fall. 2–3 credits. Prerequisites: BIOMI 290–291. M W F 12:20–1:10. C. A. Batt.
Microorganisms play a central role in a variety of food, agricultural, and environmental processes. This course presents a comprehensive survey of the roles that microorganisms play in industrial/biotechnological processes as well as their importance in the safety and production of foods. Issues related to the biochemistry, genetics, and physiology of microorganisms important in these processes are reviewed. A two-credit core section on food microbiology is complemented by a one-credit section on industrial/biotechnology applications.

FOOD 395 Food Microbiology Laboratory
Fall. 2 credits. Prerequisite: BIOMI 291 or equivalent. Letter grades only. M W 2:00–4:25. J. M. Brown.
Work includes study of the physiological characteristics of representative food microorganisms, practice in using general and rapid methods for microbiological testing and control of food products, and practice in the application of a systematic approach to controlling the safety of foods, or addressing a food safety issue.

[FOOD 396 Food Safety Assurance
Spring. 2 credits. Prerequisite: MICRO 290 or permission of instructor. T R 9:05–9:55. Offered alternate years. Next offered spring 2005, not offered 2004. R. B. Gravani.
This course provides information on procedures to control biological, chemical, and physical hazards and assure the safety of foods. Topics include discussions on the Hazard Analysis Critical Control Point (HACCP) concept, good manufacturing practices, prerequisite programs, and the application of current technologies in reducing the risk of foodborne illnesses. Case studies and exercises are used to demonstrate and apply the key principles that are discussed.]

FOOD 400 Current Topics in Food Science and Technology
Spring. 1 credit. Limited to seniors. S-U grades only. R 3:35–4:25. Staff.
Discussion of current topics in food science. Topics vary and are chosen from scientific literature and popular press.

[FOOD 401 Concepts of Product Development
Spring. 2 credits. Prerequisite: FOOD 200 or equivalent. Letter grades only. M W 11:15–12:05. Offered alternate years. Not offered 2004, next offered 2005. J. H. Hotchkiss.
A discussion of the sequence of events in developing and marketing new food products. Topics include food formulation, packaging and labeling, food additive and ingredient regulations, taste panels, market testing, market research, and patents.]

[FOOD 405 Managing Food Waste without Trashing the Environment
Spring. 2 credits. Prerequisite: FOOD 200 or its equivalent. Letter grades only. Lec, M 12:30–2:15; lab, M 2:30–4:25. Offered alternate years. Not offered spring 2004; next offered spring 2005. J. M. Regenstein.
A look at the various waste streams generated by food plants, institutional feeders, supermarkets, and restaurants. What is the role of waste minimization? What technologies can control or remediate the problems? What are the disposal, composting, and recycling options? What are the legal requirements locally, state-wide, and nationally that affect various food waste processes? This course serves as a general introduction to available waste management technologies and to policy issues faced by a wide range of businesses and production plants.]

FOOD 406 Dairy and Food Fermentations
Fall. 2 credits. Prerequisite: BIOMI 290. Letter grades only. R 12:20–2:15. M. Wiedmann.
This is a 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.

FOOD 410 Sensory Evaluation of Food
Fall. 2–3 credits (1 lab credit). Prerequisite: statistics. Letter grades only. Lec, T R 9:05–9:55; lab, F 1:25–4:25. H. T. Lawless.
Topics include the sensory evaluation methods used to test the flavor, appearance, and texture of foods by quantitative description and simple difference testing; consumer testing for product acceptability; sensory tests in quality control; strategic product research; and product development. The psychological principles in sensory testing and statistical methods for sensory data analysis are presented. The laboratory provides first hand experience in organizing and conducting sensory tests and an introduction to online date collection and analysis. Undergraduate Food Science majors are required to take both the lecture and the laboratory.

FOOD 415 Principles of Food Packaging
Spring. 3 credits. Letter grades only. M W F 9:05–9:55. Offered alternate years. Not offered spring 2005. J. H. Hotchkiss.
The chemical and physical properties and manufacture of the basic materials used to construct packaging are discussed. The influence of packaging on shelf life is presented. Emphasis is on newer packaging technologies and materials. Economics, design, and regulation of food packaging are briefly presented.

FOOD 417–418 Food Chemistry I and II
Spring 417; fall 418. 3 credits, spring; 2 credits, fall. Prerequisites: CHEM 257 or BIOBM 330 or 331. S-U or letter grade. FOOD 417, M W F 9:05–9:55; FOOD 418, M W 9:05–9:55. J. W. Brady.
A course on the chemistry of foods and food ingredients. The chemical and physical properties of water, proteins, lipids, carbohydrates, and other food components and additives are discussed in the context of their interactions and functional roles in foods. The effects of chemical changes during processing and storage on the quality and nutritional aspects of several food commodity groups (dairy, meat, fruits and vegetables, cereals and legumes) are described.

FOOD 419 Food Chemistry Laboratory
Spring. 2 credits. Prerequisites: biochemistry (BIOBM 330 or 331 or CHEM 257 or equivalent) and concurrent registration in food chemistry (FOOD 417). W 12:20–4:25. D. D. Miller.
Laboratory exercises dealing with the chemical properties of food components and changes they undergo in processing and storage. Relationships between the chemical composition of foods and functional, nutritional, and organoleptic properties are stressed. Laboratory techniques commonly used in food research are introduced. A laboratory research project is required. This 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*..

FOOD 423 Physical Principles of Food Preservation and Manufacturing
Fall. 3 credits. Prerequisites: FS 321. Letter grades only. Lec, T R 11:15–12:05; disc, T 12:20–2:15. S. J. Mulvaney and J. S. Roberts.

This course emphasizes the fundamental principles that underlie much of food preservation and manufacturing. A systems analysis approach is used 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.

FOOD 425 Dairy Foods Processing
Spring. 3 credits. Prerequisites: FOOD 321, 394, 417, 418, and 423. Letter grades only. Lec, M W 9:05; lab, W 1:25–4:25. C. Moraru.
A lecture/laboratory course focused on principles and practices fundamental to the manufacture, evaluation, and storage of dairy foods. A variety of common food processing unit operations are discussed and demonstrated using dairy foods as examples. Students develop an understanding of the science and technology that underpins modern dairy foods processing and gain hands-on experience in the manufacture of safe, high quality dairy products ranging from pasteurized milk to cheddar cheese. Laboratories are conducted in a food processing pilot plant facility. One full-day field trip to operating dairy plants in the area will be scheduled during the semester.

FOOD 430 Understanding Wine and Beer
Spring. 3 credits. Prerequisites: introductory biology and chemistry or permission of instructor. Students must be 21 years old by the first day of class (Jan. 26, 2004) to enroll. S-U grades optional. T R 1:25–3:20. T. Henick-Kling, T. E. Acree, H. T. Lawless, and K. J. Siebert.
An introduction to wine and beer appreciation through the study of fermentation biology, product composition, and sensory perception. Samples of wines and beers will be used 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.

[FOOD 447 International Postharvest Food Systems
Fall. 2 or 3 credits. Prerequisite: freshman chemistry. S-U grades optional. T R 10:10–11:00. Offered alternate years. Next offered fall 2004. Staff.
An interdisciplinary course designed for all undergraduate and graduate students. Describes postharvest food losses and methods to reduce the loss. Topics include storage and care of unprocessed and minimally processed foods such as cereal grains, fruits, vegetables, tubers, and fish; biology and control of fungi, insects, and vertebrates in foods; chemical causes of quality loss; effects of climate; and economic and social factors affecting food preservation and storage. Emphasis is given to the problems in developing countries. The third credit requires a written case study of a country or commodity.]

FOOD 450 Fundamentals of Food Law
Spring. 2 credits. Letter grades only. Lec M 1:25–3:20. Offered alternate years. Not offered spring 2005. 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. Emphasis is on the Food and Drug Administration and U.S. Department of Agriculture regulations, but the course also refers to other regulatory agencies. Emphasis is placed on how a food or agricultural professional interacts with this legal system during legislative action, regulatory rule making, and with respect to compliance.

[FOOD 456 Advanced Concepts in Sensory Evaluation
Spring. 2 credits. Prerequisite: FOOD 410. S-U grades optional. Offered alternate years. Offered spring 2005. F 1:25–3:20. H. T. Lawless.
Readings and discussions of primary source materials in sensory evaluation, including recent advances in sensory methods, historical perspectives, psychophysics, perceptual biases, and multivariate statistical approaches to sensory data. A major independent research project is conducted on a current issue in sensory evaluation.]

FOOD 494 Special Topics in Food Science
Fall or spring. 4 credits maximum. S-U grades optional. Staff.
The department teaches "trial" courses under this number. Offerings vary by semester, and are advertised by the department before the semester starts. Courses offered under the number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

FOOD 497 Individual Study in Food Science
Fall or spring. 3 credits maximum. Prerequisite: permission of instructor. Students must register with an Independent Study form (available in 140 Roberts Hall). S-U grades optional. Staff.
May include individual tutorial study, a special topic selected by a professor or a group of students, or selected lectures of a course already offered. Since topics vary, the course may be repeated for credit.

FOOD 498 Undergraduate Teaching Experience
Fall or spring. 3 credits maximum. Prerequisite: permission of instructor. Students must register with an 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.

FOOD 499 Undergraduate Research in Food Science
Fall or spring. 4 credits maximum. S-U grades optional. Students must register with an Independent Study form (available in 140 Roberts Hall). This course may be repeated for credit. Staff.
Students conduct original research directed by a food science faculty member.

FOOD 599 Research for Lausanne Exchange Students
Fall/spring. 10 credits maximum. Prerequisite: permission of instructor. S-U grades optional. Staff.
Undergraduate senior thesis research for Lausanne exchange students only. Students conduct original research directed by a food science faculty member. A final report is written and presented to the faculties of both Cornell University and the University of Lausanne.

FOOD 600 Seminar in Food Science
Fall and spring. 1 credit. S-U grades only. Required for all graduate students in the field of Food Science and Technology. T 4:00–5:00. Staff.
A 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. Required of all graduate students in the field of Food Science and Technology. Strongly recommended for graduate students minoring in Food Science and Technology.

[FOOD 604 Chemistry of Dairy Products
Fall. 2 credits. Limited to 16 students. Prerequisites: introductory organic and biochemistry, food chemistry and a dairy foods processing course. Permission of instructor required, if lacking prerequisites. Letter grades only. Offered alternate years. Next offered fall 2004. F 1:25–3:20. D. M. Barbano.
A detailed study of milk constituents and their properties. The chemical and physical changes that occur in dairy products prior to, during, and after processing are covered. This course emphasizes current research in dairy chemistry.]

FOOD 607 Advanced Food Microbiology
Spring. 2 credits. Prerequisites: Microbiology (BIOMI 290), Food Microbiology (FOOD 394). Letter grades only. Offered alternate years. Not offered spring 2005. M W 11:15. M. Wiedmann.
This two-credit course explores advanced topics in food microbiology. A major emphasis is placed on critical evaluation of current literature and on microbiological concepts that affect food microbiology. Specific areas that are 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).

[FOOD 608 Chemometric Methods in Food Science
Fall. 2 credits. Prerequisites: basic statistics and chemistry or permission of instructor. S-U grades optional. W 1:25–3:20. Offered alternate years. Next offered fall 2004. K. J. Siebert.
Food science applications using multivariate statistical methods (chemometrics) include extracting information from large data sets, modeling molecular and product properties,

optimizing analytical methods and processing operations, discerning relationships between product composition and sensory properties, identifying cultivars or species, and detecting adulteration. The techniques covered are also applicable to many other problems in biology and chemistry.]

FOOD 616 Flavors—Analysis and Applications
Spring. 2 credits. S-U grades optional. Lec, F 1:25; disc, F 2:30. Offered alternate years. Not offered 2005. H. T. Lawless and T. E. Acree.
An 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. The course surveys taste, aroma and volatile flavors, and trigeminal stimuli from the perspectives of chemical structures, methods of analysis, uses and interactions in food systems, and consumer acceptance.

FOOD 620 Food Carbohydrates (also NS 620)
Spring. 2 credits. Limited to qualified seniors and graduate students. Prerequisite: BIOBM 330 or equivalent. T R 10:10–11:00. Offered alternate years. Not offered spring 2005. B. A. Lewis and J. W. Brady.
A consideration of the chemistry of carbohydrates, including sugars, starches, pectins, hemicelluloses, gums, and other complex carbohydrates. Emphasis is on the intrinsic chemistry and functionality in food systems and the changes occurring during food processing and storage.

[FOOD 621 Food Lipids
Spring. 2 credits. Letter grade only. Prerequisite: a basic biochemistry course. Offered alternate years. Next offered spring 2005. M W 2:30–3:20. R. H. Liu.
An advanced course in food lipids. Describes the physical, chemical, biochemical, and functional properties of lipids. Emphasis is on lipid oxidation, emulsions, and functional foods associated with lipids.]

FOOD 664 Food Polymer Science: Principles and Applications
Spring. 2 credits. Prerequisites: Introductory chemistry and physics. T R 12:20–1:10. Offered alternate years. S. J. Mulvaney.
Integration of 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. Emphasis is on 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.

[FOOD 665 Food and Bioprocessing Systems
Spring. 3 credits. Prerequisite: FOOD 423. Letter grades only. Offered alternate years. Next offered spring 2005. Lec, T R 12:20; disc T 1:25–2:15. S. S. Rizvi, S. J. Mulvaney.
Fundamental and quantitative analyses of processes for manufacture of foods and related biological products. Topics covered include centrifugation, membranes, supercritical fluids, extrusion, high pressure, pulsed electric field, thermal processing, drying and crystallization.]

FOOD 694 Special Topics in Food Science
Fall or spring. 4 credits maximum. S-U grades optional. Staff.
The department teaches "trial" courses under this number. Offerings vary by semester, and are advertised by the department before the semester starts. Courses offered under the number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

FOOD 695 Current Readings in Food Science
Fall and spring. 1 credit. Prerequisite: 300- to 400-level course relevant to the chosen topic. S-U grades only. Lec., by arrangement/1 hour per week. Staff.
A seminar series on current topics chosen by participating faculty 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 (but are not limited to) Food Microbiology and Food Safety; Food Chemistry; Packaging; Food Engineering. This course can be taken multiple times. Graduate students in Food Science are strongly encouraged to enroll in this course. Interested students should contact the designated instructor(s) for each term.

FOOD 698 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.

FOOD 800 Masters-Level Thesis Research
Fall or spring. Credit TBA. Maximum credit, 12. Prerequisite: limited to master's candidates; permission of Special Committee chair. S-U grades only. Graduate faculty.

FOOD 900 Graduate-Level Thesis Research
Fall or spring. Credit TBA. Maximum credit, 12. Prerequisite: limited to doctoral students who have not passed the "A" exam; permission of Special Committee chair. S-U grades only. Graduate faculty.

FOOD 901 Doctoral-Level Thesis Research
Fall or spring. Credit TBA. Maximum credit, 12. Prerequisite: limited to doctoral students who have passed the "A" exam; permission of Special Committee chair. S-U grades only. Graduate faculty.

FREEHAND DRAWING AND SCIENTIFIC ILLUSTRATION

Freehand Drawing is a program in the Department of Horticulture.

[FR DR 109 Nature Drawing]

[FR DR 214 Watercolor]

FRUIT AND VEGETABLE SCIENCE: HORTICULTURAL SCIENCE

See Horticulture.

HORTICULTURE

M. P. Pritts, chair; N. L. Bassuk, R. R. Bellinder, M. P. Bridgen, L. Cheng, L. E. Drinkwater, M. Eames-Sheavly, L. A. Ellerbrock, S. Gan, G. L. Good, D. E. Halseth, C. P. Mazza, I. A. Merwin, W. B. Miller, J. Mt. Pleasant, K. W. Mudge, A. M. Petrovic, D. A. Rakow, A. Rangarajan, F. S. Rossi, C. B. Watkins, T. C. Weiler, L. A. Weston, T. H. Whitlow, H. C. Wien, D. W. Wolfe

HORT 101 Horticultural Science and Systems
Fall. 4 credits. Lec, M W F 9:05; lab, W 1:25–4:25. I. A. Merwin.
The 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 190 Sustainable Agriculture (also CSS 190)
Fall. 2 or 3 credits. Lec, R 10:10; lab, M or T 2:00–4:25. C. J. Peters and J. Mt. Pleasant.
Designed to be an enjoyable introduction to basic food production resources (soils, crops, and climates) and emphasizes scientific principles of management that conserve or renew those resources for continuing benefit to society. The information is of general value for nonmajors and students new to the field. Laboratories include several field trips and stress hands-on experience with soils, crops, and descriptive climatology. Written assignments are prepared for the web. Extra credit can be earned by participation in team preparation and delivery of a lesson in sustainable agriculture.

HORT 201 The Art of Horticulture
Fall and spring. 2 credits. Studio T 1:25–4:25. M. Eames-Sheavly.
This introductory course explores the breadth of the art and beauty of horticulture. It addresses the symbolic use of plants and gardens in art, the natural history of horticulture as recorded in art, the artist's relationship with the garden, and the use of plant materials in art forms. Students will have ample opportunity to paint, illustrate, photograph, and write about plants and gardens.

[HORT 225 Vegetable Production
Fall. 4 credits. Lecs, M W F 11:15; lab, W 2:00–4:25; 4 field trips (September). W 11:15–6:00. L. A. Ellerbrock.
Intended for those interested in the production, processing, and marketing of vegetables. Topics included are techniques, problems, and trends in the culture, harvesting, and storage of the major vegetable crops. Field trips to conventional and organic farms and hands-on experience in growing vegetables in the greenhouse are included.]

[HORT 243 Taxonomy of Cultivated Plants (also BIOPL 243)
Fall. 4 credits. Prerequisite: 1 year of introductory biology or written permission of instructor. May not be taken for credit after BIOPL 248. Lec, M W F 10:10–11:00; lab, M or W 2:00–4:25. Offered even years. M. A. Luckow.
A study of ferns and seed plants, their relationships, and their classification into families and genera, emphasizing cultivated plants. Particular emphasis is placed on gaining proficiency in identifying and distinguishing families and in preparing and using analytic keys. Attention is also given to the economic importance of taxa, to the basic taxonomic literature, and to the elements of nomenclature.]

HORT 300 Herbaceous Plant Materials
Fall. 3 credits. Fee for field trip: $75. Lecs, T R 10:10; lab, T 2:00–4:25. 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 301 Plants for Interiors
Spring. 3 credits. Lecs, M W 11:15; lab, M 1:25–4:25. Offered even years. T. C. Weiler.
Study of plants for interiors: identification, design characteristics, and cultural requirements; use of plants as elements of planting design (trees, shrubs, groundcovers, and accent plants including potted flowering plants and cut flowers); the interior landscape industry (organization, bidding, installation, maintenance). Required three-day field trip, estimated cost, $130.

[HORT 310 Production and Marketing of Greenhouse Crops
Spring. 4 credits. Letter grade only. Lecs, T R 10:10; lab R 1:25–4:25. Offered odd years. T. C. Weiler.
Covers basics of establishing a greenhouse operation, growing crops in optimized environments, and serving niche or mass markets. The course discusses technology basics including structures and equipment, systems for heating and cooling, lighting, irrigating and fertilizing, materials handling; environmental stewardship and integrated pest management; and production management. Also covered are world centers of greenhouse crop production; culture of cut, pot, bedding, vegetable, and fruit crops in greenhouses, emphasizing predictive harvesting through environmental, physical, and chemical management of growth and development. Each student grows one or more crops. Required three-day field trip, estimated cost, $130.]

HORT 317 Seed Science and Technology (also CSS 317)
Fall. 3 credits. Prerequisites: BIOPL 241 or an equivalent course approved by instructor. Letter grade only. Offered odd years. Lecs, T R 11:40–12:30; lab, R 1:25–4:25. A. G. Taylor, Geneva Experiment Station.
Study of the principles and practices involved in seed production, conditioning, storage, quality management, seed enhancements and stand establishment. Information is applicable to various kinds of agricultural and horticultural seeds. Hands-on laboratory experience.

[HORT 330 Turfgrass Management
Fall. 4 credits. Prerequisite: CSS 260 or permission of instructor. Lec, M W F 11:15; lab, F 1:25–4:25. A. M. Petrovic.
Study of the scientific principles involved in the management of golf courses, athletic fields, parks and industrial grounds, and commercial sod production. Considerations given to principles of establishment, mowing, irrigation, growth and development, species selection, pest management, and nutrition in the management of turfgrass sites.]

HORT 400 Principles of Plant Propagation
Fall. 3 credits. Prerequisites: BIOPL 242 and 244 or another course in plant physiology. Lecs, T R 9:05; lab, R 1:25–4:25. K. W. Mudge.
Sexual (seed) propagation and asexual (vegetative) propagation including cuttage, graftage, tissue culture, layering, and specialized vegetative reproductive structures. Physiological, environmental, and anatomical principles and industry applications are stressed in lecture and hands-on skills in laboratories. Examples include both temperate and tropical horticultural, agronomic, and forestry crops.

HORT 401 The How, When, and Why of Grafting—A Distance Learning Approach
Spring. 2 credits. Lec: autotutorial (web); lab: greenhouse/autotutorial (web/cd); discussion: web. One introductory face-to-face meeting TBA. K. W. Mudge.
A ten-week, web/CD-based autotutorial approach to the principles and practices of grafting and budding as applied to plant propagation. Emphasis is on the role of grafting in modern horticultural practice and on student development of hands-on grafting skills. Instruction involves web-based asynchronous presentation of lecture and lab materials (web, CD-rom), asynchronous discussion, and autotutorial hands-on grafting lab exercises.

HORT 415 Principles and Practices of Agroforestry (also NTRES 415 and CSS 415)
Fall. 3 credits. Prerequisite: senior or graduate standing or permission of instructor. S-U option. Lec, M W F 10:10–11:00. Optional laboratory, HORT 416 (also NTRES 416 and CSS [SCAS] 416). Offered odd years. E. Fernandes, K. Mudge, L. Buck.
An introduction to modern and traditional agroforestry systems which involves spatial or temporal integration of multipurpose woody plants (trees or shrubs) with annual or perennial crops or with livestock. Interactions between woody and nonwoody components of agroforestry systems are considered, based on above- and below-ground processes. The sustainability of agroforestry systems is critically examined from biophysical, socio-economic, and policy perspectives.

HORT 416 Principles and Practices of Agroforesty—Laboratory (also NTRES 416 and CSS 416)
Fall. 1 credit. Optional lab component of HORT 415 (also NTRES and CCS [SCAS]). S-U grades optional. Prerequisites: junior, senior, or graduate standing or permission of instructor; prior or concurrent enrollment in HORT 415. W 1:25–4:25. Offered odd years. K. Mudge, E. Fernandes, L. Buck.
An integrated set of laboratory and field exercises designed to develop competency in diagnostic and management skills applied to agroforestry practice. Sessions include field trips to local practitioners as well as working demonstration farms and forests, case study design and analysis, use of computer-based sources of information, and practical skills with woody plants including identification, propagation, planting, pruning, and measurement.

HORT 420 Principles of Nursery-Crop Production
Fall. 4 credits. Prerequisite: HORT 400. Lecs, M W F 9:05; lab, M 2:00–4:25. Field trips. Offered odd years. G. L. Good.
Principles of commercial production of nursery crops to marketable stage, including postharvest handling and storage. Term project required. Field trips are made to commercial nurseries.

HORT 425 Postharvest Biology of Horticultural Crops
Fall. 3 credits. Lecs, M W 9:05–9:55; lab, W 1:25–4:25. Offered odd years. S. Gan.
A study of the biological processes controlling physical and chemical changes in harvested yet living horticultural crops or their parts. The theoretical principles and fundamental processes underlying these changes will be discussed. Strategies and practical handling requirements/conditions for storage, transportation, and quality monitoring of harvested horticultural crops will also be discussed.

[HORT 435 The Care of Woody and Herbaceous Plants in the Landscape
Fall. 4 credits. Prerequisites: HORT 301 and 491. Lecs, M W F 9:05; lab, M 2:00–4:25. Offered even years. G. L. Good.
A study of the practices involved in the maintenance of ornamental plants in the landscape. The major emphasis is on post-planting techniques, including water and fertilization management, weed management, pruning, and general tree care. Labs have a hands-on focus.]

HORT 440 Restoration Ecology
Fall. Weeks 1–10. 3 credits. Prerequisite: upper division or graduate standing. Letter grade only. Lecs, T R 10:10; lab, F 1:25–4:25. Offered odd years. T. H. Whitlow.
An inquiry based treatment of the principles and methods of ecology, conservation biology, hydrology, soil science and related disciplines applied to the restoration of degraded terrestrial ecosystems. Weekly labs, four weekend field trips, and a semester-long project provide many opportunities for experiential learning. Substantial commitment outside of the classroom is expected.

[HORT 442 Berry Crops: Culture and Management
Fall. 3 credits. Lecs, M W 9:05; lab, M 1:25–4:25. Offered even years. M. P. Pritts.
A study of the evolution, breeding history, and physiology of strawberries, raspberries, blackberries, blueberries, and other minor small fruit crops, and of cultural practices that influence productivity, fruit quality, and pest damage. Marketing and economics are considered, and alternative production practices for both commercial and home gardeners are discussed. Frequent field trips enhance classroom activities.]

HORT 444 Vineyard Management
Fall. 3 credits. Lecs, T R 9:05; lab, R 1:30–4:25. Offered odd years. R. M. Pool.
Commercial grape production with an emphasis on the problems of production in cold climates. Students examine site selection, world and regional grape varieties, and the anatomical and physiological basis for vineyard management decision making. Laboratory exercises and field trips offer hands-on experience.

HORT 445 Ecological Orchard Management
Spring. 3 credits. Prerequisite: introductory biology. S-U grades optional. Lec T R 10:10; lab, T 1:25–4:25. Offered even years. I. A. Merwin.
The ecology and technology of deciduous tree-fruit production. Topics include basic tree and fruit physiology, orchard renovation and design systems, nutrition, irrigation and freeze protection practices, tree pruning and training, post-harvest fruit storage, marketing and economic spreadsheet models, monitoring and decision systems for integrated pest management, and efficient use of orchard equipment. Emphasis is on the agroecology of perennial crop systems, with labs providing hands-on experience in orchard management. Previous coursework in horticulture and other plant sciences is suggested.

HORT 449 Green Signals and Triggers—The Plant Hormones (also BIOPL 449)
Fall. 1 credit. Prerequisites: introductory biology course and BIOPL 242 or 342 or permission of instructor. S-U grades optional. Lecs, F 1:25–2:15. Offered odd years. P. J. Davies.
A study of the plant hormones and how they regulate plant growth and development. Topics include the discovery, role in growth and development, mode of action and practical uses of the plant hormones auxin, gibberellins, cytokinins, abscisic acid, ethylene, and brassinosteroids.

HORT 455 Mineral Nutrition of Crops and Landscape Plants (also CSS 455)
Spring. 3–5 credits. Prerequisite: CSS 260 and BIOPL 242, or equivalent. Lecs, M W F 9:05; lab, R 2:00–4:25. Offered even years. H. C. Wien and staff.
A modular course on principles of plant mineral nutrition and nutrient management. A mandatory module on principles is followed by others on agronomic crops, vegetables, floriculture, and fruit crops. Each module carries one credit; a minimum of three credits must be taken in one semester. By the end of the course, students understand the principles of mineral nutrient function in crop plants, are able to diagnose deficiencies by symptoms and tissue tests, and can devise organic and conventional nutrient management schemes that maximize productivity and mineral nutrient quality.

HORT 460 Plant-Plant Interactions
Spring. 3 credits. Prerequisite: any crop production or plant ecology course or permission of instructor. Lecs, T R 9:05; lab/disc, M 2:00–4:25. Offered even years. D. W. Wolfe.
This course utilizes our basic understanding of plant ecology and physiology to evaluate the mechanisms by which plants perceive "neighbors" and compete or positively interact with each other in natural and managed ecosystems. The emphasis is on agricultural systems, from tropical home garden polyculture, to pastures, to intensive row-crop monoculture. In laboratory exercises the effects of plant density and environmental factors such as light and fertility on plant interactions are quantified, and students gain first-hand experience in techniques such as isolation of allelochemicals and determination of weed thresholds.

[HORT 462 Physiology of Vegetables and Flowers
Spring. 4 credits. Prerequisite: BIOPL 242 or its equivalent. Lecs, M W F 9:05; lab/disc, M 2:00–4:25. Offered odd years. H. C. Wien.
Study of the physiological principles that govern growth, development and production of reproductive structures of vegetable crops and herbaceous ornamental plants. Processes of flower induction, fruit and seed set, and the balance of vegetative and reproductive growth, especially in perennials are emphasized. Practical hands-on greenhouse experiments and small group discussions illustrate the lecture material.]

HORT 466 Soil Ecology and Research (also CSS 466)
Spring. 4 credits. Prerequisites: one year of biology, ecology and CSS 260 or permission of instructor. Lecs, T R 10:10–11:25; lab W 1:25–4:25. J. E. Thies and L. E. Drinkwater.
Surveys the diversity of soil organisms and their roles in terrestrial ecosystems. The course covers the fundamental principles and features of biologically mediated processes in the soil and the function of soil organisms in the wider context of both managed and unmanaged ecosystems. The role of plant-microbe interactions in shaping the larger ecosystem will serve as the basis for comparing soil community structure and function across a variety of ecosystems. The class investigates the consequences of anthropogenic activities from local soil management to global change on soil biodiversity and microbially mediated soil processes. In the laboratory, students explore an array of methods for assessing soil biological community composition and microbially mediated processes in soil.

HORT 475 Golf Course Management
Fall. 2 credits. Prerequisite: HORT 330 or equivalent. Lecs, F 1:25–4:25. Offered odd years. A. M. Petrovic.
Advanced study in the management of golf course operations including selection of root zone materials, fertilization practices, integrated pest management practices, irrigation systems, environmental based decision making, personnel management, and financial operations. Analysis of a central New York golf courses provides the basis for discussion.

[HORT 476 Practical Problem Solving in Horticulture
Fall. 2 credits. Prerequisite: permission of instructor. Minimum class size for semester is 8 students. Lec/disc, W 1:25–4:25. Offered even years. C. P. Mazza.
Foundation for extension or similar career oriented students. Application of horticultural science principles to practical situations faced primarily by home gardeners. Techniques of synthesizing information from various scientific disciplines and strong emphasis on communications skills. Classes led by staff in several departments. Topics are interdisciplinary, drawing from expertise in horticultural science (landscape and food), entomology, plant pathology, natural resources, and Cornell Plantations.]

HORT 480 Plantations Seminar Series
Fall. 1 credit. S-U grade only. W 7:30. D. A. Rakow.
A 10-week series of seminars given by prominent speakers on a variety of horticultural, natural sciences, and human cultural themes.

[HORT 485 Public Garden Management
Spring. 3 credits. Prerequisites: HORT 300 or HORT 301; HORT 230 or HORT 335. Lec, T R 10:10–11:00, lab, T R 11:15–12:05. Two-and-a-half-day field trip to visit other botanical gardens and arboreta. Offered odd years. D. A. Rakow.
The course explores the history of public gardens, types of contemporary public gardens, and the operation of botanical gardens and arboreta. Included are separate units on: collections curation, design of collections, management of landscapes and natural areas, educational programming, interpretive programs, research, financial management, and staffing.]

HORT 491 Creating the Urban Eden: Woody Plant Selection, Design, and Landscape Establishment (also LA 491)
Fall. 4 credits. Prerequisites: major in horticulture or landscape architecture or permission of instructor. Limited to 48 students. Preregistration required. Lec, T R 12:20–1:10; Lab, T R 1:25–4:25. N. L. Bassuk and P. J. Trowbridge.
This course 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.

HORT 492 Creating the Urban Eden: Woody Plant Selection, Design, and Landscape Establishment (also LA 492)
Spring. 4 credits. Prerequisite: a passing grade in HORT/LA 491. Attendance limited to horticulture and landscape architecture majors or permission of the instructors. Limited to 48. Preregistration required. Lec, T R 12:20–1:10, lab, T R 1:25–4:25. N. L. Bassuk and P. J. Trowbridge.
The second half of this course continues focus 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, select appropriate trees, shrubs, vines and ground covers for a given site. Design for specific sites followed by written specifications and graphic details are produced to implement these proposals. Students implement, in a hands-on manner, site remediation and

planting techniques they have learned by creating new landscapes that serve to integrate theory, principles, and practices. Together, HORT/LA 491 and 492 constitute an integrated course. Attendance limited to Horticulture and Landscape Architecture majors or permission of the instructors.

HORT 494 Special Topics in Horticulture
Fall or spring. 4 credits maximum. S-U grades optional.
The department teaches "trial" courses under this number. Offerings may vary by semester, and will be advertised before the semester begins. Courses offered under the number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

HORT 495 Undergraduate Seminar—Current Topics in Horticulture
Fall and spring. 1 credit. Undergraduate participation in weekly departmental seminar series. Graduate students should enroll in HORT 600. May be taken four times for one credit per semester. S-U grades only. R 4. L. A. Weston, D. W. Wolfe.

HORT 496 Internship in Horticultural Sciences
Fall or spring. Credit variable. S-U grades optional. Prerequisite: permission of student's adviser **in advance of participation** in internship programs. Students must register with an Independent Study form (available in 140 Roberts Hall) signed by the faculty member who will supervise their study and assign their grade. Staff.

HORT 497 Independent Study in Horticultural Sciences
Fall or spring. Credit variable. S-U grades optional. Prerequisite: permission of instructor(s). Students must register with an Independent Study form (available in 140 Roberts Hall). Independent study in horticultural sciences under the direction of one or more faculty members. Staff.

HORT 498 Undergraduate Teaching Experience
Fall or spring. Credit variable. S-U grades optional. Prerequisites: previous enrollment in course to be taught or equivalent, and written permission of the instructor. Students must register with an Independent Study form (available in 140 Roberts Hall). Staff.
Designed to give qualified undergraduate students teaching experience through actual involvement in planning and teaching horticultural sciences courses under the supervision of departmental faculty members. This experience may include leading discussion sections; preparing, assisting in, or teaching laboratories; and tutoring.

HORT 499 Undergraduate Research
Fall or spring. Credit variable. S-U grades optional. Prerequisite: permission of instructor. Students must register with an Independent Study form (available in 140 Roberts Hall.) Staff.
Undergraduate research projects in horticultural sciences.

HORT 500 Master of Professional Studies (Agriculture) Project
Fall or spring. 1–6 credits. (6 credits maximum toward M.P.S. [Agriculture] degree). S-U grades optional. Staff.
A comprehensive project emphasizing the application of principles and practices to professional horticultural teaching, extension, and research programs and situations. Required of Master of Professional Studies (Agriculture) candidates in the respective graduate fields of horticulture.

HORT 600 Seminar in Horticulture
Fall and spring. 1 credit. S-U grades only. R 4:00. D. W. Wolfe and L. A. Weston.
Weekly seminars consist of graduate student research project reports, faculty research topics, as well as guest speakers from other universities and/or industry. Required of graduate students majoring or minoring in horticulture. Undergraduate students register under HORT 495.

HORT 615 Quantitative Methods in Horticultural Research
Spring. Weeks 1–7. 2 credits. Prerequisite: BTRY 601, BTRY 602 or permission of instructor. S-U grades only. W F 2:30–4:25. Offered even years. D. W. Wolfe.
This course provides experience in applying statistics principles to real-world agricultural research problems. Examples of lab, greenhouse, and field studies from the published literature are utilized. Other quantitative methods are explored. 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 618 Breeding for Pest Resistance (also PL BR 618)
Fall. 2 credits. S-U grades optional. Prerequisites: BIOGD 281 and PL BR 403 or equivalents. An introductory course in plant pathology and/or entomology also highly recommended. Offered even years. Lec, M 2:30–4:25. P. D. Griffiths.
For description, see PL BR 618.]

[HORT 620 Woody Plant Physiology
Spring. 4 credits. BIOPL, BIOBM 331, CHEM 357, or equivalent, or permission of instructor. Letter grade only. Lecs, T R 8:40–9:55; lab, T 1:25–4:25. T. H. Whitlow.
An examination of physiological processes in woody plants emphasizing whole plant integration and how these processes affect plant growth under both natural and cropping systems. Topics include: evolution of the woody plant form, structure and function of the root and shoot, growth periodicity, dormancy, growth analysis, carbon balance and allocation, root symbioses, and physiological responses to biotic and abiotic stress. Faculty from Geneva and Fruit and Vegetable Science collaborate in teaching.]

HORT 625 Advanced Postharvest Biology
Spring. 3 credits. TBA. Coordinator: S. Gan.

Section 01 Advanced Postharvest Physiology. 1 credit. (14 lecs); S. Gan.
Emphasis on the physiological and biochemical aspects of growth and maturation, ripening, and senescence of harvested horticultural plant parts.

Section 02 Advanced Postharvest Technology. 1 credit. (14 lecs); C. B. Watkins.
Emphasis on advanced existing and emerging technology and practice for handling, monitoring, and storage of horticultural crops after harvest.

Section 03 Molecular Postharvest Biology. 1 credit. (14 lecs); S. Gan.
Introduces molecular biology and its applications in postharvest research. Topics include gene expression and regulation associated with physiological and biochemical changes in maturing, ripening, senescing, or harvested horticultural plants or parts. Use of various molecular markers in monitoring harvested products and genetic manipulation of postharvest processes will also be discussed

HORT 635 Tools for Thought
Fall. 1 credit. Open to graduate students only. S-U grade only. Disc. TBA. T. H. Whitlow.
A discussion of readings from Kuhn, Waddington, Wilson, Lewontin, and others emphasizing application of the philosophy of science to the real world practices of scientists.

HORT 636 Current Topics in Horticulture
Fall or spring. 1 credit. S-U grades only. One hour per week, TBA. Staff.
A seminar series on current topics chosen by participating students and faculty, on a rotating basis. Format consists of weekly discussion groups, with each participant presenting at least one oral report based on independent reading and/or experimentation relating to the chosen topic. Interested students should contact the designated instructor(s) for each term.

HORT 694 Special Topics in Horticulture
Fall or spring. 4 credits maximum. S-U grades optional. Staff.
The department teaches "trial" courses under this number. Offerings vary by semester, and are advertised by the department before the semester starts. Courses offered under the number will be approved by the department curriculum committees, and the same course are not offered more than twice under this number.

HORT 700 Graduate Teaching Experience
Fall or spring. Credit variable. Open only to graduate students. Undergraduates should enroll in HORT 498. S-U grades optional. Prerequisite: permission of instructor. Hours TBA. 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.

HORT 800 Thesis Research, Master of Science
Fall or spring. Credit TBA. S-U grades only.

HORT 900 Thesis Research, Doctor of Philosophy
Fall or spring. Credit TBA. S-U grades only.

INTERNATIONAL AGRICULTURE

INTAG 300 Perspectives in International Agriculture and Rural Development
Fall. 2 credits. R. W. Everett.
A forum to discuss both contemporary and future world food issues and the need for an integrated, multidisciplinary team approach in helping farmers and rural development planners adjust to the ever-changing food needs of the world.

INTAG 314 Tropical Cropping Systems: Biodiversity, Social, and Environmental Impacts (also CSS 314)
Fall. 3 credits. Prerequisite: an introductory course in crop science, soil science, or biology or permission of instructor. E. C. Fernandes.
Characterization and discussion of traditional shifting cultivation, lowland rice-based systems, upland cereal-based systems, smallholder mixed farming including root crops and livestock, plantation fruit and oil crop systems, and agroforestry. In addition to species diversity and domestication, factors such as climate, land quality, soil management, land tenure, labor, and markets are considered. The effect of tropical cropping systems on the environment is evaluated.

INTAG 402 Agriculture in the Developing Nations I
Fall. 2 credits. K. V. Raman, W. R. Coffman.
The goal of this course is to acquaint students with the major issues and problems in international agriculture and rural development and to show how problems in development are being addressed by international, government, and non-government agencies. The lectures/discussions attempt to establish the global context for sustainable agricultural development and focus on agriculture and rural development in the tropics, using case studies. This course may be taken as a stand-alone survey course in international agriculture, but it is also the preparatory course for participation in Agriculture in the Developing Nations II (INTAG 602), which includes a trip to a developing country during the intersession.

INTAG 403 Traditional Agriculture in Developing Countries
Fall. 1 credit. S-U only. Staff.
Today, perhaps over half of the world's arable land is farmed by traditional farmers. They developed sustainable agriculture practices which allowed them to produce food and fiber for millennia with few outside inputs. Many of these practices have been forgotten in developed countries but are still used by many traditional, subsistence, or partially subsistence farmers in developing countries. The course examines traditional systems from several disciplinary points of view.

INTAG 404 Crop Evolution, Domestication, and Diversity (also PLBR 404, BIOPL 404)
Spring. 2 credits. Prerequisite: BIOGD 281 or PL BR 225 or permission of instructor. S-U grades optional. S. Kresovich.
Evolution, domestication, and breeding of crop plants have molded the current diversity we conserve and use. Based on advances in systematics and molecular genetics, this course presents an integrated approach to understanding and describing diversity of agricultural and horticultural species. Underlying ethical, legal, and social issues affecting conservation and use also are addressed.

INTAG 480 Global Seminar: Environment and Sustainable Food Systems (also ALS 480 and EDUC 480)
Spring. 1–3 credits. Prerequisite: juniors, seniors, and graduate students. Letter grade. J. Lassoie, L. Buck, D. Miller.
For description, see ALS 480.

INTAG 494 Special Topics in International Agriculture (also INTAG 694)
Fall, spring, summer. 1–3 credits. S-U grades optional. Staff.
The department teaches "trial" courses, and special topics not covered in other courses, at the undergraduate level, under this number. Offerings vary by semester, and will be advertised by the department. Courses offered under the number are approved by the department curriculum committee, and the same course is not offered more than twice under this number.

INTAG 496 International Internship
Fall, spring. 1–6 credits. See CALS internship policy guidelines and submit approved internship form prior to enrollment. S-U grades optional. Staff.
An 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.

INTAG 497 Independent Study in INTAG
Fall and spring. 1–3 credits. S-U or letter grade. Prerequisites: permission of instructor and signed Independent Study form. Staff.
Independent Study in INTAG 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.

INTAG 598 International Development M.P.S. Project Paper
Fall and spring. 1–6 credits. (A maximum of 6 credits may be applied toward M.P.S. degree requirements). Limited to M.P.S. candidates in the field of International Development (ID). S-U grades only. N. Uphoff.
A 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.

INTAG 599 International Agriculture and Rural Development M.P.S. Project Paper
Fall and spring. 1–6 credits. (A maximum of 6 credits may be applied toward M.P.S. degree requirements). Limited to M.P.S. candidates in the field of International Agriculture and Rural Development (IARD). S-U grades only. R. Blake.
A 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.

INTAG 602 Agriculture in The Developing Nations II
Spring. 3 credits. Prerequisites: INTAG 402 and (or) permission of instructors. Field trip to India during January intersession. Note: cost of January 2004 field-study trip is approx. $2500, which includes air fare, board and lodging (some merit and need based financial aid may be available). T R 2:30–4:25 until midterm only. K. V. Raman and W. R. Coffman.
Oriented to provide students an opportunity to observe agricultural development in a tropical environment and promote interdisciplinary exchange among staff and students. The two-week overseas field-study trip to India, during January is followed by discussions and assignments dealing with problems in food, agriculture and livestock production in the context of social and economic conditions.

INTAG 603 Administration of Agricultural and Rural Development (also GOVT 692)
Spring. 4 credits. N. T. Uphoff and T. W. Tucker.
An intercollege course designed to provide graduate students with a multidisciplinary perspective on the administration of agricultural and rural development activities in developing countries. The course is oriented to students in agricultural or social sciences who may have administrative responsibilities during their professional careers.

INTAG 612 Intellectual Property Management and Licensing (also PL BR 612)
Spring. 2 credits. Prerequisite: open to graduate students and to senior undergraduates. S-U grades optional. A. F. Krattiger, M. A. Mutschler, R. Potter, and R. D. Kryder.
For description, see PL BR 612.

[INTAG 620 Rural Livelihoods and Biological Resources: Technologies and Institutions]

INTAG 685 Training and Development: Theory and Practice (also EDUC 685)
Spring. 4 credits. S-U grades optional. M. Kroma.
Analysis, design, and administration of training programs for the development of human resources in small-farm agriculture, rural health and nutrition, literacy as nonformal education, and general community development. Designed for scientists, administrators, educator-trainers, and social organizers in rural and agricultural development programs in the United States and abroad.

INTAG 694 Graduate Special Topics in INTAG
Fall or spring. 1–4 credits. S-U or letter option. 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.

INTAG 696 Organic Inputs in Tropical Soils and Agroforestry (also NTRES 696 and CSS 696)
Fall, spring. 1 credit. S-U grades only. E. Fernandes, L. Fisher, L. Buck
A variety of speakers present seminars on organic inputs in the tropics and agroforestry. Students are required to prepare synopsis of each seminar.

INTAG 697–698 International Development M.P.S. Seminar
Fall, spring. 1 credit. S-U only. N. Uphoff.
A seminar for M.P.S. students to discuss important issues in international development and to prepare them to write their project papers. Specific content varies.

INTAG 699 International Agriculture and Rural Development M.P.S. Project Seminar
Fall, spring. 1 credit. S-U grade only. Required for, and limited to, M.P.S. IARD students or with permission of instructor. R. Blake.
The seminar provides students with the opportunity to develop and present their special projects. It also serves as a forum for discussion of current issues in low-income agricultural and rural development, with particular attention to interdisciplinary complexities.

INTAG 783 Farmer Centered Research and Extension (also EDUC 783)
Fall. 3 credits. S-U or letter option. M. Kroma and T. Tucker.
This course provides an introduction to participatory traditions in farming systems research, extension, evaluation of rural development, technology generation, gender analysis, participatory rural appraisal, and documentation of local and indigenous knowledge of community-based development. Case studies of farmer-centered research and extension provide a focus for analysis. Appropriate roles of researchers and extensionists as partners with farmers are examined. A major contribution of farmer-centered research and extensions is its potential to legitimize people's knowledge by enhancing their capacity to critically analyze their own problems, to conduct their own research, and to empower them to take direct action to solve those problems.

Related Courses in Other Departments

In addition to International Agriculture (INTAG) courses, there are a wide variety of other courses with an international focus. The following are suggested relevant courses:

Applied Economics & Management

International Trade and Monetary Economics (AEM 230)

*Global Agribusiness Management (AEM 329)

International Trade Policy (AEM 430)

*Food Marketing Colloquium (AEM 446/447)

Global Marketing Strategy (AEM 449)

Seminar on Agricultural Trade Policy (AEM 730)

Agriculture & Life Sciences

*Agriculture Study Tour to Burgundy, France (ALS 402)

*Internship Opportunities in Burgundy, France (ALS 403)

Global Seminar (ALS 480/INTAG 480)

Animal Science

Tropical Livestock Production (AN SC 400)

Tropical Forages (AN SC 403)

Asian Studies

Southeast Asia Seminar: Country Seminar (ASIAN 601)

Biology

Biology of the Neotropics (BIOEE 405)

Food, Agriculture, and Society (BIOEE 469)

The Healing Forest (BIO PL 348)

Communication

Communication in the Developing Nations (COMM 424)

City & Regional Planning

Seminar in International Planning (CRP 671)

Seminar in Project Planning in Developing Countries (CRP 675)

Crop & Soil Science

Properties and Appraisal of Soils of the Tropics (CSS 471)

Ecology of Agricultural Systems (CSS 473)

Tropical Cropping Systems (CSS/INTAG 314)

Education

Comparative Studies in Adult Education (EDUC 483)

Farmer-Centered Research & Extension (EDUC/INTAG 783)

Food Science

International Postharvest Food Systems (FOOD 447)

Nutritional Science

Nutritional Problems in Developing Nations (NS 306)

Integrating Food Systems and Human Needs (NS 380)

National and International Food Economics (NS 457)

International Nutrition Problems, Policy, and Programs (NS 680)

Natural Resources

Ecological Dimensions of Global Change (NTRES 350)

International Environmental Issues (NTRES 400)

Religion, Ethics, and the Environment (NTRES 407)

Principles and Practices of Agroforestry (NTRES/HORT 415)

Plant Breeding

Introduction to Plant Breeding (PL BR 201)

Genetic Diversity (PL BR 404)

Rural Sociology

Population Dynamics (R SOC 201)

International Development (R SOC 205)

Social Indicators, Data Management and Analysis (R SOC 213)

Sustainable Development (R SOC 261)

Education, Inequality and Development (R SOC 305)

Comparative Issues in Social Stratification (R SOC 370)

Population Policy (R SOC 418)

Migration and Population Redistribution (R SOC 430)

Social Impact of Resource Development (R SOC 440)

Population, Environment, and Development in Sub-Saharan Africa (R SOC 495)

Sociological Theories of Development (R SOC 606)

The Sociology of "Third World" States (R SOC 725)

*Includes overseas travel

LANDSCAPE ARCHITECTURE

K. L. Gleason, chair; M. I. Adleman, S. Baugher, H. W. Gottfried, P. H. Horrigan, R. Jaenson, D. W. Krall, L. J. Mirin, A. Okigbo, R. T. Trancik, P. J. Trowbridge

LA 140 The Symbols of New York State's Cultural Landscape
Spring. 3 credits.
Lectures with slides and other media illustrate how successive waves of New Yorkers continually defined and redefined their sense of place and "the power of place" by references to natural symbols such as Niagara Falls and to human constructions such as towns of Iroquois long houses and cities of skyscrapers.

LA 141 Grounding in Landscape Architecture
Fall. 4 credits. Limited to 15 students. Letter grade only. Cost of basic drafting equipment for the major plus materials for projects; about $250.
Introduction to the representation and design of landscapes and to working in a studio setting. Freehand drawing, measured drawing, and model making are used to understand design principles of the changing landscape.

LA 142 Grounding in Landscape Architecture
Spring. 4 credits. Limited to approximately 20 students; freshman landscape architecture majors or permission of instructor. Cost of basic drafting equipment and project supplies, about $250.
Fundamentals of landscape design applied to small-scale site-planning projects. Work in the studio introduces course participant to the design process, design principles, construction materials, planting design, and graphics.

LA 155 American Indian Cultural Landscapes: Changes in Time
Fall. 3 credits.
Lectures with slides and other media illustrate American Indian cultures and philosophies both before and after 1492. A major focus is how all Indian societies, from hunting societies to agricultural communities, continually transformed their cultural landscapes. Lectures also include how European expansion forcefully transformed Indian American cultural landscapes.

LA 201 Medium of the Landscape
Fall. 5 credits. Limited to landscape architecture majors. Cost of basic drafting equipment, supplies, and fees, about $200; expenses for field trip, about $250.
This studio course emphasizes the design process and principles involved in organizing and giving form to outdoor space through the use of structures, vehicular and pedestrian circulation systems, earthform, water, and vegetation.

LA 202 Medium of the Landscape
Spring. 5 credits. Prerequisite: LA 201 with a grade of C or better. Cost of supplies and fees, about $250; expenses for field trip, about $250.
This course focuses on the role of materials in design, design theory, and design vocabulary associated with landscape architectural projects.

LA 260 Pre-Industrial Cities and Towns of North America (also CRP 360 and CRP 666 and LA 666)
Fall. 3 credits. Offered alternate years.
Various American Indian civilizations as well as diverse European cultures have all exerted their influences on the organization of town and city living. The course considers how each culture has altered the landscape in its own unique way as it created its own built environments.

LA 261 Fieldwork in Urban Archaeology (also CRP 261 and AIS 261)
Fall. 4 credits.
Urban archaeologists study American Indian, colonial, and nineteenth-century sites which now lie within the boundaries of modern cities. This course explores how urban centers evolve; what lies beneath today's cities; and how various cultures have altered the urban landscape. Students participate in a local archaeological excavation. Three Saturday 8-hour field labs are required; students choose three labs from seven that are offered.

LA 262 Laboratory in Landscape Archaeology (also ARKEO 262)
Spring. 3 credits. Prerequisites: LA 261 or ARKEO 261 or permission of instructor.
Various American Indian civilizations and European cultures have all altered the landscape to meet the needs of their cultures. Students learn how to interpret the American Indian and Euro-American landscapes of specific archaeological sites by identifying and dating artifacts, studying soil samples, and creating site maps.

[LA 263/547 American Indians, Planners, and Public Policy (also CRP 363/547)
Spring. 3 credits. Offered in alternate years. Offered spring 2005.
Decisions made by public agencies and private enterprise too often lead to the flooding, polluting, strip-mining, or other destruction of American Indian reservations, archaeological sites, and burial grounds. The central focus of this course is how to address urban and regional problems without imperiling the cultural survival of minorities.]

LA 266 Jerusalem through the Ages (also NES 266, JWST 266, ARKEO 266, RELST 266)
Fall. 3 credits.
Explores the history, archaeology, and natural topography of Jerusalem throughout its long life, from its earliest remains in the Chalcolithic period (ca. 4000 B.C.E.) to the 19th century, including Jebusite Jerusalem, Jerusalem as the capital of the Davidic dynasty, the Roman era city of Herod and Jesus, the Crusaders and medieval Jerusalem, and Ottoman Jerusalem as the city entered the modern era. Students examine the original historical sources (e.g., Bible, Josephus, the Madeba map, etc.) which pertain to Jerusalem. Slides and videos will be used to illustrate the natural features, human-built monuments, and artifacts which flesh out the textual material providing a fuller image of the world's most prominent spiritual and secular capital.

[LA 282 The American Landscape
Fall. 3 credits.
An interdisciplinary study of the environmental and cultural history of the American landscape. Topics include the relation of landscape to culture, landscape use and ecological change, regional and national landscapes, and perceptions of landscape expressed in paintings, photographs, and literature.]

LA 301 Integrating Theory and Practice I
Fall. 5 credits. Prerequisite: LA 202 with a grade of C or better. Cost of supplies and fees, about $250; expenses for field trip, about $250.
Course participants are engaged in the art and science of design. This includes relating construction and planting details to concepts and program. The studio focuses on site-scaled projects that consider significant cultural and natural landscapes. Theories of landscape restoration, sustainable design, and landscape representation are explored through projects that derive form from site and place.

LA 302 Integrating Theory and Practice II
Spring. 5 credits. Cost of supplies and fees, about $250; basic expenses for field trip, about $250.
The studio focuses on the expression of design solutions that grow from and affirm an explicit sense of site and place. Social, cultural, physical, and historic factors and their relationships to site design and planning are critically explored through theory and practice in this studio.

LA 315 Site Engineering I
Spring. 3 credits. Prerequisite: permission of instructor.
Lectures and studio projects focusing on the professional skills and knowledge required to competently and creatively develop grading plans for project-scale site design.

LA 316 Site Engineering II
Fall. 2 credits. Prerequisite: LA 315 or permission of instructor.
Lectures and studio projects dealing with earthwork estimating; storm water management, site surveys, site layout, and horizontal and vertical road alignment.

LA 318 Site Construction
Spring. 5 credits. Prerequisite: permission of instructor.
The emphasis of this course is detail design and use of landscape materials in project implementation. Exploration of construction materials, including specifications, cost estimates, and methods used by landscape architects in project implementation are the foci for this course. The course includes lectures, studio problems, and development of drawings leading to construction documentation for a comprehensive project. Students develop a process of self criticism related to measured drawings specific to the comprehensive project. Course participants fabricate material prototypes in wood and metal.

LA 402 Integrating Theory and Practice: Community Design Studio
Spring. 5 credits. Prerequisite: LA 301 with a grade of C or better. Cost of supplies and fees, about $250; expenses for field trip, about $250.
This course engages the theory and practice of participatory community design through a real community service project. Participants gain an understanding of how to integrate meaningful public service with design invention and creativity, engage rigorous design research methods, and understand how institutional and community contexts influence design problem-solving. Students will be expected to work independently and collaboratively on team projects in a community. One class period per week will be designated for community fieldwork. Studio theme to be announced.

LA 403 Directed Study: The Concentration
Fall, spring. 1 credit. Prerequisite: any landscape architecture undergraduate students in their final year of study.
Working with their adviser, students create a written and visual paper that documents the concentration intent.

LA 410 Computer Applications in Landscape Architecture
Fall or spring. 3 credits. Offered to landscape architecture students only. Limited to 15 students.
This course is designed to develop a working knowledge of various computer software applications with emphasis on Autocad. The course explores other applications relative to land-use planning and the profession of landscape architecture.

LA 412 Professional Practice
Spring. 1 credit.
Presents the student with a comprehensive understanding of the role of the professional landscape architect and the problems and opportunities one may encounter in an office or in other professional situations. Topics discussed include practice diversity, marketing professional services, office and project management, construction management, computers in the profession, and ethics.

LA 483 Seminar in Landscape Studies
Fall. 3 credit. Limited to seniors in any major or graduate students in any field.
A topical seminar with a different subject and method each time it is offered. Subject and schedule include "Landscape and Visual Culture," (fall 2003) an inquiry into the visual construction of landscape and landscape representation in visual (painting,

photography, film, graphic design) and written texts; "Understanding Ordinary Landscapes," (fall 2004) a study of common places, including their spatial and visual patterns, uses, and material culture; "Landscape and Critical Thinking," (fall 2005) dealing with landscape as a tool for studying social and artistic issues, landscape as a basis for social order, and landscape as critical inquiry.

LA 486 Placemaking by Design
Fall. 3 credits. Preference given to juniors, seniors and graduate students. Limited to 20 students. S-U grades optional.
This seminar provides an understanding of contemporary planning and landscape architectural 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. The seminar 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 490 Rome Wasn't Built in a Day
Spring. 3 credits.
In this electronic course, students learn about how the form and spatial structure of the city of Rome has evolved through time. Using the interactive CD-ROM *Layers of Rome* as a digital text, the course engages participants in the investigations of urban design in Rome both as a case study and as a vehicle for exploring concepts applicable to many contemporary cities worldwide. The material focuses on the intersection between historical studies of urban space, architectural geography, urban landscape formation, and the design of cities. Lectures, research, readings and exercises are developed using the *Layers of Rome* CD, web searches, digital networking, and various interactive learning technologies geared toward urban analysis and visual design media.]

LA 491 Creating the Urban Eden: Woody Plant Selection, Design and Landscape Establishment (also HORT 491)
Fall. 4 credits. Prerequisites: major in horticulture or landscape architecture or permission of instructor. Limited to 48 students. Pre-registration required. Cost of supplies, about $50; expenses for field trips, about $50.
This course focuses on the identification, uses, and establishment of woody plants in urban and garden settings. By understanding the environmental limitations to plant growth, students are able to critically assess potential planting sites, select appropriate trees, shrubs, vines, and ground covers for a given site, and learn about the principles and practices of site amelioration and plant establishment. Design followed by written specifications and graphic details is produced to implement these practices.

LA 492 Creating the Urban Eden: Woody Plant Selection, Design, and Landscape Establishment (also HORT 492)
Spring. 4 credits. Prerequisites: a passing grade in HORT/LA 491. Attendance limited to horticulture and landscape architecture majors or permission of the instructors. Limited to 48 students. Preregistration required. Cost of supplies about $50; expenses for field trips $50.
The second half of this course continues to focus 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, select appropriate trees, shrubs, vines and ground covers for a given site. Design for specific sites followed by written specifications and graphic details are produced to implement these proposals. Students implement in a hands-on manner, site remediation and planting techniques they have learned by creating new landscapes that serve to integrate theory, principles and practices. Together, HORT/LA 491 and 492 constitute an integrated course.

LA 494 Special Topics in Landscape Architecture
Fall or spring. 1–3 credits; may be repeated for credit. S-U grades optional.
Topical subjects in landscape architectural design, theory, history, or technology. Group study of topics not considered in other courses.

LA 495 Green Cities: The Future of Urban Ecology (also CRP 495)
Fall. 4 credits.
Explores the history and future of the ecology of cities and their role in solving the present global ecological crisis. The politics, design, and economics of "green cities" are examined in terms of transportation, renewable energy, solid waste and recycling, land use, and the built environment.

LA 497 Individual Study in Landscape Architecture
Fall or spring. 1–5 credits; may be repeated for credit. Students must register with an Independent Study form (available in 140 Roberts Hall). S-U grades optional.
Work on special topics by individuals or small groups.

LA 498 Undergraduate Teaching
Fall or spring. 1–2 credits. Prerequisites: previous enrollment in course to be taught and permission of instructor. Students must register with an 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.

LA 499 Undergraduate Research
Fall or spring. 1–5 credits. Students must register with Independent Study Form.
Permits outstanding undergraduates to carry out independent research in Landscape Architecture under appropriate faculty supervision. Research goals should include description, prediction, and explanation and should generate new knowledge in the field of landscape architecture.

LA 501 Composition and Theory
Fall. 5 credits. Limited to graduate students. Cost of drafting supplies and fees, about $250. Field trip about $250.
Basic principles of natural and cultural processes that form "places" in the landscape. Projects focus on design applied to the practice of landscape architecture: particularly the relationship between measurement, process, experience, and form at multiple scales of intervention.

LA 502 Composition and Theory
Spring. 5 credits. Limited to graduate students. Cost of drafting supplies and fees, about $250; expenses for field trip, about $250.
The studio focuses on the spatial design of project-scale site development. Students develop their expertise in applying the design theory, vocabulary, and graphic expression introduced in LA 501.

LA 505 Landscape Representation I
Fall. 3 credits. Prerequisite: concurrent enrollment in LA 501 or permission of instructor.
This course introduces students to both conventional and unconventional modes of landscape architectural design representation. Drafting, orthographic drawing, axonometric project, lettering, analysis and concept drawing are taught alongside more expressive modes of direct site study and representation.

LA 506 Graphic Communication II
Spring. 3 credits. Prerequisites: LA 505 and concurrent enrollment in LA 502 or permission of instructor.
An intermediate level course focused on modes of landscape representation from ideation to presentation. Representation modes may include freehand, process drawing, analysis and orthographic drawing; concept modelling; composite drawings; and visual books.

LANAR 524 History of European Landscape Architecture*
Fall. 3 credits.
*Offered through the College of Architecture, Art, and Planning.

LANAR 525 History of American Landscape Architecture*
Spring. 3 credits.
*Offered through the College of Architecture, Art, and Planning.

LA 545 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 by permission of the instructor.
This advanced seminar is seeking an interdisciplinary group of students in classics, art history, archaeology, landscape architecture, horticulture, and architecture to bring their knowledge of Latin, Greek, Italian, archaeology, drawing, design, or computer modeling to a collaborative study of the ancient fora and public parks depicted on the Severan Marble plan of Rome. Opportunity for a spring break trip to Rome.

[LA 569 Archaeology in Preservation Planning and Site Design (also CRP 569)
Spring. 3 credits. Offered alternate years. Offered spring 2005.
In response to federal, state, and local legislation, historical archaeology now plays an important role in design, planning, and land-use decisions. Students develop the research skills needed to complete environmental review projects and historic landscape plans.]

[LA 580 Landscape Preservation: Theory and Practice
Fall. 3 credits. Prerequisites: limited to junior and senior undergrads, and graduate students.

This course 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 for the class is assigned readings and discussion, invited speakers, lectures, and a project documenting a local site.]

[LA 582 The American Landscape
Fall. 3 credits.
An interdisciplinary study of the environmental and cultural history of the American landscape. Topics include the relation of landscape to culture, landscape use and ecological change, regional and national landscapes, and perceptions of landscape expressed in paintings, photographs, and literature. Graduate students complete additional outside work and attend an additional class session.]

LA 590 Theory Seminar
Spring. 3 credits.
Seminar in landscape design theory. For graduate students and seniors.

LA 598 Graduate Teaching
Fall or spring. 1–3 credits. Prerequisite: permission of instructor. Students must register with an Independent Study form. 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 term. (Credit hours are determined by: 2 hours per week = 1 credit hour).

LA 601 Integrating Theory and Practice I
Fall. 5 credits. Limited to graduate students. Cost of supplies and fees, about $250.
The studio focuses on site-scaled projects that consider significant cultural and natural landscapes. Theories of landscape restoration, sustainable design, and landscape representation are explored through projects that derive form from site and place. The integration of site history, ecology, and site construction supports an understanding and relationship between design and site.

LA 602 Integrating Theory and Practice II
Spring. 5 credits. Limited to graduate students. Cost of drafting supplies and fees, about $250; expenses for field trip, about $250.
The studio builds upon 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. The course focuses on the expression of design solutions that grow from and affirm an explicit sense of site and place. Social, cultural, physical, and historic factors and their relationship to site design and planning are critically explored through theory and practice.

LA 603 Directed Study: The Concentration
Fall, spring. 1 credit. Prerequisite: any landscape architecture graduate student in their final year of study.
Working with their adviser, students create a written and visual paper that documents the concentration intent.

LA 615 Site Engineering I
Spring. 3 credits. Prerequisite: permission of instructor.
Lectures and studio projects focusing on the professional skills and knowledge required to competently and creatively develop grading plans for project-scale site design.

LA 616 Site Engineering II
Fall. 2 credits. Prerequisite: LA 615 or permission of instructor.
Lectures and studio projects dealing with earthwork estimating, storm water management, site surveys, site layout, and horizontal and vertical road alignment.

LA 618 Site Construction
Spring. 5 credits. Prerequisite: permission of instructor.
The emphasis of this course is detail design and use of landscape materials in project implementation. Exploration of materials, including specifications, cost estimates, and methods used by landscape architects in project implementation are the foci for this course. The course includes lectures, short studio problems, and the development of drawings leading to construction documentation for a comprehensive project. Students develop a process of self-criticism related to measured drawings specific to the comprehensive project. Course participants fabricate material prototypes in wood and metal.

[LA 619 Advanced Site Grading
Fall. 2 credits. Limited to 10 students. Prerequisite: LA 315 or LA 615.
Grading skills and knowledge applied as a design component of site planning projects.]

LA 666 Pre-Industrial Cities and Towns of North America (also CRP 666)
Fall. 3 credits. Offered alternate years.
Various American Indian civilizations as well as diverse European cultures have all exerted their influences on the organization of town and city living. This course considers how each culture altered the landscape in their own way as they created their own built environments.

LA 680 Graduate Seminar in Landscape Architecture
Fall or spring. 1–3 credits. May be repeated for credit. Limited to graduate students. S-U grades optional.
Topical subjects in landscape architectural design, theory, history, or technology. Includes seminar topics and group study not considered in other courses.

LA 694 Special Topics in Landscape Architecture
Fall or spring. 1–3 credits; may be repeated for credit. S-U grades optional.
Topical subjects in landscape architectural design, theory, history, or technology. Includes group study of topics not considered in other courses.

LA 701 Urban Design and Planning: Designing Cities in the Electronic Age (also CRP 555)
Fall. 5 credits. Limited to graduate students. Cost of supplies and fees, about $250; expenses for field trip, about $250.
Application of urban-design and town-planning techniques to specific contemporary problems of city environments. Issues of urbanism are investigated and applied to physical design interventions and spatial typologies involving the street, square, block, garden, and park systems. 3-D computer modeling and digital design media are introduced as tools for urban design. This is a specially arranged collaborative studio with the Department of City and Regional Planning.

LA 702 Advanced Design Studio
Spring. 5 credits.
A capstone studio that provides the opportunity to explore issues in contemporary landscape architecture and to integrate related fields. Topics include the influences of culture, history, and criticism, as well as reinterpretations of engineering and representation.

LA 800 Master's Thesis in Landscape Architecture
Fall or spring. 9 credits.
Independent research, under faculty guidance leading to the development of a comprehensive and defensible design or study related to the field of landscape architecture. Work is expected to be completed in final semester of residency.

NATURAL RESOURCES

B. A. Knuth, chair; R. A. Baer, M. B. Bain, B. L. Bedford, B. Blossey, T. Brown, L. E. Buck, E. Cooch, P. Curtis, D. J. Decker, J. Enck, T. J. Fahey, T. A. Gavin, J. W. Gillett, J. R. Jackson, C. Kraft, M. E. Krasny, J. P. Lassoie, B. Lauber, R. A. Malecki, E. Mills, S. Morreale, M. E. Richmond, L. Rudstam, R. Schneider, R. Sherman, P. J. Smallidge, C. R. Smith, P. Sullivan, J. Tantillo, S. Wolf, J. B. Yavitt

Note: class meeting times are accurate at the time of publication. If changes are necessary, the department will provide new information as soon as possible.

NTRES 110 Introduction to the Field of Natural Resources
Fall. 3 credits. Limited to first-year students in Natural Resources.
This course provides a comprehensive overview of the modern field of natural resources and environment to new students. The course focuses on identifying the components of knowledge required to understand the Earth's natural resources and ecological systems, and to participate intelligently in their conservation and management. Local case studies are used to introduce students to the scientific, ethical, and societal basis for protection and management of natural resources and environments. Students become actively engaged in data collection and analysis, use quantitative models to analyze and interpret data, explore the human dimensions of natural resource issues, and come to understand the complexities of the policy process and management strategies.

NTRES 201 Environmental Conservation
Spring. 3 credits. T. Fahey.
At the beginning of the twenty-first century, our lives are increasingly touched by questions about environmental degradation at local, regional, and global scales. Business as usual is being challenged. This course stimulates students to go beyond the often

simplistic portraits of the environmental dilemma offered by the mass media to gain a firmer basis for responsible citizenship and action on environmental issues.

NTRES 210 Introductory Field Biology
Fall. 4 credits. Limited to 90 students. Open to sophomores and juniors with an adviser in Natural Resources or by permission of instructor. Prerequisites: BIO G 101 and 102 or equivalent. 2 overnight weekend field trips required. Cost of field trips, approximately $12. C. Smith.
Introduction to methods of inventorying, identifying, and studying plants and animals. Students are required to learn the taxonomy, natural history, and how to identify approximately 170 species of vertebrates and 80 species of woody plants. Selected aspects of current ecological thinking are stressed. The interaction of students with biological events in the field and accurate recording of those events are emphasized.

NTRES 212 People, Values, and Natural Resources
Spring. 3 credits. J. Tantillo.
Cultural and political context for natural resources conservation and management in North America. Historical basis is explored through analysis of North American environmental history, examining shifts in attitudes and conceptions of human relationships to natural resources and the environment. Key laws guiding policy, conservation, and management of natural resources are reviewed. Concepts underlying the study of human attitudes, behaviors, institutions, and decision-making processes related to natural resource conservation and management are introduced.

NTRES 301 Forest Ecology
Fall. 3 credits. Prerequisite: introductory biology. T. J. Fahey.
A 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 302 Forest Ecology Laboratory
Fall. 1 credit. Cost of weekend trip approximately $30. Concurrent enrollment in NTRES 301 required. 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 303 Forest Management and Maple Syrup Production
Spring. 3 credits. Letter grades only. Offered alternate even years. P. J. Smallidge.
A practical, field-oriented course emphasizing principles and practices of stewardship and multiple purpose management of small, nonindustrial, private forest land in the northeastern United States, including the production of maple syrup.

NTRES 305 Applied Population Ecology
Fall. 3 credits. Letter grade only. Prerequisite: NTRES 210 and background in biology or ecology strongly recommended; completion or concurrent enrollment in CALS math requirement. E. Cooch.
An in-depth analysis of the ecological factors influencing the natural fluctuation and regulation of animal population numbers. The course 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 and field-based exercises are used to reinforce concepts presented in lecture.

NTRES 306 Coastal and Oceanic Law and Policy
Summer. 2 credits. A special 1-week course offered at Cornell's Shoals Marine Laboratory (SML), on an island off Portmouth, N.H. For more details and an application, consult the SML office, G14 Stimson Hall. Staff.
Intended for students interested in careers in management of marine or coastal resources or in the natural sciences. Subjects include law and policy related to ocean dumping, marine sanctuaries, environmental impact statements, water and air pollution, fisheries management, offshore gas and oil production, and territorial jurisdiction. Lectures on the status and history of law are accompanied by discussion of relevant policy and efficacy of various legal techniques. A case study that requires extensive use of the laboratory's library and personnel is assigned. The week concludes with a mock hearing.

NTRES 308 Natural Resources Planning and Management
Fall. 3 credits. Prerequisite: junior standing. T. B. Lauber.
Focus is on terrestrial and aquatic resources. Concepts emphasized include 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 310 Fish Ecology, Conservation, and Management
Spring. 3 credits. Prerequisites: NTRES 210 or permission of instructor; NTRES 305 or a general ecology course recommended. J. Jackson, E. Mills, L. Rudstam.
Basic principles of fish ecology at the individual, population, and community level are covered, particularly as they relate to interactions between fish and the aquatic environment. Emphasis is placed on the application of these principles to the conservation and management of fisheries resources and aquatic habitats. Illustrative examples are provided from current literature and case studies.

NTRES 311 Fish Ecology Laboratory
Spring. 1 credit. Prerequisite: NTRES 310 or concurrent enrollment. Two weekend field trips. J. Jackson, E. Mills, L. Rudstam.
Two overnight weekend field trips to the Cornell Biological Field Station and the Adirondack Field Station. Activities include experiences with various fish sampling gear and analysis of collected samples. Discussions about sampling considerations and inferences we can make by contrasting the ecology of fish in lakes of different productivity. Includes visit to a state of the art fish hatchery and evening discussion session during the field trips. Written reports required.

NTRES 314 Environmental Governance (also S&TS 314 and B&SOC 314)
Spring. 3 credits. S. Wolf.
This course considers the question of environmental governance, defined as the assembly of social institutions that regulate natural resource use and shape environmental outcomes. Participants will explore the roles of public policy, market exchange, and collective action in resource (mis) management. Theoretical concepts from a variety of social science perspectives will be introduced to support case studies and student-led discussions. Comparative analysis of how governance is pursued in different countries, historical periods, and ecological contexts (forestry, endangered species, water quality) will highlight scope for institutional innovation. Students who wish to take the course for graduate credit should see NTRES 603.

NTRES 315 Biological Statistics I (also BTRY 301)
Fall. 4 credits. Prerequisite: 1 semester of calculus. P. J. Sullivan.
Statistical methods are developed and applied 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 316 Biological Statistics II (also BTRY 302)
Spring. 4 credits. Prerequisite: NTRES 315 or BTRY 301. P. J. Sullivan.
Linear statistical methods are applied 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 320 Principles of Toxicology (also TOX 320)
Spring. 3 credits. Prerequisites: one year each of chemistry and biology with labs; 1 semester of organic chemistry lecture or permission of instructor. J. W. Gillett.
This introductory lecture course in human and environmental toxicology emphasizes basic principles (exposure, dose-response, effects) involved with pesticides, hazardous wastes, and natural products. Science-based assessments for risk analysis and policy are integrated with other considerations. Guest speakers and extensive case studies augment lectures and student team exercises applied to management.

NTRES 321 Introduction to Biogeochemistry (also EAS 321)
Fall. 4 credits. Prerequisites: college-level chemistry, plus a course in biology and/or geology. J. B. Yavitt and L. A. Derry.
For description, see EAS 321.

NTRES 350 Global Ecology and Management
Spring. 3 credits. Prerequisites: college-level course in biology. 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 370 Conservation of Birds
Spring or summer. 2 credits. Prerequisite: NTRES 210 or permission of instructor. Offered alternate odd years. Next offered spring 2005. 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. Current resource management issues relevant to birds are explored in the contexts of agricultural practices, habitat management, tropical deforestation, the design and management of natural preserves, endangered species management, global climate change, and the economic importance of bird study as an outdoor recreational activity.]

[NTRES 371 Conservation of Birds Laboratory
Spring or summer. 1 credit. Concurrent enrollment in NTRES 370 required. Saturday mornings TBA. Offered alternate odd years. Next offered spring 2005. 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. Topics covered include the choice and effective use of field guides, binoculars, and other tools for bird identification; procedures for taking and organizing field notes; the relationships of birds to their habitats and to other birds; and methods and procedures for censusing and surveying songbird populations.]

[NTRES 400 International Environmental Issues
Fall. 4 credits. Prerequisite: junior standing or above. Next offered fall 2004.]

NTRES 402 Environmental and Natural Resources Policy Processes
Spring. 3 credits. Prerequisites: junior standing; special application process, and course fee (approx. $400). Lec, January 12-day intersession; three 2-hour orientation sessions in fall semester and four 2-hour sessions in February and March. Completed applications due by October 15. Applications are available by contacting map10@cornell.edu or at www.dnr.cornell.edu/courses/NR402/402info.htm. B. A. Knuth.
An intensive exploration of the environmental policy process and its conceptual framework. Recognizing and defining natural resource or environmental problems and issues; aggregating interests; agenda-setting; formulating and selecting alternative solutions; implementation and evaluation stages; roles of lobbyists, legislature, executive branch, and other actors. Case studies; presentations by and discussions with about twenty prominent Washington policy makers appearing as guest lecturers. Required interviews, term paper, and oral reports. Includes 11 days in January in Washington, D.C.

NTRES 406 Ecology Risk Assessment (also TOX 406)
Fall. 3 credits. Prerequisites: BIOES 261 or equivalent; permission of instructor if not an advanced student in natural sciences of engineering. J. W. Gillett.
This course strives to develop understanding of and competence in the different types of ecological (nonhuman health) risk assessments based on USEPA principles and methods. Focus is on cases for chemical, physical, and biological stressors in a variety of circumstances.

NTRES 407 Religion, Ethics, and the Environment
Fall. 4 credits. For juniors, seniors, and graduate students; others by permission only. S-U grades optional. R. A. Baer.
How religion (especially Christianity and Judaism), philosophy, and ethics influence our treatment of nature. Terms like religion, nature, fact, value, knowledge, and public interest are examined in detail. Particular themes include character and moral development, similarities and differences between moral and scientific claims, truth telling, public reason, and property. Also covers animals rights vs. ecosystem concerns, responsibility to future generations, the limitations of rationalism in ethics, and discussion of whether women approach moral issues differently than men. One additional credit may be available through the Writing-in-the-Majors program. Students may apply at the first class; only 8–10 students will be accepted.

NTRES 411 Seminar in Environmental Ethics
Fall. 3 credits. For seniors, juniors and graduate students. S-U grades optional.
Moral concerns relative to the natural environment and agriculture. Major themes generally include: animal rights vs. ecosystem concerns; natural resource management and the concept of the public interest; applying environmental ethics in a democratic and pluralistic society; how our treatment of one another parallels our treatment of nature; and land use ethics. Several classes focus on the nature of facts, values, knowledge, and truth telling.

NTRES 415 Principles and Practices of Agroforestry (also HORT 415 and CSS 415)
Fall. 3 credits. Prerequisites: senior or graduate standing or permission of instructor. S-U option. Lec, M W F 10:10–11:00. Offered alternate years; possibly offered fall 2003. L. Buck, E. Fernandes, K. Mudge.

NTRES 416 Principles and Practices of Agroforesty—Laboratory (also HORT 416 and CSS 416)
Fall. 1 credit. Optional lab component of NTRES 415 (also HORT and CSS [SCAS]). S-U grades optional. Prerequisites: junior, senior, or graduate standing or permission of instructor; prior or concurrent enrollment in NTRES 415. Offered alternate years; possibly offered fall 2003. W 1:25–4:25. K. Mudge, E. Fernandes, L. Buck.

NTRES 418 Wetland Ecology and Management-Lecture
Fall. 3 credits. Prerequisite: BIOEE 261. B. L. Bedford.
Examination of the structure, function, and dynamics of wetland ecosystems with an emphasis on principles required to understand how human activities affect wetlands. Current regulations, protection programs, and management strategies are considered.

NTRES 419 Wetland Ecology and Management-Laboratory
Fall. 1 credit. Optional. Concurrent enrollment in NTRES 418 is required. 1 weekend fieldtrip required. B. L. Bedford.
An integrated set of laboratory field 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 420 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 428 Landscape Impact Analysis
Spring. 3 credits. Prerequisites: 1 introductory and 1 advanced course in ecology or the equivalents, and junior standing. B. L. Bedford.
This course presents ecological concepts and analytical tools needed to evaluate environmental impacts to natural resources and ecosystems within an integrated context that incorporates the landscapes in which these resources occur. It explores diverse conceptual frameworks for landscape impact analysis and exposes students to modern tools for evaluating landscapes.

NTRES 444 Resource Management and Environmental Law (also CRP 444)
Spring. 3 credits. For juniors, seniors, and graduate students. S-U grades optional. R. Booth.
For description, see CRP 444.

NTRES 450 Conservation Biology: Concepts and Techniques
Fall. 3 credits. Prerequisite: NTRES 210. Limited to first 30 seniors, plus graduate students. E. G. Cooch.
A thorough analysis of the ecological and quantitative dimensions for decision making in modern conservation biology and management. Emphasis is on analysis of variation and maintenance of biological diversity, and principles and techniques, including demographic viability analysis of populations, genetic analysis, as well as aspects of the human dimensions of conservation biology.

NTRES 454 Environmental Strategies
Fall. 3 credits. Prerequisite: AEM 250 or permission of instructor. S. Wolf.
How is conservation of natural resources pursued in today's institutional environment? The course focuses on opportunities to mobilize market mechanisms and competitive strategies of firms to harmonize social and ecological demands on environmental systems. Through production of a portfolio of analyses of real-world integrated environmental management schemes, students explore the mechanics of this general class of policy tools and develop a critique as to why the market does not represent a comprehensive approach to sustainability.

NTRES 456 Stream Ecology (also ENTOM 456, BIOEE 456)
Spring. 4 credits. Limited to 60 students. Prerequisites: none; BIOEE 261 recommended. Offered even years. B. Peckarsky.
For description, see ENTOM 456.

NTRES 458 Human Dimensions of Natural Resource Management
Spring. 3 credits. S-U grades optional. Limited to juniors and seniors. J. Enck and B. Lauber.
This course focuses on how a social science-based understanding of human attitudes, values, and behaviors can be incorporated in natural resource management decisions and actions. Examples from federal, state, and nongovernmental fish, wildlife, and forest management programs are used to illustrate the importance of socioeconomic considerations in problem solving and decision making.

NTRES 459 Wildlife Population Analysis: Techniques & Models
Spring. 3 credits. Prerequisites: NTRES 305 (or equivalent, or by permission of instructor), a college-level math or statistics class. Lecture/lab: 2-week intensive course (M T W R F morning lectures, afternoon labs) in January with follow-up meetings during the spring semester.
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. The course will focus on exploration of a selection of the tools needed for modern wildlife conservation and management, including (possibly) analysis of mark-recapture data, population viability analysis, decision theory, and matrix modeling.

NTRES 460 Quantitative Ecology and Management of Fisheries Resources
Spring. 4 credits. S-U grades optional. Prerequisites: NTRES 304 recommended or permission of instructor. Offered alternate even years. P. J. Sullivan.
The dynamics of marine and freshwater fisheries resources are examined with a view towards observation, analysis, and decision making within a quantitative framework. Growing pressure on fisheries' resources, habitat modification, and increased uncertainty about the nature of biological systems are at the center of many fisheries' issues. Quantitative models are useful for integrating information needed by decision makers in addressing these issues. The course develops analytical methods to assess the dynamics and status of fisheries' resources and then demonstrates how the information may be transformed into useful information for decision makers.

NTRES 471 Ecoregions: Ecology and Conservation
Spring. 2 credits. Letter grade only. Prerequisites: NTRES 210, 305; statistics recommended; junior standing or above. Lec/Lab. Offered alternate even years. C. R. Smith.
Approaches to characterizing and classifying terrestrial habitats and ecoregions at a variety of spatial scales are reviewed and discussed. A landscape approach is used to introduce habitat management concepts and land cover classifications. Legislation guiding federal land management decisions is discussed, and field trips may go to areas managed by public and private land management organizations.

NTRES 493 Individual Study in Resource Policy, Management, and Human Dimensions
Fall, spring, or winter. Credit TBA. S-U grades optional. Prerequisite: permission of instructor. R. A. Baer, T. Brown, L. E. Buck, D. J. Decker, J. Enck, J. Gillett, B. Knuth, T. B. Lauber, J. Tantillo, S. Wolf.
Topics in environmental and natural resource policy, management, and human dimensions are arranged depending on the interests of students and availability of staff. Students must register with an Independent Study form (available in 140 Roberts Hall).

NTRES 494 Special Topics in Natural Resources
Fall or spring. 4 credits maximum. S-U grades optional.
The department teaches "trial" courses under this number. Offerings vary by semester, and are advertised by the department before the semester starts. Courses offered under the number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

NTRES 495 Individual Study in Fish and Wildlife Biology and Management
Fall or spring. Credit TBA. S-U grades optional. Prerequisite: permission of instructor. M. Bain, E. Cooch, P. Curtis, T. Gavin, J. R. Jackson, C. Kraft, R. Malecki, E. Mills, A. Moen, S. Morreale, M. Richmond, L. Rudstam, C. Smith, P. Sullivan.
Topics in fish and wildlife biology and management are arranged depending on the interests of students and availability of staff. Students must register with an Independent Study form (available in 140 Roberts Hall).

NTRES 496 Individual Study in Ecology and Management of Landscapes
Fall or spring. Credit TBA. S-U grades optional. Prerequisite: permission of instructor. B. Bedford, B. Blossey, T. Fahey, M. Krasny, J. Lassoie, R. Schneider, R. Sherman, P. Smallidge, J. Yavitt.
Topics in ecology and management of landscapes are arranged depending on the interests of students and availability of staff. Students must register with an Independent Study form (available in 140 Roberts Hall).

NTRES 498 Teaching in Natural Resources
Fall and spring. 1–4 credits. Prerequisite: permission of instructor. Students must register with an Independent Study form (available in 140 Roberts Hall). S-U grades optional.
Course designed to give students an opportunity to obtain teaching experience by assisting in labs, field trips for designated sections, discussions, and grading. Students gain insight into the organization, preparation, and execution of course plans through application and discussions with instructor.

NTRES 500 Professional Projects—M.P.S.
Fall and spring. Credit TBA. Limited to graduate students working on professional master's projects. S-U grades only.

NTRES 600 Introduction to Graduate Study in Natural Resources
Fall. 2 credits. Prerequisite: course is open to beginning graduate students whose faculty advisers are in Natural Resources. S-U grades. Lec TBA.
Designed for beginning Natural Resources graduate students, this course includes faculty-led discussions of key natural resources issues, student discussions of research ideas, and skill building sessions on proposal writing and giving research presentations. Students are required to complete a research proposal.

NTRES 601 Seminar on Selected Topics in Natural Resources
Fall or spring. 1 credit. S-U grades only. TBA. Check with department for availability. Staff.
Selected readings and discussions of research and/or current problems in natural resources. Offering varies by semester and is subject to availability of staff.

NTRES 604 Seminar on Selected Topics in Resource Policy and Management
Fall. 2 credits. S-U grades only. TBA. Check with department for availability.
Special topics seminar on subjects related to resource policy and management. Offering varies by semester and is subject to availability of staff.

NTRES 605 Issues in Risk Analysis Seminar (also CEE 605)
Fall. 1 credit. Prerequisite: calculus, advanced course in statistics and basic natural sciences (Chemistry, Biology, Earth Systems). S-U only. Lec, TBA. J. Gillett and R. Davidson.
Discussion of current issues and ongoing research on risk analysis issues from many perspectives with an emphasis on environmental risk analysis. Speakers address problem formulation, quantitative/qualitative methods in assessment of risks, communication issues, and challenges to risk assessment methodologies. Some sessions held jointly with other seminar series. Enrollment in seminar requires short reports and participation in two required discussion meetings for class members designed to integrate the issues raised during the semester.

NTRES 607 Ecotoxicology (also TOX 607)
Spring. 3 credits. Prerequisites: graduate or senior status and two 300-level courses in chemistry, biological science, or toxicology. Offered alternate even years. J. W. Gillett.
Lectures, readings, and special guests focus on the principles of effects of toxic chemicals on natural ecosystems, their components, and processes. Major topics include fate and transport of chemicals (chemodynamics), comparative biochemical toxicology,

ecosystem process analysis, simulation through mathematical and physical (microcosm) models, and relationships to regulation and environmental management.

NTRES 612 Fish and Wildlife Ecology Seminar
Fall and spring. 1 credit. Prerequisite: permission of instructor. Check with department for availability. Staff.
Discussion of individual research, current problems, and current literature in fish and in wildlife ecology. Offering varies by semester and subject to availability.

NTRES 614 Environmental Governance
Spring. 4 credits. S. Wolf.
For description, see NTRES 314. Students taking the course for graduate credit will be required to read supplemental materials, undertake more complex research assignments, and participate in seminar discussion section.

[NTRES 615 Case Studies and Special Topics in Agroforestry
Fall. 2 credits. Prerequisites: NTRES/CSS/HORT 415 or permission of instructor. S-U grades optional. Not offered 2003–2004. L. E. Buck.]

NTRES 616 Forest Science and Management Seminar
Fall. 2 credits. For graduate students and upper-level undergraduates. J. B. Yavitt.
This seminar course includes review of current literature, student research, and selected topics of interest. Topics include biogeography, ecology, and human use of forests located in boreal, temperate, and/or tropical environments.

NTRES 618 Critical Issues in Conservation and Sustainable Development
Fall. 3 credits. Preference to graduate students with minor in conservation and sustainable development; seniors by permission. Limited to 30 students. T R 2:30–4:25. Staff.
Establishes a conceptual foundation for analyzing and addressing conservation and development issues from an interdisciplinary perspective. Engages students in the inherent conflicts between natural resource conservation and rural development. Students work in interdisciplinary groups to analyze issues and cases from both developing and developed countries.

NTRES 659 Wildlife Population Analysis: Techniques and Models
Spring. 3 credits. Prerequisites: NTRES 305 (or equivalent, or by permission of instructor), a college-level math and statistics class. Lecture/lab: 2-week all-day (Monday through Friday) course in January with follow-up meetings during the spring semester.
For description, see NTRES 459.

NTRES 660 Quantitative Ecology and Management of Fisheries Resources
Spring. 4 credits. S-U grades optional. Prerequisites: NTRES 304 recommended or permission of instructor. Offered even years. P. J. Sullivan.
This course is taught in conjunction with NTRES 460 (see description above). Students taking the course for graduate credit are asked, in addition to the 400-level projects and homework, to construct and document a model of population or community dynamics that reflects and extends the concepts covered in the course.

[NTRES 670 Spatial Statistics
Spring. 3 credits. Prerequisites: BTRY 601 and 602; an intro GIS course strongly recommended. S-U grades optional. Offered alternate odd years. Next offered spring 2005. P. J. Sullivan.
Spatial statistical concepts and techniques are developed and applied to ecological and natural resource issues. Topics include visualizing spatial data and analysis and modeling of geostatistical, lattice, and spatial point processes. Students should consider taking this course simultaneously with CSS 620.]

NTRES 694 Special Topics in Natural Resources
Fall or spring. 4 credits maximum. S-U grades optional.
The department teaches "trial" courses under this number. Offerings vary by semester, and are advertised by the department before the semester starts. Courses offered under the number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

NTRES 696 Organic Inputs in Tropical Soils and Agroforestry (also INTAG 696 and CSS 696)
Fall and spring. 1 credit. S-U grades only. F 12:20–1:10. E. Fernandes, L. Fisher.
For description, see INTAG 696.

NTRES 698 Current Topics: Environmental Toxicology (also TOX 698)
Fall, spring. 1–3 credits. Prerequisites: graduate or senior standing in scientific discipline and permission of instructor.
A student-faculty colloquium on subjects of current interest, usually focusing on multidisciplinary aspects of topical problems (e.g., Superfund, oil spills).

NTRES 699 Graduate Individual Study in Natural Resources
Fall or spring. Credit TBA. S-U grades optional. Prerequisite: permission of instructor. NTRES graduate faculty.
Study of topics in natural resources more advanced than, or different from, other courses. Subject matter depends on interests of students and availability of staff.

NTRES 800 Master's Thesis Research
Fall and spring. Credit TBA. Limited to graduate students working on master's thesis research. S-U grades only.

NTRES 900 Graduate-Level Thesis Research
Fall and spring. Credit TBA. Limited to graduate students in a Ph.D. program **only before** the "A" exam has been passed. S-U grades only.

NTRES 901 Doctoral-Level Thesis Research
Fall and spring. Credit TBA. For students admitted to candidacy after the "A" exam has been passed. S-U grades only.

Related Courses in Other Departments

Courses in many other departments are relevant to students majoring in Natural Resources. The following list includes some of the most closely related courses but is not exhaustive.

Environment and Society (R SOC 208, 324, 340, 410, 440, 495)

Ecology and Biology (ENTOM 370, 456, 470, 471; BIOEE 261, 263, 274, 278, 452, 457, 459, 461, 462, 463, 465, 466, 468, 471, 472, 475, 476, 478; BIOMI 290–292, 397, 418)

Environmental Law, Ethics, and Philosophy (S&TS 206; CRP 390, 443, 444, 451, 453; PHIL 241, 246, 247, 381)

Human Systems and Communication (COMM 260, 285, 352, 421)

Physical Sciences (BEE 151, 301, 371, 425, 435, 471, 473, 475, 478; CSS and EAS 260, 321, 365, 371, 398, 483; EAS 102, 104; CEE 432)

Public Policy and Politics (GOVT 427, 428; BIO & SOC 461; CEE 529)

Resource Economics (AEM 250, 450, 451)

Spatial Data Interpretation (CSS 411, 420, 620, 660)

PLANT BREEDING

T. Brutnell, W. R. Coffman, W. De Jong, J. Doyle, E. D. Earle, V. Gracen, P. Gregory, S. Kresovich, M. M. Jahn, S. R. McCouch, M. A. Mutschler, K. V. Raman, M. E. Smith, M. E. Sorrells, S. D. Tanksley, D. R. Viands, K. Watanabe

Emeritus Professors: R. E. Anderson, H. M. Munger, R. P. Murphy, W. D. Pardee, R. L. Plaisted

Note: class meeting times are accurate at the time of publication. If changes are necessary, the department will provide new information as soon as possible.

PL BR 201 Plants, Genes, and Global Food Production
Fall. 2 credits. Prerequisite: 1 year of introductory biology or permission of instructor. Lecs, T R 11:15. S. R. McCouch.
This course provides an introduction to plant breeding. It offers a sense of the historical and social importance of the field, tracing its evolution from the pre-scientific days of crop domestication to modern applications of biotechnology. It offers specific examples of how breeding objectives are realized and raises questions about the environmental, social, and economic consequences of intensive food production systems. This course may be used for partial fulfillment of the CALS distribution requirement GROUP B—Biological Sciences.

PL BR 225 Plant Genetics
Spring. 2 or 3 credits (2 credits if taken after BIOGD 281). Prerequisites: 1 year of introductory biology or equivalent; permission of instructor required for students who have taken BIOGD 281. Lecs, M W 11:15–12:05; lab, R 1:25–4:25. M. Mutschler.
This course surveys the fundamentals of plant genetics. It shows how this information is used in plant biology and allied agricultural sciences and provides a basis for understanding the complex issues related to modern crop genetics. Topics include simple inheritance, linkage analysis, polyploidy, analysis of nuclear, chloroplast and

mitochondrial genomes, pollination controls, and methods for analysis and manipulation of genes, chromosomes, and whole genomes. Examples and materials are drawn from diverse crops and plant species.

PL BR 401 Plant Cell and Tissue Culture
Fall. 3 credits. Prerequisites: a course in plant biology or genetics, or permission of instructor. Lecs, T R 10:10. E. D. Earle.
Lectures and demonstrations dealing with the techniques of plant tissue, cell, protoplast, embryo, and anther culture and the applications of those techniques to biological and agricultural studies. Plant improvement via gene transfer and other manipulations of cultured cells is a major topic.

PL BR 402 Plant Tissue Culture Laboratory
Fall. 1 credit. Enrollment limited. Prerequisites: PL BR 401 (may be taken concurrently) or permission of instructor. W or R 1:25–4:25 (alternate weeks) plus 1 hr TBA. E. D. Earle, A. R. Alan.
This course provides hands-on experience in plant tissue culture and complements PL BR 401. Lab work includes cell, tissue and organ culture techniques related to propagation, storage, and genetic manipulation. Experiments use a broad range of plant materials and include protoplast culture and *Agrobacterium*-mediated gene transfer.

PL BR 403 Genetic Improvement of Crop Plants
Fall. 3 credits. Prerequisites: genetics (BIOGD 281, PL BR 225, or other standard genetics course), and a course in crops or horticulture. M W F 9:05–9:55. V. Gracen.
Genetic enhancement of crop value to humans began with domestication and continues with farmers' variety development and scientifically trained plant breeders' applications of Mendelian, quantitative, and molecular genetics. This course examines crop genetic improvement methods by discussing the history and current practice of plant breeding, tools available to breeders, choices and modifications of those tools to meet specific objectives, and challenges plant breeders face in developing varieties for the future.

PL BR 404 Crop Evolution, Domestication and Diversity (also BIOPL 404, INTAG 404)
Fall. 2 credits. S-U or letter grade. Prerequisites: BIOGD 281 or PL BR 225 or permission of the instructor. Lecs, T R 9:05. S. Kresovich.
Evolution, domestication, and breeding of crop plants have molded the current diversity we conserve and use. Based on advances in systematics and molecular genetics, this course presents an integrated approach to understanding and describing diversity of agricultural and horticultural species. Underlying ethical, legal, and social issues affecting conservation and use also are addressed.

PL BR 446 Plant Cytogenetics Laboratory
Spring. 1 credit. S-U only. Prerequisites: a course in genetics or permission of instructor. Will be offered as a 2-week module at a time to be arranged. Check with department for further information. K. N. Watanabe.
This course aims to provide fundamental knowledge and techniques in plant cytogenetics. Emphasis is on applications to research on plant genetics and plant breeding. Plant materials involve a wide range of crop species. Basic techniques for examination of plant chromosomes are covered.

PL BR 494 Special Topics in Plant Breeding
Fall or spring. 4 credits maximum. S-U grades optional.
The department teaches "trial" courses under this number. Offerings vary by semester, and are advertised by the department before the semester starts. Courses offered under the number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

PL BR 496 Internship in Plant Breeding
Fall or spring. Credits variable, may be repeated to a maximum of 6. Minimum of 60 on-the-job hours per credit granted. Prerequisites: permission of adviser and enrollment during the pre-enrollment period of the semester before the internship. Student must be a plant breeding junior or senior with a minimum 3.0 average in plant breeding courses. Students must attach to their course enrollment materials a "CALS Independent Study, Research, Teaching, or Internship" form signed by the faculty member who will supervise their study and assign their 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 student, stating the conditions of the work assignment, supervision, and reporting.

PL BR 497 Individual Study in Plant Breeding
Fall or spring. Credits variable, may be repeated to a maximum of 6. S-U optional. Prerequisite: permission of instructor. Students must register with an Independent Study form (available in 140 Roberts Hall). Staff.

PL BR 498 Undergraduate Teaching
Fall or spring. Credits variable, may be repeated to a maximum of 6. S-U optional. Prerequisites: permission of instructor, and previous enrollment in course to be taught or equivalent. Students must register with an Independent Study form (available in 140 Roberts Hall). Staff.
Undergraduate teaching assistance in a plant breeding course. Teaching experience may include leading a discussion section, preparing and teaching laboratories, and tutoring.

PL BR 499 Undergraduate Research
Fall or spring. Credits variable. S-U optional. Prerequisite: permission of instructor. Students must register with an Independent Study form (available in 140 Roberts Hall). Staff.
Undergraduate research projects in plant breeding.

PL BR 604 Methods of Plant Breeding Laboratory
Fall. 2 credits. Prerequisite: PL BR 403 or equivalent (may be taken concurrently). S-U optional. T R 1:25–4:15. M. E. Sorrells and R. E. Anderson.
Field trips to plant breeding programs involve discussion of breeding methods used, overall goals, selection and screening techniques, and variety and germ plasm release. Additional labs include use of computers in plant breeding research and selection techniques for disease resistance. For a term project each student designs a comprehensive breeding program on a chosen crop.

PL BR 606 Advanced Plant Genetics
Spring. 3 credits. S-U grades optional. Prerequisites: BIOGD 281 or equivalent and instructor's permission. Lecs, T R 1:25–2:40. M. Jahn.
Provides an advanced survey of genetics in higher plants including selected topics in Mendelian genetics, plant reproductive biology, chromosome biology, cytogenetics, and epigenetics. The development of critical analytical skills is stressed through case studies, in-class exercises, and the course project.

PL BR 607 Analysis of Sequence Similarity
Spring. 1 credit. Enrollment limited. S-U grades only. Prerequisites: basic biology, basic genetics, familiarity with computers. Permission of instructor required. M W F 11:15–12:05 for 4 weeks. Dates TBA. Check with Plant Breeding Office after June for details.
This course focuses on the tools available for accessing nucleotide and protein sequence similarity in plants, animals, and microbes and the strengths and limitations of these approaches for answering biological questions. The mathematical and statistical background of the algorithms is presented in lectures, and weekly on-line projects provide students with experience in addressing a range of biological problems involving sequence analysis.

PL BR 612 Intellectual Property Management and Licensing
Spring. 2 credits. Prerequisite: open to graduate students and to senior undergraduates. S-U or letter option. Lec, M 12:20–4:25, weeks 1–8. A. F. Krattiger, M. A. Mutschler, R. Potter, and R. D. Kryder.
Comprehensive course for graduates and senior undergraduates in any field of agriculture and the life sciences on intellectual property (IP) management and licensing. The course covers statutory protection (copyright, trademarks, patents, plant variety protection), contracts (from material transfer to licensing), management of IP (freedom-to-operate, valuation, genetic resources, trade, marketing, etc.) and negotiation. Emphasis is on technology transfer and international aspects. The course is particularly relevant to students interested in science management, technology transfer, international agriculture, and business.

[PL BR 618 Breeding for Pest Resistance (also HORT 618)
Fall. 2 credits. S-U grades optional. Prerequisites: BIOGD 281 and PL BR 403 or equivalents. An introductory course in plant pathology and/or entomology also highly recommended. Lecs, M 2:30–4:25. Offered alternate even years. P. Griffiths.
A multidisciplinary examination of the challenge of incorporating disease and insect resistance into crop plants. Topics covered include national and international germplasm collections, identification of sources of resistance, resistance mechanisms in plants, monogenic and polygenic control of

resistance, approaches to breeding for resistance, stability of genetic resistance mechanisms, and the use of biochemical, physiological, and molecular tools in breeding for pest resistance.]

PL BR 622 Seminar
Fall or spring. 1 credit. S-U grades only. T 12:20–1:10. Staff and graduate students.

PL BR 650 Special Problems in Research and Teaching
Fall or spring. 1 or more credits. Prerequisite: permission of instructor supervising the research or teaching. Staff.

PL BR 653.1 Concepts and Techniques in Plant Molecular Biology (also BIOPL 653.1, PLPA 663.01)
Fall. 2 credits. S-U grades optional. Prerequisities: (Listed under BIOPL 653 Plant Molecular Biology I). Lec, M W F 10:10 (24 lecs). S. McCouch, J. Giovannoni, J. Rose.
This introductory module provides a broad overview of molecular biology concepts relevant to the plant sciences. This section serves as a prerequisite to other modules in the BIOPL 653 (fall) and BIOPL 652 (spring) series. The course is divided into three sections: (1) Gene discovery: covers genetic, molecular, and genomics approaches to the isolation of plant genes; (2) Gene characterization: covers DNA sequence analysis, assessment of gene expression, functional genomics approaches, and production of transgenic plants. (3) Analysis and characterization of proteins and metabolites: includes metabolomic techniques. This course consists of two lectures and one day of discussion/week. Course material is coordinated with BIOPL 641 (lab). Emphasis is on understanding techniques and approaches that are appropriate for different experiments and objectives.

PL BR 653.2 Plant Biotechnology (also PL PA 663 and BIO PL 653.2)
Fall. 1 credit. S-U grades optional. Prerequisite: BIO PL 653.1 or permission of instructor. Lecs, M W F 1:25–2:15 (12 lecs) Oct. 1–Oct. 29. E. D. Earle and M. Zaitlin.
This course deals with production and 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, produce useful products, or have improved nutritional and food processing characteristics. Regulatory and social issues relating to plant biotechnology are discussed.

[PL BR 653.3 Plant Genome Organization (also BIO PL 653.3)
Fall. 1 credit. S-U grade or letter option. Prerequisites: BIO PL 653.1. M W F 10:10–11:00 (12 lecs) Oct. 2-Oct. 30. Offered alternate years. S. D. Tanksley.
The structure and variation of plant nuclear genomes, including changes in genome size, centromere/telomere structure, DNA packaging, transposable elements, genetic and physical mapping, positional gene cloning, genomic sequencing, and comparative genomics.]

PL BR 653.6 Molecular Breeding (also BIOPL 653.5)
Fall. 1 credit. S-U grade or letter option. Lecs, M W F 10:10–11:00 (12 lecs) Oct. 1–Oct. 29. Offered alternate years. S. Tanksley.
Application of DNA markers to the identification, manipulation and isolation of genes important to plant and animal productivity using molecular genetic techniques. Students learn how to design and execute experiments to identify quantitative trait loci (QTLs), as well as how to apply molecular markers to plant and animal breeding programs.

PL BR 694 Special Topics in Plant Breeding
Fall or spring. 4 credits maximum. S-U grades optional.
The department teaches "trial" courses under this number. Offerings vary by semester, and are advertised by the department before the semester starts. Courses offered under the number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

[PL BR 716 Perspectives in Plant Breeding Strategies
Spring. 3 credits. S-U grades optional. Prerequisite: PL BR 403. Offered alternate years. W 3:35–5:15, F 3:35–4:25. M. E. Sorrells.
Emphasis is on critical discussion and evaluation of selected benchmark papers and current literature. Selection techniques and breeding objectives, methods, and strategies for both self- and cross-pollinated crops are reviewed and discussed. Extensive outside reading is required. Grades are based on 4 papers demonstrating creative thinking and analysis of plant breeding concepts.]

PL BR 717 Quantitative Genetics in Plant Breeding
Spring. 3 credits. S-U grades optional. Prerequisites: PL BR 403 and BTRY 601 or equivalent. M F 2:55–4:10. Offered even years. D. R. Viands.
Discussion of quantitative genetics and quantitative trait loci (QTLs) for more efficient plant breeding. Specific topics include: components of variance (estimated from various mating designs); theory and computer analysis for QTL, population structure, multiple locus regressions, and interval analysis; heritability; theoretical gain from selection; and genotypic and phenotypic correlation coefficients. During one period, plants in the greenhouse are evaluated to provide data for computing quantitative genetic parameters.

PL BR 726 Problems and Perspectives in Computational Molecular Biology (also CS 726 and BTRY 726)
Fall and spring. 1 credit. S-U only. Prerequisite: permission of instructor. Lec M 1:25–2:15.
This is a weekly seminar series discussing timely topics of computational molecular biology. The course addresses methodological approaches to sequence annotation, protein structure and function relationships, evolutionary relationships across species. Statistical and deterministic computational approaches are covered and specific and detailed biological examples are discussed. Topics of interest are discussed in relation to papers prepared by teams of students and/or faculty. We pair students/faculty from biology backgrounds with students from math, computer science and statistics for paper preparation. Students summarize the salient questions addressed by the paper, the research methods used and the results obtained. At the end of the presentation, questions should be listed on an overhead slide to initiate discussion in the group.

PL BR 800 Master's-Level Thesis Research
Fall or spring. Credit TBA. Prerequisite: permission of instructor. S-U grades optional. Graduate faculty.
For students working on a master's thesis.

PL BR 900 Graduate-Level Dissertation
Fall or spring. Credit TBA. Prerequisite: permission of instructor. S-U grades optional. Graduate faculty.
For students in a Ph.D. program **only before** the "A" exam has been passed.

PL BR 901 Doctoral-Level Dissertation Research
Fall or spring. Credit TBA. Prerequisite: permission of instructor. S-U grades optional. Graduate faculty.
For students admitted to candidacy **after** the "A" exam has been passed.

PLANT PATHOLOGY

R. Loria, chair; S. V. Beer, G. C. Bergstrom, A. R. Collmer, T. P. Delaney, W. E. Fry, S. M. Gray, K. T. Hodge, G. W. Hudler, S. G. Lazarowitz, J. W. Lorbeer, G. B. Martin, M. T. McGrath, M. G. Milgroom, E. B. Nelson, R. J. Nelson, K. L. Perry, B. G. Turgeon, M. Zaitlin, T. A. Zitter

Note: class meeting times are accurate at the time of publication. If changes are necessary, the department will provide new information as soon as possible.

PL PA 201 Magical Mushrooms, Mischievous Molds
Spring. 2 credits. S-U optional. Lecs, T R 11:15. G. W. Hudler.
A presentation of the fungi and their roles in nature and in shaping past and present civilizations. 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 are emphasized.

PL PA 241 Plant Diseases and Disease Management
Fall. 4 credits. Prerequisite: one year of biology. Lecs, M W F 11:15; lab, T or W 1:25. Lectures co-meet with PL PA 401; laboratories and exams are separate. Credit can only be for one of these courses. Staff.
An introduction to plant diseases, their diagnosis, and their management. Topics covered include: fungi, bacteria, viruses, nematodes, and other plant pathogens; disease cycles, plant disease epidemiology, disease forecasting, and the principles and practices of plant disease management. This course is intended for students who want a practical knowledge of plant diseases and their control.

[PL PA 309 Introductory Mycology
Fall. 3 credits. Prerequisite: 1 year of biology. Concurrent registration in PL PA 319 is recommended. Lecs, T R 9:05–9:55; lab R 1:25–4:25. K. T. Hodge.
A survey of the astounding kingdom of fungi, including mushrooms, molds, yeasts, athlete's foot, fairy rings, and the blue stuff in blue cheese. The course covers fungal biodiversity and systematics, how fungi work, and their roles in the environment and in human affairs. Students work with preserved and living fungi and learn basic identification skills. Grades are based on two prelims, a final exam, and a culture collection project.]

[PL PA 319 Field Mycology
Fall, weeks 1–8. 1 credit. Letter grades only. Lab, W 1:25–4:25 and W 7:30–9:25 P.M. K. T. Hodge.
Learn to identify mushrooms and other macrofungi on a series of eight afternoon field trips followed by evening lab sessions. Fungi are collected during afternoon trips to sites around Ithaca. In the evenings, students use technical keys and microscopes to identify the fungi and learn about their ecology. The course runs only the first eight Wednesdays of fall semester. Grades are based on a collection project and a final laboratory examination.]

PL PA 401 Basic Plant Pathology
Fall. 4 credits. Prerequisite: 1 year of biology and BIO PL 241 or equivalent. Recommended: general microbiology, plant physiology. Lec, M W F 11:15; lab R 1:25. Lectures co-meet with PL PA 241; laboratories and exams are separate. Credit can only be earned for one of these courses. Staff.
An introduction to plant diseases, their diagnosis, and their management. Topics covered include: fungi, bacteria, viruses, nematodes, and other plant pathogens; disease cycles, plant disease epidemiology, disease forecasting, and the principles and practices of plant disease management. This course shares lectures with PL PA 241; laboratories and exams are separate. The laboratory is similar to that of PL PA 241, but more basic principles in plant pathology are emphasized. This course is intended for students who want preparation for graduate-level studies in plant pathology.

[PL PA 411 Plant Disease Diagnosis
Fall. 3 credits. Limited to 18 students. Prerequisites: PL PA 241 or equivalent and permission of instructor. Lec, T R 10:10; lab T R 1:25–4:25. Next offered fall 2005. G. W. Hudler.
A method of diagnosing plant diseases caused by infectious and noninfectious agents is taught with emphasis on application of contemporary laboratory techniques and effective use of the literature. After seven weeks of formal lecture and laboratory sessions, students spend the rest of the semester working on their own to determine the causes of plant diseases on samples that have either been received by the Plant Disease Diagnostic Lab or that have been prepared by instructors.]

[PL PA 443 Pathology and Entomology of Trees and Shrubs (also ENTOM 443)
Fall. 4 credits. Limited to 30 students. Prerequisites: PL PA 241 or equivalent, ENTOM 212 or equivalent. Lec, M W F 11:15; lab F 1:25–4:25. Offered alternate years. Next offered fall 2004. G. W. Hudler, P. A. Weston.
For students preparing for careers in horticulture, urban forestry, natural resources, and pest management. Deals with identification, impact, assessment, biology, and management of insects and diseases that damage trees and shrubs. Emphasis is on pests of northeastern flora but examples from other parts of the country and the world are also used. Forest, shade, and ornamental plants are considered.]

PL PA 494 Special Topics in Plant Pathology
Fall or spring. 4 credits maximum. S-U grades optional.
The department teaches "trial" courses under this number. Offerings vary by semester, and are advertised by the department before the semester starts. Courses offered under the number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

PL PA 497 Independent Study
Fall or spring. 1–5 credits. Students must register with an Independent Study form (available in 140 Roberts Hall). S-U grades optional.
An opportunity for independent study of a special topic in mycology or plant pathology under the direction of a faculty member.

PL PA 498 Teaching Experience
Fall or spring. 1–5 credits. Students must register with an Independent Study form (available in 140 Roberts Hall). S-U grades optional.
Undergraduate teaching assistance in a mycology or plant pathology course by mutual agreement with the instructor.

PL PA 499 Undergraduate Research
Fall or spring. 3–5 credits. Students must register with an Independent Study form (available in 140 Roberts Hall). S-U grades optional.
An opportunity for research experience under the direction of a faculty member.

PL PA 600 Professional Skills in Science and Plant Pathology
Fall. 1 credit. S-U grades only. Lec, 9:05–9:55. Graduate faculty.
Provides new students with a philosophical overview of the preparation required to pursue a scientific career in plant pathology. Topics address (1) what it means to be a scientist and plant pathologist, (2) preparation required of graduate students in plant pathology programs, (3) ethical considerations important to plant pathologists, (4) how to seek funding to support research activities, (5) managing the scientific literature, (6) funneling curiosity into scientific inquiry, and (7) how to read a scientific paper, among others. A portion of the semester is devoted to familiarizing students with the faculty programs and resources available on the Cornell campus to support contemporary plant pathology research.

PL PA 601 Concepts of Plant Pathology
Spring. 3 credits. Prerequisites: PL PA 401 or equivalent. S-U grades optional. Lec, T R 8:40–9:55; lab R 2:00–4:25. A. R. Collmer, M. G. Milgroom.
Concepts in plant-pathogen relationships uniting molecular and population biology approaches, with emphases on molecular/cellular investigations of model pathosystems and population biology studies integrating host-pathogen evolution, genetics, and ecology. The discussion section is used for examining current research literature and other exercises complementary to lecture topics; emphasis is on critical thinking in science. Students prepare and review mock grant proposals.

[PL PA 605 Viral Plant Diseases
Spring. 1 credit. S-U grades optional. Prerequisites: PL PA 401 or permission of instructor. Lec, M W 11:15 (7 weeks, 2nd half of semester). Offered alternate years. Next offered spring 2005. S. M. Gray.
Introduces students to plant viruses and the disease they cause. Addresses nomenclature, taxonomy, disease economics, ecology and epidemiology, transmission, and disease control. A virtual laboratory is used to introduce students to virus disease diagnosis.]

[PL PA 606 Molecular Plant Virology (also BIOMI 650)
Spring. 1 credit. S-U grades optional. Prerequisites: BIOMI 409 (Principles of Virology), (BIOMI 409), a course in Cell Biology, or permission of instructor. Lec, M W 11:15 (7 wks, 1st half of semester). Offered alternate years. Next offered spring 2005. S. G. Lazarowitz.
Introduces students to the molecular biology of plant virus replication and interactions with the host to produce disease. Material covered includes virus replication strategies, cell-to-cell and systemic movement, host defense responses and virus counterstrategies, and engineered resistance.]

[PL PA 607 Bacterial Plant Diseases
Fall. 1 credit. S-U grades optional. Prerequisites: PL PA 401 or permission of instructor. Lec, W 9:05 (7 weeks, 1st half of semester only); lab W 1:25–4:25 (7 weeks, 1st half of semester only). Offered alternate years. Next offered in 2005. S. V. Beer.
This course emphasizes bacterial disease of plants, their occurrence in the field, isolation of bacterial pathogens and their identification by traditional and contemporary techniques. Bacterial culture and plant inoculation, epidemiology and control.]

[PL PA 608 Genomics of Bacterium-Host Interactions (also BIOMI 651)
Fall. 1 credit. S-U grades optional. Prerequisites: BIOMI 290 or equivalent or permission of instructor. Lec, M W 9:05 (2nd half of semester). Offered alternate years. Next offered in fall 2005. A. Collmer and S. Winans.
Introduction to genomic approaches, tools, and discoveries involving the study of bacterial interactions with plant and animal hosts. Topics include the TIGRE Comprehensive Microbial Resource and Artemis tools, the pathogens *Yersinia pestis, V. enterocolitica, Pseudomonas syringae, Ralstonia solanacearum,* and *Agrobacterium tumefaciens,* and the symbiont *Sinorhizobium meliloti.*]

PL PA 609 Fungal Plant Diseases
Spring. 1 credit. S-U grades optional. Prerequisites: PL PA 309, 401 or equivalents, or permission of instructor. Lec, F 1:25–2:15 (7 weeks, 2nd half of semester); lab F 2:30–4:25 (7 weeks, 2nd half of semester). Offered alternate years. J. W. Lorbeer.
A team taught course providing basic information on the biology of fungal pathogens and the diseases they cause. The

life cycles and disease cycles of representative pathogens and diseases they cause are emphasized along with etiological and epidemiological aspects of the diseases covered.

[PL PA 610 Oomycete Biology and Pathology
Spring. 1 credit. S-U grades optional. Prerequisites: PL PA 401 or permission of instructor. Lec, M W 9:05–9:55 (7 weeks, 1st half of semester). Offered alternate years. Next offered fall 2005. E. B. Nelson.
This course is intended to provide students with a broad exposure to the biology of Oomycetes. The basic attributes of this important group and animal, plant, and invertebrate parasites are detailed in lectures and demonstration sessions. Emphasis is placed biological characteristics important to the pathology of these organisms. Topics address evolutionary biology, systematics, genetics, developmental biology, mechanisms of pathogenesis, unique aspects of Oomycete metabolism and reproduction, growth, and dormancy. Key ecological aspects of the interaction of Oomycetes with plants and other microbes are covered. Practical aspects of Oomycete biology, including isolation from environmental samples, epidemiology and disease control are also addressed.]

PL PA 620 Ecology of Plant Pathogens
Spring. 1 credit. S-U grades optional. Prerequisites: PL PA 401 or permission of instructor. Lec, M W 9:05–9:55 (7 weeks, 1st half of semester). Offered alternate years. E. B. Nelson.
The basic ecological concepts, principles, methods, and literature important to the understanding of the interactions of plant pathogens with their physical, biochemical, and microbial environments are covered. Ecological processes that regulate the pre-infection behavior of plant pathogens are emphasized in both aboveground and belowground habitats. Topics include the nature and behavior of pathogen inoculum, population and community biology, pathogen interactions with plant-associated microbial populations and communities, rhizosphere and phyllosphere dynamics, and more.

PL PA 621 Chemical and Biological Disease Control
Spring. 1 credit. S-U grades optional. Prerequisites: PL PA 401 or permission of instructor. Lec, M W 9:05–9:55 (7 weeks, 2nd half of semester). Offered alternate years. E. B. Nelson and W. Koeller.
A discussion of the principles and methods used for the control of plant diseases. Emphasis is placed on chemical and biological strategies for disease control. Topics include historical aspects of disease management in plant pathology, the discovery, use and mode of action of major fungicide groups, pathogen resistance to fungicides, microbial strategies for biological control, regulation and commercialization of microorganisms, transgenic microorganisms and strategies for integrating biological and chemical control strategies.

PL PA 622 Plant Disease Epidemiology
Fall. 1 credit. S-U grades optional. Prerequisites: PL PA 401 or permission of instructor. Lec, M W 9:05 (7 weeks, 1st half of semester). Offered alternate years. M. G. Milgroom.
An introduction to basic concepts of population dynamics of plant pathogens and plant diseases in time and space. Emphasis is on the interplay between theory and empirical studies on disease progress, spatial patterns and spread, forecasting and risk assessment for plant pathogens.

PL PA 623 Pathogen Population Genetics
Fall. 1 credit. S-U grades optional. Prerequisites: PL PA 401 or permission of instructor. Lec, M W 9:05 (7 weeks, 2nd half of semester). Offered alternate years. M. G. Milgroom.
Introduction to basic principles of population genetics and evolution as they relate to plant pathogens. Topics include quantifying genetic diversity, population structure, reproductive systems and migration. Special emphasis is on the applications of population genetics to answering questions about the biology and epidemiology of plant pathogens. Examples from fungi, oomycetes, bacteria and viruses are included.

[PL PA 638 Filamentous Fungal Genomics and Development (also BIOGD 638)
Spring. 1 credit. S-U grades optional. Prerequisite: BIOGD 281 or equivalent. Lec, M W F 10:10. (4 weeks, last 4 of semester) Next offered spring 2005. 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 plant pathogenesis (including host and tissue specificity) and reproduction, both sexual and asexual, are described. Experimental evidence supporting various hypotheses to explain fungal pathogenicity is evaluated. Examples are chosen from investigations of model plant pathogenic fungi such as *Cochliobolus heterostrophus, Magnaporthe grisea,* and *Ustilago maydis* and from well known genetic models such as *Aspergillus nidulans* and *Neurospora crassa*.]

PL PA 642–661 Special Topics Series
Unless otherwise indicated, the following description applies to courses 642–661. Fall or spring. 1 credit. Prerequisite: permission of instructor. S-U grades only.
Weekly discussions of current topics in special areas of plant pathology and mycology. Students are required to do extensive reading of current literature and to present oral and written reports.

PL PA 642 Pathogen Population Biology
Fall. TBA. M. G. Milgroom.

PL PA 644 Current Topics in Oomycete Biology
Fall. R 12:20. E. B. Nelson.

PL PA 645 Plant Virology
Fall. F 12:20. S. M. Gray.

PL PA 647 Phytobacteriology Research Updates
Fall and spring. Alternate M 12:20. S. V. Beer.
Emphasizes current research in phytobacteriology undertaken in laboratories at Cornell.

PL PA 649 Fungal Biology
Spring. 1 credit. TBA. K. T. Hodge.

PL PA 650 Diseases of Vegetable Crops
Fall. T 12:20. S-U grade only. J. W. Lorbeer and T. A. Zitter.

[PL PA 652 Field Crop Pathology
Spring. W. G. C. Bergstom.]

PL PA 660 Special Topics in Plant Disease Management
Fall and spring. 1 credit. S-U grades only. Lec, F 12:20–1:10. C. D. Smart.
Weekly discussions of current topics in plant disease management. These include not only management practices, but also factors that influence management strategies. Students are required to read current literature and present oral reports on a topic. This course is offered only at the Geneva campus.

PL PA 661 Diagnostic Lab Experience
Summer and fall. 1 or 2 credits. S-U grades only. Requires 3 hrs/wk 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. Coursework or experience in diagnostic techniques is strongly advised. Priority is given to graduate students in plant pathology and plant protection.

PL PA 662 Molecular Plant-Pathogen Interactions I and II (also BIOPL 652.1)
Spring. 1 credit. Prerequisites: BIOGD 281, BIOBM 330 or 331, and BIOPL 653.1. Lecs, M W F 10:10 (12 lecs) Jan. 26–Feb. 20. A. Collmer, S. G. Lazarowitz, G. Martin, B. Turgeon.
Examines the molecular and cellular factors that control pathogen-plant interactions from the perspectives of pathogen biology and plant responses to pathogen infection. Beginning spring 2004, alternate years will focus on: (I) 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 (II) the genetic and molecular mechanisms of microbial pathogenesis, with an emphasis on fungal and bacterial virulence proteins, toxins, and their deployment systems.

PL PA 663 Plant Molecular Biology 1
Fall. 1–5 credit. Prerequisites: BIO GS 281, BIO BM 330 or 331.

Section 01 Concepts and Techniques in Plant Molecular Biology (BIO PL 653.1)
2 credits. Lec, M W F 10:10 (12 lecs). Sept 3–Sept 29. J. J. Giovannoni, S. R. McCouch, J. Rose.
This is an introductory module that provides a broad overview of molecular biology concepts relevant to the plant sciences, and serves as a prerequisite to other modules in the BIO PL 653 (fall) and BIO PL 652 (spring) series. The course is divided into two sections: 1) gene discovery, which covers genetic, molecular, and genomics approaches to the isolation of plant genes; and 2) gene characterization, which covers DNA sequencing, DNA and RNA blotting, use of gene databases, and various approaches to producing transgenic plants. Emphasis is on understanding the appropriate

approach that is needed for different experiments.

Section 02 Plant Biotechnology (BIO PL 653.2 and PL BR 653.2)
1 credit. Lecs, M W F 1:25 (12 lecs) Oct. 1–Oct. 29. M. Zaitlin, E. D. Earle.
This course deals with production and uses of transgenic plants for agricultural and industrial purposes. Topics include procedures for gene introduction and control of gene expression, as well as strategies for obtaining transgenic plants that are resistant to insects, diseases, and herbicides, produce useful products, or have improved nutritional and food processing characteristics. Regulatory and social issues relating to plant biotechnology are discussed.

PL PA 664 Molecular Plant-Microbe Interactions (also BIOPL 652, Sec 02 and BIOMI 652, Sec 02)
Spring. 1 credit. Prerequisites: BIOGD 281, BIOBM 330 or 331 or 333, and BIOPL 653 (section 01) or their equivalents. S-U grades optional. Lecs, M W F 12:20 (12 lecs) Jan. 26-Feb. 20. Offered alternate even years. S. C. Winans.
For course description, see BIOPL 652, Sec 02.

PL PA 681 Plant Pathology Seminar
Fall and spring. 1 credit. Required of all plant pathology majors. S-U grades only. W 12:20–1:10. S. V. Bear.

PL PA 694 Special Topics in Plant Pathology
Fall or spring. 4 credits maximum. S-U grades optional.
The department teaches "trial" courses under this number. Offerings vary by semester, and are advertised by the department before the semester starts. Courses offered under the number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

PL PA 788 Research in Molecular Plant Pathology
Fall and spring. 2, 4, or 6 credits. Prerequisite: permission of instructor before beginning research. S-U grades only. S. V. Beer.
Guided research experiences in laboratories addressing questions concerning the interaction of pathogens (bacteria, fungi, viruses) and plants at the molecular level. Intended for beginning graduate students with a concentration in Molecular Plant Pathology and sufficient theoretical background and practical laboratory experience. Students submit plans and reports on each research experience.

PL PA 797 Special Topics
Fall or spring. 1–5 credits. S-U grades optional.
An opportunity for independent study of a special topic.

PL PA 798 Graduate Teaching Experience
Fall or spring. 1–5 credits. S-U grades. Staff.
Graduate teaching assistance in a mycology or plant pathology course by mutual agreement with the instructor. This experience may include, but is not limited to, preparing, assisting in, and teaching laboratories, preparing and delivering lectures, leading discussion sessions, and tutoring.

PL PA 800 Master's-Level Thesis Research
Fall or spring. Credit TBA. S-U grades optional. Prerequisite: permission of adviser. Graduate faculty.
For students working on a master's degree.

PL PA 900 Graduate-Level Thesis Research
Fall or spring. Credit TBA. S-U grades optional. Prerequisite: permission of adviser. Graduate faculty.
For students in a Ph.D. program who have not passed the "A" exam.

PL PA 901 Doctoral-Level Thesis Research
Fall or spring. Credit TBA. S-U grades optional. Prerequisite: permission of adviser. Graduate faculty.
For doctoral candidates who have passed the "A" exam.

POMOLOGY (FRUIT SCIENCE)

See Horticulture.

RURAL SOCIOLOGY

P. D. McMichael, chair; D. L. Brown, P. R. Eberts, P. Eloundou-Enyegue, S. Feldman, J. D. Francis, C. C. Geisler, P. K. Gellert, A. Gonzales, D. T. Gurak, T. A. Hirschl, T. A. Lyson, M. J. Pfeffer, L. B. Williams

Note: class meeting times are accurate at the time of publication. If changes are necessary, the department will provide new information as soon as possible.

R SOC 101 Introduction to Sociology
Fall, spring, or summer. 3 credits. Enrollment limited to 300 in the fall, 400 in the spring. Lecs, T R 10:10–11:00; sec, various times. Fall, T. Hirschl; spring, C. Geisler and D. Brown.
This course provides an introduction to theory and research in sociology. It 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. The course 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.

[R SOC 103 Self and Society (also SOC 103)]

R SOC 105 Economic Sociology (also SOC 105)
Fall. 4 credits. S-U optional. M W 2:30–3:20; sec 1 F 12:20–1:10; sec 2 F 1:25–2:15. V. Nee.
This course examines how sociologists understand the economy as a social phenomena. The focus is on classical and contemporary theorists as well as empirical studies in economic sociology. Students consider the impact of the dynamics of capitalism and globalization on social life and how the economic organization of society can be related to religion, culture, and concepts of leisure. Also investigated are areas in which people interact with the economy on a daily basis: in selling, shopping, and consuming.

R SOC 175 Issues in Contemporary American Indian Society (also AIS 175)
Spring. S-U option. Enrollment limited to 125. Lec, M W 11:15–12:05; sec, various times, M. Tsosie.
This course addresses major U.S. policies affecting American Indians in the twentieth century, and ways in which American Indians pursued strategies to sway the process of social change. American Indian political, economic, and cultural issues are examined through history, literature, music/art, and film/documentary. The approach of this course is interdisciplinary and an emphasis is placed on the study of American Indians as living cultures. Current trends are discussed, and the implications for American Indians in the twenty-first century are explored. Guest lecturers, including American Indian scholars, leaders, and activists, provide additional perspectives.

[R SOC 200 Social Problems (also SOC 200)]

R SOC 201 Population Dynamics (also SOC 202)
Spring. 3 credits. S-U optional. Enrollment limited to 35. ALS students must register for this course as R SOC 201. T R 2:55–4:10. P. Eloundou-Enyegue.
This course provides an introduction to population studies. After reviewing basic concepts and demographic principles and techniques, the course focuses on how demographic processes (fertility, mortality, and migration) affect social and economic outcomes. Discussions cover special topics related to population growth and distribution, including mass education, marriage and family formation, labor force participation, inequality and poverty, women's status, resource allocation, and the environment.

R SOC 205 International Development (also SOC 206)
Spring. 3 credits. Enrollment limited to 74. M W F 10:10–11:00. P. McMichael.
New questions concerning development models in the post-Cold War era are examined 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, we examine 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 examined are the new global justice movements, such as environmentalism, feminism, and landless workers, peasant, and grassroots activism.

R SOC 206 Gender and Society (also FGSS 206)
Spring. 3 credits. Enrollment limited to 100. Lecs, M W 11:15–12:05; sec, various times. Staff.
Course familiarizes students with origin of gender hierarchies, social and behavioral

similarities/differences between females and males, and the degree that biological, psychoanalytic, psychological and sociological perspectives help to understand the differences. United States and cross-cultural comparisons of the consequences of gender inequality are a major focus of the course. Objectives are met through lectures, readings, films, participant observation, and personal experiences.

[R SOC 207 Problems of Contemporary Society (also SOC 207)
Fall. 4 credits. S-U grades optional. Lec, M W F 11:15–12:05; Sec F. D. Heckathorn.
This course examines contemporary social problems, with a focus on their sources in the organization of society. Modern societies are based on three fundamental types of institutions—social norms, hierarchies, and markets. Each is subject to distinctive types of failures resulting in problems that include poverty, prejudice and discrimination, intolerance and hate, alcohol and drug abuse, physical and mental illness, crime and delinquency, and urban problems. In analyzing these problems, the institutions through which they are created and perpetuated, and the forms of institutional change required to address them, are emphasized.]

[R SOC 208 Technology and Society]

[R SOC 209 Social Inequality (also SOC 208)]

R SOC 213 Social Indicators, Data Management, and Analysis
Fall. 3 credits. Offered alternate years (complement of R SOC 214). T R 11:40–12:55. J. Francis.
A survey of definitions of social indicators and general principles of social indicators research is illustrated from data on both developed and less-developed countries. Data management and analysis of measures of poverty, level of living, inequality, quality of life, and so on, based on census data, household surveys, and key-informant and other low-cost techniques, are examined using personal computers.

[R SOC 214 Research Methods for the Social Sciences]

[R SOC 215 Introduction to Organizations (also SOC 215)]

R SOC 220 Sociology of Health of Latinos and Ethnic Minorities (also LSP 220)
Fall. 3 credits. S-U optional. Enrollment is limited to 15. T R 10:10–11:25. P. A. Parra.
Discusses the health status of minorities in the United States. This course 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.

[R SOC 261 Sociology of Sustainable Development]

R SOC 275 Immigration and a Changing America
Fall. 3 credits. S-U grades optional. M W 2:55–4:10. M. M. Kritz.
Immigration has shaped population and society throughout U.S. history. Today immigration has reemerged as a major force in American life. The course examines how contemporary and earlier immigrations differ in their determinants and consequences. The first part of the course focuses on who the new immigrants are, why they come, where they live, and what they do. Current trends in immigration are discussed as well as immigration and refugee policies that shape immigration. The second part of the course evaluates the impacts that immigration is having on U.S. society, economy, and polity. Theories of immigration, immigration policies, and the diversity of immigrant experiences receive attention throughout the course.

R SOC 301 Theories of Society (also SOC 375)
Spring. 3 credits. Prerequisites: Rural sociology or sociology course. S-U grades optional. Enrollment is limited to 30. T R 11:40–12:55. P. Eberts.
An introduction to the "classical" sociological theorists (Marx, Weber, Durkheim) of the late nineteenth and early twentieth century, as well as "erased" and missing sociological voices of the period (such as C. Perkins Gilman, W.E.B. DuBois). The course addresses the dramatic social upheavals including the fall of the Öold order,' industrialization, capitalism, and rise of bureaucracy to which these thinkers reacted and the inspiring (and conflicting) visions for the future which they offered. The intellectual history, the influence of the theorists on subsequent sociology, and the potential for relevance to contemporary society are emphasized.

R SOC 302 Evaluating Statistical Evidence (also SOC 301)
Fall. 4 credits. S-U optional. Lec, M W 11:15–12:05. S. Szelenyi.
A first course in statistical evidence in the social sciences, with emphasis on statistical inference and multiple regression models. Theory is supplemented with numerous applications.

R SOC 305 Education, Inequality and Development
Spring. 3 credits. Letter grade. Prerequisite: introductory social science course or permission of instructor. T R 10:10–11:00. P. Eloundou-Enyegue.
Improvements in formal schooling are often advocated as solutions for a variety of socioeconomic problems in nonindustrial and industrial nations alike. This course critically assesses human capital approaches to development. Topics include (1) the variety and functions of school systems, (2) the individual and macro-level determinants of education, (3) education and socioeconomic stratification, (4) the effects of education on development, and (5) tools for evaluating education projects.

R SOC 311 Social Movements (also AIS 311)
Spring. 3 credits. Prerequisites: R SOC 101/SOC 101 or permission of instructor. S-U grades optional. T R 1:25–2:40. A. Gonzales.
Social movements are collective efforts by relatively powerless groups of people to change society. Typically conceptualized as political activity outside the institutional framework, social movements are politics by other means. This course examines the transnational dimensions of social movements to assess the implications of globalization for political mobilization and the ways that social movement actors engage global political process to effect social change. Under what circumstances do movements emerge? How do global processes shape both domestic and transnational political mobilization? How do movements internally organize and choose political tactics and strategies to achieve their goals? How have social movements changed history, identities, society, and politics? This course addresses these and related questions through an examination of indigenous peoples movements in the United States, Canada, and Latin America.

[R SOC 318 Ethnohistory of the Northern Iroquois (also AIS 318)]

R SOC 324 Environment and Society (also S&TS 324 and SOC 324)
Fall or summer. 3 credits. Enrollment limited to 100. T R 2:55–4:10. C. Geisler.
The main objective of the course is to develop a critical understanding of the dominant trends in modern U.S. environmental thought like preservationism, conservationism, deep ecology, social ecology, NIMBYism, risk assessment, ecological modernization, and environmental equity. Another 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.

R SOC 331 Consumer Demographics (also AEM 416)
Fall. 3 credits. Letter grades only. M W 8:40–9:55. W. Brown.
Students participate in a consulting project, using demographic and geographic analysis to describe consumer characteristics and behavior for a chain of retail establishments. Requires skills in both quantitative analysis and technical writing.

[R SOC 333 Genomics and Society]

[R SOC 336 Rural Areas in Metropolitan Society]

[R SOC 340 Sociology of Food Systems]

[R SOC 360 Sociology of American Indians (also AIS 361)]

[R SOC 367 American Indian Politics and Policy (also AIS 367)]

R SOC 370 Comparative Issues in Social Stratification (also SOC 371)
Fall. 3 credits. Prerequisite: an introductory social science course. T R 1:25–2:40. T. A. Lyson.
This course reviews both classical and contemporary issues in the comparative social stratification literature. Particular attention is given to the changing configurations of different labor markets, debates on the meaning of new economic constituencies, and the role of gender, race, ethnicity, and sexuality in assessing the patterns, meaning, and experiences of inequality. Throughout the course special attention is given to the importance of understanding how questions of measurement are constructed and employed in understanding social inequality.

R SOC 380 Independent Honors Research in Social Science
Fall and spring. 1–6 credits. Limited to students who have met the requirements for the honors program. A maximum of 6 credits may be earned in the honors program. Staff.
Students should select a faculty adviser and begin proposal development during the junior year. Students must submit written proposals by the third week of the semester of their senior year to the departmental honors committee representative.

R SOC 410 Health and Survival Inequalities (also SOC 410)
Fall. 4 credits. S-U grades optional. T R 2:55–4:10. A. Basu.
Historical inequalities in health and survival continue to exist today. This course covers some of the markers of such inequalities, including region, class, race, gender, and age and examines some of the biological, socioeconomic, and political determinants of these differences. Macro as well as individual and family-level determinants are examined. Policy prescriptions are evaluated and new innovative approaches proposed.

[R SOC 418 Population Policy (also B&SOC 414)]

R SOC 421 Theories of Reproduction (also SOC 421)
Spring. 4 credits. S-U grades optional. TBA. A. Basu.
Examines the contentious debate on 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.

R SOC 430/629 Human Migration: Internal and International
Fall. 3 credits. Offered even years. Prerequisite: undergraduates, one demography course or permission of instructor. R 2:30–4:25. 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. (For 629, graduate students will also meet with instructor every other week to discuss graduate readings and topics relevant to term project).

R SOC 431/631 Comparative Ethnic Stratification: Demographic Perspectives
Spring. 3 credits. S-U grades optional. Prerequisite: Intro to Sociology or permission of instructor. T R 11:40–12:55. D. Gurak.
A comparative examination of ethnic stratification and mobility that focuses principally on dimensions of social groups that can be empirically measured using readily available demographic sources. These include residential segregation, occupational status and mobility, marriage and family formation patterns, health and mortality, family structure, fertility, and intermarriage. The role of migration in shaping ethnic stratification systems is also examined. About half of the course examines the U.S. situation. Other societies receiving significant attention include India, Brazil, Nigeria, and several European societies. For 631, graduate students will also meet with the instructor every other week to discuss graduate readings and topics relevant to their papers.

R SOC 435/635 Indigenous Peoples and Globalization (also AIS 435/635)
Spring. 3 credits. Limited to 25 students. Prerequisites: undergraduates, permission of instructor. S-U grades optional. M 10:10–1:10. A. Gonzales.
Explores ways in which processes of globalization affect indigenous peoples worldwide and the strategies indigenous peoples are using to deal with those pressures. Globalization, whether under the auspices of the World Trade Organization and regional economic agreements such as the NAFTA or the de-territorialization of social and political arrangements cotemporal with modernization or the expansion of communication technology and its impact on traditional knowledge systems, have had profound social, cultural, and economic impacts on indigenous peoples. At issue are the lands, resources, traditional knowledge, intellectual and cultural property, and indigenous struggles for recognition and self-determination.

[R SOC 437 Aging and Aging Social Policy in the 1990s]

R SOC 438/638 Population and Development
Fall. 3 credits. S-U grades optional. Prerequisite: permission of instructor. T R 11:40–12:55. D. Gurak.
Examines major historical and recent demographic transitions in mortality, fertility, age structure, and composition and explores the relationships between these transitions and the social, or economic, and cultural changes being experienced by diverse societies 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.

R SOC 494 Special Topics in Rural Sociology
Fall or spring. 4 credits maximum. S-U grades optional.
The department teaches "trial" courses under this number. Offerings vary by semester, and are advertised by the department before the semester starts. Courses offered under the number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

[R SOC 495/695 Population and Development in Sub-Saharan Africa]

R SOC 497 Independent Study in Rural Sociology
Fall or spring. 3 credits variable (may be repeated for credit). Students must register with an Independent Study form (available at 140 Roberts Hall). S-U grades optional. Informal study may include a reading course, research experience, or public service experience.

[R SOC 560 Managing Local Environmental Systems: Social Perspectives and Research Bases]

R SOC 599 M.P.S. Project
Fall and spring. 1–6 credits. S-U optional. Lec: TBA. Graduate faculty.
For students admitted specifically to a MPS program.

R SOC 601 Theoretical and Methodological Approaches to Community and Rural Development
Fall. 3 credits. Letter grade only. Prerequisite: graduate student. Lec, W 7:30–10:00 P.M. P. Eberts.
A survey of three general approaches for conducting analysis and practice in community and rural development. These approaches include examinations of: (1) community structural changes and policymaking; (2) participatory processes for generating community development; and (3) planning strategies as mechanisms for creating community development opportunities.

[R SOC 602 Community Development Seminar]

R SOC 603 Classical Sociological Theory
Fall. 4 credits. Prerequisites: open to graduate students only. T R 2:55–4:10. M. J. Pfeffer.
Students review 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 of the course 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.

R SOC 606 Sociological Theories of Development
Spring. 3 credits. T 2:30–5:30. Staff.
This course is a critical examination of a historical range of theories and research in the sociology of development from the post-war 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.

[R SOC 607 Sociology of Natural Resources and Development]

R SOC 608 Demographic Techniques (also PAM 606)
Fall. 3 credits. Prerequisite: multivariate statistics or permission of instructor. S-U grades optional. W 4:30–7:30. D. Gurak, K. Joyner.
This course provides an 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.

[R SOC 611 Globalization and Social Movements]

R SOC 612 Population and Development in Asia (also FGSS 612)
Spring. 3 credits. W 4:30–7:30. L. B. Williams.
This graduate seminar considers issues surrounding population and development in Asia. Case studies pertaining to Southeast Asia are highlighted. The linkages between population and development are elaborated and both are considered from a historical perspective. Recent social, economic, and demographic changes in the region are considered in depth. Evolving gender roles in the family, labor force, and broader social context are examined.

R SOC 615 Qualitative Research Methods
Fall. 3 credits. Letter grades only. Lec, W 10:10–1:10. L. Williams.
This seminar introduces students to a number of qualitative methods of field research in the social sciences. We discuss field observation, archival research, in-depth individual interviews, and focus group interviews. We assess the strengths and weaknesses of various strategies of field research and consider a range of practical matters such as choice of research site (and sample where appropriate), choice of questions, and issues of validity and reliability. Ethical considerations are highlighted.

R SOC 617 Foundations in Social Research: Comparative Epistemologies
Fall. 3 credits. Letter grades only. W 1:25–4:25. T. Lyson.
This seminar is designed to introduce graduate students in the social science to the variety of epistemological approaches used by social scientists to analyze social change and development. Both positivist and non-positivist approaches are examined. The relationship of quantitative and qualitative methodologies are related to different epistemologies.

[R SOC 618 Research Design I]

R SOC 619 Quantitative Research Methods
Spring. 4 credits. Prerequisite: previous course in statistics. Letter grades only. T R 12:20–2:15. J. Francis.
Graduate level course in measurement and analysis of survey, demographic and observational data. Topics include linear regression, analysis of variance, and analysis of covariance with both continuous and categorically coded variables. Introduction to logistic regression and some nonlinear models. Special attention is given to handling ordered and unordered categorical data as these are prevalent in social/demographic data sets. Data from real surveys like the American National Election Studies and the General Social Surveys will be analyzed using programs like SAS and SPSS. Includes labs writing programs to analyze these data. Students familiarize themselves with data cleaning, missing data estimation, transformations, subsetting and other data handling procedures.

[R SOC 620 Sociology of the Community]

[R SOC 621 Foundations of Environmental Sociology]

[R SOC 625 State, Economy, and Society]

[R SOC 630 Field Research Methods and Strategies]

[R SOC 640 Community and Changing Property Institutions]

[R SOC 641 Politics and Economics of Rural and Regional Development]

[R SOC 643 Land Reform Old and New]

[R SOC 645 Rural Economy and Society]

[R SOC 655 Advanced Techniques of Demographic Analysis]

[R SOC 661 Sustainable Agriculture and Development]

[R SOC 666 Genomics, Agriculture, Food Systems and Development]

[R SOC 671 Epistemological Challenges to Social Science Paradigms: A Feminist Inquiry (also FGSS 671)]

[R SOC 675 Global Patterns of International Migration]

R SOC 694 Special Topics in Rural Sociology
Fall or spring. 4 credits maximum. S-U grades optional.
The department teaches "trial" courses under this number. Offerings vary by semester, and are advertised by the department before the semester starts. Courses offered under the number will be approved by the department curriculum committee, and the same course is not offered more than twice under this number.

[R SOC 715 Comparative Research Methods]

[R SOC 718 Multidimensional Measurement and Classification]

[R SOC 719 Logistic and Log Linear Models]

R SOC 725 Theories of State, States of Theory]

[R SOC 730 Sociology of Global Change]

R SOC 791 Teaching Experience
Fall or spring. 1–3 credits. Limited to graduate students. S-U grades only. Graduate faculty.
Participation in the ongoing teaching program of the department.

R SOC 800 Master's-Level Thesis Research
Fall or spring. Credit TBA. Prerequisite: permission of instructor. S-U grades optional. Graduate faculty.
For students admitted specifically to a Master's program.

R SOC 872 Development Sociology
Limited to master's and doctoral degree candidates with permission of the graduate field member concerned. S-U grades optional. Graduate faculty.

R SOC 900 Graduate-Level Thesis Research
Fall or spring. Credit TBA. Prerequisite: permission of instructor. S-U grades optional. Graduate faculty.
For students in a Ph.D. program **only before** the "A" exam has been passed.

R SOC 901 Doctoral-Level Thesis Research
Fall or spring. Credit TBA. Prerequisite: permission of instructor. S-U grades optional. Graduate faculty.
For students admitted to candidacy **after** the "A" exam has been passed.

Related Courses in Other Departments

(Others may be added)

Population Dynamics (SOC 205)

Gender Relations, Gender Ideologies, and Social Change (FGSS 524)

Summer Session Courses

Introduction to Sociology (6-week session)

Environment and Society (3-week session)

Sociology of Health and Human Behavior (3-week session)

Soil, Crop, and Atmospheric Sciences (SCAS) courses are located in the Departments of Crop and Soil Sciences (CSS) and Earth and Atmospheric Sciences (EAS) section of this catalog.

VEGETABLE CROPS

See Horticulture.

FACULTY ROSTER

Abawi, George S., Ph.D., Cornell U. Prof., Plant Pathology (Geneva)
Acree, Terry E., Ph.D., Cornell U. Prof., Food Science, and Technology (Geneva)
Adleman, Marvin I., M. L. A., Harvard U. Prof., Landscape Architecture
Agnello, Arthur M., Ph.D., North Carolina State U. Prof., Entomology (Geneva)
Ahner, Beth A., Ph.D., Massachusetts Institute of Technology. Asst. Prof., Biological and Environmental Engineering
Albright, Louis D., Ph.D., Cornell U. Prof., Biological and Environmental Engineering
Aldwinckle, Herbert S., Ph.D., U. of London (England). Prof., Plant Pathology (Geneva)
Andersen, Robert L., Ph.D., U. of Minnesota. Prof., Horticultural Sciences (Geneva)
Anderson, Bruce L., Ph.D., U. of California at Berkeley. Assoc. Prof., Applied Economics and Management
Aneshansley, Daniel J., Ph.D., Cornell U. Prof., Biological and Environmental Engineering
Austic, Richard E., Ph.D., U. of California at Davis. Prof., Animal Science
Baer, Richard A., Ph.D., Harvard U. Prof., Natural Resources
Baeumner, Antje J., Ph.D., U. Stuttgart. Asst. 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. Assoc. Prof., Applied Economics and Management
Bartsch, James A., Ph.D., Purdue U. Assoc. Prof., Biological and Environmental Engineering
Bassuk, Nina L. Ph.D., U. of London (England). Prof., Horticulture
Batt, Carl A., Ph.D., Rutgers U. Prof., Food Science
Baugher, Sherene, Ph.D., SUNY Stonybrook. Assoc. Prof., Landscape Architecture
Bauman, Dale E., Ph.D., U. of Illinois. Prof., Animal Science
Baveye, Philippe C., Ph.D., U. of California at Riverside. Assoc. Prof., Crop and Soil Sciences
Beer, Steven V., Ph.D., U. of California at Davis. Prof., Plant Pathology
Bell, Alan W., Ph.D., U. of Glasgow (Scotland). Prof., Animal Science
Bellinder, Robin R., Ph.D., Virginia Polytechnic Inst. and State U. Prof., Horticulture
Bergstrom, Gary C., Ph.D., U. of Kentucky. Prof., Plant Pathology
Bills, Nelson L., Ph.D., Washington State U. Prof., Applied Economics and Management
Bjorkman, Thomas N., Ph.D., Cornell U. Assoc. Prof., Horticultural Sciences (Geneva)
Blake, Robert W., Ph.D., North Carolina State U. Prof., Animal Science
Blalock, Garrick, Ph.D., U. of California at Berkeley. Asst. Prof., Applied Economics and Management
Blossey, Bernd, Ph.D., Christian-Albrechts U., Germany. Asst. Prof., Natural Resources
Boisclair, Yves R., Ph.D., Cornell U. Assoc. Prof., Animal Science
Boisvert, Richard N., Ph.D., U. of Minnesota. Prof., Applied Economics and Management
Boor, Kathryn J., Ph.D., U. of California at Davis. Assoc. Prof., Food Science
Brady, John W., Jr., Ph.D., SUNY at Stonybrook. Prof., Food Science
Brown, Dan L., Ph.D., Cornell U. Assoc. Prof., Animal Science
Brown, David L., Ph.D., U. of Wisconsin. Professor, Rural Sociology
Brown, Susan K., Ph.D., U. of California at Davis. Assoc. Prof., Horticultural Sciences (Geneva)
Bryant, Ray B., Ph.D., Purdue U. Prof., Crop and Soil Sciences
Burr, Thomas J., Ph.D., U. of California at Berkeley. Prof., Plant Pathology (Geneva)
Bustamante, Carlos D., Ph.D., Harvard U. Asst. Prof., Biological Statistics and Computational Biology
Butler, Walter R., Ph.D., Purdue U. Prof., Animal Science
Caffarella, Rosemary S., Ph.D., Michigan State U. Prof., Education
Calderone, Nicholas W., Ph.D., Ohio State U. Assoc. Prof., Entomology
Carlsen, William S., Ph.D., Stanford U. Assoc. Prof., Education
Chan, Alice P., Ph.D., Michigan State U. Asst. Prof., Communication
Chapman, Lewis D., Ph.D., U. of California at Berkeley. Prof., Applied Economics and Management
Chase, Larry E., Ph.D., Pennsylvania State U. Assoc. Prof., Animal Science
Chau, Ho Yan, Ph.D., Johns Hopkins U. Assoc. Prof., Applied Economics and Management
Cheng, Lailiang, Ph.D., Oregon State U. Asst. Prof., Horticulture
Cherney, Jerome H., Ph.D., U. of Minnesota. Prof., Crop and Soil Sciences
Christy, Ralph D., Ph.D., Michigan State U. Prof., Applied Economics and Management
Coffman, W. Ronnie, Ph.D., Cornell U. Prof., Plant Breeding
Collmer, Alan R., Ph.D., Cornell U. Prof., Plant Pathology
Colucci, Stephen J., Ph.D., SUNY. Prof., Earth and Atmospheric Sciences
Conrad, Jon M., Ph.D., U. of Wisconsin. Prof., Applied Economics and Management
Contreras, Martha, Ph.D., U. of California at Riverside. Asst. Prof., Biological Statistics and Computational Biology
Cooch, Evan G., Ph.D., Queen's U. Asst. Prof., Natural Resources
Cook, Kerry H., Ph.D., North Carolina State U. Assoc. Prof., Earth and Atmospheric Sciences
Cooke, J. Robert, Ph.D., North Carolina State U. Prof., Biological and Environmental Engineering
Cox, William J., Ph.D., Oregon State U. Prof., Crop and Soil Sciences
Currie, W. Bruce, Ph.D., Macquarie U. (Australia) Prof., Animal Science
Curtis, Paul D., Ph.D., North Carolina State U. Asst. Prof., Natural Resources
Danforth, Bryan N., Ph.D., U. of Kansas. Assoc. Prof., Entomology
Daouk, Hazem, Ph.D., Indiana U. Asst. Prof., Applied Economics and Management
Datta, Ashim K., Ph.D., U. of Florida. Prof., Biological and Environmental Engineering
Decker, Daniel J., Ph.D., Cornell U. Prof., Natural Resources
Degaetano, Arthur, Ph.D., Rutgers U. Assoc. Prof., Earth and Atmospheric Sciences
DeGloria, Stephen D., Ph.D., U. of California at Berkeley. Prof., Crop and Soil Sciences
de Gorter, Harry, Ph.D., U. of California at Berkeley. Assoc. Prof., Applied Economics and Management
DeJong, Walter S., Ph.D., U. of Wisconsin. Asst. Prof., Plant Pathology
Delaney, Terrence, Ph.D., U. of Washington. Asst. Prof., Plant Pathology
Dillard, Helene R., Ph.D., U. of California at Davis. Prof., Plant Pathology (Geneva)
DiTommaso, Antonio, Ph.D., McGill U. Asst. Prof., Crop and Soil Sciences
Drinkwater, Laurie, Ph.D., U. of California, Davis. Assoc. Prof., Horticulture
Durst, Richard A., Ph.D., Massachusetts Institute of Technology. Prof., Food Science and Technology (Geneva)
Duxbury, John M., Ph.D., U. of Birmingham (England). Prof., Crop and Soil Sciences
Earle, Elizabeth D., Ph.D., Harvard U. Prof., Plant Breeding
Eberts, Paul R., Ph.D., U. of Michigan. Prof., Rural Sociology
Eloundou-Enyegue, Parfait M., Ph.D., Pennsylvania State U. Asst. Prof., Rural Sociology
English-Loeb, Gregory M., Ph.D., U. of California at Davis. Assoc. Prof., Entomology (Geneva)
Everett, Robert W., Ph.D., Michigan State U. Prof., Animal Science
Ewer, John, Ph.D., Brandeis U. Asst. Prof., Entomology
Fahey, Timothy J., Ph.D., U. of Wyoming. Prof., Natural Resources
Feldman, Shelley, Ph.D., U. of Connecticut. Assoc. Prof., Rural Sociology
Fernandes, Erick C. M., Ph.D., North Carolina State U. Assoc. Prof., Crop and Soil Sciences
Fick, Gary W., Ph.D., U. of California at Davis. Prof., Crop and Soil Sciences
Forsline, Philip L., M.S., U. of Minnesota. Asst. Prof., Horticultural Sciences (Geneva)
Fox, Danny G., Ph.D., Ohio State U. Prof., Animal Science
Francis, Joe D., Ph.D., U. of Missouri. Assoc. Prof., Rural Sociology
Fry, William E., Ph.D., Cornell U. Prof., Plant Pathology
Galton, David M., Ph.D., Ohio State U. Prof., Animal Science
Gan, Susheng, Ph.D., U. of Wisconsin. Asst. Prof., Horticulture
Gavin, Thomas A., Ph.D., Oregon State U. Assoc. Prof., Natural Resources
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., Rural Sociology
Gellert, Paul K., Ph.D., U. of Wisconsin. Asst. Prof., Rural Sociology
Gilbert, Cole, Ph.D. U. of Kansas. Assoc. Prof., Entomology
Gillett, James W., Ph.D., U. of California at Berkeley. Prof., Natural Resources
Gleason, Kathryn L., Ph.D., Oxford U. Assoc. Prof., Landscape Architecture
Gloy, Brent A., Ph.D., Purdue U. Asst. Prof., Applied Economics and Management
Gonzales, Angela, M.A., Harvard U. Asst. Prof., Rural Sociology
Good, George L., Ph.D., Cornell U. Prof., Horticulture
Gorewit, Ronald C., Ph.D., Michigan State U. Prof., Animal Science
Gottfried, Herbert W., Ph.D., Ohio U. Prof., Landscape Architecture
Gravani, Robert B., Ph.D., Cornell U. Prof., Food Science
Griffths, Phillip D., Ph.D., U. of Florida. Asst. Prof., Horticultural Sciences (Geneva)
Gurak, Douglas T., Ph.D., U. of Wisconsin. Prof., Rural Sociology
Hagen, James M., Ph.D., U. of Illinois. Asst. Prof., Applied Economics and Management
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 at Berkeley. Assoc. Prof., Entomology
Halseth, Donald E., Ph.D., Cornell U. Assoc. Prof., Horticulture
Hancock, Jeffrey T., Ph.D., Dalhousie U. Asst. Prof., Communication
Hang, Yong D., Ph.D., McGill U. (Canada). Prof., Food Science and Technology (Geneva)
Harman, Gary E., Ph.D., Oregon State U. Prof., Horticultural Sciences (Geneva)
Harrington, Laura, Ph.D., Massachusetts U. Asst. Prof., Entomology
Hedlund, Dalva E., Ph.D., Colorado State U. Assoc. Prof., Education
Henick-Kling, Thomas, Ph.D., U. of Adelaide (Australia). Assoc. Prof., Food Science and Technology (Geneva)
Hintz, Harold F., Ph.D., Cornell U. Prof., Animal Science
Hirschl, Thomas A., Ph.D., U. of Wisconsin. Prof., Rural Sociology
Hoch, Harvey, Ph.D., U. of Wisconsin. Prof., Plant Pathology (Geneva)

Hodge, Kathie, Ph.D., Cornell U. Asst. Prof., Plant Pathology
Hoffmann, Michael P., Ph.D., U. of California. Assoc. Prof., Entomology
Horrigan, Paula H., M.L.A., Cornell U. Assoc. Prof., Landscape Architecture
Hotchkiss, Joseph H., Ph.D., Oregon State U. Prof., Food Science
Hrazdina, Geza, Ph.D., Eidg. Technische Hochschule at ZYrich (Switzerland). Prof., Food Science and Technology (Geneva)
Hudler, George W., Ph.D., Colorado State U. Prof., Plant Pathology
Hullar, Theodore L., Ph.D., U. of Minnesota. Prof., Natural Resources
Hunter, James E., Ph.D., U. of New Hampshire. Prof., Plant Pathology (Geneva)
Hunter, Jean B., D.En.Sc., Columbia U. Assoc. Prof., Biological and Environmental Engineering
Irwin, Lynne H., Ph.D., Texas A & M U. Assoc. Prof., Biological and Environmental Engineering
Jahn, Margaret M., Ph.D., Cornell U. Assoc. Prof., Plant Breeding
Jewell, William J., Ph.D., Stanford U. Prof., Biological and Environmental Engineering
Johnson, Patricia A., Ph.D., Cornell U. Assoc. Prof., Animal Science
Just, David R., Ph.D., U. of California at Berkeley. Asst. Prof., Applied Economics
Kaiser, Harry M., Ph.D., U. of Minnesota. Assoc. Prof., Applied Economics and Management
Kanbur, Sanjiv Madhwarao, Ph.D., Oxford. Prof., Applied Economics and Management
Ketterings, Quirine, Ph.D., Ohio State. Asst. Prof., Crop and Soil Sciences
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 Polytechnical Inst. and State U. Prof., Natural Resources
Koeller, Wolfram, Ph.D., Phillips-University-Marburg (Germany). Prof., Plant Pathology (Geneva)
Kraft, Clifford E., Ph.D., U. of Wisconsin. Asst. 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
Krikorian, Dean H., Ph.D., Cornell U. Asst. Prof., Communication
Kroma, Margaret M., Ph.D., Iowa State U. Asst. Prof., Education
Kyle, Steven C., Ph.D., Harvard U. Assoc. Prof., Applied Economics and Management
LaDue, Eddy L., Ph.D., Michigan State U. Prof., Applied Economics and Management
Lailiang, Cheng, Ph.D., Oregon State U. Asst. Prof., Horticulture
Lakso, Alan N., Ph.D., U. of California at 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
Lee, Chang Y., Ph.D., Utah State U. Prof., Food Science and Technology (Geneva)
Lee, David R., Ph.D., U. of Wisconsin. Prof., Applied Economics and Management
Lehmann, Johannes, Ph.D., U. of Bayreuth, Germany. Asst. Prof., Crop and Soil Sciences
Lei, Xingen, Ph.D., Michigan State U. Assoc. 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. Prof., Applied Economics and Management
Lewenstein, Bruce V., Ph.D., U. of Pennsylvania. Assoc. Prof., Communication
Liebherr, James K., Ph.D., U. of California at Berkeley. Prof., Entomology
Liu, Ruihai, Ph.D., Cornell U. Asst. Prof., Food Science
Lorbeer, James W., Ph.D., U. of California at Berkeley. Prof., Plant Pathology
Loria, Rosemary, Ph.D., Michigan State U. Prof., Plant Pathology
Losey, John E., Ph.D., U. of Maryland. Asst. Prof., Entomology
Lovette, Irby, Ph.D., U. of Pennsylvania. Asst. Prof., Ornithology
Luo, Dan, Ph.D., Ph.D., Ohio State. Asst. Prof., Biological and Environmental Engineering
Lyson, Thomas A., Ph.D., Michigan State U. Prof., Rural Sociology
Martin, Gregory B., Ph.D., Michigan State U. Prof., Plant Pathology
McBride, Murray B., Ph.D., Michigan State U. Prof., Crop and Soil Sciences
McCouch, Susan, Ph.D., Cornell U. Assoc. Prof., Plant Breeding
McFerson, James R., Ph.D., U. of Wisconsin. Asst. Prof., Horticultural Sciences (Geneva)
McGrath, Margaret T., Ph.D., Pennsylvania State U. Assoc. Prof., Plant Pathology
McLaughlin, Edward W., Ph.D., Michigan State U. Prof., Applied Economics and Management
McMichael, Philip D., Ph.D., SUNY Binghamton. Prof., Rural Sociology
Meloy, Margaret G., Ph.D., Cornell U. Asst. Prof., Applied Economics and Management
Merwin, Ian A., Ph.D., Cornell U. Assoc. Prof., Horticulture
Milgroom, Michael G., Ph.D., Cornell U. Prof., Plant Pathology
Miller, Dennis D., Ph.D., Cornell U. Prof., Food Science
Miller, William B., Ph.D., Cornell U. Prof., Horticulture
Milligan, Robert A., Ph.D., U. of California at Davis. Prof., Applied Economics and Management
Mills, Edward L., Ph.D., Cornell U. Prof., Natural Resources
Montemagno, Carlo D., Ph.D., U. of Notre Dame. Assoc. Prof., Biological and Environmental Engineering
Mount, Timothy D., Ph.D., U. of California at Berkeley. Prof., Applied Economics and Management
Mt Pleasant, Jane, Ph.D., North Carolina State U. Assoc. Prof., Crop and Soil Sciences
Mudge, Kenneth W., Ph.D., Washington State U. Assoc. Prof., Horticulture
Mulvaney, Steven J., Ph.D., Cornell U. Assoc. Prof., Food Science
Mutschler, Martha A., Ph.D., U. of Wisconsin. Prof., Plant Breeding
Nault, Brian, Ph.D., North Carolina State. Asst. Prof., Entomology, Geneva
Nelson, Eric B., Ph.D., Ohio State U. Assoc. Prof., Plant Pathology
Nelson, Rebecca J., Ph.D., U. of Washington. Assoc. Prof., Plant Pathology
Ng, David T., Ph.D., Columbia U. Asst. Prof., Applied Economics and Management
Nielsen, Rasmus, Ph.D., U. of California at Berkeley. Asst. Prof., Biological Statistics and Computational Biology
Novakovic, Andrew M., Ph.D., Purdue U. Prof., Applied Economics and Management
Nyrop, Jan P., Ph.D., Michigan State U. Prof., Entomology (Geneva)
Obendorf, Ralph L., Ph.D., U. of California at Davis. Prof., Crop and Soil Sciences
Oltenacu, Pascal A., Ph.D., U. of Minnesota. Prof., Animal Science
Ostman, Ronald E., Ph.D., U. of Minnesota. Prof., Communication
Overton, Thomas R., Ph.D., U. of Illinois. Asst. Prof., Animal Science
Padilla-Zakour, Olga, Ph.D., Cornell U. Asst. Prof., Food Science and Technology (Geneva)
Parks, John E., Ph.D., Virginia Polytechnic Inst. Assoc. Prof., Animal Science
Parlange, Jean-Yves, Ph.D., Brown U. Prof., Biological and Environmental Engineering
Peckarsky, Barbara L., Ph.D., U. of Wisconsin. Prof., Entomology
Pell, Alice N., Ph.D., U. of Vermont. Prof., Animal Science
Perez Pedro, Ph.D., Rensselear. Asst. Prof., Applied Economics and Management
Perry, Keith, Ph.D., Cornell U. Assoc Prof., Plant Pathology
Peters, Scott J., Ph.D., U. of Minnesota. Asst. Prof., Education
Petrovic, A. Martin, Ph.D., Michigan State U. Prof., Horticulture
Pfeffer, Max, Ph.D., U. of Wisconsin. Prof., Rural Sociology
Poe, Gregory, Ph.D., U. of Wisconsin. Assoc. Prof., Applied Economics and Management
Pollak, E. John, Ph.D., Iowa State U. Prof., Animal Science
Pool, Robert M., Ph.D., Cornell U. Prof., Horticultural Sciences (Geneva)
Pritts, Marvin P., Ph.D., Michigan State U. Prof., Horticulture
Quaas, Richard L., Ph.D., Colorado State U. Prof., Animal Science
Quirk, Susan M., Ph.D., Cornell U. Assoc. Prof., Animal Science
Rakow, Donald A., Ph.D., Cornell U. Assoc. Prof., Horticulture
Raman, Kandukuri, Ph.D., U. of Reading. Prof., Plant Breeding
Rangarajan, Anusuya, Ph.D., Ohio State. Asst. Prof., Horticulture
Ranney, Christine K., Ph.D., U. of California at Davis. Assoc. Prof., Applied Economics and Management
Rao, M. Anandha, Ph.D., Ohio State U. Prof., Food Science and Technology (Geneva)
Rayor, Linda, Ph.D., U. of Kansas. Asst. Prof., Entomology
Regenstein, Joe M., Ph.D., Brandeis U. Prof., Food Science
Reiners, Stephen, Ph.D., Ohio State U. Assoc. Prof., Horticultural Sciences (Geneva)
Reisch, Bruce, Ph.D., U. of Wisconsin. Prof., Horticultural Sciences (Geneva)
Reissig, William H., Ph.D., Oregon State U. Prof., Entomology (Geneva)
Richmond, Milo E., Ph.D., U. of Missouri. Assoc. Prof., Natural Resources
Riha, Susan, Ph.D., Washington State U. Prof., Earth and Atmospheric Sciences
Rizvi, Syed S., Ph.D., Ohio State. Prof., Food Science
Roberts, John S., Ph.D., Rutgers U. Asst. Prof., Food Science and Technology (Geneva)
Robinson, Richard W., Ph.D., Cornell U. Prof., Horticultural Sciences (Geneva)

Robinson, Terence L., Ph.D., Washington State U. Assoc. Prof., Horticultural Sciences (Geneva)
Roelofs, Wendell L., Ph.D., Indiana U. Prof., Entomology (Geneva)
Rose, Jocelyn, Ph.D., U. of California, Davis. Asst. Prof., Plant Biology
Rosenberger, David A., Ph.D., Michigan State U. Prof., Plant Pathology (Geneva)
Rossi, Frank S., Ph.D., Cornell U. Asst. Prof., Horticulture
Rudstam, Lars G., Ph.D., U. of Stockholm. Assoc. Prof., Natural Resources
Rutz, Donald A., Ph.D., North Carolina State U. Prof., Entomology
Sanderson, John P., Ph.D., U. of California at Riverside. Prof., Entomology
Sanford, John C., Ph.D., U. of Wisconsin. Assoc. Prof., Horticultural Sciences (Geneva)
Scherer, Clifford W., Ph.D., U. of Wisconsin. Assoc. Prof., Communication
Scheufele, Dietram A., Ph.D., U. of Wisconsin. Asst. Prof., Communication
Schneider, Rebecca, Ph.D., Cornell U. Asst. Prof., Natural Resources
Schrader, Dawn E., Ph.D., Harvard U. Assoc. Prof., Education
Schulze, William D., Ph.D., U. of California at Riverside. Prof., Applied Economics and Management
Schupp, James R., Ph.D., Ohio State U., Asst. Prof., Horticultural Sciences (Geneva)
Schwager, Steven J., Ph.D., Yale U. Assoc. Prof., Biological Statistics and Computational Biology
Scott, Jeffrey G., Ph.D., U. of California at Berkeley. Prof., Entomology
Scott, Norman R., Ph.D., Cornell U. Prof., Biological and Environmental Engineering
Seem, Robert C., Ph.D., Pennsylvania State U. Prof., Plant Pathology (Geneva)
Setter, Timothy L., Ph.D., U. of Minnesota. Assoc. Prof., Crop and Soil Sciences
Shanahan, James E., Ph.D., U. of Massachusetts-Amherst. Assoc. Prof., Communication
Shapiro, Michael A., Ph.D., U. of Wisconsin. Assoc. Prof., Communication
Shelton, Anthony M., Ph.D., U. of California at Riverside. Prof., Entomology (Geneva)
Shields, Elson J., Ph.D., U. of Wisconsin. Prof., Entomology
Siebert, Karl J., Ph.D., Pennsylvania State U. Prof., Food Science and Technology (Geneva)
Simon, Daniel, Ph.D., U. of Maryland, Asst. Prof., Applied Economics and Management
Sipple, John W., Ph.D., U. of Michigan. Asst. Prof., Education
Smith Einarson, Margaret E., Ph.D., Cornell U. Assoc. Prof., Plant Breeding
Smith, R. David, Ph.D., Cornell U. Assoc. Prof., Animal Science
Soderlund, David M., Ph.D., U. of California at Berkeley. Prof., Entomology (Geneva)
Sorrells, Mark E., Ph.D., U. of Wisconsin. Prof., Plant Breeding
Steenhuis, Tammo S., Ph.D., U. of Wisconsin. Prof., Biological and Environmental Engineering
Steponkus, Peter L., Ph.D., Purdue U. Prof., Crop and Soil Sciences
Straub, Richard W., Ph.D., U. of Missouri. Prof., Entomology (Geneva)
Strawderman, Rob, Ph.D., Harvard U. Assoc Prof., Biological Statistics and Computational Biology
Streeter, Deborah H., Ph.D., U. of Wisconsin. Assoc. Prof., Applied Economics and Management
Sullivan, Patrick J., Ph.D., U. of Washington. Asst. Prof., Natural Resources
Tanksley, Steven D. Ph.D., U. of California at Davis. Prof., Plant Breeding
Tauer, Loren W., Ph.D., Iowa State U. Prof., Applied Economics and Management
Taylor, Alan G., Ph.D., Oklahoma State U. Prof., Horticultural Sciences (Geneva)
Thies, Janice E., Ph.D., U. of Hawaii. Assoc. Prof., Crop and Soil Sciences
Thonney, Michael L., Ph.D., U. of Minnesota. Prof., Animal Science
Timmons, Michael B., Ph.D., Cornell U. Prof., Biological and Environmental Engineering
Tingey, Ward M., Ph.D., U. of Arizona. Prof., Entomology
Topoleski, Leonard D., Ph.D., Purdue U. Prof., Horticulture
Trancik, Roger T., M.L.A., Harvard U. Prof., Landscape Architecture
Trowbridge, Peter J., M.L.A., Harvard U. Prof., Landscape Architecture
Trumbull, Deborah J., Ph.D., U. of Illinois. Assoc. Prof., Education
Turechek, W., Ph.D., Ohio State. Asst. Prof. Plant Pathology
Turgeon, B. Gillian, Ph.D., U. of Dayton. Assoc. Prof., Plant Pathology
VanAmburgh, Michael E., Ph.D., Cornell U. Assoc. Prof., Animal Science
vanEs, Harold M., Ph.D., North Carolina State U. Prof., Crop and Soil Sciences
Viands, Donald R., Ph.D., U. of Minnesota. Prof., Plant Breeding
Villani, Michael G., Ph.D., North Carolina State U. Prof., Entomology (Geneva)
Walker, Larry P., Ph.D., Michigan State U. Prof., Biological and Environmental Engineering
Walter, Michael F., Ph.D., U. of Wisconsin. Prof., Biological and Environmental Engineering
Walther, Joseph B., Ph.D., U. of Arizona. Assoc. Prof., Communication
Wang, Ping, Ph.D., Cornell U. Asst. Prof., Entomology, Geneva
Wang, Shou E., Ph.D., Princeton. Asst. Prof., Applied Economics and Management
Watkins, Christopher B., Rutgers U. Assoc. Prof., Horticulture
Weber, Courtney A., Ph.D., U. of Florida. Asst. Prof., Horticultural Sciences (Geneva)
Weiler, Thomas C., Ph.D., Cornell U.. Prof., Horticulture
Welch, Ross M., Ph.D., U. of California at Davis. Prof., Crop and Soil Sciences
Weston, Leslie A., Ph.D., Michigan State U. Assoc. Prof., Horticulture
Wheeler, Quentin D., Ph.D., Ohio State U. Prof., Entomology
White, Gerald B., Ph.D., Pennsylvania State U. Prof., Applied Economics and Management
Whitlow, Thomas H., Ph.D., U. of California at Davis. Assoc. Prof., Horticulture
Wiedmann, Martin, Ph.D., Cornell U. Asst. Prof., Food Science
Wien, Hans C., Ph.D., Cornell U. Prof., Horticulture
Wilcox, Wayne F., Ph.D., U. of California at Davis. Prof., Plant Pathology (Geneva)
Wilks, Daniel S., Ph.D., Oregon State U. Prof., Earth and Atmospheric Sciences
Williams, Linda, Ph.D., Brown U. Assoc. Prof., Rural Sociology
Wilson, Arthur L., Ph.D., U. of Georgia. Assoc. Prof., Education
Wolf, Steven, Ph.D., U. of Wisconsin/Madison. Asst. Prof., Natural Resources
Wolfe, David W., Ph.D., U. of California at Davis. Prof., Horticulture
Worobo, Randy W., Ph.D., U. of Alberta. Asst. Prof., Food Science and Technology (Geneva)
Yavitt, Joseph B., Ph.D., U. of Wyoming. Assoc. Prof., Natural Resources
Zitter, Thomas A., Ph.D., Michigan State U. Prof., Plant Pathology